Boskalis
Dredging & Marine Experts

PROJECT SHEET

SEPETIBA BAY, BRAZIL
DREDGING, RECLAMATION AND DEWATERING WORKS

INTRODUCTION

The German steel-maker Thyssen Krupp Steel and the Brazilian mining giant Companhia Vale do Rio Doce (CVRD) have teamed up to construct a € 3 billion steel factory at Sepetiba. This is a small town of 36,000 inhabitants near Rio de Janeiro with good access to the Atlantic Ocean. The new steel factory will allow Brazil not only to export more of its plentiful mineral resources, but also to produce semi-finished products that can be sold at higher margins. The government authorities of Brazil and Rio de Janeiro both support the project. PROJECT SPECIFICATIONS Dredging work on the project started in November 2006. The contract called for the dredging of 11 million m^3 of material to construct a harbor basin 14.5 meters deep and an access channel. To build the steel plant, 200 hectares of swampy terrain had to be reclaimed, requiring some 3 million m^3 of sand. The remaining 8 million m^3 of clay and silt was deposited onshore.

SITUATION

The project schedule was very tight because ThyssenKrupp Steel wants to start steel production in March 2009. Furthermore, the government authorities of Brazil and Rio de Janeiro imposed strict environmental criteria to protect the local habitat and population. The dredging works were not allowed to have any negative effect on the mangrove forest separating the project site from Sepetiba Bay, or on water quality in the bay, upon which 7,000 fishermen depend for their living. So the turbidity of the discharge water had to be kept below 500 milligrams per liter. Another challenge was the removal and disposal of previously contaminated sediment while guaranteeing minimum negative impact on the environment.

FEATURES

Client	ThyssenKrupp Steel and Companhia Vale do Rio Doce
Location	Sepetiba Bay, Brazil
Period	2006-2008
Performed by	Boskalis International bv (in joint venture with Dredging International nv)

A Aerial view construction of jetty and loading berth, with cutter suction dredger 'Vlaanderen 19' in front
B Environmental cutter dredger 'Beaver St. Lawrence' type Beaver 1500
C Floating booster station 'Cosel', capacity 9000 hp
D Environmental clamshell dredger 'Elise', type Manitowoc 4600

SOLUTIONS

Even after the provisional contract had been signed, many more soil surveys still had to be carried out and the working methods had to be assessed in the light of the environmental studies. In addition, the engineering work had not yet been completed but, because of the tight schedule, the mobilization of equipment had to start. Accordingly, an Early Works Agreement was concluded with the client, ThyssenKrupp Steel and CVRD. The agreement stipulated that the risks would be shared in a unique partnership based on trust and mutual respect. Specialists from Hydronamic, Boskalis' own engineering consultancy, and the Boskalis R&D department were called in during this phase. These experts joined forces with the local project team. In close cooperation with the client, the working methods were discussed with the environmental authorities and all necessary permits were obtained. Hydronamic dealt with the environmental side of the working methods. An essential part of the project required a grab dredger, and this presented an obstacle to obtaining the neces-sary permits. In consultation with ThyssenKrupp Steel and CVRD, a system was proposed to minimize the environmental impact. In addition to a closed bucket, the grab dredger was fitted with a state-of-the-art crane monitoring system, enabling highly accurate dredging. The entire system allowed for accurate and efficient dredging with minimal turbidity. This environ-mental mechanical dredge system was then successfully tested in the port of Rotterdam. ThyssenKrupp Steel, CVRD and Hydronamic subsequently presented the entire system to the environmental authorities in Rio de Janeiro, who granted permission for the work to be done with the proposed working method. After completion of this phase, the definitive contract was signed and dredging work started in November 2006.

METHOD

The distance between the dredging site where the cutter suction dredger was operating and the hydraulic fill for the dumping material meant that high pressure capacity was required. A cutter suction dredger (Dredging International's Vlaanderen XIX, 8,500 kW), two boosters (Cosel, owned by Boskalis, 5,500 kW) with two serial pumps and DI 509 (owned by Dredging Inter-national, 4,500 kW) and a third booster (Nieuwe Merwede, owned by Boskalis, 3,500 kW) in standby were needed to pump the sludge reliably over a distance of approximately 11 kilometers. A booster control system with a radio telemetry link made it possible to control the central process from the cutter suction dredger. A process information system provided the cutter skipper with a picture of the relevant parameters, such as the current density distribution in the pressure pipeline, the mixing speed, local pressures and the load state of the boosters. This ensured that maximum use could be made of the available pressure capacity without exceeding critical limit values (maximum pressure, minimum tubular flow speed). A newly developed automatic control system for controlling the pump drives and the cutting process of the cutter dredger helped the operator to optimize the process. This automation was only possible by using the latest control engineering technology in combination with artificial intelligence (AI) and complex filter technologies (Kalman filter).

The Boskalis Research & Development department recommended a cutter equipped with an innovative ecological head to clean the area of previously contaminated soil. This made it possible to remove the contaminated layer (half a meter) with precision, and allowed a high production level and ultra-low turbidity. Beaver St. Lawrence, a dismountable cutter suction dredger, was equipped with one of the environmental disc cutter units owned by Boskalis. The contaminated sediment was stored in special pits (Confined Disposal Facilities - CDFs, 18 meters deep) - that were dredged for this purpose at designated locations in the bay and covered with two meters of clean soil. The additional soil survey carried out by Boskalis showed that the available sand needed for reclamation was limited and widely distributed over the area to be dredged. In order to guarantee hydraulic filling of an area that would be large enough to be used as a building site, it was agreed with the client that dredging would be confined to locations where sand could be reclaimed without having to remove too much overburden first. This required a change to the working method and therefore to the contract. Enough sand was then reclaimed for the hydraulic filling of the most urgent section of the building site in 80 days. At a later stage, the rest of the building site was hydraulically filled with sand from the dredging area, plus sand reclaimed from below the design depth of the port. All the sections of the building site were delivered within the time frame and in accordance with all quality criteria.

To keep within the maximum of 500 mg/l of suspended solid particles in the process water moving into the bay, the discharge water was led through specially constructed settling basins. A total of 10 powerful pumps were used to dewater the hydraulic area. The water was pumped back to the deeper part of the bay through a pair of submerged pipes 4 kilo-meters offshore.

The water quality was monitored daily at several designated locations in Sepetiba Bay during dredging and samples were taken. The most important parameters that were monitored included turbidity, water temperature and salinity. The monitoring data was processed on a daily basis and passed on to the client. The extensive monitoring demonstrated full compliance with the environmental requirements and showed that there was no negative impact on the mangrove forest or water quality in the bay. All this was achieved without sacrificing speed and efficiency: the dredging works were completed and delivered in spring 2008.

E Aerial view reclamation works for construction site of steel plant
F Piling works in progress for the construction of the steel plant
G Aerial view reclamation site of steel plant
H Aerial view construction works in progress for steel plant

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