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DIVISION 1

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SCOPE OF WORK

1. GENERAL

- .1 Design, supply and delivery of all equipment and appurtenances required for the bioreactor aeration system.
- .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 bioreactor aeration system and all ancillary equipment, including but not limited to Shop Drawings, to the Contract Administrator during design to facilitate tendering of a Construction Contract for the construction of the West End Water Pollution Control Centre upgrade.
 - .2 Provision of operating and design process information 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 bioreactor aeration system. This will require preparation and development of preliminary layouts for review by the Contract Administrator and the City.
- .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 Completion of required factory testing of the equipment
 - .2 Supply of all ancillary equipment and materials required for proper functioning of the supplied equipment
 - .3 Delivery of the equipment
 - .4 Provision of all necessary instruction and supervision to ensure satisfactory off-loading, storage, and installation of the equipment
 - .5 Witnessing of equipment installation
 - .6 Assistance in equipment performance testing
 - .7 Guaranteed Performance Testing
 - .8 Operation and maintenance training
 - .9 Modification of all supplied Shop Drawings to reflect as-built conditions following installation and commissioning of the subject equipment.

SCOPE OF WORK

- .10 As required and at no cost to the City, modification and or replacement of the equipment to ensure that performance guarantees provided in the Bid are met.
- .11 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.

2. COORDINATION

- .1 Other parties or Contractors (and their Sub-contractors) 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 Other Contractors
- .2 The Contractor shall provide, for the times designated in the Contract Documents, the services of a trained and experienced technician (hereinafter referred to as the Manufacturer's Representative) for:
 - .1 Equipment delivery
 - .2 Installation training
 - .3 Witnessing of equipment installation
 - .4 Assistance during equipment performance testing
 - .5 Guaranteed Performance Testing
 - .6 Training of City staff
- .3 The Installation Contractor shall be responsible for:

SCOPE OF WORK

- .1 Receipt of the equipment upon delivery
- .2 Off-loading and storage of the equipment
- .3 Satisfactory equipment installation
- .4 Satisfactory equipment performance testing
- .5 Assistance with Guaranteed Performance 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 performance testing
 - .5 Satisfactory Guaranteed Performance Testing.
- .6 During the Guaranteed Performance Testing for the bioreactor aeration system, the Contractor shall attend coordination meetings as directed by the Installation Contractor. The Contractor must also take all precautions necessary to ensure that he does not hinder or delay in any way the progress of these parties or cause damage to the Work.

3. SCHEDULE AND STATUS REPORTS

- .1 It is the responsibility of the Contractor to schedule delivery of the equipment to the Site with the Installation Contractor. The equipment shall be delivered to the Site no earlier than May 15, 2006 and no later than July 31, 2006.
- .2 The Contractor may be responsible for storing and maintaining the equipment in accordance with the Contractor's storage instructions until the equipment has been delivered to the Site at a date agreed upon by the Contractor and Installation Contractor, at which point the Installation Contractor will become responsible for the equipment after taking delivery of the equipment.
- .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.

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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.

END OF SECTION

SUBMITTALS

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 Sub-contractor for supplied items and of the General Contractor for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped "Re-submit".
- .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. Jointly 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. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of Work.
- .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 shall be signed and sealed by a Professional Engineer registered in the Province of Manitoba. If requested, calculations shall be submitted for review, also signed, and sealed by a Professional Engineer registered in the Province of Manitoba.
- .16 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the Contractor's Progress Certificates.

SUBMITTALS

2. SAMPLES

- .1 Submit samples for the Contract Administrator's review where 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. Jointly 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.

3. OPERATING AND MAINTENANCE MANUALS

- .1 For the guidance of the City's operating and maintenance personnel, the Contractor shall prepare operating and maintenance 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 Substantial Performance of the Work and shipment 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 simple language to guide the City in the proper operating and maintenance of this installation.
- .4 Submit Operating and Maintenance Manuals in electronic format. Organize contents into applicable sections of Work, parallel to Specifications breakdown.

SUBMITTALS

- .5 In addition to information called for in the specifications, include the following:
 - .1 Title sheet, labeled "Operating 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, Operating and Maintenance Manuals
 - .5 Commissioning data sheets and reports
 - .6 Complete list (with prices) of spare parts and special tools required
 - .7 Any specific Product or maintenance manual requirements from the Specifications
 - .3 Reviewed Shop Drawings of all equipment.
 - .4 Detailed operating 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 Operating and Maintenance Manuals shall be supplied to the City before delivery 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.

4. RECORD DRAWINGS

- .1 After award of Contract, the Contract Administrator will provide a complete set of Drawings for the purpose of maintaining Record Drawings, electronic files in AutoCAD format will be supplied. Accurately record significant deviations from Contract Documents caused by Site conditions and changes ordered by the Contract Administrator. Update daily.
- .2 Record locations of concealed elements of mechanical and electrical services.

SUBMITTALS

- .3 Identify Drawings as "Project Record Copy". Maintain in good condition and make available for inspection on-site by Contract Administrator at all times.
- .4 On completion of the Work, two weeks prior to final inspection, submit Record Drawings to Contract Administrator for review.
- .5 Within one month after return of Record Drawings by the Contract Administrator, obtain and pay for a complete set of original reproducible sepias. Transfer all changes from Record Drawings to electronic Drawings (AutoCAD) and certify accuracy. Deliver electronic Drawings to the Contract Administrator.

5. 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.
- .2 No press or publicity releases will be permitted without prior approval of the Contract Administrator.

6. PROCEDURES

- .1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.
- .2 These statements shall also include details of constructional plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

END OF SECTION

QUALITY ASSURANCE

1. INSPECTION AND TESTING OF WORK

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

QUALITY ASSURANCE

CCMC	Canadian Construction Materials Centre
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 Concrete to CSA-A23.2 and mix designs to CSA-A23.1
 - .2 Welding to CSA-W59.1 and ASTM E109
 - .3 Bolted connections to CSA-S16 or CSA-S16.1
 - .4 Roofing to CRCA Manual

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 Test results and mix designs of each class of concrete.
 - .2 Mill test certificates for all structural steel and bolts.

2. 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.

END OF SECTION

PRODUCTS AND WORKMANSHIP

1. PRODUCTS

1.1 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.

1.2 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 job site to comply with the Schedule.
- .3 To receive approval, proposed substitutes must conform with the requirements of Section 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.

1.3 Transportation Costs of Products

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

PRODUCTS AND WORKMANSHIP

2. WORKMANSHIP

2.1 General Requirements

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

2.2 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.

3. MEASUREMENT

3.1 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.

END OF SECTION

EQUIPMENT INSTALLATION

1. INTENT

- .1 This Section describes general requirements for all equipment supplied under the Contract relating to equipment delivery, equipment installation, Guaranteed Performance Testing and associated training.
- .2 At least 30 days prior to commencing Guaranteed Performance 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 and input. No testing work can commence until this plan has been discussed by all parties involved and accepted by the Contract Administrator.

2. DEFINITIONS

- .1 Manufacturer's representative: a trained service person empowered by the Manufacturer to provide:
 - .1 Installation training
 - .2 Witnessing of equipment installation
 - .3 Assistance in Guaranteed Performance Testing
 - .4 Operation and Maintenance Training (refer to Section 01665)
- .2 Guaranteed Performance Testing: for the purpose of this Section, is defined as the testing of the equipment to prove compliance with the standard oxygen transfer efficiency listed in the Bid Opportunity Form. All requirements related to the Guaranteed Performance Testing are outlined in the equipment Specification Section. Upon the successful completion of the Guaranteed Performance Testing, the Contractor, Installation Contractor, Contract Administrator, and the City will sign the **“Certificate of Satisfactory Guaranteed Performance Testing” (Form 105)**.

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.

4. EQUIPMENT DELIVERY

- .1 All equipment shall be delivered in its entirety in one shipment.

EQUIPMENT INSTALLATION

- .2 The Contractor shall deliver all equipment required under this Contract to the West End Water Pollution Control Centre, Winnipeg, Manitoba at which point the 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. He shall especially pack electrical equipment and control panels to prevent scratching, access by dirt, moisture or dust or damage to insulation, and shall cover equipment having exposed bearings and glands to exclude foreign matter.
- .8 The Contractor shall give notice to the Installation Contractor and the Contract Administrator ten days before delivery so that arrangements 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”**

EQUIPMENT INSTALLATION

(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 job site will be the responsibility of the Installation Contractor.
- .14 The Installation Contractor shall arrange for heated and covered storage at the job site 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 guaranteed performance 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 performance testing. The Installation Contractor shall be responsible for removing any protective coatings prior to installation and Guaranteed Performance Testing in accordance with the Contractor's written instructions.

5. EQUIPMENT DELIVERY SCHEDULE

- .1 The Contractor shall deliver all equipment FOB to the West End Water Pollution Control Centre construction site (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 Schedules.
- .2 The equipment delivery schedule entered in the Bid Form shall not be modified except as mutually agreed by the Contractor and the Installation Contractor, and only if approved by the Contract Administrator in writing.
- .3 The Contractor shall not deliver the equipment to the Site until the Installation Contract has been awarded, suitable storage facilities have been made available by the Installation Contractor and the Installation Contractor and Contractor have agreed upon a delivery date within the time frame indicated in the Bid Form.

EQUIPMENT INSTALLATION

6. 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.
- .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.

7. 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, all at no cost to the City.
- .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.

EQUIPMENT INSTALLATION

- .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.
- .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.

8. GUARANTEED PERFORMANCE TESTING

- .1 Equipment will be subjected to a demonstration, running test, and performance tests 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, 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.

EQUIPMENT INSTALLATION

- .8 On satisfactory completion of the one-hour demonstration, the equipment will be stopped and the Contractor shall recheck all critical parameters such as piping connections.
- .9 Guaranteed Performance Tests will be undertaken. During this period, 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 Guaranteed Performance Tests shall be as dictated in the technical specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.
- .11 The Installation Contractor shall submit the results of the Guaranteed Performance Tests to the Contract Administrator, documented and summarized in a format acceptable to the Contract Administrator. 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 Guaranteed Performance Tests and acceptance of the test reports by the Contract Administrator.
- .12 All water, temporary power, heating, or any other ancillary services required to complete the initial demonstration and guaranteed performance tests are the responsibility of the Installation Contractor.
- .13 All chemicals, instruments, and testing equipment required to complete the initial demonstration and Guaranteed Performance Tests are the responsibility of the Contractor.
- .14 Should the initial demonstration or Guaranteed Performance Tests reveal any defects, then those defects shall be promptly rectified and the failed demonstration or Guaranteed Performance 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 demonstration, running tests, or Guaranteed Performance Tests shall be the responsibility of the Contractor.
- .15 On successful completion of the demonstration, running test, and performance tests, the **“Certificate of Satisfactory Guaranteed Performance Testing” (Form 105)** attached to this specification will be signed by the Contractor, the Installation Contractor, the Contract Administrator, and the City.
- .16 Process performance testing can commence as soon as the **“Certificate of Satisfactory Guaranteed Performance Testing” (Form 105)** is completed.

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 GUARANTEED PERFORMANCE TESTING
FORM 105**

We certify that the equipment listed below has been tested and meets the Guaranteed Performance 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. DESCRIPTION

- .1 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 Guaranteed Performance Testing.
- .3 As a minimum, the Contractor is to allow at least four hours of training for each of the City's staff shifts, 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.

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.

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 (4) 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

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.

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.

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

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

8. TRAINING

8.1 General Requirements

- .1 Conduct the training session in conjunction with the Process Performance Testing.
- .2 At least four weeks before the start of Equipment Installation Verification (**Form 102**) and any associated training. Provide final operation and maintenance manuals, as defined in Section 01300, for the specific equipment to the City.

8.2 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

8.3 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
 - .3 Reviewing and using Manufacturer's manuals in the hands-on training
 - .4 Contractor is to ensure that the City is present for and participates in the Guaranteed Performance Testing.

TRAINING

8.4 Training Completion Forms and Payment

- .1 **Form T1:** To be completed for training at the time of the Guaranteed Performance 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	Description
11005	General Process Provisions
11531	Fine Bubble Aeration System

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, bylaws, 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 and/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.

1.2 Shop Drawings

- .1 Refer to Section 01300 for the general requirements for Shop Drawings.

GENERAL PROCESS PROVISIONS

- .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/ABFMA 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 Contract Agreement process and instrumentation Drawings, 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 Drawings "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 Manufacturer 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 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 connections, 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 Agreement shall be identified by the Contractor, with a price list.

END OF SECTION

FINE BUBBLE AERATION SYSTEM

1. GENERAL

1.1 Work Included

- .1 This Section specifies the design, factory testing, supply, field testing, and commissioning of the fine bubble aeration devices.
- .2 The Contractor shall design, fabricate, factory test, and deliver components and mechanisms and all other associated equipment, appurtenances, and controls required to install a fine bubble aeration system in Bioreactor No. 1 and Bioreactor No. 2.
- .3 The Contractor shall also provide Site Services for the components and all other associated equipment and appurtenances related to the installation of fine bubble aeration system in Bioreactor No. 1 and Bioreactor No. 2 as listed below:
 - .1 Delivery inspection
 - .2 Installation training
 - .3 Witnessing of equipment installation
 - .4 Coordination of Guaranteed Performance Testing
 - .5 Operation and maintenance training

1.2 Definitions

- .1 Normal cubic metres per minute (Nm³/min): the volumetric flow rate in cubic metres per minute at 20°C, 36 percent relative humidity and 101.3 kPa absolute pressure
- .2 Dynamic Wet Pressure: pressure required to operate the diffuser in tap water at the specified flow rates, less any losses due to submergence and flow control devices
- .3 Absolute pressure, kilopascals (kPaA, or kPa absolute): pressure relative to absolute vacuum of 0 kPa
- .4 Gauge pressure, kilopascals (kPa, kPag, or kPa gauge): pressure relative to normal atmospheric pressure of 101.3 kPa absolute
- .5 All terms in the description of the aeration system guaranteed performance testing (SOTE Testing) are as described in "A Standard for the Measurement of Oxygen Transfer in Clean Water", ASCE, June 1992

1.3 Submissions

- .1 Equipment Submittals
 - .1 All drawing submittals shall include electronic copies in AutoCAD 2004 format.

FINE BUBBLE AERATION SYSTEM

- .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 with check to indicate conformance or acceptance of each clause. Non-conformance shall be indicated by a cross "X".
 - .2 Dimensioned drawings showing the aeration piping system including the location and elevation of diffusers, manifolds and laterals, pipe supports, expansion joints, droplegs, purge system, and dynamic wet pressure monitoring system.
 - .3 Manufacturers catalogue information including diffuser type designation and operating characteristics.
 - .4 Details of the dynamic wet pressure monitoring system, including connection details.
 - .5 Details of anchorage and support design.
 - .6 Maximum anticipated dropleg loads which must be supported by the upper connection.
 - .7 Calculations establishing the maximum air flow to each cell, in Nm³/min, based on the specified maximum oxygen requirements for each tank, the required diffuser depth and the Manufacturer's anticipated oxygen transfer efficiency for each tank. Calculations to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.
 - .8 Calculations establishing the number of diffusers proposed for each cell based on the maximum air flow per cell established above, and the proposed maximum air flow per diffuser and any other factors. Clearly state any other factors considered which impact the number of diffusers. Calculations to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.
 - .9 Calculations establishing the distribution of laterals and diffusers to achieve uniform dissolved oxygen concentrations through the aerated cells.
 - .10 Calculations verifying that the air flow per diffuser will not vary by more than 2.5 percent within a grid at the minimum and maximum specified air flow rate. Calculations to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.
 - .11 The name(s) of the Manufacturer's qualified technical representative, who will be responsible for witnessing installations, testing, and commissioning. Provide a list of projects on which they have worked, and their responsibility on these projects. Acceptance of the Manufacturer's representative is subject to the approval of the Contract Administrator.
 - .12 Factory testing procedures and test tank arrangement.

FINE BUBBLE AERATION SYSTEM

- .13 Start-up, testing, and adjustment procedures.
 - .14 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for service.
 - .15 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.
- .3 Operation and maintenance data: provide for incorporation in operating and maintenance 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 aeration system design: based on the basic design parameters contained in this section and the verified performance characteristics of the aeration devices proposed, undertake detailed design of the aeration 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 the Province of Manitoba.

1.4 Service Conditions

- .1 Temperature (maximum): 35°C:
- .2 Temperature (minimum): -40°C
- .3 Relative humidity at maximum temperature: 85 percent
- .4 Relative humidity at minimum temperature: 100 percent
- .5 Barometric pressure: 94.2 kPaA
- .6 Process air temperature differential: 65°C

1.5 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.

FINE BUBBLE AERATION SYSTEM

2. PRODUCTS

2.1 Function

- .1 The fine bubble aeration devices provide air to Aerobic Cell 1, Aerobic Cell 2, Aerobic Cell 3 and Aerobic Cell 4 in each of Bioreactor No. 1 and Bioreactor No. 2.
- .2 The bioreactors are configured for biological nutrient removal.
- .3 Furnish equipment under this section to supply diffused air for removal of carbonaceous and nitrogenous BOD from municipal wastewater.
- .4 Furnish equipment under this section to provide adequate mixing of Aerobic Cell 1, Aerobic Cell 2, Aerobic Cell 3 and Aerobic Cell 4 in the bioreactors to prevent solids deposition and assure uniform distribution of the mixed liquor. Air rates to Aerobic Cell 1, Aerobic Cell 2, Aerobic Cell 3 and Aerobic Cell 4 in the bioreactor will be varied independently to maintain the desired dissolved oxygen concentration.

2.2 Acceptable Manufacturers

- .1 Supply Products modified as necessary by the Manufacturer to provide the specified features and to meet the specified operating conditions.
- .2 Acceptable manufacturers are:
 - .1 Sanitaire
 - .2 Environmental Dynamics Inc
 - .3 ABS Nopon Oy Ltd
 - .4 OTT GmbH
- .3 Provide all fine bubble aeration devices by one manufacturer.

2.3 Capacities and Performances

- .1 Design the aeration system to achieve the minimum Standard Oxygen Transfer Efficiency (SOTE) for each mode in each cell when operating at the most severe condition. The most severe condition is defined as the maximum standard oxygen transfer rate (SOTR), the minimum residual dissolved oxygen (DO), maximum ambient temperatures, and maximum mixed liquor temperatures. Meet or exceed the following minimum SOTEs in the aerated cells in each bioreactor.
- .2 Maximum available airflow from existing blower system: 150 m³/minute (standard conditions)
- .3 Air into each existing blower is filtered through a Dollinger Panel Element VE-1113-2424-005, reported to remove 98 percent of 10 micron, and 90 percent of 6 micron particles.

FINE BUBBLE AERATION SYSTEM

.4 The system shall be designed to require not more than 58 kPa at the flanged connection on the dropleg, above the liquid level, as indicated on the drawings.

.1 Two bioreactors in service

.1 Minimum conditions, per reactor, two reactors in service

	<u>min SOTR</u>	<u>min SOTE</u>	<u>residual DO</u>
Aerobic Cell 1	1705 kgO ₂ /d	35 %	2.0 mg/L
Aerobic Cell 2	1385 kgO ₂ /d	35 %	2.0 mg/L
Aerobic Cell 3	921 kgO ₂ /d	35 %	1.5 mg/L
Aerobic Cell 4	644 kgO ₂ /d	35 %	1.0 mg/L

.2 Average conditions, per reactor, two reactors in service

	<u>min SOTR</u>	<u>min SOTE</u>	<u>residual DO</u>
Aerobic Cell 1	2335 kgO ₂ /d	34 %	2.0 mg/L
Aerobic Cell 2	2118 kgO ₂ /d	34 %	2.0 mg/L
Aerobic Cell 3	1728 kgO ₂ /d	34 %	2.0 mg/L
Aerobic Cell 4	1325 kgO ₂ /d	34 %	1.5 mg/L

.3 Maximum conditions, per reactor, two reactors in service

	<u>min SOTR</u>	<u>min SOTE</u>	<u>residual DO</u>
Aerobic Cell 1	3086 kgO ₂ /d	33 %	1.5 mg/L
Aerobic Cell 2	2675 kgO ₂ /d	33 %	1.5 mg/L
Aerobic Cell 3	2338 kgO ₂ /d	33 %	1.5 mg/L
Aerobic Cell 4	1929 kgO ₂ /d	33 %	1.5 mg/L

.2 One bioreactor in service

.1 Minimum conditions, per reactor, one reactor in service

	<u>min SOTR</u>	<u>min SOTE</u>	<u>residual DO</u>
Aerobic Cell 1	3197 kgO ₂ /d	33 %	2.0 mg/L
Aerobic Cell 2	2931 kgO ₂ /d	33 %	2.0 mg/L
Aerobic Cell 3	1612 kgO ₂ /d	33 %	1.5 mg/L
Aerobic Cell 4	1208 kgO ₂ /d	33 %	1.0 mg/L

.2 Average conditions, per reactor, one reactor in service

	<u>min SOTR</u>	<u>min SOTE</u>	<u>residual DO</u>
Aerobic Cell 1	4453 kgO ₂ /d	31 %	2.0 mg/L
Aerobic Cell 2	4073 kgO ₂ /d	31 %	2.0 mg/L
Aerobic Cell 3	3407 kgO ₂ /d	31 %	2.0 mg/L
Aerobic Cell 4	2650 kgO ₂ /d	31 %	1.5 mg/L

FINE BUBBLE AERATION SYSTEM

.3 Maximum conditions, per reactor, one reactor in service

	min SOTR	min SOTE	residual DO
Aerobic Cell 1	5915 kgO ₂ /d	31 %	1.5 mg/L
Aerobic Cell 2	5246 kgO ₂ /d	31 %	1.5 mg/L
Aerobic Cell 3	4208 kgO ₂ /d	31 %	1.5 mg/L
Aerobic Cell 4	3429 kgO ₂ /d	31 %	1.5 mg/L

.3 Cell dimensions and critical liquid elevations

	L x W	Floor Elevation*	Water Elevation at Q =	
			16 ML/d	54 ML/d
Aerobic Cell 1	21.4 m x 7.0 m	235.166 m	240.74 m	240.84 m
Aerobic Cell 2	21.4 m x 7.0 m	235.166 m	240.74 m	240.84 m
Aerobic Cell 3	21.4 m x 7.0 m	235.166 m	240.73 m	240.82 m
Aerobic Cell 4	21.4 m x 7.0 m	235.166 m	240.73 m	240.82 m

*Source: As-Constructed Drawing WEP-211, dated December 1994

- .4 The floor elevation may vary in each bioreactor. Ensure that the minimum elevation of the diffuser above the floor is 300 mm.
- .5 The existing perimeter walls of the reactors are filleted. The fillet bases intrude 1050 mm into the reactor, reducing the overall area of flat floor on which the diffusers can be mounted. The dimensions of the flat portion of the floors where the diffusers can be installed are:

	L x W
Aerobic Cell 1	20.35 m x 7.00 m
Aerobic Cell 2	20.35 m x 7.00 m
Aerobic Cell 3	20.35 m x 5.95 m
Aerobic Cell 4	20.35 m x 5.95 m

- .6 Minimum mixing requirement: 0.03 Nm³/min of air per square metre of tank floor.

.5 Elevation of top of diffuser

- .1 Elevation of top of diffuser: as required to meet specified SOTE and system pressures, and 300 mm above the high point of the bioreactor floor.

- .6 Provide sufficient allowance for head losses through manifold and distribution laterals, and for diffuser fouling.

FINE BUBBLE AERATION SYSTEM

2.4 Materials

.1 General

- .1 Flexible membranes: EPDM, or silicone
- .2 Diffuser holders: polypropylene or PVC
- .3 Droplegs: stainless steel, Type 304 L to ASTM A774 and ASTM A778, flanged
- .4 Manifolds and headers: stainless steel, Type 304 L to ASTM A774 and ASTM A778, or PVC schedule 40
- .5 Gaskets: Neoprene or natural rubber
- .6 Distribution laterals: PVC SDR-26 to CSA B137.3 or stainless steel, Type 316 L to ASTM A774 and ASTM A778
- .7 Piping supports and anchors: stainless steel, Type 304 embedded in concrete with Sika injection gel or approved equal, use antisieze compound on all stainless steel bolts and nuts
- .8 Fasteners: stainless steel, Type 304
- .9 Ensure materials conform to ASTM specifications where possible. State all deviations.
- .10 All stainless steel components must be pickled and passivated.

.2 Flexible Membrane

- .1 Fabricate diffuser membranes of EPDM or silicone, protected against UV, chemicals and weathering.
- .2 EPDM Membrane
 - .1 Provide membranes constructed from EPDM-based polymer having a minimum thickness of 2 mm after moulding and finishing. Provide EPDM or silicone membrane material having the following properties:
 - .2 Minimum tensile strength: 7000 kPa
 - .3 Minimum elongation: 300 percent
 - .4 Testing in accordance with ASTM D412
 - .1 Maximum change allowed in durometer Shore A: 10 points
 - .2 Maximum loss of tensile strength: 25 percent

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- .3 Maximum loss of elongation: 25 percent
- .5 Testing in accordance with ASTM D395
 - .1 Maximum compression set: 50 percent
- .3 Silicone Membrane
 - .1 Provide a membrane free of softeners (softeners can be harmful to the environment and cause adverse health effects). Provide FLEXSIL[®] or equal.
 - .2 Provide a silicon membrane with a tensile strength of 35 N/mm or higher (ASTM D 624 B), and a temperature resistance of up to 140°C.
 - .3 Provide membranes with a homogenous wall thickness and no grooves.
 - .4 Provide membranes with a high quality uniform perforation at 80 percent of the circumference of the membrane.
- .3 Diffuser Holders
 - .1 Manufacture diffuser holders of polypropylene or PVC, with additives as necessary to satisfy the requirements for strength, durability, and UV resistance.
- .4 Pipe, Supports and Fittings
 - .1 Provide PVC piping and fittings with a minimum SDR 26, conforming to CSA B137.3. All joints for PVC piping and fittings are joined either with integral anti-rotational fixed joints or full faced solvent welded using primer and solvent welding cement conforming to the requirements of ASTM D2564.
 - .2 Submerged air manifolds: ASTM D1784 and ASTM D1785 Schedule 40 PVC with 1.5 percent titanium dioxide UV inhibitor.
 - .3 Distribution laterals: ASTM D1784 and ASTM D1785 Schedule 40 PVC, or ASTM D224, or ASTM D3034 with minimum SDR 26 with 2 percent titanium dioxide UV inhibitor.

2.5 Equipment Components

- .1 General
 - .1 Number of aeration diffuser grids per cell
 - .1 Aerobic Cell 1: 1 grid
 - .2 Aerobic Cell 2: 2 grids
 - .3 Aerobic Cell 3: 2 grids

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- .4 Aerobic Cell 4: 2 grids
- .2 Design the diffuser grids as necessary to meet the requirements of this Specification, within the floor coverage limitations shown.
- .3 For each aeration system, supply:
 - .1 Aeration diffusers
 - .2 Connection devices between the diffusers and the distribution laterals
 - .3 Distribution laterals
 - .4 Manifold piping
 - .5 Droplegs (to limits identified on the Drawings)
 - .6 Reducers, if required, between the piping supplied by others and the droplegs provided by the Contractor.
 - .7 All structural piping supports for items 2.5.1.3.1 through 2.5.1.3.5 required to minimize deflection under installation and operating loads.
 - .8 The layout and distribution of diffusers shown are for illustration purposes only.
- .2 Flexible Membrane Diffusers
 - .1 Provide diffusers of the non-clog flexible membrane type. Diffusers shall be of one of the following configurations:
 - .1 Option 1A: circular disk
 - .2 Option 1B: tubular
 - .2 Circular disk configuration
 - .1 Each diffuser to be mounted to a fixed piping grid fastened to the floor of the cells. Space the diffusers on the piping grid to provide uniform air distribution over the floor of the zones or cells.
 - .3 Tubular configuration
 - .1 Each diffuser assembly shall consist of two tubes, 1360 mm long
 - .1 Diffuser membranes shall be fully supported over full length and circumference with a PVC or stainless steel support frame. Diffuser membrane shall be held in place by two Type 304 stainless steel clamps. Membranes shall be perforated on top half of unit.

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- .2 Diffuser mount saddle assembly shall be heavy-duty ABS, or glass-filled polypropylene construction. Saddle mount shall fully encompass air distribution piping reinforcing pipe wall at diffuser connection. Saddle shall attach directly to diffuser assembly.
 - .4 Incorporate an air flow orifice to ensure even air flow distribution among all diffuser units and to assure that airflow to any one device is plus or minus 5 percent of the average value at the minimum and maximum specified air flow rates.
 - .5 Ensure that all diffusers are of the same type.
 - .6 Fix the membrane to the membrane holder in a manner which does not introduce unbalanced stresses but which does increase pressures as the air flow rate to the diffuser rises.
 - .7 Manufacture a back flow prevention device integrally with the diffuser. When air flow ceases, this device will allow the pressure of the water above the diffuser to close the main flow passage and prevent backflow into the diffuser and air piping.
 - .8 Ensure the maximum diffuser flux rate is such that the stress in the diffuser material is within elastic loading limits with a safety factor of at least 10.
- .3 Manifold and Air Distribution Piping
- .1 Design air distribution piping system for easy field installation and include provisions for level adjustment, for rotational adjustment of the distribution laterals, and for thermal expansion of all piping elements over the specified operating temperature range.
 - .2 Perform all solvent welding in the Manufacturer's shop. Field solvent welding will not be permitted.
 - .3 Fabricate the submerged air manifold in sections up to 6000 mm long.
 - .4 Design the manifold piping so that the top of all diffusers is held at a constant elevation throughout all cells. Use eccentric reducers if changes in diameter are required.
 - .5 Provide a solvent-welded end cap at the end of each manifold.
 - .6 Provide connections between sections of the submerged air manifold of fixed pipe couplings designed so that individual manifold sections can be rotated independently of adjacent sections for proper alignment.
 - .7 Provide fixed joints of the positive locking type with integral anti-rotational mechanism in conjunction with guide-type supports. A fixed joint shall be either a PVC threaded coupling with threaded ring, or 150-lb ANSI flange joint. Slip on rubber sleeve couplings shall not be acceptable. Expansion will take place by the sliding of the lateral pipe through the non-gripping supports.

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- .8 In lieu of fixed joints with guide-type supports, a piping system utilizing fixed-type supports may be provided. Expansion will take place by the sliding of lateral pipe inside the expansion barrel. To insure no horizontal or rotational movement of the lateral and expansion joints, every lateral and expansion joint shall be secured to the tank floor by at least one pipe support.
 - .9 Support each manifold by floor-mounted stainless steel anchors and supports at maximum 2500 mm centres.
 - .10 Connect distribution laterals to the centerline of the manifold at the flanges or couplings provided.
 - .11 Provide coupled connections at the manifold bottom centreline for connection to the distribution laterals.
 - .12 Distribution laterals are to be connected to the centreline of the manifold at the couplings provided.
 - .13 Fabricate laterals for fine bubble diffuser systems in sections not to exceed 6000 mm in length.
 - .14 Maximum spacing between diffuser laterals for the disk type membrane is 2400 mm. In any event, the lateral spacing shall be provided to meet performance requirements.
- .4 Droplegs
- .1 For number of droplegs per cell refer to drawings.
 - .2 The dropleg will be fixed with a fixed joint at the lower connection to the manifold piping.
 - .3 The dropleg will be fixed with a flanged connection at the upper limit of supply (refer to the Drawings).
 - .4 The dropleg will be furnished with supports to prevent movement.
 - .5 A 12 mm PT test plug will be provided at the top of each dropleg. The test plug will be capable of receiving a probe 3 mm nominal outside diameter and rated for zero leakage at a pressure to 200 kPa. To be furnished by contractor with dropleg near top of concrete.
 - .6 Provide droplegs of diameter no less than indicated on the drawings.
- .5 Anchors and Supports
- .1 Provide support system to securely anchor the manifold and distribution laterals to the cell floor.
 - .2 Design supports to permit complete removal from the tank (less anchor bolts) to facilitate cleaning and maintenance of tank floor. Supports consisting of threaded rods anchored to tank floor are not permitted.

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- .3 Support rods shall have a minimum diameter of 12.5 mm and shall not extend above the top of the diffusers. Trimmed rods shall be ground down to eliminate sharp edges.
- .4 Support plates shall have minimum thickness of 4.8 mm.
- .5 Provide pipe clamps incorporated into supports with minimum thickness of 1.8 mm. Provide each support with a 38 mm wide bearing surface contoured to fit the pipe being supported. For the guide type supports, provide a 6 mm clearance around the pipe and have chamfered edges to prevent binding of the pipe. Worn gear clamps are not permitted for attaching pipe to supports.
- .6 Provide supports such that the overall geodetic elevation of the diffusers is constant, regardless of any variations in the tank floor.
- .7 In addition to providing supports that accommodate any change in floor elevation over the length and width of the bioreactor, supports shall have provision for angular alignment adjustment and for plus or minus 37 mm of vertical adjustment to allow level installation. Supports to be infinitely adjustable within its limits by raising and lowering of nuts on threaded support rods or by modifying angle of support struts.
- .8 Design supports to take into account the height of the supports in their structural design.
- .9 Design and fabricate the supports in such a manner that the elevation of the horizontal surfaces of all diffuser elements in each cell are within plus or minus 5 mm of a common horizontal plane.
- .10 Provide sufficient supports to limit deflection of the laterals to ensure that the tolerance noted on the elevation of diffuser elements is not exceeded.
- .11 Secure the supports to the floor with stainless steel expansion-type anchor bolts designed with a pull-out strength safety factor of 10 or more.
- .12 Supports shall be designed to withstand forces from mixers and mixed liquor recycle and flow from across cell partition wall draining holes during filling and draining of tanks.
- .13 Take into account the expected forces generated by the unidirectional, low speed mixer that will be located in Aerobic Cell 4 (see plan and section Drawings of the bioreactors). The maximum power output of the mixer will be 10 kW. Final maximum power output will be available during Shop Drawing review process.
- .14 Provide bracing struts for supports in cells subject to horizontal forces from under-over baffles, mixers or flushing nozzles.
- .15 For each anchor bolt provide double stainless steel nuts. Each anchor is to be double nutted to ensure that the connection does not loosen due to dynamic forces through its life.

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.6 Purge System

- .1 Design the purge system to drain the entire submerged aeration piping system and blow off moisture collected using aeration air. Provide a minimum of one purge system per grid.
- .2 Design the purge system to prevent water infiltration in the event of an interruption in the air supply.
- .3 At the end of each aeration grid, install the continuous moisture purging system. Ensure that the continuous moisture purging system is lower than the invert of the air distribution header and air distribution manifold.
- .4 Provide a sump and airlift purge eductor at each purge point.
- .5 Provide integral drain lines with each grid terminating at the sumps.
- .6 Provide purge system eductor piping fabricated of minimum 19 mm PVC Schedule 80, or 19 mm flexible tube encased in a minimum 38 mm Schedule 40 PVC pipe.
- .7 Provide a lever-operated quarter-turn stainless steel ball valve at each blow off.
- .8 In addition to the normal clamp system, provide stainless steel clamps on each end of the 25 mm flexible hose, at the connection to the diffuser header and at the connection to the PVC pipe, on all purge lines in the bioreactor.

.7 Dynamic Wet Pressure Monitoring System

- .1 Provide one moisture-proof portable pressure monitoring panel, complete with the following:
 - .1 Differential pressure gauge, 0-10 kPa range
 - .2 Equalizing valve
 - .3 3-way ball valve
 - .4 Rotameter, 0 to 0.1 m³/min range, with integral needle valve
 - .5 Cam-operated quick disconnect male couplings
 - .6 2000 mm long connecting hoses with cam-operated quick disconnect female couplings at both ends for connecting the portable pressure monitoring panel to the pressure monitoring junction box.
- .2 Provide one pressure monitoring junction box per cell, Aerobic Cell 1, Aerobic Cell 2, Aerobic Cell 3, and Aerobic Cell 4 in each bioreactor, in accessible locations, complete with the following:
 - .1 Wall-mounted support frames

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- .2 Stainless steel ball valves at all couplings
- .3 All tubing for the pressure monitoring system is to be routed to each pressure monitoring junction box through a 40 mm diameter stainless steel or schedule 40 PVC carrier column
- .4 All tubing will be connected to the junction box and diffuser grid in accordance with the Manufacturer's instructions.

2.6 Protective Coatings

- .1 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.

2.7 Spare Parts

- .1 Provide as a minimum, the following spare parts for the first two years of operation:
 - .1 Diffuser elements and assemblies: 2 percent of total
 - .2 Diffuser holders: 1 percent of total
 - .3 Piping supports: 50
 - .4 Plugs for unused diffuser locations: 10 percent of total
 - .5 Distribution lateral fixed joints: 1 percent of total
 - .6 Distribution lateral repair couplings: 20
 - .7 19 mm PVC purge valves for purge lines: 4

3. EXECUTION

3.1 Equipment Delivery Schedules

- .1 The Construction Contract is scheduled to be awarded November 15, 2005.
- .2 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 receipt of the Letter of Intent from the City.
- .3 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.

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- .4 The Contractor agrees to have the equipment and materials manufactured and delivered complete, to the West End Water Pollution Control Centre site, no sooner than May 15, 2006 and no later than July 31, 2006. The Contractor shall indicate in Form D the number of weeks required for delivery of equipment to Site, after receipt of 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 guaranteed performance 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. The trips can be combined into a single trip including a total of six days on-site.
 - .1 Equipment installation witnessing
 - .1 Duration: 3 days
 - .2 Form: 102
 - .2 Guaranteed Performance Testing assistance
 - .1 Duration: 2 days
 - .2 Form: 105
 - .3 Operator and maintenance training
 - .1 Duration: 1 day
 - .2 Form: T1
- .3 The total number of trips will depend on the Installation Contractor's schedule. The cost of additional trips required by the Contract Administrator will be born by the Installation Contractor.

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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 Structural test
 - .1 Test anchors and supports of PVC manifold and air distribution piping to ensure that they have a margin of safety of 10 against calculated buoyant forces. Test anchors and supports of stainless steel manifold and air distribution piping to ensure that they have a margin of safety of 2 against calculated buoyant forces.
 - .2 Upon installation of the anchors and supports and prior to the installation of piping, test all of the supports for the manifold piping and randomly test 10 percent of the supports for the air distribution piping. Test the anchors and supports in the presence of the Contract Administrator.
 - .3 Test each support with a lever placed on a fulcrum. Apply the static load to the opposite end of the lever, producing a vertical extracting force on the support anchor equal to either 10 times or 4 times the calculated maximum buoyant force to which the support anchors will be subjected, depending on the pipe material as detailed above.
 - .4 Structural testing shall include operation of the mixers, in tanks with both mixers and aeration equipment, to ensure the proper installation of the aeration equipment. Operation of the mixers can be undertaken as either part of the Installation Witnessing or Guaranteed Performance Testing, as agreed upon between the Contractor and the Contract Administrator.
 - .5 Repair or replace supports not meeting the test requirements, and retest in the presence of the Contract Administrator. Test an additional 10 supports for each deficient support.
- .3 Leakage and Leveling Tests:
 - .1 Flood the tanks with clear water to the top of the diffusers. Check the level of the diffusers to ensure that they are at the same elevation to within ± 5 mm.
 - .2 Flood the tanks with clear water to a depth 300 mm above the top of the diffusers. (Note that effluent water is acceptable for use; however, batch chlorination may be required for safety reasons). Turn on a blower and supply air evenly to all manifolds. Visually inspect the surface of the water in the presence of the Contract Administrator to ensure that the airflow is uniformly distributed across the tanks with no air leakage from the piping or diffuser connections.

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- .3 Repair any leaks in the element holders, elements, piping or the like. Repeat the test until the installation is void of any air leaks.
 - .4 Place each aeration tank in operation with clean water to the design operating depth. Set the blower air flows for maximum and minimum in accordance with the oxygen requirements specified herein.
 - .5 Measure and record the pressure at each dropleg. The maximum value to be accordance with the requirements specified herein. Provide all taps and pressure sensing devices necessary to perform this test.
- .4 Conform to the requirements of Section 01650.

3.6 Guaranteed Performance Testing

- .1 The intent of the Guaranteed Performance Testing is to prove compliance with the basic design requirement of achieving at least the minimum SOTE values at the most severe conditions, as listed in the specification Section 2.3 and submitted by the Contractor in the Bid form. The GPT will be undertaken using only “clean” air.
- .2 Unless otherwise specified, the Installation Contractor will bear the cost for the water and the power used during the Guaranteed Performance Testing.
- .3 Contractor to provide the services of an independent testing agency for a minimum of two days duration to witness testing.
- .4 Contractor to provide sufficient chemicals and make available the necessary instrumentation for a series of performance verification tests conducted in accordance with “A Standard for the Measurement of Oxygen Transfer in Clean Water”, ASCE.
- .5 The Contractor shall provide a means of isolating each cell.
- .6 With the assistance of the Installation Contractor, the Contractor shall conduct one test run in three of the four aerated cells. Each test cell to be in the first retrofitted bioreactor. Conduct tests at 100 percent of the design maximum air flow rate, plus or minus 5 percent. If one test fails, retest in the same cell that failed as well as in the same cell in the second bioreactor when retrofitted. Note that the bioreactors will not be retrofitted at the same time.
- .7 Provide a written summary of the test procedures and results. Analyze the results in the manner prescribed in the ASCE Standard and clearly indicate the SOTE value calculated for the test results.
- .8 The Contract Administrator will assess the results of the Guaranteed Performance Testing to determine whether the installed aeration system is capable of delivering the specified SOTE. Should the GPT results prove unacceptable, the GPT will be redone at no cost to the City.
- .9 If the tests demonstrate that the diffusion equipment fails to provide the specified SOTE or fails to distribute air flow uniformly or exceeds the maximum operating pressure

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requirements, as specified, the Contractor shall provide additional or replacement equipment or make modifications to remedy the deficiency at no cost to the City.

- .10 The equipment must be completely retested after addition or modification at no delay or expense to the City.
- .11 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.
- .12 At the successful completion of the GPT, complete **Form 105** as specified in Section 01650.

3.7 Operator Training

- .1 Conform to the requirements of Section 01665.

END OF SECTION