

Water to the World



Energy efficient SWRO Desalination
Less than 3.0 kWh/m³ ~ 11.3 kWh/1000 gal
Potable water at half the price

Seawater Desalination Container Plants



**-with
capacities
from**



**25,000
to
250,000
gal/day**



**100 m³
to
1,000
m³/day**



**no use of
chemicals**



**20-ft & 40-ft Modularized Container Plants
No Buildings Required**

Seawater desalination container plants



**No
Building
Costs**

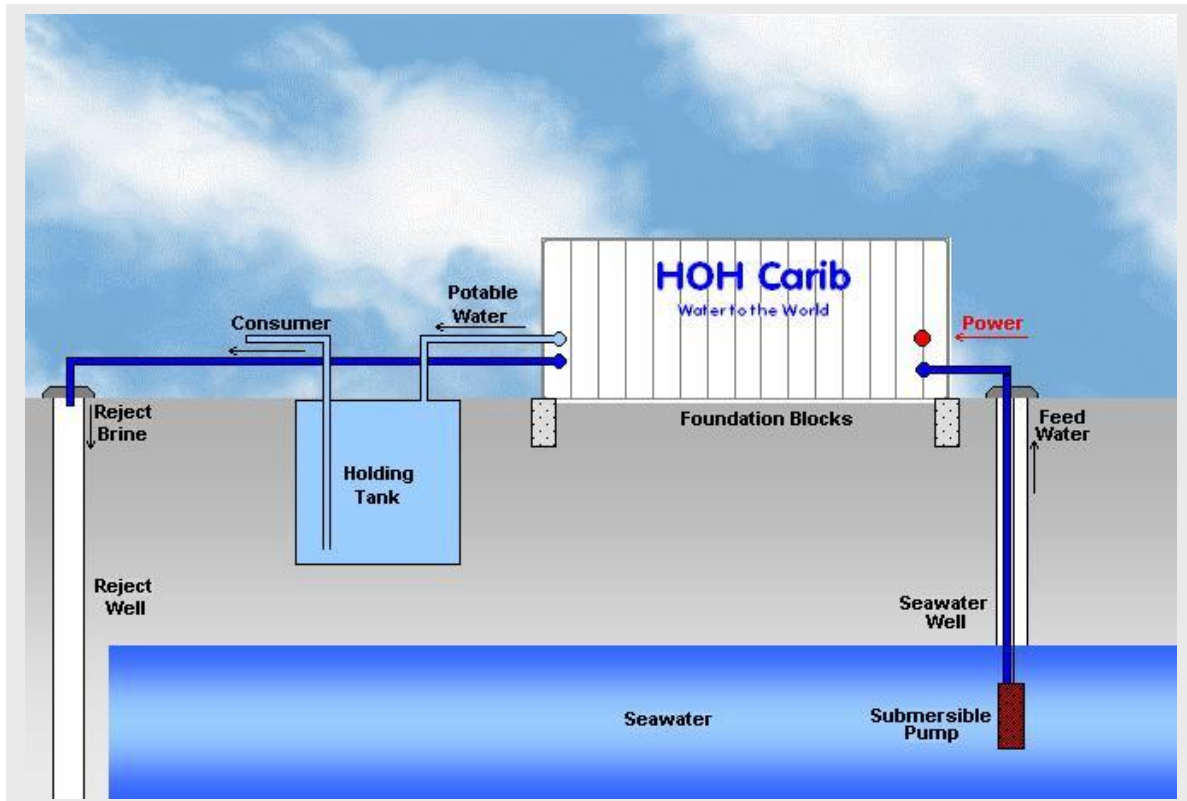


**Easy
Handling**



**Easy Installation and Commissioning.
Training of future plant operators.**

The Modularized Container Concept



The container concept takes the expenses & mystery out of SWRO desalination and brings it:

DOWN-TO-EARTH:

By making pre-designed module sized plants, built into ordinary 20-foot and 40-foot sea-containers, and install them right where the potable water is needed.

THIS MEANS:

No need for expensive buildings; advanced calculations & projecting or time consuming civil works. It's all there – in the container, ready to produce high-quality potable water within one day of delivery.

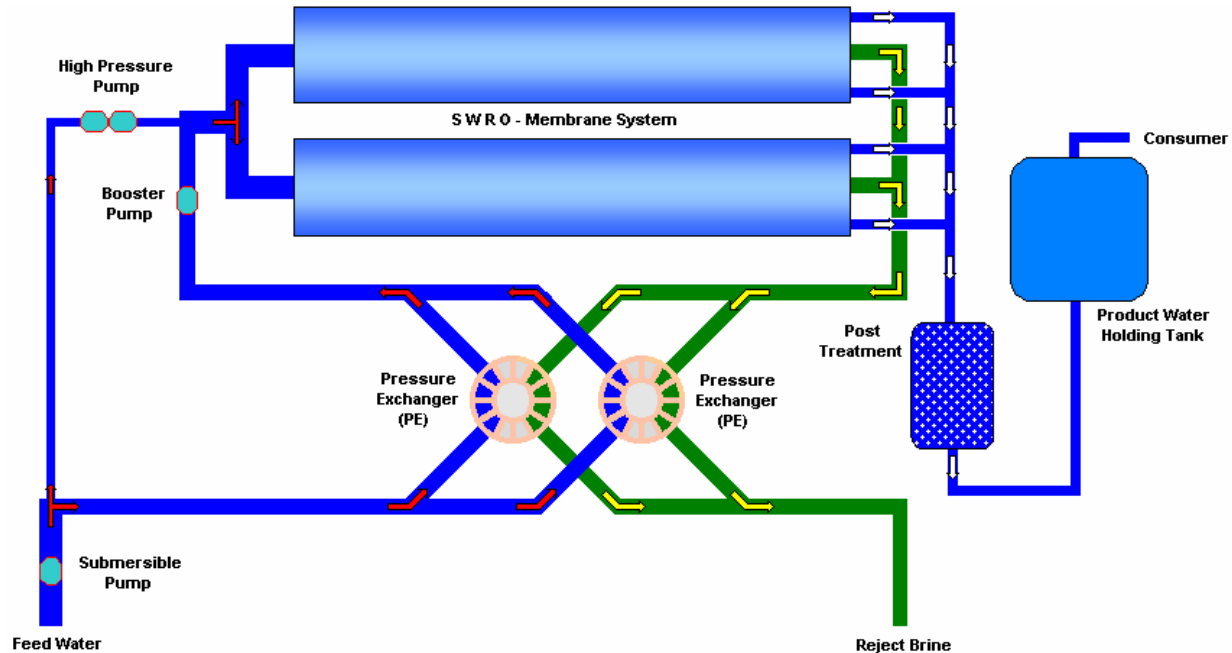
All what the clients have to do is to give us Seawater and Electricity, and a place to unload the container(s).

The Container Concept makes SWRO desalination production easy to handle, affordable and accessible anywhere on the globe.

This combined with our low maintenance costs and 60-percent energy saving feature gets our clients:

Potable Water at Half the Price

How the Pressure Exchanger (PE) works



The (PE) greatly increase the efficiency of the SWRO system by harnessing the energy of the reject brine. This efficiency can drive energy consumption from more than (7.0) to less than (2.8) kWh/m³ of product water. By directly pressurizing a portion of the incoming seawater, the main high-pressure pump size can be reduced by up to 60%. This not only saves energy, it also cuts major capital costs.

Applying (PE) technology to SWRO is different from conventional recovery devise design, but in practice its quite simple. (See diagram). The reject brine from the SWRO membranes is passed through the PE, where its pressure energy is transferred directly to a portion of the incoming raw seawater at up to 94% efficiency.

This seawater stream, nearly equal in volume to the reject stream, then passes through a small booster pump, which makes up for hydraulic losses through the SWRO system. This seawater stream now joins the seawater stream from the main high-pressure pump; **it does not pass through the high-pressure pump.**

This is significant, because now **the main pump is sized to match the permeate flow, not the full flow.** The main pump also makes up the small volume of brine lost through the PE hydrostatic bearing.

In a typical SWRO plant using the PE system, the main pump will provide 41% of the energy, the booster pump will provide 2% and the PE will provide the remaining 57%.

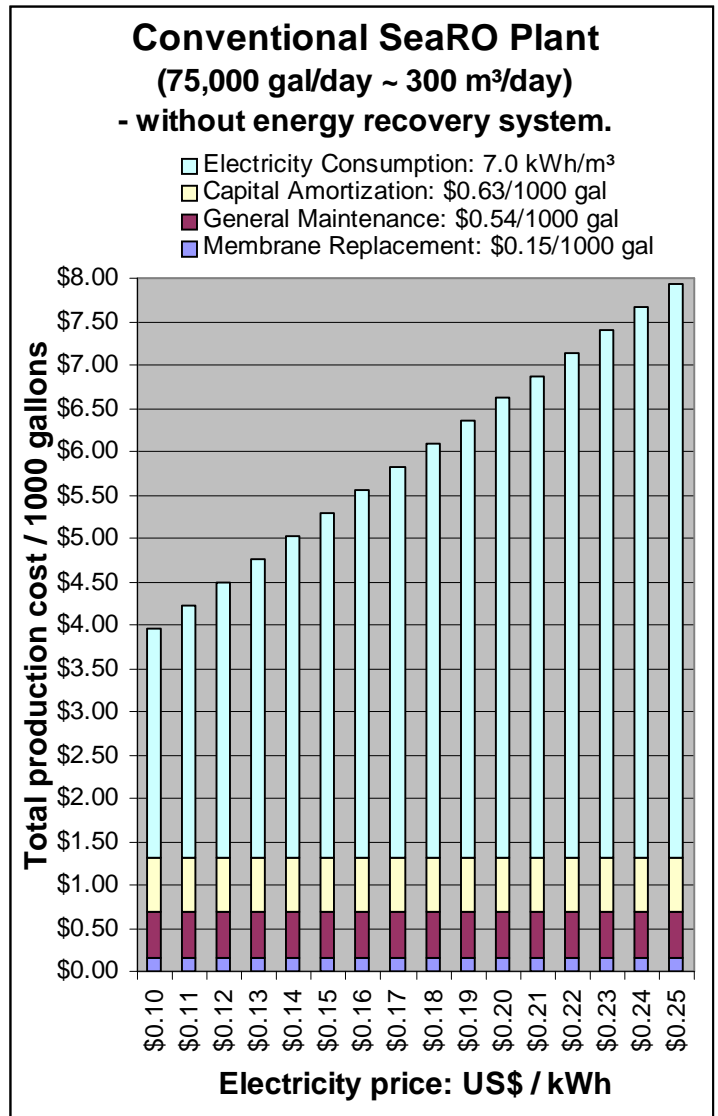
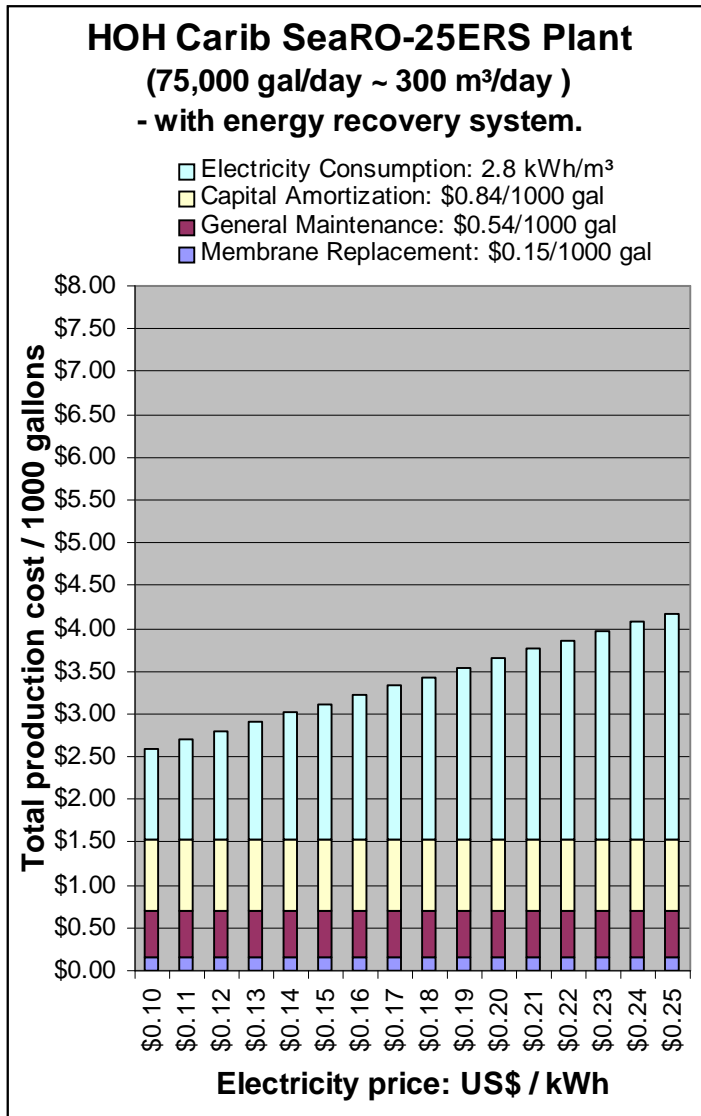
Since the PE uses no external power, the total power saving is 57%, compared to a system with no recovery.

The PE's one moving part, a shaft less ceramic rotor with multiple ducts, is hydrostatically suspended within a ceramic sleeve. The rotor affects an exchange of pressure from brine to seawater through direct contact displacement, with negligible losses.

Unlike similar devises, the PE does not use separate valves or pistons. Due to the precision of the rotor and the short resistance time, mixing of the raw water and brine is avoided.

The Economical Effect of the Pressure Exchanger

Production costs comparison between an Energy Efficient HOH SWRO plant and a Conventional SWRO plant "without" Energy Recovery System



Annual savings relative to the price (A) of electricity

A	HOH Carib SWRO-ERS Plant (75,000 gal/day ~ 300 m ³ /day) "With" Pressure Exchangers as Energy Recovery System.					Conventional SWRO Plant (75,000 gal/day ~ 300 m ³ /day) "Without" Pressure Exchangers as Energy Recovery System.					Dif.	TD / Y
	1	2	3	4	5	1	2	3	4	5		
\$0.10	\$0.15	\$0.54	\$0.84	\$1.06	\$2.59	\$0.15	\$0.54	\$0.63	\$2.65	\$3.97	\$1.38	\$35,916
\$0.11	\$0.15	\$0.54	\$0.84	\$1.16	\$2.69	\$0.15	\$0.54	\$0.63	\$2.91	\$4.23	\$1.54	\$40,055
\$0.12	\$0.15	\$0.54	\$0.84	\$1.27	\$2.80	\$0.15	\$0.54	\$0.63	\$3.18	\$4.50	\$1.70	\$44,194
\$0.13	\$0.15	\$0.54	\$0.84	\$1.38	\$2.91	\$0.15	\$0.54	\$0.63	\$3.44	\$4.76	\$1.85	\$48,333
\$0.14	\$0.15	\$0.54	\$0.84	\$1.48	\$3.01	\$0.15	\$0.54	\$0.63	\$3.70	\$5.02	\$2.01	\$52,472
\$0.15	\$0.15	\$0.54	\$0.84	\$1.59	\$3.12	\$0.15	\$0.54	\$0.63	\$3.97	\$5.29	\$2.17	\$56,612
\$0.16	\$0.15	\$0.54	\$0.84	\$1.69	\$3.22	\$0.15	\$0.54	\$0.63	\$4.23	\$5.55	\$2.33	\$60,751
\$0.17	\$0.15	\$0.54	\$0.84	\$1.80	\$3.33	\$0.15	\$0.54	\$0.63	\$4.50	\$5.82	\$2.49	\$64,890
\$0.18	\$0.15	\$0.54	\$0.84	\$1.91	\$3.44	\$0.15	\$0.54	\$0.63	\$4.76	\$6.08	\$2.65	\$69,029
\$0.19	\$0.15	\$0.54	\$0.84	\$2.01	\$3.54	\$0.15	\$0.54	\$0.63	\$5.03	\$6.35	\$2.81	\$73,168
\$0.20	\$0.15	\$0.54	\$0.84	\$2.12	\$3.65	\$0.15	\$0.54	\$0.63	\$5.29	\$6.61	\$2.97	\$77,307
\$0.21	\$0.15	\$0.54	\$0.84	\$2.22	\$3.75	\$0.15	\$0.54	\$0.63	\$5.56	\$6.88	\$3.12	\$81,446
\$0.22	\$0.15	\$0.54	\$0.84	\$2.33	\$3.86	\$0.15	\$0.54	\$0.63	\$5.82	\$7.14	\$3.28	\$85,585
\$0.23	\$0.15	\$0.54	\$0.84	\$2.43	\$3.96	\$0.15	\$0.54	\$0.63	\$6.09	\$7.41	\$3.44	\$89,724
\$0.24	\$0.15	\$0.54	\$0.84	\$2.54	\$4.07	\$0.15	\$0.54	\$0.63	\$6.35	\$7.67	\$3.60	\$93,863
\$0.25	\$0.15	\$0.54	\$0.84	\$2.65	\$4.18	\$0.15	\$0.54	\$0.63	\$6.62	\$7.94	\$3.76	\$98,003

A	Electricity Cost:	US \$ / kWh
1	Membrane replacement cost:	US\$ / 1000 gallons
2	General maintenance cost:	US\$ / 1000 gallons
3	Capital amortization cost: *)	US\$ / 1000 gallons
4	Electricity cost:	US\$ / 1000 gallons
5	Total production cost:	US\$ / 1000 gallons
Dif.	Difference in production cost	US\$ / 1000 gallons
TD / Y	Total difference in production cost per year	US\$ / Year

*) The price for the Conventional SeaRO Plant is calculated at 25% less than the HOH energy efficient SeaRO-25ERS Plant.

However, the most interesting analysis is that, even if the sales price for the Conventional plant were calculated at \$-zero, the production costs would still be quite higher than for the energy efficient plant, and the total difference in production costs would still range between \$20,000 & \$ 80,000 per year.

HOH Energy Efficient SWRO Plant

Conventional SWRO Plant



60% energy saving on HOH plants

Calculation example of total production costs at US\$ 0.20/kWh:
Including amortization, membrane replacements & maintenance

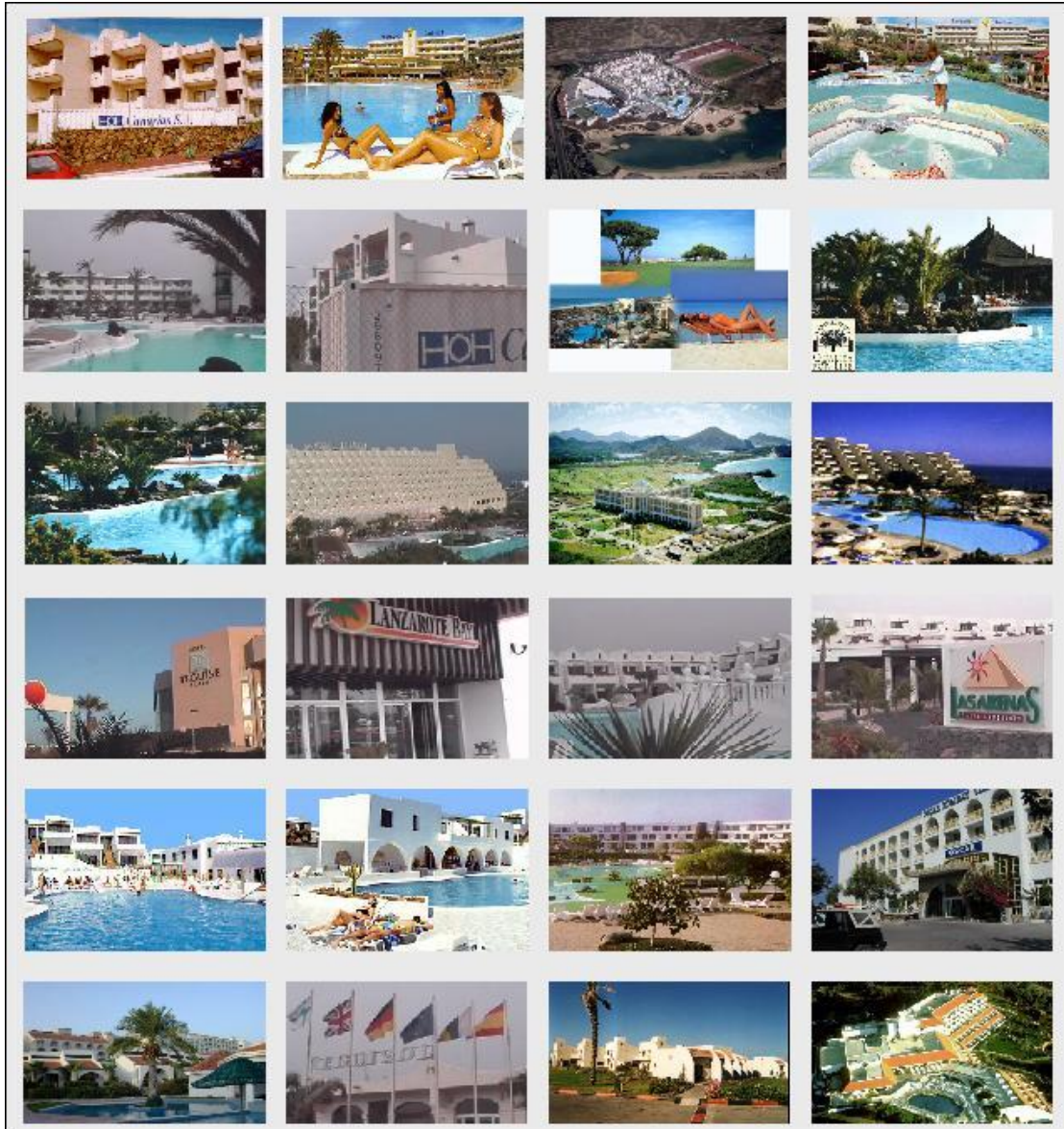
HOH Carib Plants = \$3.65 / 1000 gal

Conventional Plant = \$6.61 / 1000 gal

Cost saving = \$2.96 / 1000 gal ~ 41%

Chart Assumptions: HOH Plants: Energy consumption = 2.8 kWh/m³ - Plant price = "X" US\$
Conventional plants: Energy consumption = 7.0 kWh/m³ - Plant price = 0.75 x ("X" US\$)

Areas of Expertise



Seawater Desalination Plants for:

**Hotels, Beach & Condominium Resorts, Sports Resorts,
Golf Courses, Power Plants, Food Processing Plants,
Ships, Off-Shore Rigs, BOOT Operators,
Potable Water Distributors and
Consumer Groups with access to seawater.**

HOH European Manufacturing Plant



Seawater desalination at half-the-price



Selected references

Client	Country	Trade	Year	Capacity	Plant description	Results
Ahlmarks Rederi AB (M/S Mangan)	Sweden	Ship	1989	10.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Al Sagar Engineering Co.L.L.C – Abu Dhabi	U.A.E.	Waterworks	2001	27.5 m ³ /d	Desalination of Sea Water. Reverse Osmosis Plant	Drinking water
Al Sagar Engineering Co.L.L.C – Abu Dhabi	U.A.E.	Waterworks	2001	113.5 m ³ /d	Desalination of Sea Water. Reverse Osmosis Plant	Drinking water
Albatros, Lanzarote	Spain	Waterworks hotels	1993	150 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Amagerværket	Denmark	Power Plant	1991	240 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Process water
Amagerværket, AMV Københavns Belysningsvæsen	Denmark	Power Plant	1995	3x600 m ³ /d	Desalination of seawater, reverse osmosis. Second rate water/seawater. Reverse osmosis plant	Process water
Amarilla, Tenerife	Spain	Waterworks hotel	1994	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Amfi del Mar 3, Gran Canaria	Spain	Hotels	1996	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Amfi del Mar 4, Gran Canaria	Spain	Hotels	1996	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Amfi del Mar II, Lanzarote	Spain	Waterworks, hotel	1994	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Amfi del Mar, Gran Canaria	Spain	Waterworks, hotel	1993	200 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Apartemento Selestes, Lanzarote	Spain	Waterworks, hotel	1994	75 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Atammik, Greenland	Denmark	Waterworks, hotel	1993	10 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Barcelo, Fuerte Ventura	Spain	Hotels	1996	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Beach Club, Lanzarote	Spain	Hotels	1993	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Beatriz 2, Lanzarote	Spain	Hotels	1995	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Bermuda Waterworks	Bermuda	Waterworks	1999	575 m ³ /d	Desalination of seawater, SWRO-42-ERS	Drinking water
Brostroms Shipping (M/S Thuleland)	Sweden	Ship	1988	20.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Bruces Shipyard (Fosen) Landskrona (Anek lines, Crete)	Sweden	Ship	1999	100 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Bruces Shipyard (Fosen) Landskrona (Anek lines, Crete)	Sweden	Ship	2000	100 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Campana Beach, Lanzarote	Spain	Waterworks, hotel	1997	80 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water

Client	Country	Trade	Year	Capacity	Plant description	Results
Caramondani	Cyprus	Waterworks	2000	325 m ³ /d	Desalination of seawater, reverse osmosis, SWRO-25-ERS	Drinking water
DFDS	Denmark	Off-Shore	1996	2x125 m ³ /d	Desalination of seawater, Reverse Osmosis	Drinking water
DFDA, Queen of Scandinavia	Denmark	Ship	2001	215 m ³ /d	SeaRO 16	Drinking water
East Water	Thailand	Waterworks	1999	250 m ³ /d	Desalination of seawater, SeaRO-20-ERS	Drinking water
El Trebol, Lanzarote	Spain	Waterworks, hotel	1993	80 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Ficus, Lanzarote	Spain	Waterworks, hotel	1993	40 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Fossen Shipyard	Sweden	Off-Shore	2000	2x100 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Gaza	Denmark	Power Plant Waterworks	2000	3x330 m ³ /d	Desalination of seawater, reverse osmosis, SWRO-25-ERS	Drinking water
HOH Canarias	Spain	Hotels	2001	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
HOH Canarias	Spain	Hotels	1999	100 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
HOH Vattenteknik	Chile	Hotels	1999	30 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
HOH Canarias, Lanzarote	Spain	Hotels	1998	300 m ³ /d	Desalination of Sea Water. Reverse Osmosis, SWRO-25-ERS	Drinking water
HOH Canarias, Lanzarote	Spain	Hotels	1999	100 m ³ /d	Desalination of Sea Water. Reverse Osmosis, SWRO-10-ERS	Drinking water
HOH Canarias, Lanzarote	Spain	Hotels	1999	300 m ³ /d	Desalination of Sea Water. SWRO-25-ERS	Drinking water
HOH Canarias, Lanzarote	Spain	Hotels	1999	500 m ³ /d	Desalination of Sea Water. SWRO-42-ERS	Drinking water
Hotel El Trebol, Lanzarote	Spain	Hotels	1991	80 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Hotel Neptuno, Lanzarote	Spain	Waterworks, hotel	1997	24 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Hotel Oasis, Lanzarote	Spain	Waterworks, hotel	1993	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Hotel Tuscan	Spain	Waterworks, hotel	1993	60 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Hotel Vital Plaza, Lanzarote	Spain	Waterworks, hotel	1993	370 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Hunde Ejland, Greenland	Denmark	Waterworks, hotel	1994	5 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Ikerasaarsuk, Greenland	Denmark	Waterworks, hotel	1996	5 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Imotel, Isla Canarias	Spain	Hotels	1995	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Indian Ocean Tuna	Seychelles	Food	1999	500 m ³ /d	Desalination of seawater, 1 x SWRO-42-ERS	Drinking water

Client	Country	Trade	Year	Capacity	Plant description	Results
Indian Ocean Tuna	Seychelles	Food	1999	2x300 m ³ /d	Desalination of seawater, 2 x SWRO-25-ERS	Drinking water
IOEC-Bahreganzar	Iran	Off-Shore	1998	2x35 m ³ /d	Drinking water production for oil rig, Desalination of seawater, reverse osmosis	Drinking water
Iranian Offshore	Iran	Off-Shore	1998	2x55 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Iranian Offshore Engineering Co	Iran	Off-Shore	2000	50 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Isla Margarita, Venezuela	Venezuela	Waterworks, hotel	1993	1000 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Itelleq, Greenland	Denmark	Waterworks, hotel	1994	10 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Karlskrona AB, Karlskrona,(3 x Patrol boat "Vida" (Swedish Navy)	Sweden	Ship	1990	3.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Karlskrona AB, Karlskrona,(3 x Patrol boat "Vida" (Swedish Navy)	Sweden	Ship	1991	3.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Karlskrona AB, Karlskrona,(5 x Patrol boat "Vida" (Swedish Navy)	Sweden	Ship	1992	3.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Karlskrona AB, Karlskrona, (Schooner Falken) (Swedish Navy)	Sweden	Ship	1989	1.5 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Karlskrona AB, Karlskrona, (Schooner Falken) (Swedish Navy)	Sweden	Ship	1989	1.5 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Kockums, AB, Malmo, (Submarine "Gotland"), (Swedish Navy)	Sweden	Ship	1993	3x1.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Kockums, AB, Malmo, (Submarine "Riken"), (Singapore Navy)	Sweden	Ship	1996	1.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Kockums, AB, Malmo, (Submarine "Riken"), (Singapore Navy)	Sweden	Ship	1998	3x1.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Kureda Islands	The Maldivian Islands	Municipal	1996	200 m ³ /d	Desalination of seawater	Drinking water
La Santa Sport, Lanzarote	Spain	Waterworks, hotel	1993	500 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Lanzarote Bay, Lanzarote	Spain	Waterworks, hotel	1993	90 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Loz Zocos, Lanzarote	Spain	Waterworks, hotel	1993	150 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Maersk Olie & Gas	Denmark	Off-Shore	2000	50 m ³ /d	Desalination of seawater, reverse osmosis, SWRO-4	Drinking water
Makkah Water	Saudi Arabia	Brewery	1993	1 x 28 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Boiling water

Client	Country	Trade	Year	Capacity	Plant description	Results
Makkah Water	Saudi Arabia	Brewery	1995	1 x 20 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Boiling water
Makkah Water	Saudi Arabia	Brewery	1999	1 x 20 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Boiling water
Malé	The Maldivian Islands	Waterworks	1995	3500 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Malé Water and Sewerage Co.	Mldivies	Waterworks	1999	1000 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Marinkommando Ost, Karlskrona ((5x Missole boat)(Swedish Navy)	Sweden	Ship	1992	3.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Marinkommando Ost, Karlskrona ((6x Missole boat)(Swedish Navy)	Sweden	Ship	1993	3.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Meeru	The Maldivian Islands	Hotels	1996	100 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Municipality of Ios	Greece	Waterworks	2001	1000 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Municipality of Sifnos	Greece	Waterworks	2001	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Oceanking Maritime Inc. Piraeus (MT Paros)	Greece	Hotels	1992	10.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Oqaatsut, Greenland	Denmark	Waterworks, hotel	1993	10.0 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Parque Tropical, Lanzarote	Spain	Waterworks, hotel	1993	80 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Playa Flamingo, Lanzarote	Spain	Waterworks, hotel	1993	170 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Qeqertag, Greenland	Denmark	Waterworks, hotel	1993	10 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Remonlowa S.A. Gdansk (Prerov)	Poland	Ship	2001	25 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Remonlowa S.A. Gdansk (Sarfaq, Itluk)	Poland	Ship	1999	30 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Remonlowa S.A. Gdansk (Sarpik, Itluk)	Poland	Ship	1999	30 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Remonlowa S.A. Gdansk (Lodrog)	Poland	Ship	2001	25 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Sadafco	Saudi Arabia	Brewery	1997	1 x 8 m ³ /d	GAC + RO + Ozone, reverse osmosis	Drinking water
Sadafco	Saudi Arabia	Brewery	2000	1 x 6 m ³ /d	GAC + RO + Ozone, reverse osmosis	Drinking water
Sahma Social Housing	Oman		1994	45 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Stella Canarias, Lanzarote	Spain	Hotels	1994	250 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water

Client	Country	Trade	Year	Capacity	Plant description	Results
Saarlog Municipality, Greenland	Denmark	Waterworks, hotel	1993	12 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Saattut Kommune, Greenland	Denmark	Municipal	1997	12 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Tahiche, Lanzarote	Spain	Waterworks, hotel	1993	75 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Tequise Playa, Lanzarote	Spain	Waterworks, hotel	1993	130 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Tequise Playa, Lanzarote	Spain	Waterworks, hotel	1997	480 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water
Tequisol, Lanzarote	Spain	Waterworks, hotel	1993	90 m ³ /d	Desalination of Sea Water. Reverse Osmosis	Drinking water