Towards the end of 2012, a unique dredger ‘set sail’ from The Netherlands (figure 1). The vessel is named in honour of Mr Alberto Alemán Zubieta, the administrator and legal Autoridad del Canal de Panamá (ACP) representative, who retired in September 2012 after two successful terms in office. It is unique, because this is the first 12m³ pontoon-mounted backhoe dredger acquired by ACP and also the first built by IHC Merwede within ACP’s programme [1].

In addition, she is the second high-tech dredging vessel that ACP has ordered from IHC Merwede within the past two years. The first one was the 12,000kW 85cm cutter suction dredger (CSD), QUIBIÁN I (figure 2), delivered in April 2011 [2].

The new dredger is being assigned to the ongoing extension of the Panama Canal. After completion of the project, scheduled for 2014 and the 100th anniversary of the Canal, she will be assigned as one of ACP’s channel-maintenance vessels.

Dredging in the Panama Canal

The ACP applies some basic principles to dredging in the channel. Naturally, these influence the design of any dredging equipment and operations. The first principle is that dredging operations shouldn’t block or delay navigation through the Canal. This implies that when one barge is being loaded to its side, the next barge could not be tied to the other side, but to the fore ship.

Another principle is that if a dredger suffers from an unexpected incident, she should always remain afloat, ready to be towed out of the navigation channel. Alternatively, it should at least be possible to neutralise the effects of the incident. For the QUIBIÁN I, this implied that the foreside ropes had to be fastened to the winch drums by breakable fasteners. This allows a rope that has been accidentally picked up by a passing ship to entirely wind off, rather than dragging the dredger into the channel [2].

The personnel at the ACP are passionate about their equipment. Consequently, it still successfully runs a pair of the oldest dredgers in the world, the RIALTO M CHRISTENSEN (a large 11.5m³ dipper dredger, vintage 1977) and the 9,000kW 70cm MINDI (to our knowledge the oldest operational CSD, built in 1943). This culture was reflected in the ALBERTO ALEMÁN’s general specification that required the hull to be designed for 30 years’ service without the structural elements cracking or breaking.

IHC Global Production

IHC Merwede delegated the turnkey delivery and project management to IHC Global Production (IHC GP), which is experienced in streamlining the many parties, components and elements that are involved in this special dredger. It was also an ideal opportunity to show that IHC GP could meet its backhoe dredger ambitions [1]. Indeed, many parties have contributed to this dredger:

- IHC Offshore & Marine organised the basic naval engineering.
- Vuyk Engineering Rotterdam produced ANSYS strength calculations for the pontoon, hull girder and spud casing models, spud carrier and excavator foundation – designed for 30 years’ service.
- MTI Holland used DODO, IHC Merwede’s well-known integrated programme of hydromechanics, multi-body dynamics and soil mechanics [3] to assess the dredger’s dynamic behaviour and ensure that she may catch up with...
the required production figures, and that an unexpected incident will not influence navigation in the channel.

- Kundt Service GmbH built the Komatsu excavator from scratch and adapted it for marine applications.
- IHC Drives & Automation designed and delivered the electrical installation, from the main generators to the smallest lamps in the accommodation (figures 4-6).
- IHC Systems supplied its renowned excavator monitor (XPM®) with its safety provisions, such as pontoon protection and slew and outreach limitation, which protect the excavator’s mechanics. The XPM® is compatible with survey data provided by ACP’s standard survey systems.

The result of all parties coming together was a solid, reliable and integrated dredger, appropriately adapted to operations in the Panama Canal.

Remarkable features

The vessel’s hull is remarkable in terms of her dimensions, which seem unusually large and may be explained by two factors. Firstly, ACP has planned to replace the current Komatsu PCS500 by an even larger PC8000 in the future. With its break-out force of 1,450kN at 18 metres of depth, the latter will require more buoyancy than the former.

Secondly, with regard to channel traffic safety, the dredger is normally partially jacked up from the water on her three steel rope-operated spuds. Then, there is the conceivable risk that one of the spud ropes will break and cause a sudden imbalance at one side of the pontoon. In such cases — and particularly if the loaded bucket has been slewed above a barge, there is a risk that the pontoon will capsize, dragging itself and a loaded barge onto the bottom of the channel. This would be a huge and almost irremovable obstruction for the navigation of the Canal, not even to speak of the potential injuries and grief involved. This is where DODOO proves its capabilities (figure 8).

The simulations resulted in the confidence that the pontoon has the appropriate dimensions to prevent capsizing if the spud ropes break unexpectedly — even at the worst loading position. It also predicted the spuds’ capability to cope with the forces: of digging and breaking clay and rock; generated by waves and swell; and caused by moored barges of 1,000-1,500m³.

Teaming up hardware

ACP’s safety requirements imply redundancy in the operation and control of subsystems on board. These factors can be found in nearly every aspect of the design.

For example, the Komatsu PC5500 is a self-contained hydraulically driven, pedestal-mounted excavator for marine applications. Its hydraulic power is provided by six fixed/variable flow pumps, driven by not one, but two IMO Tier II-compliant 1,000kW diesel engines. An autonomous electro-hydraulic pack, powered by the generators in the pontoon, serves the emergency lifting of the excavator’s boom and stick at slow speed. A second hydraulic system has been dimensioned to supply the three spud winches simultaneously, as well as the spudcarrier winch, the azimuth thrusters, windlasses, deck cranes, and barge mooring and shifting winches. The hydraulic oil can flow to the pontoon through a hydraulic rotary joint.

An electrically driven hydraulic power pack has been installed in the pontoon for the operation of the hydraulic equipment in case the excavator’s engine is not running, or for the emergency control of the spuds (one by one), spudcarrier winch, windlasses, deck cranes, and barge mooring and shifting winches. The hydraulic oil can flow to the pontoon through a hydraulic rotary joint.

All equipment can be controlled from the excavator’s cabin, including the spuds and the spudcarrier. Back-up control is also available from a control console in the observation room, except for the excavator itself.

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The extensive and removable/replaceable fendering around the fore ship and both sides is also remarkable. This is to protect the hull against the thousands of impacts made by those barges that are expected to be moored alongside the dredger during its lifetime. Triple-drum locally controlled barge-mooring winches have been located amidships at starboard and port side, assisted by four small single-drum winches on the main deck.

Not so visible — but no less important — are the provisions for encountering the harsh implications of excavating, breaking and ripping a mixture of blasted material and 20-tonne boulders, in addition to diesel-hydraulic originated noise, vibrations and impacts. The specification requires noise levels that allow for normal voice communication on the dredger, except for machinery space and workshops.

Therefore, the accommodation forecastle with its so-called observation room (deckhouse) has been placed on vibration dampers. And, barely visible at the surface, the foundation of the excavator has been totally enclosed in carefully calculated, heavy rubber blocks. The backhoe dredger is of course also capable of digging loose and dense soils, as well as compact materials, but these will not generate as many vibrations or other technical issues.

Also not visible (however, see figure 1) are the recess-mounted and hydraulically operated azimuth thrusters, intended for assisting the dredger during positioning at operational locations.

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The ALBERTO ALEMÁN ZUBIETA has been fully prepared for the future installation of a Komatsu PC8000 or similar excavator. This type of backhoe dredger’s hydraulic installation is electrically driven. Therefore, the pontoon already has been provided with engine rooms prepared for the installation of diesel-generator sets for powering the PC8000. The safety backups will of course also be maintained and adapted for the new situation.

Spuds

Three spuds – one located in a spudcarrier along the forecastle in the bow centreline and two fixed spuds halfway along the aft ship – provide sufficient bearing capacity and support to the excavator. The spuds are of a totally enclosed double wire: one running to the top sheaves in the spuds; each by its own single-drum winch. Every winch has a guidance supports with replaceable wear-reducing liner blocks. Jacking up the pontoon provides a stable work platform for the excavator.

In order to reduce the wear of the steel spud wires, they are mounted well above the spuds’ lower mud-sticking end. They can be replaced through access via the spud guidance supports when the spuds are lifted. If necessary, this can be done by the spud emergency lifting system, which consists of a framework with jacking cylinders that must be applied to each spud one by one (figure 10).

Trials and delivery

In December 2012, the ACP’s dredging operators, engineers, electricians and maintenance personnel received their first equipment training. In the meantime, the dredger was tested in The Netherlands and proved to keep up with the required production levels. After that, she was seaweasted and transported to Panama, where she arrived in January 2013.

After arrival she had been ‘awoken’, as Project Manager Philip van den Broek expressed. In this phase, further equipment and practical on-board training was conducted, including the operators’ training. Subsequently, after a successful trial period of 30 continuous days on the Panama Canal (figures 11-13), the ship was handed over to ACP, represented by Mrs Regina Donelson.

The whole trajectory, from ordering through to engineering, manufacturing, launch (figure 14), commissioning, trials, transportation and extended trials of this unique dredger, had taken only two years and two weeks. This is an example of IHC Merwede at its best.

References


Principal characteristics

<table>
<thead>
<tr>
<th>ALBERTO ALEMÁN ZUBIETA</th>
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<tbody>
<tr>
<td>Type</td>
<td>Backhoe dredger</td>
</tr>
<tr>
<td>Dredger</td>
<td>Autoridad del Canal de Panamá (ACP)</td>
</tr>
<tr>
<td>Classification</td>
<td>Summa Venix</td>
</tr>
<tr>
<td>Length overall (ft/ft)</td>
<td>224/72.5</td>
</tr>
<tr>
<td>Breadth, moulded</td>
<td>35.00m</td>
</tr>
<tr>
<td>Depth</td>
<td>21.00m</td>
</tr>
<tr>
<td>Draft (fl/working)</td>
<td>29.50m / 25.25m</td>
</tr>
<tr>
<td>Spud dimensions (three identical)</td>
<td>17.50x2.00x2.00m</td>
</tr>
<tr>
<td>Spud carriage stroke</td>
<td>8.00m</td>
</tr>
<tr>
<td>Dredging depth</td>
<td>9.50m @ outreach 3.00m</td>
</tr>
<tr>
<td>Bucket contents PC8000/PC8000</td>
<td>23.00m³</td>
</tr>
<tr>
<td>Digger force with PC5500/PC7500</td>
<td>170kN @ 18m of depth</td>
</tr>
<tr>
<td>Digger force with PC8000</td>
<td>450kN @ 18m of depth</td>
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<tr>
<td>Total installed power</td>
<td>3,000kW</td>
</tr>
<tr>
<td>Day accommodation</td>
<td>Ten people plus two single-berth cabins</td>
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