

PROJECT SHEET

FEHMARN BELT

UXO IDENTIFICATION & CLEARANCE 2020 - 2022

BOSKALIS

Boskalis is a leading global marine contractor and services provider. With safety as our core value, we offer a wide variety of specialist activities to the oil & gas and renewables sectors. These activities include marine installation and decommissioning, seabed intervention, marine transport and services, subsea services and marine survey. In addition, Boskalis is a global dredging contractor, provides towage and terminal services across the globe and delivers marine salvage solutions.

By understanding what drives our clients we are able to provide the solutions that enable them to meet their specific business goals. For this reason we are constantly looking for new ways to broaden and optimize our offering and are committed to expanding our proposition, supported by our financial strength.

With our committed professionals in engineering, project management and operations, 500 specialized vessels and an unprecedented breadth of activities in 90 countries across six continents we help our clients in the offshore industry push boundaries and create new horizons.

INTRODUCTION

The Fehmarn Belt link will be an 18-kilometre-long immersed tunnel. It will be the world's longest tunnel of this type for both road and rail transport. The tunnel will carry a four-lane motorway and two electrified railway tracks. It will consist of 79 individual elements, each measuring 217 metres in length. The link will connect Rødbyhavn in Lolland, Denmark, to Puttgarden in Fehmarn, Germany.

Unlike a bored tunnel, an immersed tunnel is built using hollow concrete elements cast on land. These elements are transported to site and installed one by one. They are then joined together to form the final tunnel structure.

To enable construction, a trench is dredged in the seabed. The trench will be up to 60 meters wide, 16 meters deep, and 18 kilometers long. Around 19 million cubic meters of soil will be excavated. This process prepares the seabed and provides a stable foundation for the tunnel.

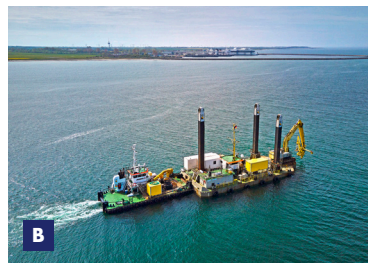
The construction of the Fehmarn Belt link is expected to take approximately 8.5 years. Once completed, it will significantly reduce travel time between Denmark and Germany. The journey, when all finished, will take only around 10 minutes by car and about 7 minutes by train.

FEATURES

Client	Fehmarn Belt Contractors I/S
Location	Between Denmark and Germany
Period	May 2020 - October 2022
Contractor	Heinrich Hirdes EOD Services GmbH.



- A** Project location Fehmarn Belt Tunnel
- B** The Backhoe Dredger HH12 sailing to its work location
- C** ROV Support Vessel Kamara
- D** ROV Support Vessel Ndeavor
- E** Double bubble curtain deployment vessel, on deck the air compressors are installed during mobilisation



SCOPE OF WORK

In 2020, prior to the tunnel dredging works, the Multitool (also known as the "Swiss Knife") was deployed on the backhoe dredger HH12. The multicat Belt provided support. The objective of this campaign was to investigate and clear potential unexploded ordnance (pUXO) linked to the construction of the work harbour and reclamation areas. All activities took place in nearshore Danish waters, at depths ranging from 3 m to 11 m. During the campaign, 117 targets were investigated and cleared. The Multitool is an in-house developed system designed for nearshore UXO clearance. It integrates several tools, including a profiler, electromagnetic (EM) detection system, imaging sonar, dredge pump, and orange peel grab. The system allows rapid switching between tools, which improves operational efficiency.

In 2021, Boskalis EOD Services was remobilized to investigate almost 3,000 pUXO targets along the planned tunnel route. The Multitool was again deployed on board the backhoe dredger HH12, supported by the multicat Belt. These works covered both Danish and German nearshore waters.

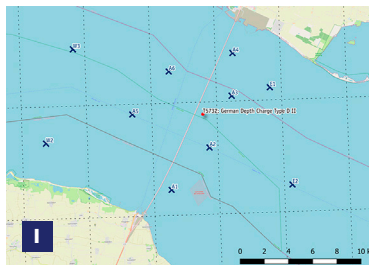
Offshore investigations, which involved a large number of targets, were carried out using the vessel Kamara. This vessel was equipped with a Work-Class Remotely Operated Vehicle (WROV) and the Submerged Transient Electromagnetic (SubTEM) system. The SubTEM system is fully certified and enhances standard detection methods such as the TSS-440. It can distinguish between natural objects (e.g. boulders) and man-made items, like UXOs. It also helps classify targets based on set thresholds. The SubTEM system played an important role in target detection and assessment.

Demolition activities were executed in October 2022 using the ROV Support Vessel Ndeavor. Several mitigation measures were applied to reduce the impact of underwater blasts:

- Deployment of a Double Big Bubble Curtain (DBBC) from the supply vessel
- Deployment of 5 Marine Mammal Observers (MMOs) with Acoustic Deterrent Devices (ADDs)
- Deployment of 4 guard vessels
- Installation of 10 hydrophones over a 10 km range for underwater noise monitoring

USED VESSELS & EQUIPMENT

- BHD HH12 with Multitool
- Multicat Belt
- ROV Support Vessel Kamara
- ROV Support Vessel Ndeavor
- DBBC Deployment Vessel
- Work-Class ROV System
- ODF (Offshore Destruction Frame)
- 4 x support vessels (Guard vessels and Marine Mammal Observers)



- F** WROV
- G** Offshore Demolition Frame in place on target.
- H** Demolition of an UXO, surrounded by two (2) bubble curtains which is common in German waters.
- I** During the demolition works 10 hydrophones were installed.

Boskalis

PO Box 43
3350 AA Papendrecht
The Netherlands
T +31 78 69 69 000
royal@boskalis.com
www.boskalis.com