Khalifa Port, the birth of a giant

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The background of the project

Kizad

Khalifa Port is situated next to the Khalifa Industrial Zone Abu Dhabi (Kizad), a cornerstone of the Abu Dhabi Economic Vision 2030, an industrial development of massive scale, which is under construction and is intended to stretch over an extraordinary 417 square kilometers. It marks a substantial drive towards the diversification of the economy in pursuit of sustainable growth that becomes less dependent on oil and gas.

The Emirates invested considerably in order to attract world-class industries. Global and local companies alike recognize outstanding market access, the low cost operating environment and the support services and facilities. Khalifa Port and Kizad are being developed to support this vision.

Environment

Just offshore from Khalifa Port and Kizad (the megaproject) lies the United Arab Emirates (UAE) and the Gulf's largest coral reef, the Ras Ghanada reef, 4 kilometers off shore and about 35 square kilometers in size. It supports coral such as Acropora downingi, Poritis Harrisoni, Acropora arabensis and flourishing marine life, such as turtles, dugongs, seasnakes, clownfish and much more. In order to protect the reef, an off shore terminal quay (the port island) was developed 4.6 kilometers out to the sea. Furthermore, 8 kilometers of internationally recognized and award-winning protective breakwater was constructed to help conserve the reef. The longest bridge in the UAE, to the port island, 1 kilometer long, allows for the current flow to the reef to be maintained.

Timeline

It was in 2008 that construction of the port island began and the first dredger started to build bunds in the Gulf. In July 2010, ADPC started to write the equipment and TOS specifications; in September 2010, the tendering for equipment started, and orders for six STS cranes, 30 ASC and 20 sprinter cranes (SCs) went out at the end of November 2010.

From 2012, Khalifa Port will be able to handle, if needed, 2 million TEU containers a year and 12 million tons of cargo capacity a year. By 2030, that figure is scheduled to rise to up to 15 million TEU containers and up to 35 million tons of cargo a year. In February 2012, 3 STS, 20 ACSs and 10 SCs had arrived in good shape and tests began. In the fourth quarter of 2012, the official opening of the megaproject will take place.

Infrastructure

The infrastructural design is solid and designed for a long life and low maintenance costs. The STS cranes run on an A150 rail with a rail span of 35 meters. The landside rail is mounted on beam stands on concrete piles of 1.2 meter diameter, every 6 meters. The waterside QC rail lies in the centre of the capping beam; a concrete beam 2.8 meters thick and 12.7 meters wide, which is built on top of a concrete block wall.

There are 30 ASCs, in 15 stacks, run on a 350 meter long AS86 rail, which is fixed on a concrete beam. This massive beam (1.5 meters by 1.2 meters) is fixed on 0.8 meter diameter concrete piles, every 6 meters on average. In the stack, the containers stand on massive concrete transverse beams as well. In general, beams are 0.9 meters by 1.5 meters, but in areas of 45 foot containers the beams are 0.9 meters by 3.3 meters. In between

Photo: ADPC/choppershoot.com

Overview of ongoing construction works for roads, utilities, buildings and cranes on the Offshore Port Island.

the beams, the stack is paved with interlocking concrete blocks. The pavement on the terminal is a special concrete mix which is applied in different thicknesses, depending on its functionality.

Equipment for the project

The equipment specifications were made in a period of six weeks and the planning for the delivery of a working terminal was challenging. It was in this way, therefore, that the TOS became linked to the ASC supplier, as it has the strongest interface and risk. This is how the ASC supplier Konecranes became responsible for the delivery and implementation of ASCs and the Navis SPARCS N4 TOS system.

Looking at market developments, more and more full system implementers are developing. Konecranes, Cargotec and Terex. These are global suppliers who can supply a whole range of container handling equipment. Cargotec, who recently took over TOS supplier Navis from Zebra Technologies Corporation and Terex Corp, who took over Demag cranes AG, became owner of Gottwald. For the customers this is intended to result in lower overall implementation costs.

The equipment specifications are adapted to the harsh environment of Abu Dhabi .The design temperature range for components is therefore from 0 to 50 degrees Celsius, while the direct sun impact is up to 65 degrees Celsius and humidity up to 100 percent. Cooling capacity of the e-houses is designed in a way that if one unit fails, 100 percent cooling capacity is still left.

The duty factor for hoist and trolley is set to S1 100 percent (designed for continuous duty). All motors outside are installed with stainless steel shields to protect against direct sunlight and sand. Stainless steel has to meet minimum DIN1.4401 (316) standards.

The STS cranes run on a rail span of 35 meters and have a lifting capacity of 110 tons under the ropes and are equipped with a Stinis long twin spreader. The cranes designed by ZPMC are fully prepared for a single hoist tandem lift. The electrical installation is delivered by TMEIC - also the electrical supplier of the installation of the ASCs. The crane has a long back reach of 38 meters, enough to accommodate six SC lanes for future fully automation. Under the portal another four SC lanes are

Photo: Jan Grinwis

available. The lanes are equipped with the maxspeed straddle carrier positioning systems of TMEIC. This system signals to the straddle carrier driver when he is close and when he has reached the point to place his container. The height under the spreader above the waterside rail is 44 meters. The crane is equipped with a Merford operator cabin, including the Ergo seat.

The semi-automated cranes are delivered by Konecranes and the electrical installation is supplied by TMEIC. The landside of the system is manual and is operated by a remote operator station, which is equipped with camera images from several positions from the crane, spreader (Bromma) and lanes. The waterside transfer zone is fully automatic and serves containers to and from the straddle carriers, and is 32 TEU in size.

When the waterside crane is in maintenance and standing on the waterside transfer zone, the landside crane is able to handle containers on the waterside too, the storage area is then 16 TEU in size. The waterside crane is able to handle trucks on the landside too. The power is connected to 11 kilovolts. The gantry speed of the crane is 4 meters per second.

The straddle carrier is the Sprinter of Noel Mobile systems from Terex. The Sprinter is also equipped with the Stinis long twin spreader and is equipped with a GPS and a RTLS positioning system. The straddle carriers are prepared for a fully automated operation. A call center is set up with 24/7 staff able to monitor all equipment

Photo: Jan Grinwis

The first ASCs.

online. The technician, working in the call center, starts by checking the status in the remote crane management system when a problem is reported. If this problem cannot be solved by computer a staff member is available to solve the problem.

The workshop is equipped with below floor service pits, two straddle carrier service bays have wide service pits for reach stacker/empty handler repair. One power shop bay has a combined-width (wide on one side, narrow on the other) service pit for forklift repair. The SC wash bay has one deeper service pit than the pits at the straddle carrier workshops so that the worker can clean from underneath and hold the gun upward. Service pits where vehicles will be maintained are connected to each other below ground.

Operational zero error

In many manually operated terminals, containers get lost – and this happens even on fully automated terminals. In manually operated terminals this number could rise. As Khalifa Port has a manual waterside operation, we have devised a way not to misplace containers. The idea behind it is that containers in SC only can be unlocked in designated places and confirmed by TOS, in addition the locking of containers can be done only after approval from TOS.

All pick-ups and drop-downs of containers by shuttle carriers (and other container handling equipment) are within the full control of the TOS. Only movements that match a valid job order are possible. This applies to the whole terminal area, not only the quay area.

Optical Character Read (OCR) systems on cranes register all incoming and outgoing container movements. An OCR system is a fully integrated system that automatically reads and records the container's ISO code number as it is handled by the crane. Every container is matched against the load and discharge lists. The location and movement of every container outside the automated stack is controlled. As a result, the stack and yard inventory are always 100 percent up to date and checked by the system. The number of crane team members is lowered.

The software remembers the position of all containers outside the automated stack (including transfer areas) and translates positions of vehicles into logical positions. With the combined input, the system requests validation from the TOS (in a similar format to the job orders given to the drivers). The TOS simply accepts or rejects the request. If the request is accepted, the vehicle's twistlocks can be applied. If not, the vehicle has to go to the correct position as indicated in the job order or the TOS will generate a new job order based on the vehicle's current position. For emergencies a big button in the cabin overrules the TOS and the straddle carrier driver can unlock his container and drive away. The button is resettable by operational people who have the unlock key.

ABOUT THE AUTHOR AND COMPANY

Jan Grinwis has worked for 28 years in the technology of container handling equipment, of which 14 years were spent as Technical Maintenance Manager of the fully automated containers terminal at ECT in Rotterdam and 4 years as a Project Manager at Kalmar industries at CTB Hamburg and Cargotec, China. He is now Deputy Project Manager of the Khalifa Port Project in Abu Dhabi.

Formed by the Abu Dhabi Government in 2006, **Abu Dhabi Ports Company** (ADPC) is a master developer of ports and industrial zones. Its primary function is to propel economic expansion by establishing the firm foundations of modern infrastructure, real estate and business services across Abu Dhabi.

ENQUIRIES

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