

## **DEPLOYABLE, READY-TO-OPERATE PACKAGED PLANT MBR System Supply Commissioning, Training & Demonstration**

Commissioning, training and demonstration are critical steps in the execution process. The goal is to show an immediate gain in system optimization and efficiency's when the plant is brought online. Good commissioning requires many factors to be taken into account at each stage of the process, in order to quickly achieve regulatory and policy aims. Each of these steps are interrelated. If preformed in a comprehensive way will result in the aforementioned and will provide a dramatic reduction in start-up costs and most important reduction in operational problems.

Having been directly involved in over 250 MBR plant start-ups, we recognize that significant communication and decisions occur early on in the project life cycle that ultimately affects the commissioning. The first few months is a critical time period, operators must quickly come up to speed in the understanding of the system and the system itself will need to be optimized to settle in to the actual flow and loading, which can vary from design values.

The plant first will need to be seeded with the best sludge available, second during the demonstration period, close monitoring of the flows and loads will allow the system to be dialed in to actual influent characteristics. Demonstration should also verify effluent goals are being consistently meet. Finally, prior to handing over the keys, it is important that the operators understand the finer points of the operation of the system.

A successful commissioning is in all parties' interest. Not all (or many) MBR System suppliers have the comprehensive means or experience to perform the required duties. Due diligence spent will result is a dramatic reduction in start-up costs and operator training, with an immediate gain in optimization and efficiency's when the plant is brought online.

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The following is suggested specification language to capture this topic:

Note to design Engineer: Verify values and statements bounded by square brackets, [ ], and remove highlighted alternates and instructions.

### **SECTION [XX XX XX] SPECIFICATION – COMMISSIONING, TRAINING & DEMONSTRATION**

#### **1.01 SYSTEM COMMISSIONING**

- A. The MBR System Supplier shall coordinate with the Contractor, Engineer, and Owner for execution of the System Commissioning. In advance of System Commissioning the MBR System Supplier shall perform an onsite Mechanical Inspection of the facility and generate a punchlist of inconsistencies. The Contractor is required to resolve the punchlist items to the satisfaction of the System Supplier, prior to scheduling System Commissioning.
  
- B. The MBR System Supplier shall prepare a "Detailed Plan of Commissioning Activities" that will be used as a guideline for Commissioning of the Goods provided by the Supplier. The Detailed Plan of Commissioning Activities shall be used to coordinate the activities of the Supplier's and Owner's personnel. The "Detailed Plan of

Commissioning Activities" will identify the Commissioning requirements for all Goods supplied by the MBR System Supplier. The guidelines shall include the following:

1. General inspection of systems (lubrication, rotation, calibration).
2. Loop checking, instrumentation, and control system verification.
3. Pipe loss testing.
4. Clean water permeability testing.
5. Sludge seeding.
6. Biological process system.
7. Chemical feed systems and Clean-in-Place.
8. Commissioning of equipment.
9. Start-up activities.
  - a. Feed, Filtered Water and Backwash Flow Pressure and Level Control Sequences.
  - b. Membrane Treatment Unit Operations including filtration, relaxation, backwashing, and clean in place.
  - c. Normal and Emergency Start Up and Shut Down Sequences.
  - d. Process Interlocks

10. Training

- C. Failure to complete the Commissioning as required by this Section within the allocated time shall constitute a failure of the MBR System Supplier to provide Special Services in accordance with the requirements of the Contract. The Supplier shall be assessed Liquidated Damages in accordance with [XXXX] of the Agreement until commissioning is complete.
- D. The Contractor shall provide materials and personnel in support of the System Commissioning to fill tanks with clean water, transfer fluids, repair/remedy any and all electrical and mechanical issues, provide temporary tie-ins, temporary piping, transfer pumps, etc.
- E. The Contractor shall coordinate with the Engineer and Owner to seed the MBR system with sludge at the conclusion of the clean water testing. The MBR Supplier is not responsible for supplying the seed sludge.
- F. The System Commissioning shall begin at the Contractor's discretion, within the limits defined herein:
  1. Successful completion of a pre-commissioning Mechanical Inspection is required.

2. Start of Commissioning shall be no later than 30 days after completion of Mechanical Inspection.
- G. The Owner shall operate the plant during the Commissioning Period; however, Supplier and Contractor shall be allowed to provide onsite assistance.
- H. Supplier is responsible for monitoring operating conditions and performance during the Commissioning Period.
- I. The MBR Supplier shall place the Goods into operation and perform tests to determine if equipment is operating properly. The purpose of these tests is to verify that both the System and each Unit are:
1. Properly installed.
  2. Operational.
  3. Capable of completing an operating cycles free of problems.
  4. Free from pump or valve cavitation, water hammer, overheating, overloading, vibration, or other operating problems
  5. The MBR System Supplier shall verify that control programming has been configured with appropriate software time delays to avoid rapid pump or membrane flow cycling in response to transient dynamic hydraulic effects caused by backwash, or chemical washing cycles or other process cycles (e.g. start -up, shut down, membrane test). "Dead-heading" or any operation of any pump under a "zero-flow" or "flow condition below the pump manufacturers acceptable limits" is not acceptable. Interlocks shall be provided to prevent operation of the any pump under a "dead- headed" condition. The pump manufacturers "maximum number of pumps starts per hour" shall not be exceeded.
- J. As a part of commissioning, the MBR System Supplier shall start-up and operate all support systems provided by or required by the Supplier for operation of the system, including but not limited to chemical feed systems, instrumentation, air compression equipment, and electric controls. This testing shall demonstrate that there are no water or air leaks in the system, that the piping has been installed and connected properly, that the electrical system is operating correctly, and that the instrumentation has been properly calibrated.
- K. The MBR System Supplier shall furnish materials (excluding chemicals and power), instruments, and incidental and expendable equipment required for commissioning/placing the Goods into operation. The Supplier shall retain the services of any manufacturer's representatives as required in the Contract Documents to assist with commissioning/placing into operation of the Goods. The costs of these services shall be borne by the MBR System Supplier.
- L. Membrane permeate quality shall be evaluated to determine compliance of the MBR System with Performance Requirements. If the MBR system fails to comply with requirements of membrane permeate quality, Supplier shall proved the Owner and the Engineer a written plan of modifications to the system (such as repairing damaged

fibers, replacing seals, complete replacement of system) to achieve compliance with the requirements. Upon implementation of modifications plan, the permeate quality tests shall re-commence in their entirety.

- M. When requested by the MBR System Supplier, the Engineer shall review the operation of the equipment to verify that the commissioning is complete.
  - 1. The Engineer shall perform random tests on equipment and witness various operational sequences to confirm general conformance to the Contract Documents
  - 2. The Engineer shall initiate alarm conditions and perform random tests on the control system to confirm general conformance to the Contract Documents.
  - 3. The Engineers review shall include a review of the HMI interface and PLC SCADA system commissioning requirements to determine conformance with, Membrane Bior The Engineers review shall identify any equipment that has not been properly installed, or operating, detailing the outstanding installation issues on a "punch list" and noting the party who shall be responsible for each correction and identify the items require that correction. eactor Equipment specifications and requirements of the Project.
  - 4. Upon satisfactory completion of the review, the Engineer shall submit to the MFEM a written "Notice of Completed Commissioning"
- N. Once the "Notice of Completed Commissioning" is issued, Training of Operation and Maintenance Personnel may commence.

## **1.02 TRAINING**

- A. The MBR System Supplier shall provide Training in the maintenance and operation of all systems included in the Supplier's control system.
- B. Failure to complete the Training as required by this Section within the allocated time shall constitute a failure of the MBR System Supplier to provide Special Services in accordance with the requirements of the Contract. The Supplier shall be assessed Liquidated Damages in accordance with [XXXX] of the Agreement until training is complete.
- C. The Supplier shall provide formal training of the Owner's personnel. Training shall commence after the "Notice of Completed Commissioning" is issued.
- D. Training of the Owner's personnel shall commence within a period of five (5) days after the "Notice of Completed Commissioning" has been issued as mutually agreed to by the Owner, Engineer, Contractor and Supplier. All training shall be performed by the MBR System Supplier or a factory-certified representative of the supplier or component supplier. Training is to include:
  - 1. Navigation of all HMI screens and menus.
  - 2. Review of automatic operations and controls.

3. Changing process set points.
  4. Overriding controls from the HMI.
  5. Manual operation of the system in the event of a power failure.
  6. Component equipment.
  7. Instrument components.
  8. Routine Maintenance.
  9. Maintenance cleaning.
  10. Biological process theory.
  11. Biological processes.
  12. Membrane filtration theory.
  13. Daily, weekly and monthly checklists and reports.
  14. Forecast maintenance requirements (predictive maintenance)
  15. Trouble shooting.
  16. Video of training & system operations.
- E. The MBR System Supplier shall provide a combination of classroom and hands-on training. All training shall be conducted at the Owner's location.
1. The MBR System Supplier shall be responsible for all costs associated with training and shall provide required materials, texts, and supplies.
  2. Training sessions shall be videoed by the MBR System Supplier at the Supplier's expense.
- F. The MBR System Supplier shall develop and submit to the Engineer and Owner a Training Manual. The Training Manual shall include the elements presented in this Section or as required by the MBR System Supplier or component equipment supplier.
1. The Supplier shall prepare a Training Lesson Plan, provide qualified instructors, and schedule the training in an organized manner.
  2. Credentials for the MBR System Supplier's designated instructor(s) shall be submitted thirty (30) days prior to the commencement of training. Credentials shall include a brief resume and specific details of the instructor(s) pertaining both to personal experience operating and maintaining the specified equipment and conducting operation and maintenance for the same equipment.
  3. The Supplier's proposed lesson plans shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached

where applicable to the proposed lesson plan. "Hands-on" demonstrations planned for the instruction shall be described in the lesson plan.

4. The Supplier shall indicate the estimated duration of each segment of the training in the lesson plan.
5. Submit information as required by the local primacy agency in support of Professional Development Hours.

### **1.03 DEMONSTRATION**

- A. The MBR System Supplier shall provide demonstration testing of the membrane bioreactor equipment.
- B. Failure to complete the Demonstration as required by this Section within the allocated time shall constitute a failure of the MBR System Supplier to provide Special Services in accordance with the requirements of the Contract. The Supplier shall be assessed Liquidated Damages in accordance with [XXXX] of the Agreement until Demonstration is complete.
- C. The demonstration shall commence after the "Notice of Completed Training" is issued.
- D. Demonstration shall extend for a period of 60 days.
- E. The Engineer shall document the time when the facilities are substantially unavailable for use by the MBR System Supplier to perform Demonstration Testing due to circumstances beyond the control of the Suppliers including but not limited to power outages, lack of feedwater, inability to transfer product water or feedwater due to factors beyond the control of the MBR System Supplier, not having adequate staff from the Contractor or the Owner. If in the sole opinion of the Engineer the facilities are substantially unavailable to the Supplier, equivalent additional Demonstration Testing time will be granted without penalty.
- F. Upon completion of the Performance Testing, the MBR Supplier shall submit to the Owner a written report detailing the results of the Demonstration Testing. The report shall include, at a minimum, the following sections:
  1. Introduction
  2. Overview of demonstration testing procedures.
  3. Summary of testing results.
  4. Appendices that include a copy of all field notes and test data.
- G. The purpose of the Demonstration Testing is to demonstrate that MFEM furnished equipment is:
  1. Properly installed.
  2. Ready to be placed into service by the Owner.

3. In compliance with the service conditions, performance requirements, material specifications, and all other requirements of the Contract Documents.
- H. The MBR System Supplier shall furnish all materials, instruments, and incidental and expendable equipment required for Acceptance Testing of the Goods, except where otherwise specified.
  - I. During the Demonstration period, the MBR SYSTEM SUPPLIER is solely responsible for identifying water quality parameters, instrumentation and control programming required to satisfy and maintain effluent requirements. The MBR SYSTEM SUPPLIER shall establish instrumentation alarm and shutdown limits to prevent operation of the equipment outside the established limits.
    1. The Owner shall maintain a high speed connection to the processor but all data monitoring shall be the responsibility of the MBR SYSTEM SUPPLIER. The Owner shall not be required to monitor, report or record instrument field data for process warranty purposes.
      - a. The MBR supplier shall monitor Influent and effluent BOD, TSS, TN, TP, Total Coliform and Turbidity.
  - J. A representative of the MBR System Supplier shall be present on site during the first five (5) days of the Demonstration period. Throughout the Demonstration period, a representative of the MFEM shall be available via means of cellular communication including non-working hours in case of an emergency.
  - K. The Owner or an authorized representative of the Owner will be present to witness the Performance Testing.
  - L. The Owner or an authorized representative of the Owner shall operate the plant as directed by the MBR System Supplier.
  - M. The MBR System Supplier shall keep detailed notes regarding the Performance Testing and record all test data and results. This will be done through operation of the data logging system.
  - N. If the System does not perform in accordance with the Contract Documents, the Supplier shall return or remain on site to perform all necessary corrections at the cost of the MBR System Supplier until compliance with Contract Documents is demonstrated.
  - O. During the Demonstration period, the System shall perform in accordance with the guaranteed product water quality to allow the Owner to discharge treated water.
  - P. Any interruption of the Performance Testing caused by circumstances beyond the control of the MBR System Supplier shall not require the testing to be restarted from the beginning. Such events include any activities that would result in an inadvertent or unplanned shutdown of the PLC / HMI control System or otherwise interfere with the Performance Test. The elapsed time of Performance Testing prior to the interruption will be applied to the required testing period.

## END OF SECTION

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The following is suggested specification language to capture and evaluate the MBR System Supply Quality Assurance & Experience:

Note to design Engineer: Verify values and statements bounded by square brackets, [ ], and remove highlighted alternates and instructions.

### SECTION [XX XX XX] PROCUREMENT BID EVALUATION – COMMISSIONING, TRAINING & DEMONSTRATION

#### 1.01 BID EVALUATION

- A. The MBR System Supplier shall provide all of the information required by the Bid Documents. This information, along with other design and equipment information contained in the Bid Documents or available to the Owner through information included in the Bid will be used by the Owner to determine the apparent successful Bidder. The Owner may verify information and references provided in the Bid as part of the Bid evaluation.
- B. In accordance with applicable law, the Owner reserves the right to reject any or all Bids and to waive any informality in any Bid. By submitting a Bid, each Bidder agrees that the Owner, in determining eligibility for the award, may consider the Bidders conduct and performance under other contracts, financial condition, and other factors, including claims against the Bidder, which could affect the Bidders ability to provide the Goods and Special Services. The Owner may conduct such investigations as the Owner deems necessary to assist in the evaluation of any Bidder and to establish the responsibility, qualifications and financial ability of the Bidder to provide the Goods and Special Services in accordance with the Contract Documents to the Owner's satisfaction within the prescribed time. The Owner shall be the sole judge of responsiveness as well as who is considered a Responsible Bidder and reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to the sole satisfaction of the Owner.

#### 1.02 COMMISSIONING, TRAINING & DEMONSTRATION QUALIFICATION CRITERIA

- A. MBR System Suppliers shall be experienced in providing the Goods and Special Services as described herein. MBR System Suppliers shall possess sufficient equipment, capital and manpower to provide the Goods and Special Services within the time allowed. A Bid may be rejected if MBR System Suppliers cannot show that they have the necessary ability, plant, and equipment to provide the Goods and Special Services at the time prescribed and thereafter to prosecute and complete the supply of Goods and Services within the time specified.
- B. Membrane System Suppliers submitted for consideration shall meet qualification criteria as described below. A "yes" answer shall be provided to all questions below to satisfy the qualification criteria for participation in Membrane Bioreactor Equipment Procurement.



1. The MBR System Supplier has the capability to prepare a "Detailed Plan of Commissioning Activities" that will be used as a guideline for Commissioning of the Goods provided by the Supplier. The Detailed Plan of Commissioning Activities shall be used to coordinate the activities of the Supplier's and Owner's personnel. The "Detailed Plan of Commissioning Activities" will identify the Commissioning requirements for all Goods supplied by the MBR System Supplier.

The Bidder hereby certifies that the above can be performed.

Yes \_\_\_\_\_

No \_\_\_\_\_

Submit Detailed Plant of Commissioning Activities.

2. The MBR System Supplier has the capability to provide Training activities and syllabus as required by the specifications. The Detailed Plan of Training Activities shall be used to coordinate the activities of the Supplier's and Owner's personnel.

The Bidder hereby certifies that the above can be performed.

Yes \_\_\_\_\_

No \_\_\_\_\_

Submit Detailed Plant of Training Activities. Include sample videos.

3. The MBR System Supplier shall oversee the Demonstration Period. The MBR System Supplier is solely responsible for identifying water quality parameters, instrumentation and control programming required to satisfy and maintain effluent requirements. The Supplier shall provide the equipment necessary to monitor Influent and effluent BOD, TSS, TN, TP, Total Coliform and Turbidity.

The Bidder hereby certifies that the above can be performed.

Yes \_\_\_\_\_

No \_\_\_\_\_

Submit Factory Acceptance Test Plan and Pre-Training Syllabus

**END OF SECTION**