

# PureBox™ DLX

## Containerized Desalination Systems



RODI Systems Corp., Aztec, New Mexico, USA

We are pleased to provide the following specifications for our PureBox™ DLX containerized desalination systems. The PureBox™ DLX is a high quality containerized desalination system designed to lower the operating cost by reducing labor and energy requirements. The DLX systems incorporate a number of features that are not commonly found on low-cost desalination systems. If your project is price sensitive, it might be possible to omit one or more of the standard features of the DLX. This will depend upon a number of factors including energy cost, the location of the system, feed water source, and qualifications of the local operators.

### I. Introduction

Here are the general features that make the PureBox™ DLX containerized desalination systems stand out from the competition:

**Complete Portability** - The PureBox™ DLX systems are completely contained in a single 20 or 40 foot intermodal shipping container. This makes them completely portable for ease of installation, minimum time for setup once on site and ease of relocation in the future.

**Versatile Design for Seawater or Brackish Water** - The PureBox™ DLX system incorporates provisions for recycling a portion of the RO reject back to the suction of the high pressure pump. This allows the system to be used on brackish water sources as well as seawater.

**Corrosion Resistant Construction** - In designing and building the DLX systems, we use non-metallic components as much as possible. This includes structural components as well as the wetted components in the desalination system. FRP structural members and 316 SS fasteners are used extensively as mechanical supports. All low pressure piping and vessels are non-metallic. High pressure piping larger than ½" is duplex 2205 or reinforced non-metallic hose. High pressure piping ½" or smaller is 316L SS, nylon, or duplex 2205. Pumps in seawater service are nickel-aluminum-bronze or duplex 2205. Pumps in permeate and cleaning service are 316 SS.

**High Performance Pretreatment** - Proper pretreatment is critical in the RO design to insure that the RO membrane elements do not foul excessively. The DLX system utilizes a two stage filter design. The primary filters consists of a bag filter element to remove larger suspended solids. The secondary filter consists of a media filtration system that uses a high performance zeolite filter media. This type of filter out performs typical sand filters in particle removal efficiency and reduced backwash volume. This DLX system is also equipped for the addition of a filter aid (coagulant) before the secondary filter to assist in the removal of small, well-dispersed colloidal solids. The secondary filters are backwashed with reject from the RO system. Use of reject for backwashing minimizes the amount of water and power necessary for operating the system. It also provides superior backwashing efficiency since the RO reject is low in suspended solids.

**Conservative RO Design** - One of the most important factors in RO design is the membrane flux rate. This is the amount of water forced through a given area of membrane surface area in a given amount of time. It is usually reported in gallons per square foot of membrane area per day or GFD. High flux rates result in less expensive RO desalination systems since they require fewer RO membrane elements, fewer pressure vessels, etc. However, increasing the flux rate also increases the fouling rate of the membrane. Designs using high flux rates will result in frequent membrane cleaning or premature membrane replacement. The RO in PureBox™ DLX system is designed with an average flux rate of 7 to 8 GFD, a conservative flux rate for this application.

**Automation** - The PureBox™ DLX systems incorporate automated controls for normal operation. This results in fewer human errors during operation which can easily cause damage to the RO membrane or other vital system components. We also include a full complement of sensors for all major operating parameters (pressure, flow,

conductivity, temperature) along with data logging in the control system. This provides valuable historic data for on-going system maintenance and troubleshooting.

**High Pressure Pump and Energy Recovery** - We have a number of options for high pressure pumps and energy recovery units. Most DLX systems will include a Danfoss APP pump with a Danfoss iSave or Danfoss APM energy recovery unit. As an option, some systems can be equipped with FEDCO pumps and energy recovery units. Both of these products boast a large number of installed units and they have proven to be well-suited for systems this size. The pump and energy recovery unit (iSave) are all equipped with VFD's for smooth starts and stops and maximum energy conservation.

**Permeate Flush System** - Because of the high dissolved solids concentrations involved with seawater desalination, it is important that the system be designed to flush the membrane elements properly upon shutdown. It is also necessary that the permeate piping be allowed to "draw back" permeate after shutdown to prevent a vacuum from being created on the permeate piping after shutdown. Low cost desalination systems may not incorporate these features since it adds cost to provide all of the necessary piping and valves comprising the permeate flush system.

**Membrane Cleaning System** - Any RO system, no matter how well-designed, will require periodic membrane cleaning. The unique design of the DLX system allows the permeate flush system to be used as a clean-in-place (CIP) system for effective membrane cleaning thus eliminating the time and expense necessary for removal of the membrane elements for off-site cleaning.

**Training and Technical Support** - RODI Systems has been designing, building, and supporting membrane treatment systems for almost two decades. Our first desalination system, built over sixteen years ago, is still in service. The technical professionals at RODI have trained over 1000 RO operators over the course of their careers. We take pride in the support we offer our clients both before and after the sale.

## II. Treatment Process and Key Design Assumptions

### A. Treatment Process

The proposed treatment process includes the following steps:

**Primary Filtration** - A primary filter is used to remove large suspended solids from the feed water in order to prevent excessive backwash of the secondary filters. The primary filter consists of 100 micron bag filters.

**Secondary Filtration** - Secondary media filters are used to polish the filtrate from the primary filters. Secondary filters are comprised of vessels containing a high performance zeolite filtration media. The zeolite media filters are also equipped with a chemical injection system for introducing a coagulant before the filter (to increase filtration efficiency) and a bag filter on the secondary filter outlet to remove any stray filter media. The secondary filter is backwashed with RO reject.

**Scale Inhibitor Injection** - Use of a high performance organic scale inhibitor can reduce the scaling and fouling potential from sparingly soluble salts, metal oxides, and naturally occurring organic materials in the feed water.

**Cartridge Filtration** - The cartridge filter acts to insure that stray particulate does not inadvertently enter the high pressure pump or RO membrane elements.

**Reverse Osmosis** - The RO removes the majority of the dissolved solids in the feed water. The RO is arranged into a single stage array with reject (brine) recycle. This allows the system to operate on brackish water as well as seawater.

**Post Treatment of RO Permeate** - Post treatment steps include pH adjustment and stabilization by means of a calcite contactor. Permeate from the RO is also treated by means of a UV sterilizer before exiting the treatment container. Use of calcite and UV for post-treatment greatly simplifies the treatment system and eliminates shipment of hazardous chemicals.

## B. Design Parameters

The following values are used in the design of the DLX system:

Secondary Media Filtration: 0.6 mm zeolite 40" deep, filtration rate of 7 gpm/ft<sup>2</sup>, backwash rate of 10 gpm/ft<sup>2</sup>

Coagulant Injection: As needed for minimum turbidity, generally 2 ppm

Scale Inhibitor Injection: 2 ppm

Cartridge Filtration: Filtration rate of < 3 gpm/10" of filter equivalent

Pass Reverse Osmosis: Average flux rate of 7 to 8 GFD

Overall System Recovery: 43-70% depending upon feed water quality

## C. Analytical Parameters

Parameter <sup>(1)</sup>	Feed Water	Permeate <sup>(2)</sup>	Reject
pH	8.0	6.9	8.2
Calcium, ppm	650	4.33	1,080
Magnesium, ppm	1,450	3.62	2,414
Sodium, ppm	10,740	107	17,830
Potassium, ppm	390	4.2	647
Strontium, ppm	13	0.06	22
Carbonate, ppm	3.4	0.01	5.7
Bicarbonate, ppm	145	3.84	240
Chloride, ppm	20,246	160	33,636
Sulfate, ppm	2,700	7.87	4,495
Boron, ppm	4.5	1.20	6.7
TDS, ppm	36,346	293	60,381

<sup>(1)</sup> Typical seawater analysis. Actual seawater composition may vary.

<sup>(2)</sup> Before post-treatment.

## III. Scope of Supply

### A. 20,000 GPD System

#### System Operating Data

Minimum Inlet Feed Pressure:	Sufficient to lift 5 ft above floor of the container
Minimum Available Feed Flow Rate:	43 gpm (9.8 m <sup>3</sup> /hr)
Maximum Feed Temperature:	105 Deg F (41 Deg C)
Nominal Product Flow Rate @ 7.6 GFD:	20,000 gallons per day (75 m <sup>3</sup> /day)
Design Recovery:	36%
Electrical Requirement:	380-460 VAC, 3 Phase, 50/60 Hz
Power Consumption:	Approximately 4.5 kWh/m <sup>3</sup>

**Container** - Complete system is built inside seaworthy "one trip" intermodal container. Container is equipped with a valid CSC plate.

- Container dimensions 20' long x 8' wide x 8'6" ft tall. Estimated shipping weight - 15,000 pounds;
- Container is insulated and equipped with interior lighting, ventilation fan, and inlet louvers;
- Laminated wooden floor with waterproof coating and floor drains;
- Raised fiberglass walkway over piping and conduit;
- Main electrical disconnect with branch circuit protection;
- Feed, permeate, reject, waste, and power connections on outside of container as necessary.

**Pretreatment System** - The pretreatment train for the complete treatment system includes the following:

- One 3 HP AMPCO nickel-aluminum-bronze end-suction centrifugal pump with TEFC motor and Yaskawa V1000 VFD;
- One primary filtration system consisting of one PVC bag filter. Vessel equipped with a Type 2 100 mesh bag filter;
- One secondary filtration system consisting of four 18" diameter FRP filter vessels piped in parallel. Each vessel equipped with 5 cubic feet of zeolite filtration media. Motorized valves on each vessel control service, backwash, and rinse (valves are controlled by means of main PLC). Includes one PVC bag filter housing with one Type 2 filter bag on the secondary filter outlet along with one EMEC chemical injection pump and one 5 gallon day tank for injection of coagulant into the secondary filter feed;
- One PVC cartridge filter housing with five 30" x 2.5" filter cartridges;
- One scale inhibitor injection system with one EMEC chemical injection pump and one 5 gallon polyethylene storage tank.

**Permeate Flush/CIP System** - Comprised of one permeate flush tank and associated actuated valves to automatically flush the RO system with permeate at shutdown. Also includes a 3 HP EBARA stainless steel vertical centrifugal pump for permeate flushing. This system is also piped to allow its use as a clean-in-place (CIP) system for membrane cleaning.

**RO System** - The RO system consists of the following:

- One Danfoss APP10.2 high pressure pump with 20 HP TEFC motor and Yaskawa F7 VFD;
- One Danfoss APM6.5 energy recovery unit mounted on shaft of high pressure pump motor;
- Two 8" diameter FRP pressure vessels (Protec, Codeline, or equivalent) each holding three spiral-wound, seawater membrane elements (Hydranautics, Koch, or equivalent).

**Post-Treatment System** - Post-treatment system consists of the following:

- One calcite contactor comprised of two 18" diameter FRP vessels piped in parallel. Each vessel contains 3 cubic feet of calcite;
- One UV sterilizer.

**Electrical** - The system is designed to operate from a single power source (380-460 VAC, 3 Ph, 50/60 Hz).

**Controls and Instrumentation** - The system is monitored and controlled by a PLC-based control system interfaced with the sensors described below. The control system is programmed for ease of operation along with necessary data logging and data processing to monitor on-going system performance. The system may be monitored remotely during periods when operators may not be present on site. The control system consists of the following:

- One Horner XL6 OCS PLC with integral color touch screen operator interface. PLC is programmed for operation of entire water treatment system and is configured for data logging of all operating parameters;
- Two GF Signet 8850 conductivity transmitters with sensors for feed and permeate conductivity. Feed water transmitter also monitors feed water temperature;
- Three GF Signet 2536 paddlewheel flow sensors with integral transmitters for RO feed, recycle, and permeate flows;
- Five IFM PX series pressure transmitters for monitoring pressures before and after filters (including HP pump suction);
- Three IFM PX series pressure transmitters for monitoring RO feed, reject, and permeate pressures;
- All controls mounted in non-metallic NEMA 4X enclosures per UL508 requirements.

**Documentation** - The system will be furnished with the following documentation:

- Process description
- Process flow diagrams
- Piping and instrumentation diagrams
- Instrumentation schedules
- Electrical diagrams
- Operating and maintenance instructions
- Major component documentation

**Spare Parts for Three Years of Operation (Optional)** - The system will be furnished with the following set of spares:

- Rebuild kit for high pressure pump;
- Rebuild kit for energy recovery unit;
- Repair kit for chemical injection pump;
- Set of spare fuses;
- Set of spare seals for RO pressure vessels;
- Set of spare seals for filter vessels;
- Spare actuated valve, one of each type (with actuator);
- Spare manual valve, one of each type;
- One spare conductivity transmitter;
- Spare conductivity sensors, one of each type;
- One spare flow transmitter and sensor;
- Spare pressure transmitters, one of each type;
- One set of spare RO membrane elements;
- One spare UV lamp;
- Handheld pH/conductivity meter.

**Consumables for One Year of Operation (Optional)** - The system will be furnished with the following set of consumables:

- Two hundred filter cartridges;
- One hundred filter bags;
- Four cubic feet of zeolite filtration media;
- Four cubic feet of calcite;
- Fifty gallons of coagulant (filter aid);
- Fifty gallons of scale inhibitor;
- Forty gallons of high pH membrane cleaner;
- Forty gallons of low pH membrane cleaner;
- Conductivity and pH standard solutions.

**Climate Control (Optional)** - This option entails equipping the container with a 12,000 BTU air conditioner. Controlling the temperature and humidity inside the container prolongs equipment life and provides a more comfortable environment for operators.

## ***B. 40,000 GPD System***

### System Operating Data

Minimum Inlet Feed Pressure:	2 psig
Minimum Available Feed Flow Rate:	69 gpm (15.6 m <sup>3</sup> /hr)
Maximum Feed Temperature:	105 Deg F
Nominal Product Flow Rate @ 7.6 GFD:	40,000 gallons per day (151 m <sup>3</sup> /day)
Design Recovery:	40-70% depending upon feed water quality
Electrical Requirement:	380-460 VAC, 3 Phase, 50/60 Hz
Power Consumption:	< 3.0 kWh/m <sup>3</sup>

**Container** - Complete system is built inside seaworthy “one trip” intermodal container. Container is equipped with a valid CSC plate.

- Container dimensions 40’ long x 8’ wide x 8’6” ft tall. Estimated shipping weight - 22,000 pounds;
- Container is insulated and equipped with interior lighting, ventilation fan, and inlet louvers;
- Laminated wooden floor with waterproof coating and floor drains;
- Raised fiberglass walkway over piping and conduit;
- Main electrical disconnect with branch circuit protection;
- Feed, permeate, reject, waste, and power connections on outside of container as necessary.

**Pretreatment System** - The pretreatment train for the complete treatment system includes the following components:

- One 5 HP AMPCO nickel-aluminum-bronze end-suction centrifugal pump with TEFC motor and Yaskawa V1000 VFD;
- One primary filtration system consisting of one PVC filter vessel equipped with a 100 micron bag filtration element;
- One secondary filtration system consisting of four 24" diameter FRP filter vessels piped in parallel. Each vessel equipped with 15 cubic feet of zeolite filter media. Each vessel equipped with motorized control valves to control service, backwash, and rinse (control valves controlled by means of main PLC). Includes one PVC bag filter housing (with one Type 2 filter bag) on the secondary filter outlet along with one chemical injection pump and day tank for injection of coagulant into the secondary filter feed;
- One FRP cartridge filter housing with ten 30" x 2.5" filter cartridges;
- One scale inhibitor injection system with one chemical injection pump and one 10 gallon polyethylene storage tank.

**Permeate Flush / CIP System** - Comprised of one 100 gallon permeate flush tank and associated actuated valves to automatically flush the RO system with permeate at shutdown. Also includes a 3 HP EBARA stainless steel vertical centrifugal pump for permeate flushing.

**RO System** - The RO system consists of the following:

- One Danfoss APP7.2 high pressure pump with 20 HP TEFC motor and Yaskawa F7 VFD;
- One Danfoss iSave21 energy recovery unit with 7.5 HP TEFC motor and Yaskawa V1000 VFD;
- Two 8" diameter FRP pressure vessels (Protec, Codeline, or equivalent) each holding six Hydranautics spiral wound, seawater membrane elements.

**Post-Treatment System** - Post-treatment system consists of the following:

- One calcite contactor comprised of two 24" diameter FRP vessels piped in parallel. Each vessel contains 7 cubic feet of calcite;
- One UV sterilizer.

**Electrical** - The system is designed to operate from a single power source (380-460 VAC, 3 Ph, 50/60 Hz).

**Controls and Instrumentation** - The system is monitored and controlled by a PLC-based control system interfaced with the sensors described below. The control system is programmed for ease of operation along with necessary data logging and data processing to monitor on-going system performance. The system may be monitored remotely during periods when operators may not be present on site. The control system consists of the following:

- One Horner XL6 OCS PLC with integral color touch screen operator interface. PLC is programmed for operation of entire water treatment system and is configured for data logging of all operating parameters;
- Two GF Signet 8850 conductivity transmitters with sensors for feed and permeate conductivity. Feed water transmitter also monitors feed water temperature.
- Three GF Signet 2536 paddlewheel flow sensors with integral transmitters for RO feed, recycle, and permeate flows;
- Five IFM PX series pressure transmitters for monitoring pressures before and after filters (including HP pump suction);
- Three IFM PX series pressure transmitters for monitoring RO feed, reject, and permeate pressures;
- All controls mounted in non-metallic NEMA 4X enclosures per UL508 requirements.

**Documentation** - The system will be furnished with the following documentation:

- Process description
- Process flow diagrams
- Piping and instrumentation diagrams
- Instrumentation schedules
- Electrical diagrams
- Operating and maintenance instructions
- Major component documentation

**Spare Parts for Three Years of Operation (Optional)** - The system will be furnished with the following set of spares:

- Rebuild kit for high pressure pump;
- Rebuild kit for energy recovery unit;
- Repair kit for chemical injection pump;
- Set of spare fuses;
- Set of spare seals for RO pressure vessels;
- Set of spare seals for filter vessels;
- Spare actuated valve, one of each type (with actuator);
- Spare manual valve, one of each type;
- One spare conductivity transmitter;
- Spare conductivity sensors, one of each type;
- One spare flow transmitter and sensor;
- Spare pressure transmitters, one of each type;
- One set of spare RO membrane elements;
- One spare UV lamp;
- Handheld pH/conductivity meter.

**Consumables for One to Two Years of Operation (Optional)** - The system will be furnished with the following set of consumables:

- Two hundred filter cartridges;
- One hundred filter bags;
- Ten cubic feet of zeolite filtration media;
- Ten cubic feet of calcite;
- Two hundred gallons of coagulant (filter aid);
- Two hundred gallons of scale inhibitor;
- One hundred fifty gallons of high pH membrane cleaner;
- One hundred fifty gallons of low pH membrane cleaner;
- Conductivity and pH standard solutions.

**Climate Control (Optional)** - This option entails equipping the container with a 24,000 BTU air conditioner. Controlling the temperature and humidity inside the container prolongs equipment life and provides a more comfortable environment for operators.

### **C. 60,000 GPD System**

#### System Operating Data

Minimum Inlet Feed Pressure:	2 psig
Minimum Available Feed Flow Rate:	104 gpm (24 m <sup>3</sup> /hr)
Maximum Feed Temperature:	105 Deg F
Nominal Product Flow Rate @ 7.6 GFD:	60,000 gallons per day (227 m <sup>3</sup> /day)
Design Recovery:	40-70% depending upon feed water quality
Electrical Requirement:	380-460 VAC, 3 Phase, 50/60 Hz
Power Consumption:	< 3.0 kWh/m <sup>3</sup>

**Container** - Complete system is built inside seaworthy “one trip” intermodal container. Container is equipped with a valid CSC plate.

- Container dimensions 40’ long x 8’ wide x 8’6” ft tall. Estimated shipping weight - 22,000 pounds;
- Container is insulated and equipped with interior lighting, ventilation fan, and inlet louvers;
- Laminated wooden floor with waterproof coating and floor drains;
- Raised fiberglass walkway over piping and conduit;
- Main electrical disconnect with branch circuit protection;
- Feed, permeate, reject, waste, and power connections on outside of container as necessary.

**Pretreatment System** - The pretreatment train for the complete treatment system includes the following components:

- One 7.5 HP AMPCO nickel-aluminum-bronze end-suction centrifugal pump with TEFC motor and Yaskawa V1000 VFD;
- One primary filtration system consisting of one PVC filter vessel equipped with a 100 micron bag filtration element;
- One secondary filtration system consisting of four 30" diameter FRP filter vessels piped in parallel. Each vessel equipped with 15 cubic feet of zeolite filter media. Each vessel equipped with motorized control valves to control service, backwash, and rinse (control valves controlled by means of main PLC). Includes one PVC bag filter housing (with one Type 2 filter bag) on the secondary filter outlet along with one chemical injection pump and day tank for injection of coagulant into the secondary filter feed;
- One FRP cartridge filter housing with thirty 30" x 2.5" filter cartridges;
- One scale inhibitor injection system with one chemical injection pump and one 25 gallon polyethylene storage tank.

**Permeate Flush / CIP System** - Comprised of one 150 gallon permeate flush tank and associated actuated valves to automatically flush the RO system with permeate at shutdown. Also includes a 3 HP EBARA stainless steel vertical centrifugal pump for permeate flushing.

**RO System** - The RO system consists of the following:

- One Danfoss APP10.2 high pressure pump with 30 HP TEFC motor and Yaskawa F7 VFD;
- One Danfoss iSave21 energy recovery unit with 7.5 HP TEFC motor and Yaskawa V1000 VFD;
- Three 8" diameter FRP pressure vessels (Protec, Codeline, or equivalent) each holding six Hydranautics spiral wound, seawater membrane elements.

**Post-Treatment System** - Post-treatment system consists of the following:

- One calcite contactor comprised of two 30" diameter FRP vessels piped in parallel. Each vessel contains 10 cubic feet of calcite;
- One UV sterilizer.

**Electrical** - The system is designed to operate from a single power source (380-460 VAC, 3 Ph, 50/60 Hz).

**Controls and Instrumentation** - The system is monitored and controlled by a PLC-based control system interfaced with the sensors described below. The control system is programmed for ease of operation along with necessary data logging and data processing to monitor on-going system performance. The system may be monitored remotely during periods when operators may not be present on site. The control system consists of the following:

- One Horner XL6 OCS PLC with integral color touch screen operator interface. PLC is programmed for operation of entire water treatment system and is configured for data logging of all operating parameters;
- Two GF Signet 8850 conductivity transmitters with sensors for feed and permeate conductivity. Feed water transmitter also monitors feed water temperature.
- Three GF Signet 2536 paddlewheel flow sensors with integral transmitters for RO feed, recycle, and permeate flows;
- Five IFM PX series pressure transmitters for monitoring pressures before and after filters (including HP pump suction);
- Three IFM PX series pressure transmitters for monitoring RO feed, reject, and permeate pressures;
- All controls mounted in non-metallic NEMA 4X enclosures per UL508 requirements.

**Documentation** - The system will be furnished with the following documentation:

- Process description
- Process flow diagrams
- Piping and instrumentation diagrams
- Instrumentation schedules
- Electrical diagrams
- Operating and maintenance instructions
- Major component documentation

**Spare Parts for Three Years of Operation (Optional)** - The system will be furnished with the following set of spares:

- Rebuild kit for high pressure pump;
- Rebuild kit for energy recovery unit;
- Repair kit for chemical injection pump;
- Set of spare fuses;
- Set of spare seals for RO pressure vessels;
- Set of spare seals for filter vessels;
- Spare actuated valve, one of each type (with actuator);
- Spare manual valve, one of each type;
- One spare conductivity transmitter;
- Spare conductivity sensors, one of each type;
- One spare flow transmitter and sensor;
- Spare pressure transmitters, one of each type;
- One set of spare RO membrane elements;
- One spare UV lamp;
- Handheld pH/conductivity meter.

**Consumables for One to Two Years of Operation (Optional)** - The system will be furnished with the following set of consumables:

- Two hundred filter cartridges;
- One hundred filter bags;
- Ten cubic feet of zeolite filtration media;
- Ten cubic feet of calcite;
- Two hundred gallons of coagulant (filter aid);
- Two hundred gallons of scale inhibitor;
- One hundred fifty gallons of high pH membrane cleaner;
- One hundred fifty gallons of low pH membrane cleaner;
- Conductivity and pH standard solutions.

**Climate Control (Optional)** - This option entails equipping the container with a 24,000 BTU air conditioner. Controlling the temperature and humidity inside the container prolongs equipment life and provides a more comfortable environment for operators.

#### ***D. 80,000 GPD System***

##### System Operating Data

Minimum Inlet Feed Pressure:	2 psig
Minimum Available Feed Flow Rate:	139 gpm (32 m <sup>3</sup> /hr)
Maximum Feed Temperature:	105 Deg F
Nominal Product Flow Rate @ 7.6 GFD:	80,000 gallons per day (303 m <sup>3</sup> /day)
Design Recovery:	40-70% depending upon feed water quality
Electrical Requirement:	380-460 VAC, 3 Phase, 50/60 Hz
Power Consumption:	< 3.0 kWh/m <sup>3</sup>

**Container** - Complete system is built inside seaworthy “one trip” intermodal container. Container is equipped with a valid CSC plate.

- Container dimensions 40’ long x 8’ wide x 8’6” ft tall. Estimated shipping weight - 24,000 pounds;
- Container is insulated and equipped with interior lighting, ventilation fan, and inlet louvers;
- Laminated wooden floor with waterproof coating and floor drains;
- Raised fiberglass walkway over piping and conduit;
- Main electrical disconnect with branch circuit protection;
- Feed, permeate, reject, waste, and power connections on outside of container as necessary.

**Pretreatment System** - The pretreatment train for the complete treatment system includes the following components:

- One 7.5 HP AMPCO nickel-aluminum-bronze end-suction centrifugal pump with TEFC motor and Yaskawa V1000 VFD;
- One primary filtration system consisting of two PVC filter vessels equipped with a 100 micron bag filtration elements;
- One secondary filtration system consisting of three 36" diameter FRP filter vessels piped in parallel. Each vessel equipped with 20 cubic feet of zeolite filter media. Each vessel equipped with motorized control valves to control service, backwash, and rinse (control valves controlled by means of main PLC). Includes two PVC bag filter housings (with one Type 2 filter bags) on the secondary filter outlet along with one chemical injection pump and day tank for injection of coagulant into the secondary filter feed;
- One FRP cartridge filter housing with thirty 30" x 2.5" filter cartridges;
- One scale inhibitor injection system with one chemical injection pump and one 25 gallon polyethylene storage tank.

**Permeate Flush / CIP System** - Comprised of one 225 gallon permeate flush tank and associated actuated valves to automatically flush the RO system with permeate at shutdown. Also includes a 4 HP EBARA stainless steel vertical centrifugal pump for permeate flushing.

**RO System** - The RO system consists of the following:

- Two Danfoss APP7.2 high pressure pumps with 20 HP TEFC motors and Yaskawa F7 VFDs;
- One Danfoss iSave21 energy recovery unit with 7.5 HP TEFC motor and Yaskawa V1000 VFD;
- Four 8" diameter FRP pressure vessels (Protec, Codeline, or equivalent) each holding six Hydranautics spiral wound, seawater membrane elements.

**Post-Treatment System** - Post-treatment system consists of the following:

- One calcite contactor comprised of two 36" diameter FRP vessels piped in parallel. Each vessel contains 14 cubic feet of calcite;
- One UV sterilizer.

**Electrical** - The system is designed to operate from a single power source (380-460 VAC, 3 Ph, 50/60 Hz).

**Controls and Instrumentation** - The system is monitored and controlled by a PLC-based control system interfaced with the sensors described below. The control system is programmed for ease of operation along with necessary data logging and data processing to monitor on-going system performance. The system may be monitored remotely during periods when operators may not be present on site. The control system consists of the following:

- One Horner XL6 OCS PLC with integral color touch screen operator interface. PLC is programmed for operation of entire water treatment system and is configured for data logging of all operating parameters;
- Two GF Signet 8850 conductivity transmitters with sensors for feed and permeate conductivity. Feed water transmitter also monitors feed water temperature.
- Three GF Signet 2536 paddlewheel flow sensors with integral transmitters for RO feed, recycle, and permeate flows;
- Five IFM PX series pressure transmitters for monitoring pressures before and after filters (including HP pump suction);
- Three IFM PX series pressure transmitters for monitoring RO feed, reject, and permeate pressures;
- All controls mounted in non-metallic NEMA 4X enclosures per UL508 requirements.

**Documentation** - The system will be furnished with the following documentation:

- Process description
- Process flow diagrams
- Piping and instrumentation diagrams
- Instrumentation schedules
- Electrical diagrams
- Operating and maintenance instructions
- Major component documentation

**Spare Parts for Three Years of Operation (Optional)** - The system will be furnished with the following set of spares:

- Rebuild kit for high pressure pump;
- Rebuild kit for energy recovery unit;
- Repair kit for chemical injection pump;
- Set of spare fuses;
- Set of spare seals for RO pressure vessels;
- Set of spare seals for filter vessels;
- Spare actuated valve, one of each type (with actuator);
- Spare manual valve, one of each type;
- One spare conductivity transmitter;
- Spare conductivity sensors, one of each type;
- One spare flow transmitter and sensor;
- Spare pressure transmitters, one of each type;
- One set of spare RO membrane elements;
- One spare UV lamp;
- Handheld pH/conductivity meter.

**Consumables for One to Two Years of Operation (Optional)** - The system will be furnished with the following set of consumables:

- Two hundred filter cartridges;
- One hundred filter bags;
- Ten cubic feet of zeolite filtration media;
- Ten cubic feet of calcite;
- Two hundred gallons of coagulant (filter aid);
- Two hundred gallons of scale inhibitor;
- One hundred fifty gallons of high pH membrane cleaner;
- One hundred fifty gallons of low pH membrane cleaner;
- Conductivity and pH standard solutions.

**Climate Control (Optional)** - This option entails equipping the container with a 24,000 BTU air conditioner. Controlling the temperature and humidity inside the container prolongs equipment life and provides a more comfortable environment for operators.

### ***E. 100,000 GPD System***

#### System Operating Data

Minimum Inlet Feed Pressure:	2 psig
Minimum Available Feed Flow Rate:	162 gpm (37 m <sup>3</sup> /hr)
Maximum Feed Temperature:	105 Deg F
Nominal Product Flow Rate @ 7.6 GFD:	100,000 gallons per day (379 m <sup>3</sup> /day)
Design Recovery:	43-70% depending upon feed water quality
Electrical Requirement:	380-460 VAC, 3 Phase, 50/60 Hz
Power Consumption:	< 3.0 kWh/m <sup>3</sup>

**Container** - Complete system is built inside seaworthy “one trip” intermodal container. Container is equipped with a valid CSC plate.

- Container dimensions 40’ long x 8’ wide x 8’6” ft tall. Estimated shipping weight - 25,000 pounds;
- Container is insulated and equipped with interior lighting, ventilation fan, and inlet louvers;
- Laminated wooden floor with waterproof coating and floor drains;
- Raised fiberglass walkway over piping and conduit;
- Main electrical disconnect with branch circuit protection;
- Feed, permeate, reject, waste, and power connections on outside of container as necessary.

**Pretreatment System** - The pretreatment train for the complete treatment system includes the following components:

- One 10 HP AMPCO nickel-aluminum-bronze end-suction centrifugal pump with TEFC motor and Yaskawa V1000 VFD;
- One primary filtration system consisting of two PVC filter vessels equipped with a 100 micron bag filtration elements;
- One secondary filtration system consisting of four 36" diameter FRP filter vessels piped in parallel. Each vessel equipped with 20 cubic feet of zeolite filter media. Each vessel equipped with motorized control valves to control service, backwash, and rinse (control valves controlled by means of main PLC). Includes two PVC bag filter housings piped in parallel (each with one Type 2 filter bag) on the secondary filter outlet along with one chemical injection pump and day tank for injection of coagulant into the secondary filter feed;
- One FRP cartridge filter housing with thirty 40" x 2.5" filter cartridges;
- One scale inhibitor injection system with one chemical injection pump and one 25 gallon polyethylene storage tank.

**Permeate Flush / CIP System** - Comprised of one 300 gallon permeate flush tank and associated actuated valves to automatically flush the RO system with permeate at shutdown. Also includes a 5 HP EBARA stainless steel vertical centrifugal pump for permeate flushing.

**RO System** - The RO system consists of the following:

- One Danfoss APP21 high pressure pump with 60 HP TEFC motor and Yaskawa F7 VFD;
- One Danfoss iSave21 energy recovery unit with 7.5 HP TEFC motor and Yaskawa V1000 VFD;
- Five 8" diameter FRP pressure vessels (Protec, Codeline, or equivalent) each holding six Hydranautics spiral wound, seawater membrane elements.

**Post-Treatment System** - Post-treatment system consists of the following:

- One calcite contactor comprised of three 36" diameter FRP vessels piped in parallel. Each vessel contains 14 cubic feet of calcite;
- One UV sterilizer.

**Electrical** - The system is designed to operate from a single power source (380-460 VAC, 3 Ph, 50/60 Hz).

**Controls and Instrumentation** - The system is monitored and controlled by a PLC-based control system interfaced with the sensors described below. The control system is programmed for ease of operation along with necessary data logging and data processing to monitor on-going system performance. The system may be monitored remotely during periods when operators may not be present on site. The control system consists of the following:

- One Horner XL6 OCS PLC with integral color touch screen operator interface. PLC is programmed for operation of entire water treatment system and is configured for data logging of all operating parameters;
- Two GF Signet 8850 conductivity transmitters with sensors for feed and permeate conductivity. Feed water transmitter also monitors feed water temperature.
- Three GF Signet 2536 paddlewheel flow sensors with integral transmitters for RO feed, recycle, and permeate flows;
- Five IFM PX series pressure transmitters for monitoring pressures before and after filters (including HP pump suction);
- Three IFM PX series pressure transmitters for monitoring RO feed, reject, and permeate pressures;
- All controls mounted in non-metallic NEMA 4X enclosures per UL508 requirements.

**Documentation** - The system will be furnished with the following documentation:

- Process description
- Process flow diagrams
- Piping and instrumentation diagrams
- Instrumentation schedules
- Electrical diagrams
- Operating and maintenance instructions
- Major component documentation

**Spare Parts for Three Years of Operation (Optional)** - The system will be furnished with the following set of spares:

- Rebuild kit for high pressure pump;
- Rebuild kit for energy recovery unit;
- Repair kit for chemical injection pump;
- Set of spare fuses;
- Set of spare seals for RO pressure vessels;
- Set of spare seals for filter vessels;
- Spare actuated valve, one of each type (with actuator);
- Spare manual valve, one of each type;
- One spare conductivity transmitter;
- Spare conductivity sensors, one of each type;
- One spare flow transmitter and sensor;
- Spare pressure transmitters, one of each type;
- One set of spare RO membrane elements;
- One spare UV lamp;
- Handheld pH/conductivity meter.

**Consumables for One Year of Operation (Optional)** - The system will be furnished with the following set of consumables:

- Two hundred filter cartridges;
- One hundred filter bags;
- Ten cubic feet of zeolite filtration media;
- Ten cubic feet of calcite;
- Two hundred gallons of coagulant (filter aid);
- Two hundred gallons of scale inhibitor;
- One hundred fifty gallons of high pH membrane cleaner;
- One hundred fifty gallons of low pH membrane cleaner;
- Conductivity and pH standard solutions.

**Climate Control (Optional)** - This option entails equipping the container with a 24,000 BTU air conditioner. Controlling the temperature and humidity inside the container prolongs equipment life and provides a more comfortable environment for operators.

#### IV. Client's Responsibilities

The Client is responsible for providing the following:

- Any equipment or hardware not specified in Section III above including, but not limited to, the following:
  - Seawater intake system and pump;
  - Piping between seawater intake pump and raw water storage tank;
  - Brine outlet works and piping;
  - Treated water storage.
- Any labor, power, or expendable items necessary for system operation.
- Any civil work, construction, piping, or electrical equipment necessary to install or operate the system (including piping from water intake system to container).
- Moving and positioning the system for installation.
- Shipping, taxes, duties, and any other fees, bonds, insurance, permits, or licenses necessary for importation, installation, startup, or operation.

505-334-5865 ph 505-334-5867 fax  
 www.rodissystems.com  
 email: info@rodissystems.com  
 936 Highway 516 Aztec, NM 87410

