Dodging tides in Le Havre

Dredging International's complicated portion in the 'Port 2000' project

The eyecatching hydraulic engineering project on the French coast these days is the port of Le Havre's enlargement. This thriving port on what the French call La Manche and everybody else the English Channel, gets in the first phase an extra 700m container berths for 6000+ TEU vessels, with direct access from the sea. Eventually some 1,800m of container berths will accommodate vessels up to a length of 350m overall, 45m beam and 14.50m draught at all states of the tide. Environmental preconditions require that the river Seine approaches to the port of Rouen may not be affected by increased siltation and that no measurable negative effects on the marine ecology are allowed. A tight nut to crack for Belgian contractor Dredging International of Zwijndrecht. Works are in full swing at the moment and the harbour is supposed to become operational in the course of 2003, a tight schedule given the complexity of the work. The new basin is expected to strengthen Le Havre's aim of becoming a major container hub, with short sea, road, rail and river links to other Western European and French destinations. Located directly on the Channel, and approaches dredged to a depth of 15m, the port's position is very promising indeed.

Cuddling container growth

Le Havre, founded in 1517 by king François Ist as a naval and merchant port, enjoys a varied marine trade.
In 1998 nearly 67 million tonnes of seaborne trade carried in 7,273 vessels, sloshed through the stretched harbour area: 42.73 million tonnes in liquid bulk, 7.64 million tonnes in dry bulk and 16.03 million tonnes in general cargo, of which 12.19 million tonnes in 1,319,278 TEU containers. These numbers make Le Havre France's second oil port and first general cargo and container port. Of Le Havre's total of over 5km of container handling quay with 29 cranes, less than half is on open water; for the rest vessels have to negotiate the

Gravel spraying pontoon BAYARD II, owned by Dredging International

60- and 90-tons pulling force winches, delivered by IHC Hytop

François I locks, as is the case with all oil and chemical tankers. The larger the vessels, however, the shorter throughput times must be, especially in today's container shipping in post-Panamax 6,000TEU+ vessels. Cutting out locking time drastically improves Le Havre's competitive edge over other container ports in the vicinity.
One of the major container lines calling at Le Havre is P&O Nedlloyd, with a service between Northern Europe and Asia, from Hamburg, Rotterdam, Le Havre and Southampton to Singapore, Kobe, Nagoya, Shimizu and Tokyo, with four 6,690 TEU Southampton class vessels, drawing 14.04m. This is about the maximum that can enter Le Havre at all states of the tide, while the future of intercontinental container transport will be the so called Malaccamax of 18,000 TEU. These giants' draught of 21m requires some interesting dredging jobs if Le Havre intends to stay in the picture as a container hub.

Checking the silt

So, there are plenty of sound reasons for Le Havre to extend its open water container handling capacity and that is what Dredging International is doing, but within the environmental and navigational constraints of the Seine estuary. In order to avoid unwanted collateral silting effects, the most desirable tactics have been thoroughly researched in the Sogréah hydraulic laboratory. This has produced a phased strategy in which the existing tidal flow directly south of Le Havre's southern breakwater is gradually nudged south, scouring a new channel but hugging the newly projected breakwater. This process is stimulated by dredging pits in the desirable track of the new channel, before a temporary dam is constructed that blocks the future fairway. Great care is to be taken to avoid the stream suddenly having to find a new outlet, breaking out too far south and dumping deposits into the river Seine's fairway.

IHC Hytop's hydraulic power pack and piping

The phased approach forces the contractor to build the new harbour within an enclosed area, which will be opened to the sea by the time the new harbour channel is dredged to design depth and can take the full force of the tide without spilling-over of tidal deposits in unwanted places. The fierce 5 knot tides with a range of up to 8m, which make the complicated approach necessary, also dictate that even temporary dams be made quite solid. Even so, some 10% of the breakwaters' bases is expected to be washed away.
The sea takes and the sea gives, however: the dredged areas had silted on average 30cm from January to June 2002.

One of the MMI screens of the dynamic control system made by IHC Systems

Very wet and dry

Putting the breakwaters' bases in place on what is a leeshore most of the time with, for good measure, a significant funneling effect in strong winds, requires equipment that is not only highly accurate and powerful but also seaworthy. Dredging International's area of operation virtually dries out at LW spring and spraying operations cannot proceed then. In fact dredgers and the gravel spraying pontoon can only work without running the risk of grounding from, roughly, half tide before to half tide after HW.
The entire € 321.5 million project is carried out by the contractors' combination Groupement d'Entreprises Solidaires, in which Dredging International cooperates with the French contractors GTM Construction (representative) and Dumez-GTM, both of Nanterre, and Campenon Bernard of Ruel Malmaison. Dredging International is in charge of all 'wet' works, to the tune of € 244.2 million; extension of the basin further inland and construction of the container handling facilities will be carried out 'in the dry'.
Dredging International's job includes: under water construction of some 10km of substructure basements for breakwaters (6.2 million m^3); reclamation of 78ha new harbour areas inside the digue d' enclôture (with reclamation levels up to +7.00m CMH for the Casier Est and +11.00m CMH for the Casier Central, estimated at 2.94 million m^3 and 4.76 million m^3 respectively); construction of a temporary causeway from the Digue d'enclôture to part of the southern mole (Digue Sud) and removing it after completion of the project; creating two beaches with pebbles and sand; dredging of fairways to a depth of –16.00m CMH; construction and removal of temporary dam basements; transport, positioning and placing of two quoin caissons into previously dredged trenches, to mark the entrance of the new Port 2000's inner channel (Chenal intérieur), including additional swell and erosion protection works to incorporate the caissons in the breakwaters' structures; capital dredging of the approach channel (Chenal extérieur) as well as the inner channel (Chenal Intérieur) and swinging basin (Cercle d'évitage).

An IHC fleet

The work involves dredging of fairways and winning gravel, often in one go, where gravel deposits are especially found to seaward as well as close inshore in the future swinging basin of Port 2000. First a small, shallow draught hopper moved in, to be replaced by bigger craft later on. So at first the 1,270m^3 VLAANDEREN I (draught 5.50m) went to work; 8,000m^3 ANTIGOON (draught

Cutter dredger VLAANDEREN XIX is extracting the gravel from the future swinging basin...

... and delivers it through a floating pipeline to gravel spraying pontoon BAYARD II

BAYARD II's "wet" work is uncovered at low tide

9.80m) and the brandnew 13,700m³ UILENSPIEGEL will do the seaward part of the job. VLAANDEREN I was built by IHC in 1951 and is still alive and kicking; a fitting tribute to IHC's shipbuilding quality and the client's maintenance department. ANTIGOON was built in 1990 in Belgium in close cooperation with IHC, who were in charge of design, engineering and dredging installation. The design of UILENSPIEGEL, now under completion after launch at IHC, is similar to LANGE WAPPER's, which was, when built by IHC in 1997, the first trailing suction hopper dredger with fully integrated bridge automation. UILENSPIEGEL has a bulb stem added for better fuel economics and higher free sailing speed. Also Dredging International's recently completed 5,000m³ gravel dredger CHARLEMAGNE's stem is adorned by a bulb like that, with excellent hydrodynamic results. (see P&D 157)

The gravel is fed to the gravel spraying pontoon BAYARD II by the self-propelled seagoing cutter dredger VLAANDEREN XIX. Built in 1978 this is no juvenile either, but still going very strong indeed. In its time, VLAANDEREN XIX was rather revolutionary as a self-propelled cutter dredger, with the cutter ladder aft but spuds and two rudder propellors forward, which proved the best compromise between seagoing characteristics and unhampered dredging. The 11,755kW cutter dredger measures 100m overall. Because VLAANDEREN XIX is a renowned seakindly vessel, she is especially suitable for this area, where the sea state can deteriorate very rapidly. Heavy weather endurance is crucial in cutting down idle hours, whereas a less capable craft would have to seek shelter long before work becomes impossible.
Most gravel for the breakwaters' bases is directly won in the eastern part of the project, while deepening the inner channel and swinging basin. In order to stay within the cutter dredger's pumping range, large quantities of gravel will be dumped further west in the new harbour's area, in pits created by the hopper dredgers.
The brandnew 10,700 DWT trailing gravel dredger CHARLEMAGNE will store up gravel depots ashore, also for use by the French contractors of the Groupement, who do the dry part of the breakwaters' construction as well as the prefabrication of both concrete caissons and the accropode layers on the breakwaters. CHARLEMAGNE's high efficiency submerged dredge pump is driven by a 1,700kW electric motor, which allows a dredging depth of 60m. CHARLEMAGNE has a grab unloading system and discharges the aggregates 'in the dry', after dewatering through 12 pumped wells. Enormous fixed tip up dump trucks and articulated dump trucks ultimately bring the gravel to the breakwaters, where the bodies and cores are built 'in the dry'. Applying the time-honoured principle of 'making work with work' saves costs considerably. French quarries deliver the rest of the necessary rock material.

'BAYARD II' born

Constructing a sound, tide-resistant base for breakwaters on an exposed leeshore is, of course, one of the most challenging parts of the job. As soon as the contract was signed, Dredging International approached IHC Engineering & Renovation for designing the conversion of their 54 x 22m pontoon DIABOLIX with a depth of 2.20m to the gravel spraying pontoon BAYARD II. IHC Gusto finished the initial engineering by Dredging International's newbuilding and research department, to create, on a very tight schedule, an accurate, dynamically positioned and automatically guided spraying pontoon. IHC E&R translated the operational requirements into the basic and detailed engineering of all constructions and components.
E&R actually delivered the more complex parts, such as the spray pipe gantry, three 5m tall wire sheave towers, two height adjustable tumbles sheaves and 28 heavy wire sheaves.
Subsequently IHC HYTOP supplied the pontoon's complete hydraulic installation, including engineering of the main power pack, six anchor handling winches, the spraying pipe's drive and all piping. Finally IHC Systems was entrusted with engineering and delivery of instrumentation -i.e. loading pins and angle transmitters and a production transmitter with the patented Al2O3 tiles liner- and the dynamic control automation. The algoritms for translating the measurements into input for the hydraulic winches were made by Dredging International. BAYARD II ultimately became a clear example of IHC's multi disciplinary capabilities and of what close cooperation with a client's technical and R&D departments may achieve.
BAYARD II's job is to build the breakwater's basements up to a height of 3.20m to 3.70m from the seabottom, with a slope tolerance of 3/1 to 3.5/1. That is to say: BAYARD's computer calculates how much gravel must be sprayed and where, to achieve a squarish shape, which

natural forces are expected to batter into the desired profile. The existing seabottom's profile, tidal forces and the impact of waves are all taken into account.
The contract with the Port Autonome du Havre contains a number of 'safety' valves ensuring that, when the contractors do not fulfill a number of exacting standards, the client will have a prohibitively high recoup. So it pays to stay exactly within the prescribed tolerances, hence the importance of BAYARD's precision guided computer system.

Dynamic control

While spraying gravel, the dynamically controlled BAYARD II has to move across and fore and aft over the alignment of the projected breakwater. This kind of continuous movement, and the swell prone character of the shallow surroundings, ruled out the use of spuds. BAYARD II is therefore anchored on six wires, the winches of which are computer controlled to ensure that the gravel is sprayed in exactly the place where it is needed. Of IHC business unit HYTOP's winches, two have a pulling force of 90 tons and four of 60 tons.
Thanks to the on-line LRK-based position pointing system with 10cm accuracy, and measuring of the mixture's density and velocity, the joint DEME/IHC System's dedicated developed computer can calculate the exact quota, in which surveys of the seabed play a decisive role as well. The more precise this works the less material is wasted. Visiting BAYARD II in June, we were impressed with the precision of BAYARD II's gravel dumping and the amount of information the computer gave. Anywhere between the cutter dredger -which produces the gravel- and the BAYARD II, the pebbles' whereabouts are known and graphically depicted on the monitor. As long as only water is 'produced' the craft remains in place, but as soon as gravel appears through the sprayhead, the pontoon starts to move, driven by its computer controlled anchor winches. This process continues smoothly, even in over 4 knots tides.
BAYARD II's lay out was the first of its kind, so quite some fine tuning was needed before the computer could be trusted for spraying the right amount of gravel in the right place. Gradually, the crew's life has become more relaxed, however, when the craft's brains learned to do the tending, but of course a full complement remains necessary for keeping generators, winches and wires running, and for keeping a wary eye open for straying computer minds.
As described above, BAYARD II is fed by cutter dredger VLAANDEREN XIX, which has a pumping distance of some 2km. The distance from the places where natural gravel deposits surface may be over 5km away, however. In order to remain within the cutter dredger's reach, temporary deposits will be dredged alongside the future fairway, where the trailers dump their gravel and the cutter picks it up.

The gantry, delivered by IHC E&R, keeping the spray pipe at 6.30m aside the BAYARD II

Difficult environment

In the original tender it was reckoned that during the entire project's 34 months, 60 days would be lost through heavy weather. Unfortunately, sea conditions have proven to be much worse than that and from late January 2002 these 60 days have already been lost. VLAANDEREN XIX is a fully fledged seagoing vessel, capable of riding out the worst gales at anchor, or seeking shelter under her own steam. But most other contractors' equipment other than trailing suction hopper dredgers is rarely designed for weathering out gales at sea, so must seek refuge when weather forecasts turn gloomy. Hence the rather high incidence of storm delays. Despite the much praised seaworthiness and luff-biting lines of its historic namesake, the Delaware pilot schooner Thomas F. Bayard of 1880 vintage, even BAYARD II becomes an awkward dwelling place when the wind pipes up. Life aboard and transfers from pontoon to workboats may in such circumstances involve character building leaping, but with its six anchors BAYARD II is kept in position through the thick of it.
Dredging International is beyond doubt busy doing the most complex, and even daring, part of the Le Havre harbour extension project. The obligation to stay within rather tight contractual confines concerning precision of the job, effect on the marine habitat and amount of collateral siltation, has apparantly triggered the Belgian contractor's considerable ingenuity. Despite the days lost due to bad weather, the project is on schedule and in progress.
When P&D visited the project, we enjoyed fair weather with no wind at all. Building breakwaters on the beautiful French coast alongside a fine city seemed one of the more agreeable jobs in life. The next day, deep Atlantic Lows came running down the Channel like charging rhinos. Although the rain drove horizontally at times, Dredging International's men and craft kept their stations and your correspondent was very happy with his desk job back home. From terra firma we could barely figure out the big VLAANDEREN XIX's contours, although she was working close inshore. It dawned that here, on this battered leeshore with awesome tides and tight restrictions on environmental effects, Dredging International is doing exactly what made dredging companies from the Low Countries rightly famous: taking thoroughly calculated risks, clinging tenaciously to their schedule and delivering what they promise, whether or not against the odds.

The spray pipe is lowered under water only when gravel production starts