

# PROJECT SHEET

**GORGON PROJECT – BARROW ISLAND LNG PLANT**  
DESIGN AND CONSTRUCTION OF A NEW PORT AND MATERIALS OFFLOADING FACILITY IN A CLASS 'A' NATURE RESERVE

## INTRODUCTION

The project Owner is developing LNG process facilities on Barrow Island off the north west coast of Western Australia approximately 140 km west of Dampier and 95 km north east of Onslow.

Barrow Island is a Class A Nature Reserve and an internationally important conservation estate.

Boskalis' scope of work on the Project included:

- Detailed design and construction of a Pioneer Materials Offloading Facility (PMOF).
- Design and construction of abutment structures for a Ro-Ro berth, module carrier berth and barge berth.
- Design and construction of mooring dolphins and access walkways for the PMOF barge berth, module carrier berth and Ro-Ro berth.
- Dredging and reclamation work for the approach channel, turning basin and berth pockets associated with the construction of the MOF.
- Dredging for the LNG jetty area including an approach channel, turning basin and berth pockets.
- Installation of temporary and permanent navigation aids including two permanent front and rear lead support structures.
- Provision and operation of a Marine Construction Support Vessel to accommodate personnel involved in the Project.

## FEATURES

Owner	Chevron Australia Pty Limited
Client	Kellogg Joint Venture – Gorgon
Location	Barrow Island, Western Australia
Period	2009 to 2013
Contractor	Boskalis Australia Pty Limited



**A** Location map  
**B** Aerial view

- Construction of the Eastern Materials Offloading Facility (EMOF) causeway including all armour rock, construction of a breakwater, placement of X-blocs and installation of concrete nib wall.
- Compaction of the EMOF (Cofra).
- Materials testing (Boskalis Environmental).



**DREDGING AND RECLAMATION WORKS**

The dredging works consisted of 2 major parts:

- A MOF access channel and turning basin to create access for heavy load transport vessels to bring in construction materials and large modules for the construction of the LNG plant on Barrow Island.
- An access channel and turning basin for the LNG carriers once the plant is operational.

Dredging started in May 2010 and was completed in November 2011 during which 6.7 million m<sup>3</sup> of material was removed. The majority of the material was placed at a marine relocation area at sea while around 1.5 million m<sup>3</sup> was used for reclamation of the MOF and EMOF platforms. Material consisted of sediments and rock material.

The TSHD's Gateway and Cornelis Zanen initially removed the sediments and undertook direct dredging of the underlying rock material, with the material either being transported to the material relocation area or to the reclamation areas. The majority of the underlying rock material was crushed by the SPCSD Taurus and the material was removed by the TSHD's Gateway and Cornelis Zanen, the BHD Baldur and the GD Goomai and either transported to the material relocation area or to the reclamation areas. The BHD Baldur also executed direct dredging works.



**C** Aerial view rock protection works  
**D** TSHD Gateway

**ROCK PROTECTION AND BREAKWATER WORKS**

These works consisted of 3 major components:

- Design and construction of a protection of the MOF platform against cyclonic waves with rock only.
- Construction of a protection of the EMOF platform against cyclonic waves with rock underlayers and concrete X-blocs.
- Construction of a breakwater for protection of a tug harbour against cyclonic waves with rock underlayers and concrete X-blocs.



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The core of these structures was constructed with reclamation material consisting of crushed rock material. Other materials used:

- 470,000 tons of rock
- 8,400 x 3.6 ton X-blocs
- 6,100 x 14.4 ton X-blocs
- 45,000 m<sup>2</sup> of geotextile

The rock was quarried in the Perth area and transported by Boskalis to Barrow Island by sea with a fleet of tugs and barges, a distance of 1,500 km each way. The X-blocs were procured by the client in Indonesia and delivered to Barrow Island for Boskalis to install.

Rock and X-bloc barges were unloaded with dry equipment and placement was carried out with excavators equipped with a crane monitoring system (CMS) and based on DGPS allowing for precise placement and recordkeeping.

### CIVIL WORKS

The construction of the abutment structures consisted of caissons which were fabricated offsite using 1,980 m<sup>3</sup> of concrete and 615 tons of reinforcement steel. The caissons were placed on site on a stone bed consisting of 375 tons of stone. The concrete deck for the abutment was built in situ and consisted of 5,500 m<sup>3</sup> of concrete and 1,060 tons of reinforcement steel. Scour mats (constructed from 445 m<sup>3</sup> of concrete) have been placed both in front and behind the abutment structures.



In front of the abutments a mooring facility was installed consisting of 7 dolphins connected by walkways. Each dolphin was constructed on steel pile frames, consisting of 1,750 tons of steel which have been grouted in drilled sockets in the seabed (1,240 m<sup>3</sup> of grout was used). 7 steel prefabricated dolphin jackets, consisting of 2,200 tons of steel and the connecting walkways were installed using a heavy lift vessel.

Two permanent channel lead markers were installed to identify the MOF channel center line.

### COMPACTION WORKS

Boskalis subsidiary Cofra was contracted to carry out compaction works with its CDC [Cofra Dynamic Compaction] technique. The EMOF had to be compacted in layers of 4 m mainly in order to reduce any further settlement for the LNG pipelines which will eventually run on top of the EMOF. 2 heavy O&K compactors were used to carry out the compaction works.

### LOGISTICS AND ACCOMMODATION

The remote location and the limited accommodation on Barrow Island at the time of the work scope resulted in Boskalis chartering a Marine Construction Support Vessel to accommodate up to 400 staff and workers. The vessel Finnmarken, a large Norwegian cruise ship, was on location for a period of 18 months after which sufficient accommodation could be provided on Barrow Island itself.

The island's remote location required all materials to be transported to site. Most materials were shipped from the Boskalis yards in Dampier where all goods were stored and made quarantine compliant.

### QUARANTINE AND ENVIRONMENT

Barrow Island is a special environment which is isolated from the Australian mainland and is home to unique flora and fauna, some of which are not found anywhere else. Barrow Island is a Class A Nature Reserve, which provides the highest level of environmental protection offered by the Western

- E** More than 450,000 marine transfers of personnel were undertaken without incident
- F** Ballasting before final placement
- G** The vessel Finnmarken accommodated up to 400 staff and workers during a period of 18 months



Australian government. To ensure the island's environment was protected, strict quarantine and environmental requirements were imposed upon Gorgon Project operations.

To protect nesting turtles and turtle hatchlings, all Project vessels had to comply with strict lighting specifications and implement special measures to protect turtles during dredging.

In addition, a rigid turbidity and coral monitoring program ensured impact to the coral and underwater flora and fauna was minimised.

Quarantine expectations were also high, with zero tolerance to the introduction of non-indigenous species. To ensure this, very strict procedures had to be complied with, including cleaning all equipment and materials to prevent the introduction of soil, plant material, insects or non-indigenous fauna to Barrow Island. A rigorous inspection regime upon departure and on arrival at Barrow Island helped confirm quarantine compliance.

Our positive performance resulted in recognition by our client with the following awards:

- Quarantine Certificate of Appreciation
- Barrow Island – Environmental Excellence Award.

The Gorgon Project – Dredging and Materials Offloading Facility Construction was awarded the 2013 WA Engineering Excellence Award in the Environment category.

## CYCLONES

The coast of North Western Australia, where the Project site was located, is an area impacted by cyclones during a part of the year. The designs for the PMOF structures had to withstand a cyclone impact with minimal damage.

During a cyclone event a part of the Boskalis fleet would sail to open sea in order to avoid the weather system and part of the fleet had to be secured in a safe haven. In order to secure these vessels, 20 cyclone moorings were designed and installed in Dampier, 140 km east of the construction site.

Because of this distance and time involved between prediction and securing to a mooring a customized cyclone trigger forecast system was developed. A cyclone response team was established and responsible for the installation, maintenance, demobilisation and mooring / unmooring operations during a cyclone demobilisation event.

During construction on site, covering two full cyclone seasons a total of 16 demobilisation events occurred in which 350 mooring and unmooring operations were safely undertaken.

## HEALTH, SAFETY AND SECURITY

The complexities of working in a dynamic environment on a remote site with varying nationalities, differing cultures and a strong Australian union presence provided some significant initial challenges to create the appropriate safety culture on the Gorgon Project.

With effective planning and commitment to safe production we successfully achieved the following:

- Chevron awarded Boskalis with an 'A' ranking in Chevron's 'Contractor Health Environment Safety Management' (CHESM), the highest rank possible.
- Over 4 million man hours completed without a lost time injury
- Boskalis undertook more than 450,000 marine transfers of personnel without incident.



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- H 2 heavy Cofra O&K compactors were used to carry out the compaction works
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