

# Membrane Performance Contracts



**Nano** · **H<sub>2</sub>O**



# Partnering for Performance

NanoH<sub>2</sub>O's Membrane Performance Contracts create added value for our customers. They allow SWRO plant owners and/or operators to cost-effectively retrofit existing SWRO plants to lower energy usage or to increase production. Under this program, NanoH<sub>2</sub>O partners with its customers to optimize their SWRO system permeate flow and energy usage to maximize operating economics. Additionally, NanoH<sub>2</sub>O will warranty the performance of its elements over the course of a five-year contract term. This partnership will ensure the efficiency and increased capacity of the desalination system.



Under a Membrane Performance Contract, NanoH<sub>2</sub>O assesses our customers' current plant design and operations. Modeling software is used to project improved facility performance using **QuantumFlux** elements. In addition to guaranteeing energy usage and water production rates, NanoH<sub>2</sub>O will provide its Membrane Performance Contract customers with **QuantumFlux** elements for either a deeply discounted or zero upfront charge. In return, Membrane Performance Contract customers pay NanoH<sub>2</sub>O a percentage of the value created by using **QuantumFlux** products over a 5-year term, creating a partnership between membrane supplier and customer that is unparalleled in the industry.

Features include:

- Contract costs based on the economic benefit generated by Qfx elements with little to no upfront cost
- Exceptional support by highly trained Application and Field Engineers
- Guaranteed energy savings, performance efficiency and an increase in productivity
- Remote monitoring of element performance by NanoH<sub>2</sub>O Technical Support, plus more site visits than any other service program on the market
- Expert guidance on element maintenance and optimization

Call +1 424.218.4000 or email [sales@nanoh2o.com](mailto:sales@nanoh2o.com) to find out how **QuantumFlux** can lower the cost of desalination.

# Changing the Economics of Desalination

NanoH<sub>2</sub>O is a global provider of reverse osmosis (RO) membranes that change the fundamental economics of desalination. Based on breakthrough nanostructured materials and industry-proven polymer technology, NanoH<sub>2</sub>O's thin-film nanocomposite (TFN) **QuantumFlux**<sup>™</sup> membranes dramatically improve desalination energy efficiency and productivity.

**QuantumFlux** seawater reverse osmosis (SWRO) membranes exhibit the highest flux and the highest rejection on the market. **QuantumFlux** membranes are available in standard 4-inch (10 cm) and 8-inch (20 cm) diameter elements that fit easily into new and existing desalination plants, purifying water from a broad range of sources.

In 2011, after extensive membrane development and three years of testing at the United States Navy Facility in Port Hueneme, California, NanoH<sub>2</sub>O commenced commercial operations from its manufacturing and R&D facility located in El Segundo, California.



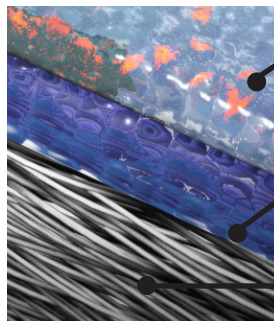
## More Water. Less Energy.

**QuantumFlux**<sup>™</sup> membranes feature benign nanomaterials incorporated into the polyamide layer of the thin-film composite membrane. This innovative patented and patent-pending technology increases membrane permeability by 50-100% when compared to the competition, while still maintaining best-in-class salt rejection.

**QuantumFlux** membranes come in 4-inch or 8-inch spiral wound configurations designed to slide easily into standard pressure vessels. For a retrofit of an existing plant, **QuantumFlux** elements can:

- Reduce energy usage by up to 20%, **OR**
- Increase production capacity by as much as 70% without increasing operating pressure

Cross-section View of **QuantumFlux** Membrane



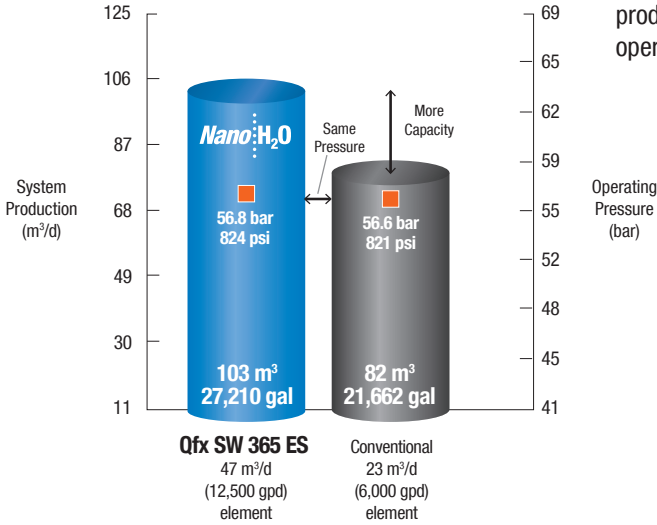
Nanoparticle-Polyamide Dense Film Layer

Porous Polysulfone Support

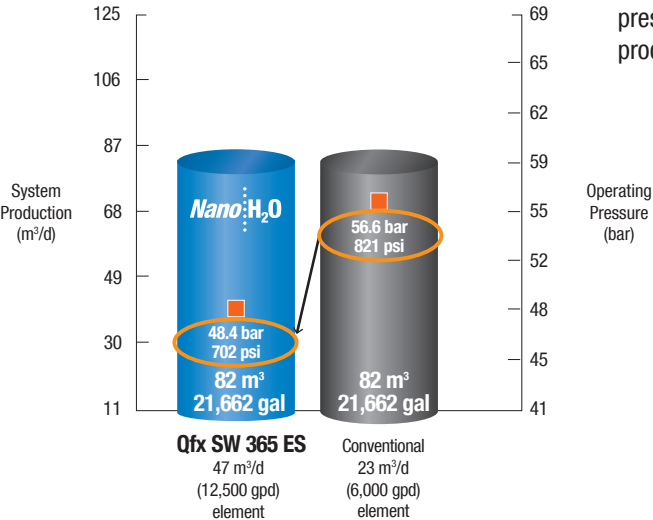
Polyester Non-Woven Fabric

- Higher flux with best-in-class salt rejection
- Less driving pressure
- Standard 4-inch or 8-inch spiral-wound elements
- Easy to retrofit into existing SWRO plants
- NSF Standard 61 Certified

# Competitive Advantage



**Chart 1: 25% increase in system production with no increase in operating pressure.**



**Chart 2: 17% decrease in operating pressure at the same level of system production.**

*Results are based on actual data from US Navy's Port Hueneme Desalination Test Facility: 11 m³/hr; 40% FWR, 15-18 °C; 34,000 ppm open intake.*

# Case Study

## Installation Overview

Site Location	Cayman Islands
Date	July 1, 2011
Scale	556 m <sup>3</sup> /d (146,880 USGPD)
Product	Qfx SW 365 ES
Offering	Membrane Performance Contract
Client	Water Authority Cayman



## System Description

Cayman Brac is a single train 2-pass SWRO plant with inland feed wells and cartridge filtration. It provides potable water to the Cayman Brac distribution system. The plant was expanded and upgraded in 2003 featuring ERI, new vessels and elements, and additional pre-filtration. The plant nameplate is 556 m<sup>3</sup>/d (146,880 USGPD). It uses five PX25 ERI's, a Wheatley HP125 PD Pump, a Grundfos Booster pump, 36 (6x6) Filmtec™ SW30HR elements and 36 (6x6) FilmTec 4-inch BW30-4040 BWRO elements. The second pass is a 2-stage 4-into-2 design. There are three spare 8-inch 6-element vessels. Second pass pressure is 14.1 BAR (205 PSIG) and second pass feed is 6.6 m<sup>3</sup>/h (29 USGPM). The overall plant permeate quality is 50 TDS. First pass overall permeate quality is approximately 120 TDS.

The flow and feed streams are given in Table 1. Conversion is estimated at 37%.

Table 1: Plant operating parameters **PRIOR** to installation of **QuantumFlux** elements.

Stream	BAR (PSIG)	m <sup>3</sup> /h (USGPM)	TDS
Overall HP Feed	70.6 (1,024)	59.3 (261)	34,380
1st Pass Permeate	0.69 (10)	15.2 (67)	120
Specific Energy	3.47 kWh/m <sup>3</sup> (13.14 kWh/1,000 USG)		
1st Pass Recovery	37%		

Note: Temperature range is between 25° to 29° C

## Performance Results

NanoH<sub>2</sub>O installed Qfx SW 365 ES elements and consequently saved Water Authority Cayman 0.98 kWh/m<sup>3</sup> (3.7 kWh/1,000 USG), or 28%, by lowering the pressure from 70.6 BAR (1,024 PSIG) to 44.8 BAR (650 PSIG) while exceeding their required permeate quality. In addition, NanoH<sub>2</sub>O offered the client an opportunity to partner with NanoH<sub>2</sub>O through the company's unique Membrane Performance Contracts offering.

Table 2: Plant operating parameters **AFTER** to installation of **QuantumFlux** elements.

Stream	BAR (PSIG)	m <sup>3</sup> /h (USGPM)	TDS
Overall HP Feed	44.8 (650)	57.7 (254)	31,445
1st Pass Permeate	0.69 (10)	16.1 (71)	263
Specific Energy	2.49 kWh/m <sup>3</sup> (9.44 kWh/1,000 USG)		
1st Pass Recovery	40%		

Note: Temperature range is between 25° to 29° C

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