Boskalis
Dredging & Marine Experts

PROJECT SHEET

BUKOM SBM 48
SUBSEA PIPELINE REPAIR PROJECT

BOSKALIS' ENERGY SOLUTIONS

Boskalis is a leading global dredging and marine expert. With safety as our core value we provide innovative, sustainable and all-round solutions for our clients in the energy market. Realizing projects in remote locations with a heightened environmental focus is one of our specialties. Under brands such as Boskalis Offshore, Dockwise, SMIT and Smit Lamnalco we offer more services than any other company in our industry, making us your next one-stop solution provider.
We support the development, construction, maintenance and decommissioning of oil and gas import and export facilities, fixed and floating exploration and drilling facilities, pipelines and cables and offshore wind farms.

BUKOM SBM 48" SUBSEA PIPELINE REPAIR PROJECT

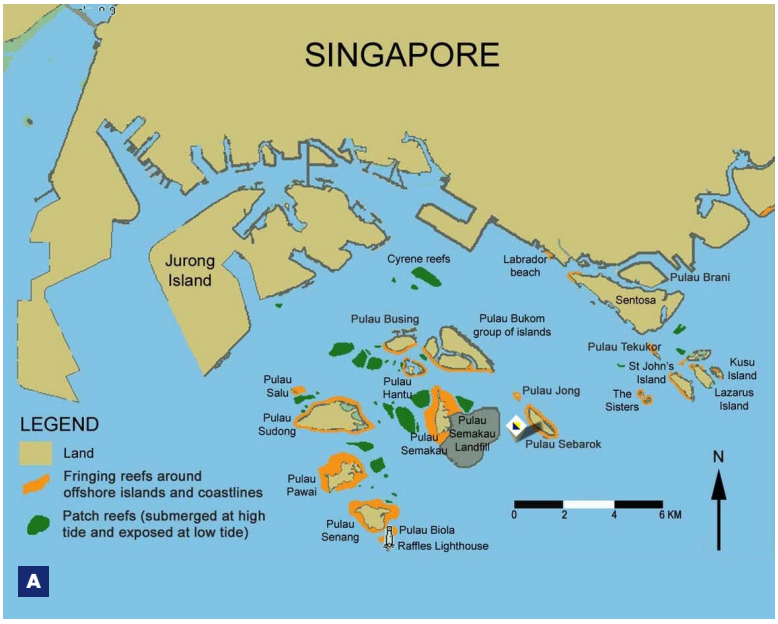
The Shell Bukom Refinery on Bukom Island imports the bulk of its crude oil feedstock through a Single Buoy Mooring (SBM) situated approximately 5.2 km from the island in the deeper water necessary to accommodate Very Large Crude Carriers.

The SBM is connected to the shore by a 48" concrete weight coated submarine pipeline. To extend the operating life of this pipeline, a 2.7-km section starting at the Pipeline End Manifold (PLEM) containing most of the corroded spots was replaced.

The overall project scope included laying approximately 2.7 kilometers of new pipeline in the re-routed trenched corridor, de-oiling the

FEATURES

Client	Shell Eastern Petroleum (Pte) Ltd
Location	Singapore
Period	October 2012 – October 2013
Contractor	Leighton Offshore Pte Ltd and Boskalis International (S) Pte Ltd (Leighton-Boskalis Consortium)



A Location map
B Ripper head TSHD
C TSHD Queen of the Netherlands dredging hard spot close to the existing SBM

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existing pipeline, removing the existing SBM buoy and PLEM, in-situ inspection of the SBM mooring chains, de-burial, cutting and removal of the existing pipeline at both tie-in locations, installation of the new PLEM, associated tie-in connections between the newly laid pipeline and the existing facilities, re-installation of the SBM, hydro-testing and final leak testing of the modified facilities. The scope was extended to include the removal of the replaced pipeline section.

Due to the close proximity to the existing SBM and its mooring chains, soil surveys requiring anchored vessels could not be carried out on a potential hard spot. There was a serious concern that dredging this section would not be possible using the proposed dredging equipment during pipeline outage. Boskalis suggested dredging this particular trench section using the Trailing Suction Hopper Dredger (TSHD) Queen of the Netherlands with a ripper draghead well in advance of the actual trench dredging works. The ripper draghead broke and removed the weathered rock and overlying, stiff to very stiff, clay and gravel.

Boskalis deployed the TSHD Cornelis Zanen for the trench dredging works. Using the boulder-clay dragheads, the Cornelis Zanen dredged a total volume of approximately 160,000 m^3 and discharged the dredged material at the designated disposal area by pumping it down to a depth of some 40 m through the suction pipe.

The tie-in and pipeline removal activities required the full de-burial of the existing pipeline. The TSHD Cornelis Zanen successfully completed de-burial in jetting mode, acting as a large but highly maneuverable and controllable mass flow excavator.

Prior to the installation of the PLEM and the new pipeline, a gravel bed was installed extremely accurately by the fallpipe pontoon (FPP) Zinkoon 6.

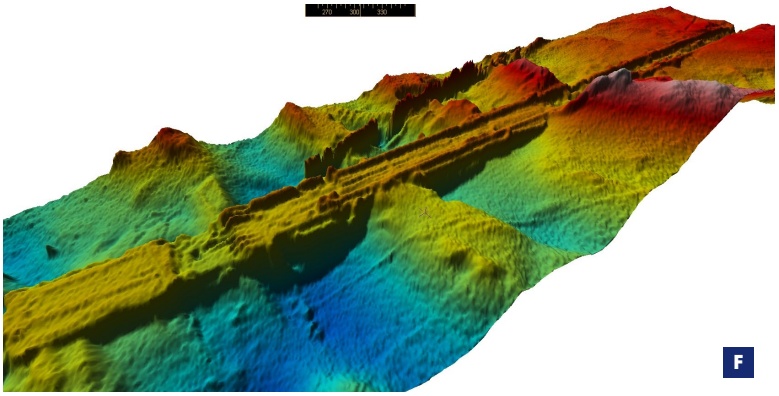
Upon completion of the pipe-lay activities, the entire trench was backfilled. The FPP Zinkoon 6 also carried out the backfilling and the installation of rock armor using gravel and armor rock from quarries in Malaysia and Indonesia.

Strict environmental requirements were applicable and to demonstrate that there was no impact exceeding tolerable levels to the identified environmental receptors, Boskalis commissioned online monitoring of water quality by deploying an environmental feedback monitoring system.

On a separate sub-contract for Boskalis' consortium partner Leighton Offshore, Boskalis Offshore Subsea Services carried out all the diving activities on the project.

The Boskalis Safety Program NINA (No Injuries No Accidents) was recognized by Shell, and Boskalis was authorized to use NINA throughout the project.

The entire project was completed ahead of schedule, allowing for an early start-up of the facilities, within budget and to the client's full satisfaction.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D FPP Zinkoon 6 and multicat BKM 102
E TSHD Cornelis Zanen and Lay Barge Leighton Stealth
F Post-survey of gravel bed installation at PLEM area

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