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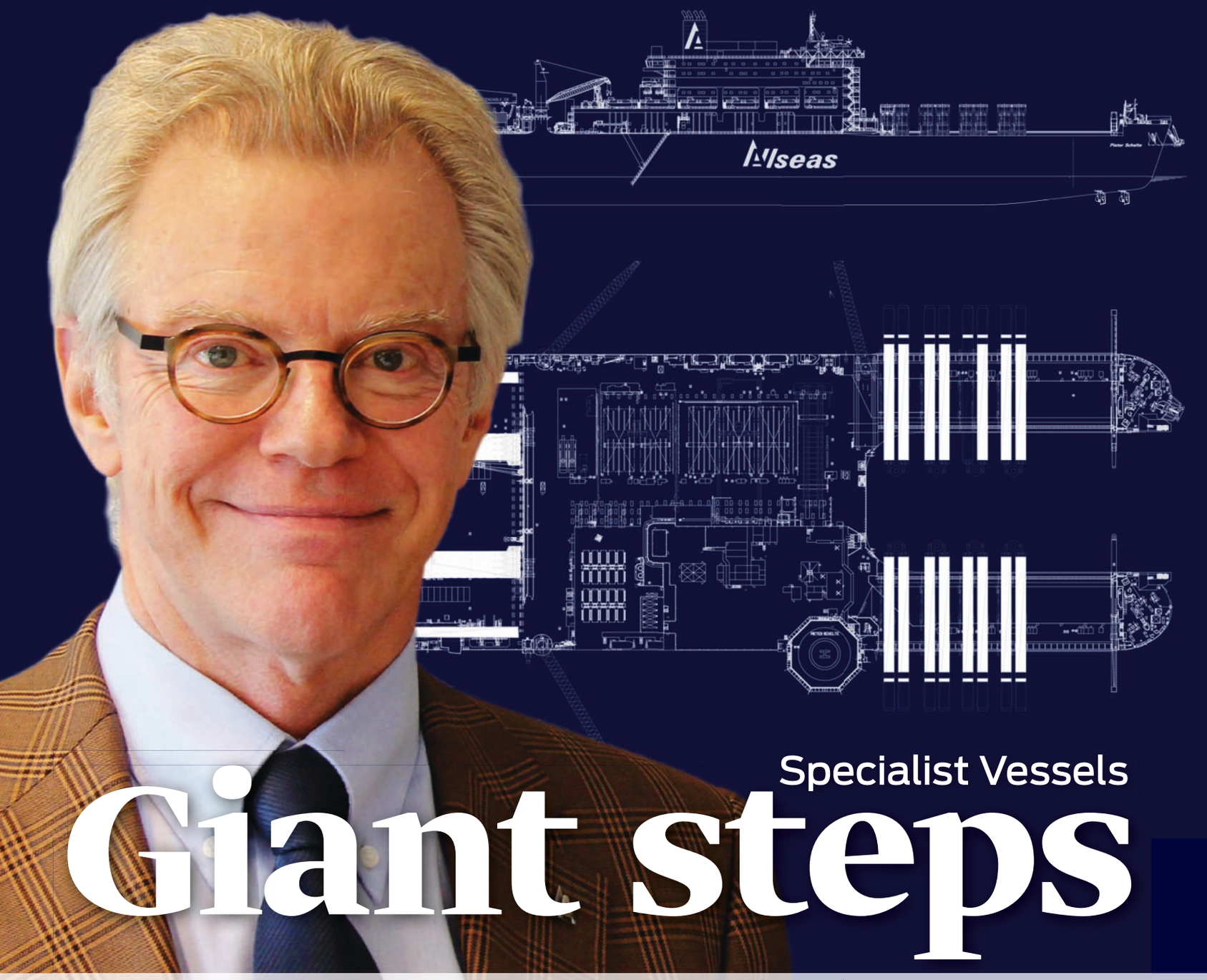

Specialist Vessels

Giant steps

LNG:
Asia Pacific mega-project teams step on the gas

GTL:
'Small-scale' rivals close to commercial breakthrough

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Cover: Allseas president Edward Heerema and the blueprints for the *Pieter Schelte*. Images: Allseas

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Supersizing for success

Custom-designed and hugely expensive floating hardware of every size and shape is pouring into the upstream oil and gas sector at an unprecedented rate as the industry spreads its operational nets deeper and wider. They don't come any bigger than *Pieter Schelte*, the multi-role catamaran contractor Allseas is building to take on the toughest platform removal and installation tasks along with such high-end pipelay assignments as may come along from time to time.

Photo: Allseas

A GIANT AWAKENS: The *Pieter Schelte* at Daewoo's yard in South Korea.

Allseas boss Edward Heerema's 2006 declaration that he would build this mighty vessel and dedicate it to the memory of his father, the legendary Dutch civil engineer and Heerema contracting group founder who died in 1981, had some industry observers scratching their heads at the time. Just how tall an order this was hit home a few years back when the anticipated cost of this spec-built vessel headed north of the €2 billion ($3.2 billion) mark.

Like his father before him, however, Edward Heerema has never been one to sidestep an engineering challenge or pass up a solid business opportunity.

Heerema senior revolutionised the offshore installation process in the late 1970s by introducing not one but two giant semisubmersible crane barges to a North Sea market still in its infancy. At a stroke, he handed platform designers hitherto undreamt of possibilities.

Second son Edward, also a product of Delft's civil engineering school, has the launch of the world's largest pipelayer among other impressive industry credits to his name since striking out on his own to establish Allseas in the 1980s. In workability terms, *Solitaire* would do for the harsh environment and deepwater trunkline sector pretty much what his father's *Balder* and *Hermod* semisubs did for platform construction years earlier. He is now raising the bar much higher.

The jury is still out on just how transformative an impact the new leviathan *Pieter Schelte*, not to mention an even bigger brother already on the Allseas drawing board, may have on future offshore installation and decommissioning practices.

But as Adrian Cottrill's expert opener to this edition's specialist vessels review vividly illustrates, the signs are not at all bad. With a handful of North Sea infrastructure removal jobs already booked, and a maiden pipelay contract lined up in the Black Sea's deeper waters, *Pieter Schelte's* time may well have come.

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European editor

Veteran oil industry journalist Russell McCulley (pictured) joined the editorial team of Upstream Technology as European Editor in May. He has relocated from Houston, where he served most recently as Offshore magazine's Senior Technology Editor, and will operate from Upstream's London office. Russell has been quick to make his mark on this magazine's pages, turning in two telling contributions — interviews with BP's David Eyton and Shell's Marjan van Loon — for this edition's Tech Talk pages.

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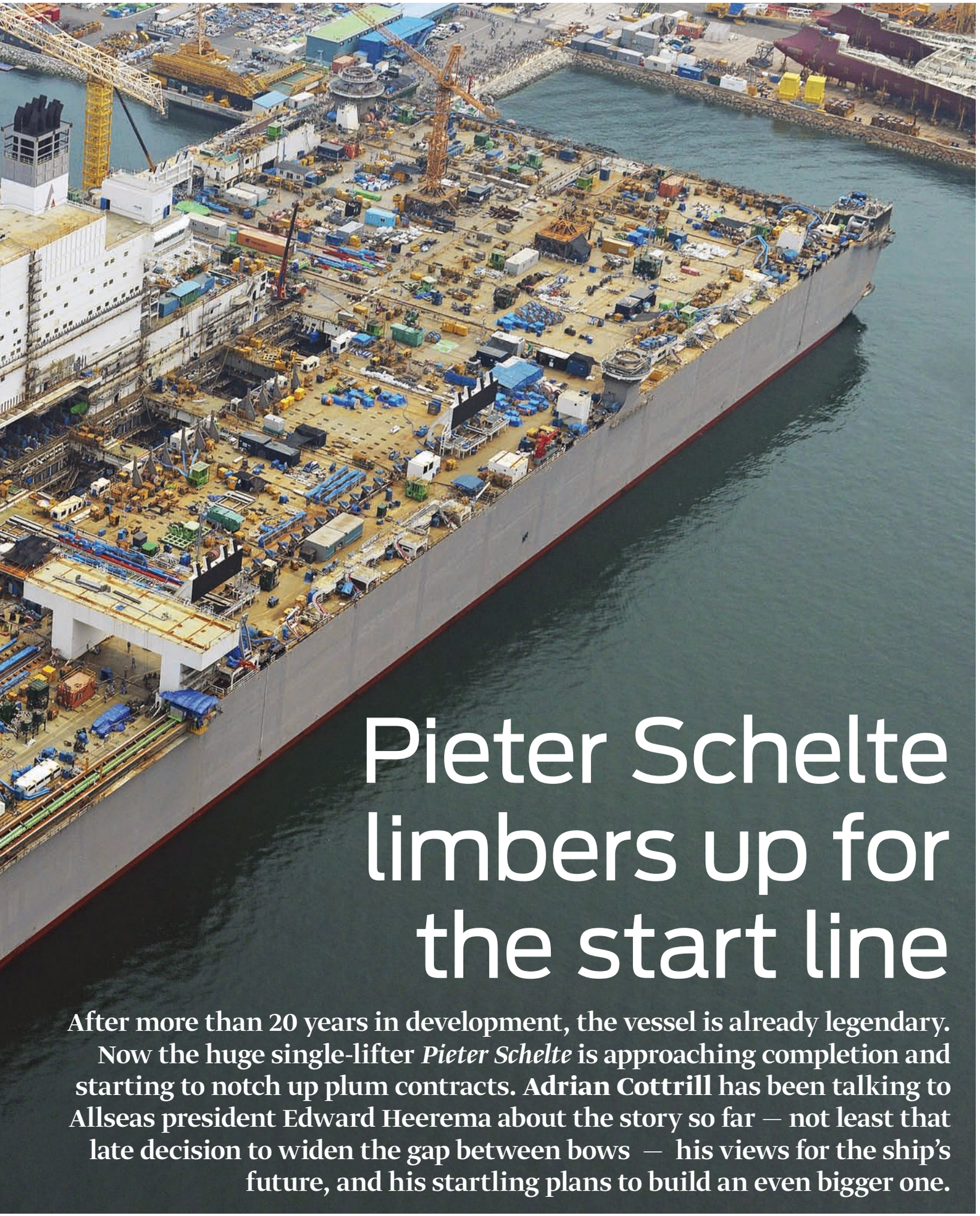
SPECIALIST VESSELS

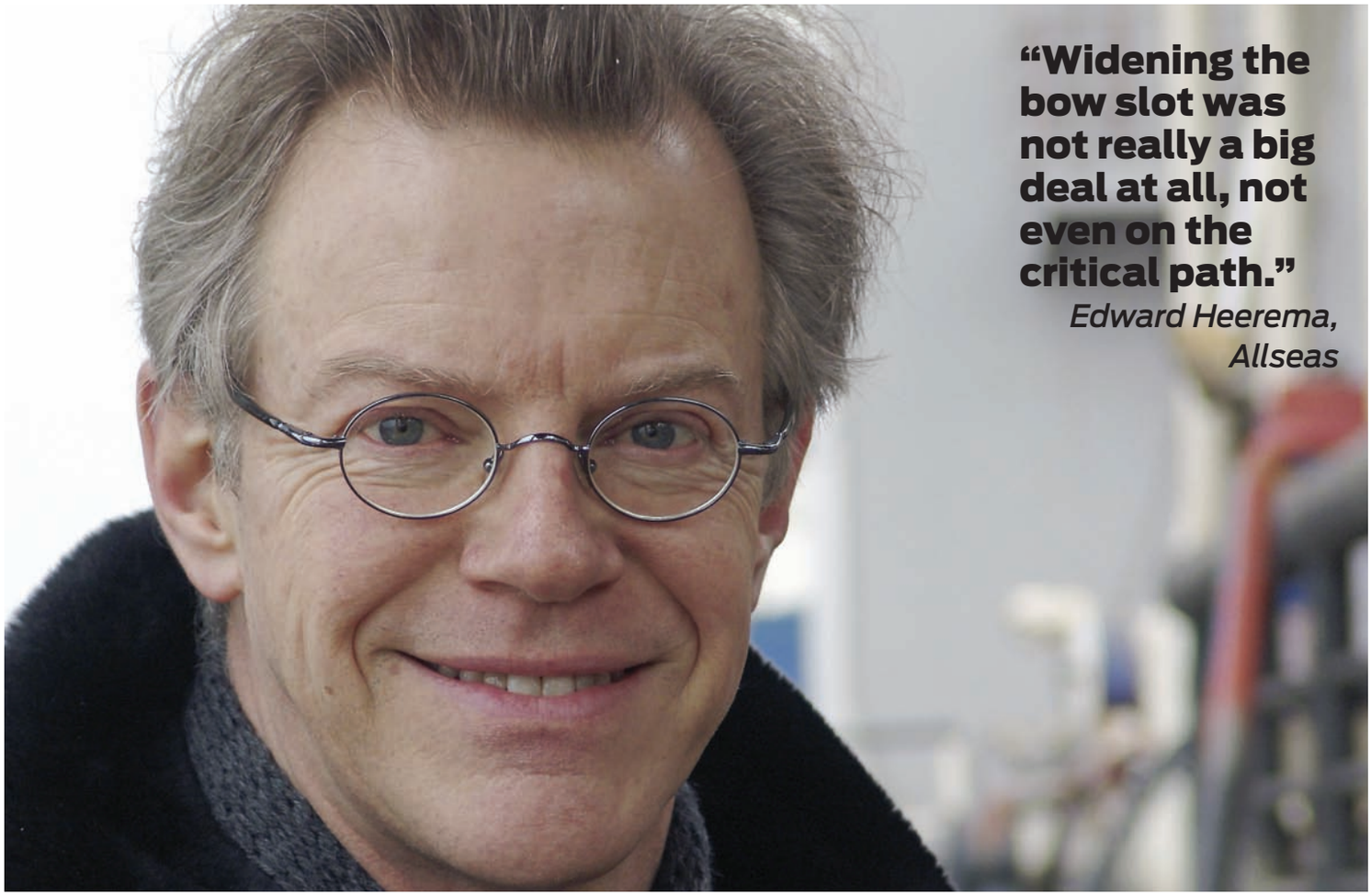
REJOINED AT OKPO: With its two halves brought together again last summer to give a wider bow slot, and now a whole lot more outfitting and painting done in the nine months since this picture, *Pieter Schelte* is due to leave Daewoo's yard in October.



Photos: Allseas

Pieter Schelte limbers up for the start line

After more than 20 years in development, the vessel is already legendary. Now the huge single-lifter *Pieter Schelte* is approaching completion and starting to notch up plum contracts. Adrian Cottrill has been talking to Allseas president Edward Heerema about the story so far — not least that late decision to widen the gap between bows — his views for the ship's future, and his startling plans to build an even bigger one.



"Widening the bow slot was not really a big deal at all, not even on the critical path."
Edward Heerema, Allseas

ALL SET TO REPEAT: Even before Allseas president Edward Heerema has seen his first huge speculative newbuild lift vessel to go into service, he has decided to build yet another, even bigger one.

Six months from now the mightiest ship ever built for the offshore installation industry should have reached Europe from its South Korean construction yard and be on the brink of entering service.

More than two decades in the making by contractor Allseas, the gigantic catamaran *Pieter Schelte* represents a mind-boggling speculative investment of €2.3 billion ($3.2 billion). The aim was to revolutionise the platform decommissioning market by gliding in around a platform substructure and then picking up whole topsides weighing as much as 48,000 tonnes in a single lift.

Instead of many months of arduous and costly piece-by-piece removal offshore, the whole lot would be off and away within a day. This may be quick, but is only made possible by a highly sophisticated motion compensation system powerful enough to let huge topsides like these do an elegant three-dimensional dance on the eight pick-up points.

HOW IT WORKS: Simply glide in beneath a deck and lift it off in one go. *Pieter Schelte* will enter the commercial arena next spring.

At its stern, the vessel will also be able to pluck from the seabed whole steel jackets weighing up to 25,000 tonnes and rotate them aboard. And just for good measure, and to widen the chances of keeping this exceptionally specialised vessel busy for as much time as possible, it has the ability to lay the heaviest and deepest of trunk pipelines.

All this is beginning to bear rewarding fruit. In the month of May alone, news came of two more major contracts to add to the two already under the company's belt from last year.

Pieter Schelte is so far booked to lift five defunct topsides weighing a cumulative total of some 110,000 tonnes, along with a 7250-tonne defunct jacket, all in the demanding environment of the North Sea. It is now also booked to place one new topsides of 15,000 tonnes off Newfoundland, and to lay nearly 900 kilometres of pipeline in Black Sea waters that reach 2200 metres deep.

So enthused is the man who has driven this concept through to reality over such a long time — Allseas president Edward Heerema — that he recently announced plans to build another one much like it, but able to raise loads 50% bigger than *Pieter Schelte* (see separate story, page 18).

As the whole offshore industry knows, *Pieter Schelte* is named after Edward Heerema's father, who pioneered the use of crane ships with world-beating lift capabilities in the early days of North Sea development.

After close to four years of construction in South Korea — including an outwardly surprising late change to widen it by seven metres — the vessel

SEVEN-METRE INSERT: To widen the bow slot the tack-welded vessel was last year split back into two halves and this section added to one half before rejoining the two.

is due to leave the Okpo yard of shipbuilder Daewoo early in October for the six-week journey to Europe. The initial destination is yet to be confirmed. It could be Italy, France, or the Netherlands, says Heerema.

On arrival, the first job will be to install the 16 giant lifting beams (3000 tonnes apiece) that have been built in Italy and need to be mounted on deck either side of the bow slot.

With those in place performance trials can begin. These will start with each of the eight pairs of beams being tested to 10% above the 6000-tonne nominal lift capacity per pair. Two opposing sets will be tested together, lifting a water-filled cargo barge out of the water in a sheltered setting.

Then comes "a much more interesting phase" — the full dynamic testing at sea of the motion compensation system. This will be carried out over several weeks, starting around March next year. For this "we had hoped we could find some redundant platform of moderate size — a topside of say 6000 tonnes or so," says Heerema. "But we have not discovered one in Europe that needs to come out on this schedule, although there is one a year later.

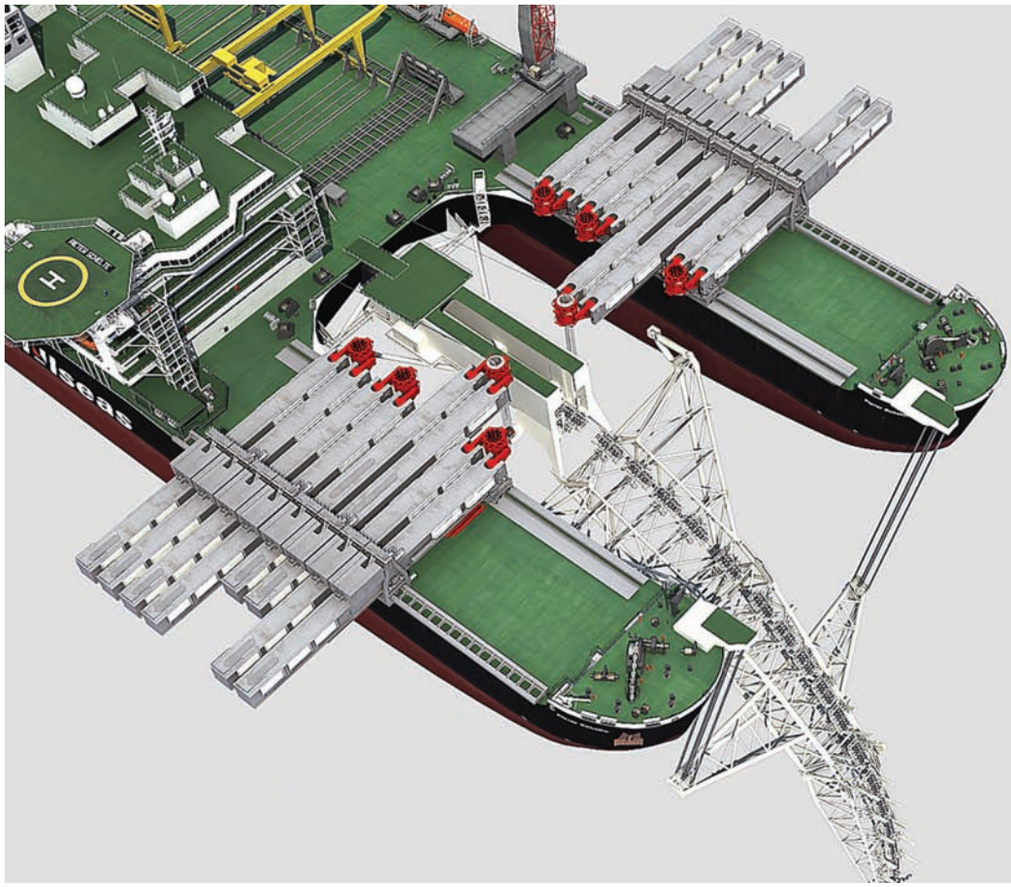
SECOND JOINING: The two halves of *Pieter Schelte* were brought together a second time at Okpo last July after a December 2012 decision to widen the bow slot.

"It would still be nice to run into something unexpected," he continues, "but otherwise we will either fabricate or purchase a representative structure and set that in the sea." The site will most likely be offshore Netherlands in maybe 30 metres of water.

There the ship will do trial lifts of the topsides in increasingly demanding weather until it reaches the limits of its motion compensation system. Then it will be ready to move off to its first commercial assignment, at Talisman's Yme field off Norway in the North Sea.

Widening

Apart from its sheer size, one of the more surprising things about *Pieter Schelte* is that the whole vessel had seven metres added to its width at what seems a very late stage to the outside observer. Actually, says Heerema, "this »



LIFTING BEAMS: The 16 lifting beams are combined in pairs with levers at their tips supporting a clamp that grabs a topsides support leg. And when in pipelaying mode, as shown here, two of the pairs form part of the support system for the removable stinger.

»

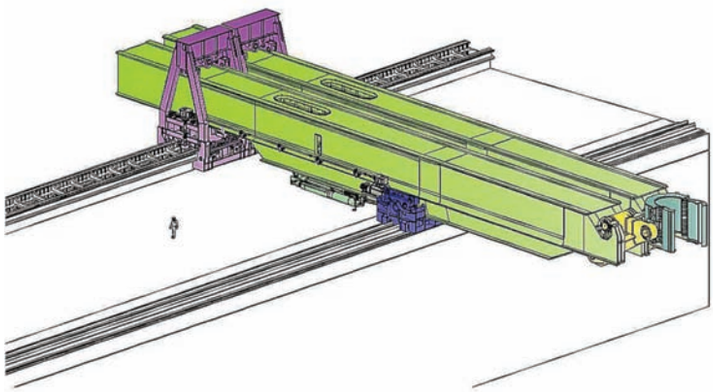
was not really a big deal at all, not even on the critical path".

Width had always niggled. More precisely, the width of the slot between the bows had always niggled. In the early days a dozen years ago, Allseas pushed as close as possible to the limits of what could be built in the dry docks available at that time.

The best information then coming from operators about their platform dimensions indicated a maximum substructure width of 48 metres to be enclosed. That translated into a desirable slot width of 52 metres between the hulls, allowing a reasonable margin for manoeuvring and safety.

The resulting overall vessel width of 117 metres was in turn just about feasible to fit in the largest drydocks of the time, with a few metres to spare. "In establishing the slot width it was always accepted that some platforms would be too big for the perceived concept," Heerema told listeners at this year's OTC conference in Houston in an informative update on the project.

So that was the picture when Daewoo was awarded the construction contract in June 2010, for delivery at the end of 2013.



HANDLING MOTIONS: Due to the hugely powerful and sophisticated motion compensation arrangements, the system of lift beams can move in all three dimensions to keep a 48,000-tonne topsides moving elegantly at the beam tips.

However, over the past three years, operators have started going down to their basements and digging out accurate drawings to supply for feasibility studies for future decommissioning projects.

"Repeatedly," says Heerema, "we found that, although manageable, the clearances for moving in around the platforms were small and could lead to collision risks and weather limitations".

The prospect of spending many weeks waiting on weather was definitely not attractive for an expensive vessel, where the philosophy is to "come, lift and go".

"It was very frustrating to have a ship that was almost perfect in every respect except for having a slot that was a bit too narrow," says Heerema.

"Yes, it was a big decision to go ahead with widening the slot," he agrees, but at that time, in 2012, *Pieter Schelte* still consisted of two halves. Things were also made easier by the fact that the vessel's centre line is almost free of machinery, except for the firing line for pipelaying that will go there later. And Daewoo's largest drydock is 135 metres wide.

So, the shipyard was asked to make an offer for widening the vessel to 124 metres by adding a seven-metre insert at the point where the two halves join.

Initially, it was reluctant to break the iron discipline that has made the South Korean shipyards so successful. But a little later the yard became more interested to add half a year to the schedule for *Pieter Schelte* because of pressure on some of its other projects.

So, by December that year, a trade-off had been agreed. "It was still a lot of money," says Heerema, "but it was a reasonable price — about €140 million ($190 million), including the cost of widening the cargo barge, the pipelay stinger and lengthening the lifting beams."

In spring last year, the two halves of the ship were separated

and a new seven-metre wide insert block added to one half. In July, the two halves were rejoined to give a new slot gap of 59 metres.

Separation was not as major an exercise as might first appear. The two halves had provisionally simply been "tack-welded" together — enough to keep them joined, but nothing like the extremely rigid ultimate connection. And the insert was added to the vessel half that did not have all the machinery and accommodation.

"The work of widening had little influence on progress," says Heerema, "virtually all of it could carry on regardless". In addition, the big topsides lifting beams had to be lengthened, and the cargo barge for topsides transport was widened to 57 metres.

Now Allseas can sit back and enjoy the benefits. "Widening has increased our potential project base very much because it makes quite a few platforms much more viable," says Heerema. "For example, Brent C would not have fitted before, but now fits very nicely."

The total lightship weight, including lifting systems, is slightly over 250,000 tonnes.

Contracts

Pieter Schelte has now won four major contracts, which between them will show off the full range of the vessel's abilities — from removal of topsides and jackets through to installation of topsides and high-end pipelaying.

The long-awaited breakthrough came in August last year when Shell engaged the vessel for a huge scope of work in the Brent field decommissioning project, starting in May 2015 and stretching over as many as six years.

The topsides of all four Brent platforms are to be removed, calling for lifts of between 16,000 tonnes and 30,000 tonnes. Also, the steel jacket at Brent A is to be taken out.

The second contract came from Talisman in January this year. This is for the removal of the

Sequence for a big lift

The topsides support legs are separated from the base structure by castellated cuts before the lift vessel arrives. Then the vessel carefully moves in to enclose the platform and the lift beams are extended.

Once the motion compensation system has actively eliminated all relative movement, the clamps are closed around the support legs. Then pre-tension in the lift system is gradually increased to transfer the weight of the topsides to the vessel.

In the final stage, a 2.5-metre rapid lift-off is performed by the hydraulic cylinders within seconds, to eliminate the risk of re-impact of the topsides on the jacket. Then, the vessel is de-ballasted and withdraws with the topsides. Topsides installation is roughly the reverse of this. The ship is designed to perform heavy lifts in seas up to a significant wave height of about 3.5 metres. Model tests show that movements in these conditions are comparable to that of semisubmersible crane vessels, says Allseas.

For lifting jackets up to 25,000 tonnes, the two tilting beams at the stern of *Pieter Schelte* come into play. Once the jacket base has been cut at the foundation piles or just above the pile clusters, the tilting beams are raised and the four main hooks connected to the jacket.

Then the jacket can be lifted off the seabed and gradually hung against the lift beams. With that done, the beam/jacket combination can be rotated onto the vessel deck and the jacket skidded further inboard.

TOP-END TENSIONERS: Four 500-tonne capacity tensioners, designed in-house, combine to allow the vessel to lay heavy deepwater pipeline.

ill-fated Yme jack-up production platform in the central North Sea — a 15,000 tonne topsides.

At the end of April, Allseas notched up its first pipelay contract for *Pieter Schelte*. This is for the South Stream project in the Black Sea, where it will lay trunkline number two, calling for 890 kilometres of 32-inch pipe to be placed in water depths up to 2200 metres. This work will begin in August 2015 and run until March 2016. Part of the work might be done by Allseas lay vessel *Solitaire*.

And in just the last month Allseas is rumoured to have won its first topsides installation contract. This is to set a deck weighing over 15,000 tonnes for Husky at the White Rose field off Newfoundland, Canada, in the summer of 2017.

It was a lengthy process to winning the first contract agrees Heerema. "Shell studied our ship and our proposal for about four years. These were extensive studies, which they paid for. They scrutinised the ship and its methods in tremendous detail. We had to prove every aspect to them.

"It took a lot of time," he says, "but on the other hand, it's very good to have a demanding client because you really have to prove your point. After that, the other projects went a lot faster. Once you have one large project you have already earned quite some credibility and everybody knows Shell would always do a very thorough evaluation."

As it happens, Heerema remembers the Brent A platform as one of the first he became familiar with as a young engineer, when working for his father researching foundation pile-driving in very hard clay. This platform was a prime target back in 1974.

Reflecting on the interest taken in *Pieter Schelte* by potential clients, he says it has been "better than I had dared hope for. Years ago I was always questioning — when will we get the first big job, will we have to fight very hard for it? Will the oil companies be fearful in committing themselves, will we only get very small projects first?

"But it has been far more positive than I feared it could be," he says. "From the moment we awarded the building of the ship in 2010, and it was clear we were definitely going ahead, many oil companies began serious talks with us. Shell Brent was the first contract, but at the same time several other companies were also looking very seriously at *Pieter Schelte*."

Outlook

Asked how he sees life working out for *Pieter Schelte*, Heerema says: "You do your heavy North Sea lift work in the summer, although you may also find such work at other times of the year in other parts of the world where conditions are not so demanding. Then you do the heavy pipelay jobs in winter, though there is not enough large pipelay work to do that every year.

"We don't have any real idea about how big a part pipelaying will play. I think that there will be years when we are primarily lifting structures, and other years when we will be laying pipe more."

As to how small the target tasks might be: "We haven't answered that yet, we don't know. Looking at it one way, the ship is just too expensive to do light work. On the other hand, its operating cost is not so extreme, it's mainly the amortisation factor. I don't think we would normally go after small platforms that can very well be done by other contractors. It will depend."

As for dayrates, Heerema responds: "We are often asked that, and we laugh and we say we don't know.

"The vessel is working to her capacity only for a few moments on a project that might take a number of weeks to prepare for. We do our projects on a lump-sum basis and price it with an amortisation element in it."

The work on site for a big topsides removal can be done in one or two days from encircling the substructure to backing out with the booty. And that actual critical heavyweight lift takes just a few minutes.

Nevertheless, the full contract will occupy *Pieter Schelte* for far longer. "When you add it all up, it comes to a number of weeks," says Heerema. "You have to prepare for a job, go out, wait for the right weather and then do the lift. After that there is transit to the port area and handing over the topsides to the cargo barge in sheltered water, from which it is skidded onto the quayside."

MIGHTY HYDRAULICS: Cylinders like this power horizontal movement of the beams. Far mightier rams in the motion compensation system — kept firmly under wraps by Allseas — provide vertical power.

Motion compensation

With its top of the range DP3+ positioning capabilities, *Pieter Schelte* will move back and forth "only a few dozen centimetres" when stationed beneath a topsides. Its 12 thrusters have 95 megawatts of power behind them.

Once the ship is in position, the lifting beams do everything else needed in the way of motion compensation to avoid re-impact of the separated deck as it rises off its supports.

The massive hydraulic cylinders sited beneath enable them to accommodate movement in all three dimensions.

This is motion compensation at its most extreme, juggling a 48,000 tonne mass so that relative movement is completely eliminated. The system that does this was the central engineering challenge for *Pieter Schelte*. It is completely novel, very costly, big and complex.

The full stroke of the 32 massive hydraulic vertical rams is 4.5 metres. However, the fast lift to clear the topsides from its base is only about 2.5 metres. After that the ship has a quick deballasting system that continues to raise it further over the next few minutes.

A unique computer programme — "completely developed in house by some very bright engineers" — controls it all. Not surprisingly, says Heerema, it is "completely secret — we don't make the programme available to anyone, not even the client. The lead time for such technology is many years."

The 16 lift beams are coupled off into eight pairs — four on each side of the slot. Each of these pairs holds a clamp that closes around a topsides support leg, and is served by four hydraulic cylinders that together deliver a lift force of 6000 tonnes.

A major influence in designing the clamps has been the desire to do as little as possible to the platform legs, despite the different types that may be encountered.

Pipelay

For trunk pipeline installation *Pieter Schelte* aims to meet top-end demand and has the pipe tensioners and stinger design to do just that.

It can lay pipe up to 68-inch outside diameter including concrete coating, and go as deep as 3000 metres with, say, a 28-inch outer diameter pipe. The newly-won South Stream contract, which calls for 32-inch line to be placed in depths to 2200 metres in the summer of 2015, is an ideal challenge for the vessel.

The firing line includes four tensioners that combine to provide a world-beating capacity of 2000 tonnes. The four units are "bigger than anything that exists at the moment and we designed them completely by ourselves using a lot of inside knowledge," says Heerema.

The production line with its six welding stations is below main deck level, leaving more free deck space above. There is plenty of room aboard for a large workforce — two-berth cabins for 571 people.

The pipeline goes out over a stinger long enough to divide into two parts. A transition frame starts the descent from horizontal. Then the second section is adjustable for curvature and for an angle that can reach near-vertical. When not needed, the stinger is removed from its place in the bow slot and stored on a cargo barge.

Heerema says one of the most difficult aspects of the vessel project has been getting suppliers to perform well on the tremendous dimensions involved — the high steel wall thicknesses of up to 270 millimetres, the high steel grades of up to nearly 70,000 psi yield strength, and the complexity of the hydraulics.

"We knew this would be hard, but it was even harder," he says. "Yet, I've always had confidence that *Pieter Schelte* would work well technically, even if that is still to be proved, because I'm a very dedicated engineer.

"Some 23 years were spent developing the concept and basic design, done entirely in-house by a large team," Heerema told his audience at this month's OTC conference in Houston. "In hindsight, the many years of preparation were no luxury, ideas developing very gradually for this ship.

"It will be a challenge to obtain a reasonable return on investment," he continued. "However, the interest from industry is favourable." The future looks wide open. U

No topsides too big

Not willing to concede that a dozen or so of the world's largest decks are just too big for the single-lift approach, Allseas is planning a vessel fit even for that challenge.

It is still almost a year before Allseas mega-vessel *Pieter Schelte* will start its first commercial contract, *writes Adrian Cottrill*. Yet last November the company announced plans to build an even bigger catamaran with a rough current cost estimate of over €2.5 billion ($3.4 billion) and to be operational in 2020.

Vessel Two — yet to be named — will have a lift capacity of 72,000 tonnes, 50% more than its sister ship. The aim is to be able to "remove all platform topsides in the North Sea which are beyond the capability of *Pieter Schelte*, and also install very large topsides worldwide", says the company.

However, very large topsides projects are scarce and Allseas president Edward Heerema freely concedes that the company is consciously proposing a vessel that "cannot be busy over a large part of the year. Yes, isn't that strange".

Whatever possessed them? "We always realised that while *Pieter Schelte* is a very big vessel, there is a league of platforms so much bigger that we would never be able to touch them," he says.

"Its slot would fit around most of the large platforms, but there are 13 that are either too heavy, too wide or too long. So in the early days we didn't dream of those. We thought — well, that's something that just can't be done."

But over the past three years "we've had so much interest from the industry for *Pieter Schelte* that — getting used to the attention — we realised that if we could find a way to deal with these very large platforms we would have a considerable advantage. It's clear from our studies that, as platform size increases, the benefits become disproportionally bigger."

So the specification for Vessel Two is defined by the most extreme platforms worldwide. Allseas is still gathering precise data from the oil companies, but

EVEN BIGGER: How the new vessel compares with its sister. Its single lift capacity of 72,000 tonnes comes from 12 pairs of lift beams, not eight. The bow slot is 13 metres wider and the vessel's overall width is 36 metres greater. Its length of 400 metres is only 18 metres more then *Pieter Schelte*, but the bow slot takes up a greater proportion of that length.

Image: Allseas

"We intend to learn from lift projects with *Pieter Schelte* before we finalise these designs."

Edward Heerema, Allseas

has formed a broad picture.

The heaviest topsides is possibly Oseberg A at roughly 60,000 tonnes, closely followed by Gullfaks C, both off Norway. "When you add in all the factors such as eccentricity of the centre of gravity, you find you need a lift capacity of 72,000 tonnes," says Heerema.

The widest support structure may be Magnus in the UK North Sea at 68 metres. So Vessel Two's slot width has been set at 72 metres, which is 13 metres wider than *Pieter Schelte's*. The length of its slot is set by the North Sea's longest support structure, which looks to be Sleipner A off Norway.

The new vessel is very unlikely to be fitted out for pipelaying. "Large pipeline projects are so scarce that the industry doesn't need another big vessel with that capability."

"We are very sure we want to build this ship, says Heerema. "We are currently doing conceptual design, will move to basic design in the coming year and probably start detail design in 2015." Tenders to shipyards will likely follow in 2016, then a building period of about three years. The experience of building *Pieter Schelte* will be a big benefit Heerema says. "The knowledge base within our organisation is now extremely large."

As for improvements: "We already have some ideas about the lift and clamping systems — there are always ways to do things a little better. We intend to learn from our first lift projects with *Pieter Schelte* before we finalise these designs."

And looking to the future: "We hope that as time goes by we will have new ideas about other things we can do with the ship that we haven't thought of yet."