# Tuaspring Integrated Water and Power Project

## Asia’s First Integrated Water and Power Project

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## Facts & Figures

| **Client** | PUB, Singapore |
| **Developer** | Tuaspring Pte Ltd, a wholly-owned subsidiary of Hyflux Ltd |
| **Location** | Tuas, western Singapore |
| **Project Description** | Design-Build-Own-Operate (DBOO) on 25-year concession |
| **Technology** | Reverse osmosis (RO) with ultrafiltration (UF) for the pre-treatment |
| **Capacity** | 318,500 m³, or 70 million gallons per day |
| **Online** | 2013 |
| **Land Area** | 14.4 hectares (desalination plant and power plant) |
| **Award** | Global Water Awards 2014 - Distinction, Desalination Plant of the Year |

### Special Features

(a) 411 MW on-site combined cycle gas turbine power plant to supply electricity to the desalination plant. Energy generated will be sold to the national grid.

(b) One of the world’s largest installations of Hyflux’s Kristal® UF membranes for the pre-treatment system before the RO process.

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Coupling a desalination plant with a power plant ensures a secure source of energy for the production of water. At the same time, heat from the power generation process warms the water which is fed into the desalination plant. With warmer feed water, lower osmotic pressure is required during the reverse osmosis phase. This results in lower energy consumption and cost savings.

INTEGRATED WATER & POWER PLANT PROCESS
Intake
Two intake towers are anchored 50 m from shore. They are connected to the intake chamber via two 2.5 m diameter pipes laid under the sea bed.

The seawater passes through filter screens of 20 mm and 2 mm before being pumped to an array of auto-strainers of 100 µm and onwards to the UF pre-treatment system.

Pre-treatment
Hyflux’s Kristal® UF membranes are used in the pre-treatment system. Kristal® UF membranes have been tested to effectively remove microorganisms and bacteria which can foul the downstream RO system. The result is a permeate of consistently high quality that will boost the performance and lifespan of the RO membranes.

Reverse Osmosis
There are two RO passes for the treatment of the permeate from the UF treatment process.

The first RO pass uses seawater reverse osmosis (SWRO) technology. Approximately 45% of the pre-treated seawater is recovered from the first RO pass for treatment in the second RO pass. The latest energy recovery technology is adopted to recover the residual energy.

The second RO pass using low pressure reverse osmosis (LPRO) process further treats the water to meet the boron specification. About 90% of the water from the first RO pass is recovered after the second RO pass.

Outfall
After the RO, the RO reject stream is discharged back into the sea through an outfall diffuser 120 m from shore.

Post-treatment
The water after the two-pass RO treatment is very pure and is re-mineralised by dosing with lime and carbon dioxide to adjust the pH level. Chlorine, fluoride and ammonium sulphate are added for fluoridation and chloramination.

The water is then stored in the product water tank before being pumped to a PUB service reservoir for delivery to homes and industries in Singapore.
A combined-cycle power plant using both a gas and a steam turbine has higher energy efficiency than a simple-cycle plant.

In a combined-cycle power plant, the gas turbine burns fuel gas and converts thermal energy into kinetic energy. This drives a generator which transforms kinetic energy into electrical energy.

Waste heat from the gas turbine is captured by a heat recovery steam generator and used to create steam. The steam powers the steam turbine to generate a higher electricity output.

Fuel gas consumed by a combined-cycle power plant is transformed into electrical power at 60% efficiency compared to 40% efficiency for a simple-cycle plant which only has a gas turbine without the heat recovery process.