

PROJECT SHEET

JAVA-BALI SUBMARINE CABLES
150 KV CIRCUIT 3&4 PROJECT (REPLACEMENT AND REINFORCEMENT)

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, VBMS and Smit Lamnalco we offer a wide range of services, 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.

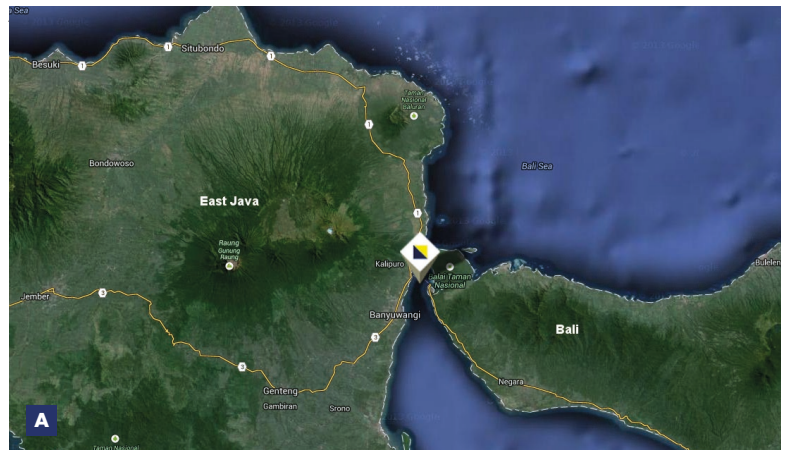
JAVA-BALI SUBMARINE CABLES 150 KV CIRCUIT 3&4 PROJECT

The island of Bali has been suffering a constant shortage of power. PLN contracted a Consortium of PT. Boskalis International Indonesia, Sumitomo Corporation and J-Power Systems Corporation to procure and install two 150 kV submarine and underground interconnecting power cables to replace existing cables and to reinforce the link between the electricity grids on the Indonesian islands of Java and Bali. The cables have the capability to transfer power at 130 MVA per circuit. This project will provide enough additional power to solve Bali's shortage and facilitate the further development of a popular tourist destination, which attracts around 2.3 million tourists each year.

Boskalis' scope ran roughly from the high water mark at Ketapang, Java, to the high water mark at Gilimanuk, Bali and involved the installation of the two submarine cables, including four cable landings. After cable installation, both cables had to be covered with a rock berm over nearly the

FEATURES

Client	PT. PLN (Persero)
Location	Ketapang (Java)-Gilimanuk (Bali) – Indonesia
Period	February – April 2014
Contractor	Consortium of PT. Boskalis International Indonesia, Sumitomo Corporation and J-Power Systems Corporation



- A** Location map
- B** View on the 5,000 tons carousel of the Ndurance
- C** Second end landing operation

entire length of the routes. The newly built Cable Laying Vessel (CLV) Ndurance was deployed for the cable installation.

ENGINEERING

One of the most complicating factors was the extremely strong current which occurs in the Bali Strait. Boskalis' in-house engineering company Hydronamic was involved to analyze the most efficient installation method and period. Based on a current measurement campaign, which lasted over one year, the most favorable installation window was determined.

Since Boskalis was also responsible for the cable routes design, an extensive hydrographic survey was undertaken to map the seafloor. This survey and the



JAVA-BALI SUBMARINE CABLES

150 KV CIRCUIT 3&4 PROJECT (REPLACEMENT AND REINFORCEMENT)

design parameters specified by the Client were used to design the optimum cable routes, taking the properties of the cables into account. Mitigation of free spans and vortex induced vibrations (VIV) formed part of the engineering work, coordinated by Boskalis' affiliate VBMS.

To assess the station keeping capabilities of the Ndurance at this specific location with very strong currents, a series of simulations was performed at the Marin ship simulator. Based on these simulations, it was decided to have an Azimuth Stern Drive (ASD) tug boat stand-by in the direct vicinity of the CLV during cable lay operations to avoid any risk for crew, vessel and cable. Extensive sea trials were undertaken in Singapore and on site to practice and determine the behavior of the Ndurance and the combination of CLV and ASD tug.

SUBMARINE CABLE INSTALLATION

The CLV was mobilized in Singapore, where the two cables were loaded in the 5,000 tons carousel of the vessel, and subsequently sailed to Indonesia. After preparation of the landing sites, the Ndurance moved into position near shore for the pull-in of the first cable at Gilimanuk. As soon as the cable reached the jointing bay, it was kept

in position and the Ndurance commenced laying the cable towards Ketapang. At Ketapang the second end landing was performed. The Ndurance then moved back to the Bali side to position itself for the pull-in of the second cable, after which the cable installation sequence of the first cable was repeated for the second cable. For the touchdown monitoring Boskalis developed an automated system based on departure angle monitoring. A Dynamically Positioned Anchor Handling Tug (DP AHT) was fitted out with two working class Remotely Operated Vehicles (ROVs) owned and operated by Boskalis Offshore Subsea Services. The ROVs were used for visual inspections and as-built surveys of the installed cables. OTDR testing was performed on the two cables during installation and afterwards during the rock installation. Once the second cable was installed, the Ndurance was demobilized. Boskalis' affiliate VBMS was responsible for the installation of the submarine cables and associated engineering work.

SUBSEA ROCK INSTALLATION

Over the entire length of both cables, except for the very nearshore and onshore sections, a fallpipe vessel installed a rock berm to protect the cables. The required rock quantity was produced at a local quarry in East Java and transported to the port of Banyuwangi. Here a large stockpile was created and a purpose-built conveyor belt constructed to load the fallpipe vessel. In a well-coordinated manner and by making use of the available tidal windows, the rock was installed over the cables.

NINA

The project was carried out without incidents or accidents. NINA, the Safety Program of Boskalis, was implemented on this project with an emphasize on the safe behavior of the many local sub-contractors.



D



F



E

- D Aerial view of the second landing operation
- E CLV Ndurance
- F The fully integrated bridge of the Ndurance

Royal Boskalis Westminster N.V.
PO Box 43
3350 AA Papendrecht
The Netherlands
T +31 78 69 69 000
F +31 78 69 69 555
royal@boskalis.com
www.boskalis.com