

PROJECT SHEET

LNG PROJECT, ANGOLA
DREDGING, RECLAMATION, SHORE PROTECTION

INTRODUCTION

Angola is one of the world's deep water oil exploration 'hot spots'. More than 50 significant oil discoveries in Blocks 14, 15, 17 and 18 are believed to contain at least 10 billion barrels of oil. With the increase in oil production comes large quantities of associated gas. Historically, in the absence of a local market, associated gas has been flared or reinjected into the reservoirs. Sonangol, the state oil company, and some of its oil producing partners developed the Angola LNG Project to reduce flaring of gas and curtail gas injection. Angola LNG is a joint venture project involving the major oil producers in the country. Sonangol and Chevron are the co-leaders of the project; the other partners are Total, ENI and BP.

The LNG plant will be built on a site south of the Congo River, in Zaire Province, West of the city of Soyo. The plant will have a capacity of 5.0 million tonnes per year, a full containment LNG storage, a LPG and condensate storage and a loading jetty. Angola LNG Limited awarded the contract for preparation of the plant site to the joint venture of Boskalis International BV and Jan de Nul Dredging Ltd., in which Boskalis had the lead.

FEATURES

Client	Angola LNG Limited
Location	Soyo, Angola
Period	2006 / 2009
Contractor	Boskalis International bv and Jan de Nul Dredging Ltd



- A** Location map
- B** Aerial view of the project, taken in April 2009.
- C** Work in progress. Boskalis' cutter suction dredger Ursa pumped the material over a maximum distance of 5 kilometers into a deep section of the river



PROJECT SPECIFICATION

The preparation of the plant site consisted of widening and deepening the existing shipping channel in the 'Baia de Diogo Cão'; dredging a turning basin for the LNG facility and improving the existing Kwanda Basin. The volume dredged was 28 million cubic meters. The land reclamation works for the LNG facility consisted of raising 125 hectares of existing land on the north side of Kwanda Island and creating 65 hectares new land in the Congo river estuaria. The reclamation works required a total of 7 million cubic meters suitable material. Besides dredging and land reclamation, the works involved the construction of 1.5 km shore and slope protection, the installation of 4.5



km drainage around the fill areas, the installation and monitoring of geo instrumentation, the installation of a concrete oil/water separator and flood valve as well as the placing of navigation aids in the channel and basins. The design and construct works were awarded by the end of January 2007, and all operations had to be completed by December 2008. The works entailed a highly challenging timeline and required a high degree of flexibility as the scope of work changed over time. This demanded maximum adaptability and fast decision-making, particularly in the design phase. Extensive environmental mitigation measures presented a further challenge, as did the unexploded bombs and other ordnance lying on the seabed in the area, a legacy from Angola's 27-year civil war, which ended in 2002.

SAFETY, HEALTH AND THE ENVIRONMENT (SHE)

Angola LNG Limited set an offshore SHE level as working standard for the whole project. The combination of a big local workforce who were not used to this way of working and a site area which is well known for malaria and various species of dangerous animals, made this quite challenging. Extensive induction trainings,

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continuous training on the job and a never decreasing attention for SHE issues resulted in more than 2 million safe working hours without LTI (Lost Time Injury).

DREDGING AND HYDRAULIC FILL

The unsuitable material from the channel and the basins was dredged by a number of large and medium size trailing suction hopper dredgers, dumping the material into the Congo River. A self-propelled cutter suction dredger pumped the material over a maximum distance of 5 km into a deep section of the river. Part of the material in the turning basin was identified as suitable fill material. This material (4.2 mln m³) was dredged by a medium size cutter suction dredger and pumped onshore using a system of sinker-, floating-and shore pipelines. Only one fill area needed much coarser material to optimize the performance of the PVD's to be installed afterwards. For this area 2.8 mln m³ was gathered from an offshore borrow area at a distance of 80 Nautical miles. Large size trailing suction hopper dredgers were used for this operation. The location of the 'offshore' reclamation area can be characterized as having very soft subsoil layers, at particular spots up to a thickness of 14 meters. At these particular locations, the local soil conditions were improved by dredging a sand key, 'capping' the soft subsoil by placing fill material over it, using a spraying pontoon and installing of PVD's. This spraying pontoon was computer-controlled to place the material in thin layers on these soft layers, adjusting the velocity and direction of the pontoon, depending on the discharge rate of the production unit.

VERTICAL DRAINS AND GEOTECHNICAL INSTRUMENTATION

Vertical drains were applied to expedite the consolidation process beneath the reclamation areas. Boskalis called in its subsidiary Cofra, which specializes in geosynthetic ground improvement solutions, including vertical drains. A total length of 1,800 km was installed, of which some to a depth of 21 meters. This required a total of five installation rigs, in weight ranging between 40 and 80 tons. Before and after completion of the reclamation operations, several different measurements devices (such as settlement beacons, surface monuments, vibrating wire piezometers, borros extensometers, inclinometers and deep datums) were installed and the measurements were monitored in order to secure the stability of the subsoil layers. Dolman, another Boskalis subsidiary, was contracted for these works.



- D** Boskalis' subsidiary Cofra, specialized in geosynthetic ground improvement solutions, carried out the consolidation process by means of vertical drains
- E** Placement of one the buoys
- F** Local workforce carrying out the impressive shore protection works

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