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DIVISION 1

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SCOPE OF WORK

1. GENERAL

1.1 General

- .1 Design, supply, delivery, supervise installation, commissioning and supervise equipment testing of all equipment and appurtenances required for the decaners.
- .2 The initial portion of the Contract shall consist of the supply of design services, which shall include all supporting technical services and products described in this Bid Opportunity and that may be reasonably required by the Contract Administrator and the City. Design services shall include but are not necessarily limited to the following:
 - .1 Provision of information relating to the decaners and all ancillary equipment, including but not limited to Shop Drawings, to the Contract Administrator during design to facilitate tendering of an Installation Contract for the construction of the North End Water Pollution Control Centre Centrate Nitrogen Removal Facility
 - .2 Provision of operating and design process information pertaining to equipment being supplied including control philosophy, standard operating procedures, preventative maintenance schedule, equipment data and reference materials, supplier schedules, loop drawings, I/O exchange tables, etc.
 - .3 Provision of necessary performance specifications for all related processes and equipment material required to ensure optimal function of the decanter units. This will require preparation and development of preliminary layouts for review by the Contract Administrator and the City.
 - .4 Provision of information related to support requirements, pedestals, decant piping (size, elevation, routing).
- .3 The second portion of the Contract includes the supply of equipment and Site services for the equipment and associated appurtenances as listed below:
 - .1 Supply of all ancillary equipment and materials required for proper functioning of the supplied equipment
 - .2 Delivery of the equipment to the jobsite
 - .3 Provision of all necessary instruction and supervision to ensure satisfactory off-loading, storage, and installation of the equipment
 - .4 Witnessing of equipment installation
 - .5 Assistance in equipment testing
 - .6 Equipment testing
 - .7 Operation and maintenance training

SCOPE OF WORK

- .8 Modification of all supplied Shop Drawings to reflect As-Constructed conditions following installation and commissioning of the subject equipment.
- .9 As required and at no additional cost to the City, modification and or replacement of the equipment to ensure that equipment guarantees provided in the Bid are met.
- .10 Provision of all technical support for and repair of all defects to the equipment, at no cost to the City, during the warranty period.
- .4 The supplied equipment shall include all accessories required to ensure the supplied equipment safely and satisfactorily operates as an integral system as required by the Contract Documents.
- .5 Provide any appurtenances or services not specifically mentioned or included in the Contract Documents but which are necessary as part of the Work to ensure that the equipment is fully operational when installed.
- .6 Notify the Contract Administrator immediately upon discovery of discrepancies or omissions in the Contract Documents or of any doubt as to the meaning or intent of any part thereof.
- .7 To proceed with the Work when an error is suspected or when there is doubt as to the interpretation of the project requirements constitutes full acceptance of any cost associated with any remedial Work that may be required.

1.2 Coordination

- .1 Other parties or contractors (and their subcontractors) that will be working within and adjacent to the Site include, but are not necessarily limited to the following:
 - .1 The City and its appointed representatives
 - .2 Installation Contractor
 - .3 Aeration Equipment Supply Contractor
- .2 The Contractor shall provide, for the duration designated in the Contract Documents, the services of a trained and experienced technician (hereinafter referred to as the Contractor's representative) for:
 - .1 Equipment delivery
 - .2 Installation training
 - .3 Witnessing of equipment installation
 - .4 Assistance during equipment testing
 - .5 Equipment Testing

SCOPE OF WORK

- .6 Training of City staff
- .3 The Installation Contractor shall be responsible for:
 - .1 Receipt of the equipment upon delivery
 - .2 Off-loading and storage of the equipment
 - .3 Satisfactory equipment installation
 - .4 Satisfactory equipment testing
 - .5 Assistance with Equipment Testing
- .4 The Contractor shall cooperate fully with the Installation Contractor (or City, if the Installation Contract has yet to be assigned) to ensure that the delivery of the equipment and the provision of Site services meet and conform to the Installation Contractor's construction schedule and to these Contract Documents.
- .5 The Contractor will be required to certify:
 - .1 Satisfactory delivery of the equipment
 - .2 Satisfactory equipment installation training
 - .3 Satisfactory equipment installation
 - .4 Satisfactory equipment testing
- .6 During the equipment testing for the decanter units, the Contractor shall attend coordination meetings as requested by the Contract Administrator. The Contractor must also take all precautions necessary to ensure that he does not hinder or delay in any way the progress of the Installation Contractor or cause damage to the Work.

1.3 Schedule and Status Reports

- .1 It is the responsibility of the Contractor to coordinate and schedule delivery of the equipment to the Site with the Installation Contractor.
- .2 After delivery the Installation Contractor will be responsible for storing and maintaining the equipment in accordance with the Contractor's storage requirements.
- .3 The Contractor shall prepare, sign, and submit a typewritten report at the end of each month to the Contract Administrator and the Installation Contractor, stating the status and rate of progress of design, fabrication, shipping and delivery of the equipment and the effect, if any, on the delivery schedule.

SCOPE OF WORK

1.4 Independent Inspection and Testing Agencies

- .1 Independent inspection and testing agencies may be retained by the City for the purpose of inspecting and testing portions of the Work. All costs of such services will be borne by the City unless otherwise noted.
- .2 Employment of inspection and testing agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.

2. PRODUCTS

- .1 Not Used

3. EXECUTION

- .1 Not used

END OF SECTION

SUBMITTALS

1. GENERAL

1.1 Shop Drawings and Product Data

- .1 "Shop Drawings" mean custom drawings, product data, diagrams, illustrations, schedules, performance charts, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work.
- .2 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, 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 Shop Drawings shall be submitted with a copy of the associated Specification. For each specification clause, note compliance or deviation from Specification. Provide full explanation for any deviation. Shop Drawings submitted without the associated specification sections will be returned to the Contractor as "Rejected".
- .4 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 Contractor and any subcontractors. Shop Drawings not stamped, signed and dated will be returned without being reviewed and stamped "Re-submit".
- .5 Submit Shop Drawings with reasonable promptness and in an orderly sequence so as to cause no delay in the Work. Failure to submit Shop Drawings in ample time is not to be considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed. Prepare a schedule fixing the dates for submission and return of Shop Drawings.
- .6 The Contract Administrator will review and return Shop Drawings in accordance with the schedule agreed upon or otherwise with reasonable promptness so as to cause no delay in the Work.
- .7 Submit six (6) copies of white prints, plus one (1) copy of reproducibles, and six (6) copies of all fixture cuts and brochures.
- .8 Shop Drawing review 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.

SUBMITTALS

- .9 Review by the Contract Administrator shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.
- .10 Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation and coordination of all parts of the Work rests with the Contractor.
- .11 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 & 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.
- .12 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.
- .13 Any adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. Increases in the Contract Price must be approved by the Contract Administrator prior to proceeding to fabricate.
- .14 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.
- .15 Shop Drawings indicating design requirements not included in the Contract Documents require the seal of a qualified Professional Engineer, registered in the North America. Calculations shall be submitted for review, if requested, and sealed by a qualified Professional Engineer.
- .16 Only two 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 current rates. The Contract Administrator's charges for the additional Work will be deducted from the Contractor's Progress Certificates.

SUBMITTALS

1.2 Samples

- .1 Submit samples for the Contract Administrator's review as specified or as the Contract Administrator may reasonably request. Clearly label samples as to origin and intended use in the Work. Reference samples to Drawings and Specifications.
- .2 Submit samples with reasonable promptness and in orderly sequence so as to cause no delay in the Work. Failure to submit samples in ample time is not to be considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed. Prepare a schedule fixing the dates for submission and return of samples.
- .3 Notify the Contract Administrator in writing, at the time of submission, of any deviations in samples from requirements of Contract Documents.
- .4 The Contract Administrator's review will be for conformity of design concept and general arrangement only. Such review is not to be considered relief of responsibility for errors or omissions in samples or of responsibility for meeting all requirements of the Contract Documents.
- .5 Any adjustments made on samples 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 the Work.
- .6 Make changes in samples, which the Contract Administrator may require, consistent with Contract Documents.

1.3 Operating and Maintenance Manuals

- .1 For the guidance of the City's operating and maintenance personnel, the Contractor shall prepare O&M Manuals for the Work, describing in detail the construction of each part of the Work and the recommended procedure for operation, servicing and maintenance.
- .2 Three (3) advance copies of the manuals shall be submitted prior to delivery of the equipment for review and comments. A minimum of eight weeks after review, six (6) copies of the final manuals shall be supplied. Each copy shall be clearly titled to show all of the information required by the Specifications as well as operational information including: the item of Work concerned, the City's Contract number, the name and address of the Contractor, the issue date, operational information on equipment, cleaning and lubrication schedules, filters, overhaul, and adjustment schedules.
- .3 All instructions in these manuals shall be in plain language to guide the City in the proper operations and maintenance of this installation.
- .4 Submit O&M Manuals in electronic format. Organize contents into applicable sections of Work, parallel to Specifications break-down.
- .5 In addition to information called for in the Specifications, include the following:

SUBMITTALS

- .1 Title sheet, labeled "Operation and Maintenance Instructions", and containing project name and date.
- .2 List of contents.
 - .1 Brochures and catalogue excerpts of all architectural, mechanical and electrical components of the Work
 - .2 Documentation of all test results
 - .3 Complete set of equipment and assembly drawings
 - .4 Installation, start-up, O&M Manuals
 - .5 Commissioning data sheets and reports
 - .6 Lists of spare parts, consumables, and special tools, with prices and names and addresses of nearest supplier
 - .7 Any specific product or maintenance manual requirements from the technical specifications
- .3 Reviewed Shop Drawings of all equipment
- .4 Full description of entire mechanical system and operation
- .5 Names, addresses and telephone numbers of all major subcontractors and suppliers
- .6 Detailed operations and maintenance instructions for all items of equipment, including a preventative maintenance program
- .6 The Contractor shall modify and supplement the manual as required by the Contract Administrator.
- .7 Provide list of spare parts and consumables, including name and address of nearest supplier.
- .8 The O&M Manuals shall be supplied to the City before delivery of equipment and provision shall be made for additions and deletions, which may be dictated by the City's operational experience. Where these amendments to the manuals are indicated to be necessary during initial operation before acceptance, the Contractor shall supply the amended sections free of charge.
- .9 Payment for this item of the Work will not be issued until all requirements for the O&M Manuals have been satisfied.

1.4 Photographs and Publicity

- .1 No photographs of the Site or of any portion of the Work will be permitted without prior approval of the Contract Administrator.

SUBMITTALS

- .2 No press or publicity releases will be permitted without prior approval of the Contract Administrator.

1.5 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 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.

2. PRODUCTS

- .1 Not used

3. EXECUTION

- .1 Not used

END OF SECTION

QUALITY ASSURANCE

1. GENERAL

1.1 General

- .1 The City, the Contract Administrator, and other authorities having jurisdiction shall have access to the Work. If parts of the Work are in preparation at locations other than the place of the Work, access shall be given to such Work whenever it is in progress.

1.2 Laboratories and Agencies

- .1 Independent inspection and testing agencies may be engaged by the City for the purpose of inspecting or testing portions of the Work. All costs 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 carrying out inspection and testing will be provided by the respective agencies.
- .3 Employment of inspection and testing agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.
- .4 Allow the inspection and testing agencies access to all portions of the Work on the Site and manufacturing or fabrication plants, as may be necessary. Provide facilities for such access.

1.3 Reference Standards and Acronyms

- .1 Within the Drawings and Specifications, reference may be made to the following standards and organizations by their acronyms, as defined below. Conform to such standards, in whole or in part, as specified.

| | |
|--------|---|
| AABC | Associated Air Balance Council |
| AFBMA | Anti-Friction Bearings Manufacturers Association |
| ACI | American Concrete Institute |
| AMCA | Air Movement and Control Association |
| AGMA | American Gear Manufacturers Association |
| AISC | American Institute of Steel Construction |
| AISI | American Iron and Steel Institute |
| ANSI | American National Standards Institute |
| APHA | American Public Health Association |
| ARI | Air-conditioning and Refrigeration Institute |
| ASHRAE | American Society of Heating, Refrigerating and Air-conditioning Engineers |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASPE | American Society of Plumbing Engineers |
| ASTM | American Society for Testing and Materials |
| AWS | American Welding Society |
| AWWA | American Water Works Association |
| BS | British Standard |
| CCA | Canadian Construction Association |
| CCMC | Canadian Construction Materials Centre |

QUALITY ASSURANCE

| | |
|--------|--|
| CEA | Canadian Electricity Association |
| CEC | Canadian Electrical Code |
| CEMA | Canadian Electrical Manufacturers Association |
| CGSB | Canadian Government Specification Board |
| CISC | Canadian Institute of Steel Construction |
| CLA | Canadian Lumberman's Association |
| CPCA | Canadian Painting Contractors Association |
| CPCI | Canadian Prestressed Concrete Institute |
| CRCA | Canadian Roofing Construction Association |
| CSA | Canadian Standards Association |
| CSSBI | Canadian Sheet Steel Building Institute |
| DIN | Deutsche Industrie Norm |
| EEMAC | Electrical and Electronic Manufacturers Association of Canada |
| EJMA | Expansion Joint Manufacturers Association |
| FM | Factory Mutual Engineering Corporation |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electrical and Electronic Engineers |
| IPCEA | Insulated Power Cable Engineers Association |
| ISA | Instrumentation, Systems, and Automation Society |
| MSDS | Material Safety Data Sheets |
| MSS | Manufacturers Standardization Society of the Valve and Fittings Industry |
| NAAMM | National Association of Architectural Metal Manufacturers |
| NABA | National Air Barrier Association |
| NACE | National Association of Corrosion Engineers |
| NBC | National Building Code |
| NECA | National Energy Conservation Association |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| NLGA | National Lumber Grading Authority |
| RSIC | Reinforcing Steel Institute of Canada |
| SAMA | Scientific Apparatus Makers Association |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |
| SSPC | Steel Structures Painting Council |
| TTMAC | Terrazzo Tile and Marble Association of Canada |
| ULC | Underwriters Laboratories of Canada |
| WCB | Workers Compensation Board |
| WEF | Water Environment Federation |
| WHMIS | Workplace Hazardous Materials Information System |

- .2 If there is question 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. The cost for such testing will be borne by the City in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.
- .3 Where specified standards are not dated, conform to latest issue of specified standards as amended and revised to the Bid closing date.

QUALITY ASSURANCE

1.4 Design Standards, Code Requirements

- .1 Inspection and testing will be performed in accordance with, but not limited to, the following:
 - .1 Welding to CSA-W59.1 and ASTM E109
 - .2 Bolted connections to CSA-S16 or CSA-S16.1

1.5 Tests and Mix Design

- .1 Prior to start of the Work, submit to the Contract Administrator and inspection and testing agency, the following:
 - .1 Mill test certificates for all structural steel and bolts.

1.6 Procedures

- .1 Notify the Contract Administrator well in advance of the requirements for tests in order that necessary arrangements can be made.
- .2 Submit samples and materials required for testing with reasonable promptness so as to cause no delay in the Work.
- .3 Provide facilities to allow inspection and testing and make available space for storage and curing of the test samples.
- .4 If defects are revealed during inspection and testing, then the Contract Administrator may issue instructions for removal or correcting defective Work and irregularities. The Contractor shall notify the Contract Administrator within two working days if such instructions are in error or at variance with the Contract Documents.
- .5 Costs for re-inspection and retesting of rejected Work shall be borne by the Contractor.

2. PRODUCTS

- .1 Not used

3. EXECUTION

- .1 Not used

END OF SECTION

PRODUCTS AND WORKMANSHIP

1. GENERAL

1.1 Metric Project

- .1 Unless otherwise noted, this project has been designed and is to be constructed in the SI metric system of measurements.
- .2 During construction, when specified metric elements are unattainable at the time they are required to meet the Construction Schedule, the Contractor shall notify the Contract Administrator in writing and suggest alternative substitutions. Costs due to these substitutions shall be borne by the Contractor.

2. PRODUCTS

2.1 Quality of Products

- .1 Provide new materials, equipment and articles incorporated in the Work, not damaged or defective, and of the best quality compatible with Specifications for the purpose intended. If requested, furnish evidence as to type, source, and quality of products provided.
- .2 Defective materials, equipment and articles whenever found may be rejected regardless of previous inspection. Inspection by the Contract Administrator or an independent inspection and testing agency does not relieve the Contractor of his responsibility but is merely a precaution against oversight or error. Costs for removal and replacement of defective materials and responsibility for all delays and expenses caused by rejection shall be borne by the Contractor.
- .3 Should any dispute arise as to the quality or fitness of materials, equipment or articles, the decision rests strictly with the Contract Administrator based upon the requirements of the Contract Documents.
- .4 Unless otherwise indicated in the Contract Documents, maintain uniformity of manufacturer for any particular or like item throughout the Work.
- .5 Permanent labels, trademarks and nameplates on materials, equipment and articles are not acceptable in prominent locations except where required for operating instructions and when located in mechanical or electrical rooms.

2.2 Availability of Products

- .1 If the event of delays in deliveries of materials, equipment or articles, the Contract Administrator reserves the right to substitute more readily available products later in order to prevent delays at no additional cost to the City.
- .2 No substitution of any item will be permitted unless the item cannot be delivered to the jobsite to comply with the schedule.

PRODUCTS AND WORKMANSHIP

- .3 To receive approval, proposed substitutes must conform with the requirements of B5 in the Bidding Instructions.
- .4 Provide documented proof of equality and delivery dates in the form of certified quotations from manufacturers of both specified items and proposed substitutions.
- .5 The Contractor shall be responsible for all costs including any and all revisions required to accommodate such substitutions.

2.3 Transportation Costs of Products

- .1 Pay all costs for transportation of products required for the Work.

3. EXECUTION

3.1 Workmanship

- .1 Workmanship is to be of the best quality executed by workers fully experienced and skilled in their respective trades.

3.2 Fastenings

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent material unless otherwise specified.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive, non-staining fasteners and anchors for securing exterior Work unless otherwise specified.
- .4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and lay out neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .7 Details of the structural design (e.g. materials, wall thicknesses etc.) will be provided to the Contractor by the Contract Administrator prior to Shop Drawing submission.

END OF SECTION

EQUIPMENT INSTALLATION

1. GENERAL

1.1 Intent

- .1 This Section describes general requirements for all equipment supplied under this Contract relating to the supervision of installation and testing. The intent is that the Installation Contractor will be responsible for undertaking the installation, testing, and commissioning of the equipment to be supplied under this Contract. The Contractor shall be responsible for providing guidance and assistance to the Installation Contractor in supervision of the installation Work, and testing of the supplied equipment.
- .2 At least 30 days prior to commencing equipment testing the Contractor shall assist the Installation Contractor to prepare and submit a detailed start-up plan to indicate the schedule and sequence of equipment installation checks and tests required for the Contract Administrator's review. No testing Work can commence until this plan has been accepted by the Contract Administrator.

1.2 Definitions

- .1 Contractor's Representative: a trained service person empowered by the Contractor to provide:
 - .1 Installation training
 - .2 Witnessing of equipment installation
 - .3 Assistance in equipment testing
 - .4 Operation and Maintenance Training (refer to Section 01665)

1.3 Expertise and Responsibility

- .1 The Contract Administrator recognizes the expertise of the Contractor.
- .2 Should the Contract Administrator issue an Addendum, Notice of Proposed Change, Field Order or Change Order to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two days upon receipt.

2. PRODUCTS

- .1 Not used

EQUIPMENT INSTALLATION

3. EXECUTION

3.1 Equipment Delivery

- .1 All equipment shall be delivered in its entirety in one shipment.
- .2 The Contractor shall deliver all equipment FOB to the North End Water Pollution Control Centre (or other storage facility in Winnipeg as designated by the City or Installation Contractor) including freight, duty, insurance and all covering charges on the delivery scheduled within the time frame indicated in the Bid Opportunity Supplemental Conditions. Installation Contractor will become responsible for taking delivery of the equipment. Written acceptance of receipt, at delivery, by the Installation Contractor shall constitute “Delivery to Site” under this Contract. A representative from each of the following will be in attendance at the time of delivery:
 - .1 Contractor
 - .2 Installation Contractor
 - .3 Contract Administrator
- .3 The Contractor shall clearly mark each item to be shipped and identify and reference it to the packing lists and to bills of materials on the Shop Drawings. The lists will be used by the Installation Contractor and the Contract Administrator to check the contents of each delivery. No shipments will be off-loaded until itemized packing lists have been received by the parties mentioned herein.
- .4 The Contractor shall adequately pack and crate each component to provide protection during transport, handling, and storage. Equipment suitable for outside storage shall be stored to the satisfaction of the Contractor and Contract Administrator. The Contractor shall identify each component with durable labels or tags securely attached to each piece of equipment, crate, or container.
- .5 No item shall be shipped loose or in such a way as to be adversely affected by weather conditions, pilferage, normal transit hazards, or other reasonably anticipated shipping hazards.
- .6 Where the equipment is to be stored on-site for any period of time exceeding one week, the Contractor shall instruct the Installation Contractor of the specific storage requirements to ensure there is no uneven wear or distortion of equipment component parts.
- .7 The Contractor shall protect polished and machined metal surfaces from corrosion and damage during shipment and storage and shall carefully pack and crate the equipment for shipment. The Contractor shall protect threaded connections with threaded plugs or caps and shall protect open plain end pipes with caps. Pack electrical equipment and control panels to prevent corrosion, scratching, access by dirt, moisture or dust or damage to insulation, and cover equipment having exposed bearings and glands to exclude foreign matter.

EQUIPMENT INSTALLATION

- .8 The Contractor shall give notice to the Installation Contractor and the Contract Administrator ten days Business days before delivery so that arrangements can be made for receipt and inspection. The Contractor shall arrange for delivery during normal working hours.
- .9 When the Installation Contractor is satisfied that the equipment has been delivered in its entirety without damage, he shall complete the “Certificate of Equipment Delivery” (Form 100) attached to this Specification. The completed form shall be delivered to the Contract Administrator.
- .10 The Contractor shall instruct the Installation Contractor in writing on the off-loading, storage and periodic maintenance requirements for the materials and equipment, emphasizing any particular precautions, including any special oils or greases needed, to be taken during the off-loading, storage and pre-start-up periods.
- .11 The Contractor shall maintain an inventory of all equipment supplied and delivered to the Installation Contractor.
- .12 The Installation Contractor shall examine all crates and packages on delivery and compare them with the packing lists. The Installation Contractor shall inform the Contract Administrator, the Contractor and the carrier in writing of any visible damage, missing items or defects. The Contractor shall arrange to replace forthwith items not delivered or delivered defective or damaged to the Site.
- .13 Off-loading and storage of the equipment at the jobsite will be the responsibility of the Installation Contractor.
- .14 The Installation Contractor shall arrange for heated and covered storage at the jobsite as required by the Contractor for sensitive items of equipment. The Contractor shall clearly identify such sensitive items on the packages and crates.
- .15 The equipment may have to be stored on the Site for an extended period of time before installation and equipment testing. Accordingly, the Contractor shall provide any special packaging and protective coatings, lubricants, etc. which the Contractor deems necessary to protect the equipment during the protracted storage and prior to equipment testing. The Installation Contractor shall be responsible for removing any protective coatings prior to installation in accordance with the Contractor’s written instructions.

3.2 Equipment Delivery Schedule

- .1 Refer to D10 of the Bid Opportunity.

3.3 Installation Assistance

- .1 Before commencing installation of the equipment, the Contractor shall provide instructions to the Installation Contractor in writing of all the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

EQUIPMENT INSTALLATION

- .2 The Contractor shall provide advice and instructions to the Installation Contractor on the installation of the equipment but shall not be responsible for the detailed supervision of the installation of the equipment or of the workers installing it. The Contractor shall notify the Contract Administrator in writing immediately in the event of any disputes with the Installation Contractor concerning installation of the equipment.
- .3 When the Contractor is satisfied that the Installation Contractor is aware of all installation requirements, he and the Installation Contractor shall so certify by completing the “Certificate of Equipment Installation Instruction” (Form 101) attached to this Specification. Such certification shall be provided to the Contract Administrator.
- .4 Installation of the equipment shall not commence until the Contract Administrator has advised that he has accepted the completed Form 101.
- .5 Form 101 is included in this document for information only. The Form 101 that will be signed prior to installation may be worded slightly differently and will be included in the Installation Contract.

3.4 Installation

- .1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Installation Contractor shall contact the Contractor to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.
- .2 If it is found necessary, or if so directed by the Contract Administrator, the Installation Contractor shall arrange for the Contractor to visit the Site to provide assistance to the Installation Contractor during installation.
- .3 Prior to completing installation, the Installation Contractor shall inform the Contractor and arrange for the attendance at the Site of the Contractor to verify successful installation.
- .4 The Contractor shall conduct a detailed inspection of the installation including alignment, attached pipe work, lubrication, workmanship, and all other items as required to ensure successful operation of the equipment.
- .5 The Contractor shall identify any outstanding deficiencies in the installation and shall provide a written report to the Contract Administrator and Installation Contractor describing such deficiencies.
- .6 The deficiencies shall be rectified by the Installation Contractor and the Contractor will be required to re-inspect the installation, at no cost to the City.
- .7 When the Contractor accepts the installation, he and the Installation Contractor shall certify the installation by completing the “Certificate of Satisfactory Equipment Installation” (Form 102), attached to this Specification.
- .8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the Contractor from the Site.

EQUIPMENT INSTALLATION

- .9 Form 102 is included in this document for information only. The Form 102 that will be signed after installation may be worded slightly differently and will be included in the Installation Contract.

3.5 Equipment Testing

- .1 Equipment will be subjected to a demonstration and testing after the installation has been verified and any identified deficiencies have been remedied.
- .2 The Installation Contractor shall inform the Contract Administrator at least 14 days in advance of conducting the tests and arrange for the attendance of the Contractor. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Installation Contractor and the Contract Administrator.
- .3 The Contractor will conduct all necessary checks to the equipment and if necessary, advise the Installation Contractor of any further Work needed prior to confirming the equipment is ready to run.
- .4 The Installation Contractor shall then operate the equipment for at least one hour to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.
- .5 The Installation Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.
- .6 With the assistance of the Contractor, the Installation Contractor will demonstrate that the equipment is properly installed. Alignment, piping connections, levels etc. will be checked.
- .7 The equipment shall then be run for one hour. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage will be checked to ensure that they are within the specified or Contractor's recommended limits, whichever is more stringent.
- .8 On satisfactory completion of the one-hour demonstration, the equipment will be stopped and the Contractor shall recheck all critical parameters, such as alignment, piping connections, levels, operating parameters, etc.
- .9 As practicable, conditions will be simulated which represent maximum or most severe conditions. These conditions will be mutually agreed by the Contractor, the Installation Contractor and the Contract Administrator on the basis of the information contained in the Supply Contract Documents, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.
- .10 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 equipment tests and acceptance by the Contract Administrator.

EQUIPMENT INSTALLATION

- .11 All water, temporary power, heating, or any other ancillary services required to complete the initial demonstration and equipment tests are the responsibility of the Installation Contractor.
- .12 All chemicals, instruments, and testing equipment required to complete the initial demonstration and equipment tests are the responsibility of the Contractor.
- .13 Should the initial demonstration or equipment tests reveal any defects, then those defects shall be promptly rectified and the failed demonstration or tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Installation Contractor, the Contract Administrator, or the City, due to repeat demonstrations or tests shall be the responsibility of the Contractor.
- .14 On successful completion of the demonstration and testing, the “Certificate of Satisfactory Equipment Testing” (Form 105) attached to this Specification will be signed by the Contractor, the Installation Contractor, the Contract Administrator, and the City.

EQUIPMENT INSTALLATION

**CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100**

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

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Installation Contractor)

Date

(Authorized Signing Representative of the Contract Administrator)

Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101**

I have familiarized the Installation Contractor of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Contractor)

Date

I certify that I have received satisfactory installation instructions from the equipment supplier.

(Authorized Signing Representative of the Installation Contractor)

Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102**

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

OUTSTANDING DEFECTS: _____

(Authorized Signing Representative of the Contractor)

Date

(Authorized Signing Representative of the Installation Contractor)

Date

Acknowledgement of Receipt of O&M Manuals

(Authorized Signing Representative of the City)

Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF SATISFACTORY EQUIPMENT TESTING
FORM 105**

We certify that the equipment listed below has been tested and meets the Equipment Testing Requirements as set out in the Contract.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Contractor)

Date

(Authorized Signing Representative of the Installation Contractor)

Date

(Authorized Signing Representative of the Contract Administrator)

Date

EQUIPMENT INSTALLATION

END OF SECTION

TRAINING

1. GENERAL

1.1 Description

- .1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.
- .2 A training session for the City's staff is required in conjunction with the equipment testing.
- .3 As a minimum, the Contractor is to allow at least 16 hours of training spread over three consecutive working days, as required for each item of equipment or system. Refer to the equipment specifications for specific time periods.
- .4 The intent is that the City staff should receive sufficient training on the equipment system that they are going to operate and maintain. The Contract Administrator shall have the authority to determine the duration and content of each training session required.

1.2 Quality Assurance

- .1 Where required by the equipment specifications, provide on-the-job training of the City's staff. Training sessions will be conducted by qualified factory-trained representatives, with a minimum of two years experience. Training includes instruction of City's staff in equipment operation and preventive maintenance and instruction of maintenance mechanics in normal maintenance up to major repair.
- .2 The trainers proposed by the Contractor shall be experienced in training plant operators and shall have relevant experience in similar Work.

1.3 Submittals

- .1 Submit the following information in accordance with Section 01300. For phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material will receive a "REVIEWED" or "REVIEWED AS MODIFIED" status by the Contract Administrator no later than four weeks prior to delivery of the training:
 - .1 Lesson plans and training manuals, handouts, visual aids, and other reference materials for the training session to be conducted by the Contractor's trainer(s)
 - .2 Date, time, and subject of the training session
 - .3 Training schedule

TRAINING

1.4 Location

- .1 Where specified, conduct training sessions for the City's staff, operation and maintenance personnel, on the operation, care, and maintenance of the equipment and systems installed under this Contract. Training will take place at the Site of the Work and under the conditions specified in this Section.
- .2 Field training sessions will take place at the Site of the equipment.

1.5 Lesson Plans

- .1 Prepare formal written lesson plans for each training session and coordinate with the Contract Administrator. Lesson plans to contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Furnish ten (10) copies of necessary training manuals, handouts, visual aids and reference materials at least two weeks prior to each training session.

1.6 Format and Content

- .1 Include time in the classroom and at the location of the equipment or system for each training session. As a minimum, cover the following topics for each item of equipment or system:
 - .1 Familiarization
 - .2 Safety
 - .3 Operation
 - .4 Troubleshooting
 - .5 Preventive maintenance
 - .6 Corrective maintenance
 - .7 Parts
 - .8 Local representatives
 - .9 Special tools

1.7 Video Recording

- .1 The City may video record each training session. After recording, the material may be edited and supplemented with professionally produced graphics to provide a permanent record for the City's use.

TRAINING

2. PRODUCTS

- .1 Not used

3. EXECUTION

3.1 General Requirements

- .1 Conduct the training session in conjunction with the equipment testing.
- .2 At least four weeks before the start of equipment installation (Form 102) and any associated training, provide final O&M Manuals, as defined in Section 01300, for the specific equipment to the City.

3.2 Classroom Training

- .1 As a minimum, classroom equipment training for both the operations and maintenance personnel will include:
 - .1 The equipment's specific location in the plant and an operational overview
 - .2 Purpose and function of the equipment
 - .3 Operating theory of the equipment
 - .4 Routine start-up and shutdown procedures
 - .5 Normal and major repair procedures
 - .6 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings
 - .7 Preventive maintenance and up to and including major repairs such as replacement of major equipment parts with the use of special tools
 - .8 Routine disassembly and assembly of equipment if applicable for purposes such as operator inspection of equipment
 - .9 Operator detection, without test instruments, of specific equipment trouble symptoms

3.3 Hands-On Training

- .1 Hands-on equipment training for maintenance and repair personnel will include:
 - .1 Reviewing normal test and repair procedures
 - .2 Performing routine start-up and shutdown procedures

TRAINING

- .3 Reviewing and using Contractor's manuals in the hands-on training
- .4 Contractor is to ensure that the City is present for and participates in the equipment testing.

3.4 Training Completion Forms and Payment

- .1 Form T1: To be completed for training at the time of the equipment testing (Form 105)
- .2 A sample of Form T1 is attached to this specification section.

TRAINING

**CERTIFICATE OF SATISFACTORY TRAINING
FORM T1**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Contractor)

Date

(Authorized Signing Representative of the City)

Date

TRAINING

END OF SECTION

TABLE OF CONTENTS

DIVISION 11

| Section | Title |
|----------------|--------------------------------|
| 11005 | General Process Provisions |
| 11205 | Process Motors Less Than 150kW |
| 11538 | Decanters |

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Definitions and Interpretations

- .1 Where the term "Provide" is used herein, it shall be understood to include labour, materials, and services necessary to supply items or Work referenced.
- .2 Where the terms "Instructions" or "As Instructed" or "Where Instructed", are used herein, they shall be understood to mean as instructed by the Contract Administrator including supplementary instruction notices and all comments made regarding submittals of Shop Drawings and samples for review.
- .3 Where the term "Listed" is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, have been approved and listed for the intended use by a testing authority which itself has been approved by the authorities having jurisdiction.
- .4 Where the terms "Approved", or "Approval", are used herein, they shall be understood to mean approved by authorities having jurisdiction as conforming to codes, standards, by-laws, etc.
- .5 Where the terms "Acceptable", or "Acceptance", are used herein, they shall be understood to mean acceptable to the Contract Administrator as generally conforming to the requirements of the Contract Documents.
- .6 Where the term "Submit for Review" is used herein, it shall be understood to mean submit to the Contract Administrator.
- .7 Where the term "Subject to Review" etc. is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc. as specified or as may be reasonably requested by the Contract Administrator.
- .8 Where the term "Accessible" is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.
- .9 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

GENERAL PROCESS PROVISIONS

1.2 Shop Drawings

- .1 Refer to Section 01300 for the general requirements for Shop Drawings.
- .2 In addition to the requirements of Section 01300, submit the following specific information with Shop Drawings:
 - .1 Assembly Drawings showing details of connections and termination of equipment for connection by others.
 - .2 List of materials of construction, detailing the component parts and reference specifications (ASTM, CSA, ANSI, etc.).
 - .3 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and description of construction, complete with illustrative drawings.
 - .4 Gearbox and drive data, including AGMA/AFBFMA ratings for components, materials of construction, tolerances and description of construction.
 - .5 Control schematics, text and wiring diagrams as required to describe control operations.
 - .6 Required ancillary services including but not limited to electrical, non-potable water and drains.
 - .7 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances and points of connection for ancillary services.
 - .8 Start-up instructions including lubricant requirements, electrical requirements, etc.
 - .9 Details of coating systems to be applied.
 - .10 Details of insulation provided to prevent galvanic corrosion between mating surfaces constructed of dissimilar metals.
 - .11 A copy of the process and instrumentation diagrams, with addenda updates, that apply to the equipment marked to indicate special changes necessary for the supplied equipment. If no changes are required, mark the Drawing(s) "No Changes Required".
 - .12 A copy of the related specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

1.3 Temporary Usage

- .1 Temporary usage by the City of any process device, apparatus, machinery or equipment prior to interim or final inspection is not to be construed as acceptance.

GENERAL PROCESS PROVISIONS

1.4 Design Standards, Acceptable Products and Acceptable Manufacturers

- .1 Equipment lists included in the Specifications may be in two parts. The first part is the "Design Standard" equipment items. The second part of the list is comprised of "Acceptable Manufacturers" if the equipment of a specific supplier is specified.
- .2 The design has been based on the design standard. Quality of workmanship, dimensions, operating protocol, basic materials and ancillary services have been defined on this basis and incorporated in the design.
- .3 Where acceptable products or acceptable manufacturers have been listed after a design standard, these products or ranges of products have been accepted by the Contract Administrator as being capable of meeting the basic functional requirements of the equipment, but may not be the same as the design standard in detail. Provide all ancillary services, material upgrades, etc. as necessary to satisfy the quality requirements defined by the design standard. Make all minor changes in arrangement, piping and/or electrical connections, etc. as necessary to suit the requirements of the acceptable products or acceptable manufacturers.
- .4 Where acceptable products or acceptable manufacturers have been listed, but no design standard is listed, these products or ranges of products have been accepted by the Contract Administrator as being capable of meeting the basic functional requirements of the equipment. Provide all ancillary services and minor modifications to arrangement, piping, or electrical connections, etc. as necessary to suit the functional requirements of the equipment.
- .5 No additional payment will be made for revisions or alterations made to accommodate the equipment supplied.

2. PRODUCTS

2.1 Spare Parts

- .1 Any required special spare parts not listed in the Contract shall be identified by the supplier, with a price list.

2.2 Flanges and Pipe Threads

- .1 Provide flanges on cast iron equipment and appurtenances that conform in dimension and drilling to ANSI B16.1, Class 125 and flanges on steel equipment and appurtenances that conform in dimension and drilling to ANSI B16.5, Class 150 otherwise specified.
- .2 Provide pipe threads that conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.
- .3 Provide flange assembly bolts that are heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Provide threads that conform to Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

GENERAL PROCESS PROVISIONS

2.3 Bearings

- .1 Unless otherwise specified, provide oil or grease lubricated, ball or roller type equipment bearings, designed to withstand the stresses of the service specified. Rate each bearing in accordance with ABFMA Methods of Evaluating Load Ratings of Ball and Roller Bearings.
- .2 Provide equipment bearings that have a minimum L-10 rating life of 50,000 hour, as determined using the maximum equipment operating speed, unless otherwise specified.
- .3 Fit grease lubricated bearings, except those provided factory sealed and lubricated, with easily accessible grease supply, flush, drain, and relief fittings. Use extension tubes where necessary. Provide standard hydraulic alemite type grease supply fittings.
- .4 Equip oil-lubricated bearings with either a pressure lubricating system or a separate oil reservoir type system. Provide each oil lubrication system to be of sufficient size to absorb the heat energy generated in the bearing under a maximum ambient temperature of 40°C. Provide a filler pipe and an external level indicator gauge.

2.4 V-Belt Assemblies

- .1 Select belt for not less than 150 percent of rated driver power. Where two sheave sizes are specified, ensure belt sizing is appropriate for both sets.
- .2 For explosion-proof equipment, use anti-static type belts.
- .3 Statically balance sheaves and bushings. Where sheaves and bushings are to operate at peripheral speeds greater than 1650 m/min, dynamically balance the assembly.
- .4 Separately mount sheaves on their bushings by means of three pull-up grub or cap tightening devices. Key seat bushings to the drive shaft.

2.5 Couplings

- .1 For equipment with drives over 0.375 kW and less than 120 kW, and where the driver is directly connected to the driven unit, provide a flexible coupling. Couplings shall accommodate angular misalignment, parallel misalignment, and end float and shall cushion shock loads and dampen torsional vibrations.
- .2 The flexible member of flexible couplings shall consist of a tire, with synthetic tension members bonded together in rubber. Attach the flexible member to flanges by means of clamping rings and cap screws, and attach the flanges to the stub shaft by means of taperlock bushings. Provide the equivalent of a shrunk-on fit. There will be no metal-to-metal contact.
- .3 For larger couplings, provide continuous sleeve flexible gear type, forged steel couplings.
- .4 Size each coupling as recommended by the coupling manufacturer for the specific application, considering applied power, speed of rotation, type of service and other pertinent details.

GENERAL PROCESS PROVISIONS

2.6 Guards

- .1 On moving parts, provide sheet steel guards in accordance with workplace safety regulations. Fabricate of 14 gauge steel and galvanize after construction.
- .2 Guards shall be removable to facilitate maintenance of moving parts.

3. EXECUTION

- .1 Not used

END OF SECTION

PROCESS MOTORS LESS THAN 150 kW

1. GENERAL

1.1 Description

- .1 This Section specifies alternating current induction motors, 150 kW or less, to be provided with the driven equipment.
- .2 This Section does not specify medium voltage (2300 V and greater) and specialty motors such as submersible motors, valve operator motors or torque rated motors.
- .3 Unless specified otherwise, the manufacturer of the driven equipment is to provide electric motors as an integral component of the driven equipment, as specified in Section 11005.
- .4 This Section specifies motors suitable for driving centrifugal pumps, fans, blowers, compressors, gears, progressive cavity pumps or other loads fed via variable frequency drives (VFDs) or connected across-the-line.

1.2 Reference Standards

- .1 CSA C22.2 No. 100, Motors and Generators
- .2 CSA C22.2 No. 145, Motors and Generators for Use in Hazardous Locations
- .3 CSA C390, Energy Efficient Test Methods for Three Phase Induction Motors
- .4 EEMAC M1-7, Motors and Generators
- .5 NEMA Std. MG1, Motors and Generators
- .6 IEEE 112, Polyphase Induction Motors and Generators – Testing
- .7 IEEE 114, Single Phase Induction Motors – Testing

1.3 Submittals

- .1 Shop Drawings: submit with the related items of equipment in accordance with Section 01300 and Section 11005. In addition, submit the following information for each typical size or type of motor-driven equipment.
 - .1 Shop Drawings and product data in accordance with Division 16
 - .2 Overall dimensions of motor
 - .3 Shaft centreline to base dimension
 - .4 Shaft extension diameter and keyway, coupling dimensions and details
 - .5 Fixing support dimensions

PROCESS MOTORS LESS THAN 150 kW

- .6 Terminal box location and size of terminals
 - .7 Arrangement and dimensions of accessories
 - .8 Diagram of connections
 - .9 Speed/torque characteristic
 - .10 Weight of motor
 - .11 Installation data
 - .12 Rotation direction
 - .13 Starting restrictions (time between starts)
 - .14 Terminal leads marking
 - .15 Bearing data (including part numbers)
 - .16 Recommended lubricant
 - .17 Design ambient temperature and temperature rise ratings
 - .18 Torque characteristics including rated starting torque and breakdown torque
 - .19 The AFBMA L-10 rated life for the motor bearings
 - .20 The nominal efficiency of all motors
 - .21 Class, division, group, and UL frame temperature limit code for explosion-proof motors
- .2 Operating and Maintenance Data: provide for incorporation in O&M Manual of the related item of process equipment as specified in Section 01300.

1.4 Coordination

- .1 For motors fed via VFDs, communicate motor requirements to, and comply with drive requirements of, the VFD manufacturer in accordance with Division 16.

1.5 Quality Assurance

- .1 Build motors in accordance with CSA C22.2 No. 100, CSA C22.2 No. 145, NEMA Standard MG1, and to the requirements specified.

1.6 Shipment, Protection and Storage

- .1 Ship, protect and store equipment in a manner that prevents damage or premature aging.
- .2 Handle motors with suitable lifting equipment.

PROCESS MOTORS LESS THAN 150 kW

- .3 Store motors in heated, dry, weather-protected enclosure.

2. PRODUCTS

2.1 Description

- .1 Unless specified otherwise, provide motors suitable for continuous operation at an elevation of 220 m above sea level.
- .2 Provide motors suitable for continuous operation in a 40°C ambient temperature.

2.2 Acceptable Manufacturers

- .1 Baldor
- .2 General Electric
- .3 GEC Alsthom
- .4 Reliance
- .5 Siemens
- .6 Toshiba
- .7 U.S. Motors
- .8 Westinghouse

2.3 Materials

- .1 Motors: to EEMAC M1-6
- .2 Lead markings: to EEMAC M2-1
- .3 Unless specified otherwise, provide all motors with:
 - .1 Cast iron frame
 - .2 Cast metal fan blades and shrouds
 - .3 Stainless steel hardware
 - .4 Non-hygroscopic windings

2.4 Components

- .1 Bearings

PROCESS MOTORS LESS THAN 150 kW

- .1 Provide sealed ball bearing type on motors less than 37.5 kW.
- .2 Bearings on 37.5 kW motors or larger to be greaseable ball bearing type, rated for a minimum L-10 life of 100,000 hours at the ambient temperature specified herein.
- .2 Provide adequately sized, diagonally split, gasketed, EEMAC 4 terminal boxes complete with threaded hub for conduit entry for ODP and TEFC motors.
- .3 Provide adequately sized, diagonally split, gasketed EEMAC 7 terminal boxes complete with threaded hub for conduit entry for explosion-proof motors.
- .4 Provide a ground connection and lifting eyes or lugs.
- .5 Align and balance the motor with the related equipment in the shop to minimize vibration and undue stresses.
- .6 Where specified, equip motors with anti-condensation heaters suitable for connection to 120 volts, single phase, 60 Hz power supply.
- .7 Current Imbalance
 - .1 Do not exceed the values listed below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system:
 - .1 Under 37.5 kW: 25 percent
 - .2 37.5 kW and above: 10 percent
 - .2 Base imbalance criteria upon the lowest value measured.
- .8 Winding Over-temperature Protection
 - .1 Provide stator winding over-temperature protection on all motors rated 45 kW and larger.
 - .2 Provide stator winding over temperature protection on motors rated less than 45 kW, when required by the specific equipment specification section, or if recommended by the driven equipment manufacturer.
 - .3 Over-temperature protection for motors rated 45 kW and larger and other motors, where specified, to be NEMA MG1-12.53, Type 1, winding running and locked rotor over temperature protection. Provide one detector per phase. Detectors to be positive thermal protection (PTC) thermistor type, with leads brought out to a terminal strip in a NEMA 4 enclosure in Type 2 motors and a NEMA 7C or 9 enclosure for Type 3 motors.

2.5 High Efficiency Motors

- .1 Use motors that have efficiencies that conform to or exceed the requirements of EPACT.

PROCESS MOTORS LESS THAN 150 kW

- .2 Where vertical motors are specified or provided, ensure efficiency is within 0.5 percent of the values specified for horizontal motors.
- .3 Test motor efficiency in accordance with CSA C390 and NEMA MG1, accounting for stray load losses, measured indirectly based on the IEEE method.

2.6 Motors Smaller Than 0.25 kW

- .1 General
 - .1 Unless otherwise specified, provide squirrel cage, single phase, capacitor start, induction run type motors 0.25 kW and smaller
 - .2 Provide single phase motors with Class F insulation
 - .3 Small fan motors may be split-phase or shaded pole type
 - .4 Provide copper windings
- .2 Rating
 - .1 Unless specified otherwise, provide motors rated for operation at 115/1/60 VAC, and continuous-time rated in conformance with NEMA Standard MG1, paragraph 10.35.
- .3 Enclosures
 - .1 Unless otherwise specified, provide motors with totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) enclosures.
 - .2 Where explosion-proof motors are specified or required, provide explosion-proof motors bearing the UL label for Class I, Division 1, Group D hazardous locations.
 - .3 Provide advice in the enclosure to detect over temperature and automatically de-energize the motor.

2.7 Motors 0.25 kW to 150 kW

- .1 General
 - .1 Unless otherwise specified, provide 3-phase, squirrel cage, full voltage start, high efficiency induction type motors 0.25 kW to 150 kW.
- .2 Rating
 - .1 Unless otherwise specified, provide heavy duty, high efficiency, and TEFC motors for all motors which run continuously.
 - .2 Unless otherwise specified, provide squirrel cage induction type motors, with a service factor of 1.15 at 40°C ambient, Class F insulation and non hygroscopic windings.

PROCESS MOTORS LESS THAN 150 kW

- .3 Provide motors with EEMAC Design B torque characteristics. Size motors to satisfy the driven equipment's starting torque requirements. For special high torque applications such as sweep arm drives, motors with Design C characteristics may be specified or provided subject to the Contract Administrator's acceptance.
 - .4 Rated for 600/3/60 VAC service unless otherwise specified.
 - .5 Design motors for full voltage starting, capable of running successfully when terminal voltage is from +10 percent to -10 percent of nameplate voltage.
 - .6 Motors with a service factor of 1.0 to operate at no more than 90 percent of their nameplate current rating and motors with a service factor of 1.15 to operate at not more than 100 percent of their nameplate current rating.
 - .7 Ensure sufficient capacity to operate the driven load and associated devices under all conditions of operation without overloading.
- .3 Enclosure and Insulation
- .1 Classify motors as:
 - .1 Type 1 (General Duty)
 - .2 Type 2 (Process)
 - .3 Type 3 (Explosion-proof)
 - .2 Enclosures and insulation systems are specified in the following clauses. Temperature rise for all motor types not to exceed that permitted by Note II, paragraph 12.42, NEMA MG1.
 - .3 Provide non hygroscopic insulation
 - .4 Type 1 Motors (General Duty): unless specified otherwise, provide TEFC enclosures with Class F insulation.
 - .5 Type 2 Motors (Process): provide TEFC enclosures, with Class F insulation, suitable for moist and corrosive environment. Provide Class F insulation with Class B temperature rise for motors rated 7.5 kW and larger. Coat all internal surfaces with an epoxy paint. Aluminum frame motors are permitted. Steel frame motors are permitted for motors with frames 184 and smaller.
 - .6 Type 3 Motors (Explosion-proof): provide motors to be rated for operation in a Class 1, Division 1, Group D hazardous location in accordance with CSA C22.1. Provide a Class F insulation. Steel frame motors are not permitted. Provide an approved breather/drain device in the motor drain hole.

2.8 Motors for Variable Frequency Drives

- .1 Comply with the requirements of the intended VFDs and Division 16.

PROCESS MOTORS LESS THAN 150 kW

- .2 Select premium efficiency units, inverter duty rated, in conformance with NEMA MG1.
- .3 Use Type 2 or Type 3 motors.
- .4 Insulation: Class F insulation with Class B temperature rise, suitable for moist and corrosive environments and in accordance with NEMA MG1, Part 30 and Part 31.
- .5 Motors for variable frequency systems are not to deliver more than 80 percent of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.
- .6 Ensure motors have adequate cooling capacity when operating through the entire speed range capacity of the drive.

2.9 Vertical Motors

- .1 Unless otherwise specified, provide full voltage vertical motors with a Type P base specifically designed for vertical installation.
- .2 Universal position motors are not acceptable.
- .3 Provide vertical motors with solid shafts unless specified otherwise.
- .4 Provide thrust bearing rating compatible with the loads imposed by the driven equipment.

2.10 Two Speed Motors

- .1 Provide two speed motors with separate windings. Single winding two speed motors are not acceptable.

2.11 Power Factor Correction Capacitor Sizing

- .1 Confirm the maximum capacitor size which may be connected to motors 37.5 kW and larger, on constant speed drives.

2.12 Noise

- .1 Sound levels of motors, uncoupled from the driven machinery but operated under load, not to exceed 80 dBA at 1 m in any direction in open field conditions. Provide certified shop noise test results for one motor of each size provided.

2.13 Finishes

- .1 Finish motors in manufacturer's standard finish

2.14 Equipment Identification

- .1 Permanently fasten nameplates to the motor frame and position to be easily visible for inspection.

PROCESS MOTORS LESS THAN 150 kW

- .2 Provide motor nameplates on engraved or stamped stainless steel. Include information enumerated in NEMA Standard MG1, paragraph 10.37, 10.38 or 20.60, as applicable.
- .3 Nameplates shall indicate:
 - .1 The AFBMA L-10 rated life for the motor bearings for motors 37.5 kW and larger.
 - .2 The nominal efficiency for all motors.
 - .3 Class, division, group and UL frame temperature limit code for explosion-proof motors.

2.15 Spare Parts

- .1 Provide spare parts in accordance with Section 11005.

3. EXECUTION

3.1 Contractor's Representative

- .1 All motors are supplied as an integral component of some other item of equipment. The manufacturer's representative for that equipment is responsible for the supervision of installation, Site testing, and commissioning of the motor as part of the equipment as specified in other Sections. Ensure that the motor manufacturer's representative informs both the representative for the equipment and the installer of requirements for the motor, installation, testing and commissioning.

END OF SECTION

DECANTERS

1. GENERAL

1.1 Work Included

- .1 This Section specifies the design, manufacture, supply, factory testing, delivery, and supervision of installation, operation and maintenance training, testing and commissioning of decaners for the covered sequencing batch reactors (SBRs). Supply the decaners complete and operational as shown and specified herein.
- .2 The equipment that is to be provided for the decaners includes but is not necessarily limited to:
 - .1 Decanter assemblies
 - .2 Bearing assemblies
 - .3 Support assemblies
 - .4 Electro-mechanical actuators
 - .5 Variable frequency drives
 - .6 Local control panels for each decanter actuator complete with front-mounted controls and indicators.
 - .7 Control logic and algorithms for control of variable speed drives
 - .8 Field-mounted controls, sensors, transmitters and associated equipment required to operate the decaners.
- .3 The Installation Contractor will:
 - .1 Provide and connect power feeder and control cables from the plant electrical system to the variable frequency drives, motors and local control stations.
 - .2 Provide and connect data communication cables from the plant Bailey Distributed Control System (DCS) to the variable speed drives.
 - .3 Provide concrete support system
 - .4 Provide decant piping
- .4 Provide Site services for the components and all other associated equipment and appurtenances related to the decaners as identified in Section 01010.

1.2 Submissions

- .1 Equipment Submittals

DECANTERS

- .1 All Drawing submittals shall include electronic copies in AutoCAD 2004 format.
- .2 Shop Drawings: submit in accordance with Section 01300 and Section 11005. In addition to the requirements of Section 11005, include the following:
 - .1 A copy of this Section marked up to indicate conformance or non-conformance with each clause. Conformance shall be indicated by a check adjacent to the clause; non-conformance shall be indicated by a cross "X" adjacent to the clause.
 - .2 Dimensioned drawings showing the decanter design including the outlined dimensions, assembly data and mounting details.
 - .3 Itemized material list
 - .4 Contractor's catalogue information including decanter type designation and operating characteristics.
 - .5 Details of anchorage and support design
 - .6 Details of the structural calculations for wall loading and mounting brackets
 - .7 Calculations establishing the number of decaners proposed for each SBR tank. Clearly state any other factors considered which impact the number of decaners.
 - .8 Hydraulic calculations indicating head loss through the various components of the system. Provide the velocity in pipes, specifically the mainshaft and downcomers.
 - .9 Factory alignment and deflection measurements procedures and other factory testing procedures as appropriate
 - .10 Start-up, testing, and adjustment procedures
 - .11 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for service
 - .12 List of which components and materials to be shipped pre-assembled and parts lists for the other components and materials. Weights and physical dimensions to be indicated for each part, assembly, and package to be shipped.
 - .13 Estimate of the number of man hours required for decanter installation.
 - .14 Provide wiring diagrams, loop diagrams, and control philosophy for local control stations.
 - .15 Provide control logic and algorithms for use by the Installation Contractor and/or City to program the Bailey Distributed Control System.
 - .16 Provide a certificate of materials specification from steel tube supplier.

DECANTERS

- .3 Operation and Maintenance Data: provide for incorporation in O&M Manual, as specified in Section 01300. Include complete description of operation together with general arrangement and detailed drawings; parts catalogues, with complete list of repair and replacement parts with section drawings, illustrating the connections and identifying numbers.
- .4 Detailed Decanter System Design: based on the basic design parameters contained in this section and the verified performance characteristics of the decanter proposed, undertake detailed design of the decanter system and submit the calculations, drawings and any other explanatory information. Ensure the design calculations are signed and sealed by a Professional Engineer registered in North America.

1.3 Service Conditions

- .1 Due to the use of ferric chloride at the North End Water Pollution Control Centre, the contents of the SBR will have an average chloride concentration of 550 mg/L. All material shall be resistant to chloride corrosion.
- .2 Wastewater temperature
 - .1 Average 22°C to 28°C
 - .2 Maximum 36°C
 - .3 Minimum 15°C
- .3 Ambient Conditions: -35°C to +30°C

1.4 Shipment, Protection and Storage

- .1 Ship equipment pre-assembled to the degree practicable.
- .2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion, weathering of components or any other deterioration of the components.
- .3 Identify all other special storage requirements.

2. PRODUCTS

2.1 Decanter Mechanism

- .1 Furnish sufficient decaners in each SBR tank to efficiently remove clarified effluent.
- .2 Supply decaners complete with decanter collection trough, downcomer pipes, collector pipe, scum guard mechanism, seals and bearings, electro-mechanical actuator, wall plate (if required).

DECANTERS

- .3 Decanter weir and trough shall always be visible from the tank hatches thereby providing the operator with a visual check of the effluent quality during the decant phase of the cycle.
- .4 The decanter travel time from top water level to bottom water level is adjustable but will typically be 60 minutes. Design such that when decanting, the discharge rate is uniform from the top water level to the bottom water level. Provide a control algorithm in combination with the variable speed drive to discharge flows within ± 10 percent of the steady state flow rate for a given decant cycle time.
- .5 The drive mechanism or actuator shall consist of an electro-mechanical screw jack with protective boot and dual redundant, magnetic end position limit switches. The actuator shall be equipped with a 600 V/3 phase/60 Hz, TEFC motor, suitable for continuous duty in an outdoor, moist environment. Ambient Conditions: -35°C to $+30^{\circ}\text{C}$.
- .6 The drive mechanism or actuator shall be designed for a continuous duty, variable speed mode of operation thereby producing a uniform effluent flow rate throughout the decant phase. The decanter drive system shall be configured such that the decanter weir reaches bottom water level at the end of the decant phase thereby maximizing settling time.
- .7 The decanter shall be parked above the design top water level during aeration and settling phases, thereby eliminating any possibility of solids carryover during these phases.
- .8 At top park position, the decanter shall provide 'fail safe' overflow protection in the event of a power failure. Settled supernatant will flow via gravity, under the scum guard, over the weir, and into the decaners.
- .9 Design the decanter for prolonged service life, minimum maintenance requirements and maximum corrosion resistance. Design the decanter seals and bearings to be submerged in service and construct of synthetic material for longest possible service life. Ship all seals and bearings factory assembled.
- .10 The decanter shall be designed with a scum guard mechanism to prevent the discharge of scum and floatables during decanter or overflow operation.
- .11 All in-tank seals and bearings shall be maintenance free.
- .12 The drive mechanism and actuator shall be mounted on the walkway to provide easy access for maintenance and service purposes.
- .13 Actuator limit switches and motor will be integrated with the process control system to prevent blower operation during the decant phase of the cycle.
- .14 Incorporate duplicate limit switches in the actuator drive at top and bottom of travel to ensure reliable operation. Fully integrate the limit switches with process control time overrides and interlocks, thereby eliminating the potential for blower activation during decant.

DECANTERS

- .15 Sequencing batch reactors will be covered. Hatches will be provided to facilitate inspection of the equipment. Provide the Contract Administrator will all necessary information related to access hatches.
- .16 Decaners will be supported on concrete structures (pedestals or similar). The support structures will be designed by the Contract Administrator. Provide necessary information (e.g. pedestal dimensions) to the Contract Administrator to facilitate design. The concrete support structures will be supplied and installed by the Installation Contractor.
- .17 Decanted effluent will flow to the equalization tank via pipes. Design the pipes to ensure equal flow from each decanter in an SBR i.e. flow from one decanter in an SBR should not impact the flow from another decanter in the same SBR. Design the piping system so that the headloss of the system does not exceed the maximum specified value. The Contract Administrator will use the Contractor's piping design to specify the contract for the Installation Contractor. The pipes will be supplied and installed by the Installation Contractor.
- .18 If concrete effluent boxes are required, provide the Contract Administrator with all necessary information to facilitate specification of the contract for the Installation Contractor.

2.2 Control Logic

- .1 Decanter speed will be controlled with a variable speed drive which controls the speed of the decanter actuator motor. The variable speed drive shall be ABB ACS 800 Series.
- .2 Provide an enclosure for each variable speed drive. The enclosures are to be located in the Blower Building. The drive control keypad shall be flush mounted in the enclosure cover.
- .3 Provide control logic and algorithms in text and function block diagrams. The control logic and algorithms will be used by the Installation Contractor and/or the City to program the Bailey DCS. The Bailey DCS will control the operation of the variable speed drive.
- .4 The variable speed drive shall allow programming of the torque curve, speed and voltage, over current and overload protection. It shall have protective, warning and self-diagnosis functions. The unit shall have programmed automatic fault restarts, low power ride through, and speed feedback to the DCS.
- .5 The speed of the decanter is determined by the DCS in order to maintain a uniform vertical lowering of the decanter weir. The maximum decanter travel shall be controlled by magnetic limit switches mounted on the decanter actuator. In addition, there shall be a decanter local control station for each tank consisting of a 4-position switch enclosed in a NEMA 4X enclosure. The local station shall allow manual raise and lower control as well as off and automatic control. Provide a dry contact for remote indication of automatic selection to the DCS. Speed control is provided by the DCS in automatic mode. Speed reference shall switch to VFD internal reference for local control mode.

DECANTERS

2.3 Acceptable Manufacturers

- .1 Supply Products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions.
- .2 Provide all decaners by one manufacturer.
- .3 Acceptable manufacturers
 - .1 ABJ-Sanitaire
 - .2 P.J. Hannah

2.4 Capacities and Performances

- .1 The decaners shall have a design life of no less than 15 years.
- .2 Each decanter shall consist of a single scum guard mechanism and an effluent withdrawal manifold having adequate weir length.
- .3 The decaners shall be capable of intermittent operation.
- .4 The decanter system shall be designed to be capable of withdrawing the effluent at an average rate of 384 L/s per SBR tank.
- .5 Where two or more decaners are provided per SBR, ensure that decant flow is equal across all the decaners. Provide all necessary instrumentation and controls to ensure equal decant flow across the decaners.
- .6 The decanter system shall use a maximum weir loading rate of 70 m³/m/hr providing a total weir length of no less than 19.7 m per SBR tank.
- .7 Maximum SBR water depth: 7.00 m
- .8 SBR water depth after decant: 5.07 m
- .9 Maximum decant depth: 1.93 m
- .10 Maximum allowable head loss (from SBR water depth after decant to water level in equalization tank): 1.0 m
- .11 Bottom water level set position for weir must be equal or greater than 0.75 m above the centerline of the horizontal decant collection pipe.
- .12 The decanting system shall not withdraw any foam and/or scum accumulated on the tank surface. The effluent withdrawal weir should be located no more than 80 mm below the tank water surface at all conditions.
- .13 Deflection shall not exceed 13 mm of the decanter span.

DECANTERS

2.5 Anchor Bolts

- .1 Anchor bolts of sufficient size and quantity shall be supplied for mounting of all Contractors supplied decanter units and piping in the tank. The anchor bolts shall be two part stud and capsule system. The capsule shall consist of a sealed glass capsule containing premeasured amounts of a polyester resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule.
- .2 Each anchor bolt shall be supplied with a stud, flatwasher, lockwasher and nut of Type 316L stainless steel.

2.6 Materials

- .1 Fabricate all in-tank welded decanter components, except seals and bearings, of 316L stainless steel or other corrosion resistant steel of equal or better grade. SS 304 is not acceptable.
- .2 All fasteners shall be constructed of 316L stainless steel.
- .3 All stainless steel components must be pickled and passivated.
- .4 Weirs shall be constructed of stainless steel plate of no less than 3 mm
- .5 Conduct dye penetration tests on all welds.
- .6 The decanter seals and bearings shall be constructed of maintenance free, synthetic materials for longest possible service life. All seals and bearings shall be shipped factory assembled, simplifying installation.
- .7 Provide certificate of quality of raw material from steel tube supplier.

2.7 Protective Coatings

- .1 All finished decanter units to be free of abrasions, damage, flaws, carbon contamination and discoloration. All weld burn and discoloration shall be removed with pickle paste.
- .2 Pickle all stainless steel surfaces to remove carbon deposits, grease and oil, and to aid the regeneration of a uniform corrosion resistant chromium oxide film. Pickle by means of a full immersion passivation bath.

2.8 Spare Parts

- .1 Provide as a minimum, the following spare parts for the first two years of operation:
 - .1 One (1) spare variable speed drive
 - .2 One (1) spare motor/ gearbox/ actuator - complete assembly
 - .3 One (1) set of limit switch

DECANTERS

- .4 Four (4) spare seals

3. EXECUTION

3.1 Equipment Delivery Schedules

- .1 The Contractor agrees to make an initial data submission with sufficient technical information to allow the Contract Administrator to design the process, mechanical and structural elements within 30 calendar days from notification from the City.
- .2 The Contractor agrees to have complete Shop Drawings and other detailed drawings and descriptive matter for the equipment and materials delivered to the Contract Administrator for review within 21 calendar days from receipt of the reviewed Shop Drawings.

3.2 Fabrication

- .1 Prevent electrolytic action between dissimilar metals and materials.
- .2 Where dissimilar metals are mated, isolate all mating surfaces and bolts, nuts and washers to prevent galvanic corrosion.
- .3 Clean and coat surfaces that are to be assembled or bolted together for shipment.
- .4 Provide match markings on sections for ease of field erection.

3.3 Contractor's Representative

- .1 The Contractor's Representative shall be required to attend the Site to train operating and maintenance staff, to witness installation and equipment testing to ensure the equipment is installed and operated as intended.
- .2 The minimum periods of Site attendance are identified in the following clauses along with the form to be completed on each of these trips. A "day" is defined as eight working hours on-site.
 - .1 Unloading and delivery of equipment witnessing
 - .1 Duration: one day
 - .2 Form: 100
 - .2 Equipment installation witnessing and installation completion certificate
 - .1 Duration: four days
 - .2 Form: 102

DECANTERS

.3 Equipment testing assistance

.1 Duration: two days

.2 Form: 105

.4 Operator and maintenance training

.1 Duration: one day

.2 Form: T1

.3 The total number of trips will depend on the Installation Contractor's schedule as directed by the Contract Administrator. The cost of additional will be born by the City.

3.4 Installation Training

.1 The Contractor shall train the Installation Contractor in the proper installation methods of the equipment in conformance with the requirements of Section 01650.

3.5 Installation Witnessing

.1 The Contractor shall verify that the Installation Contractor installs the equipment plumb, square and true within tolerances specified by the Contractor and as indicated in the Contract Documents.

.2 Conform to the requirements of Section 01650.

3.6 Equipment Testing

.1 The intent of the equipment testing is to prove compliance with the basic design requirement of achieving the specified decant rate and head loss requirements, and to demonstrate uniform flow across the full length of the decanter system.

.2 Unless otherwise specified, the Installation Contractor will bear the cost for the water and the power used during the testing.

.3 Provide a written summary of the test procedures and results.

.4 The Contract Administrator will assess the results of the tests to determine whether the installed decanter units have achieved the specified requirements. Should the test results prove unacceptable, the test will be redone at no cost to the City.

.5 If the tests demonstrate that the decanter equipment fails to provide the specified decant rate uniformly across the decanter system or meet the head loss requirements, as specified, the Contractor shall provide additional or replacement equipment or make modifications to remedy the deficiency at no cost to the City.

DECANTERS

- .6 The equipment must be completely retested after addition or modification at no delay or expense to the City.
- .7 If the equipment fails to meet performance requirements after the second test, the City may, at their option, accept the equipment with a penalty paid to the City, or replace the equipment with that of an alternative supplier. The Contractor will incur all costs due to replacement and testing.
- .8 At the successful completion of the equipment testing, complete Form 105 as specified in Section 01650.

3.7 Operator Training

- .1 Conform to the requirements of Section 01665.

END OF SECTION

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DIVISION 11

| Section | Title |
|----------------|---------------------------------|
| 16010 | Electrical General Requirements |
| 16015 | Electrical Scope of Supply |
| 16815 | Variable Frequency Drives |

ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

- .1 Complete and operational electrical package for each process unit as required. A process unit is a supplier package or individual process equipment as specified in other sections.
- .2 Identify and submit to the Contract Administrator power requirements for each process unit. The Contractor shall identify the size of an over current protection device (fuses and/or breaker) and feeder size for each process unit supplied.

1.2 Quality Assurances

- .1 Codes, Rules, Permits & Fees
 - .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.
 - .2 Comply with all rules of local Electrical Code and the applicable building codes.
 - .3 Quality of Work specified shall not be reduced by the foregoing requirements.
 - .4 All components shall be UL or CSA approved.
- .2 Standard of Workmanship:
 - .1 Execute all Work in a competent manner and to present an acceptable appearance when completed.

1.3 Submittals

- .1 Submit samples as required where specified in Division 16.
- .2 Refer to Section 01300 for general requirements for submittals.
- .3 Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes, and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed.
- .4 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work.
- .5 Manufacturer of products shall conform to reviewed Shop Drawings.

ELECTRICAL GENERAL REQUIREMENTS

1.4 Operation and Maintenance Manuals

- .1 Refer to Section 01300 for general requirements for O&M Manuals.

1.5 Product Handling

- .1 Use all means necessary to protect the products of this Division before, during, and after installation.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all electrical equipment. Do not remove identification or certification labels.
- .4 Remove dirt, rubbish, grease, etc. resulting from this Work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

2. PRODUCTS

2.1 Selected Products and Equivalents

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses, which result from defective products being rejected. Related materials shall be by the same manufacturer.

2.2 Quality of Products

- .1 All products provided shall be UL or CSA approved or approved by local authority having jurisdiction in the area where the equipment is going to be installed.
- .2 If products specified are not approved as specified above, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

2.3 Uniformity of Manufacture

- .1 Unless otherwise specifically called for in the specifications, maintain uniformity of manufacture for similar products throughout the Work.

ELECTRICAL GENERAL REQUIREMENTS

3. EXECUTION

3.1 Equipment Identification

- .1 3 mm thick plastic lamacoid name plates, black face, white core, mechanically attached with self tapping screws, 6 mm high lettering, to be attached to the front face of the following equipment:
 - .1 Starters, contactors, disconnects (designation, voltage, load controlled)
 - .2 Terminal cabinets and pull boxes (system, voltage)

END OF SECTION

ELECTRICAL SCOPE OF SUPPLY

1. GENERAL

- .1 Refer to Division 11
- .2 This Section describes the electrical division scope of supply for the decanter and associated electrical equipment – variable frequency drives (VFDs) and harmonic filters.
- .3 The supplier shall furnish all necessary components to provide a complete and fully functioning decaners and associated VFDs and harmonic filters.

1.2 PROCESS AREA ENVIRONMENT

- .1 This paragraph describes process area environment for various components electrical components associated with the VFD and filtering equipment.
 - .1 The electrical equipment associated with the decanter VFD controllers and harmonic filters will be located in the electrical room and blower room. These rooms will be dry and be suitability conditioned with air handling units.

1.3 SCOPE OF SUPPLY

- .1 For the decanter electrical system the supplier shall provide the following:
 - .1 All VFDs and control devices as required to operate the decaners.
 - .2 Harmonic filtering as may be required and indicated.

2. PRODUCTS

- .1 Not Used

3. EXECUTION

- .1 Not Used

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Standards

- .1 All variable frequency drives (VFDs) supplied under this Contract shall meet or exceed the following Specifications.
- .2 Provide a complete inventory (as specified) of spare cooling fans, and fuses, for each VFD supplied.
- .3 The adjustable frequency controller shall be designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting NEMA MG1 Part 31.
- .4 Harmonic loading shall not exceed a motor service factor of 1.0.
- .5 Products shall comply with IEEE Standard 519.
- .6 VFD unit shall be UL listed and CSA certified.
- .7 VFD unit shall comply with applicable requirements of the latest standards of CSA, ANSI, IEEE and the Canadian Electrical Code.

1.2 Tests

- .1 Factory testing
 - .1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.
 - .2 Provide certified copies of production test results required by CSA and EEMAC, prior to acceptance of the equipment.
- .2 Provide certified copies of all production test results required by CSA and NEMA.

1.3 Warranty

- .1 The Contractor shall provide warranty coverage as defined in Section D13.
- .2 Contractor will review specifications of motors for application compatibility. The Contractor shall obtain and submit written approval from both the motor and VFD suppliers confirming that both pieces of equipment are compatible when used together to maintain the required warranty.
- .3 The Contractor shall indicate the level of local support detailing response time if a piece of equipment should happen to fail or malfunction. Details are to include estimated replacement part delivery times, as well as nearest parts depot location and a contact name and phone number.

VARIABLE FREQUENCY DRIVES

- .4 The Contractor shall guarantee that parts for VFD drive units will be available for a minimum of ten years from time of delivery.

2. PRODUCTS

2.1 Variable Frequency Drives

- .1 VFDs as supplied by the following acceptable manufacturer:
 - .1 ABB ACS 800 series
- .2 The VFD shall be designed to withstand a fault current of 18,000 A. All power distribution components of the VFD shall be rated for the 18,000 A short circuit current.
- .3 Variable speed controller shall be electronic adjustable frequency and voltage output unit.
- .4 The VFD shall employ a minimum 6-pulse PWM (pulse width modulated) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line reactors or DC link filters.
- .5 The drive shall be rated for continuous duty while operating a NEMA design induction motor of the sizes and operating voltages as shown in the following schedules and indicated on the drawings. Drive output shall be sized for a 1.0 motor service factor. The VFD shall have a current rating at least 10 percent in excess of the motor full load amp rating. Overload service factors of 110 percent for 30 minutes and 135 percent for 1 minute must be provided to ensure adequate safety margins. VFD selection shall be based on load current at constant torque ratings. Do not size VFDs based on variable torque maximums.
- .6 The VFD shall have a fixed bridge type converter (PWM) with a minimum of 98 percent input displacement power factor over a 10 to 100 percent speed range. The efficiency shall be a minimum of 97 percent for all inverters when operated at full speed and load.
- .7 Input voltage shall be as indicated by the supplier and on the suppliers drawings (line voltage variation ± 10 percent). Based on 347/600 V systems (Not 575v). Line frequency variation ± 5 percent. Output voltage shall vary with motor speed to nominal motor voltage. Speed stability shall be ± 1 percent. Drive shall match torque characteristic of load.
- .8 Input frequency setting signal will be selective between 4 to 20 mA or 0-10 V DC. Output speed monitoring signal shall be selective between 4 to 20 mA or 0-10 V DC.
- .9 Enclosure:
 - .1 Drive shall be installed in individual CSA 1 enclosure, drip-proof or NEMA 12. Filters to be provided for any forced air cooled enclosures as required by the supplier. VFDs shall be suitable for mounting in a typical building electrical room and shall be able to operate under these conditions with no special cleaning requirements. VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFDs is 1000 mm.

VARIABLE FREQUENCY DRIVES

- .10 Protective devices to be incorporated are:
 - .1 Fast acting electronic circuit board protective devices for protection of electronic components.
 - .2 Line reactor, DC link or filter in the drive input to protect electronic components from transient voltage conditions.
 - .3 Integral electronic motor overload protection adjustable up to 150 percent of motor rating for 60 seconds.
 - .4 Overcurrent instantaneous trip 250 percent
 - .5 Programmable short-circuit protection
 - .6 Programmable ground fault protection
 - .7 Overvoltage/overcurrent DC bus monitor/protection
 - .8 Undervoltage protection
 - .9 Loss of phase and phase unbalance protection
 - .10 Inverter over-temperature protection
 - .11 Capable of running without motor for start-up
 - .12 Output filter package (as required) to limit motor voltage to 1200 V maximum at motor terminals. A reflective wave trap mounted at the motor may be used to accomplish this.
 - .13 Longlead (motor feeder) filter package, as required for these installations. Contractor is responsible to determine where this will be required, and must indicate as to the requirement or non-requirement of longlead filter package components in their bid submission, and the Contractor is responsible for carrying all such costs in their Bid Price.
 - .14 Maximum acceptable noise level is 80 dBA at 1 m.
- .11 Operation features:
 - .1 Flush mounted display on VFD enclosure cover with keypad for programming, monitoring and operating of drive, accessible through password or other acceptable security measure only. Remote keypads, completely duplicating functions of integral keypads, shall also be provided for all VFD(s) located inside a fan plenum. The remote keypads in these cases shall be located adjacent to the door entering the plenum.

VARIABLE FREQUENCY DRIVES

- .2 Each VFD and pump/motor assembly shall be provided complete with all process and safety interlocks, i.e., low level, temperature, vibration, leakage, moisture, emergency stop, etc. to prevent equipment damage and to provide personnel safety. The process and safety interlocks shall be included in the control wiring for the VFDs. All safety instruments, i.e., temperature, vibration, moisture, and leakage detection shall be provided as a part of the equipment supply. All process interlock instruments, i.e., low level switch, will be provided by others.
- .3 Fault shutdown and indication
- .4 Automatic re-start following power outage
- .5 Ability to disconnect motor load for setup or trouble
- .6 Manual speed control (potentiometer or keypad)
- .7 Adjustable maximum and minimum speed
- .8 Acceleration and deceleration time adjustment
- .9 Controller “stop” interlock from a NC dry contact
- .10 Drive fault contact
- .11 Stop/start push buttons on key pad
- .12 Transient voltage protection
- .13 Provide three (3) dry “C” type contacts programmable for any combination of the following:
 - .1 Running (output frequency being generated)
 - .2 Fault lockout
 - .3 Stopped
 - .4 At speed
 - .5 Under speed
 - .6 Forward/Reverse
 - .7 Low reference
 - .8 Manual/Auto Mode
 - .9 Local/Remote Mode

VARIABLE FREQUENCY DRIVES

- .14 Soft start sequence
- .15 Regenerative braking
- .16 Minimum of three (3) skip frequencies
- .17 Provide Hand/Off/Auto selector switch. Keypad HOA is not an acceptable replacement.
- .18 Password protection of parameter programming or some method to prevent unauthorized changes.
- .19 Input speed control signal shall be optically isolated and shall be selective between 4 to 20 mA or 0 to 10 V.
- .20 Output speed monitoring signal shall be optically isolated and shall be selective between 4 to 20 mA or 0 to 10 V.
- .12 Environmental Capabilities: the drive shall operate without mechanical or electrical damage under any combination of conditions as follows:
 - .1 Ambient temperature 0° to 40°C
 - .2 Humidity 0 to 90 percent (non condensing)
 - .3 Vibration up to 0.5g
 - .4 Altitude 0 to 1250 m
- .13 Diagnostic and indicating features:
 - .1 Power ON indication
 - .2 Percentage speed indicator
 - .3 Overload indication
 - .4 Short circuit indication
 - .5 Ground fault indication
 - .6 Overvoltage indication
 - .7 Undervoltage indication
 - .8 High temperature (controller)
 - .9 AC voltmeter (output)

VARIABLE FREQUENCY DRIVES

- .10 AC ammeter (output)
- .11 Inverter ready
- .12 Inverter fault
- .13 External fault
- .14 Cooling System:
 - .1 VFD supplier to provide adequate proven cooling devices for VFD equipment.
 - .2 VFD supplier to ensure any enclosure utilized will not allow a build up of heat. This can be accomplished by use of fans or sufficient guarded, filtered openings.
- .15 Normal Distribution
 - .1 Normal power distribution is subject to voltage surges and sags as a normal condition of operation. Design and supply with each VFD the required inverter protection such that the VFD will not be stressed or damaged, in the following conditions:
 - .1 Line transients of up to 3,000 V with energy levels of 50 Joules.
 - .2 Line surges of up to 115 percent of rated voltage for up to ten cycles. Based on 347/600 V systems.
 - .3 Line voltage sags down to 85 percent of rated voltage of up to one second duration.
 - .2 Control wiring shall be TEW 105°C rise.
 - .3 Terminal blocks in separate control enclosures for remote interface shall be Weidmueller SAK6N or approved equivalent.
 - .4 Provide wire markers at both ends of all control wires, Electrovert Type Z or approved equivalent.
- .16 Spare Parts
 - .1 Provide one (1) complete power module.
 - .2 Provide any special tools that are specific to the equipment being supplied.

3. EXECUTION

- .1 Not used

END OF SECTION