Royal HaskoningDHV
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client | Nakilat

Erhama bin Jaber Al Jalahma Shipyard

Introduction

The North Field, located in the State of Qatar's territorial waters, is the one of the world's largest natural gas fields, with reserves estimated at 400 trillion cubic feet. It represents almost 14 per cent of the world's total known natural gas reserves.

Construction of the Erhama bin Jaber Al Jalahma Shipyard in the Port of Ras Laffan, on the Arabian Gulf, 80km north of Qatar's capital city Doha, is a key milestone in implementing the vision of His Highness Sheikh Hamad bin Khalifa Al Thani, the Emir of Qatar, to create a marine industry to support production and transportation of the country's oil and gas to world markets.

The first three phases of the Shipyard, which were inaugurated by His Highness in November 2010, were constructed on reclaimed land, 7km out to sea, and represent one of the largest and most impressive maritime and civil engineering projects ever undertaken. From concept to start of operations in under five years, the new Shipyard comprises all the facilities necessary for the repair, maintenance and conversion of very large ships, as well as the construction of specialist ships, including offshore supply vessels, tugs and coastal tankers.

Royal HaskoningDHV worked closely with Qatar Gas Transport Company Ltd. ("Nakilat"), owner of the world's largest fleet of LNG carriers, and overall Project Manager on behalf of Qatar Petroleum for design and construction of the Shipyard. Over 60 million man-hours were absorbed in construction of the Shipyard, and the construction workforce peaked at some 11,500 persons in late 2010.

Ground preparation and reclamation

The Shipyard is located within the expanded Port of Ras Laffan, approximately 7km from the shoreline, and was constructed on reclaimed land, totalling some 110 hectares. Royal HaskoningDHV specified and supervised the comprehensive geo-technical investigation of the site for all phases of the Shipyard development.

Drydock design is highly dependent upon accurate prediction of the permeability of the ground in which the dry dock is to be constructed, as well as the ability of the ground to support the enormous loads placed on the dry dock floors. Detailed investigation and accurate analysis of the ground conditions was therefore vital for economic design of the two massive dry docks, as well as the foundations for the major buildings.

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The geo-technical investigation took over four months, and was undertaken even before reclamation of Shipyard site began. The geology of the Shipyard site was found to be complex – there is approximately 1m of cap rock, overlaying some 12m of Simsima limestone, overlaying approximately 10m of Basal Simsima limestone, overlaying a Rus formation of indeterminate depth.

Great care had to be taken with the geo-technical investigation and interpretation of the results, particularly because Simsima limestone is known to be a non-homogeneous material which can contain large karst structures (voids), and be highly fractured, leading to considerable differences in permeability over relatively small distances.

Some thirty boreholes, up to 25m below the sea bed were made from a jack-up drilling rig. Permeability and penetration tests were carried out in-situ, and numerous rock samples were obtained for laboratory testing. A detailed geo-technical risk analysis was then prepared by Royal HaskoningDHV, and mitigation measures were developed to cope with the possibility that actual conditions found during construction of the drydocks would vary from those predicted by the site investigation.

Following the reclamation of the site, Royal HaskoningDHV advised on the ground improvement and densification. Over 3,200 steel-reinforced concrete piles were placed to support the buildings to be constructed on the site. Each pile was socketed into the sea bed by up to 5m.

The Shipyard development was divided into two parts - marine and onshore works. Royal HaskoningDHV was appointed, in 2006, to design and supervise the construction of the marine works. A year later, Royal HaskoningDHV was also selected to design and supervise the construction of the onshore works, which comprise some 75,000 m² of workshops, warehouses, offices and related structures.

Marine Works

The marine works are immense, including two drydocks, the largest measuring 400 by 80m with a depth of 17.6m, and wet berths totalling 2.5 km in length.

Royal HaskoningDHV's more than 40 years of experience in shipyard and drydock design was called upon when designing and supervising the construction of the two large drydocks and their dock gates, a complex undertaking, involving integration of many different design disciplines.

Drydocks and pumphouse

Construction of the drydocks and the combined pumphouse required an area 500m by 500m of sea bed to be enclosed within a bund, from which the water was pumped out, allowing construction work to proceed in the dry. The bund contained more than 600,000 m^3 of dredged rock and general fill.

The pumphouse, containing 16 pumps including the dock dewatering system, is a significant part of the design - particularly with a requirement to dewater the larger dock in three hours. Four main dewatering pumps are located in the pumphouse which serves both docks, each pump having a capacity of 33,000mffi per hour.

Dock gates

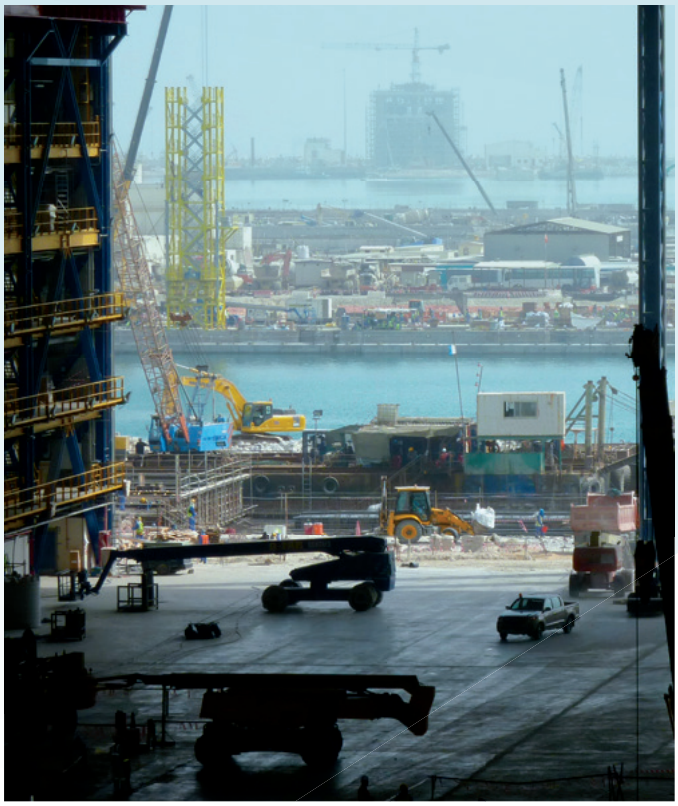
The function of the dock gates is critical, holding back the sea with minimal leakage when the dock is dry, while opening quickly when the dock is flooded so a ship can be docked or undocked.

Designed to open fully within 10 minutes, the two "Box" flap dock gates, fabricated on-site under Royal HaskoningDHV supervision, comprise a total of 3,500 tonnes of steel plate and sections.

The wider of the two gates has a span of 80.5m, and is the largest and deepest of its type in the world.

Quays and piers

Piers and quays having a total length of 1,350m were constructed using 54 concrete caissons, each measuring some 36m long, 20m wide and 14.5m high, and weighing over 5,000 tonnes. Each caisson was continuously slip-formed on site, over a period of three and a half days, to create a high-integrity structure. After curing, the caissons were skidded from the slip-forming yard onto a floating dock for transfer to their installation site, where they were ballasted down onto a carefully prepared rubble mound. Each caisson was then filled with sand and pre-loaded, to ensure its stability in service.



The quays and finger piers enable maintenance work on large ships, and incorporate all required mechanical and electrical services. There are numerous piped systems, distributing all the fluids necessary for ship repair, including acetylene, carbon dioxide, compressed air, LPG and oxygen, in addition to the ballast water and fire fighting systems.

Integrating the extensive mechanical and electrical services of the Shipyard with the civil works was a challenge for the Royal HaskoningDHV team and required careful analysis. The saline environment, high ambient temperature (up to 50° Celsius) and high humidity make the piped systems vulnerable to corrosion, especially in the "splash zone". The systems

also have to accommodate movement due to thermal expansion, with a temperature range of 40°C. Extensive use was made of corrosion resistant materials, such as glass-reinforced epoxy and stainless steel, to minimize through-life maintenance costs and maximise reliability of the piped systems.

Electrical control systems

Site-wide high and low voltage power distribution systems were designed by Royal HaskoningDHV, in close collaboration with the Shipyard operators. The pump house equipment includes pumps for dewatering, dock drainage, contaminated water, fire fighting, ship ballasting and cooling of compressors.

The control system is an integral part of the operation of dock equipment and used to sequence such operations as starting of pumps and opening of valves and penstocks. Royal HaskoningDHV developed piping, electrical and instrumentation diagrams and specifications for tender and construction.

Along with conventional copper cabling, the latest fibre-optic communication systems were utilised to transfer data to a central point, where HV & LV switchgear status, water levels, system pressures and positional signals, etc. around the site can be monitored.

Onshore Works

Commissioned for its expertise in design and supervision of construction of industrial facilities, the onshore works of the Shipyard represented one of the largest and most complex developments Royal HaskoningDHV has undertaken.

Working closely with Nakilat, the overall Project Manager, Royal HaskoningDHV assisted with creation of a phased approach to completing the buildings and infrastructure, to enable some parts of the Shipyard to be used as staff facilities and for fabricating the dock gates, while other parts of the yard were still under construction. Royal HaskoningDHV's role included not only engineering of the facilities, but also supervising the construction works, coordinating a variety of sub-consultants and assisting with delivery of the entire project to an extremely tight schedule.

The onshore works include three multi-storey administration buildings as well as seven industrial workshops, the largest of which is a 270m long, 65m wide, by 40m high ship construction hall, attached to which are support workshops, offices and amenities totalling over 15,000 m^2. A challenge for the team was advising on installation in the construction hall of two 120 tonne overhead travelling cranes on rails 32m above floor level. Due to the cranes' size, they had to be erected when the outer shell of the building was partially completed.

The three multi-storey buildings, designed by Royal HaskoningDHV provide offices and amenities for 9,000 shipyard employees and subcontractors, as well as representatives of ship owners, Classification Societies, etc.

The next phases

The Port of Ras Laffan has been under expansion by Qatar Petroleum for the past several years, and is now one of the world's largest ports, through which Qatar expects to export 77 million tonnes of LNG per annum of LNG from 2011.

Located on the south breakwater of the Port of Ras Laffan, the Erhama bin Jaber Al Jalahma Shipyard is a state-of-the-art facility created to repair and maintain large and complex vessels, including the 54 LNG carriers owned by Nakilat, which include the largest in the world (having cargo capacities of up to some 265,000 m^3). Construction of specialist ships is also undertaken, completely undercover, in the massive construction hall, which is capable of simultaneously building four ships each 120m in length.

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Royal HaskoningDHV's shipyard expert subsidiary, First Marine International, has been working with Nakilat since inception of the Erhama bin Jaber Al Jalahma Shipyard project, and is now assisting with developing the next four phases of the yard. These phases extend the facilities to include the fabrication and maintenance of offshore structures, repair of small ships, construction of superyachts, and manufacture of FRP craft for leisure and domestic markets.

Ras Laffan Industrial City, managed by Qatar Petroleum, is an immense complex for the reception, processing and export of hydrocarbons, and can be clearly seen from space.

The inauguration of the Shipyard at Ras Laffan, in November 2010, marked the birth of a new marine industry in Qatar.

Royal HaskoningDHV is proud to be associated with Qatar Petroleum and Nakilat in the conception and execution of one of the largest and most impressive civil and maritime engineering projects in the world.

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