

# PROJECT SHEET

## KHALIFA PORT AND INDUSTRIAL ZONE (KPIZ) PROJECT, ABU DHABI

A LARGE-SCALE DESIGN, PROCUREMENT AND CONSTRUCTION CONTRACT IN SENSITIVE ENVIRONMENTAL SURROUNDINGS

### INTRODUCTION

The Khalifa Port and Industrial Zone (KPIZ), one of the world's largest greenfield development projects, is part of Abu Dhabi's major diversification plan to develop various sectors such as property, tourism, infrastructure and others. Abu Dhabi's main existing port, Mina Zayed, is hemmed in by Abu Dhabi city, limiting its accessibility and the possibility for expansion. The new Khalifa Port, located 4.6 km offshore, is built on an artificial island (Port Island) with a separate berth island (for Emirates Aluminum). These islands are connected to the mainland by causeways and bridges. Khalifa Port is scheduled to replace Mina Zayed by late 2012 and provides infrastructure for a wide range of industrial and commercial activities in Abu Dhabi. When completed, the first phase of Khalifa Port will handle 2 million TEUs, four times the capacity of Mina Zayed.

### A MULTI-FACETED DESIGN, PROCUREMENT AND CONSTRUCTION CONTRACT

In June 2007 the Khalifa Port Marine Consortium (KPMC) was formed with partners Boskalis Westminster Middle East Ltd., Archirodon Construction and Hyundai Engineering & Construction. In October 2007 KPMC was awarded a multi-faceted design, procurement and construction contract. The specified work included dredging of an access channel and port basin, land reclamation, rock protection works,

### FEATURES

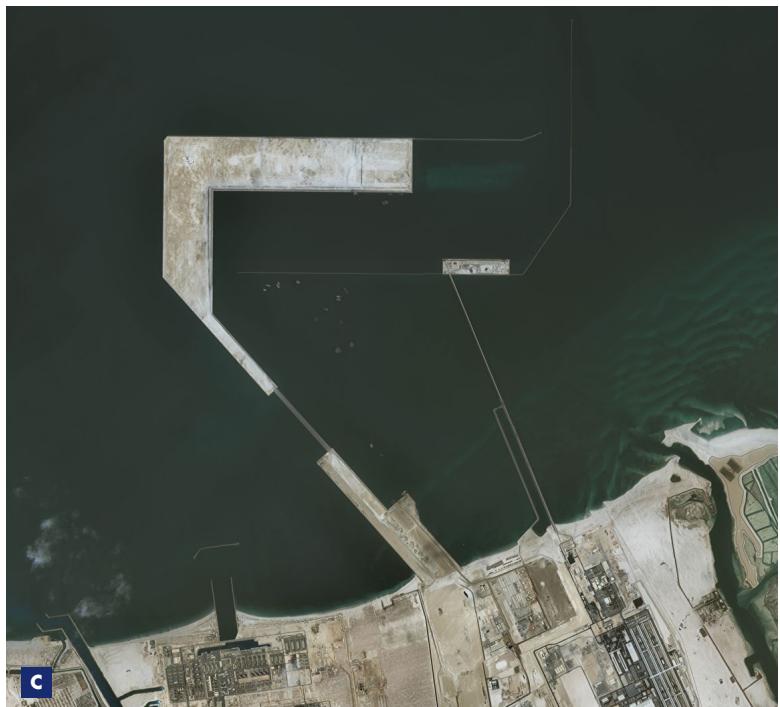
Client	Abu Dhabi Ports Company (ADPC)
Location	Al Taweeleah, Abu Dhabi, U.A.E.
Period	October 2007 – January 2012
Contractor	Khalifa Port Marine Consortium – KPMC



**A** Location map

**B** Khalifa Port is nearby the most extensive coral reef in the Arabian Gulf. This meant utilizing the latest methods to protect the marine environment.

**C** Aerial view of the project



breakwaters and quaywall construction, to be performed by the Consortium in which Boskalis had a 43% share. When the contract was awarded, most of the final design work for the port's construction had yet to be done. The client – Abu Dhabi Ports Company (ADPC) – sought contractors with the skills and multidisciplinary services able to deliver design expertise as the operations progressed. Boskalis engineers from the inhouse company Hydronamic coordinated the design activities, not only in the dredging and reclamation works, but also in the rock protection works, breakwaters and construction of the quay walls, bridges and breakwaters.

### ENVIRONMENTAL AND COMMERCIAL CHALLENGES

Early-stage design and planning were crucial because of the combination of environmental and commercial challenges. First of all, Khalifa Port is nearby the most extensive coral reef in the Arabian Gulf. This meant utilizing the latest methods to protect the marine environment. Secondly, the project area is close to seawater and cooling water intakes. Protecting both these areas from excessive turbidity levels during the dredging and reclamation works was of critical importance. Lastly, the integration of the port development with the construction of the Emirates Aluminum (EMAL)

smelter heightened the commercial importance of the project. EMAL, a joint venture between the emirates Abu Dhabi and Dubai, carries significant economic consequences for the region.

### DESIGN AND ENGINEERING TEAMS FIND SOLUTIONS

Early involvement in the project meant that members of the Boskalis environment, design and engineering teams, including the in-house engineering company Hydronamic, remained on-site from the tender into the execution phase, ensuring that the plan was put into action with maximum efficiency. Their expertise was applied to all aspects of the operations. To protect the marine environment extensive measures were taken, including the installation of 15 fixed monitoring stations, transmitting real-time data on turbidity, waves, currents, water levels and weather conditions; the placement over a distance of several kilometers of heavy-duty silt screens, specially designed by Boskalis in cooperation with the supplier for use in rough open water, which separated the marine operations from the corals and the seawater and cooling water inlets; the construction of a 6-km long "environmental breakwater" designed to protect the coral reef and water inlets; the development of a special "spreader pontoon" in the reclamation area to evenly disperse coarse and fine materials; continuous hydrographic surveying; and plume modeling carried out at Deltares, the Netherlands, to predict turbidity levels around the working areas. A separate project sheet on "Marine Environmental Monitoring" covers these environmental solutions in greater depth. In 2010 ADPC received The Environment Protection Award for the design and construction of Khalifa Port for the protection of the coral reef.

Due to the higher than expected silt content in the material for the reclamation the originally designed working method with a sophisticated spreader pontoon did not give the desired results and with the revised working method,



**D** The shallow draft TSHD Alpha B at work, together with WID BKM 100

**E** Three of the largest Boskalis Cutter Suction Dredgers working together: Phoenix, Cyrus and Taurus II



removing silt with water injection vessels WID Roomklopper and WID BKM 100 and the shallow draft TSHD Alpha B, the required quality and performance criteria of the fill were achieved.

Other challenges arose while working at remote locations up to 18 km from the shore, unprotected from the "shamals" (northwesterly winds) and from swells. The operations of the backhoe dredgers, such as the Wodan, Rocky and Colbart which constructed the bunds for the reclamation area for the artificial island 4 km offshore, were influenced by this rough weather during the winter season at the beginning of 2008.

Important technical services were performed by two Boskalis subsidiaries, Cofra and Boskalis Dolman. Cofra carried out the dynamic compaction (the so-called CDC) of the reclaimed

**F** Northwest part of the onshore port area, facing the seaside

**G** Breakwater nearing completion

**H** Combined view of work in progress at the northern part of the South Causeway

material for the platform. While this method has been used previously, it was applied at Khalifa Port with much heavier equipment specifically designed for the project. The CDC method improved the overall performance of the soil significantly.

Boskalis Dolman supported sediment quality control with vibrocoring sampling, Cone Penetration Tests and laboratory tests to guarantee that the reclaimed material complied with contract specifications.

Ultimately, 46 million m<sup>3</sup> were dredged from the access channel and harbor basin by the cutter suction dredgers, Phoenix, Taurus II and Cyrus. This dredged material was reclaimed in the port platform and berth island and the remainder stored in the footprint of the future works. The unsuitable materials were disposed of offshore in a designated area. These operations were completed in the first week June 2010.



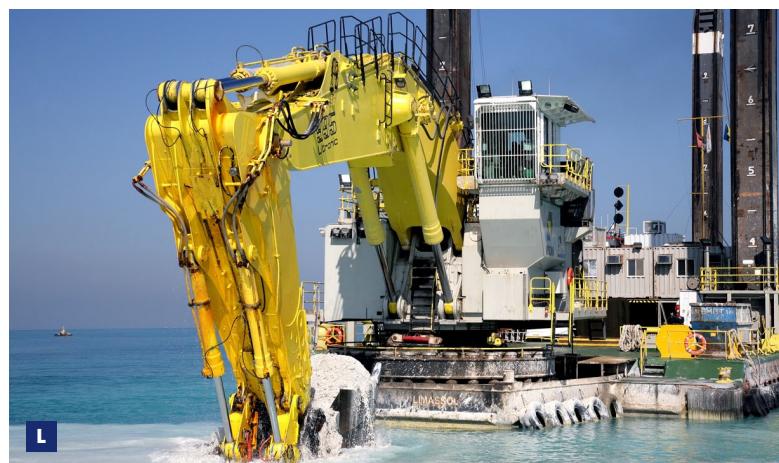
### SAFETY AWARDS

All work was executed under the strictest safety standards as specified by the US-based Bechtel, which, acting as a consultant for ADPC, provided Program Management Services for the KPIZ project. In June 2009 Bechtel conducted a Corporate Environment, Safety & Health Assessment of the project. This resulted in an ES&H Program Implementation Rate of 94.5 percent. Boskalis Westminster Middle East Ltd. received a safety recognition award from ADPC for 365 days without a lost time injury / illness

(LTI) and the Consortium reached 12,000,000 work hours without LTI on May 2, 2010.

### CONCLUSIONS

Although the contractual completion date for all dredging works is 2012, the port platform was delivered on July 31, 2010, 18 months ahead of schedule. The significant contribution of Boskalis as a member of the Consortium and as leader of the engineering team in the design, procurement, construction and management of the Khalifa Port and Industrial Zone project clearly expedited completion. It also demonstrates the positive impact of integrating these services, as client and contractor work together to achieve a common goal.



- I Reclamation works in full swing
- J Cofra carried out the dynamic compaction (CDC) of the reclaimed material
- K Boskalis Dolman supported sediment quality control with vibrocoring sampling, Cone Penetration Tests and laboratory tests
- L The backhoe dredger Wodan constructing the bunds for the reclamation area for the artificial island 4 km offshore

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