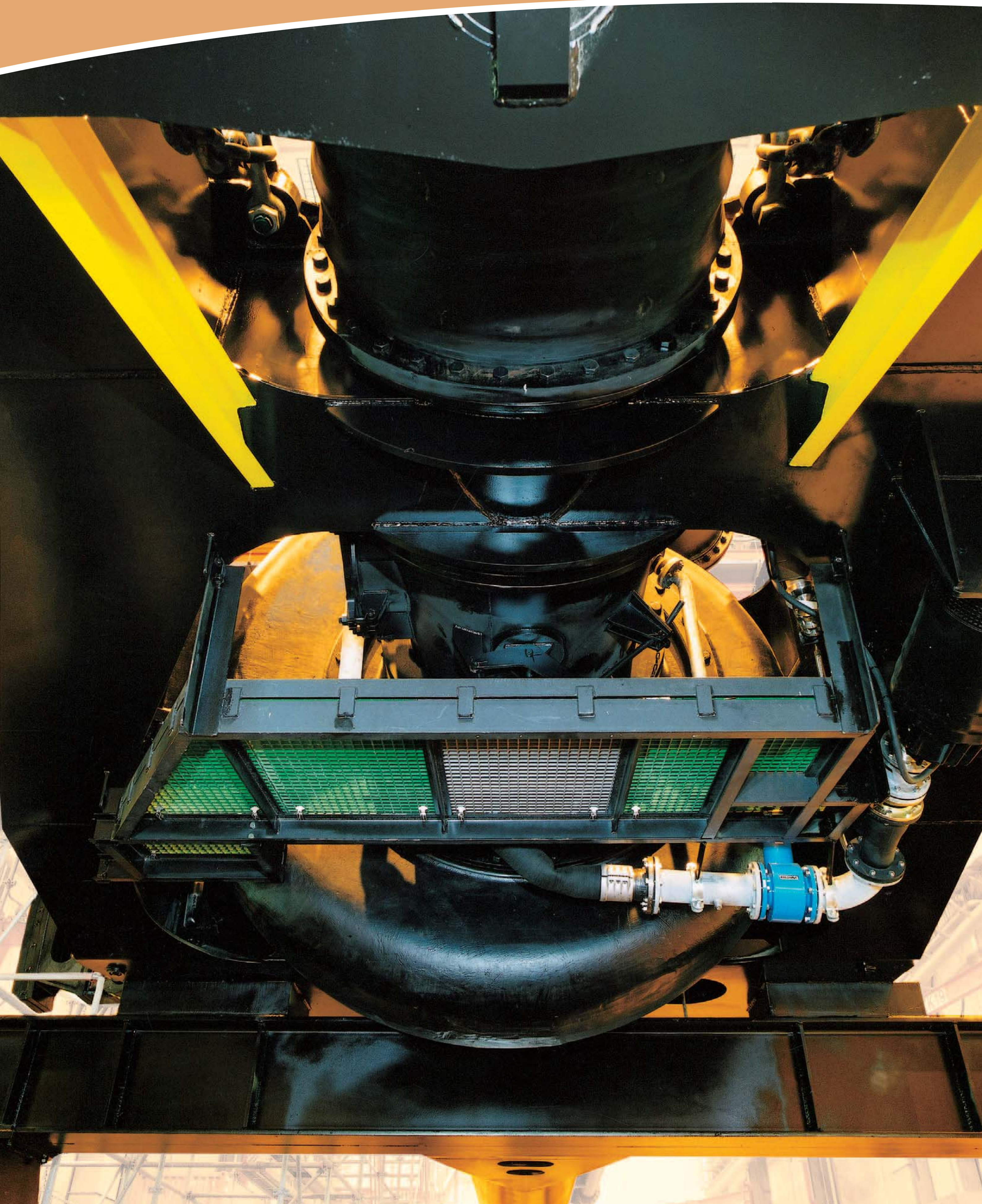
Ports and Dredging

Published by IHC Holland in 2005 . E 163

IHC HOLLAND



BVQI

Certification

Awarded to

IHC HOLLAND DREDGERS B.V.

Smitweg 6, 2961 AW, KINDERDIJK, The Netherlands

BVQI certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standards detailed below

STANDARD

ISO 9001:2000

SCOPE OF SUPPLY

Development, design, production and life cycle support of advanced dredging equipment.

Original Approval Date: 5 January 2005

Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid until: 5 January 2008

To check the validity of this certificate please call (+31 (0)10 28 22 666)
Further clarification regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation

Certificate Number NLDGNG004489 *Date:* 3 February 2005

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IHC Holland Dredgers BV obtains Quality Management Registration to ISO 9001:2000 certificate

IHC Holland Dredgers BV recently obtained ISO 9001:2000 certification for the development, design, assembly and life-cycle support of advanced dredging equipment.

Considering the market that IHC Holland Dredgers operates in and the product that the company is focused on, strong concentration on the customer and market expectations (an important principle in the case of ISO 9001) has been an essential part of those particular business processes for a long time.

The certification process has been used to clarify the business process for the employees and it has also served as a framework for the continous improvement of products and production processes.
Apart from that, the only parts of those processes that have been restricted are their basic flows, so there is still enough flexibility to respond promptly to the specific demands and needs of our customers.

The management of IHC Holland Dredgers considers the quality management system a useful tool for pursuing the chosen way of professionalising and constantly improving itself energetically way under the slogan 'We want to contribute to the enlargement of the success of our customers by supplying dredging equipment with the highest profitability'.

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Cover: Detail of the deep dredging installation of the PEARL RIVER

Ports and Dredging

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Ports and Dredging is published by IHC Holland.

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PEARL RIVER

gets deep dredging installation

Although the world craves large infrastructural improvements, sand is ever more difficult to get at, for instance for political reasons, as in the Far East. Elsewhere in the world, genuine fear of environmental effects, for instance the effect of apparent rises in sea level when dredging takes place close inshore, makes governments apprehensive about large scale sand winning near their shores. Political as well as environmental obstacles can only be avoided by winning sand offshore and on larger depths, above 100m. IHC delivered deep winning dredging equipment to the giant TSHD VASCO DA GAMA in early 2003. This project was brought to a successful conclusion thanks to what was then the recent development by IHC of a Bellow Pressure Compensator, which keeps the sea water effectively out of the submerged dredge pump's electric motor. To create sufficient vacuum at the end of a suction pipe for dredging depths from 50m, one needs an extra pump down below in the pipe. Since electric motors and water do not mix, it is imperative to keep water out of them, even when outside pressure increases at greater depths. IHC's patented Bellow Pressure Compensator (BPC) does that vastly better than anything conceived previously; in fact the BPC was necessary to make these deep winning installations viable at all.

The Bellow Pressure Compensator

In 1994 the world's first genuine jumbo trailer in a rapidly evolving market was the PEARL RIVER, built by IHC. In the course of her relatively short existence, she has had to prove her flexibility in a series of modifications. First, the hull was lengthened from 144m overall to 181.80m, enlarging the hopper from 17,000m^3 to 24,124m^3. In December 2004 her capacities were potentially further enhanced when a deep dredging installation was completed, which will increase maximum dredging depth from the original 50m up to 120m, enough to dredge on the edges of continental shelves. Quite naturally the order was given to IHC Holland's business unit IHC Holland Parts & Services (IHC P&S), for whom it is the latest in a succession of deep dredging installations.

IHC P&S are specialists in the design and construction of all types of dredging installations, wherever or whenever the ships have been built, and are also in charge of after sales service and spare part delivery. Back in the early 1990's, IHC P&S had also developed the outer pump casings of the PEARL RIVER's main dredge pumps (total power: 11,400kW). At the time these monsters were a major source of headaches, since pump casings had never before been made so large. Initial problems at the contracted foundry taught IHC P&S's engineers a thing or two about walking tight ropes while trying to keep hold of a greased ferret.

Now the PEARL RIVER has once again got one of the biggest pumps of its kind, a submerged one this time: an IHC high efficiency single-walled centrifugal pump with three-bladed impeller. The pump, wearing plates and suction mouth liner are made of an extremely wear-resistant special cast iron, Max5. The pump shaft sealing is of the patented IHC 'LIQUIDYNE' type.

A submerged pump has to be driven electrically, since driving it directly from the vessel's engine room is only practical in stationary dredgers, and diesels need oxygen, which is in short supply below the waves. The pump's impeller is mounted by IHC patented Threaded Slip Protection (TSP) to the extended impeller shaft of the oil-filled submersible three-phase AC squirrel cage 3,400kW induction motor, working at 3,300V. The TSP makes it possible to mount wear-resistant specially cast iron impellers, also substantially reducing the time needed for mounting and dismounting the double-shrouded three-bladed type impeller.

Water must be kept out of the submerged electric motor's system at all costs; overpressure in the motor's oil bed is expected to do that job. IHC's patented Bellow Pressure Compensator (BPC)-system is a vast improvement on earlier systems, in that its overpressure is variable and increases with depth.

It is in fact a passive pressure system, in which the surrounding water helps maintan a slight overpressure inside through a bellows and spring configuration. For big motors, multiple BPCs can be fitted in series. More can be read about BPC in P&D 160 as well: 'VASCO DA GAMA's giant deep dredging installation.'

Before: 144m - 17,000m³ - max. dredging depth 50m

After: 181.80m - 24,124m³ - max. dredging depth 122m

Moving the suction pipe

The PEARL RIVER's original suction pipe inlets are to port and starboard, aft of the hopper, near the pump and engine rooms. Handling a suction pipe of nearly the same length as the hull itself, however, required some fresh thinking about the inlets and a major relocation of more powerful winches.

A new suction pipe inlet with guide tracks has been created to starboard, forward of the hopper, alongside the deckhouse, complete with jet water hull connection. The cable and pipe connections between suction pipe and ship are laid on a service frame made of square section pipes, just forward of the trunnion gantry and abaft the raised foredeck. The forward suction inlet implies that the spoil has to enter the hopper through a new discharge pipe via the general store forward of the hopper, instead of from the aft end on both starboard and port side. In deep dredging mode the new pipe will be connected to the forward end of the starboard discharge pipeline over the hopper, in which the direction of the flow will be reversed, so that a number of branches have to be turned 180°. At the aft end of the hopper, this starboard pipe will then be connected to its counterpart on the port side, from where the original direction of flow will be maintained.

This layout allows the dredge master to load the hopper evenly.

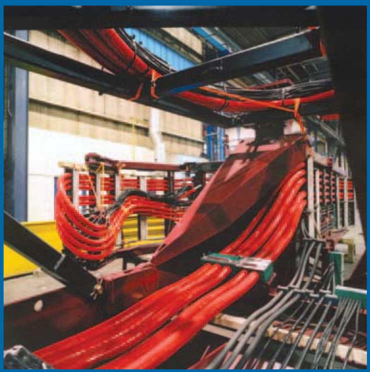
Sub-foundations of trunnion, pump and intermediate gantries have been modified or put in place. The trunnion gantry and the pump gantry are new, as are their hydraulic winches, while the intermediate and draghead gantries have been re-used, though relocated.

Easy handling of the entire submerged pump unit was a major consideration. Specially designed plug connections and junction boxes for power cables and the flange-connected division in the support beam, which is welded to the sliding piece of the service frame, make mounting or dismounting the deep dredging installation relatively easy.

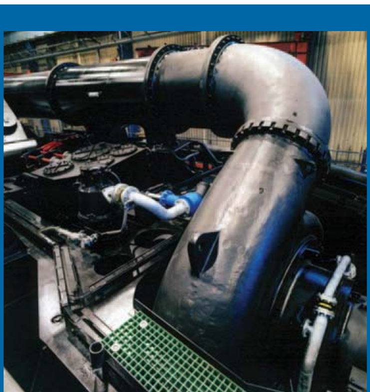
The cradle that carries the submerged dredge pump and motor unit has an active buffering system on the inside, to protect both hull and cradle from the impact of them swinging against each other while the suction pipe is being put out, and also to buffer the suction pipe while it is being hoisted in.

The hard part here was to squeeze all the hardware in, despite pinching lack of space. For the trunnion gantry with affiliated hardware, the remaining side deck between superstructure and gantry barely leaves room to walk through. The service frame had to be kept low to keep it from obstructing the wheelhouse. When the vessel was lengthened, its top-sides were raised alongside the hopper to satisfy Bureau Veritas' freeboard requirements. The resulting raised deck presented IHC's engineers with an unusual challenge: how to decently store the entire pipe on deck as close to a horizontal position as possible.

In the end the upper pipe jauntily climbs the hump to the pump gantry, runs horizontally to the intermediate gantry and from there goes down to the suction gantry, like a pensive swan's feet in



drifting mode. The 138m long suction pipe is made up of three parts with an internal diameter of 1,200mm below the pump and 1,100mm above, and a 350mm jet water line alongside, designed for a working pressure of 12 bar. The jointed swell-compensated structure is sufficiently flexible that it can always keep the draghead with self adjusting visor flat on the underwater bottom, also on uneven bottoms and when it gets under the hull or veers out while the ship alters course. This flexibility is achieved by a trunnion elbow and a vertical hinge with a rubber hose at the upper end of the trailing suction pipe. The original lower pipe and its lengthening pieces have been incorporated into the new deep winning pipe, as were the turning gland, cardan with arm pieces and the corresponding jet pipes, cable trays and mounting materials.
Re-use of existing equipment was an important consideration and it certainly shows in the (re)distribution of hydraulically driven suction pipe winches and the gantries. The starboard draghead winch's single grooved drum has been modified to store the hoisting wire in two layers. The winch itself was moved forward a bit. The port draghead gantry and winch have been shifted to star-board, to become an intermediate gantry and winch, also with two layers hoisting wire on the drum. Pump and trunnion winches have been delivered new, both with a hoisting speed of 8m/min. or 4m/min. at the suction pipe. The pump gantry's outreach is 10.5m, its nominal pulling force over 200 tons.

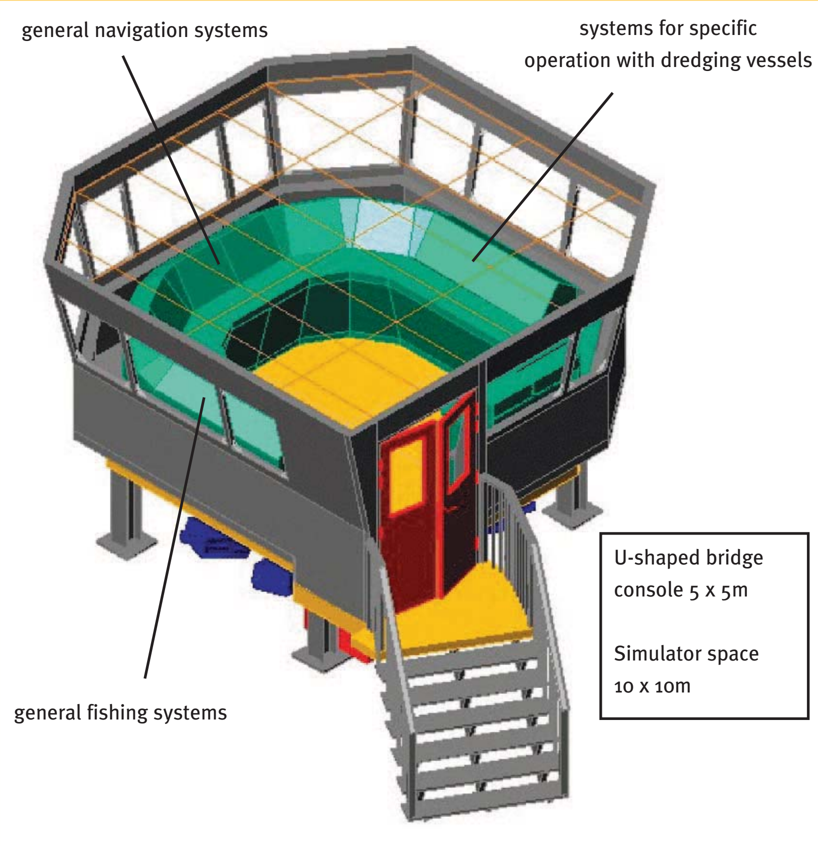


Driving and measuring

The submerged pump's drive is powered by the existing board net through a step-up transformer and controlled by a frequency converter. The electrical installation will be kept running by two shaft-driven main alternators on the main engines; an auxiliary alternator and an emergency alternator, both driven by auxiliary diesels. To avoid complicated changes to the existing switchboard a new switchboard has been built for parallel switching of the main generators. The existing main switchboard was adapted, a separate Dredge Pump Drive Switchboard delivered, for parallel operation of the main generators.
The suction pipe position monitor (STPM) gets information from the existing pressure transducer near the suction mouth and from synchro-angle transducers measuring the vertical and horizontal angles of lower, intermediate and upper pipe. One vacuum meter in the suction line, plus pressure meters in the discharge line of the dredge pump as well as in the discharge line of each gland pump, tell the dredge master about the state of the spoil. At all gland pumps the flow rate is measured by magnetic inductive flow meters.
Pressure at the draghead is gauged by a transducer that survives up to a depth of 125m. An IHC Systems type DVT.FT integrated density and velocity transmitter has been fitted in the 1,100mm diameter inboard delivery pipe of the submerged dredge pump. The transmitter has stainless steel electrodes for inductive velocity measurement and radio active parts for gauging the density. The radioactive source and the measuring transducer (scintillation type) are flanged to the measuring pipe, enabling easy removal while keeping the radiation beam completely shielded. The source has a life time of at least five years.
The total hardware weight of the order was nearly 1,000 tons. Where possible, IHC standard components have been used, which also facilitates rapid replacement of spare parts. To give an idea of the hard work that dredging really deep still involves: the PEARL RIVER now fills its hopper in three hours when she is dredging at a depth of 120m. At a depth of 70m it takes two hours. With her enormous new suction pipe, the PEARL RIVER can face up to the tasks of modern dredging again. Even a decade after her launch and some fiddling, the world's first jumbo trailer is still one of the biggest and deepest dredging crafts afloat.

IHC

A new integrated bridge training simulator for Zeebrugge, Belgium



Artist's impression of the bridge

In December 2004, a new integrated bridge training simulator was inaugurated at the Centre for Maritime Education in Zeebrugge (Belgium). This project is the result of intensive cooperation and sharing of knowledge by all parties involved, i.e. the Belgian government, dredging- and fishing industries, and other maritime partners.
The contract was awarded to a consortium of three Dutch companies: IHC Holland Systems, Imtech Marine & Offshore and MARIN. Each of them brought in specific knowledge: IHC Systems of dredging, Imtech M&O of hardware and overall project management and MARIN of vessel behaviour in general.
The Belgian dredging contractors Dredging International and Jan De Nul also contributed significantly to the success of this project.
The advantages of training simulators for maritime navigation are evident. Not only maritime students but also experienced seafarers can be put through a great variety of navigation circumstances in a relatively short time, without the astronomical costs of gaining the same experience with the real thing. In recent years, many navigation simulators have been built all over the world. But what makes the Zeebrugge simulator so unique?

Simulation of trailing suction hopper dredgers

Contrary to a free-sailing ship where only the hull interacts with the water, on a dredger, lowering or raising the suction pipes, or dredging with the suction heads down, this extra hardware interacts with the water and the water bottom, adding many forces to count with. Sudden changes in water currents, composition and level of the bottom or the speed and direction of the vessel while dredging have an important influence on the behaviour of the ship and require a specific approach and anticipation from the person on the bridge.
Special operations such as dredging trenches and slopes make this even more demanding! Last but not least, it is also very important to know how to

Impression of a training session on the simulator in Zeebrugge: in the wheel-house with bridge consoles, projectors create a 330° 'real time' view of the seascape

Instructor's desk/debriefing station. From his station, the instructor can send all kinds of data: position, speed and extreme weather conditions, as well as specific data that can influence the dredging process. The debriefing station (background) is where each simulated situation can be evaluated. A bird's eye view projection on the wall screen is possible in some cases.

react in emergencies involving the suction pipe, for example when it gets stuck or is damaged.
On the Zeebrugge simulator a virtually unlimited variety of such and other situations or even rather extreme ones, can be trained in a realistic environment.
The new simulator should not be confused with already existing hopper simulators. These simulators only simulate the dredging process and are used for training dredge masters; they do not include the navigation part of the dredger.
The simulator in Zeebrugge is the first one in the world where the navigation and the dredging aspects of a hopper dredger have been incorporated.
Its main purpose is navigation training; the instructor outside the simulator or a second man on the bridge can operate the suction pipes as an input for the training of the captain or officer at the controls. Hoppers from $5,000m^3$ to $16,000m^3$ can be simulated. Most instructors will be well-trained and very experienced captains.

The Zeebrugge simulator with outside view projection. IHC Systems delivered and set up the dredging part of the simulator.

A sophisticated electro-hydraulic position controller for the J.F.J. DE NUL

The J.F.J. DE NUL is the largest self-propelled suction cutter dredger in operation today. The efficiency of the dredging process has been greatly enhanced by implementation of numerous sophisticated techniques. One of the technological improvements that allow the J.F.J. DE NUL to dredge efficiently is the spud carriage control system. As a result of the completely new design of the spud carriage control system, the J.F.J. DE NUL is now able to meet the strictest requirements.

HYTOP has delivered the entire hydraulic system for operation of spud system, hydraulic winches, sluice valves and ladder tensioning system for the self-propelled cutter suction dredger J.F.J. DE NUL, including the hydraulic cylinders, power pack and piping.
Main data items are:

- total number of hydraulic consumers (cylinders and winches): 111
- total oil volume: approx. 45,000l
- installed power: approx. 1,500kW
- installed pump capacity: approx. 4,000l/min
- maximum system pressure: 320 bar.

fig. 2: spud carriage (prior to shipment to Kinderdijk)

In the design and commissioning process for the hydraulic system, special attention was paid to the spud carriage, for which HYTOP has designed a positioning system (including an electronic controller) on the basis of a completely new control philosophy.

Main details of the spud carriage cylinder are:

- cylinder bore: 540mm
- cylinder rod: 360mm
- stroke: 9,300mm
- pushing force 3,000kN
- pulling force 2,500kN
- speed: 0..100mm/s
- maximum flow 1,375l/min
- integrated position measuring system.

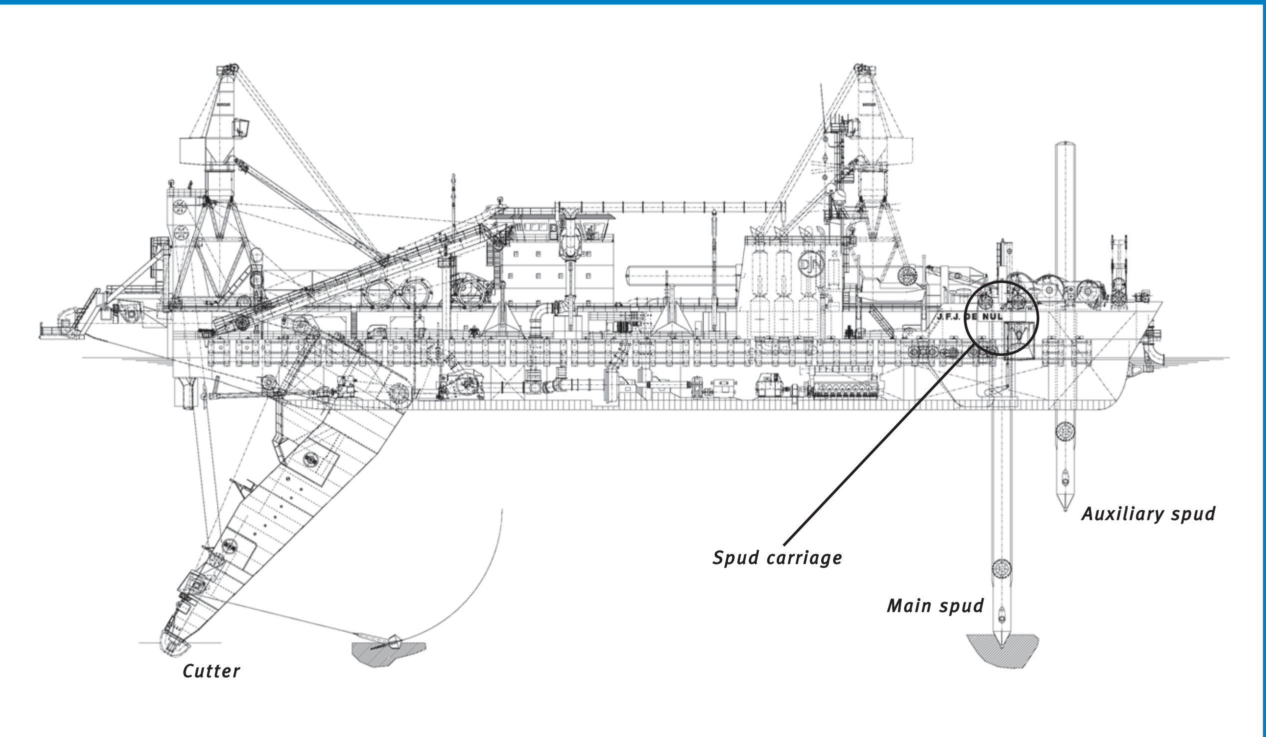


fig. 1: J.F.J. DE NUL

Functional requirements are:

1) Active dynamic position/speed control with active force limitation, i.e.:
   - It must be possible to select one of the following modes of operation:
     - position control
     - speed control.
   - Position control and speed control must be active. This means that the hydraulic servo-valves are controlled in such a way that there is full agreement between desired position and actual (measured) position or between desired speed and actual speed.
   - The electronic controller checks for overloading of the cylinder and prevents it. As soon as an overload is detected, the control system responds by reducing the speed or even by reversing the direction of movement. When normal load conditions have been restored, the electronic controller returns the cylinder to the desired position (or desired speed).
2) Central hydraulic system. It is possible to use a dedicated hydraulic power pack for the spud carriage. In order to keep installed hydraulic power as low as possible, however, a single hydraulic power pack is used for all users.

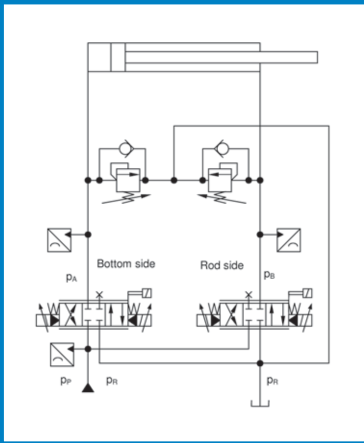


fig. 4: principle of the hydraulic control system spud carriage with 2 servo valves

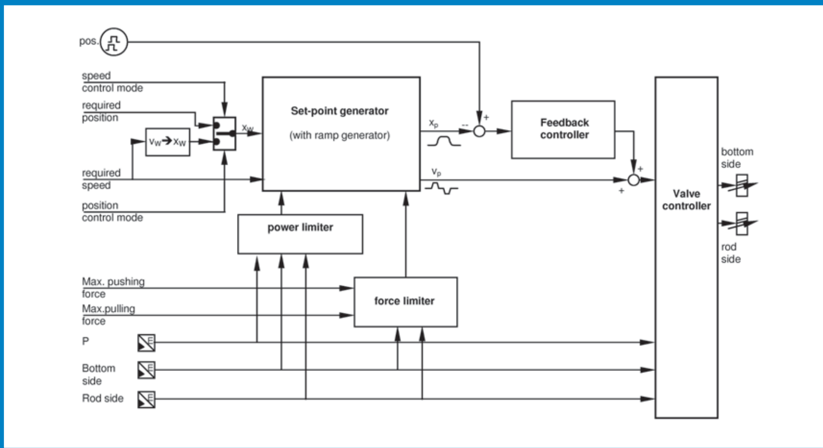


fig. 5: control principle block diagram

3) Power control. Since the total flow required -when all users are being operated at the same time- is larger than the installed pump capacity, the controller responds by reducing the power (i.e. the speed) to the spud carriage whenever necessary.
4) Pressure in the discharge line of the hydraulic pump may not fall below the level where cavitation sets all bells ringing.
5) It should be possible to operate the system with only part of the hydraulic pumps (albeit at a lower speed).
6) When the system is not in operation, the pressure in the cylinder must be reduced by hydraulic pressure relief valves, set as low as possible.

These functional demands require a non-standard hydraulic set-up. Active control with the accuracy as described above, requires the use of hydraulic servo valves.

A normal servo-valve system, with one valve for both retracting and extending the spud carriage cylinder, is not possible, amongst other reasons because such a system needs a high pump pressure, even under negative load, which is ruled out here by the above-mentioned functional demands. To overcome this, a non-standard set-up was chosen with two servo valves: one for the bottom side and one for the rod side of the cylinder.

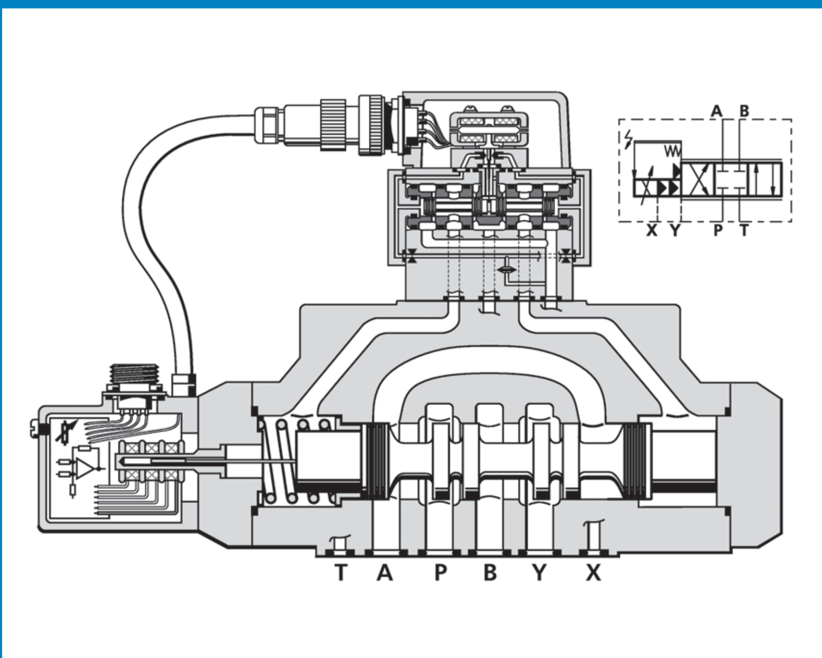


fig. 3: hydraulic servo valve

The electronic controller for the spud carriage is based on a dedicated ABB PLC with a cycle time of 10ms. Monitoring inputs for this PLC are the pressures in the pump discharge line and the pressures in bottom and rod side, as well as the position of the cylinder. The dredging computer (IMC) sends commands to the spud carriage controller through a MOD-bus connection. Commands are: operational mode (position or speed), required position or speed, force limits etc. The spud carriage controller fulfills these commands by controlling the currents to the servo-valve. Required speeds and positions are accurately mirrored in actual speeds and positions, provided that the actual force (as calculated from the pressures on bottom and rod side) stays within the set limits, as far as allowed by the available power.

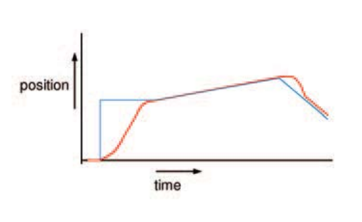


fig. 7: smoothing of input signal

Key features of the control system are:

- Accurate position control. This enables the dredger to operate more efficiently. For instance the inefficiency of a traditional cutter suction dredger when the spud cylinder is retracted (fig 6) is overcome in this way. On the J.F.J. DE NUL, the operational radius of a sweep is independent of the position of the spud carriage.
- Accurate speed control.
- Smoothing of input signal (the input position signal can be very 'bumpy' and is translated into a smooth signal prior to further processing (fig. 7)
- Active force limitation.
- Power control allows the spud carriage to operate correctly even when the available power is in fact too low.
- Smooth transfer between position and speed control.
- Communication of all system parameters (speed, position, actual force, etc.) to the IMC.

Conclusion

By installing a sophisticated hydraulic servo-system for the spud carriage, an accurate hydraulic servo control system is possible without the usual disadvantages of such a system. The advantages of the system supplied are:

- Accurate position and speed control in 4-quadrant control.
- More efficient dredging as a result of the active position control.
- Limitation of the spud load at a safe (adjustable) value.
- Lower installed hydraulic power in one centralised unit.
- No risk of damage due to insufficient pump capacity.
- Full controllability of the spud carriage even when available power is low.

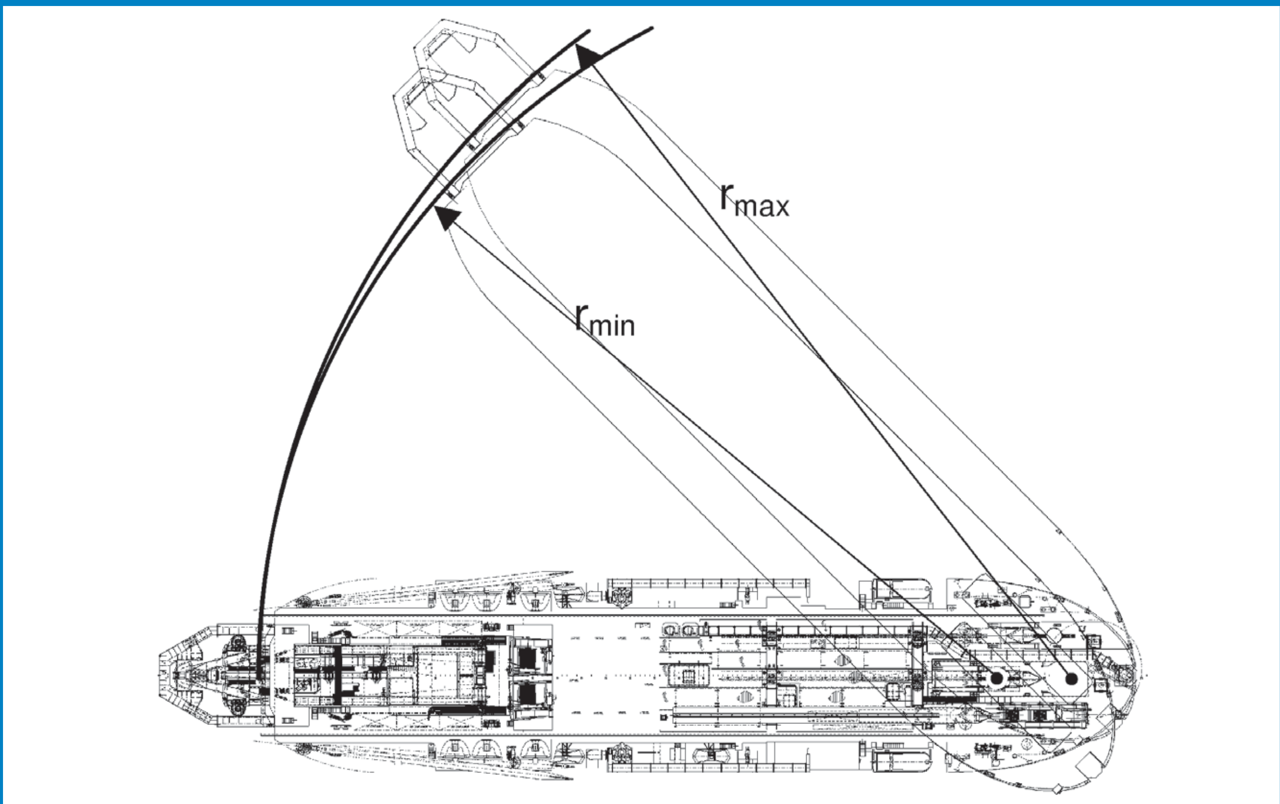


fig. 6: radius of operation of a cutter suction dredger with a traditional spud carriage system depends on the position of the spud carriage

J.F.J. DE NUL all around the world

Over a year ago, IHC Holland delivered the self-propelled cutter suction dredge J.F.J. DE NUL to her owner, Jan De Nul of Aalst, Belgium. Earlier editions of 'Ports and Dredging' described the design and construction of this giant dredger. Owners and builders were honoured with the 'Ship of the Year Award 2004' of the Royal Dutch Association of Naval Engineers (KNVTS).

After completing extra tests and modifications, the J.F.J. DE NUL left the Yangtze-harbour in Rotterdam on Saturday 14 February 2004, bound for Dubai (U.A.E.). During the passage, the vessel demonstrated her excellent sea-keeping, making 12 knots on average. She arrived in Dubai on Sunday 7 March and began work on Monday.

The Jan De Nul Group works on two contracts in Dubai. The first includes widening and deepening of the harbour entrance of Jebel Ali Port, constructed in the early 1980's by Gulf Cobla (see P&D 95). Four heavy duty cutter suction dredgers built by IHC were deployed: the JEBEL ALI BAY, JUMEIRA BAY, MAKTOUM BAY and the ZABEEL BAY. Three of them are still in use. For a depth of up to -17m BCD, some 17 million m^3 of rock, sand and limestone had to be dredged.
The dredging operation was complicated by navigation, continuing round the clock, so that anchors had to be shifted frequently and dredging interrupted, to let ships pass the dredger. The IHC-built Cutter Suction Dredger MARCO POLO and a smaller hopper dredger had already been working on the job when the J.F.J. DE NUL arrived.

Early in 2002, the Jan De Nul Group had been awarded the prestigious contract for reclamation of the 'Palm Island Jebel Ali'. Suitable material, dredged from the Jebel Ali Port entrance channel, has been used for reclamation of the Palm. The 'Palm Island II' holds the creation of a 4km long peninsula in the shape of a palm tree, protected by a 200m wide and 17km long breakwater built around the artificial island. Some 135 million m^3 of cap-rock, calcarenite, limestone and sand are needed for the job. First, temporary channels had to be dredged in the shallow area, for the hopper dredgers to bring their loads ashore.

The new J.F.J. DE NUL worked on this project together with the older IHC-built self-propelled cutter dredgers MARCO POLO and LEONARDO DA VINCI, both famously big and powerful when they were built in 1979 and 1986 respectively. The fleet of hopper dredgers deployed on the project varied in number and size, from the 16.500m^3 JUAN SEBASTIAN DE ELCANO to the 3.400m^3 PINTA.

The island's shore protection includes some 10 million tons of rocks, varying in weight from 100kg to 7 tons. All rock is hauled over land from the Emirate Ras al Khaimah to Jebel Ali Port, where it is sorted and loaded on rock barges. For this part of the contract, Jan De Nul purchased a large fleet of tugs, barges, bulldozers, shovels, dumpers and other earth, or rather, rock moving equipment.

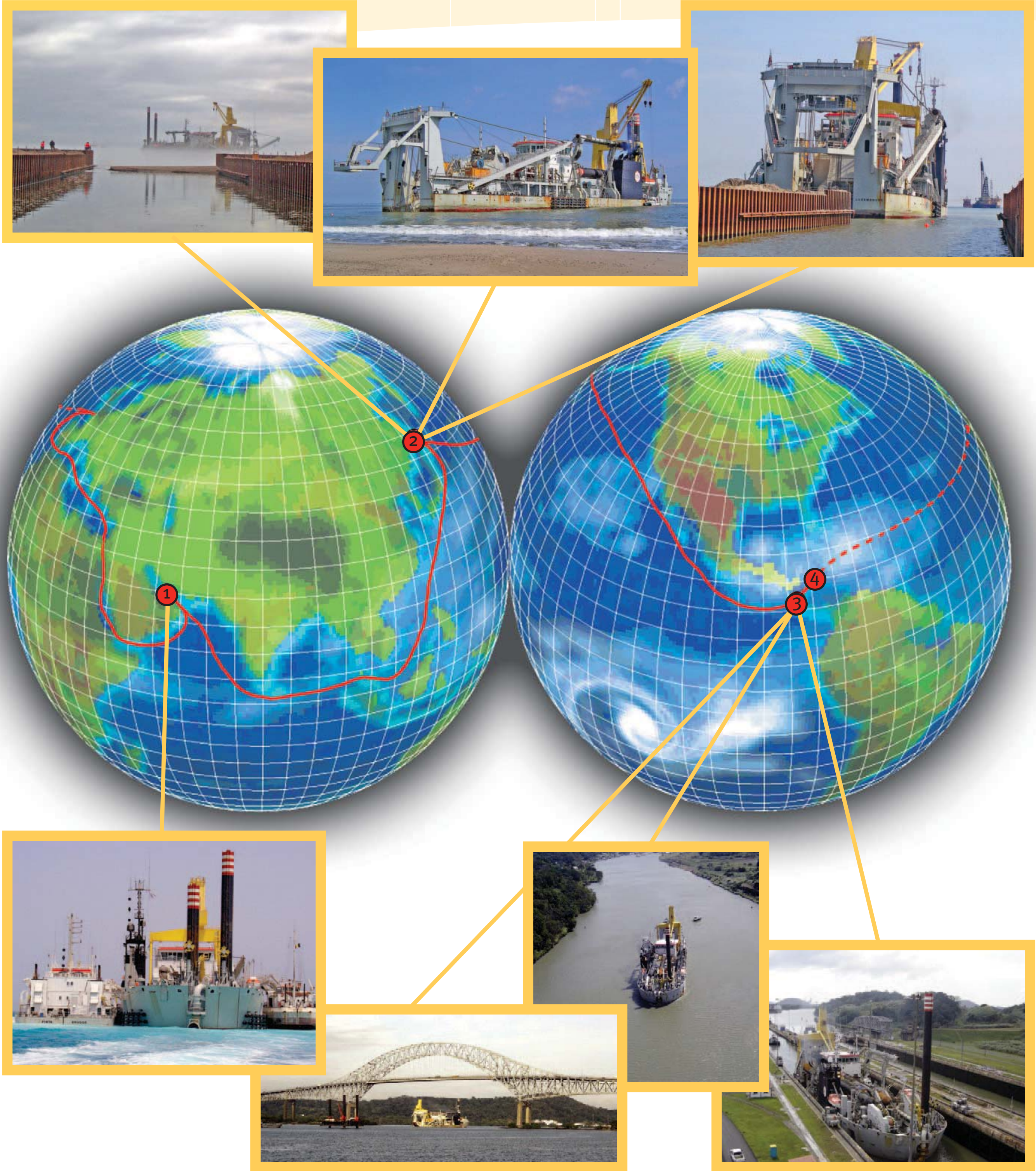
Once the reclamation has been done, 'Palm Island Jebel Ali' will be completed with houses, hotels, marinas, etc., to create a luxurious holiday resort.

In June 2004, J.F.J. DE NUL left for Sakhalin, a large island to the north of Japan in Russia's Far North, where shore approaches and trenches for pipelines in the Sakhalin Energy Project had to be dredged. During the passage, the cutter called at Singapore for bunkering.
A consortium of oil companies is constructing an oil and gas installation on Sakhalin for the treatment and transport of oil and gas to Russia as well as for export. The pipelines running to and from the island must be protected against ice scouring. For the landfalls, Jan De Nul constructed a cofferdam. The environment is unforgiving: temperatures as low as -30°C, very windy and the distance to the nearest supply base is about 1.000km. Such arctic conditions require specially adapted equipment, which Jan De Nul's civil engineering department had arranged. While dredging the shore approach together with a number of hopper dredgers, the J.F.J. DE NUL demonstrated her capacity to work in unsheltered, even rather harsh offshore conditions. The newly developed spud system allows to lower and rise the spuds in a very short time, which reduces the dredger's vulnerability when the weather turns nasty. The crew managed to tilt and sea fasten both spuds -each 46m long, 2.2m diameter and weighing 230 tons- in a horizontal position in less than five hours! During the trials, the job took about two days.
The J.F.J. DE NUL also has the lowest underwater noise emission of any dredger, which sharply reduces her environmental disturbance of marine life, especially sea mammals.

The next jobs for the dredger are in Central America, in Honduras, Panama and again Honduras (Atlantic side).
She left Sakhalin in December 2004 and arrived in Honduras on 4 January 2005, after bunkering and victualling in Honolulu, Hawai. Work began immediately after arrival: deepening a local harbour and its entrance. After this contract, the dredger will be employed in Colon, Panama for the widening and deepening of the entrance to the Panama Canal. The Latin-American part of the round-the-world trip will be concluded with a smaller job in Porto Cortes, Honduras. In the spring of 2005 the dredger is expected to return to Europe, for a number of projects around the North Sea.

By that time, the vessel will have sailed all the world's oceans in a year!

The article in Ports and Dredging 95 is available on our website www.ihcholland.com under the heading P&D 163.



J.F.J. DE NUL's 1,550-tons ladder and 6,000kW on the 35-tons cutter make her the most powerful cutter suction dredger in the world, capable of attacking any compact and rocky soil. The vessel's sheer size and hydrodynamic design allow her to work world-wide and to continue dredging with unparalleled precision while lesser craft scuttle for cover. In the 230-tons spuds, a balance had to be struck between sufficient weight to penetrate the unyielding soils for the dredging of which the vessel has been designed, and sufficient stiffness to avoid them collapsing under their own weight.

On 14 February 2004, the J.F.J. DE NUL left Rotterdam for Dubai where she worked in Jebel Ali Port and on the Palm island II project (1) - 11,655km sailing. After these jobs she left for Sakhalin in June 2004 (2) - 17,870km sailing. In December 2004, the J.F.J. DE NUL sailed to Central America where she worked in Honduras and Panama (3+4) - 16,075km sailing. The dredger is scheduled to return to Europe in 2005, having sailed and worked around the world in slightly over a year.

Dubai = capital dredging and reclamation dredging, Sakhalin = trenching and backfilling, Central-America = capital dredging and maintenance

‘Wild Dragon®’ rules the sediments

‘威龙耙头’

‘Wei Long® Patou’ written correctly, in Chinese characters. ‘Wei Long®’ is the registered Chinese name for ‘Wild Dragon®’; Patou is Chinese for draghead.

Once upon a time, a dredger man’s life was simple, since there were only bucket dredgers to choose from, either for ‘new work’ or for maintenance jobs. In 1680, the first centrifugal pump had been invented, but only after its introduction on the World Exhibition of 1851 did it finds its way into dredging. From 1855 the US Corps of Engineers converted three steamers into suction hopper dredgers. The concept became economical after further development by IHC-predecessor J. Smit in the 1870’s. This decisively broadened the scope for dredging, especially for removing silt in the seaward approaches of ports, where bucket dredgers were useless. By 1900, choices widened when cutter dredgers came available, for working in compacted soils. Contractors operating in the vanguard of dredging had from the 1950’s trailing suction hopper dredgers in their fleets. These, however, were mainly useful for maintenance work, removing silt from channels.
In short: the post World War Two contractor had to make up his mind whether he would approach a job mechanically or hydraulically. Until dredging instrumentation reached maturity by the 1970’s, he often preferred a bucket dredger: it could attack very compact soil as well as very soft mud, was safe to dredge any slope without the risk of breaching and, by just looking at the buckets, the dredge master could see whether he was earning money or carrying water.

How times have changed: IHC has done more than anyone else to develop dredging instrumentation and automation, so that today’s dredgers know better what is going on than their masters. Since the 1970’s, trailing suction hopper dredgers have steadily become bigger, more powerful and, consequently, more versatile. IHC’s research laboratory MTI and business unit Parts & Services have from the very start of trailer dredging pioneered active suction heads that can cope with compacter soils. Increasingly, trailers are used for new work these days, thanks to IHC’s trailblazing trailer heads.

So, when the 12,888m^3 trailing suction hopper dredger XIN HAI LONG, handed over to the Shanghai Dredging Corporation (SDC) in November 2002, began its dredging career, no one was surprised that it performed very well indeed, even in rather compacted clayey sands. So well in fact that a plan arose to let the mighty dredger cut its teeth on an extraordinary unyielding bank in the Yangtze estuary. This had hitherto been the monopoly of cutter dredgers, but the

XIN HAI LONG’s businesslike appearance should send shivers through all decent sandbanks, but the Yangtze river’s stubborn shoals demanded something extra

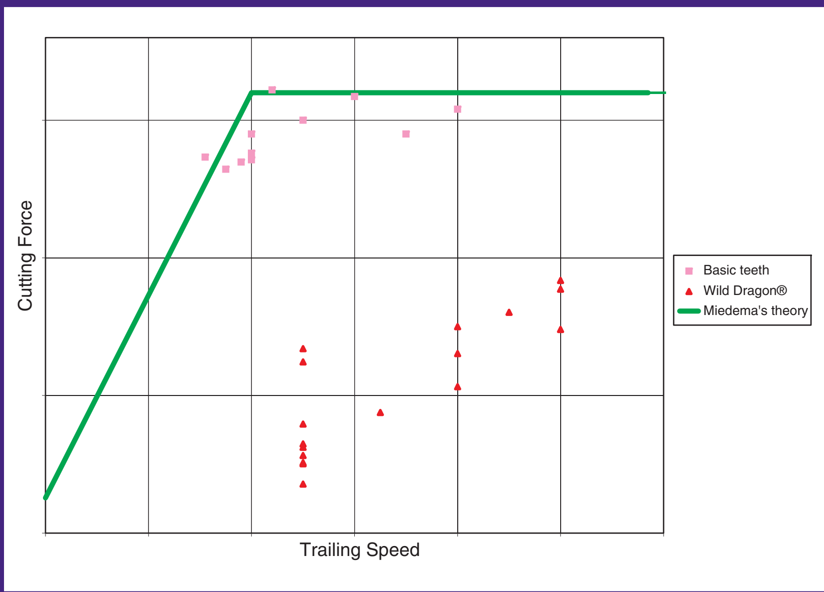


Diagram of the results of laboratory measurements with standard teeth and with ‘Wild Dragon®’ teeth. The line represents Miedema’s[1] cutting theory, which is confirmed by the measured points for the standard teeth.
It also clearly shows the reduced specific forces of ‘Wild Dragon®’ cutting.

[1]‘Calculation of the cutting forces when cutting water-saturated sand’ - Basic theory and Applications for 3-D Blade Movements and Periodically Varying Velocities for, in Dredging Commonly used Excavating Means. Ph.D. Thesis, Delft University of Technology, 15 September 1987.

dangers that stationary dredgers and their outlaying anchors, floating pipelines, or barges ferrying on and off, present to navigation in Shanghai’s crowded approach channels, make trailing suction hopper dredgers a much safer choice.
As was to be expected, XIN HAI LONG initially produced barely more than turbid water when dredging over the unusually fine, compact (60 to 100μm) sand and clay bank. Nobody had ever thought of such solid soils when the vessel’s specifications were drafted. Nevertheless, it hurt IHC’s pride; our engineers saw it as their calling to solve the problem. Clearly, an even more active trailer head was needed than anything in existence at that moment. This requirement set a process in motion that ultimately delivered a revolutionary, patent pending trailer head with a new type of teeth and jet water supply, which made possible a uniquely efficient trailing dredging process, for which a patent is also in the pipeline.

Probing and solving together

Early in 2003, a combined SDC and IHC team met on board: SDC’s head of Research and Development Mr. Lin Feng, their Equipment Department manager Mr. Hou Xiaoming and the dredge master, captain Zang; and IHC Dredgers’ head of Product Development and the delivery captain. They had a go at the hard to dredge Yangtze estuary water bottoms and found that there obviously was scope for improvement of the installation as it was then. The gentlemen agreed on a broad outline of approach: SDC would put XIN HAI LONG at the disposal of the project team for trials, while IHC was to develop a new, more powerful trailer head. Preliminary experiments by MTI convinced SDC of the feasibility of the chosen approach.

While XIN HAI LONG had been running into its indigestible sand bunker, IHC’s business units IHC Holland Parts & Services, IHC Holland Dredgers and MTI had already for some time been researching further improvements of the trailing suction process. This new Shanghai problem presented nothing less than the ultimate goal of that project: if a trailer could gobble up the finest Yangtze sand, it could swallow anything.

A project group was formed by three units of IHC: Parts & Services, Dredgers and MTI; R&D subsidies were applied for and awarded; and subsequently MTI could begin tests, with input from the

Laboratory test of ‘Wild Dragon®’ cutting compacted fine sand. After cutting, the sand comes up like a sausage, still needing of (lots of) water before there can be any hope of moving it hydraulically.

projects they had already been busy with. While the laboratory tests were being run, a revolutionary trailer head was being designed. Over the next period, the researchers and hardware designers influenced each other's work, so that by creative trial and error a succession of trailer head concepts was developed. Ultimately a concept was chosen, that was further worked out and fine-tuned with ongoing laboratory research before it was built expertly by the IHC Service Centre in Tianjin. Other parts, notably teeth girders with specially developed teeth and water supply tubes, were shipped from Kinderdijk.

No shortage of hands: the SDC yard's crew mounting the 'Wild Dragon®' drag head to the XIN HAI LONG suction pipe

One of 'Wild Dragon®''s jet systems on test alongside the MTI laboratory: the search for the most effective jet water distribution system kept the team on its toes for quite some time

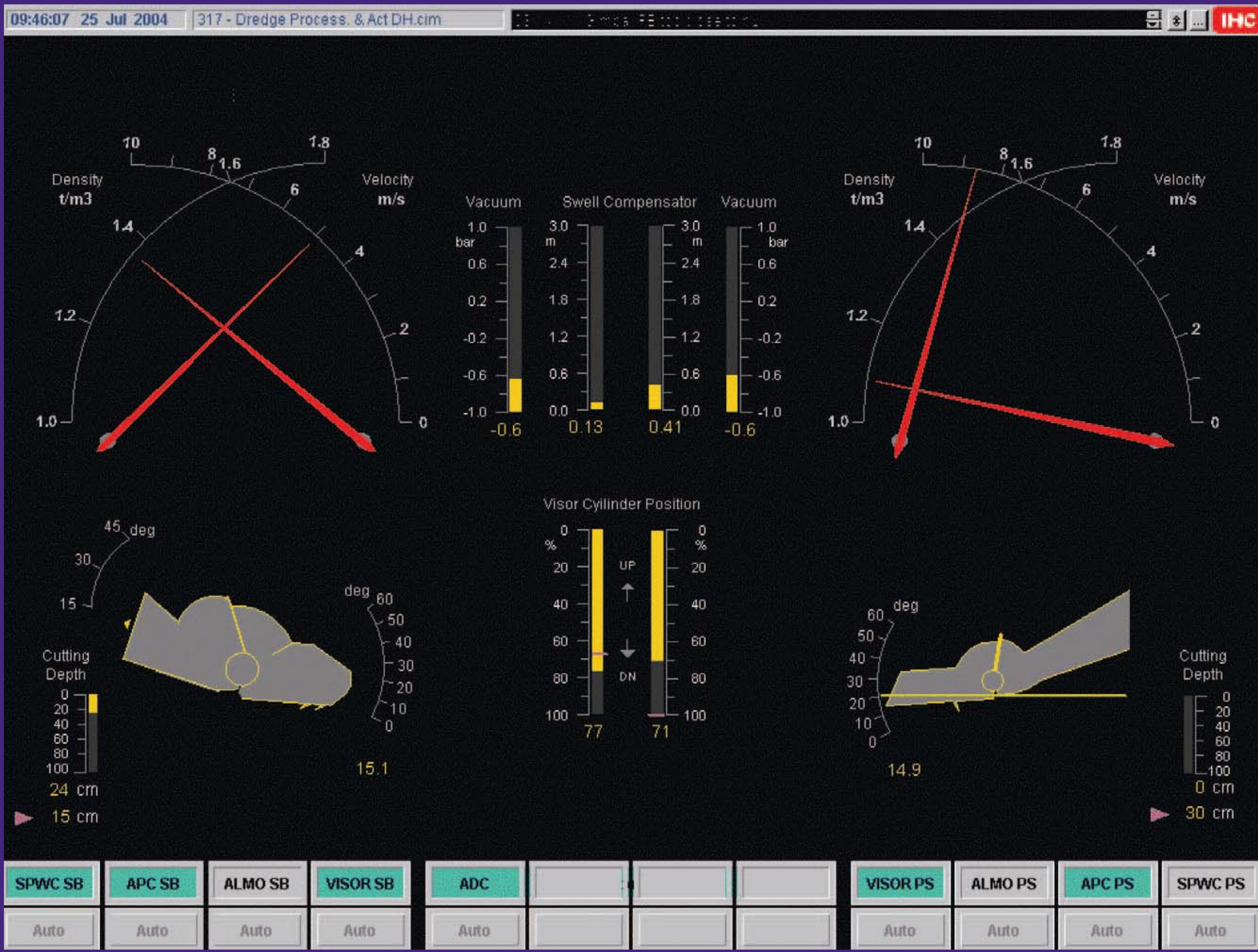
The trailer head was assembled at SDC's Shanghai yard. The schedule was tight, since it had to be fitted while the vessel was undergoing its service for 10,000 running hours of the engines.

On 21st July 2004, trials of the new suction head could begin. IHC's delivery dredge master, who had first-hand experience with similar obstinate sandbanks, joined the team along with an IHC engineer. The latter was needed to assist with data collecting through the Integrated Monitoring and Control System and for tuning of software, since the new head's characteristics differs considerably from other suction heads.

While systematically adjusting settings, the new trailer head, officially registered as the 'Wild Dragon®', was tried at selected locations with densely compacted sand and clay. Its productivity was beyond all expectations: 50 to 100% improvement on earlier performance in the same soils, which triggered rip-roaring excitement with IHC's dredge master as well as the Chinese captain and R&D Manager. It was quite a surprise that dredging could be so much fun! Even gobbling up a sunken buoy only cost some teeth, but barely dented the rest.

Chinese co-researchers discussing 'Wild Dragon®''s dental advantages for the drag head

Jetting violence: 'Wild Dragon®' living up to its name; it truly is the mother of all sediment softening jet systems



With both the experimental 'Wild Dragon®' and a standard IHC Excavating draghead at work on the unyielding Yangtze bank, the yield indicators tell it all; left 'Wild Dragon®', right the standard excavating drag head

The 'Wild Dragon®' draghead seemed to gobble up anything that crossed its path, even a sunken buoy. It cost some teeth but barely dented the rest.

Just add water

What made the 'Wild Dragon®' a success where other trailer heads failed? Certainly its integral design, in which the sizes and positions of cavities, cutting hardware and jets are finely tuned to optimise the sediment-softening qualities of the device. Thorough research of cutting in water bottoms indicated that double rows of cutting teeth, with water jets fitted ingeniously into those teeth, would do the job best.

That was, of course, only the beginning, before a trailer head could be produced that would be capable of jetting its teeth into even the most unforgiving bottoms rather than bouncing along without doing anything useful. The result was the 'Wild Dragon®', which bites deeper with lesser specific resistance in the forward movement than any other trailer head. The dredger consequently produces more while guzzling less fuel per m^3 of dredged soil. Since the entire dredging process runs more smoothly, components wear slower, while the hopper mixture's velocity is much lower, so that the spoil settles sooner and the hopper is loaded faster. Lower emissions and less turbidity thanks to lower overflow from the hopper make the 'Wild Dragon®', much better for the environment. Apart from the trailer head itself, maximising the 'Wild Dragon®''s collateral advantages requires thoroughly balancing the design of trailer head, suction tube, pump and hopper. That is why patents are in the pipeline for the unique tooth construction of the trailer head itself as well as for the entire dredging process in which the 'Wild Dragon®', or 'Wei Long®' by its Chinese registered name, plays a central part. What began as a mind-boggling bank in the Yangtze estuary has, in sound IHC tradition, been turned into a major advance in trailer dredging. Other kinds of soil may require different equations, but the idea is very promising indeed, and a clear example of symbiotic client-shipyard cooperation.

Cutter Suction Dredger PULAU TUJUH latest in a long tin line

Recently, the Cutter Suction Dredger PULAU TUJUH ('Seven Islands') was delivered to PT Timah Tbk, within the short delivery time of only seven months. It is the latest in a long line of dredgers built by IHC Holland for Indonesian tin mining companies. In fact IHC Holland owed in 1943 its formation to the need, felt by the six founding shipyards, to cooperate, in order to meet the expected surge in demand for tin mining dredgers after the war. The MARAS is one of the first six bucket dredgers with extensive processing equipment, delivered by IHC.

Timah's recent order gave IHC the opportunity to revive an old relationship. The order included:

- an IHC Beaver 6518 Cutter Suction Dredger
- spare parts
- transport from the Netherlands to Kundur, Indonesia
- an intensive training program at IHC's Training Institute for Dredging (TID)
- documentation
- service and hands-on training in Indonesia.

History of PT Timah Tbk

After Indonesia's Declaration of Independence in 1945, the tin mining industry gradually came under Indonesian control. In 1960, the State Tin Enterprise Coordinating Board was established; three tin-producing units on the islands of Bangka, Belitung and Singkep became public companies.

In 1968 they merged to become the public conglomerate PN Tambang Timah, which was given control over the known tin deposits in Indonesia.

In 1976, this became PT Tambang Timah (Persero), a limited liability corporation, with the Government of Indonesia as sole shareholder.

The restructuring program was completed on 19 October 1995, when Timah went public, with listings on the Jakarta, Surabaya, and London stock exchanges. Today, 65% of the company's shares are owned by the government of Indonesia and the remaining 35% are owned by domestic and international investors.

Mining operations of PT Timah Tbk

The company's main operations used to be around the islands of Bangka, Belitung and Singkep. In 1991, a major restructuring program began, winding up mining operations on the island of Singkep and shifting the corporate head office to Bangka Island. The company modernised its production facilities and concentrated on its core business.

PT Timah's tin smelting operation at Mentok on Banka Island is the world's largest, thanks to a seventh furnace, installed in 1996, which brought smelter capacity up to 50,000 tons a year. The adjacent wash-plant receives alluvial placer tin concentrate and upgrades it to a tin content of about 74%. Some heavy mineral by-products are produced. Smelting at Mentok produces crude molten tin and recyclable by-products known as 'dust' and 'hardhead'. Crude tin is further refined in a smelting kettle.

The MARAS, one of the six bucket dredgers IHC delivered in 1947

Waste from refining, known as 'tin dross', is recycled. PT Timah's 21 dredgers form the world's largest offshore mining fleet. The fleet mines several kilometres offshore to a depth of about 50m, mining over 3.5 million tons of material every month. Mined concentrate contains up to 30% tin, and is brought by barge to the company's washing plant. Ashore, PT Timah works through private contractors at more than 300 mining sites controlled by the company, and about half of total mining output is by these operations.

In recent years productivity has increased significantly. Even though fewer people work for the Company now than in 2000, more tin is being produced. Manpower productivity increased from 3.0 tons per employee in 1992 to 7.2 tons in 1996. Timah is now one of the world's lowest-cost tin producers. In 2004 production fell some 20% in the wake of rising tin prices, but profitability rose by a heady 100%.

Timah, more than the world's leading tin miner

Geographically and geologically, Indonesia is a wealthy country. Across the inland and offshore tin reserves controlled by Timah, mineral deposits are some of the best in the world.

The company holds tin exploration and mining rights until 2025 for more than 10,000km² spread across several islands and offshore areas in the Java sea.

Exploration for tin is concentrated around Bangka Island. Geophysical surveys suggest that large deposits outside the 'traditional' tin belt are likely. South East Asia's tin belt runs 3,000km from Myanmar to the southern part of Sumatra, some 75km wide on average. PT Timah's proven and probable tin reserves are substantial.

Recently, gold exploration was taken up and the company holds rights over 27,000km² for hard-rock gold exploration in North Sumatra, Kalimantan and Java. Preliminary surveys for coal are also underway in East Kalimantan.

Even after a long history of tin mining, many of Timah's mining rights are still unexplored. The future looks very promising indeed.

The new Cutter Suction Dredger, an IHC Beaver 6518 C

The PALAU TUJUH will be used by PT Timah for removing sediments on top of the tin deposits, which will subsequently be mined by the huge 7 to 24ft³ bucket dredgers of PT Timah, working at up to 28 buckets per minute.

For this job the dredging depth of a standard Beaver 6516C was increased

from 16m to 18m. The craft was further equipped with a spud carriage and following pontoons. The spud carriage further boosts efficiency significantly. Note: in the type designation
65 is discharge pipeline diameter in cm
18 is maximum dredging depth in m and
C stands for Cutter.

Improvements in efficiency and savings in fuel consumption are spectacular compared with traditional dredgers. Installed power is significantly less than in other dredgers with similar delivery pipelines, because its high efficiency under-water dredge pump is directly driven by the diesel engine, through the IHC patented Pivoting Gearbox. The diesel engine itself is a modern computer-controlled diesel engine with low fuel consumption, and low NOx and soot emissions.

The training program at IHC's Training Institute for Dredging (TID)

A supervision team of PT Timah inspected quality and progress of construction of the dredger. During this period, a number of Timah's staff and crew followed a training course at IHC's TID. There were in fact two courses, one for operators and one for maintenance engineers, but topics were combined where possible. The course was based on the standard TID-IHC Beaver course, but customised for PALAU TUJUH.

Important program topics included the selection of dredging equipment, dredging processes, soil characteristics, pump process & slurry transport, production calculations, theoretical and practical aspects of cutter dredging, general maintenance aspects, information and explanation about dredger design particulars, systems and components, automation and production control, manuals and an engine training.

Alongside theoretical sessions, much time was spent on the dredger itself, explaining and demonstrating important points as well as more practical activities, such as witnessing several tests, actually using the equipment and practicing trouble-shooting protocols.

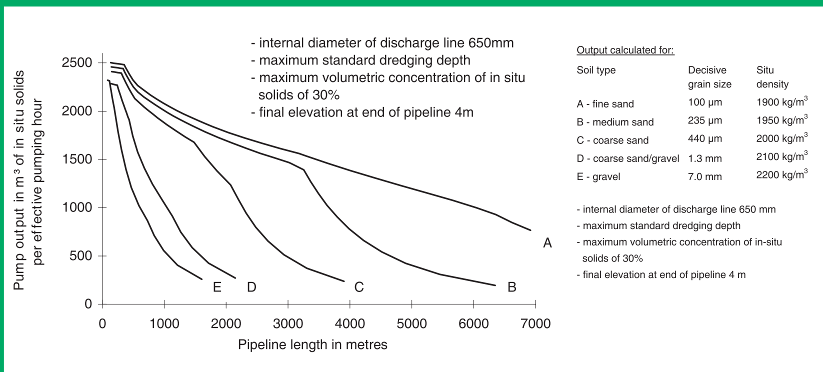
Transport

PT Timah requested IHC to arrange transport of the dredger to Kundur, Indonesia. A rather fast heavy cargo ship, steaming at 21 knots, delivered the PALAU TUJUH within three weeks safely on the island of Kenipaan, near the dredging location at Kundur Island. After a smooth offloading operation the dredger was reunited with its ladder, following pontoons and spuds, and ready for service.

Early in 2005, the dredger was at work with an IHC service engineer training operators on the job.

Principal characteristics

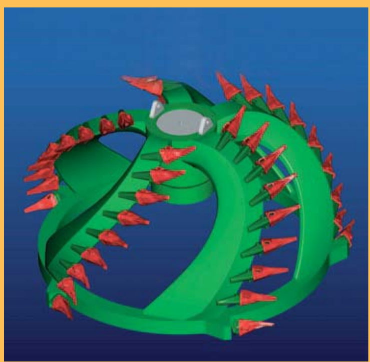
Length overall, ladder raised	47.50m
Length over pontoons, moulded	32.50m
Breadth, moulded	12.44m
Depth, moulded	2.97m
Side pontoons, moulded	30.50 x 3.72 x 2.97m
Mean draught with full bunkers approx. (standard design)	2.10m
Maximum dredging depth	18.00m
Internal diameter of suction tube	650mm
Internal diameter of discharge pipes	650mm
Total installed power	2,700kW (3,672hp)
Total dry weight approx.	370t
Dredge pump type IHC HR/MD 121-26-60 power at shaft	1,571kW
Cutter power at shaft	585kW



Cutters

Full spectrum

IHC Holland Parts & Services has been developing cutters for many decades based on practical experience with numerous types of soil and cutter dredgers. Cutter design today also benefits from the latest in 3D solid modelling, Finite Element Method stress calculations and the latest IHC development: the cutter and side winch power prediction software CudiC. IHC cutters are subject to continuous technical development and provide an ideal tailored response to every cutter dredging challenge. They can be fitted with a variety of teeth and replaceable cutting edges to offer the full spectrum of standard and customised excavation tools for all types of bottom soils.



The latest in 3D solid modelling means perfectly positioned teeth

The basic cutter skeleton consists of a hub, a ring and several curved arms linking them together. On the front side of the cutter arms, adapters with teeth or replaceable cutting edges are fitted that do the actual cutting work.

Special benefits include:

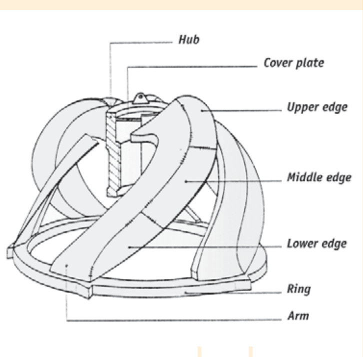
- widely varying dimensions
- refined tooth and cutting edge design
- exceptional wear resistance
- competitive maintenance cost
- rapid delivery
- low cost per ton production
- simplified maintenance.

Cutter with teeth and adapters

The dredging industry requires cutters for many types of dredging work. IHC meets those needs by designing and supplying replaceable optimum efficiency edge cutters and more sophisticated toothed cutters in close consultation with the client.

Cutters with replaceable teeth

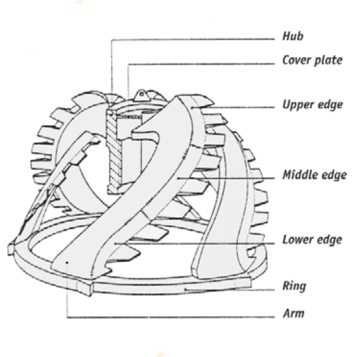
In the case of a toothed cutter, the adapters are welded on the front side of the cutter arm. The easily replaceable teeth are fitted on these adapters and locked in place with a locking pin. When a tooth has to be replaced, the locking pin simply has to be removed with a punch. This ensures rapid tooth change in the event of a change in bottom soil type, or for maintenance purposes. CudiC, the new cutter and side winch power prediction software, is now a successful cutter design tool.



...best results in peat and soft clay

Cutters with cutting edges

For standard cutter types replaceable cutting edges are available in both plain and in serrated form. The plain edges give best results in peat and soft clay. But they are also effective if the bottom contains roots, cabling and other objects that may block up the cutter. Serrated edges offer a higher penetration effect, which can be of importance in hard clay, compact sand and gravel bottoms. Changing from smooth to serrated knives and vice versa optimises the effectiveness and versatility of the hardware.



Each cutting edge is made up of two or three separate sections that allow maximum usage of unworn material

Teeth with a wide front chisel are typically used for peat, soft clay, loose sand and gravel. For stiffer or harder ground, a tooth with a narrower chisel can be selected. For extremely hard ground and rock, teeth of the pick point type provide the most effective results.

Standard and customised

IHC can supply a wide range of standard cutters and cutter equipment from stock. Customised hardware can naturally also be supplied. Various optional parts serve to further improve production or lifetime: root cutters, stone grids, protection against backring wear and plates for arm extension known as skirts. IHC Cutters contribute to a remarkably level dredged bottom profile.

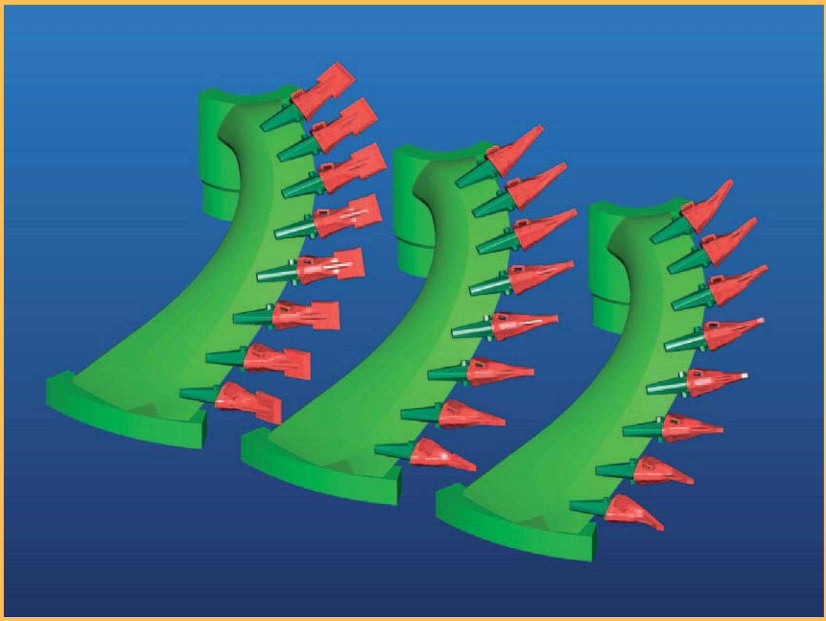
Cutter with cutting edges

Teeth and adapters

Meeting the strictest demands

IHC Holland Parts & Services is constantly upgrading the range of teeth and adapters to increase the efficiency of the dredging process. Their shape, material and fixation system, combined with their strength and reliability can make a major contribution to improving production. Sophisticated 3D solid modelling design systems and Finite Element Method strength investigations optimise the designs. With combined experience of designing cutters and complete dredgers, practical feedback and material investigations, IHC can now deliver teeth and adapters to meet the strictest demands of the dredging industry.

From top to bottom: Locking Pin, Pick Point, Narrow Chisel, Flared Chisel, Adaptor Weld on Nose and Adaptor Leg



Carefully designed... to meet the strictest demands of the dredging industry

All soil types

IHC teeth and adapters are available in various types and sizes. Flared teeth are used for peat, sand and soft clay. Narrow chisels are employed in packed sand and stiff clay. Teeth with pick points are used for soft and hard rock. They can be used on various types of dredging equipment; principally cutters, dragheads and dredging wheels.

Special mounting geometry

The mounting geometry of IHC teeth and adapters has no play, is self-adjusting and reduces contact area stresses.
This ensures precise and stable tooth positioning and extended lifetime of the mounting contact surfaces.
The mounting geometry simplifies maintenance by ensuring that the teeth are easily to remove from the adapters even with overtight tooth clamping. If a tooth jams on an adapter a specially designed wedged tool facilitates tooth removal.

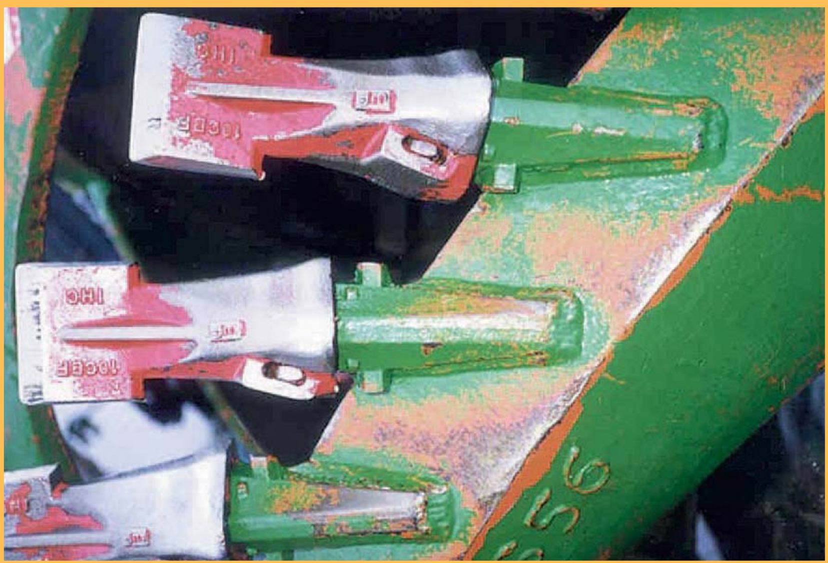
Optimising uptime

The shapes of the various teeth have been designed to give the longest operating lifetime. They have maximum wear volume with the minimum wear surface. This produces the most economic dredger use and the maximum uptime. The locking pin is made from two specially shaped forged steel bars bonded to a flexible rubber core for easy mounting and removal, and can be reused many times.

Maximum wear volume at minimum wear surface

Continued research

Because of the demands on the product, the highly complex shape of the equipment and the versatility of the manufacturing process, the teeth and adapters are cast. IHC is continuing to do research into both new shapes and materials combining wear and impact resistance, hardness, toughness and strength to meet present and future applications.



Mounting geometry simplifies maintenance

Benefits:

- high versatility
- maximum output
- long lifetime
- high tonnage per tooth
- reduced mounting wear
- easy tooth replacement.

IHC's multidisciplinary champions

Forty years of IHC Holland Engineering & Renovation

IHC Holland was formally established in 1943, but its founder members had already joined forces before then on various occasions. Most had been busy from the 1860's building steam bucket dredgers; in the early 1870's J&K Smit had invented the suction hopper dredger, with surging demand as a result. Especially for what were then the Dutch East Indies, many demountable tin dredgers were constructed in the Netherlands and assembled locally.
During the Interbellum, IHC's founders increasingly combined their operations and developed other types of demountable craft, such as the passenger motor vessel MODESTA VICTORIS for Lago Nahuel Huapi, 1,100ft above sea level.
A major project was in 1934 the construction of two 700-litre demountable bucket dredgers for Siberia. From local assembly to local building was a logical step, which was also pioneered with tin ore dredgers in Indonesia. Of course, this required a different approach: instead of sending an assembly crew to instruct the locals, highly qualified IHC engineers had to put up shop 'in situ' and they had to find or establish a suitable shipyard for the purpose. Local personnel had to be trained and designs were needed that would suit their technical level.
After the second World War, most European countries were short of cash, while an increasing number of Third World countries were gaining independence and were understandably eager to acquire industrial skills at low cost. The common denominator was that new infrastructure was sorely needed everywhere, while hard currency was in short supply. Demand for cooperation on projects increased.

Exporting ships -intellectually

Aware that local building of IHC dredgers required a specialist approach, IHC's members of those days: J. & K. Smit, L. Smit & Zn, Gusto and De Klop (note that I.H.C. still appeared with separate capitals then, because the companies were not yet fully merged) established a dedicated company and furnished the capital. Smit Engineering NV began life in 1964, with Mr. Theo de Jooden at the helm, a future President of IHC Holland NV, and a small staff. In the early 1970's a mushrooming order portfolio forced 'Engineering', with over

50 on the payroll by then, to move into L. Smit & Zn's monumental office, which had become vacant when J. & K. Smit and L. Smit & Zn yards merged to become IHC Smit. In 1972, the company was augmented with Naval Consult Holland, led by Mr. W.L. Bastian with a team of four, specialised in developing modern covered shipyards. Their experience, including designing the new IHC shipyard at Kinderdijk, complemented Engineering's activities wonderfully. These often included not only designing the ships, but creating the shipyards for their construction as well.
In their monumental office, Smit Engineering consulting engineers and naval architects clearly felt at home, since they are still there. That is to say, their successors are. In the late 1980's a drastic reorganisation of IHC Holland and its subdivision into business units caused the name to be changed to IHC Holland NV Engineering. In the wake of further sprucing up of IHC's structure in 2000, Engineering was amalgamated with IHC Parts & Services - Renovation to become -as it is now- IHC Holland Engineering and Renovation BV, 'IHC E&R' for short, led by Mr. J.H. Hylkema. When IHC E&R celebrated its 40th jubilee, its building celebrated its centenary.

This leaded glass panel was given by the employees on the occasion of the 150th anniversary of the company's foundation. It still hangs in the staircase.

ANTIGOON in Antwerp

Standard surge, one-off flood

A major part of Engineering's activities in the 1970's was devoted to developing standard designs, which would put up with a moderate level of sophistication of the building yard. The sophistication was, so to speak, put into the thinking before the welders got to work. It should always be like that, but only works if the naval architects have direct experience with and feed-back from the actual building of ships. Only then will they be able to avoid re-inventing wheels in each new design.
IHC's 'omnibarges', hydraulically operated split hoppers in sizes from 60m³ to 2,000m³, were very successful in those years, with many dozens being built. Their success was only dwarfed by the IHC Beaver standard cutter and wheel dredgers. Also in those years the IHC Stantrail Mk I and II, the Graveldredge and IHC Stanbuck were hatched, with varying degrees of market success.
Alongside these exercises in designing do-it-yourself-craft, Engineering designed many one-offs for both foreign and Dutch clients, for building at IHC shipyards and elsewhere. Some 20 trailing suction hopper dredgers were produced, 10 of which were for China, plus a variety of other dredgers, mostly for South American, African, Indian and European accounts. Design and engineering of tankers, fire-fighting craft, salvage tugs, patrol boats, anchor handling craft, buoy-age vessels, etc. was also taken on. The flood of orders during the 1970's saturated the Kinderdijk shipyard's capacity, so quite a few were built on other shipyards in the Netherlands wich is were Engineering came in. A special bestseller in those years was the Tranquilduct, a passive stabiliser based on a partially filled U-shaped water tank. It was widely used in super-yachts, ferries and supply vessels.
During the shipbuilding crisis of the late 1970's and 1980's, the engineers did not sit on their hands. One of Engineering's inventions of the Crashing Eighties was a trail-unit, for economical retrofitting in Omnibarges and an 'arctic dredging installation' for working in ice layers up to 1m thick. Another brain child of the time was a simple to build and economical to operate Multi Purpose Dredger (MPD) with a modular construction and designed for series production. Quite a few remarkable projects were brought to a successful, though lawyer-infested, conclusion in the United States. Through IHC's American branch Dredge Technology Corporation (DTC), dredging installations were delivered for locally-built craft. One of these, the Army Corps of Engineers trailer ESSAYONS, has recently been thoroughly upgraded by IHC E&R.

Sharing responsibility

For a wide variety of international accounts, Engineering continued to design dredgers and dredging installations, renovations and conversions and by 1990 business had picked up reassuringly.
A major design and engineering project was Dredging International's 8,400m³ trailer ANTIGOON in 1989/90. This was a forerunner of the large, shallow draught type with sophisticated automatic dredging controls that was to dominate the jumbo-trailer boom of the 1990's.
In fact the design had evolved since the previous trailer boom of the mid-1970's and could evolve thanks to Engineering's close involvement in actually building ships on IHC's own shipyards at Kinderdijk and Sliedrecht.
Increasingly, Engineering was asked to design and deliver dredging installations for vessels that were designed and built by third parties. Such projects generally involved, alongside the relevant design work, delivery of dredge pumps, suction pipes with hoists and winches, valves, bottom doors, hydraulics, consoles and instrumentation, plus supervision at the shipyard of choice. Such projects were carried out for British, American, Finnish, Chinese, Russian, Belgian and other accounts. Gradually, Engineering's emphasis shifted from despatching big delegations of technicians and engineers for carrying out the project -and assuming responsibility for- to concentrating on design and engineering, while sharing responsibility for the product with the local builder.

IHC Holland Engineering & Renovation

By 2000 the flow of orders came to resemble a rain river's flow -either surging or wanting. Engineering merged with IHC Renovation, to become IHC Holland NV Engineering & Renovation. Apart from the synergy and cutting of duplications, which had been

Launching of one of five locally built IHC dredgers for China Water Investment Co. at Andec shipyard in Bengbu, Anhui Province 2001

unavoidable when working in very similar markets, this move resulted in a smoother distribution of work. It was further improved when IHC E&R widened its product range. Today's IHC E&R describes its task as 'deploying IHC Holland's knowledge infrastructure for the design of dredgers and integrated systems, and the project management of their construction or renovation anywhere in the world.'

1,700m³ TSHD CAUVERY under construction at Cochin Shipyard Ltd., India

To fully appreciate the symbiosis of IHC Holland's shipbuilding business units Dredgers and Beaver Dredgers, automation specialists IHC Systems, Parts & Services and IHC E&R, you need to fathom out the intricacies of modern dredging itself and the vagaries of the dredging market. What is more, IHC's R&D business unit MTI Holland BV is crucial for extending IHC's knowledge infrastructure.

So, history, practical understanding and intellectual backing place IHC E&R firmly apart from any other engineering company. IHC E&R's added value also depends on its familiarity with working in many very different cultural environments, as well as on its dredger creating home base. All this is indispensable for helping others to create excellent dredgers. On the other hand, IHC E&R's local knowledge of almost any client's environment and the expert knowledge assembled in IHC Holland concerning any aspect of dredging hardware and its impact on the world's soils, combine to help clients anywhere in the world with whatever dredging problem they may encounter.

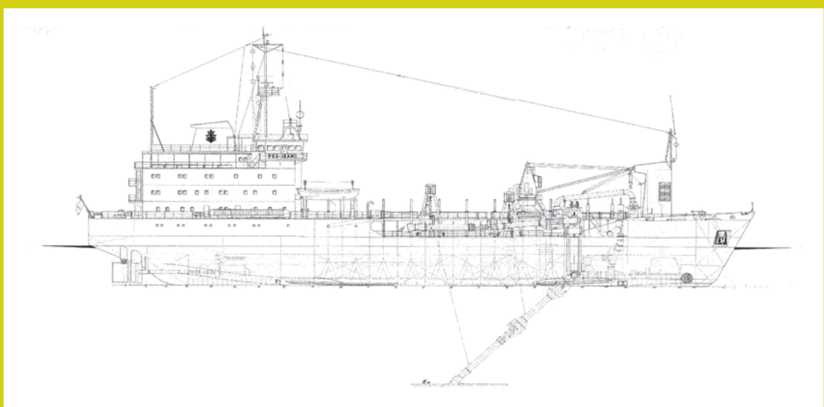
Modern dredgers do not just dig up dirt and pump it to another place like any clapped-out converted coaster could do. To be fully economical, dredgers will constantly have to find the right fit between the environment in which they are working and the production that is required. Ever-mounting levels of automation steam close in the wake of tighter margins and clients who demand ever more precision and recording.

For special duties, special craft must be developed. Today's large and powerful dredgers are simply too expensive to have mess around in less than optimum conditions. To design dredgers that suit their owners and environments best, engineers need not only to be proficient in shipbuilding, but also to have intimate knowledge of the dredging process and its hydrodynamic interactions. IHC E&R within IHC Holland meets these conditions like no other. IHC E&R's position of mutual trust with many clients in so many different cultures has over time worked as a sensible selection valve, to choose, for each different project, the most economical option, also with regard to efficiency, longevity and building time of the vessel. Where a dredger can best be built depends on many aspects. The more advanced and complicated the dredger, the more helpful it may be to have the experience and skill of the full IHC crew close at hand and build the boat in the Netherlands. Being entirely dedicated to building dredgers, IHC Holland's experience in such projects is second to none. IHC E&R however, has been established precisely to offer clients a genuine, technically advanced choice to build dredgers locally, with the most experienced naval architects and engineers to help them in getting to grips with constructing complicated craft. IHC E&R offers tailor-made, state of the art solutions to meet the specific circumstances and demands of clients as economically as possible.

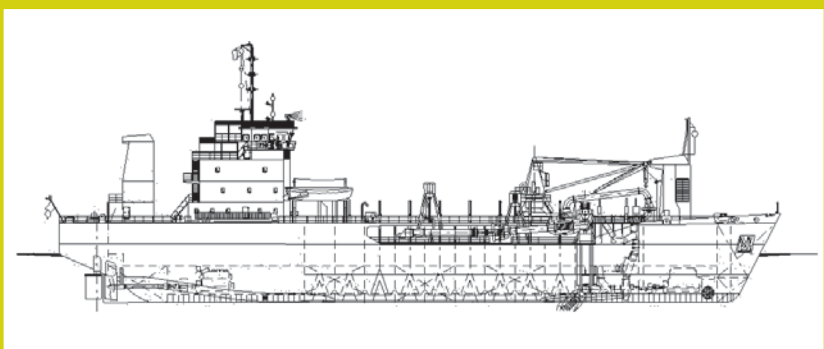
SOUMAR beats its former self

In 1979 IHC built four identical 3.000m³ trailing suction hopper dredgers (construction numbers CO 1120 to CO 1123) for the Ports and Shipping Organisation (PSO), the port authority of the Islamic Republic of Iran. The dredgers have been maintaining Iran's Persian Gulf ports ever since.

The ABTIN on its maiden trial



General accommodation ABTIN – 1978



The 'new' SOUMAR on the design board

The first one built, SOUMAR (formerly ABTIN), suffered severe damage from fire in the engine room while undergoing maintenance repairs. The fire destroyed the aft engine room and accommodation. Collateral water damage was considerable.

Since the hull, dredging installation and forward engine room were spared, PSO decided to have the vessel repaired and to seize the opportunity to upgrade the engine room and rebuild the accommodation. Understandably, the order went to IHC Holland Engineering and Renovation, IHC Holland's specialists in new building and renovation projects on non-IHC ship-yards. A major inspection and overhaul of the entire ship was part of the order.

The repair is now underway at the Darvishi shipyard, a member of the Marine Industrial Group (M.I.G) in Iran. IHC is supplying all new parts for the aft engine room and for the accommodation.

In dock for inspection

Darvishi shipyard is installing the components delivered by IHC and doing all related steel- and installation work. IHC is on site for supervision and guidance and will take care of commissioning. This fine symbiosis of the experience and skills of IHC and the capabilities of Darvishi shipyard's committed staff and management its working very well indeed. IHC's first-hand knowledge of the ship as it was built, with drawings and files as well as surviving specialists who have actually built her at hand, is certainly helpful in this project.

Hoisting the new main engines on board

The scope of the job:

• Delivery and installation of a complete new aft engine room. The aft engine room has been stripped to the bare hull, removing all piping, cabling and

Under reconstruction

equipment. From there, the compartment could be thoroughly redesigned: it got new main engines, auxiliary engines and ancillary equipment as well as a new electrical installation. All piping will also be

Inspection of part of the hydraulic installation

renewed. Where applicable, the new installations are fully compliant with today's Class and Solas Rules.

• Delivery and installation of a new deckhouse. Back in 1979, the ships had been delivered with crew's quarters for a complement of 66. The new super-structure above the poop deck accommodates 17 crew. The space between main and poop decks, originally in use as accommodation, will now be used for technical and utility purposes, creating a buffer between the crew cabins and the engine room. The new funnel is located aft of the accommodation. With these alterations, the fire safety of the ship will improve significantly, and noise and vibration will also be reduced.

• Supervision on overhaul of ship and equipment. All other components and installations of the ship are subjected to a major overhaul. Prior to this, all items are thoroughly inspected, and the availability of spares is checked. IHC E&R subsequently suggests a sensible approach per item and assumes responsibility for this advice. The actual course of action is decided upon in close cooperation with the owner. As a result, some items may be left virtually untouched while other items will be replaced.

Eventually the ship's components and installations will be either new, or thoroughly checked and overhauled, or still in perfect order after 26 years. Part new building, part repair, this project clearly demonstrates that symbiotic cooperation in a major overhaul, between owner, shipyard and IHC E&R, can make an elderly dredger even better than new.

A new concept for accurate and efficient dredging in deep water

This article is based on the paper 'The development of a concept for accurate and efficient dredging at great water depths' by O. Verheul, P.M. Vercruijsse and S.A. Miedema. It was first presented at WODCON XVII in September 2004 in Hamburg, Germany and published in the Congress Proceedings. Publication in P&D is with the permission of CEDA.

Dredging projects are carried out at an ever increasing depth and scale. Trailing Suction Hopper Dredgers, for instance, can now reach depths of up to 150 metres. However, for certain projects it is necessary to exceed this limit. Think of the exploitation of certain minerals, which may be economic in the near future, or sea floor levelling to accommodate structures for the offshore oil and gas industry.
Basically, there are two ways to meet the ever-increasing demands: firstly, by extending, the capabilities of existing concepts step by step, as was done with deep suction installations for Trailing Suction Hopper Dredgers; or secondly, by developing new concepts.

Starting point for our study is a water depth of 300 metres, deliberately set beyond the feasibility of existing concepts; innovation was a prerequisite and new solutions had to be found. Given the great water depth, an important assumption was the impossibility of a 'rigid' structure on the sea surface, reaching all the way down to the sea floor. What was envisaged was a device operating on the sea floor that excavates and transports the material to the surface through a flexible hose.
Such a concept presents many challenges, such as:

- Sufficient stability to relay the generated excavating forces to the sea floor.
- Deep water operations typically demand high accuracy.
  The positioning of the device must therefore be accurately controllable.
- The device must be able to deal with local conditions, such as the high surrounding pressure, currents, zero visibility and poor condition of the sea floor.
- And naturally, production requirements must be met.

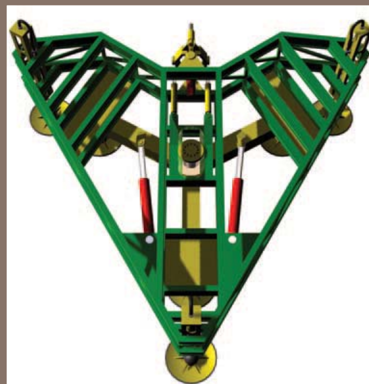
With a crawler-type tool as reference, the challenges were met with a 'keep it simple' strategy, reducing the number of moving parts and simplifying the design of the frame on the sea floor.
The result of the design process is shown in figure 1: a remotely operated dredger named TRIPOD.

➔ fig. 1

Basic design

The TRIPOD shown in figure 1 basically consists of a Triangular Walking Platform (TWP), a ladder-mounted excavating device and two dredge pumps working in series. Alternatively, the platform can be equipped with a range of other excavating tools, for instance a cutter, a suction pipe, a backhoe crane or drill units. The basic philosophy behind the TWP is its separation of movements.
The connecting pin and sliding surfaces shown in figure 2, in combination with the two cylinders shown in figure 3, allow translational and rotational movement between the frames in the horizontal plane. The three spud cylinders of the upper frame control the stepping process in the vertical plane.
The lower frame is fitted with fixed feet.
Figure 4 illustrates a TWP's complete step procedure:
Position 1: Upper frame is resting on extended spuds
Lower frame is off the sea floor
Position 2: Upper frame is lowered; resting on its spuds
Lower frame rests on the sea floor
Position 3: Upper frame rests on the lower frame
Lower frame rests on the sea floor
Position 4: Upper frame slides over the

➔ fig. 3



➔ fig. 2

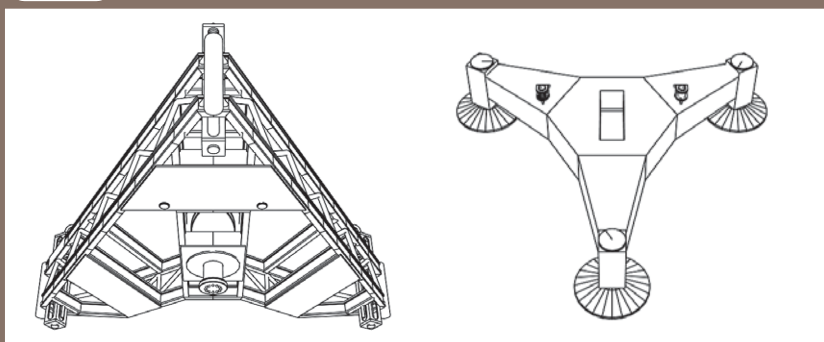


fig. 4

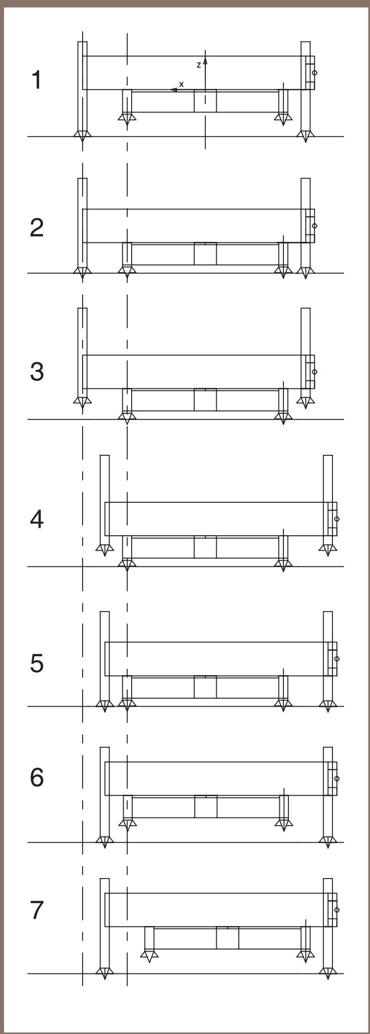


fig. 5

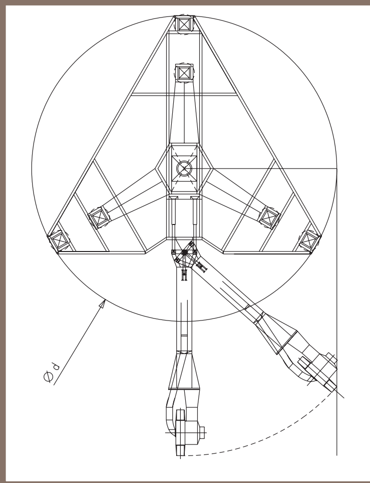


fig. 6

lower frame
Lower frame rests on the sea floor
Position 5: Upper frame extends spuds into their new position
Lower frame rests on the sea floor
Position 6: Upper frame is resting on its spuds
Lower frame is off the sea floor
Position 7: Upper frame is resting on extended spuds
Lower frame slides into its new position
The TWP moves forward by equal extension of the hydraulic cylinders shown in figure 3. The frames will then rotate, allowing the TWP to adjust its walking direction. The TWP is thus able to walk in any direction by using only 5 hydraulic cylinders; 3 for the spuds moving the upper frame up and down and 2 for sliding the upper frame over the lower frame.

TRIPOD's dimensions

Like a Remotely Operated Vehicle (ROV), TRIPOD is launched and recovered from a gantry. Size and mass are thus important constraints.

To get a feeling for size and mass of the concept, a case study was specified in which 2.8 million tons of medium sized sand per year had to be dredged from a depth of 300 metres. Given these starting points, the following dredging installation was defined:

- a 250mm suction pipe and flexible pressure line
- two IHC 62-12.5-25, 3-blade type pumps working in series
- an IHC 1803-type dredging wheel.

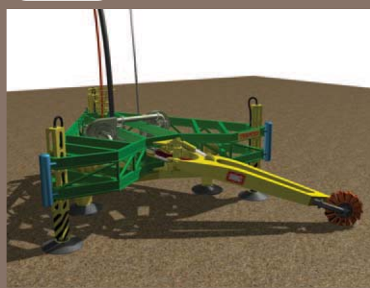
The TRIPOD scaled to the requirements set by the case study has an estimated total mass of 30 tons in air. The size is mainly determined by the length of the ladder and the geometry of the upper frame. The ladder's length of 8 metres assures that the TRIPOD can rotate its frame fully within the width of the dredged lane, see figure 5.
The ladder's length in combination with the cutting forces generated by the dredging wheel, mainly determine the required stability, and consequently the length of the upper frame's sides. For the case study, the sides of the upper frame are 10 metres long. This modest length and the weight of 30 tons are comfortably within the reach of standard gantries.

A distinctive feature of the TRIPOD is that it walks in its dredged lane. This implies that it has to be able to step down into a dredged slope, see also figure 6. To do this, the TRIPOD can adjust its spud cylinders independently. Please note in figure 6 that the front spuds are extended further than the aft spud.
The independently moving spud cylinders make light work of moving around on an uneven sea floor, which greatly widens the variety of areas where the concept can be deployed.

Resume

The Triangle Walking Platform TWP is an innovative concept that brings sea areas hitherto far beyond dredging depth within reach of the dredging or mining industry, it could also be advantageous in projects where wave conditions impede conventional craft.
Sticking to the 'keep it simple' principle, the TWP is designed for maximum reliability. Especially when compared with a crawler-type tool, the result is striking; the TWP has a minimum of moving parts, and a maximum of fail-safe components. For instance: the TWP uses only 5 hydraulic cylinders, 3 for the spuds of the upper frame and 2 for sliding the upper frame over the lower frame. The TWP is made of two triangular frames, enabling it to walk in any direction, using a minimum number of moving parts. The resulting movement is simple, yet its design features allow unrestricted maneuverability. The technique allows the TWP to work accurately and efficiently in different areas.

fig. 7



The TRIPOD shown in figure 7 is just one possible configuration; alternatively the platform can be equipped with a range of excavating tools, e.g. a cutter, a suction pipe, a backhoe crane, or drill units. Both the TRIPOD and the TWP have been patented by IHC Holland Merwede.

A presentation of the TRIPOD is available on our website www.ihcholland.com under the heading P&D 163.

IHC

ON ORDER

Type	Yard no. / name	Specifications	Country
CUTTER SUCTION DREDGER			
	02413	Beaver 300	Serbia & Montenegro
	02418	Beaver 1200	Saudi-Arabia
	02417	Beaver 1200	Tunisia
	02401	Beaver 1600	Morocco
	02409	Beaver 5014C	Russia
	02420	Beaver 6520C	India
	09.654	Beaver 1200	India
	09.654	Beaver 1200	India
	09.659	5,355kW	China
CSD - Custom-Built			
	15038	Electrical dredger	Mozambique
	15039	Electrical dredger	Mozambique
Booster Station			
	02416	Booster station	India
CSD - Custom-Built - Self-Propelled			
	CO 1241 D'ARTAGNAN	28,200kW	France

Type	Yard no. / name	Specifications	Country
DELTA SHIPYARD			
	11012	Delta MultiCraft 1600	Scotland
	11013	Delta MultiCraft 1600	Scotland
	11014	Delta MultiCraft 1600	Scotland
	11015	Delta Pusher 2500	Germany
	11016	Delta Multi Purpose Pusher Tug 2500	The Netherlands
	11017	Delta Multi Purpose Pusher Tug 2500	The Netherlands
	11018	Delta Multi Purpose Pusher Tug 2500	The Netherlands

Delta Multi-Purpose Pusher Tug 2500

RECENTLY DELIVERED

Type	Yard no. / name	Specifications	Country
TRAILING SUCTION HOPPER DREDGER			
	09.629/CO 1240 YASIN	1,000m³	Iran
CUTTER SUCTION DREDGER			
	02407	Beaver 6518C	Indonesia
	09.630 FU MIN 9 HAO	8,000kW	China
WHEEL SUCTION DREDGER - Custom-Built			
	15037	Beaver 600W	Colombia

Beaver 600W custom-built wheel suction Dredger for Colombia

YASIN

1,000m³ Trailing Suction Hopper Dredger with oil recovery equipment

PRINCIPAL CHARACTERISTICS	
Name	YASIN
Type	Trailing Suction Hopper Dredger with oil recovery equipment
Year	2004
Owner	Ports & Shipping Organization
Builder	IHC Holland
Length overall	70.30m
Length between perpendiculars	63.00m
Beam	14.00m
Depth	4.80m
Hopper capacity	1,000m³
Loading capacity	1,425t
Dredging depth	8m
Propulsion power	2x800kW
Total machinery output	2,957kW
Laden speed	11.3 knots
Accommodation	14 persons

Grab hopper dredger DIYA-KOWULLA back in the water thanks to IHC Holland Merwede

On Saturday 12 March 2005 the DIYA-KOWULLA was lifted back into the water using a heavy lift crane ship. The DIYA-KOWULLA was stranded on the quay during the tsunami on 26 December 2004. IHC delivered the 300m³ dredger to the Sri Lanka Ports Authority in 2003. The dredger is suitable for both capital and maintenance dredging in all ports in Sri Lanka. The design was based on an international tender including a full technical specification. The DIYA-KOWULLA was working in the port of Galle (120km south of Colombo) at the time of the tsunami.

The cost of getting the ship back into the water has been paid by the Dutch development bank FMO from Dutch aid funds. IHC Holland Merwede was awarded the order after a tender procedure from the FMO.

The dredger was lifted back into the water using a heavy lift crane ship. Eight special hoisting eyes were temporarily welded onto the dredger to enable the heavy lifting ship's crane to lift her back into the water.

IHC present at EUROPORT MARITIME 2005

EUROPORT MARITIME 2005: Dutch international trade fairs combined

EUROPORT MARITIME 2005 is the name of the new maritime exhibition that developed from the merger of Europort Amsterdam and Rotterdam Maritime. It provides the venue for exhibitors from all over the world to concentrate on one of their most important tasks: informing (prospective) customers about their products, technologies and services in a relaxed environment. Being held in Rotterdam -the heart of the international maritime industry- EUROPORT MARITIME is the perfect place for transferring knowledge and networking.

EUROPORT MARITIME will take place on alternative years, starting on 1 to 5 November 2005. As one of the world's premiere maritime shipping exhibitions, EUROPORT MARITIME 2005 provides quality management and support to facilitate a dynamic business platform designed to meet the demands of companies operating in a broad range of maritime sectors. The global maritime industry has enormous potential for innovation. EUROPORT MARITIME 2005 will be the living proof, with a minimum of 700 exhibitors from many countries and over 35,000 international trade visitors. Nearly every visitor is a potential customer and in a position to purchase the exhibited products or to exert a lot of influence over the decisions their companies will take. Quality sales time can be spent with genuine prospects... and that is why most exhibitors at EUROPORT MARITIME 2005 sell directly from their stand.

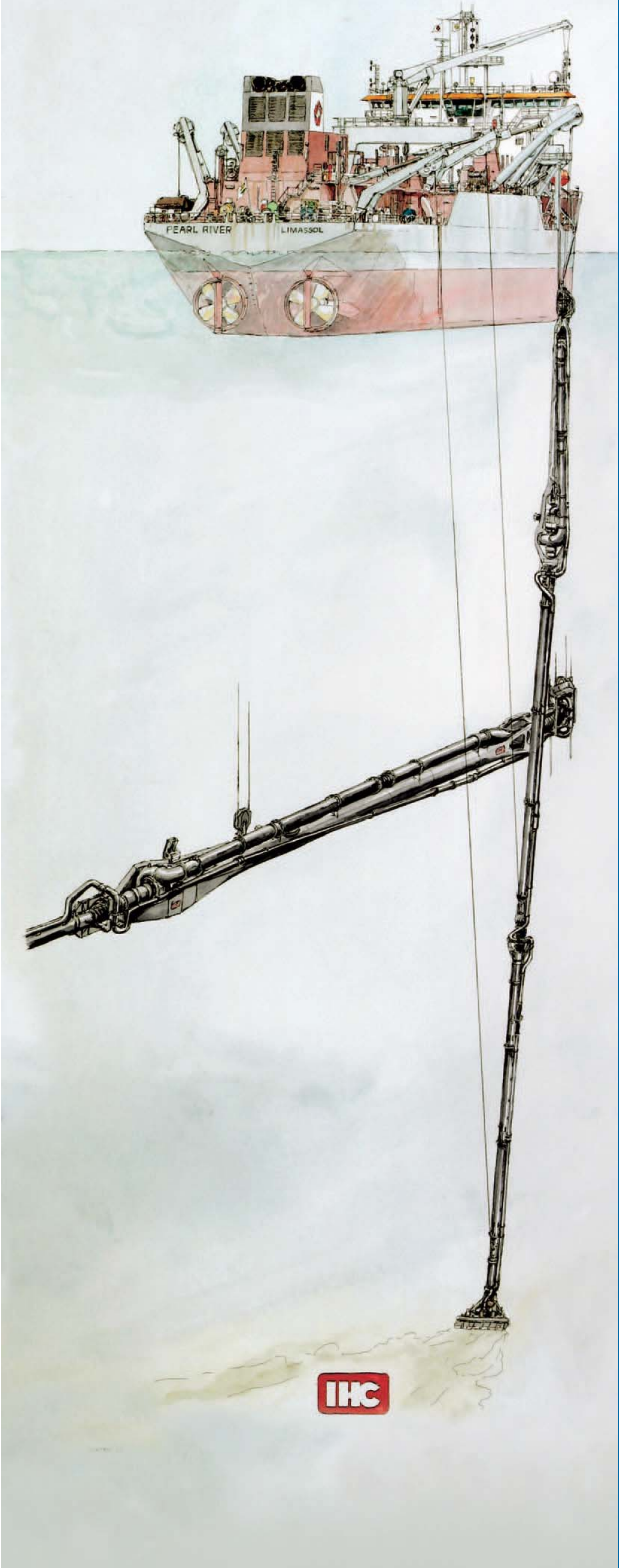
CEDA Dredging Days: Dredging the extremes

The renowned CEDA Dredging Days will also be part of the EUROPORT MARITIME 2005 programme on 3 and 4 November 2005. This conference for the international dredging industry will focus on extreme dredging conditions throughout the world. The programme for this prestigious conference will be published later this year.

You will find details of the exhibition and the congresses which will be held during the same period, on the website www.europortmaritime.com.

1-5 November 2005
AHOY' Rotterdam
The Netherlands

EUROPORT MARITIME



Ports and Dredging is published by IHC Holland with the aim of keeping the dredging industry informed about new developments in dredging technology, vessels and other items of dredging equipment delivered, and the experiences of users all over the world.

IHC Holland develops and applies new techniques. These are manifested in a range of advanced products and services: custom-built and standardised dredgers, dredging installations and components, instruments and automatic control systems, engineering and consultancy, research and development, renovation, operator training and after-sales service. IHC Holland provides optimum solutions for the problems faced by the dredging and alluvial mining industries.

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