PROJECT MEETINGS

1. GENERAL

1.1 Administrative

.1 Schedule and administer project meetings throughout the progress of the Work at the call of the Contract Administrator.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Contract Administrator.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 The Contract Administrator shall record the meeting minutes.

.7 Representative of the Construction Contractor, Subcontractor and Suppliers attending the meetings will be qualified and authorized to act on behalf of party each represents.

1.2 Weekly Newsletter

.1 The Contractor shall prepare weekly newsletters (including the weekly look-ahead schedules attached to the newsletters) and e-mail a PDF copy to the Contract Administrator and the City every Monday morning.

.2 Newsletters shall summarize the Work completed the previous week and shall include pictures associated with this Work. A detailed description of the work completed by all subcontractors/trades daily are to be included in the Newsletters, and not just the caption of the picture.

.3 Throughout the project, the City and Contract Administrator can request the raw (non- PDF) electronic copies of any newsletters, including pictures.

.4 At Substantial Performance, six (6) CDs containing all of the raw (non-PDF) and PDF copies shall be provided.

.5 Any Work completed between Substantial Performance and end of Warranty shall also be included in newsletters and six (6) CDs updated at the end of the Warranty period to cover the entire project.

1.3 Underground Commissioning Reports

.1 Once any underground infrastructure (pipes, cables, ductbanks, tanks, etc.) is commissioned and prior to any backfilling, the Contractor is to provide the Contract Administrator with the underground commissioning report within five (5) days of completing the installation work prior to any backfilling.

.2 The underground commissioning report shall include at a minimum the following:

.1 Photographs of all locations of the installed infrastructure and include in the report with details showing the area, direction of view, description of the photograph, identification of any piping and equipment by tag number and English description and dates of completion.

.2 A site plan showing the locations of the various pictures shall also be clearly provided. The photographs captions shall be identified on the site plan for referencing purposes.

.3 Records of each testable joints, where applicable.

.4 Records of the hydrostatic pressure test for the installed pipe, where applicable.

.5 Records of the disinfection and neutralization procedure and results, where applicable.

.6 Records of the approval from the regulatory agency/authority, where applicable (e.g. ESA, TSSA, local hydro, gas utilities, etc.).

.7 A copy of the finalized shop drawing.

.3 The Contractor shall not commence any backfilling until these reports are submitted by shop drawings and approved by the Contract Administrator. The Contractor is required to conduct a site walk through of the installed infrastructure with the Contract Administrator to verify the accuracy of the underground commissioning report.

1.4 Preconstruction Meeting

.1 Within fifteen (15) days after award of the Construction Contract, request a meeting and organize of parties in Construction Contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Contract Administrator, Construction Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Establish time and location of the meeting and notify parties concerned minimum five (5) days before meeting.

.4 Incorporate mutually agreed variations to Construction Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work

.3 Schedule of submission of Shop Drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences

.5 Delivery schedule of specified equipment.

.6 Site security

.7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

.9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.11 Monthly progress claims, administrative procedures, photographs, hold backs.

.12 Appointment of inspection and testing agencies or firms.

.13 Insurances, transcript of policies.

1.5 Progress Meetings

.1 Schedule progress meetings twice a month during the course of Work and three (3) weeks prior to project completion.

.2 Construction Contractor and Contract Administrator are to be in attendance.

.3 Notify parties minimum seven (7) days prior to meetings.

.4 Contract Administrator to record minutes of meetings and circulate to attending parties and affected parties not in attendance within seven (7) days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for effect on construction schedule and on completion date.

.12 Other business.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION PROGRESS SCHEDULES

1. GENERAL

1.1 Description

.1 Section includes administrative and procedural requirements for planning, monitoring and documenting the progress of construction during performance of the Work.

.2 Contractor shall prepare and submit to Contract Administrator for review within fourteen (14) days after Notice to Proceed, a construction progress schedule.

.3 No work shall be done between 4:00 p.m. and 7:00 a.m. nor on Sundays, Saturdays, or legal holidays without written permission of City. However, emergency work that may result in injury or damage to the equipment or facilities if not addressed may be done without prior permission. The Contract Administrator is to be informed when starting emergency work.

.4 The Contractor has the obligation and responsibility at all times to plan and monitor all of its activities, anticipating and scheduling its staff, materials, plant and Work methods in a manner that is likely to ensure completion of the Work in accordance with the terms and conditions of the Contract and at a rate that will allow it to be completed within the Contract Time.

1.2 Form of Schedules

.1 Prepare schedules in form of a horizontal bar chart.

.1 Provide separate horizontal bar for each trade or operation.

.2 Horizontal Time Scale: Identify first work day of each week.

.3 Scale and spacing to allow space for notations and future revisions.

.4 Schedule to meet the conditions and requirements of Appendix A: The Migration Plan.

.5 Schedule to allow for full length of review periods and notice lead time in Appendix A: The Migration Plan and as specified.

.2 Format of Listings: Chronological order of start of each item of work.

.3 Identification of Listings: By major specification section numbers.

.4 Computer scheduling software: Use Microsoft Project.

1.3 Content of Schedules

.1 Construction Progress Schedule:

.1 Show complete sequence of construction by activity.

.2 Show dates for beginning and completion of each major element of construction and installation dates for major items of equipment. Elements shall include, but not be limited to, the following:

.1 Shop Drawing receipt from supplier/manufacturer submitted to Contract Administrator, review and return to supplier/manufacturer.

.2 Material and equipment order, manufacturer, delivery, installation, and checkout.

.3 Performance tests and supervisory services activity.

.4 City review.

.5 Factory Acceptance Test.

.6 System Integration Function Test.

.7 Wiring installation.

.8 Panel installation

.9 Electrical work activity.

.10 Subcontractor's items of work.

.11 Operator switchover notice lead time.

.12 Site Acceptance Test.

.13 Site Integration Test.

.14 Functional Testing.

.15 Start-up.

.16 Commissioning.

.17 Performance testing.

.18 Training.

.19 Final cleanup.

.20 Allowance for inclement weather or process conditions.

.21 Demolition.

.22 Development of Operations and Maintenance Manuals.

.23 Development of As-Builts.

.3 Show projected percentage of completion for each item as of first day of each month.

1.4 Schedule Revisions

.1 Every thirty (30) calendar days the Contractor shall revise construction schedule to reflect changes in progress of work.

.2 Indicate progress of each activity at date of submittal.

.3 Show changes occurring since previous submittal of schedule.

.1 Major changes in scope.

.2 Activities modified since previous submittal.

.3 Revised projections of progress and completion.

.4 Other identifiable changes.

.4 Provide a narrative report as needed to define:

.1 Problem areas, anticipated delays, and impact on schedule.

.2 Corrective action recommended and its effect.

.3 Effect of changes on schedules of other Contractors.

.5 Recovery Schedule:

.1 When periodic update indicates the Work is fourteen (14) or more calendar days behind the current accepted schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

.2 If, at any time, the Work is behind schedule with respect to the progress schedule currently in force, and if the Contract Administrator believes there is a risk of the Work not being completed within the Contract Time as a result of such delay, the Contractor shall take all necessary measures to make up for such delay either by increasing staff, plant or facilities, or by amending its Work methods, whichever is applicable, with no change to the Contract Price.

1.5 Submittal Requirements

.1 For initial submittal of construction schedule and subsequent revisions thereof, furnish six copies of schedule at the next Progress Meeting. Provide electronic copies to the Contract Administrator upon development.

.2 Format for Submittals: Submit required submittals in the following format:

.1 Working electronic copy of schedule file, where indicated.

.2 PDF electronic file.

1.6 Contractor's Look-Ahead Schedules

.1 The Contractor shall provide short interval "look ahead" schedules bi-weekly, identifying Work that has been performed during the past two weeks and activities that are planned for the next four (4) weeks. The short interval schedule shall be consistent with the progress schedule currently in force.

.2 The Look-Ahead Schedules shall generally reflect the Work associated with the Detailed Progress Schedule. The activities in the Look-Ahead Schedules shall be identified by the same number coding as the Detailed Progress Schedule and revised as necessary.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

SUBMITTALS

1. GENERAL

1.1 Description

.1 Submit to Contract Administrator submittals listed for review. Submit promptly and in 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.

.1 Allow ten (10) Working Days for review of submittals by the Contract Administrator.

.2 Resubmit will be subject to same review time

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present Shop Drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Contract Administrator, in writing at time of submission for review, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator’s review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

.10 Review of the Contractor’s drawings does not relieve the Contractor of the responsibility for the results arising from errors or omissions of design

.11 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.

.12 After Contract Administrator’s review and return of copies, distribute copies to sub-trades as appropriate. Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 The Contractor shall arrange for the preparation of clearly identified Shop Drawings as specified or as the Contract Administrator may reasonably request. Shop Drawings are to clearly indicate materials, weights, dimensions, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. Shop Drawings are to indicate their relationship to design Drawings and Specifications. Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract Documents.

.3 Have Shop Drawings stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba where required in the Specifications or by the Contract Administrator.

.4 The Contractor shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract Documents. Examination of each Shop Drawing shall be indicated by stamp, date and signature of a responsible person of the sub-contractor for supplied items and of the General Contractor for fabricated items. Shop Drawings not stamped, signed and dated will be returned without being reviewed and stamped "Re-submit". Ensure that the following are verified:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.4 Submittals shall be one electronic PDF copy.

.5 Shop Drawing reviews by the Contract Administrator is solely to ascertain conformance with the general design concept. Responsibility for approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.

.6 Shop Drawings will be returned to the Contractor with one of the following notations:

.1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.

.4 When stamped "NOT REVIEWED" or "REJECTED", submit other Drawings, brochures, etc., for review consistent with the Contract Documents.

.5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.7 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.8 Any adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of Work.

.9 Make changes in Shop Drawings, which the Contract Administrator may require, consistent with Contract Documents. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.

.10 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 Contractor's Progress Certificates.

.11 Accompany submissions with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each Shop Drawing, product data and sample.

.5 Specification Section, Title, Number, and Clause

.6 Other pertinent data.

.7 Date and revision dates.

.8 Project title and Bid Opportunity number.

.9 Name of:

.1 Contractor

.2 Subcontractor

.3 Supplier

.4 Manufacturer

.5 Separate detailer when pertinent

.6 Identification of product of material.

.7 Relation to adjacent structure or materials.

.8 Field dimensions, clearly identified as such.

.9 Specification section name, number and clause number or drawing number and detail/section number.

.10 Applicable standards, such as CSA or CGSB numbers.

.11 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

1.3 PROCEDURES

.1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplement with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

.3 Other Considerations :

.1 Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

.2 Material and equipment delivered to the site of the works will not be paid for at least until pertinent Shop Drawings have been submitted and reviewed.

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

.4 No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of Shop Drawings.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

QUALITY REQUIREMENTS

1. GENERAL

1.1 Description

.1 This Section covers Quality Assurance and Quality Control requirements for this Contract.

.2 The Contractor is responsible for controlling the quality of work, including work of its subcontractors, and suppliers and for assuring the quality specified in the Technical Specifications is achieved.

1.2 Summary

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

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 The Contract Administrator will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, the City shall pay.

1.3 Independent Inspection Agencies

.1 Independent Inspection/Testing Agencies may be engaged by the City for purpose of inspecting and/or testing portions of Work. 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 responsibility to perform Work in accordance with Contract Documents. If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by the Contract Administrator at no cost to the City. Pay costs for retesting and re-inspection.

1.4 Submittals

.1 Submit draft inspection and test reports to Contract Administrator, prior to inclusion with the O&M manuals, in accordance with Section 01 33 00 - Submittal Procedures.

1.5 Access to Work

.1 The City, the Contract Administrator, and other authorities having jurisdiction shall have access to the work.

1.6 Rejected Work

.1 Remove defective Work, whether 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 Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of the Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the City will deduct from Contract Price difference in value between Work performed and that called for by Contract

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

QUALITY CONTROL

1. GENERAL

1.1 References

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

.1	ACI	American Concrete Institute
.2	AISC	American Institute of Steel Construction
.3	ANSI	American National Standards Institute
.4	ASTM	American Society for Testing and Materials
.5	AWWA	American Water Works Association
.6	CANI	National Standard of Canada
.7	CEC	Canadian Electric Code (published by CSA)
.8	CGA	Canadian Gas Association
.9	CGSB	Canadian Government Specification Board
.10	CISC	Canadian Institute of Steel Construction
.11	CLA	Canadian Lumberman's Association
.12	CPCA	Canadian Printing Contractors Association
.13	CPCI	Canadian Pre-stressed Concrete Institute
.14	CRCA	Canadian Roofing Construction Association
.15	CSA	Canadian Standards Association
.16	DIN	Deutsches Institut Normung
.17	EEMAC	Electrical and Electronic Manufacturer's Association of Canada
.18	EIB	Electrical Inspection Branch
.19	FMEC	Factory Manual Engineering Corporation
.20	IEEE	Institute of Electrical and Electronic Engineers
.21	IPCEA	Insulated Power Cable Engineers Association
.22	NAAMM	National Association of Architectural Metal Manufacturers
.23	NACE	National Association of Corrosion Engineers

.24 NBC National Building Code

.25 NEMA National Electric Manufacturers Association

.26 NFPA National Fire Protection Association

.27 ULC Underwriters Laboratories of Canada

.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 Construction Contract Documents, or by the Construction Contractor in the event of non-conformance.

1.2 Inspection

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

.2 Give minimum seventy-two (72) hours notice when requesting inspection if the Work is designated for special tests, inspections or approvals by the Contract Administrator, or law of Place of Work.

.3 If the Construction Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work at no cost to the Owner.

.4 The Contract Administrator will order part of the Work to be examined if Work is suspected to be not in accordance with the Construction Contract Documents. If, upon examination such work is found not in accordance with the Construction Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with the Construction Contract Documents, the City shall pay cost of examination.

1.3 Independent Inspection Agencies

.1 Where inspecting, testing and similar quality control services are specifically indicated in the Specification Sections as the Construction Contractor’s responsibility, the Construction Contractor shall engage appropriate Independent Inspection/Testing Agencies. The cost of such services will be borne by the Construction Contractor.

.2 The City may elect to engage Independent Inspection/Testing Agencies for the purpose of quality assurance inspecting and/or testing portions of the Work. The cost of such services will be borne by the City.

.3 Where the City has engaged an Inspection/Testing Agency for testing and inspection of a part of the Work and the Construction Contractor is also required to engage an Inspection/Testing Agency for the same or related part of the Work; the Construction

Contractor shall not employ the same agency engaged by the City without the prior written approval of the City.

.4 All equipment required for carrying out the above inspection and testing will be provided by the appointed agencies.

.5 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Construction Contract Documents.

.6 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 City at no cost to the City. Pay costs for retesting and re-inspection.

1.4 Access to Work

.1 Allow inspection/testing agencies access to Work, off Site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.5 Procedures

.1 Notify appropriate agency and the Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in the Specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on Site. Provide sufficient space to store and cure test samples.

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 Construction Contract Documents. Replace or re-execute in accordance with the Construction Contract Documents.

.2 Make good other Construction Contractor's work damaged by such removals or replacements promptly.

.3 If in the opinion of the Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with the Construction Contract Documents, The Contract Administrator will deduct from the Construction Contract Price the difference in value between Work performed and that called for by the Construction Contract Documents, the amount of which will be determined by the Contract Administrator.

1.7 Reports

.1 Submit one (1) electronic copy of inspection and test reports to the Contract Administrator.

.2 Provide copies to the Subcontractor of work being inspected or tested and to the manufacturer or fabricator of material being inspected or tested.

.3 Each report shall include:

.1 Date of issue.

.2 Construction Contract name and number.

.3 Name, address and telephone number of Inspection/Testing Agency.

.4 Name and signature of inspector and tester.

.5 Date of inspection or test.

.6 Identification of the Product and Specification Section covering inspected or tested Work.

.7 Location of the inspection or the location from which the tested product was derived.

.8 Type of inspection or test.

.9 Complete inspection or test data.

.10 Test results and an interpretation of test results.

.11 Ambient conditions at the time of sample taking and testing.

.12 The remarks and observations on compliance with the Construction Contract Documents.

.13 Recommendations on retesting or other corrective action where necessary.

.14 Signature of a qualified and authorized representative of the Agency.

.4 Submit reports within forty-eight (48) hours; notwithstanding, notify the Contract Administrator immediately if the test indicates improper conditions or procedures.

.5 Refer to Specification section for definitive requirements.

1.8 Equipment and Systems

.1 Submit adjustment and balancing reports for process, mechanical, electrical and building equipment systems as indicated in Section 01 33 00.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY FACILITIES

1. GENERAL

1.1 Scope of Work

.1 The Contractor shall provide all temporary facilities for the proper completion of the work, as required and as specified.

.1 Section Includes:

.1 User Charges:

.1 Electric.

.2 Temporary heat.

.2 Project identification.

.3 Temporary Facilities:

.1 Field offices and trailers as required.

.2 Site meeting room that can accommodate ten (10) attendees.

.4 Equipment.

.5 Support facility installation.

.6 Security and Protection:

.7 Operation, termination, and removal.

1.2 References

.1 American National Standards Institute (ANSI):

.1 A 117.1: Accessible and Usable Buildings and Facilities.

.2 American Society for Testing and Materials (ASTM):

.1 E84: Standard Test Method for Surface Burning Characteristics of Building Materials

.2 E136: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg. C.

.3 Canadian Electrical Code.

1.3 Use Charges

.1 General: Costs for installation, removal and use of temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services

and facilities without cost, including, but not limited to, City's construction forces, Contract Administrator, occupants of Project, testing agencies, and authorities having jurisdiction.

.2 Sewer Service: Provide a portable washroom for usage by all entities for construction operations.

.1 The Contractor shall provide adequate sanitary facilities for the use of those employed on the Work. Such facilities shall be made available when the first employees arrive on the site of the Work, shall be properly secluded from observation, and shall be maintained during the progress of the Work in suitable numbers and at such points and in such manner as may be required by pertinent health and safety regulations.

.2 The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. The Contractor shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the City, or on adjacent property.

.1 The Contractor shall not use the City’s sanitary facilities.

.3 Potable Water Service: Provide potable water for usage by all entities for construction operations.

.4 Electric Power Service from Existing System: Electric power connection to Manitoba Hydro is available for use with metering and payment of use charges. Contractor to coordinate with Manitoba Hydro for energization and payment. Provide connections and extensions of services as required for construction operations.

.1 The Contractor shall make all necessary applications and arrangements for electrical energy for power and light necessary for the proper completion of the Work and during its entire progress. The Contractor shall provide and pay for all temporary wiring, switches, connections, and meters.

.2 The Contractor shall provide sufficient electric lighting so that all work may be done in a workmanlike manner when there is not sufficient daylight.

.3 Any electrical power required beyond the available power in section 01 50 00 3.2 shall be the responsibility of the Contractor to coordinate and provide.

.5 Notwithstanding the availability of potable water and effluent water services from the existing system, the Contractor shall be solely responsible for the provision of water for leakage and other testing, for concrete protection and to prevent freezing of equipment, as required by the Contract.

.6 Temporary Heat:

.1 If temporary heat is required for the protection of the Work, the Contractor shall provide and install suitable heating apparatus, shall provide adequate and proper fuel, and shall maintain heat as required. Costs for temporary heating, cooling, and ventilating required to execute the Work shall be borne by the Contractor.

.2 Temporary heating apparatus shall be installed and operated in such manner that finished work will not be damaged thereby. After the permanent heating system has

been installed, tested, and made ready for operation, the Contractor may, at his own risk and expense, use it for providing heat for protection of the Work. He shall provide and pay for all fuel and care necessary, and, when the Work is ready for acceptance, he shall, at his own expense, put the system into first-class condition, even to the extent of replacing worn or damaged parts.

.3 If permanent natural gas piping is used for temporary heating units, the Contractor shall not modify or reroute gas piping without the prior approval of the natural gas supplier. The Contractor shall provide separate gas metering as required by the natural gas supplier.

.4 The Contractor shall provide 24-hour monitoring of temporary heating, cooling and ventilating equipment.

1.4 Project Identification

.1 Project Identification Sign:

.1 One (1) sign of construction, design, and content.

.2 Three sq m area.

.3 Content:

.1 Project number, title, logo and name of City as indicated on Contract Documents.

.2 Names and titles of authorities.

.3 Names and titles of Contract Administrator.

.4 Name of Prime Contractor.

.4 No other signs are allowed without City permission except those required by law.

.2 Design sign and structure to withstand 100 km/hr wind velocity.

.3 Finishes: Adequate to withstand weathering, fading, and chipping for duration of construction.

.4 Maintenance: Maintain signs and supports clean, repair deterioration and damage.

.5 Removal: Remove signs, framing, supports, and foundations at completion of Project and restore the area.

1.5 Traffic Regulation

.1 Signs, Signals, and Devices:

.1 Traffic Cones as required.

.2 Flag Person Equipment: As required by local jurisdictions.

.2 Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

.3 Haul Routes:

.1 Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.

.4 Removal:

.1 Remove equipment and devices when no longer required.

.2 Repair damage caused by installation.

1.6 Submittals

.1 Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

.2 Fire-Safety Program: Show compliance with requirements of authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

.3 Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

.1 Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.

.2 Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

.3 Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.7 Quality Assurance:

.1 Electric Service: Comply with NECA, NEMA, and CSA standards and regulations for temporary electric service. Install service to comply with the Canadian Electrical Code.

1.8 Project Conditions

.1 During adverse weather and against the possibility thereof, the Contractor shall take all necessary precautions so that the Work may be properly done and satisfactory in all respects. When required, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other suitable means.

.2 During cold weather, materials shall be preheated, if required, and the materials and adjacent structure into which they are to be incorporated shall be made and kept sufficiently warm so that a proper bond will take place and a proper curing, aging, or drying will result. Protected spaces shall be artificially heated by suitable means which will result in a moist or

a dry atmosphere according to the particular requirements of the work being protected. Ingredients for concrete and mortar shall be sufficiently heated so that the mixture will be warm throughout when used.

2. PRODUCTS

2.1 Temporary Facilities

.1 Field Offices, General: Mobile units with serviceable finishes, temperature controls, internet access, and foundations adequate for normal loading.

.2 The Contractor shall maintain a temporary field office near the work for his own use during the period of construction at which readily accessible copies of all contract documents and schedules shall be kept. The office shall be located where it will not interfere with the progress of the work. In charge of this office there shall be a competent superintendent of the Contractor as specified under "Supervision of Work" in the Tender documents.

.3 Temporary Storage Yards: The Contractor shall construct temporary storage yards for storage of Products that are not subject to damage by weather conditions.

.4 Temporary Storage Buildings:

.1 The Contractor shall provide environmental control systems that meet the recommendations of Suppliers and manufacturers of the equipment and materials stored.

.2 The Contractor shall arrange for a chain link partition fence to provide security of contents and ready access for inspection and inventory.

.5 The Contractor shall store combustible materials (paints, solvents, fuels) in a well ventilated and remote building meeting all applicable safety standards.

.6 Minimum Field Office Area: 16’ x 32’

.7 Field Office standard minimum quality:

.1 Willscot Modular Office Trailer 16ft x 32ft.

2.2 Equipment

.1 Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

3. EXECUTION

3.1 Installation, General

.1 Locate facilities in and associated parking within the laydown area designated by the Contract Administrator

3.2 Temporary Utility Installation

.1 General: Install temporary service or connect to existing service.

.1 Arrange with utility company, City, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

.2 Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

.1 Toilets: Use of City's existing toilet facilities is prohibited.

.3 Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

.4 Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

.1 Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.

.5 Electric Power Service: Connect to Manitoba Hydro's existing electric power service. Maintain equipment in a condition acceptable to City.

.6 Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

.1 Connect temporary service to Manitoba Hydro's existing power source, as coordinated with Manitoba Hydro. Available power: 600 Vac 60 A.

.7 Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.3 Support Facilities Installation

.1 General: Comply with the following:

.1 Maintain support facilities until Contract Administrator schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to City.

.2 All roads within the plant are used simultaneously by vehicles and pedestrians. The speed limit of 15 km/h applies throughout the plant, including the access roads and parking lots. Failure to comply with speed limit or to operate vehicles safely will result in possible removal of the staff from the plant.

.2 Parking: Provide fenced temporary parking areas for construction personnel. The Contractor shall not use public roads or undesignated areas for parking.

.3 Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

.4 Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

.1 Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

.5 Snow Removal: Upkeep snow removal for temporary facilities, walkways, and driveways

3.5 Operation, Termination and Removal

.1 Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

.2 Maintenance: Maintain facilities in good operating condition until removal.

.1 Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

END OF SECTION

DELIVERY, STORAGE AND HANDLING

1. GENERAL

1.1 General Requirements

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

1.2 Transportation and Delivery

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

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

.3 Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended. All spare parts shall be cross-referenced to their applicable the Specification Section.

.4 Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment and installation. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter. Carefully pack machines for shipment and protect electrical equipment from moisture damage. Protect bearings, seals and glands from grit and dirt.

.5 Identify each component with durable identifying labels or tags securely attached to each piece of equipment, crate or container.

.6 Finished surfaces of all exposed flanges shall be protected by fiberboard blank flanges strongly built and securely bolted thereto.

.7 Deliver spare parts at same time as pertaining equipment. Deliver spare parts to City after completion of Work.

.8 Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

.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 site.

.11 All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

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

.13 Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. City, other Contractors), perform inspection in the presence of the Contract Administrator. Notify Contract Administrator verbally, and in writing, of any problems.

.14 Pay all demurrage charges if failed to promptly unload items.

1.3 Storage and Protection

.1 Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and may be reviewed by the Contract Administrator. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.

.2 Arrange storage of products and equipment to permit access for inspection. Periodically inspect to make sure products and equipment are undamaged and are maintained under specified conditions.

.3 Store loose granular materials on solid flat surface in a well-drained area. Prevent mixing with foreign matter.

.4 All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Contract Administrator. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.

.1 Prior to acceptance of the equipment, the Contractor may have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CLEANING UP

1. GENERAL

1.1 Summary

.1 Execute cleaning during progress of Work and at completion of Work.

.2 Refer to Specification Sections for specific cleaning for Products or Work.

1.2 Disposal Requirements

.1 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 Project 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.

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 manufacturer of surface to be cleaned.

3. EXECUTION

3.1 Cleaning During Construction

.1 Comply with General Conditions.

.2 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.

.3 During execution of work, clean site, adjacent properties, and public access roads and dispose of 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.

.4 Wet down dry materials and rubbish to lay dust and prevent blowing dust.

.5 Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

.6 Where material or debris has washed or flowed into or been placed in existing 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 ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

.7 On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

.8 Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations.

3.2 Final Cleaning

.1 General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

.1 Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

.1 Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

.2 Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

.3 Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

.4 Remove tools, construction equipment, machinery, and surplus material from Project site.

.5 Remove snow and ice to provide safe access to building.

.6 Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

.7 Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

.8 Sweep concrete floors broom clean in unoccupied spaces.

.9 Vacuum clean concrete/tile floors in occupied spaces.

.10 Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

.11 Remove labels that are not permanent.

.12 Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

.13 Vacuum inside and outside of all new and existing electrical panels, MCCs, variable speed drives, etc., which have been affected by dust or dirt due to construction activities.

.14 Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

.15 Leave Project clean and ready for occupancy.

.2 Touch-up paint or repaint damaged finishes on electrical items delivered to Project with finish coat of paint. Contract Administrator will make final determination of items to be repainted or touched-up.

.3 Prior to substantial completion, Contractor with Contract Administrator and City**,** shall conduct inspection of sight-exposed interior and exterior surfaces and work areas to verify Work and site is clean.

END OF SECTION

CONTRACT CLOSEOUT

1. GENERAL

1.1 Related Documents

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 Summary

.1 Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

.1 Substantial Completion procedures.

.2 Final completion procedures.

.3 Warranties.

.4 Final cleaning of equipment and site.

.5 Repair of defective and deficient Work.

1.3 References

.1 Canadian Electrical Code.

.2 Manitoba Amendments to the Canadian Electrical Code.

.3 City of Winnipeg By-laws.

.4 Manitoba Building Code.

.5 City of Winnipeg Automation Design Guide.

.6 City of Winnipeg Electrical Design Guide.

1.4 Submittals

.1 Submit Shop Drawings as required.

.2 Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

.3 Certified List of Incomplete Items: Final submittal at Final Completion.

.4 Certificates of Release: From authorities having jurisdiction.

.5 Certificate of Insurance: For continuing coverage.

.6 Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

.7 Certificate of Payment: For payment of sub-trades and release of hold-back.

1.5 Substantial Completion Procedures

.1 Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

.2 Submittals Prior to Substantial Completion: Complete the following a minimum of ten (**10)** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

.1 Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting City unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

.2 Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

.3 Submit closeout submittals specified in individual Divisions 02 through 42 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

.4 Submit maintenance material submittals specified in individual Divisions 02 through 42 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Contract Administrator. Label with manufacturer's name and model number where applicable.

.1 Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Contract Administrator signature for receipt of submittals.

.5 Submit test/adjust/balance records.

.6 Submit changeover information related to City's occupancy, use, operation, and maintenance.

.3 Procedures Prior to Substantial Completion: Complete the following a minimum of ten (10) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

.1 Advise City of pending insurance changeover requirements.

.2 Complete start-up and testing of systems and equipment.

.3 Perform preventive maintenance on equipment used prior to Substantial Completion.

.4 Instruct City's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

.5 Terminate and remove temporary facilities from Project site, along with mock-ups, construction tools, and similar elements.

.6 Complete final cleaning requirements, including touch-up painting.

.7 Touch-up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

.4 Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of ten (10) days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Contract Administrator will either proceed with inspection or notify Contractor of unfulfilled requirements. Contract Administrator will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Contract Administrator, that must be completed or corrected before certificate will be issued.

.1 Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

.2 Results of completed inspection will form the basis of requirements for final completion.

1.6 Starting of Systems

.1 Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

.2 Verify wiring and support components for equipment are complete and tested.

.3 When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, approve equipment or system installation prior to start-up, to supervise placing equipment or system in operation, and to train the City’s staff.

.4 Submit a written report that equipment or system has been properly installed and is functioning correctly.

.5 functioning correctly.

1.7 Demonstration and Instructions

.1 Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with City's personnel in detail to explain all aspects of operation and maintenance.

.2 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

.3 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.8 Testing, Adjusting and Balancing

.1 Adjust operating Products and equipment to ensure smooth and unhindered operation.

.2 Reports will be submitted to the Contract Administrator indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.9 Project Records Documents

.1 The Contractor shall record any actual revisions to the Work and maintain one set of the following Project Record Documents on Site:

.1 Contract Drawings, Specifications, and Addenda.

.2 Change Orders, Field Orders, and other written notices.

.3 Shop drawings, Product data, and samples.

.4 Records of surveying and layout Work.

.5 Project Record Drawings.

.2 The Contractor shall record information on the Project Record Documents concurrent with construction progress and store these documents separately from the documents used for construction.

.1 The City will supply a set of Contract Drawings. The Contractor shall mark thereon all revisions as the Work progresses in order to produce a set of as-built drawings.

.2 The Contractor shall note any changes made during construction by any of the Contractor's forces or those of any Subcontractors.

.3 The Contractor shall dimension the locations of buried or concealed Work, especially piping and conduit, with reference to exposed structures.

.4 The Contractor shall dimension the installed locations of concealed service lines on the Site or within the structure by reference from the centre line of the service to the structure column lines, or other main finished faces, or other structural points which are easily identified and located in the finished Work.

.5 Certificates of Substantial Performance and Total Performance shall not be issued until as-built drawings are complete and submitted, and the Contractor has satisfied all requirements for Substantial Performance and Total Performance of the Work.

.3 For Project Record Documents and Record Shop Drawings, the Contractor shall legibly mark each item to record actual construction including:

.1 Field changes of dimensions and details.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances which are concealed in construction, referenced to visible and accessible features of the Work.

.4 Changes in the Work caused by Site conditions, or originated by the City, the Contract Administrator, the Contractor, Preselected Equipment Vendors, or Subcontractors and by addenda, supplemental drawings, Site instructions, supplementary instructions, change orders, correspondence, and directions of any regulatory authorities.

.5 Record the location of concealed mechanical services and electrical main feeders, junction boxes and pullboxes.

.4 Upon completion of the Work, the Contractor shall prepare two (2) USB drives of the Record Shop Drawings, and index, and a physical printed and bound copy.

.5 The Record Shop Drawings CD-ROM index shall identify the City's project number, project name, and Contract number and the contents of each USB in the following format:

.1 The index shall include the following columns of information for each Record Shop Drawing:

.1 USB number.

.2 Specification Section number.

.3 Specification title.

.4 Shop drawing transmittal number.

.5 Shop drawing equipment description including Preselected Equipment Vendor and Supplier.

.2 The index shall be printed by the following two sorts:

.1 Primary sort: Specification Section number. Secondary sort: Shop Drawing transmittal number.

.2 Primary sort: USB number. Secondary sort: Specification Section number.

.3 The index shall be generated using Microsoft Excel software. A copy of the electronic file shall be furnished to the City.

.4 The Contractor shall remove the Architect/Engineer seal from all documents.

.5 The Contractor shall provide a set of Project Record Documents on a USB drive in an electronic format compatible with the plant USB drive record standards. All drawings are to be provided electronically on USB drive in both AutoCAD (latest version) and Adobe Acrobat PDF (latest version). Also provide a set of USB drives containing the software implemented on this project, including standard software and custom application software. Also provide a set of USB drives containing the various programming tools and files necessary for maintenance, editing, backing up and restoring programmable equipment implemented on this project.

1.10 Equipment Inventory Spreadsheet

.1 As part of the City's asset management program, the Contractor shall complete all fields for the equipment inventory file for each piece of equipment and device provided under this Contract, as a requirement for Substantial Performance. An electronic format of the equipment inventory spreadsheet will be provided on a CD or USB drive to the successful General Contractor.

1.11 Equipment Preventative Maintenance Spreadsheet

.1 As part of the City's asset management program, the Contractor shall complete all fields for each piece of equipment and device provided under this Contract, as a requirement for Substantial Completion. The Contractor shall transfer all of the manufacturer's recommended preventative maintenance tasks and frequencies into the spreadsheet. An electronic format of the equipment inventory spreadsheet will be provided on a CD or USB drive to the successful General Contractor

1.12 Protecting Installed Construction

.1 Protect installed Work and provide special protection where specified in individual Specification Sections.

.2 Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

.3 Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

.4 Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

.5 Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

.6 Prohibit traffic from landscaped areas.

1.13 Spare Parts and Maintenance Products

.1 Furnish spare parts, maintenance, and extra products in quantities as specified within Division 26 and Division 40.

.2 Spare parts shall be delivered and on site prior to Commissioning. Deliver to Project site and place in location as directed by the City; obtain receipt prior to final payment.

.3 Spare parts shall be turned over to the City during the hand over phase of each area.

.4 Coat parts to protect from moisture.

.5 Crate in containers designed for prolonged storage suitable for handling with hoisting equipment containers: palletized.

.6 Stencil on containers:

.1 Manufacturer/supplier name.

.2 Unit name.

.3 Spare part name.

.4 Manufacturer catalogue number.

.5 Other identifying information.

.6 Precautionary information.

1.14 Final Completion Procedures

.1 Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

.1 Submit a final Application for Payment according to Section D.

.2 Certified List of Incomplete Items: Submit certified copy of Contract Administrator's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Contract Administrator. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

.3 Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

.2 Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Contract Administrator will either proceed with inspection or notify Contractor of unfulfilled requirements. Contract Administrator will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

.1 Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.15 List of Incomplete Items (Punch List)

.1 Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

.1 Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

.2 Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

.3 Include the following information at the top of each page:

.1 Project name.

.2 Date.

.3 Name of Contractor.

.4 Page number.

.4 Submit list of incomplete items in the following format:

.1 MS Excel electronic file. Contract Administrator will return annotated file.

.2 PDF electronic file. Contract Administrator will return annotated file.

2. PRODUCTS

2.1 Materials

.1 Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

.1 Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

3. EXECUTION

3.1 Final Cleaning

.1 General: Perform final cleaning .

.2 Dispose of Construction Waste.

3.2 Repair of The Work

.1 Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

.2 Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

.1 Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

.2 Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

.1 Do not paint over "CSA" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

.3 Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

.4 Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.3 Adjusting

.1 Adjust operating products and equipment to ensure smooth and unhindered operation.

END OF SECTION

COMMISSIONING PLAN

1. GENERAL

1.1 Description

.1 Provide a complete and fully functional system ensuring that:

.1 City personnel have been fully trained in aspects of installed systems.

.2 Documentation relating to installed equipment and systems has been completed.

.2 The Contractor shall develop a Detailed Commissioning Plan and Commissioning Schedule using this Section as a Base Commissioning Plan.

.3 Use this Section as a master planning document for Commissioning as it:

.1 Outlines organization, scheduling, allocation of resources, and documentation pertaining to implementation of Commissioning.

.2 Communicates responsibilities of team members involved in Commissioning including scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to operation, maintenance, process and administration of Commissioning.

.4 Describes how the process of verification meets the design requirements of the completed Works.

.5 Sets out scope, standards, roles and responsibilities, expectations, deliverables and provides:

.1 An overview of Commissioning.

.2 A general description of elements that make up the Detailed Commissioning Plan.

.3 A process and methodology for successful Commissioning.

.4 The Contract Administrator shall witness and certify tests and reports of results.

.5 Commissioning activities must be completed before issuance of Substantial Performance.

1.2 Definitions

.1 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City. This shall occur after the successful end of Commissioning of each area through a formal acknowledgement between the Contract Administrator, the City, and the Contractor. Success of the Commissioning period is determined by the Contract Administrator.

.2 Base Commissioning Plan: General Commissioning requirements within this Section to be used in the development of a Detailed Commissioning Plan.

.3 Commissioning: for the purpose of this Specification Section, Commissioning shall be defined as the successful operation of components, equipment, systems, subsystems, or integrated systems in accordance with its design requirements for a period of one (1) month, the last seven (7) of which shall be consecutive, unless otherwise specified.

.4 Commissioning Agent: Agent of the Contractor with minimum 10 years of experience in Commissioning, satisfactory to the Contract Administrator, responsible for the oversight and execution of Commissioning.

.5 Commissioning Report: the final Commissioning document as described in Item 3.14.

.6 Commissioning Schedule: Gantt chart showing planned dates for performing all activities related to commissioning of all upgraded systems. The Commissioning Schedule is to be developed by the Contractor and submitted to the Contract Administrator for review, as described in Item 3.1.

.7 Demonstration: a one-hour demonstration of the successful installation and operation of the equipment.

.8 Detailed Commissioning Plan: Commissioning Plan developed by Contractor from the Base Commissioning Plan to be submitted and reviewed by the Contract Administrator, as described in Item 3.2. Unless defined as “Base Commissioning Plan”, all other instances of “Commissioning Plan” refer to the Detailed Commissioning Plan.

.9 Performance Test: a test in which the equipment is run continuously for seven (7) days (168 hours) or as specified for different equipment. Successful completion of the Performance Test is required for Form 104.

.10 Running Test: a test in which equipment is run continuously for a minimum of three (3) days (seventy-two (72) hours) or as specified for different equipment. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. Successful completion of the Running Test is required for Form 103.

.11 System: for the purpose of this Specification section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.

1.3 Submittals

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

.2 Commissioning Schedule to be submitted and accepted by the Contract Administrator as per Item 3.1.

.3 Detailed Commissioning Plan to be submitted and accepted by the Contract Administrator as per Item 3.2.

.4 Detailed Commissioning Plan for each area to be refined and resubmitted as required during the construction phase as per Item 3.3.

1.4 Composition, Roles, and Responsibilities of Commissioning Team

.1 Commissioning Team to consist of the following members:

.1 Contract Administrator who is responsible for:

.1 Monitoring Commissioning activities.

.2 Witnessing and certifying reported results.

.3 Reviewing and approving Contractor submissions.

.4 Assisting in the resolution of issues resulting from all tests.

.5 Reviewing the final Commissioning Report.

.2 City personnel who are responsible for:

.1 Attending Commissioning activities to verify re-installed existing equipment, including but not limited to any removed flow meters, operates as per the original sequence of operations.

.2 Attending Commissioning activities to verify newly installed equipment operates as intended.

.3 Performing necessary testing as noted in Item 3.11.

.3 Construction Team: Contractor, Subcontractors, suppliers, and support disciplines, who are responsible for construction/installation in accordance with Contract Documents, including:

.1 Testing.

.2 Mechanical testing, adjusting and balancing (TAB).

.3 Integrating Commissioning activities into the Contractor’s Project Schedule (Project Schedule).

.4 Performing and documenting equipment installation as per Section 01 65 00 - Equipment Installation.

.5 Performing and documenting start-up including installation/start-up checklists.

.4 Contractor's Commissioning Agent who is responsible for implementing specified Commissioning activities including:

.1 Planning/preparing checklists (installation/start-up checklists as required, product information) and test procedures.

.2 Determining operational training requirements.

.3 Developing a Detailed Commissioning Plan, updating information provided in the Base Commissioning Plan.

.4 Performing and documenting Running Testing and Performance Testing.

.5 Preparing and updating issues logs.

.6 Verifying, reviewing, and conducting training.

.7 Preparing final Commissioning Report.

1.5 Extent of Commissioning

.1 Testing of electrical panels must be completed before proceeding with Commissioning activities.

.1 Testing after the electrical modifications shall conform to CSA C22.2 No. 14, CSA C22.2 No. 286 and related CSA standards. CSA special inspections shall be coordinated by the Contractor after operation is confirmed.

.2 Commission mechanical systems and associated equipment.

.3 Commission Process systems and associated equipment.

.4 Commission Electrical systems and associated equipment.

.5 Commission Fire alarm systems, equipment.

.6 Commissioning shall demonstrate all control modes functioning, demonstrating the logic of all control modes in across the expected and foreseeable operating conditions.

2. PRODUCTS

2.1 Equipment

.1 Provide sufficient instrumentation to verify and commission the installed systems.

3. EXECUTION

3.1 Commissioning Schedule

.1 Prepare a detailed Commissioning Schedule and submit to the Contract Administrator for review and approval at the same time as the Project Schedule. Include milestones, testing, documentation, training, and Commissioning activities of components, equipment, subsystems, systems, and integrated systems.

.2 After approval, incorporate the Commissioning Schedule into the Project Schedule.

.3 Contractor, Contractor's Commissioning Agent, and Contract Administrator will monitor progress of Commissioning against the approved Commissioning Schedule.

3.2 Development of Commissioning Plan

.1 The Detailed Commissioning Plan and associated Commissioning Schedule is to be approved by the Contract Administrator at least twenty (20) Business days prior to the planned start of Commissioning. The plan shall comply with the requirements that have been established by the Contract Administrator.

.2 The Detailed Commissioning Plan shall be drafted by the Contractor and reviewed by the Contract Administrator and shall incorporate the contents of the Base Commissioning Plan as specified in this Section. The Detailed Commissioning Plan shall include the following:

.1 A detailed schedule of Commissioning events to be incorporated into the Project Schedule, including but not limited to, the schedule for completion of testing of all component parts of the system.

.2 Test equipment necessary to verify compliance with the performance specifications.

.3 Inform the Contract Administrator at least fifteen (15) Business Days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.

.4 The Manufacturer's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

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

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

.7 List and details for all temporary equipment or component (additional spool pieces, etc.) required to facilitate Commissioning.

.8 List of all personnel who the Contractor plans to be in attendance for Commissioning and handover with information indicating their qualifications for this Work.

.3 The Detailed Commissioning Plan to take into account:

.1 Approved Shop Drawings and product data.

.2 Approved changes to the Contract.

.3 Project Schedule.

.4 Contractor's, Subcontractor's, and suppliers' requirements.

.5 Project construction team's and Commissioning team's requirements.

.4 The Detailed Commissioning Plan to include:

.1 Commissioning Schedule.

.2 Installation/start-up check lists provided by manufacturers and suppliers.

.3 Manufacturer Performance Testing forms provided by manufacturers and suppliers.

.1 Forms to include testing parameters at full range of operating conditions to verify responses of equipment and systems.

.5 Submit the completed Detailed Commissioning Plan to the Contract Administrator for review and acceptance. The Detailed Commissioning Plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.

3.3 Refinement of Commissioning Plan

.1 During the construction phase, revise, refine, and update the Detailed Commissioning Plan to include approved design and construction changes.

.1 At each revision, indicate revision number and date.

.2 Submit each revised Detailed Commissioning Plan to the Contract Administrator for review and acceptance.

3.4 Equipment

.1 All process, electrical, control, and miscellaneous equipment related to the system shall be successfully installed and tested as described in this Section, and any specific requirements noted in other Divisions. Form 103 and Form 104 shall be executed for each piece of major equipment.

.2 Temporary equipment or components will be installed and tested as necessary to ensure that it functions reliably and consistently through the Commissioning period.

3.5 Controls

.1 All controls which are the responsibility of this Contractor shall be installed and tested prior to Commissioning.

.2 The Contractor shall arrange for the simulation of the control sequences at the discretion of Contract Administrator. Every effort shall be made to ensure that the Commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

3.6 Plant Utility Service

.1 The City will provide power and other ancillary services as necessary to operate the facility through the Commissioning period. Provision of these services shall be limited to reasonable levels.

3.7 Manpower

.1 Supply all staff required during Commissioning as necessary to assist the City’s staff in the operation of the facility.

.2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the Commissioning period.

.3 Ensure equipment Manufacturer's Representatives are on site to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.

3.8 Operating Descriptions

.1 Operating descriptions shall be prepared by the Contract Administrator for the facility systems. Other information outlining the operating requirements shall also be available from the Contract Administrator. The Contractor will review these descriptions and will make themselves familiar with the requirements in order that they can undertake Commissioning in an appropriate manner.

.1 Operating descriptions shall be considered part of documentation for systems as listed in Item 3.14.2.

3.9 Design Parameters

.1 Design parameters for the system to be commissioned shall be as defined in the Specifications and/or the operating descriptions.

3.10 Pre-Commissioning Activities

.1 Conduct pre-start-up pressure, static, flushing, cleaning, "bumping" testing, and loop validation during construction as specified in the individual sections. This testing to be witnessed and certified by the Contract Administrator and does not form part of Commissioning specifications. Include completed documentation with the Final Commissioning Report.

.2 Perform prestart up inspections prior to commencing Commissioning. Utilise approved installation/start-up check lists if required. Rectify any deficiencies to the Contract Administrator's satisfaction. Include completed documentation with the Final Commissioning Report.

3.11 Tests to be Performed by City

.1 City staff may conduct additional testing at their own discretion to supplement testing required by the Contractor as part of this Work.

3.12 Commissioning of Instrumentation and Control

.1 Commissioning activities shall only proceed after instrumentation and control tests have been completed. Refer to Division 26 and Division 40 for additional requirements and test forms.

.2 A minimum written notice of two (2) weeks is required prior to commencing with process commissioning activities. In order to qualify for process commissioning the following activities must be completed:

.1 Instrument Calibrations;

.2 Initial Control Settings and adjustments have been made;

.3 All field devices have been set-u;

.4 Forms (i.e., misc. 100 forms; signed off where required) have been completed;

.5 PLC/SCADA IO and loop checks have been completed; and

.6 Proper mounting and connections have been made.

.3 During Commissioning, demonstrate to the Contract Administrator proper scaling and operation of instruments and gauges.

.4 Commissioning of the instrumentation and control system to include but not be limited to the following:

.1 Verify installation of components and wiring connections.

.2 Verify wiring continuity.

.3 Verify instrument calibrations and loop tests and provide a written report.

.1 The report shall include record of functional checks and any adjustments required for the instruments and control equipment under operational conditions.

.4 Coordinate and cooperate with the Integrator, City, Contract Administrator, and other contractors to commission the Control System I/O points.

.5 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.6 Ensure that the instrumentation and control equipment suppliers cooperate to complete the Work.

.7 Verify signal levels and wiring connections to all instrumentation and control equipment.

3.13 Start-Up and Commissioning of Process Equipment

.1 Following the installation and calibration of the equipment, the Contractor shall perform a Demonstration, Running Test, and Performance Test of the full system. It will be the responsibility of the Contractor to communicate to arrange the times for testing and start-up activities. The Contractor must confirm that these times are acceptable to the Contract Administrator and the City.

.1 During the Demonstration, Running, and Performance tests, the Contractor shall operate equipment as required to meet the requirements from all Divisions of this Specification.

.2 If required, the Contractor shall supply any ancillary equipment or services required to complete the initial Demonstration, Running Test, and Performance Tests.

.3 Should the initial Demonstration, Running Test, or Performance Tests reveal any defects, then those defects shall be promptly rectified and the Demonstration, Running Tests, and/or Performance Tests shall be repeated to the satisfaction of the Contract Administrator.

.4 Additional costs incurred by the Contractor due to repeat Demonstration, Running Tests, and/or Performance Tests shall be borne by the Contractor.

.2 On successful completion of the Demonstration and Running Test, Form 103 – Certificate of Equipment Satisfactory Running Test Performance (Form 103) (attached to this Specification) will be signed by the Contractor, and the Contract Administrator. Form 103 is required for each piece of major equipment, which includes its associated electrical/control modifications by extension.

.3 On successful completion of the Performance Test, Form 104 – Certificate of Equipment Satisfactory Performance Test Performance (Form 104) (attached to this Specification) will be signed by the the Contractor, and the Contract Administrator. Form 104 is required for each piece of major equipment, which includes its associated electrical/control modifications by extension.

.4 Demonstration:

.1 The Contractor shall notify the Contract Administrator of their readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend.

.2 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters will be checked to ensure that they are within the specified or Manufacturer's Representative's recommended limits, whichever is more stringent. This step shall be repeated for each modified system.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters shall be rechecked.

.5 Running Test:

.1 The Running Test shall be performed subsequent to modification and successful Demonstration of equipment.

.2 The equipment shall be restarted and run continuously for a minimum of three (3) days (seventy-two (72) hours) or as specified. During this period, as practicable, conditions shall be simulated which represent maximum (or most severe), average, and minimum (or least severe) conditions. These conditions will be mutually agreed to by the Manufacturer's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each. This step shall be repeated for each piece of major equipment.

.3 The Running Test shall be completed as follows:

.1 To perform the Running Test, the Contractor shall operate all controls and other devices to ensure they are functional.

.2 The purpose of the Running Test shall be to demonstrate the effectiveness of all system components and control features in all modes of control.

.1 Local control of all devices when local controllers and/or HMI are not in service.

.2 Automatic shutoff and alarm for various failure modes. This includes air monitoring, process monitoring, and shutdown sequences are operating as intended for both life safety and process safety.

.3 Automatic switchover from normal power to emergency power, and emergency power to normal power, if this function has been disturbed by modifications.

.4 Operation of mechanical cleaning system and chemical cleaning system where applicable.

.5 Operation of all monitoring instruments.

.6 All control functions, both at local system, HMI, and PCS OIT(s).

.4 The Contractor shall submit results of the Running Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days.

.1 Results shall include, at a minimum, Pass or Fail status of all tasks and commentary on the performance of each task.

.5 The Contractor shall complete the Running Test to the satisfaction of the Contract Administrator and the City prior to commencing the Performance Test.

.6 Performance Tests:

.1 Following completion of the Demonstration and Running Tests, the Contractor in cooperation with the City's operating staff shall conduct the Performance Test.

.2 A Performance Test shall be restarted if a critical failure occurs. A critical failure shall be deemed as a failure which prohibits the process from functioning successfully or which creates a safety hazard.

.3 Performance Tests shall be as dictated in this Section, the technical specifications for each piece of equipment, and as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.

.4 The Contractor shall submit the initial results of each Performance Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days.

.5 The Contract Administrator reserves the right to request additional testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the Performance Tests and receipt of the test reports.

.6 To perform the Performance Test, the Contractor in cooperation with City's operating staff shall operate the system with supervision assistance from the Manufacturer's Representative over a seven (7) day test period and collect and summarize data to demonstrate that the system meets the Performance Test requirements for the parameters listed below.

.7 In all cases, compliance with the requirements of this Specification shall be determined for each day of the testing period.

.8 The Manufacturer's Representative and the Contractor shall provide the Performance Test Report within five (5) Business days of completion of the Performance Test.

.1 The Performance Test Report shall include the following as a minimum:

.1 Performance Test conditions and procedures.

.2 Corrective actions taken.

.3 Retesting results (if necessary).

.4 Other pertinent information (if any).

.5 Conclusions.

.6 Recommendations for future actions.

3.14 Final Commissioning Report

.1 Contractor to submit the completed Commissioning Report within a maximum of two (2) weeks of completion of Commissioning. The final Commissioning Report is to be reviewed and accepted by the Contract Administrator prior to granting Substantial Performance.

.2 Final Commissioning Report to include:

.1 Start-up, pre- Commissioning activities, and documentation for systems and equipment.

.2 Description of Commissioning activities and documentation.

.3 Description of Commissioning of integrated systems and documentation.

.4 Completed installation checklists if required by manufacturer.

.5 Completed Running and Performance Test Report(s).

.6 Final settings of commissioned equipment.

.7 Training Plans.

.3 Before the final Commissioning Report is accepted, individual reported results to be subject to verification by the Contract Administrator.

3.15 Training Plans

.1 Refer to Section 01 79 00 - Demonstration and Training.

CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE RUNNING TEST FORM 103

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Running Testing 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 Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

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

Acknowledgement of Receipt of O&M Manuals.

_____ _____
(Authorized Signing Representative of the City) Date

CERTIFICATE OF SATISFACTORY PERFORMANCE TEST PERFORMANCE FORM 104

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Performance Testing criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT: _____

SYSTEM DESCRIPTION: _____

_____

TAG NO (S): _____

REFERENCE SPECIFICATION (S): _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

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

_____ _____
(Authorized Signing Representative of the City) Date

1. GENERAL

1.1 Description:

.1 This contract is to provide the field services for the DCS Migration. Provide complete and operational systems for the Process Control System as shown in the specifications, drawings, and appendices. Refer to Appendix A, the DCS Migration Plan, for an overview and sequencing of the DCS Migration. The Work under this contract is described by the "General Contractor" in Appendix A. Perform all work, testing, and commissioning as indicated and specified.

.2 Be responsible as Prime Safety Contractor for the NEWPCC DCS Migration. This includes but is not limited to the Site Safety defined in this contract and the Work defined in 76-2023 for the Integrator.

.1 The Contract 76-2023 work shall maintain their own Safe Work Procedures for their tasks and remain responsible for safety on their laydown area.

.3 Provide field installation services for the NEWPCC DCS Migration.

.1 Install PLC and RIO panels in locations shown in drawings. PLC and RIO panels built by others and delivered and stored onsite by Integrator.

.2 Provide breakers, cabling, and terminations from local panelboards to the PLC and RIO panels as required to power the PLC and RIO panel boards. Refer to Power Distribution Schematic drawings for panel power requirements.

.3 Due to space limitations, the panels will not fit in the area control rooms until the existing controller cabinets are removed. In the interim the PLC panel backboards will be installed on temporary stands.

.1 Install panel backboards on temporary stands.

.2 Provide physical protection to the temporary stand and exposed part of the PLC panel.

.3 Install panel enclosures and panel backboards separately as required. Allow for enough cabling to reach the temporary panel locations as shown on the drawings, routing through enclosure final location. Panel backboards to be installed in enclosure from temporary stand outside of enclosure with field wiring connections already terminated.

.4 Install cables between PLC and RIO panels and Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels. See Appendix C, IO Lists, for the IO counts for each area. See the typical loop wiring drawings for conductor and termination counts per IO. Allow for enough cable to reach the temporary panel locations as shown on the drawings.

.5 Provide firestopping as indicated and in compliance with Contract Documents.

.6 Label all conductors between the new PLC panels and the existing termination cabinets at both ends following the City Standards. Re-label all existing field terminal blocks within the termination cabinets with the updated tags. Provide supplemental labelling on existing terminals as required for clarity during the switchovers.

.1 Utilize heat shrink labels for conductor and circuit identification

.2 Conductor and circuit identification to follow the City of Winnipeg Identification Standard.

.7 Terminate cables at the PLC and RIO panel prior to the migration switchovers, as scheduled by the Integrator.

.8 Provide loop checks and checklists for all installed circuits. See Appendix H for loop check test form templates.

.4 Switchovers

.1 Review detailed switchover plans, produced by the Integrator, and provide feedback within three (3) business days.

.2 Attend and provide field services for the DCS Migration switchovers as scheduled by the Integrator. One (1) week notice will be provided for switchovers.

.3 De-energize and remove existing terminations to DCS Control System at Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels. Terminate pre-installed conductors to PLC.

.1 Review the Appendix A – DCS Migration Plan, Appendix C – IO Count, Appendix H – Test Forms, and Specification 40 99 92 to assist with quantifying the scope of work to perform the switchovers.

.4 Revert IO to DCS as instructed.

.5 Provide updated red-line drawings within two (2) weeks from each switchover.

.5 Demonstration

.1 During the switchovers, assist Integrator with testing by reading out voltages and injecting signals as directed. Tests must demonstrate plant functionality. See Appendix B, Process Control Narratives, in each area for scope of demonstration.

.6 Provide salvaging and demolition services for the NEWPCC DCS Migration.

.1 Salvage and package in anti-static weatherproof packaging the DCS cards. The City will provide a list of cards to salvage. Deliver to the City at the provided location.

.2 Remove DCS cabinets and associated cabling upon the successful completion of an area migration to PLC control.

.7 Provide conduit, wiring and connections for equipment furnished by others unless otherwise specified and indicated.

.8 Provide temporary circuits, overcurrent devices, interface relays, conduit and wiring, and other equipment required during construction and as part of the modification of the existing electric system and existing control cabinets. Perform work at the convenience of the City.

.9 Disconnecting, removing, and relocating existing electrical equipment is a part of this Contract and this Section. Make equipment scheduled for removal free of shock hazard.

.10 The equipment enclosure classification of the plant areas are indicated on the drawings. Provide all equipment, devices and material meeting the requirements for these area classifications unless otherwise noted or specified.

.11 Review all existing available City drawings for utilities embedded in the ceilings, walls, and floors. Perform scans on all surfaces that will be cored. Install the electrical system in a manner that avoids conflict with existing utilities.

1.2 General Requirements

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

.2 Refer to all Sections of Division 26, 40, Drawings, and Appendices.

.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.

1.3 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, most current adopted edition.

.2 CSA-C22.3 No. 1-20, Overhead Systems.

.3 CSA C22.3 No.7-20, Underground Systems.

.4 CSA-C22.2 No. 232, Optical Fiber Cables.

.5 CSA CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

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

.1 IEEE SP1122 (2007), The Authoritative Dictionary of IEEE Standards Terms.

.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 ASTM International (ASTM):

.1 E84: Standard Test Method for Surface Burning Characteristics of Building Materials

.2 E2174: Standard for On-Site Inspection of Installed Fire Stops

.5 Underwriters Laboratories of Canada (ULC):

.1 S115: Fire Tests of Fire Stop Systems

.2 Guide #40U19.

.6 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.7 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 CAD Drafting Manual.

.4 WWD CAD/GIS Standards.

.5 Winnipeg Electrical By-Law.

.6 Information Bulletins.

1.4 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these Specifications, and on Drawings, are those defined by IEEE SP1122

.2 Firestopping: Asbestos free closures to fire and smoke at openings around penetrations, gaps and joints within fire separations and assemblies having a fire-resistance rating and no fire-resistance rating, including openings and spaces at perimeter edge conditions.

.1 Draft tight barriers to retard passage of flame and smoke, and firefighter's hose stream and passage of liquids around outside of mechanical and electrical assemblies where they penetrate fire separations.

Maintain fire resistance rating of adjacent floor, wall or other fire separation assembly acceptable to authorities having jurisdiction.

.2 Conform to both the temperature and flame ratings of CAN/ULC-S115 and, where applicable, , and other requirements of authorities having jurisdiction.

1.5 Quality Assurance

.1 Install electrical work in conformance with latest rules and requirements of the Canadian Electrical Code, the Manitoba Electrical Code, and the Winnipeg Electrical By-law.

.2 Firestopping:

.1 Installer Qualifications: A firm experienced in installing firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

.2 Fire-Test-Response Characteristics: Firestopping shall comply with the following requirements:

.1 Firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

.2 Firestopping is identical to those tested per testing standard referenced. Provide rated systems complying with the following requirements:

.3 Firestopping products bear classification marking of qualified testing and inspecting agency.

.4 Classification markings on firestopping correspond to designations listed by the following:

.1 ULC or UL (cUL) in its "Fire Resistance Directory."

.2 Intertek ETL SEMKO (WH) in its "Directory of Listed Building Products."

.5 Regulatory Requirements**:** Be responsible for securing approval from authority having jurisdiction where project conditions require modification to tested and listed systems.

.6 Submit authority having jurisdiction approval for modified systems.

1.6 Qualifications of Electrical Contractor

.1 The Electrical Contractor shall have been engaged in work of a similar nature to this contract for the past five (5) years.

.2 The Electrical Contractor shall have a minimum of five projects of equal or greater size with the type of equipment specified under this project.

.3 Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor licenses or apprentices 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 Project/Site Conditions

.1 Environmental Limitations: Do not install firestopping when ambient or substrate temperatures are outside the limits permitted by firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

.2 Install and cure firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 Submittals

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

.1 The following defines a minimum for all Division 26 Shop Drawing and data submittals:

.1 Submit Shop Drawings delineated by specification number with all information for one piece of equipment provided as one package.

.2 Partial submittals will be returned without action.

.3 Submit bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or similar identification on all other drawings where item appears.

.4 Submittal shall include:

.1 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.

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

.3 Indicate on Drawings clearances for operation, maintenance, and replacement of operating equipment devices.

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

.5 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor’s drawings.

.6 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 markups.

.7 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.

.8 Shop drawings shall follow the WWD CAD/GIS Standards.

.5 Firestopping submittals shall include:

.1 Indicate ULC or cUL assembly number for each condition, required temperature rise and flame rating, hose stream rating, thickness, installation methods and materials of firestopping and smoke seals, damming materials, reinforcements, anchorages and fastenings, size of opening, adjacent materials and number of systems.

.2 Submit copies of current ULC or cUL listings for each system and certified copies of test reports verifying that firestopping and smoke seals meet or exceed specified requirements.

.3 Engineering Judgment: Indicate manufacturer's engineering judgment identification number and drawing details acceptable to authority having jurisdiction when no ULC or cUL system is available for an application. Include project name and name of installing company who will install work.

.4 Identification Label: Full size sample, indicate sample wording, and text and background colours.

.5 Product Data: For each type of product indicated.

.6 Product Schedule: For each penetration and joint firestopping system. Include location and design designation of qualified testing and inspecting agency.

.7 Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular firestopping condition, submit illustration, with modifications marked, approved by firestopping manufacturer's fire-protection engineer as an engineering or equivalent fire-resistance-rated assembly.

.8 Qualification Data: For qualified Installer.

.9 Installer Certificates: From Installer indicating firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

.10 Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for firestopping.

.6 Submit only completed drawings showing all local and remote devices associated with each item.

.7 Mark shop drawings and data submitted showing only items applicable to specific contract. Complete catalogues that have not been curated to the specific products submitted will be rejected.

.8 Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new work.

.9 Submit time-current characteristic curves for all submitted protection devices such as circuit breakers and fuses.

.10 Submit other documentary or descriptive information as required for each assembly to demonstrate compliance with the applicable contract documents.

.2 Shop drawings and data are included but not limited to the following list:

.1 Cables & Accessories.

.2 Cable Trays, & Installation Accessories.

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

.4 Equipment Cabinets, Racks & Consoles.

.5 Firestopping

.6 Terminal and Wire Marking System.

.7 Equipment Identification

.8 Record Drawings

.3 Submit instruction manuals for installation, operation, and maintenance of equipment, and parts list for equipment listed below. Specifically mark standard publications forming a part of this contract. Cross out, blank out, or otherwise delete non-applicable items. Submittals which do not clearly indicate items and features provided shall be rejected. Coordinate with the system integrator contractor to compile reviewed and accepted instruction manuals into one area manual for final submission to the City.

.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 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.

.8 List of included spare items.

.3 Operations and maintenance manuals to include at least the following systems:

.1 Panelboard schedules

.2 UPS schedules

.3 Detailed field wiring diagrams

.4 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.

.5 Drawings of Record:

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

.6 Submit test results of installed electrical systems and instrumentation. See Section 26 08 10 for testing requirements

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

.8 Submit copies of electrical permit when attained and when closed.

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

.10 Manufacturer's Field Reports: submit to 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 3.18 Field Quality Control.

1.9 Nameplates and Labeling

.1 Provide nameplates and labels as specified in Section 26 05 53.

1.10 Interference and Erroneous Locations

.1 Locations of electrical equipment, devices, outlets, and similar items, as indicated, are approximate only. Exact locations shall be determined during construction.

.2 Verify in field, all data and final locations of work installed under other sections of specifications, required for placing of electrical work.

.3 In case of interference with other work or erroneous locations with respect to equipment or structures, furnish all labor and materials to complete the work.

1.11 Delivery, Storage, and Handling

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

1.12 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. Turn over any copper materials for the City to exercise its right of first claim. Disposal of materials not claimed by the City shall be the responsibility of the Contractor.

.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.

1.13 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 Items covered under the scope of Appendix F, Standardized Goods, shall be procured under the Standardized Goods contract using the City's negotiated price.

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

.4 Requests for approval of alternative suppliers shall be submitted to the Contract Administrator prior to tender closing. To ensure the integrity and fairness of the tender process, unapproved alternates provided after award will be rejected.

.5 The majority of equipment shall be supplied by a single manufacturer, particularly where technical performance is of concern. Also, for equipment that requires uniformity of looks and aesthetics, such as in power and control panels, wiring devices and luminaires.

.6 Material and equipment to be CSA Certified. Where CSA Certified material and equipment are not available, inform the Contract Administrator and obtain special approval at no cost to the City from inspection authorities before delivery to site and submit such approval to the Contract Administrator. Include any special approvals in the Operating and Maintenance manuals.

.7 Factory assembled control panels and component assemblies.

.8 Clearly mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other pertinent information on a nameplate.

2.2 Wiring Terminations

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

2.3 Equipment Identification

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

.1 Nameplates: lamacoid 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

NAMEPLATE SIZES			
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 All essential power labelling to be red face nameplate with white letters.

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

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

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

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

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

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

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

.10 For all PLC and RIO panels, label circuit panel designations and where fed from.

2.4 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 C22.1.18.

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

2.5 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 5 m intervals.

.3 Provide cable identification label at 3m intervals or less along all conduits. Provide labels within 1m of penetrations. Labels shall be on both sides of wall, ceiling, or floor penetrations.

.4 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colour.

Item	**Prime**	**Auxiliary**
Medium Voltage (> 750 V)	Orange	
347/600 V	Yellow	
208/120/240 V Power	Black	

Item	Prime	Auxiliary
UPS 208/120/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (< 50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Grounding	Green	
Fibre Optic Cable	Purple	

2.6 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 enclosures light gray or black finish.

2.7 Firestopping

.1 General: Certified and listed by ULC or WH in accordance with CAN/ULC-S115 and bearing ULC, cUL or WH label, heat resistant, flexible, durable and compatible with adjacent materials and finishes, self supporting at capable to adhere and maintain its integrity while providing effective barrier against passage of flame, smoke and gases, and provide flame and temperature rating in accordance with requirements of governing building code for openings in respective fire resistance rated floor, wall or other assemblies.

.2 Materials and products shall not cause stress, chemical or physical reaction, or other damage to penetrating items or adjacent materials.

.3 Firestop Systems: Certified by ULC, WH and listed in ULC Guide No. 40 U19.

.4 Firestop System Components: Certified by ULC, WH and listed in ULC Guide No. 40 U19.13 under the Label Service of ULC.

.5 Accessories: Provide components for each firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

.1 Permanent forming/damming/backing materials, including the following:

.1 Slag-wool-fibre or rock-wool-fibre insulation.

Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.

.2 Fire-rated form board.

Fillers for sealants.

.2 Temporary forming materials.

Substrate primers.

.3 Collars.

Steel sleeves.

2.8 Fill Materials

.1 Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

.2 Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

.3 Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

.4 Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

.5 Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

.6 Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

.7 Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

.8 Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber fibre cloth cases filled with a combination of mineral-fiber,fibre, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

.9 Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

.10 Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

.1 Grade: Pourable (self-levelling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.9 Mixing

.1 For those products requiring mixing before application, comply with firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and

other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

3. EXECUTION

3.1 Installation

.1 The complete installation shall be carried out in accordance with the latest CSA C22.1.18 - 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 other works, including coordinating with City operations, for the equipment being installed.

3.2 Removal and Relocation of Material and Equipment

.1 Equipment shall only be removed or relocated upon the receipt of written approval from the Contract Administrator.

.2 Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

.1 Deliver material and equipment not indicated for reuse to City for his disposal.

.3 Remove from site and dispose of material and equipment not indicated for reuse.

3.3 Workmanship

.1 Workmanship shall be the best quality, executed by workers qualified, experienced, and skilled in the respective duties for which they are employed.

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

.3 The Contract Administrator reserves the right to require the dismissal from the site of workers deemed incompetent, careless, unsafe, or otherwise objectionable.

.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 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.

3.4 Drawings and Specifications

.1 The Drawings, Specifications, and Appendices 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 existing 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 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.

3.5 Firestopping

.1 Examination

.1 Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

.2 Preparation

.1 Surface Cleaning: Clean out openings immediately before installing firestopping to comply with manufacturer's written instructions and with the following requirements:

.1 Remove from surfaces of joints and opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestopping.

.2 Clean joints, opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

.3 Remove laitance and form-release agents from concrete.

.2 Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

.3 Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

.3 Installation

.1 General: Install firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

.2 Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

.1 After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

.3 Install fill materials for firestopping by proven techniques to produce the following results:

.1 Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

.2 Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

.3 For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

.4 Identification

.1 Identify firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

.1 The words "Warning - Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

.2 Contractor's name, address, and phone number.

.3 Designation of applicable testing and inspecting agency.

.4 Date of installation.

.5 Manufacturer's name.

.6 Installer's name.

.5 Field Quality Control

.1 Owner may engage a qualified testing agency to perform tests and inspections.

.2 Where deficiencies are found or firestopping is damaged or removed because of testing, repair or replace firestopping to comply with requirements.

.3 Proceed with enclosing firestopping with other construction only after inspection reports are issued and installations comply with requirements.

.6 Cleaning and Protection

.1 Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by firestopping manufacturers and that do not damage materials in which openings occur.

.2 Provide final protection and maintain conditions during and after installation that ensure that firestopping is without damage or deterioration at time of Substantial Performance. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated firestopping and install new materials to produce systems complying with specified requirements.

3.6 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.

3.7 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.

3.8 Work In Existing Structures

.1 In general, any or all existing electrical equipment and services are to remain in operation and shall not be disturbed unless otherwise noted in these Specifications and/or on the drawings or as required for the proper execution of the work.

.2 In each area of the work, disconnect and carefully remove the existing electrical equipment and devices so noted. With the exception of items indicated as having to be re-used, all such existing equipment and devices shall be disposed of as specified herein. If not required by the City, remove them from the premises and site. All existing electrical equipment and devices indicated as not removed or abandoned are to be maintained in operation and any circuits disturbed by the construction shall be restored.

.3 Maintain existing electrical services and systems to and in the buildings throughout the project and all “down-time” shall be scheduled at least two (2) weeks in advance with the permission of the Contract Administrator and such scheduling shall be rigidly adhered to.

3.9 Dedicated Neutrals

.1 Each circuit shall have its own dedicated neutral wire. Shared neutral for more than one (1) circuit shall not be permitted.

3.10 Area Category and Classifications

.1 Refer to the drawings for building areas that have the non-ordinary electrical categories and classifications as defined in the CEC.

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	Transformers and CSTE	NEMA 3R

.5 Any Network Panel not installed in a control room shall be NEMA 4X.

.6 Network panels installed in the following control rooms shall be NEMA 4X:

.1 Primary Clarifiers.

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 Trench or directional drill as required to not disturb the existing plant concrete and facilities. If a roadway is required to be shut down for any installation, provide a shutdown plan to the Contract Administrator at least three weeks in advanced for approval.

.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 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.

3.15 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 the Work with other Divisions such that all equipment, conduits and wiring will be installed in the best arrangement.

.5 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.

.6 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.

.7 Furnish all work and materials in accordance with CSA codes, provincial and local inspection department, and local utility regulatory requirements.

3.16 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.

3.17 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 Access hatches shall be installed at no additional cost to the Contract Documents in walls and ceilings to provide accessibility to electrical equipment within these areas.

.4 Locations of such access hatches shall be of an approved type and shall be installed in a pre-approved location.

3.18 Field Quality Control

.1 The Contractor shall conduct and pay for tests as identified in Section 26 08 10.

.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 Provide instruments, meters, equipment and personnel required to conduct.

.5 Ground fault detectors shall be dynamically tested by injecting current flow into the zero sequence current sensor.

.6 Submit test results for the Contract Administrator's review.

3.19 Spare Parts

.1 Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

.2 Deliver to City and place in location as directed by City; obtain receipt prior to final payment.

.3 Coat parts to protect from moisture.

.4 Crate in containers designed for prolonged storage suitable for handling with hoisting equipment containers.

.5 Stencil on containers:

.1 Manufacturer/supplier name.

.2 Unit name.

.3 Spare part name.

.4 Manufacturer catalogue number.

.5 Other identifying information.

.6 Precautionary information.

3.20 Substantial Performance Inspection

.1 Prior to Substantial Performance inspection, submit written confirmation that:

.1 The installation as specified is completely assembled and wired.

.2 All wiring devices and other equipment are operational, clean and correctly labeled.

.3 All systems have been tested as required and are in proper working order.

.4 All lamacoid nameplates have been installed.

.5 Factory finished equipment has been cleaned, touched up or refinished to present a new appearance.

.6 Communication Networks, Device Level Busses, have been setup, addressed, tested and are fully functional.

.7 Operation and Maintenance manuals have been submitted.

3.21 Care, Operation and Start-Up

.1 Instruct the City's Representatives in the operation, care and maintenance of equipment.

3.22 Demolition

.1 Survey the existing electrical systems and equipment identified for removal with representatives from the other trades prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

.2 Where a piece of equipment is to be removed all associated ancillary components (e.g. solenoid valves, pressure switches, etc.) and associated wiring and conduit shall also be removed.

.3 Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect all electrical power, communications, alarm and signal system.

.4 Equipment scheduled to be turned over to the City shall be carefully disconnected, removed and delivered to the City where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

.5 Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

.6 Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

.7 Disconnect abandoned outlets and removed devices. Removed abandoned outlets if conduit services them is abandoned or being removed. Provide blank covers for abandoned outlets which are not removed.

.8 Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

.9 Repair adjacent construction and finishes damaged during demolition and extension work.

.10 Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

.11 The electrical and process equipment to be removed or relocated under this contract has been identified on the Drawings.

.12 Trace out existing wiring that is to be relocated or removed and perform the relocation or removed work as required for a complete operating and safe system.

.13 Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

.14 All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc. furnished and installed to the temporarily keep circuits energized shall be removed when the permanent installation is fully operational.

3.23 Protection of Electrical Equipment

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

.2 Store equipment in compliance with manufacturer's recommendations and as specified herein.

.3 Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

.4 Do not store equipment outdoors.

.5 Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

3.24 Defective or Damaged Equipment

.1 All equipment shall be inspected for defects or damage upon delivery, report any defects or damages to the Contract Administrator within two business days. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost to the City.

.2 All equipment showing signs of water damage shall be rejected regardless of dielectric test results.

.3 All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

3.25 Drawings and Specifications

.1 Drawings and specifications are typical of work to be done and of the arrangement desired. Provide accessories and appurtenances which the Contract Administrator deems functionally necessary for a complete installation, whether or not explicitly indicated or described.

3.26 As-Built Drawings

.1 The Contractor shall maintain a master set of as-built drawings showing the changes and deviations from the contract drawings on site and upon request provide to the Contract Administrator for review.

.2 Within two (2) weeks after a switchover the Contractor shall update all changes to a clean set of red lined 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 A minimum of thirty (30) days prior to application for Final Payment, submit two sets of drawings for approval that are marked to show the as-installed equipment, devices, raceway locations and wiring. The markings on the drawings are to be neat, clean and legible.

.5 No Substantial Performance shall be issued until final “Record Drawing” CAD files and one set of prints have been received and accepted by the Contract Administrator.

.6 The final record drawings shall incorporate the new fibre rings as well as the existing network cabling. Refer to Figure 1, Existing Backbone Routing for the existing network. Confirm existing cables on site.

3.27 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.

3.28 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

ELECTRIC WIRES AND CABLES

1. GENERAL

1.1 Description

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

.2 Supply and install wireways and auxiliary gutters and fittings as a means for flexible wiring system. All wireways and gutters to be two pieces with removable cover to provide access to wiring.

1.2 References

.1 Canadian Standards Association (CSA), latest adopted revisions:

.1 CSA C22.2 No. 0.3-09 (R2014), Test Methods for Electrical Wires and Cables, and Update No. 1 (2010).

.2 CSA-C22.2 No. 131-14, Type TECK 90 Cable, and Update No. 1 (2016).

1.3 Submittals

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

.1 Outline drawings of termination cabinets showing dimensions, cables, jumpers and associated hardware for termination.

.2 Provide written confirmation that product is to be submitted as acceptable to control systems supplier.

.3 Detailed drawings to follow the City of Winnipeg CAD Drafting Manual and the WWD CAD/GIS Standard.

.4 For each component and material submit shop drawing which shall include:

.1 Manufacturer.

.2 Model number.

.3 General data and description.

.4 Engineering specifications and data sheets.

.5 Catalogue cuts.

.6 For information purposes only, submit manufacturer’s printed installation instructions.

.5 Submit a drawing showing the routing for the cables. Include the following information:

.1 Routing and length.

.2 Cable and conduit identification.

.3 Location and table of terminations.

.2 Detailed drawings to follow the City of Winnipeg CAD Drafting Manual and the WWD CAD/GIS Standard.

1.4 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 66 10 and as specified.

1.5 Equipment Identification

.1 Each wire/fibre shall be labelled at each termination point and all splice location. Conductor or circuit identification shall be applied at specified points with circuit numbers or other identification stamped on terminal boards when provided, or on the cable itself in such a manner that the identification is visible around the cable's circumference.

.2 Utilize machine printed heat shrink labels for conductor and circuit identification

.3 Conductor and circuit identification to follow the City of Winnipeg Identification Standard

1.6 Quality Assurance

.1 Comply with the requirements specified in Section 01 43 00.

1.7 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of five years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period of five years. All third party warranties shall be passed through from the Contractor to the Owner.

.2 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the CEC.

.3 The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guide.

2. PRODUCTS

2.1 Type RW90 Conductor

.1 In accordance with CSA C22.2 No.38.

.2 Circuit conductors shall be concentric stranded soft copper, size as indicated (#12 AWG minimum where not indicated).

.3 Insulation to be chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90 XLPE, 600V.

.4 Suitable for installation in temperatures down to -40°C.

.5 90°C conductor operating temperature.

2.2 600V Teck90 Control Cables

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, as indicated and minimum #12 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, 600V.

.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.

2.3 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 Individual 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.

2.4 Ethernet Cable – Shielded – 300V – Non-Armored – Low Bend Radius For Use Only in Automation Panels Patch Cords and Between Ganged Automation Panels

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 300V, Shielded, Ethernet cable.

.2 Shield Design: Overlapped aluminum-clad foil, sheathed in a braided screen of tin-plated copper wires.

.3 Conductors: 4 pair, 24 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: -40°C to 85°C.

.6 Installation temperature: -40°C to 85°C.

.7 c(UL)us, CMG, RoHS compliant.

.8 Traction stress maximum: 100 N.

.9 Minimum bending radius: 24mm single bend / 40 mm multiple bends.

2.5 Ethernet Cable - Shielded – 600V – Non-Armored

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 600V, Shielded.

.2 Shield Design: 100 percent coverage Foil Shielded.

.3 Conductors: 4 pair, Bonded pair, 23 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: -40°C to 75°C.

.6 Installation temperature: -25°C to 75°C.

.7 Flame test: CSA FT4.

.8 cUL, CMR, RoHS compliant.

.9 Traction stress maximum: 177.928 N.

.10 Minimum bending radius: 101.600 mm.

2.6 Ethernet Cable Unshielded – 300V – Armored

.1 Requirements:

.1 Cable: Industrial Grade, Enhanced Cat 6 Cable, 300V, Solid, Unshielded, Aluminum Interlocked Armor.

.2 Conductors: 4 Pair, Bonded pair, 23 AWG, copper, solid.

.3 Conductor insulation: PO-Polyolefin.

.4 Outer jacket: Industrial Grade PVC.

.5 Temperature rating: -40°C to 75°C.

.6 Flame test: CSA FT4.

.7 Approvals: CMG, CSA or equivalent.

3. EXECUTION

3.1 General

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements.

.2 Install unarmoured power, control and communication cables in conduit.

.3 Install in accordance with manufacturer’s recommendations, observing requirements for minimum bending radius and pulling tensions.

.4 Minimum power conductor including luminaire drops to be #12 AWG.

.5 Minimum conductor size #14 AWG for all discrete control cables.

.6 Minimum conductor size #18 AWG for twisted pair analog signal cables.

.7 At each end of the run leave sufficient cable length for termination.

.8 Maintain jacket over shielded cables. Shields are permitted to be exposed up to a maximum of 50mm at terminations

.9 Protect all conductors against moisture during and after installation.

.10 Protect wiring against damage from welding spatter and other construction activity by suitable means.

.11 Protect metallic cable connectors in process areas with heat-shrinkage sleeves. Sleeve length to extend 75 mm past the connector and to provide a tight fit around connector and cable.

.12 Do not use TC cable in areas classified as hazardous locations.

.13 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.

.14 Provide sufficient length of "free" cable for motors mounted on slide rails to permit the motor to travel the full length of the rails.

.15 Install reducing bushings where threaded entry in a motor connection box is larger than the hub size of the cable connector.

.16 In-line splices are not acceptable unless done in a junction or splice box.

.17 At the discretion of the Engineer damage to a cable jacket may be repaired in accordance with the manufacturer's recommendation. If requested by Engineer, replace the entire length of a damaged cable.

.18 Arrange cable supports such that maintenance work or removal of the equipment served by the cable, will not cause any damage to the cable.

.19 Feeder cables exiting duct banks exposed into buildings and tunnels are to be run to their final termination point in conduit or covered cable tray if not of armored construction.

3.2 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.

3.3 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 as “Spare” and indicate the location of the other end of the wire.

3.4 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 fire alarm system station circuits, P.A. wiring, etc.

.4 Provide conductors as shown on Drawings. Minimum conductor sizes are indicated. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Engineer if problem is foreseen.

.5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.5 Identification, Coding and Balancing

.1 Provide wiring identification in accordance with Section 26 05 10.

.2 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.

.3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 10 and smaller are required to be factory coloured or numbered, not taped on Site.

.5 For direct current wiring use red for positive and black for negative.

.6 Install cable tags at both ends of cable.

.7 Identify each instrumentation conductor with wire numbers using a machine printed heat shrink wire marker.

3.6 Intermediate Pull Boxes

.1 Provide pull boxes and so the pulling requirement is at least 5 percent below the manufacturers pulling strength recommendations. Provide pulling procedures as part of the installation submittal requirements:

.2 Provide plans showing proposed pull boxes.

3.7 Physical Checkout

.1 General Procedures:

.1 Physical checkout shall be performed prior to functional testing.

3.8 Check Procedures: Testing

.1 Test all conductors for opens, shorts, or grounds.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC on all conductors.

.3 Individually test each conductor with all other conductors and shields grounded.

.4 The test duration shall be one minute.

.5 Investigate resistances less than 50 megaohms, or deviations between parallel conductors.

.6 Resistance values shall be as recommended by the cable manufacturer.

.7 Conductors with insulation resistance values, at one minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50 percent will be rejected.

.8 Contractor to properly tabulate all wire test results, signed, dated, and submitted to the Contract Administrator for review and acceptance.

.9 Ethernet cable testing:

.1 Test for the following:

.1 Continuity.

.2 Pair placement and polarity.

.3 DC resistance.

.4 Characteristics at highest contemplated frequency:

.1 Attenuation - data cable.

.2 Mutual Capacitance - data cable.

.3 Near-end crosstalk (NEXT) - data cable.

.5 Run length.

.2 Tests to be conducted to Cat 6 standards.

.3 Reconnect or re-install and retest as necessary to correct excessive variations.

3.9 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Related Sections

.1 Section 26 05 10 - Common Work Results – Electrical

1.2 Submittals

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

1.3 Work Included

.1 Supply and install all hangers, supports and inserts for the installation shown on the Drawings and specified herein, and 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 galvanized steel 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 galvanized steel structural members.

.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 Cable tray supports shall be installed in accordance with the tray Manufacturer's recommendations and as per Section 26 05 36, whichever is more stringent.

2.2 Concrete and Masonry Anchors

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized, except for installations in corrosive areas, which shall be stainless steel.

.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, tray, 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 poured concrete with expandable inserts.

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

.4 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

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

.6 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.

.7 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.

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

.9 Shot driven pins may only be used with written approval of the Contract Administrator.

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

.11 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.

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

.13 For surface mounting of two or more conduits, refer to Section 26 05 34.

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

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

.16 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

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, most current adopted edition.

.2 CSA C22.2 No.76, Splitters.

.3 CSA C22.2 No. 30, Explosion-Proof Enclosures for Use in Class I hazardous Locations.

.4 CSA C22.2 No. 40, Enclosures for Electrical Equipment, Non-Environmental Considerations (Tri-National Standard, with NMX-J-235/1-ANCE-2007 and UL 50).

.5 CSA C22.2 No. 94, Special Purpose Enclosures.

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

.1 IEEE SP1122 (2007), The Authoritative Dictionary of IEEE Standards Terms.

.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.5 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

.6 National Electrical Manufacturers Association (NEMA):

.1 NEMA ICS 6-1993 (R2011), Industrial Control and Systems: Enclosures.

1.2 Related Sections

.1 Section 26 05 01 - Common Work Results – Electrical.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 10 and Section 01 33 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 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three (3) spare terminals on each set of lugs in splitters less than 600A.

2.2 Junction Boxes, Cabinets, and Pull Boxes

.1 NEMA Type of enclosure refer to Section 26 05 10.

.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.

2.3 Network Cabinets

.1 Materials:

.1 12 gauge steel frame with integral struts.

.2 16 or 14 gauge steel doors and sides.

.3 Gland plate.

.4 Locks: to match panelboards.

.5 Finish to be pretreated coated steel in black or grey powder paint.

.6 Two sets of 19 inch racks for both front and rear of enclosure.

.7 42 rack units.

.8 Levellers and anti-tip bracket.

.9 Dimensions as shown on drawings.

.10 Nema 12 rating for all ordinary locations, Nema4x for hazardous or corrosive locations.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, continuous piano hinge, 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 panelboard keys 19 mm.

3. EXECUTION

3.1 Installation

.1 Splitters:

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.2 Junction Boxes and Pull Boxes:

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

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

.3 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, Weidmuller or equivalent, where indicated.

.4 Identification:

.1 Provide equipment identification in accordance with Section 26 05 53.

.2 Install identification labels indicating panel name and fibre connections, and voltage.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA), latest adopted edition:

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

.2 CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.

.3 CSA C22.2 No. 18.2-06 Non-metallic Outlet Boxes.

.4 CSA C22.2 No. 18.3-12 Conduit, Tubing, and Cable Fittings.

.5 CSA C22.2 No. 18.4-15 Hardware for the Support of Conduit, Tubing, and Cable.

.6 CSA C22.2 No. 18.5-13 Positioning Devices.

.7 CSA C22.2 No. 45.1-07 Electrical Rigid Metal Conduit – Steel.

.8 CSA C22.2 No. 45.2-08 Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.9 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.10 CSA C22.2 No. 83-M1985, Electrical Metallic Tubing.

.11 CSA C22.2 No. 227.3-15, Mechanical Protection Tubing (MPT) and fittings.

.2 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.3 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 10.

1.3 General Conduit Requirements

.1 The Drawings do not show every specific conduit run. Supply and install conduit, and support systems as required for a complete installation.

.2 The materials for each conduit must meet the requirements of the area. Some areas are wet, highly corrosive; other areas have chemicals which may adversely interact with specific materials. Care must be taken in making the proper conduit selection for the particular area.

.3 Design equipment anchorage and support system for vertical and lateral loading in accordance with the Manitoba Building Code.

2. PRODUCTS

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45.2, aluminum threaded (galvanized steel threaded).

.2 Epoxy coated conduit: to CSA C22.2 No. 45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

.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 hole stainless steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole stainless steel straps for conduits larger than 50 mm.

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

.3 Channel type supports for two or more conduits at spacing as per the Rules for the applicable conduit type as indicated in Section 12 of the CEC.

.4 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.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

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 in office area. Surface mount conduits in mechanical and electrical service rooms and in unfinished areas. RGS conduit required for exterior.

.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 Minimum conduit size for lighting and power circuits: 19 mm.

.7 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.

.8 Mechanically bend steel conduit over 19 mm in diameter.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

.13 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.

.14 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.

.6 Provide stand-off conduit clamps/clips.

3.3 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 23.

.2 On Completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Description

.1 Section includes cable tray, cable tray accessories, hangers and supports.

1.2 References

.1 ASTM International (ASTM):

.1 A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

.3 B766: Standard Specification for Electrodeposited Coatings of Cadmium

.2 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC elsewhere in this document shall include reference to such amendments.

.2 C22.2 No. 65: Wire Connectors.

.3 C22.2 No. 126.1: Cable Tray Systems.

.4 CSA HA Series M, CSA Standards for Aluminum and Aluminum Alloys.National Electrical Manufacturers Association (NEMA):

.1 VE 1: Metal Cable Tray Systems.

.4 Underwriter's Laboratories, Inc., (UL):

.1 486A: UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

.2 486B: UL Standard for Safety Wire Connectors for Use with Aluminum Conductors.

.5 Canadian Standards Association (CSA), latest adopted revisions:

.1 CSA C22.1-18, Canadian Electrical Code (CEC), Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 126.1 - Metal Cable Tray Systems.

.3 CSA C22.2 No. 126.2-02 - Nonmetallic Cable Tray Systems.

.6 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.7 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.3 Submittals

.1 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26 05 10.

.2 Product Data for Each Component:

.1 Show tray types, dimensions, materials, installation details, layout, and finishes.

.3 Shop Drawings:

.1 Detail fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements.

.2 Designate components and accessories, including clamps, brackets, hanger rods, splice plates connectors, expansion joint assemblies, straight lengths, and fittings.

.3 Coordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.

.4 Prior to construction, submit design Drawings and calculations indicating all tray loading and seismic support designs have been reviewed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

.4 Testing:

.1 Factory certified test reports of specified products, conforming to NEMA VE 1 .

.2 Field test reports indicating and interpreting test results relative to compliance with performance requirements.

1.4 Quality Assurance

.1 Comply with the Canadian Electrical Code, the Manitoba Electrical Code, and the Winnipeg Electrical By-law for components and installation.

.2 Single-Source Responsibility: Cable tray components shall be product of single manufacturer.

1.5 Sequencing and Scheduling

.1 Coordination: Coordinate layout and installation of cable tray with other installations.

.1 Revise locations and elevations from those indicated as required to suit field conditions and as accepted by the Contract Administrator.

2. PRODUCTS

2.1 Materials and Finishes

.1 Conform to NEMA VE 1 .

.2 Cable Trays, Fittings, and Accessories: Steel, hot-dipped galvanized after fabrication conforming to ASTM A123/A123M, Class B2.

.3 Cable Trays, Fittings, and Accessories: Steel, with polyvinyl chloride (PVC) coating applied in fluidized bed or by electrostatic spray.

.4 Cable Trays, Fittings, and Accessories: Aluminum conforming to Aluminum Association alloy 6063-T6 for rails, rungs, and trays, 5052-H32 or 6061-T6 for fabricated parts.

.5 Cable Trays, Fittings, and Accessories: Stainless steel, Type 304.

.6 Protect steel hardware against corrosion by galvanizing conforming to ASTM B633 or cadmium plating conforming to ASTM B766.

.7 Fabricate cable tray products with rounded edges and smooth surfaces.

2.2 Sizes and Configurations

.1 Conform to NEMA VE 1 .

.2 Ladder-Type Trays: Class 20C unless indicated.

.1 Width: 152 mm (6 inch):

.1 102 mm (4 inch) is permitted only in low clearance areas.

.2 Inside Depth: 76.2 mm (3 inch).

.3 Cross-Rung Spacing: 152 mm (6 inch) oc.

.4 Minimum Fitting Radius: 305 mm (12 inch).

2.3 Cable Tray Accessories

.1 Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, manufactured with same materials and finishes as cable trays.

.2 Covers: Solid type, of same materials and finishes as cable trays.

.3 Covers: Louvered type, of same materials and finishes as cable trays.

.4 Covers: Ventilated-hat type, of same materials and finishes as cable trays.

.5 Barrier Strips: Same materials and finishes as cable trays.

.6 Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 Firestopping

.1 Materials: CSA listed and labeled and CSA approved for fire ratings consistent with penetrated barriers.

.2 Materials: CSA listed and labeled for fire ratings consistent with penetrated barriers.

.3 Sleeves: Schedule 40, welded, black steel pipe sleeves. Sizes as indicated or minimum CEC size for cable or cable group to be installed.

.4 Sealing Fittings: Suitable for sealing cables in sleeves or core drilled holes.

.5 Sealing Mortar: Suitable for sealing cable penetration slots/openings in fire barriers.

.6 Sealant: One-part compound for sealing cables, sleeves, and openings in fire barriers.

.7 Two-Part Sealant: Formed-in-place sealant.

.8 Sealbags: Heat activated to expand and seal penetration slots/openings in fire barriers.

2.5 Warning Signs

.1 Lettering: 40 mm (1-1/2 inch) high, black on yellow background with legend “WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL.”

.2 Materials and Fastening: Conform to Section 26 05 53.

3. EXECUTION

3.1 Examination

.1 Examine surfaces to receive cable tray for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Installation

.1 Use cable tray of indicated types and sizes, complete with manufacturer’s recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold down devices, grommets, and blind ends.

.2 Install cable tray level and plumb according to manufacturer's written instructions, rough-in Drawings, original design, and referenced standards.

.3 Check all trays for surface smoothness prior to installation. Remove burrs and sharp edges on tray surfaces to prevent damage to cables or injury to personnel.

.4 Fasten cable tray supports securely to building structure as specified in Section 26 05 29 unless otherwise indicated.

.1 Locate and install supports according to recommendations of NEMA VE 1 .

.2 Design supports, including fastenings to structure, to carry greater of calculated load multiplied by safety factor of 4, or calculated load plus 200 lbs (90 kg).

.5 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and not more than 3000 mm on centers. Fasten hangers to channels securely mounted to the structure.

.6 Do not drill through wood ceiling trusses. Provide wood blocking on top of ceiling truss to anchor rod hangers and channels.

.7 Install trays and raceways generally as indicated on Drawings. Coordinate this Work with the other trades to ensure adequate horizontal and vertical clearances.

.8 Provide minimum vertical clearance above the trays as per the CEC or as indicated on the Drawings.

.9 Provide minimum 600 mm horizontal clearance on one side of cable tray throughout.

.10 Working Space: Install cable trays with sufficient space to permit access for installing cables.

.11 Install tray systems in such a manner as to conserve head-room and minimize the use of free space through which they pass. Maintain a minimum 2100 mm clear head-room wherever possible.

.12 When the ends on square strut channel type shelf brackets are below 2100 mm AFF in a walking area, cut flush with tray. Permanently cap the end of square strut channels, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.

.13 Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the work of other Divisions.

.14 Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.

.15 Run trays parallel to building lines unless otherwise shown on the Drawings. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.

.16 Where hanger rods are used, use stainless steel and not be smaller than 12 mm in diameter.

.17 Generally run cables of different voltage classes in separate trays. Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray Manufacturer.

.18 Barriers: Install barriers to separate cables of different systems, such as power, communications, and data processing, or different insulation levels, such as 600 volts, 5,000 volts, and 15,000 volts.

.19 Make connections to equipment with flanged fittings fastened to tray and to equipment. Support tray independently of fittings. Do not carry weight of tray on equipment enclosure.

.20 Install expansion connectors in cable tray runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1 .

.21 Make changes in direction and elevation using standard fittings.

.22 Make cable tray connections using standard fittings.

.23 Firestop penetrations through fire and smoke barriers.

.24 Firestop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.

.25 Sleeves for Future Cables: Install capped sleeves for future cables through firestopped cable tray penetrations of fire and smoke barriers.

.26 Install covers after installation of cable is completed.

3.3 Cables in Cable Tray

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in tray at 2 m centers, with nylon ties.

.4 Identify cables with nameplates in accordance with Section 26 05 10.

.5 The air space between cables shall be 100% of the largest cable diameter unless otherwise specified. Main fibre cable shall be installed on the opposite side of the tray as the redundant fibre. Where the quantity of cables results in main and fibre cables within two diameters of one another, provide metallic barrier.

.6 Mark power and communication runs in accordance with colour coding outlined in Section 26 05 10.

3.4 Grounding

.1 Connect cable trays to ground as instructed by manufacturer. At a minimum, every section shall have a wire ground connection to the connecting cable trays. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer’s published

torque tightening values for equipment connectors. Solidly connect sections of tray runs to the ground bus of the local electrical room.

.2 Electrically ground cable trays and ensure continuous electrical conductivity of cable tray system. Use tray as an equipment ground conductor for itself only, not for connected equipment.

.3 Ensure to use materials and connectors to prevent corrosion. Use approved grounding clamps suitable for connecting tray with copper conductor.

3.5 Warning Signs

.1 After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.6 Field Quality Control

.1 Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.

.2 Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.7 Cleaning

.1 Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.8 Protection

.1 Provide final protection and maintain conditions in manner acceptable to manufacturer and Installer to ensure that cable tray is without damage or deterioration at Substantial Completion.

.1 Repair damage to galvanized finishes with zinc-rich paint recommended by tray manufacturer.

.2 Repair damage to PVC or paint finishes with matching touch-up coating recommended by tray manufacturer.

3.9 Closeout Activities

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

ELECTRICAL IDENTIFICATION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Identification of electrical materials, equipment, and installations.

1.2 References

.1 American Society of Mechanical Engineers (ASME):

.1 A13.1: Scheme for the Identification of Piping Systems.

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

.1 ANSI/IEEE C2: National Electrical Safety Code.

.3 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.4 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Identification Standard.

.4 Winnipeg Electrical By-Law.

.5 Information Bulletins.

.5 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC elsewhere in this document shall include reference to such amendments.

1.3 Submittals

.1 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26 05 10.

.2 Submit for each type of product specified.

.3 Miscellaneous: Schedule of identification nomenclature to be used for identification signs and labels.

2. PRODUCTS

2.1 Raceway and Cable Labels

.1 Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by the City of Winnipeg Electrical Design Guide.

.2 Components and installation shall comply with the CEC.

.3 Conform to ASME A13.1, Table 3, for minimum size of letters for legend and minimum length of colour field for each raceway or cable size.

.1 Colour: Black legend on orange field.

.2 Legend: Indicates voltage.

.4 Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

.5 Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, colour coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

.6 Colored Adhesive Tape: Self adhesive vinyl tape not less than 0.08 mm thick by 25 to 51 mm wide.

.7 Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

.1 Size: Not less than 152 mm wide by 0.102 mm thick.

.2 Compounded for permanent direct burial service.

.3 Embedded continuous metallic strip or core.

.4 Printed Legend: Indicates type of underground line.

.8 Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters.

.9 Aluminum, Wraparound Marker Bands: Bands cut from 0.4 mm thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

.10 Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

.11 Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.05 mm thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

.12 Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 51 by 51 mm by 1.3 mm.

.13 Comply with IEEE C2.

2.2 Engraved Nameplates and Signs

.1 Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by the City of Winnipeg Electrical Design Guide.

.2 Engraving stock, melamine plastic laminate, 1.6 mm minimum thick for signs up to 129 sq cm, 3.2 mm thick for larger sizes.

.1 Engraved Legend: Black letters on white face.

.2 Punched for mechanical fasteners.

.3 Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 6.4 mm grommets in corners for mounting.

.4 Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 1 mm, galvanized steel backing, with colors, legend, and size appropriate to application. 6.4 mm grommets in corners for mounting.

.5 Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.3 Miscellaneous Identification Products

.1 Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

.1 Minimum Width: 5 mm.

.2 Tensile Strength: 222 N minimum.

.3 Temperature Range: -40 to 85°C.

.4 Colour: As indicated where used for colour coding.

.2 Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

3. EXECUTION

3.1 Installation

.1 Install identification devices according to manufacturer's written instructions.

.2 Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

.3 Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

.4 Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

.5 Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

.6 Install painted identification as follows:

.1 Clean surfaces of dust, loose material, and oily films before painting.

.2 Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.

.3 Apply one (1) intermediate and one (1) finish coat of silicone alkyd enamel.

.4 Apply primer and finish materials according to manufacturer's instructions.

.7 Identify Raceways and Exposed Cables of Certain Systems with Colour Banding: Band exposed and accessible raceways of systems listed below for identification.

.1 Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each colour band 51 mm wide, completely encircling conduit, and place adjacent bands of two (2) colour markings in contact, side by side.

.1 Fire Suppression Supervisory and Control System: Red and yellow.

.2 Combined Fire Alarm and Security System: Red and blue.

.3 Security System: Blue and yellow.

.4 Mechanical and Electrical Supervisory System: Green and blue.

.5 Telecommunications System: Green and yellow.

.8 Install Circuit Identification Labels on Boxes: Label externally as follows:

.1 Exposed Boxes: Pressure sensitive, self adhesive plastic label on cover.

.2 Concealed Boxes: Plasticized card stock tags.

.3 Labelling Legend: Permanent, water proof listing of panel and circuit number or equivalent.

.9 Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous

underground plastic line marker located directly above line at the midpoint between finished grade and the highest raceway or cable. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 400 mm, use single line marker.

.1 Install line marker for underground wiring, both direct buried and in raceway.

.10 Colour Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.

.1 Field applied, colour coding methods may be used in lieu of factory coded wire for sizes larger than 10 AWG for phase conductors and for sizes larger than 2 AWG for ground and neutral conductors.

.1 Colored, pressure sensitive plastic tape in half lapped turns for distance of 150 mm from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 25 mm wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

.2 Colored cable ties applied in groups of 3 ties of specified colour to each wire at each terminal or splice point starting 76 mm from terminal and spaced 76 mm apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

.2 208/120 Volt System: As follows:

.1 Phase A: Red.

.2 Phase B: Black.

.3 Phase C: Blue.

.4 Neutral: White.

.5 Ground: Green.

.11 Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.

.1 Legend: 6.4 mm steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

.2 Fasten tags with nylon cable ties; fasten bands using integral ears.

.12 Apply identification to conductors as follows:

.1 Conductors to Be Extended in Future: Indicate source and circuit numbers.

.2 Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use colour coding for voltage and phase indication of secondary circuit.

.3 Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, colour coding, or cable marking tape.

.13 Apply warning, caution, and instruction signs and stencils as follows:

.1 Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with accepted legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

.2 Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch (9 mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

.14 Install identification as follows:

.1 Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 13 mm high lettering on 38 mm high label; where two (2) lines of text are required, use lettering 51 mm high. Use black lettering on white field. Apply labels for each unit of following categories of equipment.

.1 Panelboards, electrical cabinets, and enclosures.

.2 Access doors and panels for concealed electrical items.

.3 Push button stations.

.4 Remote controlled switches.

.5 Dimmers.

.6 Control devices.

.7 Transformers.

.8 Battery racks.

.2 Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labelling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.2 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

ELECTRICAL SYSTEM DEMONSTRATIONS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Demonstrate proper operation of electrical systems and equipment in presence of Engineer.

1.2 References

.1 American Society of Mechanical Engineers (ASME):

.1 A13.1: Scheme for the Identification of Piping Systems.

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

.1 ANSI/IEEE C2: National Electrical Safety Code.

.3 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.4 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.3 Submittals

.1 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26 05 10.

.1 Demonstration log

2. PRODUCTS

2.1 (Not Used)

3. EXECUTION

3.1 Demonstrations

.1 Demonstrate the full operation of:

.1 Each piece of provided equipment.

.2 Each integrated system.

.3 Loop Checks of each control loop, filling out form in Appendix H – Test Forms

.2 Demonstration Log:

.1 Keep a log of individual demonstrations

.2 Data:

.1 Date and time of demonstration

.2 Owner's representative

.3 Equipment of system demonstrated

.4 Result of demonstration:

.1 Pass or fail

.5 If failure:

.1 Description of failure

.2 Corrective actions taken

.3 New Demonstration result

3.2 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

INSTRUMENT LOOP DRAWINGS

1. GENERAL

1.1 Description

.1 The instrument loop drawings show typical instrument loop and wiring diagrams. The Contractor must review each wiring detail together with the reviewed Shop Drawings for the respective equipment and modify the drawing to comply with the selected equipment's requirements. Record all modifications, terminal numbers, wire numbers, etc. to as-constructed status and include copies of each drawing in the as-constructed drawing set.

.2 Provide red-line markups of detailed loop drawings within two (2) weeks after completion of a switchover.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

SIGNAL ARROW

DISCONNECT DEVICE

CIRCUIT BREAKER

DEVICE TERMINAL

I/O TERMINALS

REFERENCE ARROW

WIRE TAG TERMINAL — N999-N9

- NORMAL
- GROUNDED — X###-YYY
- FUSED — X###-YYY
- DISCONNECT — X###-YYY

BRACKET

JUMPER

TWISTED PAIRING

GROUND

WIRE FAN-OUT

WIRE FAN-OUT +

SHIELD

CONTACT

FORM C CONTACTS

RELAY COIL

TIME DELAY SWITCH

OVERLOAD RELAY

OVERLOAD CONTACT

HEATER

RESISTOR

PUSH BUTTON

SELECTOR SWITCH

LIMIT SWITCH

FLOAT SWITCH

PRESSURE SWITCH

THERMAL SWITCH

FLOW SWITCH

ALARMS

TRANSFORMER

TVSS — G N L / TVSS / L N G

DC POWER SUPPLY — POWER SUPPLY — L, N, G, V+, V-, 14 11 12

DISCRETE DEVICE

PROCESS TRANSMITTER — TRANSMITTER / PANEL NAME

KEY INTERLOCK

CAPACITOR

DIODE

BATTERY

LIGHTNING ARRESTOR

INDICATING LIGHT

	REVISIONS	DATE	DESIGN	CHECK
1	ISSUED FOR GC TENDER	2024-01-08	KG	SDS
0	ISSUED FOR TENDER	2023-03-17	KG	SDS

AECOM

DESIGNED BY: KG | CHECKED BY: SDS
DRAWN BY: KG | APPROVED BY: SRB
SCALE: NTS | DATE: 2024-01-08
ISSUED FOR CONSTRUCTION BY: DATE:
CONSULTANT NO.:

ENGINEER'S SEAL

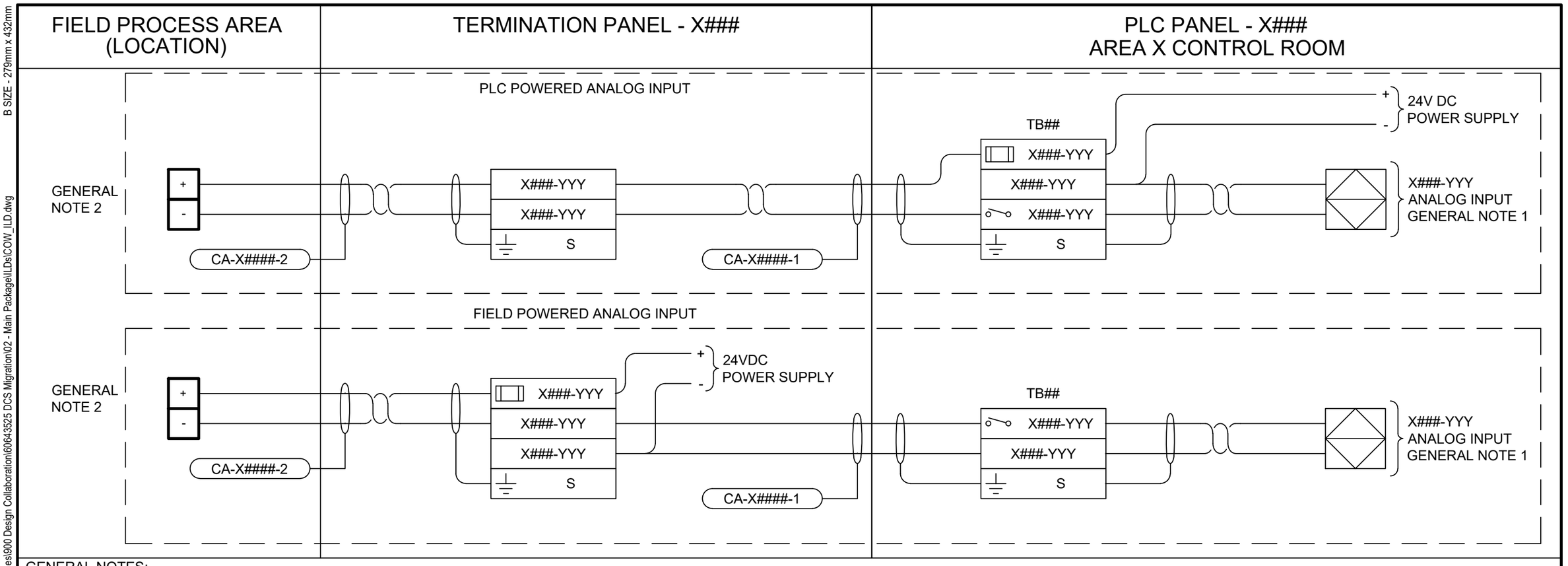
TYPICAL

NOT TO BE USED FOR CONSTRUCTION

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

NORTH END SEWAGE TREATMENT PLANT
DCS MIGRATION
LOOP DIAGRAM
LEGEND

CITY DRAWING NUMBER	SHEET	REV.	SIZE
1-0101-AILD-A001	001	1	B



GENERAL NOTES:
1. SEE DRAWING XXX FOR PLC WIRING
2. SEE DRAWING XXX FOR FIELD WIRING

INTEGRATOR NOTES:
1. SEE SPECIFICATION 40 90 00 FOR SCOPE.
2. THIS DRAWING IS TYPICAL. INTEGRATOR SCOPE IS TO PRODUCE DETAILED LOOP DRAWINGS FOR EACH EQUIPMENT BASED ON CONTRACTORS REDLINES. COMBINE APPROPRIATE LOOP TYPES FOR EACH INSTRUMENT ON A SINGLE DRAWING AS INSTALLED, UPDATE WIRE, LOOP, TERMINAL, AND TAG NUMBERS. UPDATE AND ADD DRAWING REFERENCES IN GENERAL NOTES 1 AND 2
3. REFER TO CITY OF WINNIPEG IDENTIFICATION STANDARD FOR AUTOMATION INSTRUMENT, TERMINAL, CABLE AND WIRE TAGGING CONVETION

CONTRACTOR NOTES:
1. SEE SPECIFICATION 26 05 10 FOR SCOPE.
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1	ISSUED FOR GC TENDER	2024-01-08	KG	SDS
0	ISSUED FOR TENDER	2023-03-17	KG	SDS

AECOM

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DRAWN BY: KG | APPROVED BY: SRB
SCALE: NTS | DATE: 2024-01-08
ISSUED FOR CONSTRUCTION
BY: DATE:
CONSULTANTNO.:

ENGINEER'S SEAL

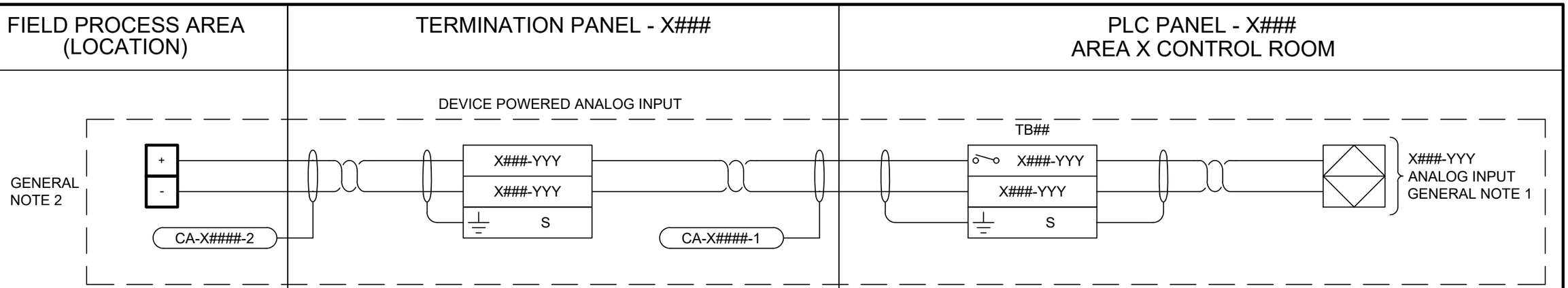
TYPICAL

NOT TO BE USED FOR CONSTRUCTION

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

NORTH END SEWAGE TREATMENT PLANT
DCS MIGRATION
LOOP DIAGRAM
TYPICAL ANALOG INPUTS

CITY DRAWING NUMBER	SHEET	REV.	SIZE
1-0101-AILD-A002	001	1	B



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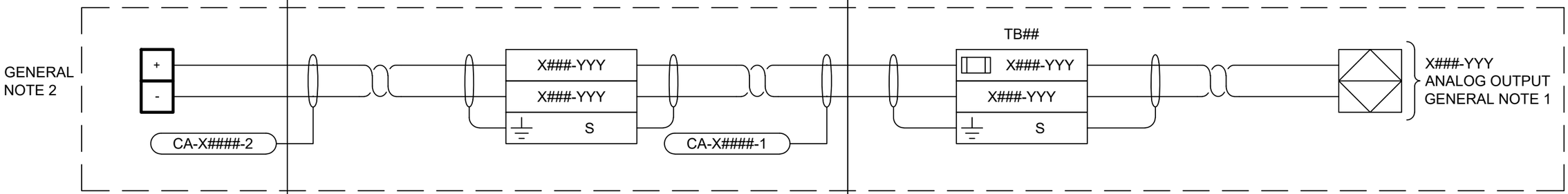
1-0101-AILD-A002	002	1	B

B SIZE - 279mm x 432mm

FIELD PROCESS AREA (LOCATION)	TERMINATION PANEL - X###	PLC PANEL - X### AREA X CONTROL ROOM



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CITY DRAWING NUMBER	SHEET	REV.	SIZE
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LAST SAVE: 2023/12/11 - 2:25pm
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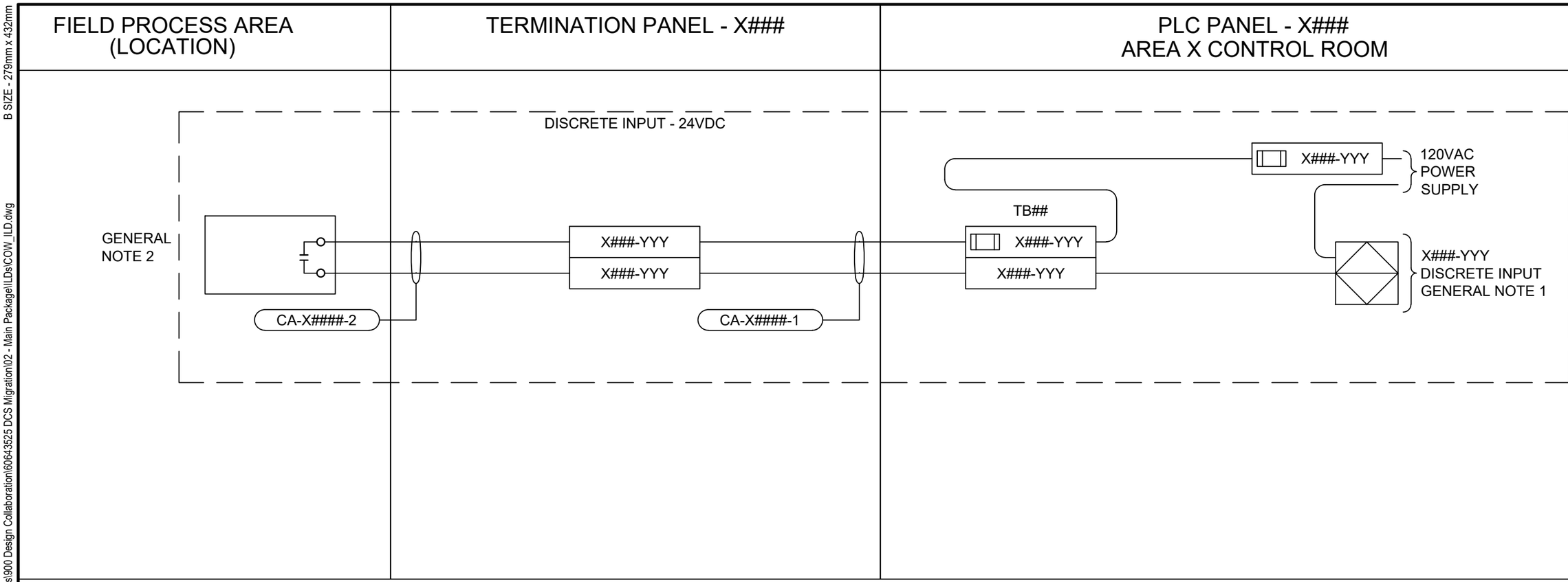

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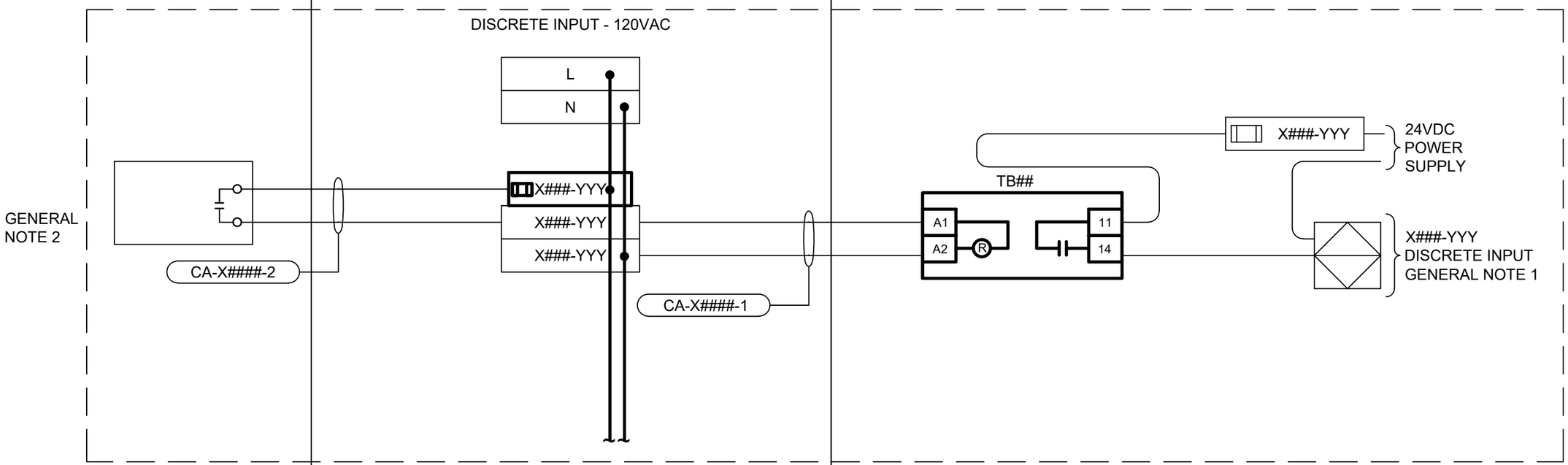
WATER AND WASTE DEPARTMENT

NORTH END SEWAGE TREATMENT PLANT
DCS MIGRATION
LOOP DIAGRAM
TYPICAL DIGITAL INPUTS 24VDC

CITY DRAWING NUMBER	SHEET	REV.	SIZE
1-0101-AILD-A004	001	1	B

FIELD PROCESS AREA (LOCATION)	TERMINATION PANEL - X###	PLC PANEL - X### AREA X CONTROL ROOM



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NORTH END SEWAGE TREATMENT PLANT
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LOOP DIAGRAM
TYPICAL DIGITAL INPUTS 120 VAC

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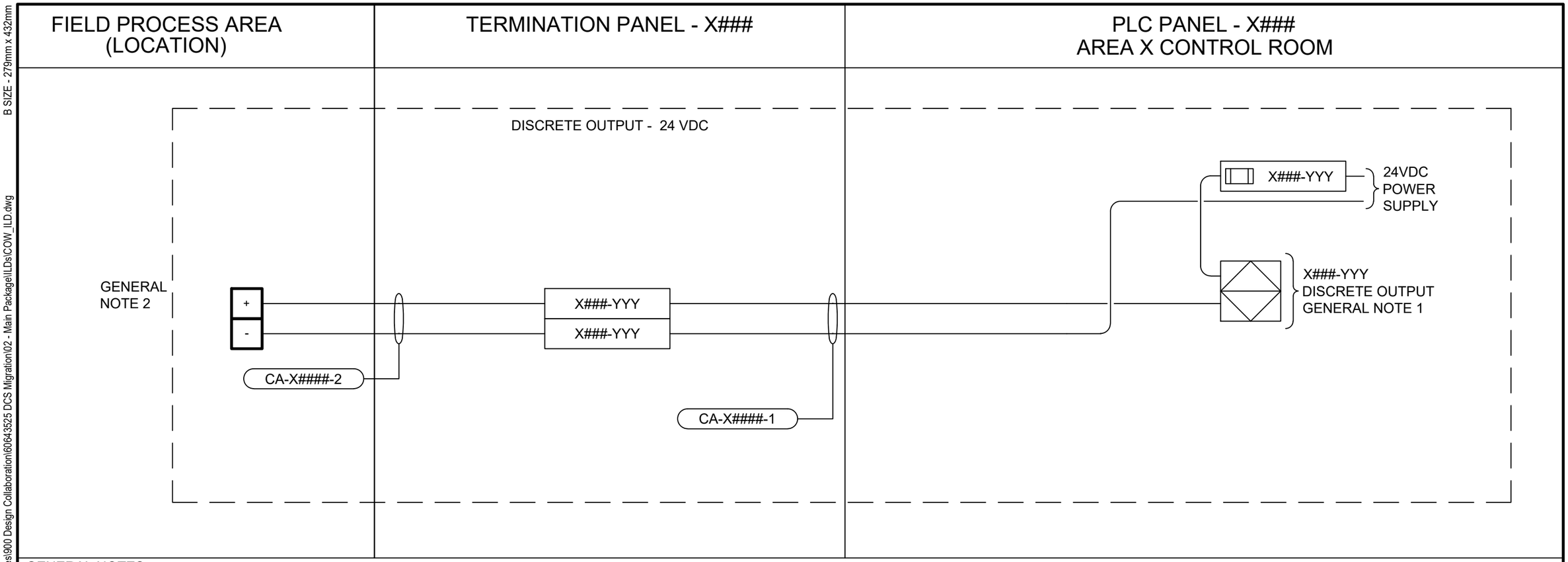
1-0101-AILD-A004	002	1	B



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LOOP DIAGRAM
TYPICAL DIGITAL OUTPUTS 24VDC

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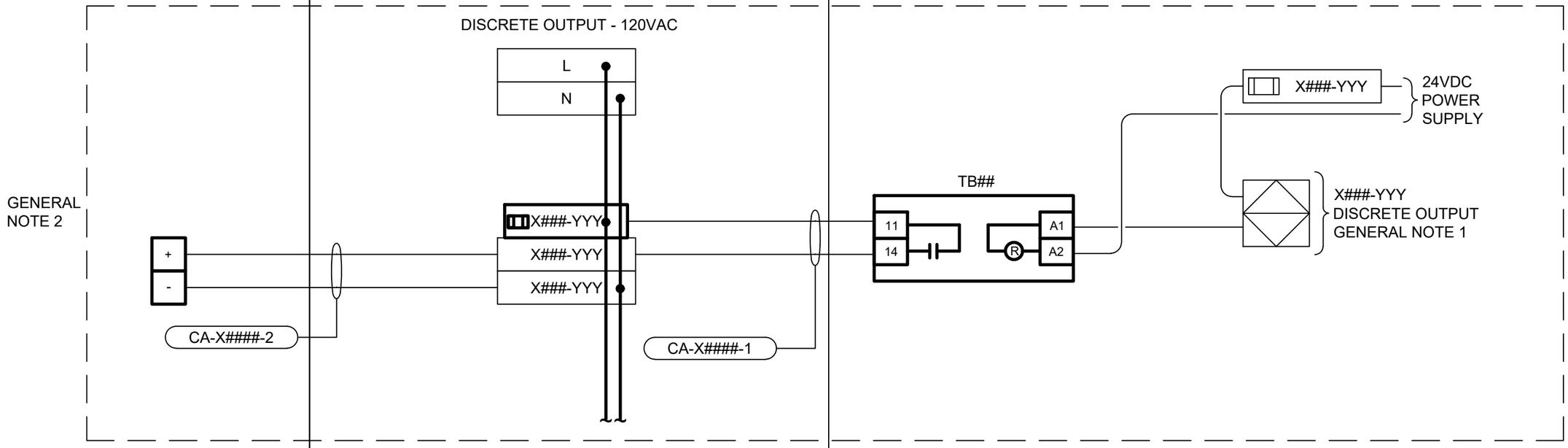
FIELD PROCESS AREA (LOCATION)	TERMINATION PANEL - X###	PLC PANEL - X### AREA X CONTROL ROOM



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DCS MIGRATION
LOOP DIAGRAM
TYPICAL DIGITAL OUTPUTS 120 VAC

CITY DRAWING NUMBER	SHEET	REV.	SIZE
1-0101-AILD-A005	002	1	B

IO LISTS

1. GENERAL

1.1 Description

.1 IO Lists for hardwired and networked IO to the DCS have been provided in Appendix C.

.2 Wire all IO listed in Appendix C from existing DCS to new PCS PLC panels following the sequence in Appendix A, the DCS Migration Plan.

.1 Pre-install multi-conductor cable and terminate wires at the new PLC panels. Terminate, test, and commission wire field side in Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels during switchover and commissioning.

.3 Provide red-lines and required data for as-builts on terminations in Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide materials and modification of control panels as indicated and in compliance with Contract Documents.

.2 Panels shall incorporate controls and protection devices as shown on the Contract Documents.

.3 All components shall be built by a CSA/cUL approved manufacturer.

.4 Supply, install, wire and test all components shown according to the specifications herein and the drawings. Supply, install, wire and test all wiring outside of panels and associated terminations within panels.

.5 Any panels that are substantially modified from the original installation shall be inspected by an authorized CSA/cUL inspector and have a new CSA/cUL applied. Perform any required updated to substantially modified panels to meet the CSA/cUL requirements.

1.2 Submittals

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

.1 For each component and material submit shop drawing which shall include:

.1 Schematic diagrams shall show the equipment serial or tag number, the Owner's drawing number, contract number, or similar identification which will indicate the particular equipment to which the diagrams apply. Diagrams shall show all equipment in the electrical system including internal wiring of subassemblies. Diagrams of subassemblies may be furnished on separate sheets.

.2 Wiring and interconnection diagrams shall show all wire connections to device terminals, terminal blocks, and all wiring within the panel. No more than two wires shall be shown connected to any one terminal. Terminals shall contain unique identifiers. All signals shall be able to be fully traced on the drawings.

.3 Identify each device by a unique number or number-letter combination.

.4 Detailed IO module wiring diagrams.

.5 Detailed loop diagrams of connections to Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels.

.6 Show spare contacts.

.7 Panel Layout drawings

.8 Complete Bill of Materials

.9 Configuration/parameter sheets including switch settings, parameter settings, and addresses. Show factory default settings and proposed settings.

.10 Diagram showing dip switches complete with proposed settings

.2 Submit shop drawings for approval prior to panel fabrication.

.3 Keep updated red line drawings of each panel in each control room during area migrations.

.4 Provide as-built drawings at the end of the area migration of the panel including detailed IO module wiring diagrams, panel layouts, panel power distribution schematics, and detailed loop drawings.

.1 As-built drawings to adhere to the City of Winnipeg CAD Drafting Manual and the WWD CAD/GIS Standards.

1.3 Quality Assurance

1.4 Inspection

.1 Provide in accordance with Section 01 43 00 and as specified.

.2 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.3 Demonstrate and test the control panel in the presence of the Contract Administrator designated representative as part of the FAT and SIFT.

1.5 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 66 10 and as specified.

.2 Transportation method to site shall be in an air ride van or equivalent.

1.6 Equipment Identification

.1 Each Panel shall be tagged with lamacoid labels on the panel backboard where visible after wires are connected.

.2 Each panel shall have a CSA certification nameplate.

1.7 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer’s official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The Owner will incur no

costs for service or replacement of parts during the warranty period of five years. All third-party warranties shall be passed through from the Contractor to the Owner.

.2 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the Canadian Electrical Code.

.3 The Contractor shall warrant that the system and individual parts will function in accordance with the manufacturers' published technical description guide.

2. PRODUCTS

2.1 Manufacturers

.1 Devices of each function shall be of the same type and manufacturer.

2.2 Components

.1 All components are to be DIN Rail Mounted.

.2 DIN Rail style TS 35mm, slotted.

.1 When used to mount terminals, use straight risers such that the top of the terminals are at the same height as the wiring duct

2.3 Control Wiring

.1 120-volt control wiring shall be Type MTW, THWN, or THHN. Conductors shall not be smaller than No. 14 AWG. Ampacity shall be in accordance with the CEC.

.2 Instrumentation signal cables shall be of the type used for field wiring.

.3 Wire and cable insulation shall be flame retardant.

.4 High flexible stranding type wire shall be used in restricted spaces or across hinged sections.

.5 Wire colour to follow the City of Winnipeg's Automation Design Guide, Electrical Design Guide, and Identification Design Guide.

2.4 Marking

.1 Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags shall be preprinted white heat-shrinkable tubing, Raychem Thermofit TMS.

.2 Plainly and permanently identify control and power devices using the same identification as shown on the schematic diagrams. Show identification for devices inside the enclosure on a plate adjacent to, not on, the device.

2.5 Supply Circuit Disconnecting Means

.1 Provide a supply circuit disconnect for each control panel. Disconnect shall be a circuit breaker mounted within the control enclosure operated by a variable depth flange-mounted circuit breaker operating mechanism.

2.6 Wiring Methods

.1 Panel wiring shall be neatly contained in narrow-slot ventilated wireways, including incoming and outgoing field control wiring. Wireways shall be light gray coloured, restricted slot design, with matching snap-on covers. Use light blue coloured wireways for intrinsically safe wireways. Provide wireways with mounting holes and nylon "push" rivets for mounting. Wireways material shall be PVC or noryl.

.1 Size wireways such that they are not more than 40% full once the wiring is installed.

.2 Provide minimum 50 mm of clearance between wireway and wire terminations to allow for clear viewing of wire identification marking.

.3 Provide the mandatory ventilation clearances around heat-generating components as specified by the component manufacturer. Indicate mandatory component clearances on the panel layout drawings.

.4 Tie wiring run to control devices on the front door together at short intervals and secure to the inside front door with adhesive mounts. Mounts shall be adjustable releasable-clamp type for wire bundles 17mm in diameter or smaller or releasable nylon cable ties for bundles larger than 17 mm in diameter. Attach mounts to front panel with adhesive.

.5 Provide a minimum of 19 mm separation between ventilated wireways containing intrinsically safe wiring and ventilated wireways containing non-intrinsically safe wiring.

.6 Categorize and group conductors based on their application. Provide separate wireways for conductors of each category in order to minimize electromagnetic interference. Categories 3 and 4 may be combined if space is limited.

.1 Category 1: AC Power and Control

.1 AC Power for power supplies

.2 120 VAC Control Wiring

.3 24 VAC Control Wiring

.2 Category 2: DC Power and Control

.1 DC Power

.2 DC Control Wiring

.3 Category 3: Analog Signals

.1 Analog I/O

.4 Category 4: Communications:

.1 Communication Cables

2.7 Terminal Blocks

.1 Provide enough terminal blocks for designed requirements including indicated spares. Wire all spare terminal blocks back to PLC or RIO cards.

.1 One terminal block shall be provided for each wire entering or exiting the control panel.

.2 No more than two wires shall terminate on the same terminal.

.2 Provide screw clamp compression terminals in style shown on drawing. Approved manufacturer:

.1 Phoenix Contact

.3 Ground Terminals shall be electrically grounded to the mounted DIN rail.

.4 Provide 15 spare terminal blocks of each type for the project.

2.8 Relays

.1 Phoenix Contact 2966171 and 2966281.

.2 Or approved equivalent.

2.9 Spare Parts

.1 Provide ten (10) spare fuses for each panel of each rating type. Store in resealable plastic bag inside panel document holder.

3. EXECUTION

3.1 General

.1 Construct panels in conformance with C22.2 N^{o}286.

3.2 Wiring

.1 Wire panels as shown in the contract drawings and as per the Shop Drawing.

.2 All wires and cables inside the control panels shall be identified on both ends using permanent labels. Labels shall be machine printed; handwritten labels shall not be accepted. Utilize heat shrink labels where practicable.

.1 Wire labels shall match the drawing labels.

.2 Wire terminations and connections shall match the drawings and schematics.

.3 All individual conductors shall be labelled.

.3 No splices shall be used while wiring the panel.

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 Bond all devices to the panel ground bus bar.

3.4 Terminals

.1 Jumper bars shall be used where possible instead of jumper wires.

3.5 Testing

.1 Provide a check list of the tests performed and results.

.2 Tests to include at a minimum:

.1 Power supply functionality

.2 Loop checks of all circuits

.3 Relay and switch functionality

3.6 Inspection

.1 Notify the Contract Administrator and replace any component damaged in transportation.

3.7 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide electrical assistance for all testing and commissioning for and Process Control System (PCS) components necessary to confirm the functional performance for the equipment and systems.

.2 Attend all testing and commissioning dates scheduled. Assist with trouble shooting of field wiring, power wiring, provided and installed components. Assist with trouble shooting of loops as directed, including but not limited to, modification of circuits, injecting signals, removing, checking, and replacing fuses, and energization and de-energization of power circuitry.

.3 Assist with Site Acceptance Test (SAT) at site prior to commissioning to demonstrate that the installation satisfies the project installation requirements and applicable codes and standards.

.4 Assist with Site Integration Test (SIT) at site to demonstrate that all the control system components are fully integrated and working together as specified in the project documents as required for complete PCS functionality.

.5 Testing is performed to:

.1 Demonstrate and document that the entire PCS is operating in accordance with the design requirements;

.2 Contribute to the safe and reliable operation of the plant; and

.3 Provide a baseline result for routine maintenance of system and related components.

1.2 Submittals

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

.2 Submit test plans and schedules a minimum of two months prior to testing.

.3 SAT Plan

.1 Contractor shall submit the SAT plan for Contract Administrator approval.

.2 The SAT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.,

.2 Hardware, including construction, visual inspection, wiring, labeling, agreement with shop drawing requirements and acceptance criteria,

.4 SIT Plan

.1 Contractor shall submit the SIT plan for Contract Administrator approval.

.2 The SIT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.,

.2 Tests to confirm interoperability of systems involved,

.3 Any functional test to be re-performed after interface to package control system.

.5 Supplement submittal documentation as needed to provide adequate records of testing and commissioning activities in accordance with accepted industry practice.

.6 Issue submittals for Contract Administrator review and acceptance in accordance with the project schedule as defined herein and in a timely manner to ensure that all required documentation is in place prior to the commencement of any testing or commissioning activities.

.7 Coordinate the submittals detailed in other sections of the specifications with the requirements defined in this section to achieve a complete set of documentation without overlap or gaps.

2. PRODUCTS

2.1 TESTING EQUIPMENT

.1 Typical test equipment to perform test, configuration, calibration and loop checks include but are not limited to:

.1 Digital multimeter;

.2 Portable pressure calibrator;

.3 Dead weight tester;

.4 Precision pressure gauge;

.5 Temperature calibrator;

.6 Temperature calibration bath;

.7 Standard temperature sensor and meter;

.8 Loop calibrator;

.9 Hand-held oscilloscope;

.10 Ethernet fiber and copper network tester;

.11 Profibus PA and DP segment tester;

.12 Profibus PA hand-held field communicator;

.13 HART hand-held field communicator if applicable;

.14 Two way radio.

2.2 Testing Equipment Calibration

.1 Contractor shall have a calibration program which assures that all applicable test instrumentsare maintained within rated accuracy.

.2 The firm providing calibration services shall maintain up-to-date instrument calibrationinstructions and procedures for each test instrument calibrated.

.3 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments analog and digital: 12 months maximum;

.2 Laboratory instruments: 12 months maximum;

.3 Leased specialty instruments: 12 month maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Calibrating standard shall be of better accuracy than that of the instrument tested.

3. EXECUTION

3.1 General

.1 The testing and commissioning activities described herein applies to all components and systems that make up the entire Process Control System for the NEWPCC DCS Migration.

.2 All test reports shall include:

.1 The date,

.2 The name, title, and company of the personnel performing the test. Document any required qualifications held.

.3 The conditions during the test as applicable (weather, process conditions, etc.)

.4 The name, title, and company of the representative observing the test.

3.2 Qualification of Personnel

.1 The personnel performing the field tests and commissioning shall be experienced and thoroughly familiar with the apparatus and systems being tested and commissioned. They shall be capable of conducting the tests and commissioning activities in a safe manner, analyze the test data and make a decision on operability of specific equipment and system.

.2 The Contract Administrator shall witness the testing and commissioning.

.3 City of Winnipeg representatives shall observe the testing and commissioning.

3.3 Commissioning Preparation

.1 Carry out all testing and pre-commissioning activities as required herein.

.2 Coordinate all pre-commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each pre-commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Review FAT and working copies of the construction documents to verify the condition is acceptable and suitable for commissioning.

.5 Prepare Commissioning Plan.

.6 Submit Commissioning Plan for review and approval by contract administrator.

.7 Coordination and schedule and manufacturer's assistance as required.

.8 Provide any manufacturer's instructions in the commissioning plans.

.9 Loop Checks

.1 Perform loop checks to verify proper operation of all loops prior to commissioning.

.2 Check Documentation

.3 Visually inspect the installation

.4 Verify the loop functionality

.10 Instrument system tests

.1 Demonstration of operation of all equipment in all control modes as documented in the Process Control Narratives and DCS Logic.

.11 SAT

.1 Perform the SAT to demonstrate proper functionality of the system at final installation.

.2 Check of Hardware/Software inventory;

.3 Mechanical inspection;

.4 Wiring and termination inspection;

.5 System energization;

.6 Checking hardware redundancy and diagnostic;

.7 Checking operator interface;

.8 I/O test;

.9 Verification of the device network interfaces;

.10 Function check; and

.11 .Performing the tests which could not be completed during the FAT.

.12 SIT

.1 Perform the SIT to demonstrate the functionality and compatibility of all interconnected systems at final installation to achieve the Process Control System required performance The SIT consists of testing the communication and interaction between the PCS sub-systems or with other systems, such as mechanical package control systems, to ensure desired functional performance. The SIT shall be performed after the SAT for each system/sub-system has been successfully completed.

.2 Mechanical inspection;

.3 Testing communication links;

.4 Checking operator interface;

.5 Testing Hardwired I/O;

.6 Functional tests; and

.7 Performing the tests that could not be completed during the SIFT.

.13 Produce test reports for all performed tests and results and provide in the O&M Manuals.

3.4 Commissioning

.1 Carry out all testing and commissioning activities as required herein.

.2 Coordinate all commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Reviewing commissioning plan;

.5 Reviewing pre-commissioning reports to verify acceptable condition for commissioning phase;

.6 Perform Loop Functional Checks;

.1 See Appendix G for loop check test form templates.

.2 Demonstrate equipment functionality as described in the Commissioning Plan. Minimum requirements shall demonstrate all functionality in the Process Control Narratives and DCS Logic.

.3 For analog signals use 4-20 mA sources to simulate the transmitter signal. For Profibus instruments, use a handheld communicator connected at the transmitter to simulate the signal. For discrete signals, simulation includes the use of a jumper or lifting a wire/opening a fuse in the circuit.

.4 Simulate values at multiple points (in both increasing and decreasing directions) of transmitter span (0, 25, 50, 75 and 100%) to confirm the sensor/transmitter, HMI and any other indicators all agree.

.5 Simulate values above and below range to confirm failure reaction in PCS. Simulate a sensor/transmitter failure and/or disconnection to verify the failure reaction in PCS.

.6 Reconnect the transmitter to verify the device is automatically and correctly communicating with PCS. Final alarm and control set point adjustments as necessary;

.7 Interlock Verification

.1 Force each interlock initiator, one at a time, and confirming that all interlock actions occur at the proper trip points in accordance with the Process Control Narratives and DCS Logic.

.8 Sequence Logic Check

.1 Demonstrate all sequence logic and control loops as described in the Process Control Narrative and existing DCS Logic. Force or simulate each sequence logic or control loop initiator, one at a time, and confirming that all logic actions occur properly in accordance with the Process Control Narrative and existing DCS Logic.

.9 Adjustments of controller's PID value (Loop Tuning) as necessary;

.10 Verification of complex control schemes;

.11 Monitoring the PCS diagnostic alarms;

.12 Monitoring the control system performance;

.13 Commissioning of analyzers, sample handling systems and other special instruments;

.14 Produce Commissioning report documenting the commission demonstrations, including tests and demonstrations performed, measured values, system response, and tuned values.

3.5 Contractor Representative

.1 Designate and furnish one or more Contactor personnel to coordinate and expedite all testing and commissioning activities and documentation functions.

.2 Contractor representative(s) to coordinate all testing and commissioning works carried out by specific equipment vendors in accordance with the commissioning planning and schedules submitted by the Contractor.

.3 Representative(s) to attend all meetings concerning the commissioning function as may be requested by the Contract Administrator. Representative(s) to be available at all times during

the testing, pre-commissioning, commissioning and performance evaluation phases of the project.

3.6 Contract Closeout

.1 Provide in accordance with Section 01 77 00.

END OF SECTION