

CASE STUDY

CHEMICAL

FOOD & BEVERAGE

OIL & GAS

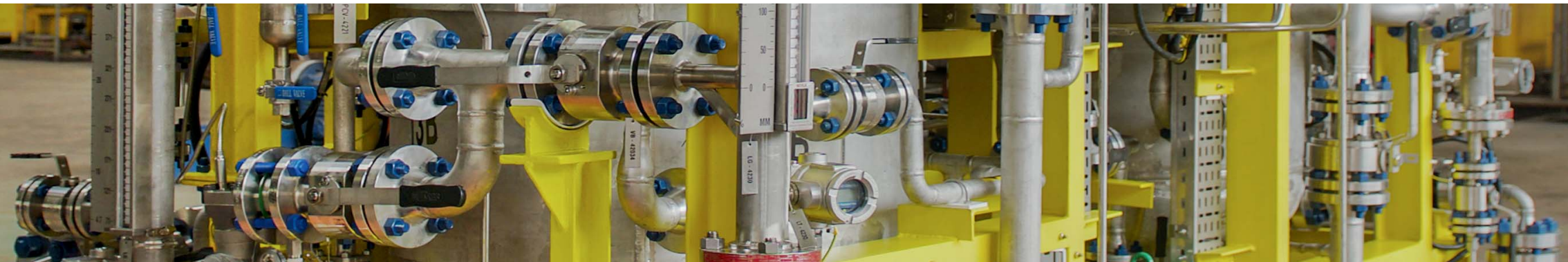
POWER GENERATION

PULP AND PAPER

SEMICONDUCTOR & SOLAR



An Aquarion Group Company



Offshore High Pressure High Performance Produced Water Treatment Package

End user: Sapura Kencana Energy

Order receipt: January 2013

Delivery: January 2014

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Process Overview

A high-pressure high-efficiency produced water treatment system designed to meet strict overboard discharge limits while accommodating onerous space and weight constraints imposed by offshore design requirements.

Petronas and Sapura Energy required a produced water treatment (PWT) system for their SK310 B15 production platform located offshore Sarawak, Malaysia.

The system was designed to reduce the produced water free-oil concentration from a maximum of 3,000 ppm at the inlet to below 20 ppm for overboard discharge. The main challenges encountered on this project centred around the inlet pressure of 117 barg, flowrate, and high turndown all coupled with limited footprint and weight allowances imposed by the offshore design. The bespoke nature of the package allowed the H2O&G mechanical design team to produce an extremely compact design which further reduced the weight. The package was fabricated to in-country and client standards to ensure a high-quality reliable construction programme was followed. This practice along with maintaining high project management standards al-

lowed for an early delivery of the package to the clients' integration yard. The solution not only achieved the required process separation duty, but also met the space and weight limitations. The package comprised 2 x 50 % deoiling hydrocyclones followed by two stages of compact flotation units (CFU) without the need for additional fuel gas or any pumping or water recycling. The inlet pressure of 117 barg meant that deoiling hydrocyclones could be used to facilitate high efficiency oil separation. Flow through the liners is controlled based on level in the upstream separator and flow of reject is controlled to maintain a constant differential pressure ratio (inlet to outlet and inlet to reject).



Finished produced water treatment package undergoing pre-commissioning checks.

The flowrate required only two liners, which were each installed in individual pipe spools to minimise space and allow flexibility during turndown / low flow.

Water from the hydrocyclones passes to the 1st-stage CFU. This unit operates as two-phase with gas and oily reject leaving together to the oil section of the 2nd-stage CFU. The 1st-stage CFU is pressure-controlled to ensure that the gas fraction in the feed water is sufficient for flotation (which typically requires 10 to 30 % v/v) but not excessive to avoid churning and erratic operation.

Water from the 1st-stage CFU passes to the 2nd-stage CFU. This unit operates as three-phase with gas, oily reject and cleaned water leaving as separate streams. The unit

receives oily reject from the hydrocyclones and 1st-stage CFU, which allows for degassing and a single oily reject stream from the package.

The 1st-stage CFU operates at low pressure. Again, the pressure drop from the upstream unit is sufficient for flotation but not excessive to avoid churning and erratic operation. This operating philosophy results in three highly efficient stages of oil separation and means that water and gas recycling are not required. The system operates without the requirement for additional fuel gas or any pumps.



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Performance Characteristics

Type of water:	Oily produced water
Operating flowrate:	0.5 to 6.82 m ³ /hr
Design flowrate:	6.82 m ³ /hr
Operating pressure:	117 barg
Oil concentration (feed):	3,000 ppm (maximum)
Oil concentration (discharge):	20 ppm (maximum)
Produced water density:	994.8 kg/m ³
Produced water viscosity:	0.61 cP
Oil density:	764.8 kg/m ³



UV fluorescence oil-in-water analyser



Hydrocyclone pipe spools

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Scope of Supply

Deoiling hydrocyclones

Quantity:	2 x 50 %
Operating flowrate:	0.5 to 3.91 m ³ /hr
Design flowrate:	3.91 m ³ /hr
Operating temperature:	46.9 °C
Operating pressure:	117 barg
Reject ratio:	2.5 %
Differential pressure ratio:	1.6

Design pressure: 135 barg (ANSI #900)

Design temperature: 70 °C

Design code: ASME B31.3

Number of liners (per unit): 1

Unit materials: 22% Cr duplex

Hydrocyclone liner materials: 22% Cr duplex (stellite inlet)



Compact flotation units

Stage:	1st stage	2nd stage
Quantity:	1 x 100 %	1 x 100 %
Operating flowrate:	0.5 to 6.82 m ³ /hr	0.5 to 6.82 m ³ /hr
Design flowrate:	6.82 m ³ /hr	6.82 m ³ /hr
Operating temperature:	46.9 °C	46.9 °C
Operating pressure:	12 barg	0.7 to 1.2 barg
Residence time:	120 seconds	300 seconds
Phases:	2-phase separation	3-phase separation
Diameter:	600 mm	800 mm
Length (tan/tan):	1,300 mm	1,850 mm
Design pressure:	14.5 barg (ANSI #150)	14.5 barg (ANSI #150)
Design temperature	75 °C	75 °C
Design code:	ASME VIII Div. 1	ASME VIII Div. 1
Unit materials:	SS 316	SS 316

Compact flotation units
(1st stage right, 2nd stage left)

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Performance Guarantee

The performance guarantee includes:

Reduction of the oil inlet concentration from a maximum of 3,000 ppmw at the inlet to a maximum of 20 ppmw suitable for overboard discharge

Note:

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Contact:

H₂Oil & Gas Ltd.
272 Bath Street
Glasgow, G2 4JR
United Kingdom

Phone: +44 141 6288220
E-Mail: info@h2oilandgas.com

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