

TWO RO PLANT TECHNICAL SPECIFICATIONS

GENERAL

- Contractors shall provide two RO desalination units for well water (TDS 3000 to 4500 ppm) and yield to satisfy the project requirements of 8 to 10 m³/hr. The salinity of the water from these units should meet the requirement to irrigate crops (less than or equal to 600 ppm). Analysis of the feed water is provided for each pilot.
- The original source of water is from wells in the Jordan valley (Karameh and Rama regions). The water will be pumped from the well to a water reservoir or tank by the farmers. A pump will be connected to the reservoir and the desalination unit will be installed near the reservoir.
- RO Supplier is responsible to provide in the RO processes all necessary pre-treatment and post-treatment to maintain the Langelies Index slightly positive and to stabilize the product water not to be corrosive or scalant. The contractor scope of work does include all labor, services, tools, materials, design, drawing, supply of the plant & equipment, erection of all civil (eg. Concrete slabs, manhole, etc...), electrical and mechanical works, testing and commissioning of the water treatment plant. The Contractor shall verify the actual water analysis and site conditions. RO design shall be based on 15% fouling factor, minimum recovery rate of 70% and design life of 4 years. Contractor shall verify the actual well water temperature and design the RO plant accordingly.
- Contractor shall make tests to reconfirm the actual feed water analysis and temperature, and if required make all the necessary changes required in the treatment process to avoid any damage to the membranes.

QUALITY ASSURANCE

A. QUALITY CONTROL

The contractor shall establish quality control procedures to ensure compliance with the specified requirements, local codes and applicable codes for all construction operations required under the specifications. The contractor shall supervise and direct the work efficiently and with his best skill and attention, and shall be solely responsible for the means, methods, techniques, sequences and procedures of construction.

B. CODES and STANDARDS

Unless otherwise specified complete system construction, S.T. Panel and desalination station shall comply with the requirements of the following:

- Jordan standards and metrology organization of drinking water and desalination plant

- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials

Supplier shall guarantee that the provided system will meet all criteria outlined and submit details and specification of the material, drawings and calculation to substantiate the quality and quantity of product water for approval.

C. SUBMITALS

1. CONTRACTOR QUALIFICATION

Contractor shall present that he has excuted simmlar desalination units. RO supplier shall submit final membrane manufacturer design analysis, B.O.Q., detailed material submittal, equipment selection and shop drawing to fulfill the design criteria for approval. Supplier shall submit list of all the electrically-operated equipment and power ratings for approval.

2. SHOP DRAWINGS

The contractor shall submit shop drawings, details and descriptive literature showing pipe, joints, fittings, and connections details, equipment materials, procedures for fabrication and erection, adapters, methods of installation and testing and other relevant details of the complete installation.

3. AS-BUILT DRAWINGS

The contractor shall maintain a full size set of AS-BUILT drawings after completion of works.

D. WARRANTY

RO plant and the related equipment specified herein shall be guaranteed for the performance and against defects for one year starting from the date of preliminary handover.

RO membranes shall have a guarantee for the performance and against defects for three years starting from the date of preliminary handover.

CONTRACTOR / PLANT SUPPLIER shall provide O & M Manual and provide training to the CLIENT's staff during maintenance period.

Contractor shall supply one year recommended spare-parts & tools for the proper operation of the plant and at the end of period, hand over to Client team.

E. RO PLANT EQUIPMENT

- RO should be mounted on a reinforced concrete (RC) slab with dimensions of 6 x 3 meters. The RC slab should have for the whole plot area a minimal compressive pressure not less than 250 kg/cm² after 28 days and should have a thickness of 15 cm. Also provided with 10 mm steel rods (tensile 60) every 20 cm in both directions. The top surface of the ground slab should be smooth polished without surface holes or bumps and roughness of any type. A base course layer of hard limestone gravel or valley gravel (grade B) with a thickness not less than 20 cm (after compaction) including spreading, mixing with water and compaction to 100% density below the ground RC slab and covering the whole area.
- RO supplier shall design, supply, install, test and commission R.O. Plant as shown on drawings and as specified herein complete with the interconnecting piping and electrical wiring, panel boards, control panels and instrumentation.
- Install standby sand filters, feedpumps, backwash pumps to insure continuous operation of the complete system without any interruption.
- The RO system is to be skid-mounted modular design, the installation of all vendor-supplier equipment shall be strictly in accordance with the manufacturer's recommendations.

The equipment should include the following:

Filter Feed Pumps, **Stainless steel.**
Multi-Media filter, **Automatic operation, 36"**.
Pre-Chlorination dosing system for the influent.
De-Chlorination dosing system for the effluent.
Acid dosing system
Anti scaling dosing system.
Sediment Cartridge filter.
Chiller to maintain water temperature at 25°C.
High pressure pump **Stainless steel.**
Membrane Housing 450 PSI.
Brackish water membranes.
Cleaning pump Stainless steel.
Cleaning tank.
PH adjustment dosing system.
PH Monitor
Rx Monitor.
Flow control Valves.

Low pressure Pipes and Valves in PVC.
High Pressure Pipes and Valves in **Stainless steel**.
Pressure Gauges.
Reject Regulation Valve, Stainless Steel, schedule 40.
Flushing Valve.
Low Pressure Cut-off Switch.
High Pressure Cut-off switch.
Product & Reject Flow Meters, Float Types.
Product conductivity meter.
Control Panel **VFD / PLC system / touch screen**.
Unit Mounted on skid frame.

F. PRE-TREATMENT

The Contractor shall assure that no salt precipitation of calcium sulphate, calcium carbonate, or turbidity on the R.O. membrane.

SAND FILTER

Sand filter used for pre-filtration shall be of pressure type with fiberglass, or carbon steel vertical type, and cylindrical tank construction. Filter should use specialized media Filter Ag from Clack Corporation or equivalent maximum filtration rate not exceeding 5 gpm/ft² of filter area.

Filter should be fully automatic with face piping and set of 5 motorized valves for automatic service and backwash. During backwash, the RO plant should not stop and duty filter capacity to be capable for handling the increased flow during this time .

DOSING SYSTEMS

Dosing system to comprise of solenoid dosing pump fixed on UV-stabilized polyethylene tank with scale for liters or US gallons and screw cap) integral sintered threaded bushes for the assembly of dosing pumps, mounting flange with integral sintered threaded bushes for electric stirrers. All tanks designed for extreme robustness with 3 lateral flats for mounting drum.

Dosing tank should have low level protection with level switch and alarm status on master control panel.

Approved Brand Prominent or equivalent for dosing pump, tank, stirrer and low level switch. All components of dosing system should be from one manufacturer only.

CARTRIDGE FILTER

Post sand filter the raw water to flow through Cartridge Filter of GRP (Glass Fiber Reinforced Polyester) and provide optimal behavior with water of various degrees of salinity, reducing the maintenance needed in these conditions

Filter to be of boltless design. The internal parts in contact with the water are of various plastics and, when of metal, are suitably plasticized. The seals are designed for easy replacement and maintenance.

Cartridges to be rated for 5 microns, and of an approved brand.

REVERSE OSMOSIS SKID

The RO system is to be skid-mounted modular design, the installation of all vendor-supplier equipment shall be strictly in accordance with the manufacturer's recommendations.

Membrane Configuration: 8-inch spiral wound, low energy Membrane. Membrane vessels should be manufactured completely from standard glass reinforced epoxy resins with multi-port configuration.

RO skid shall receive at least two coats of a high solid catalyzed epoxy with a dry film thickness of 20 mils.

RO high pressure and flush pumps shall be vertical multistage in-line centrifugal pump constructed of complete Stainless Steel 316. Manufacturer's data on pumps shall include pump characteristic curves showing head, capacity, efficiency and brake horsepower.

RO plant shall have automatic shutdown cycle for flushing the membrane in case of plant stoppage.

INSTRUMENTATION

RO plant should be provided with all instrumentation and controls for complete monitoring and protection of all operating components.

Pressure gauges: 316 Stainless steel all wetted parts including end connections.

Pressure switches Low suction and high discharge protection of RO high pressure pumps.

Flow transmitters for feed, RO permeate, mixing stream if applicable and reject flows with totalizer reading. Flow monitor to be electromagnetic type. ISOIL Italy or approved equal

ORP/pH transmitters For RO permeate inline installation.

Conductivity for feed and RO permeate inline installation.

Piping & Clamping

High Pressure Piping: Welded 316 S. Steel material w/ Butt-welded joints. Rigid couplings should be used where needed for easy maintenance.

Low Pressure Piping: PVC Sch. 40 material w/ socket cement.

CONTROL PANEL

RO plant controls shall be as per manufacturer's recommendations suitable for the RO plant operation. Control panel shall be installed in weatherproof polyester enclosure with IP 55 protection. Controls shall be interfaced with project central control system for status monitoring and alarms.

VFD control High pressure pumps

Electrical components will be housed in IP54 Universal enclosure with bottom cable entries mounted on the main frame with circuit breakers. Each breaker will be connected to a properly sized contactor and thermal protection for all motors included in the plant.

Panel door is provided with indicator lights which shows all operating status like pump run status, tank level warnings etc.

Flow, conductivity and pH transmitters are mounted on the front door of the control panel and will be identified with plastic labeling in English language.

Control panel door should have HMI display of minimum 10" size, and should display all operating parameters of RO plant.

System Components

The contractor shall provide and install all system pumps required, each duty pump unit shall have a standby unit, including:

1. Sand Filter feed pumps
2. Sand filter backwash pumps
3. High pressure pump for RO system
4. Cleaning and flushing pumps
5. Chemical dosing pumps

Drainage mahole and pipes

The contractor shall design, size and provide all works to construct a drainage system to drain all liquid residuals (generated by the treatment unit) towards the final disposal including manholes, collecting pipes from all treatment units and pipelines between manholes and final disposal.

EXECUTION

PRODUCT STORAGE AND HANDLING

A. GENERAL and STORAGE:

- The contractor shall at all times take necessary steps to protect and preserve all materials, supplies, all work equipment which has been performed towards the end. The contractor shall provide for storage facilities at the work site.
- Should work be suspended temporarily because of inclement weather or other causes, the contractor shall take such steps as are necessary to protect materials, supplies, equipment and work performed against damage or injury.
- Any damaged materials, supplies, equipment, or work performed shall be removed and replaced at the expense of the contractor.
- The contractor shall have storage facilities including temporary buildings at the site, which shall be used for storage of materials. All materials shall be handled and stored strictly in accordance with manufacturer's recommendation.

B. SITE INSPECTION:

The RO contractor shall be responsible for inspecting the job site and shall examine the conditions under which the work is to be performed. Should unsatisfactory conditions exist at the site, work shall not proceed until the Contractor corrects the unsatisfactory conditions so that the site conforms to the specifications.

C. PREPARATION AND SCHEDULING

The RO contractor shall prepare a schedule for the complete installation of RO plant for approval prior to starting the installation works.

D. SAFETY

RO contractor shall be responsible for initiating, maintaining and supervising all safety precautions in connection with the work and shall comply with all applicable laws, rules and regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss.

E. SITE MAINTENANCE

The Contractor shall confine his activities to the area within the boundaries of the area designated for the purpose of RO construction. The contractor shall control all activities in such a manner that drainage from the site is readily disposed of without making the site impassable.

F. FABRICATION, INSTALLATION AND FIELD TESTING

Fabrication and installation of all equipment and materials required for the RO plant are to be performed by the contractor as per manufacturer's instructions, drawings, out sheets and the specifications and drawings.

G. INSTALLATION

- Install material and equipment in strict accordance with the requirements of this Section and the written recommendations of the manufacturer as well as applicable codes.
- Installation shall be performed by workmen skilled in this type of work.
- Provide electrical motor-driven equipment specified herein complete with motors, motor starters, and controls. Provide motor starters with properly sized thermal overload protection and other appurtenances necessary for the motor control specified.
- The contractor shall furnish all required pipes, valves, and fittings (PVF) and other materials of the various sizes and diameters complete with jointing materials in accordance with these specifications, to ensure uniform performance throughout the water treatment units and facilities. This shall include all of the pipes, pumps, valves, meters, fittings, and other hydraulic appurtenances to have a complete and ready for operation desalination plant including connection to the RO feed tank, flush and clean treated water tank to drainage system, as indicated on the construction drawings and described herein.
- The contractor shall provide all electrical works required including labor, services, tools, materials, and equipment, cables wiring, control panels necessary to install a complete and operative electrical system to be provided in this project according to the standard specifications. Scope of work shall include connecting the treatment unit main control panel with the existing power supply as per site visit.

H. LABORATORY EQUIPMENT

GENERAL:

Contractor shall supply standard laboratory equipment necessary for day-to day operation as following:

- 1- pH meter
- 2- Ec meter
- 3- Turbidity Meter
- 4- Chlorine residual test kit

Operation and quality control of the RO plant production, including chemicals for laboratory analysis good for 3 months.

I. START-UP & FINAL INSPECTION

- Prior to the startup of each mechanical system and equipment, the RO contractor shall submit to The Client a copy of printed instructions as specified herein. Plant shall be operated at full design capacity for 3 days before the final acceptance tests and the actual performance of the system/equipment shall be verified and certified for compliance to designed performance.
- Startup of all mechanical equipment shall be conducted by the RO contractor, strictly as per written instruction of the manufacturer's manuals.
- After the acceptance of the final start up, the RO contractor shall train and instruct the personnel of the Client on the proper operation and maintenance of the plant & equipment. The instructions in Arabic & English shall be documented in a Manual.

J. TESTING AND COMMISSIONING

GENERAL:

- Provide water, power, appliance, consumable stores and drainage facilities necessary for the complete testing of the RO plant and pumps.
- RO plant shall be tested and commissioned at full load to the full satisfaction and approval of the Client's Engineer.
- Following completion of erection and cleaning of tanks, the tanks shall be tested for liquid-tightness by filling the tank to its overflow elevation. Any leakage discovered by this test shall be corrected by the Contractor in accordance to manufacturer's written recommendation.

- Prior to backfilling of any excavation, the contractor should perform the hydraulic test for the piping below. All tanks shall be filled with water and kept filled for 2 days during which time it will be regularly inspected for loss of water and for signs of leakage externally.
- Test will be deemed to be passed if Engineer is satisfied that there has been no perceptible loss of water through leakage during this period.
- Contractor shall inspect all systems which are completed and ready for Testing & Commissioning, and shall inform the ENGINEER in writing 15 days before the final Testing & Commissioning along with the detailed description as follows:
 1. Schedule of Testing & Commissioning activities.
 2. Description of testing procedure of each system, strictly as per manufacturer's recommendations and the applicable codes.
 3. Check lists for the physical inspection of each system.
 4. Test Forms for the detailed documentations of test readings for each system.
 5. All tests shall be witnessed by the representative of Contractor / ENGINEER & Client. After completion of tests, all the test records shall be submitted for the final approval of the ENGINEER.

Solar PV system-Technical specifications

- Job Type: Turnkey job
- Units Required: 2
- Scope of work : The bidder shall be required to provide the complete design, follow up with electricity company for design and approval and preliminary approval and grid impact study, procure, construct, commission, handing over, and maintenance.
- System Capacity: 15 kWp DC Side with 20 KW on AC Side for each system.

- System Components:
 - Solar Photovoltaic (SPV) Cells not less than 15 kWp total power
 - Cell type: Mono or Poly-Crystalline Anti-reflecting coated
 - Peak Power: not less than 400Wp
 - Cells Connection type: Junction box (IP67 Protection degree or higher)
 - Positive measurement power tolerance
 - Frame Material: Anodized Aluminum
 - Module Efficiency: Not less than 20%
 - Mechanical load test up to 5400 pa.
 - The PV Modules must be warranted for output wattage that should not be less than 90% at the end of 10 years and 80% at the end of 25 years.
 - MC4 Connection.
 - Warranty : 10 years

 - Mounting Structure:
 - Made of Aluminum.
 - Warranty : 10 years
 - The structure should be of adequate strength which can withstand loads (dead, live and snow) and wind speed (not less than 130km/h).
 - The structure should be placed over a reinforced concrete (RC) slab base not less than 15 cm height from lower point. The RC slab should have a minimal fracture pressure not less than 250 kg/cm² after 28 days and should have a thickness of 15 cm. Also provided with 10 mm steel rods (tensile 60) every 20 cm in both directions. The top surface of the ground slab should be smooth polished without surface holes or bumps and roughness of any type. A base course layer of hard limestone gravel or valley gravel (grade B) with a thickness not less than 20 cm (after compaction) including spreading, mixing with water and compaction to 100% density below the ground RC slab.
 - The structure should be designed to carry the PV cells at inclined angle of 25 degree south facing.
 - The minimum clearance of the lowest part of modules structure and the developed ground level shall not be less than 50 cm.
 - On Grid Inverter

- Inverter capacity 20 kW
- Three-Phase feed in (Output)
- Graphic display type
- Efficiency at max power not less than 97%
- Designed to operate the PV panels array near its maximum power point (built in MPPT function)
- Degree of Protection: IP65
- Have protections against reverse current, input over voltage and over current via fuses Temperature operating range: -20 C to 60 C
- Warranty : 5 years

- Earthing

The array structure of the PV modules and any metallic component must grounded to ensure safety of the power plant.

- Cables

- Only PVC copper cables shall be used, the size of all cables in project shall be selected to keep voltage drop and losses to the minimum.
- The allowed DC and AC maximum voltage drops shall be less than 2%.
- The DC cables used should be double-insulated single wire cables and red color for positive and black color for negative.
- Continuous cables runs only shall be used, jointing of cables is not allowed
- Rates quoted shall include termination, glands ,etc as required.
- All cables under the arrays shall be installed on cable tray, and PVC pipes for others.
- All cables, wires, wiring forms, terminals blocks, and terminal shall be clearly indicated by pre-printed labels or tags.

Other conditions

- Site visit.
Bidders shall visit site and familiarize themselves with the ground; access to facilities, infrastructure, occupancies, and all other necessary conditions to finish the scope of work.
- Connection point.
This information shall be responsibility of the bidder to familiarize themselves with the existing conditions during the site visit.
- Scope of work

The bidder shall be required to provide the complete design, follow up with electricity company for design and approval and preliminary approval and grid impact study, procure, construct, commission, handing over, and maintenance.

- Shop drawing for each component, modules, array, strings, supporting, cables, joints, single line diagram, electrical panels.
- Losses shall be studied and analyzed per each component.
- Shading study must be included in the 3D design simulation analysis submitted part of the tender.
- Inverters to be installed under protected surfaces, to guard against environmental conditions, safety sign words in both languages shall be installed on them, preferably facing north
- It is the responsibility of the winning bidder to get approvals on all studies and products from engineer.
- All works (excavation, foundations, steel, concreting, mounting structure installation, cabling, electrical works, etc., shall be executed according to program of works by supervision engineer.
- Upon completion of construction and inspection, contractor shall submit the necessary paperwork to Electricity Company for checking and final connection to grid.
- The main cable from inverter to connection point must be installed in underground trench according to local codes.
- All financial requirements by Electricity Company and any side for licensing the PV plant is the responsibility of the contractor.
- All technical requirements whatsoever, necessary drawing, and follow ups shall be provided by the contractor and is considered an integral part of the scope of work.
- The contractor shall design, procure and install all the equipment which is needed to connect the plant to the local grid.
- Design of the PV system shall be done Using PVsyst Software.
- All Low voltage AC and DC must be copper.
- All underground cable shall be protected in conduits.
- The bidder should provide a schematic drawing of the PV panels. And also should provide data sheets for all components.

The whole system parts shall be warranted for one year including free supply and installation any required spare parts.