FUTURE-PROOF ENGINEERING

Ivormatie magazine - December 2019

“WHAT DID AN ENGINEERING COMPANY LOOK LIKE 30 YEARS AGO?”

This year we have celebrated the 70th anniversary of our engineering company. A perfect moment to reflect on all that has been, but particularly, to envisage all that is to come.

Talking of all that has been; what did an engineering company actually look like thirty years ago? A sizable drawing room with rows of drawing boards and large consultation tables. A draftsman sitting at every drawing board with a Rotring pen in his hand, eraser, tracing wheel and a goose feather to brush crumbs from the paper. There were all kinds of stencils, set squares and letter templates. Sweaty forearms would stick to the paper, especially in the summertime, and you'd have to watch out for the ink smudging your paper. There was a lot of commotion on the work floor. Plenty of communication, and sometimes singing too; much to the annoyance of fellow workers. Occasionally a joke, and a treat when it was someone's birthday. It was actually quite nice.

> It's hard to imagine the changes that await us.

And what does an engineering company of 2019 look like? Sometimes long rows of rooms, with two or three employees per room. Sometimes a more open concept is chosen, in the form of an open-plan office. Each employee has a small desk with a computer and a screen; preferably two screens and as large as possible. A clean desk: all information can be found digitally in the system. It's quiet, in fact, it's very quiet. Colleagues communicate with each other by way of e-mail and it's unimportant whether the sender or receiver is sitting next to you. Talking is mostly about football and generally happens only when arriving at the office, after which, it's quiet again.

And finally, the engineering company in twenty years' time: 2040 for instance. I imagine it as a large room, and completely empty. The draughtsmen of the future will stroll through the room wearing digital glasses: virtual reality. Such glasses will allow you to walk through your own design, virtually. Everything is 3D and every slither of information will be available in the model. Installations can be switched on and off, virtually of course. This is how entire systems will be tested. The customer will be watching too. The development in these last twenty years will have gone at an astounding rate. Not only in virtual reality but also in artificial intelligence (computers becoming self-learning instruments), BIM (Building Information Management) and more of these kinds of terms. Designs will not only be produced for construction but will also serve as tools for operations and asset management.

It's hard to imagine the changes that await us. Our profession will no longer be the same in twenty years' time. The engineers of the future will be creating their designs with virtual reality headsets and joysticks, very much in the same way that our children are currently playing computer games.

I hope you enjoy reading this edition of Ivormatie.

Rob van de Waal
CEO Iv-Groep

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“THE PATENT IS THE ICING ON THE CAKE”

Self-installing floating wind turbines

The energy transition, wind energy and greater water depths were the reasons for conducting extensive research into the possibilities of a 'gravity-based' wind turbine that is secured to the seabed with tendons (cables). Eventually, this led to an innovative, patented method for a self-installing wind turbine that is suitable for greater water depths.

"It was about a year and a half ago that Rob van de Waal, CEO of Iv-Groep, wondered whether there were still opportunities for innovation within the steadily developing market of floating wind turbines", says Ad van den Dool, Sector Manager at Iv-Consult. "Extensive research showed that so many ideas for this have already been published and coming up with a totally new concept for a floating wind turbine would be virtually impossible. However, an innovative concept that could be applied in greater water depths, for example, the concept of installing a floating wind turbine, was considered promising. Together with the team, we subsequently investigated installing a wind turbine on a floating basis, with a so-called 'gravity base'. This concept is not new as such but was the starting point for the development of an innovative system based on a self-installing wind turbine. We developed a system with tendons, floats and a 'gravity base' that will only need to be towed by tugboats to its destination and will further complete the installation itself. This specific system turned out to be so innovative that it will be patented."

> We wanted a system that would be suitable for greater water depths, and it has taken a great deal of brainstorming to suitably adapt the concept for this.

An ingenious system

Fabio Amico, Structural Project Manager at Iv-Consult, continues: "The tendons are placed in the mast of the wind turbine and are released by the floats, causing the 'gravity base' to submerge and sink to the seabed. When the 'gravity base' is positioned on the seabed, the tendons are tensioned, and the float is pulled underwater. Because the tendons are in the mast, the height thereof determines the maximum water depth. However, we wanted a system that would be suitable for greater water depths, and it has taken a great deal of brainstorming to suitably adapt the concept for this."

Our concept involves a so-called 'jacking platform' at the top of the mast and directly below this a rotating platform from which the tendons are hung. A securing platform is at the bottom of the mast. By means of 'strand jacks' the tendons are successively lifted, lowered (causing the 'gravity base' to descend) and subsequently fixed to the lower platform. The rotating platform then ensures that subsequent tendons are suitably placed. The procedure is repeated until the 'gravity base' is positioned on the seabed and the tensioning of the tendons can commence. Eventually, the wind turbine is partially submerged. The concept is suitable for water depths of approximately seventy to five hundred metres and, as an alternative to the 'gravity base', the system is easily adaptable for applying so-called 'suction anchors'.

> Wind turbines of 5 to 8 MW are currently the most commonly used in North Sea waters, but soon this may rise to perhaps 20 MW.

Major developments in the offshore wind industry

The offshore wind industry is experiencing major developments, and in the Netherlands these developments, among other things, are being stimulated by the renewable energy sector. Heavier wind turbines are needed to generate a higher energy yield in areas with constantly high wind speeds. Wind turbines with a capacity of 5 to 8 megawatt (MW) are currently the most commonly used in North Sea waters, but soon this may rise to perhaps 20 MW. Such large wind turbines, far above sea level, are preferably placed further away from the coast. However, this makes offshore work activities expensive. Especially for greater water depths (more than sixty metres deep) alternatives have been devised for existing foundation structures, such as monopiles and jackets. It is often assumed that the structure is floating in combination with anchoring by means of suction anchors or piles. Of course, it is also possible to secure the structure via a so-called 'gravity-based construction', on which Iv-Consult's concept is based.

> We are not focussing on the total system, but instead on the mechanism that allows the wind turbine to self-install.

Wind turbine and foundation rolled into one

Iv-Consult is in consultation with a supplier to find out the practical issues in relation to the tendons. Ad explains: "We have completed a global feasibility study into the dimensions of the system. Our starting point for this was a 12 MW state-of-the-art wind turbine. Of course, the patented system can also be integrated into the mast of a smaller wind turbine and at variable water depths. Together with this partner, we are now investigating the integration of the tendons in the construction, considering the various installation phases and the connecting of the tendons. The concept is now evolving from an idea to a detailed plan." Fabio adds: "Because the concept is based on an integral system where all components are influenced by each other, the parts cannot be engineered separately as the entire system must be considered. This also applies to the installation equipment, which is fully integrated into the mast. Splitting the system, into a turbine, transition piece and foundation, will not work."

LEGO® models

And now? Ad continues: "There are many opportunities internationally for floating wind farms in greater water depths. Floating wind turbines are nothing new. Many concepts have already been devised and developed

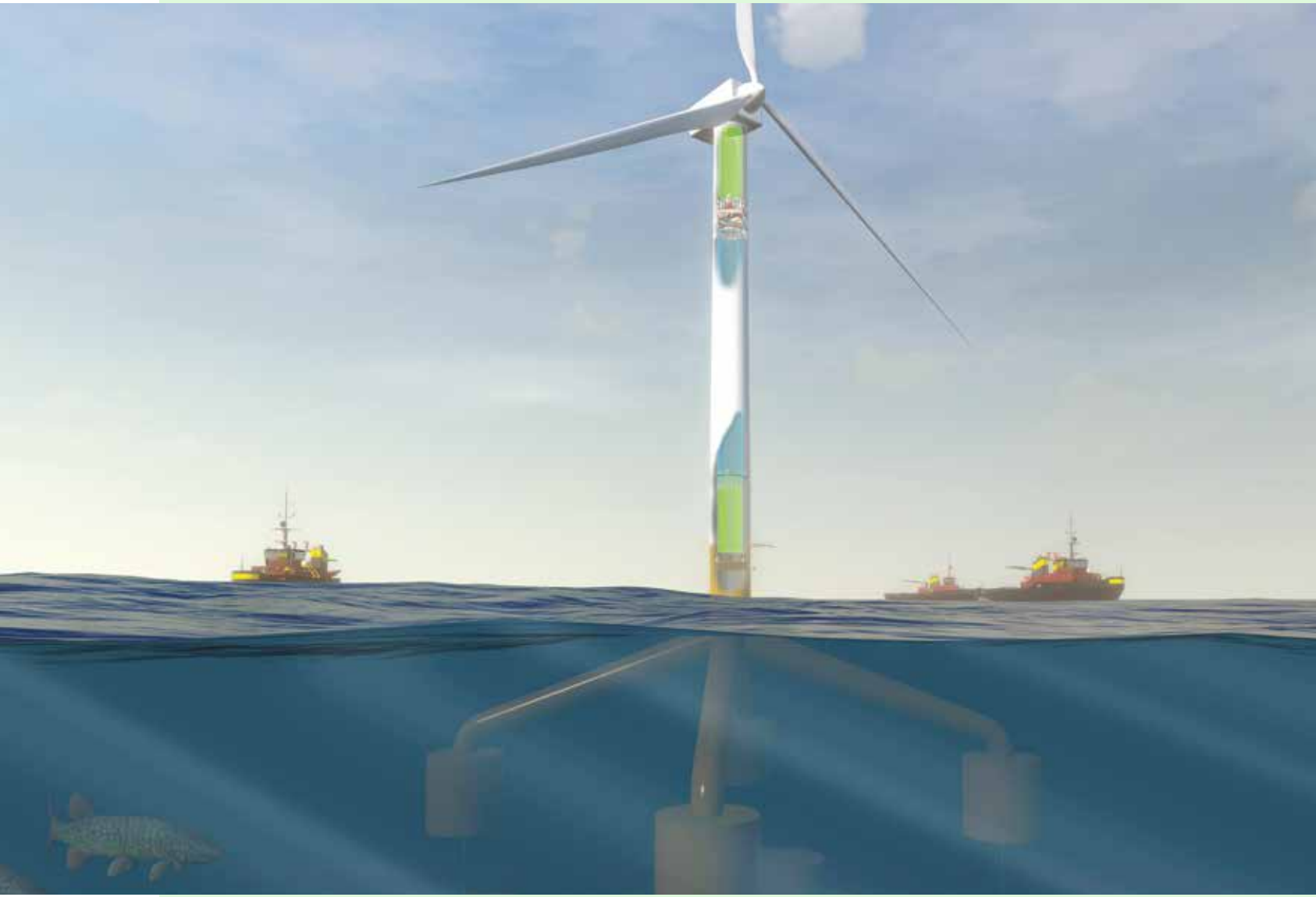
in the market. There are currently several functional prototypes and the first floating wind farm is operational. However, we are not focussing on the total system, but instead on the mechanism that allows the wind turbine to self-install. This is also completely in our comfort zone. Our goal is to present a working concept. It would, of course, be fantastic if this was to be taken on by the market and actually applied." The concept is modular and can be adjusted to size. This makes it suitable for many different turbines. "We are busy creating a 3D digital model of a mast with the platforms and tendons", says Fabio enthusiastically. "But, for example, we can also work this out with LEGO®, to make it clear how the system works." Ad adds: "Or we could 3D print it."

> It was a whole process; the patent really is the icing on the cake.

Proud

Ad and Fabio are proud of what they have achieved with the team so far. "The challenge of coming up with the concept was the best part: 'How can you make a wind turbine self-installing? How do we make this possible?' There has been much sketching, designing, brainstorming and discussion for this project. Piece by piece, we finally arrived at a solution and the fact that what we came up with is to be patented is fantastic. I am really proud of the team!", says Ad.

Fabio fully agrees with him and adds: "Since 2018, we have been working part-time on the development of this concept. Due to other work, we often had to temporarily halt our research, and it was often challenging to again restart it. Creating the text for the patent application was complicated but luckily, we had help with this. We finally completed the text, with comments, with further comments and comments about the comments! It was a rainbow of colour due to all the adjustments, comments and the adding of extra sentences. It was a whole process; the patent really is the icing on the cake."



“SMALL AND FULLY AUTOMATIC”

Walter Jansen of Amusca

Breeding flies in a sea container

An insect breeding unit for poultry farmers. That's the idea of Amusca's Walter Jansen. These protein-rich juvenile houseflies are an excellent solution for the global protein crisis and are also, incidentally, excellent waste processors. But how should such an insect farm be designed? After ten years, the quest of Walter ends at Iv-Industrie. "It's strange that I hadn't thought of them sooner."

He just didn't know what to do anymore. It appeared that after two tests, the design he had devised didn't work. Zoologist Walter Jansen stood there staring at it. He told a friend from the rowing club that he's been busy with his larvae farm for ten years. His friend gave him a tip; talk to Iv-Industrie. Maisha Verhoek, Lead Process Engineer at Iv-Industrie, has clear memories of how Walter stood before her with all his drawings. "We critically studied it. In particular, the process-technical design. Were there any sharp edges or rotating components? Are the larvae able to get stuck anywhere? We were dealing with a living and very fragile organism", explains Maisha. "It's strange that I hadn't thought of Iv-Industrie sooner", says Walter. "They brought all the separate elements of the larvae breeding unit together. They have expertise in cooling, process optimisation, human nutrition, legislation, safety requirements and engineering, which is exactly in-line with our specialist knowledge. Together we searched hard for a solution, and I now know exactly what the problem is."

> Since the outbreak of mad cow disease (BSE), it is forbidden to feed animals with animal protein.

The minister tucked into an insect

He came upon his idea when he saw Minister Gerda Verburg (Minister of Agriculture, Nature and Food Quality between 2007 and 2010 in the Cabinet Balkenende IV) tucking into an insect at the annual 'Binnenhof Barbecue', says Walter. Walter thought: wait a minute, so it is still possible. Walters company develops cattle feed. He already works with algae, bacteria and fungi. But insects...no, he is not allowed to use them. Since the outbreak of mad cow disease (BSE), it is forbidden to feed animals with animal protein. "Animal feed contained meat and bone meal derived from ground offal from mammals or poultry, and it was believed that this was the main

culprit of BSE. At that time, nobody thought about making an exception for insects. Food for fish, dogs and cats can be made from insects."

> There are six million insect species worldwide. After sifting through a viable selection, two species remained: the housefly and the cockroach.

Insects could put a stop to logging

According to the law, it is forbidden to feed processed insects to animals. However, nothing is mentioned about feeding live insects to animals. Walter thought; what if he was to create a larvae farm. Larvae are full of proteins. And farm animals need proteins to grow. That's why we feed them with high-protein soybean meal. More and more rainforests are being destroyed to make way for soy plantations. Insects could put a stop to all this logging. And with this, insects would not only be the solution to solving the global protein crisis within the agricultural animal world but would also help combat tropical deforestation.

Housefly or cockroach?

There are six million insect species worldwide. After sifting through a viable selection, two species remained: the housefly and the cockroach, and of the latter, the Red Runner and the hissing cockroach. "Cockroaches are particularly interesting," says Walter, "because – besides from being a source of protein – they contain much more chitin than the larvae of the housefly. Each time cockroaches shed their shells they release new amounts of chitin. This insect skeleton building material can be used for numerous applications in medicine, water purification, food additives, packaging and the manufacture of new materials. It can even serve as a raw material for bioplastics. But people find cockroaches horrible and dirty. Imagine if they managed to break free and invade a neighbourhood in the close vicinity of such a larvae farm... That would definitely be a risk"

> Houseflies spread disease and are extremely irritating, but more than anything; they are flying protein bombs.

Musca Domestica

The housefly, the Musca Domestica, was the remaining candidate. Notice the link to the name of Walter's company. "With an 'A' added at the beginning of Musca, because then you will be listed at the beginning of the telephone book. If people still use it, that is", says Walter laughing. We all know the housefly. In fact, there's always one zigzagging and buzzing around the home every day. They are everywhere where people are, but we certainly don't regard them as pets. Houseflies don't have a high cuddle-factor. They are extremely irritating, a nuisance and they also spread disease and love refuse. But more than anything; they are flying protein bombs.

Housefly breeding unit

Walter goes forth with the invention of a housefly breeding unit. "Cultivating insects didn't exist nine years ago. In consultation with animal organisations,

I studied the behaviour of the housefly. All aspects of the design are considerate to the rights of the fly." Walter quickly found investors for his plan: animal feed manufacturer Denkavit and waste processing company Sita. Besides the waste incinerators of AEB Amsterdam, a test breeding unit with housefly larvae will also be set up. Food and biodegradable waste will be dispatched to the breeding unit. The eggs, from which the larvae will emerge later, will be added to this. "The larvae fill their bellies with proteins and other waste goodies and are then put to sleep and dried. From this, protein-rich dog and cat food and fish food can be made." An added bonus: the larvae convert the organic waste into compost within three to four days instead of two weeks, which would be the normal time it takes for composting to occur. Fly larvae are diligent waste processors. The plan was to cost twenty million euros and after years of preparation was set to falter in 2014. "Investors were put off by strict legislation."

Musca Domestica, the housefly

Larvae for chickens

Stop? Of course not! With his adapted concept, Walter finds a new investor. "I have adapted the larvae breeding unit to be smaller and fully automatic. This way, every poultry farmer can install it with limited investment. A PLC (Programmable Logic Controller) computer program controls everything remotely. Each breeding unit is connected to all other units, whether located in Barneveld or Bogota. The PLC learns and adapts in real-time."
Yes, this type of breeding unit is especially for poultry farmers. "Chickens are insectivores by nature", he says. "We've never had the chance to feed them with the food they are accustomed to. I also have a chicken at home. It's always on the hunt for insects, all day long. That's why they potter around, that's what they are looking for.

> Those larvae grow like crazy. Altogether, they weigh roughly the same as a cat. After four days, they are as heavy as four cows.

Buy fish larvae from a fish shop, chickens love them. They will also immediately stop with pecking at other chickens. Which is something they do out of boredom. If you feed them protein-rich larvae, they will begin to behave much more naturally. The chitin contained in the larvae also possesses bactericidal properties. The chicken be will healthier and you can use the chicken manure as a basis to breed new flies."

Three sea containers

The fully automatic Amusca Insect Breeding Unit consists of three seventeen-metre sea containers. The unit is essentially a play and sleeping area for the houseflies. From there, the eggs are transferred to the breeding module. "The larvae crawl out of these eggs and are fed with residual products from the beer and sugar industries. And really, those larvae grow like crazy. Altogether, they weigh roughly the same as a cat. After four days, they are as heavy as four cows. After three days we turn them out - before they start to fly - and we feed them to chickens." With such a 'larvae factory', a chicken farmer can feed 70,000 to 100,000 chickens a year. For this, approximately six million flies (half males and half females) are required. Each female fly lays an average of thirty eggs every day. Work it out, it's around ninety million eggs every day.

> A process is a process. Whether it concerns oil, milk or larvae.

Simple (dis)assembly

After all this, it goes wrong after two tests. Iv-Industrie then checks all the possible components of the design drawings. Functionality, manufacturability and maintenance. Can the design really deliver what it was made for? Have the correct materials been chosen? Can the components handle the assumed load and are they easy to (dis)assemble? "Components that need to be cleaned regularly or on which wear parts are to be attached, must be easily accessible and easy to (dis)assemble", says Maisha. "Various components that share similarities can often be adjusted in such a way that only one variant is needed and is applied in multiple places. This makes production cheaper and assembly easier."

The humidity of the breeding module

Walter posed questions, particularly about the cooling of the larvae breeding module. A double-walled tank; with water flowing between the double walls. But are these enough litres of water to prevent the temperature in the tank from exceeding 37 degrees? Larvae are proteins that should not be too warm. Walter: "The humidity of the breeding module where

Test unit of the 'larvae factory'

the houseflies lay their eggs is also very important. There are several damp cloths hanging in the module to maintain an optimum humidity of 70%. If the humidity level rises, mould will begin to grow on the larvae."

Faith

Walter was given clear advice: make sure you have good composition and workshop drawings with which you can manufacture a prototype. "You can easily resolve any teething problems, after which you can create a revision drawing", says Maisha. If you have this, you can manufacture, assemble and commission the installation anywhere in the world. This will deliver savings on the stocking and transportation of components. Walter agrees: "You have to leave the design of such an insect breeding unit to experts. Once again, we're reminded that we're biologists, not engineers." Of course, he knew of the name Iv-Industrie but assumed their work was purely to do with building oil and gas platforms. And of chemicals, pharmaceuticals and food? Maisha: "A process is a process. Whether it concerns oil, milk or larvae. However, an important difference here is that larvae are alive and require a different approach than with a liquid or solid. This is what made it an interesting challenge for us."

Walter is hoping that the party that built the larvae breeding unit will take Iv-Industrie's recommendations on board so that in ten years' time, the first 'larvae factory' can finally be installed. Walter: "If I had known in advance that it would take so long, I probably wouldn't have started it. But that's also the key to making great steps: you have to keep going and you have to believe in it. And I never lost faith in this!"

Source: Department of Defense

How do you design a miniature village in a cylinder?

If you wish to learn more about the basic principles of designing submarines, you can join Nevesbu for a four-day Masterclass Submarine Design. Specialists Marijn Hage and Albert Jurgens explain all about handles, logical lines and a smell that is comparable to fifty sweaty youngsters in a gym. "You will find more technology within every cubic metre in a submarine than in any other vehicle."

"A handle on a hatch," says Marijn Hage, Naval Architect at Nevesbu, considering the design for a submarine, "it has to be in exactly the right place. As a submarine designer, you have to put yourself in the shoes of the users. Suppose a crew member with a fire extinguisher needs to pass through this hatch very quickly. He has his hands full, but thanks to the well-placed handle, he can pass through efficiently and timely extinguish the fire. I really enjoy having to consider these scenarios when designing. The crew must be able to act quickly and correctly. There's not always room for a second chance on board."

> To get to the engine room, you shouldn't first have to pass through the command centre.

Albert Jurgens, Manager of Projects at Nevesbu, also takes great pleasure in logistically correct submarine design. "Every space is interconnected in a submarine. It must be made up of logical lines. To get to the engine room, you shouldn't first have to pass through the command centre. There shouldn't be lines passing through a workspace. Submarine design is about designing cohesion."

Retaining knowledge

Marijn Hage and Albert Jurgens are the tutors of the Masterclass Submarine Design and have given this course four times at Nevesbu. Last summer, for the first time, the masterclass was available for open registration. Twenty-three colleagues came along. Engineers attended from member companies of the Dutch Underwater Knowledge Centre (DUKC). Such a course is quite extraordinary. Submarines are no longer made in our country. Nevertheless, the Netherlands has put itself on the international submarine map with the Walrus class - for which Nevesbu supplied the design, and later that for the life-extension programme. Albert: "In order to keep those submarines relevant and perhaps build innovative new ones in the future, it's important as a country to retain and further

develop our knowledge, otherwise we will soon be 100% dependent on foreign countries. And sometimes you want to be able to change something about a submarine without anyone knowing." A Masterclass Submarine Design is not likely to feature on the list of courses in every other country. There are hardly any companies that provide open training. "You often come across them as part of a sales process for new submarines", says Albert.

> You will find more technology within every cubic metre in a submarine than in any other vehicle.

'Dive-boat' or 'under-sea-boat'?

For the readers, Albert and Marijn would first like to clear up a misunderstanding about the distinction between a 'duikboot' (dive-boat) and 'onderzeeboot' (under-sea-boat). In English, the word submarine is a collective word for both. A 'duikboot' is capable of submerging. It sails above the water and only heads down when danger is imminent or when in attack mode. An 'onderzeeboot' has been built to permanently sail underwater and carry out enemy attacks underwater. "Since the Second World War, we only see the latter," says Albert, "because the arrival of modern electronics has led to easy detection of a 'duikboot'. A submarine (onderzeeboot) can be invisible for a long time. You could compare a submarine to a space station, but then underwater. It's completely independent and seeks as little contact with the outside world as possible. This allows missions to be carried out in secret."

Complex design

Albert describes a submarine as a high-tech machine. "You will find more technology within every cubic metre in a submarine than in any other vehicle." A submarine is like a miniature village squeezed into a steel tube. From the design phase to the christening, the construction of a submarine takes just ten years. "We're talking about hundreds of thousands of components that have to be connected in exactly the right place and with each other in order to flow together into one system." And all this in a cylinder that can reach depths of hundreds of metres.

Albert Jurgens and Marijn Hage of Nevesbu

"The design work is therefore extremely complex", Marijn says with a smile. "There's a reason why we need four days to give the students of the masterclass an idea of what this involves."

Length

A submarine's purpose is to perform its mission without being seen or noticed. For instance, this may include activities such as keeping an eye on coastal and sailing routes, eavesdropping on connections and positioning special forces on land. The design must be adjusted to satisfy these requirements. Length and noise are very important factors. The larger a submarine, the better the living comfort inside, but the easier it is to detect. Living comfort is, therefore, at odds with safety. Furthermore, a large submarine can suffer deformation at depth or even implode. Albert: "A submarine will 'shrink' as it descends to greater depths. This is due to the increasing water pressure. I think you can comprehend how important it is that all the piping is capable of bending."

Noise

Noise increases the risk of detection. A submarine is certainly not silent. When the batteries are charging, the pumps and diesel engines produce a gentle hum. The propeller and the water that flows along the hull also produce noise. Likewise, opening the lids of the torpedo tubes. And yes, when a submarine has been submerged for quite some time, it must occasionally catch a breath of air with what is literally a kind of snorkel. Oxygen is needed to again run the diesel engines and, of course, the crew also appreciates a breath of fresh air. Marijn: "To avoid the situation that a submarine has to

suddenly resurface making a lot of noise during a secret mission, it's preferable that it can stay underwater for as long as possible. This is the reason why the batteries are becoming bigger, in combination with large diesel engines for charging." And yes, the longer it's underwater, the worse the air quality becomes. There are so-called 'scrubbers' on board that remove carbon dioxide from the air to keep it as pure as possible. In an emergency, so-called oxygen candles could also be utilised. These are canisters that produce oxygen based on a chemical reaction.

> It must be possible to disassemble every component so that each is able to pass through that 60-centimetre opening.

Fifty sweaty youngsters

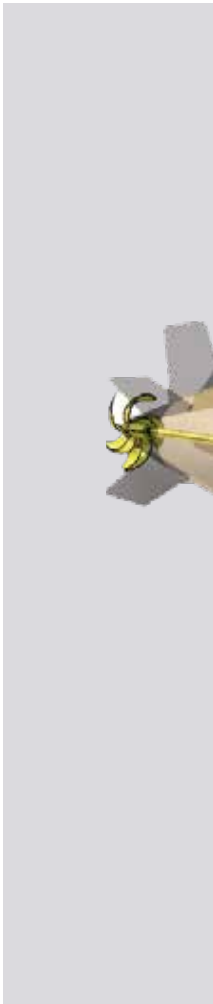
Living aboard is not exactly romantic. Albert: "Imagine the smell of fifty sweaty youngsters in a high school changing room." And having to put up with that for several months. You sleep with five other people in a bunk, a kind of cupboard built into the wall. The bed planks are stacked so closely together that you can hardly raise your knees. There is no such thing as privacy and annoyances can quickly escalate. For this reason, team building is extremely important because, during a mission, everybody must work together like a well-oiled machine. Every single person forms a part of the whole. Albert: "Every crew member must be extremely stable and social as well as able to live in a small cramped environment and cope with stressful situations." The chef plays an essential role in this. "Good food is one of the most important things when it comes to keeping the crew happy."

Modular construction set

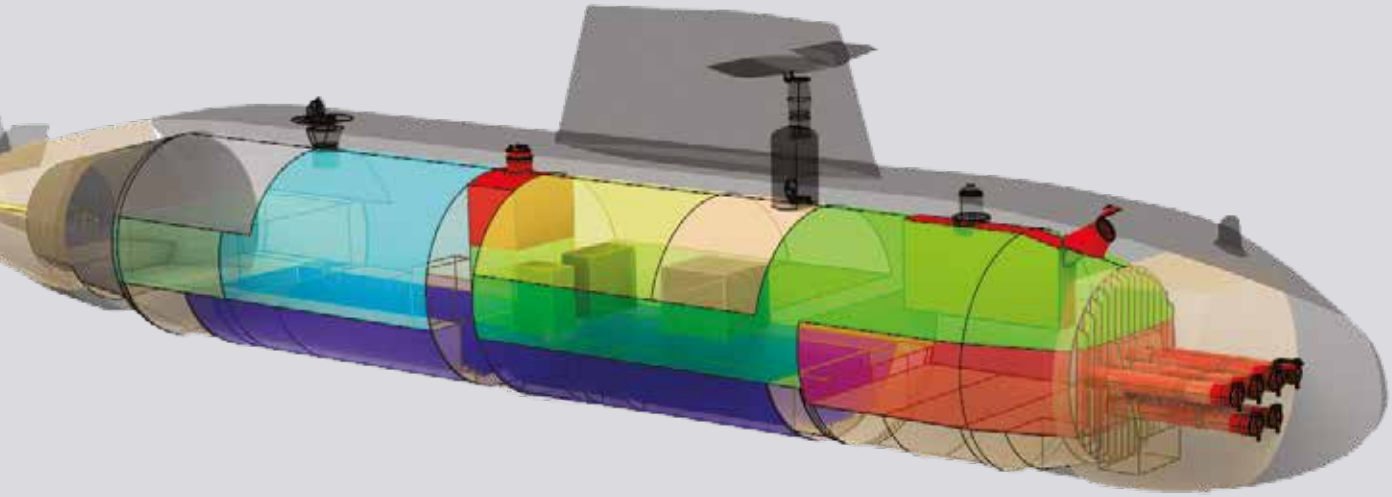
The four-day masterclass consists of elements such as energy, auxiliary & combat systems and hydrostatics & hydrodynamics. Of course, the masterclass students also get the chance to design a submarine of their own with the help of the 'Volume Estimation Tool' (VET), with which Marijn graduated from Nevesbu a few years ago as a naval architect. "When designing a submarine, it all revolves around achieving neutral buoyancy. An accurate estimation of the weight and volume of your design is also essential", says Marijn. The VET method is structured like a kind of construction set. Each module represents an element of a submarine: sleeping, living, fuel, working, energy generation, etcetera. "A more mixed crew, means that extra consideration must be given to privacy. The destination also determines the design, as different waters have different densities. For instance, the seawater around the equator has a different density to that in a Norwegian fjord. We are, therefore, increasingly adding to the set of requirements in order to gain insight into every piece of the puzzle. Either way, the submarine's centre of gravity must always be secured to prevent the submarine from pitching vertically. It needs to hover in the water."

60 centimetres

Marijn points towards the top of a submarine, to an opening of 60 centimetres wide. "Everything has to go through that", he says. "This means that it must be possible to disassemble every component. A new diesel engine enters the submarine in hundreds of pieces. This is what makes designing a submarine so fascinating. Everything you think of on the drawing board must be able to fit through that 60-centimetre opening."



“INSIGHT INTO EVERY PIECE OF THE PUZZLE”



WHAT MAKES IV SO SPECIAL?

Friendly and open culture
Iv feels like a family business: you can always drop by other colleagues to discuss your ideas. You receive a lot of freedom as well as room for entrepreneurship.

Down to earth
Instead of just following trends, we examine the content critically. We innovate because we really want to contribute to the world of tomorrow.

Unique projects
At Iv we work on projects that challenge us to push the boundaries of what is technically possible.

Work hard, play hard
We also think it's important to have fun with each other. That's why, for example, we attend the UEFA European Championship and FIFA World Cup.

Diversity
From infrastructure to submarines: we are the most diverse engineering company in the Netherlands.

A selection of our vacancies:

- Electrical engineer
- Lead naval architect
- Lead process engineer
- Senior instrumentation designer
- Senior mechanical & marine engineer

See all vacancies on
jobsativ.com

Erik Vegt, Director of Iv-Bouw

Proceeding together in high-quality utility construction

At the end of August 2019, Iv-Bouw acquired engineering company CAE. "A logical step", says Erik Vegt, Director of Iv-Bouw. "Iv-Bouw profiles itself in various sectors as a multidisciplinary engineering company in the field of construction and installation. We have many years of experience in the field of installation consultancy for data centres, care centres, educational institutions, transport companies, residential and utility construction. To substantiate multidisciplinary projects, we always worked together with our sister companies Iv-Industrie, Iv-Infra and Iv-Consult, with which we can also offer structural design. An excellent collaboration, though we would like to tackle entire projects all by ourselves. We were very interested in a possible acquisition when CAE approached us. The acquisition of CAE enables us to strengthen our knowledge in general construction and high-quality utility construction."

Working together

CAE has been around since 1986 and has a long history in the design and supervision of building constructions in complex residential and utility construction. Iv-Bouw and CAE have known each other for a long time and have previously worked together on projects such as the HAKA building, the sports park above the A4 motorway in Schiedam and the tender for the maintenance & repair building JSF (Joint Strike Fighter) Aircraft Engines. These were collaborations that always went well and whereby both parties complemented each other. With this acquisition, Iv-Bouw can now offer a total package of technical installation consultancy and structural design in the utility construction sector. A distinguishing factor compared to many other companies that often possess only one of the two specialisms.

> It's an enthusiastic, young team of people, with a number of experienced employees who coach and guide well.

Creating a good mix with more female engineers

Why does CAE fit Iv so well? Erik explains: "It's an enthusiastic, young team of people, with a number of experienced employees who coach and guide well. They are highly educated and ambitious people with a wealth of experience in a market that is similar to that in which we operate. They also

thrive on working on projects that really matter and like us at Iv, they have a real passion for technology. A good match! Furthermore, half of the CAE employees are women, which is quite special for an engineering company. We welcome a good mix of employees and are proud of this addition. I also think it is good for the atmosphere in the workplace." During the acquisition, Erik was given a pink construction helmet, symbolising the ladies of the company. "Marjolein Crone, former Director of CAE, had received this helmet as a symbol of the female influence in construction. She handed it over to me. I will certainly do my best to maintain diversity within the company. We are convinced that both CAE's customers and employees will benefit from this acquisition as it provides access to a wide variety of technical knowledge within Iv."

> As a consultant and designer and as a risk-bearing partner in Design & Construct projects we are an even more desirable partner for our customers.

The epicentre of technology

Iv-Bouw has also gained an office in Delft through this acquisition. Close to the epicentre of technology. "We consider our contact with the Technical Universities very important and are pleased with this new, well-placed office. Finding technical talent is difficult and this location provides opportunities to attract new people and to strengthen our relationship with TU Delft", says Erik.

Risk-bearing partner in D&C projects

In terms of what the future holds, Erik explains what the plans are: "By adding this strong construction department to Iv-Bouw, we are expanding our expertise, making us an even more desirable partner for our customers; as a consultant and designer and as a risk-bearing partner in D&C (Design & Construct) projects. The combination that we can offer in the tender phase for a structural engineering contractor is of great added value." In the utility construction sector, it is usually the structural engineering contractor who takes the lead in D&C requests. Since the installations are becoming an increasingly important part of the work, and the structural engineering contractor is generally unfamiliar with this kind of matter, the contractor already requires support from an installer or a consultancy company in the quotation phase. Given the impact that the construction and the installations have on the price and quality of the offer, it is important that the structural engineering contractor makes a wise choice in this. Erik: "As a risk-bearing partner, we enter into collaboration with the contractor and assume full responsibility for the design."

“CLOSE TO THE EPICENTRE OF TECHNOLOGY”

Impression of the project ‘Sportpark above the A4’

Source: municipality of Amsterdam

Utilising every square metre in the heart of Amsterdam

The city centre side of the entire width of the island where Amsterdam Central railway station is situated is to be completely renovated. Iv-Infra is responsible for the complete design coordination of project 'De Entree', including an underground bicycle parking facility. How do you convert all the separate plans into one integral design, while everyday life continues in this incredibly busy area? That's going to mean utilising every square metre as much as possible.

"How difficult can it be?" Were the first thoughts of Hans Geltink, Project Manager at Iv-Infra. "I've been used to working on projects involving kilometres of motorways such as the Schiphol-Amsterdam-Almere (SAA) road expansion, Rijkswaterstaat's largest road project. A project such as 'De Entree' is much less area in comparison. Yet it soon became apparent that a project in the heart of Amsterdam is much more complex because of the ever-changing environment. Very different from working on a motorway! On motorways, there's no tripping over cyclists, no tourists asking for directions to the 'red light district' and of course, no boats full of party animals cruising by when you step out of the site cabin." The project area on the centre-side of Amsterdam Central station is one of the busiest areas of the city. Everything comes together here: pedestrians, cyclists, trains, trams, the metro lines, buses, tour boats and coaches. Around 300,000 people come here every day and more than 1,300 tram journeys also depart from here daily. With more than 600 cables and pipelines, foundations and metro tubes, it's just as busy beneath the ground as it is above. The greatest challenge with the renewal of 'De Entree' is to piece together all the separate components within the whole and to effectively manage the many interfaces.

> Over time, much has been adjusted and changed which often means that the drawings available are no longer accurate.

Surprise-proof designs

The common thread throughout the entire design process for this project is to produce surprise-proof designs. Because the surrounding environment doesn't offer any leeway for improvisation, a 'fool-proof design' with proven solutions must be chosen. To prevent clashes during the implementation, every component of the project is designed in 3D and is subsequently 'virtually built' in a 4D BIM model.

Mapping the current environment

Given that every square metre of the area needs to be cleverly utilised, it's important to know exactly what the existing situation looks like to ensure that all the different components can be properly incorporated without clashing occurring. What exactly is where and what are the dimensions of all the elements in the given area? Over time, much has been adjusted and changed which often means that the drawings available are no longer accurate. For this reason, the entire project area was scanned at the very beginning. The bridges in the area have been adapted several times in recent years which is why the area data had to be adjusted. To be able to incorporate the integral design effectively into the existing structures, Iv-Infra has also visualised the bridges by means of 3D laser scanning from the water. "Besides mapping the project environment, we also needed to take into consideration that we too were a part of it", says Hans. "The site cabin is situated on a pontoon diagonally opposite the railway station. In the summer months, the door of the site cabin was often open, and tourists would just walk in. We had to hang a sign on the door reading: *no tourist information*."

> Designing the bicycle parking facility in 3D has also enabled us to verify the condition of existing structures, such as the posts under the adjacent bridges and the anchors of the existing quay.

The integral design

Iv-Infra is responsible for the entire integral design within this project. This includes the design of the ground level layout, the road infrastructure and the redevelopment of Stationsplein (Station Square), adjustments to the bridges and quays and the structural design of the new underground bicycle parking facility, the integration of the rail infrastructure, sewer systems, cables and pipelines, traffic control systems and the overhead tram lines.

Underground bicycle parking facility

The new bicycle parking facility, for around 7,000 bicycles, will be made of reinforced concrete and will largely be located below groundwater level between the Western Access Bridge and the Sint Nicolaas Bridge or Middle Access Bridge. The water level is NAP -0.40 m

Source: wUrck

(Normal Amsterdam Level) while the floor level of the bicycle parking facility is NAP -6.6 m, roughly six metres below groundwater level. The water pressure on the underside of the floor is equal to approximately seven tonnes per square metre and to keep the bicycle parking space positioned in place, roughly 1,100 anchor piles are needed under the floor. Before water can be pumped out, the construction pit will be provided with an underwater concrete floor. The Prins Hendrikkade forms the primary flood defence for the centre of Amsterdam, and this is where the new bicycle parking facility will be located. In consultation with the water board, the decision was made to keep the flood defence functionally and structurally separated from the bicycle parking facility. The replacement flood defence is to be implemented as an anchored sheet pile wall. From a construction point of view, this sheet pile wall is not part of the parking facility.

> A connecting tunnel will be realised between the bicycle parking facility and the metro hall below Stationsplein.

Thanks to this design solution, the construction of the bicycle parking facility does not have to be considered a part of the flood defence system and the granting of permits can also be simplified. In the construction phase, the replacement flood defence forms part of the construction pit. Designing the bicycle parking facility in 3D has also enabled us to verify the condition of existing structures, such as the posts under the adjacent bridges and the anchors of the existing quay. "Despite having a fully 3D design, surprises can still arise during

the implementation", says Hans. "We designed an adaptation to the floor of an existing concrete L-wall based on the collected area data. At least, that's what we thought. When the wall was excavated during the implementation, we didn't come across a floor. It turned out that in the past, the L-wall had already been replaced with a steel sheet pile wall."

> Iv-Infra has further developed the tram design in 3D to provide insight into any potential clashes with other elements in the area.

Tunnel

The topside of the roof of the bicycle parking facility will be approximately 2.5 metres below water level and the four mooring jetties will be placed on the roof. A connecting tunnel will be realised between the bicycle parking facility and the metro hall below Stationsplein. This tunnel will pass under the new tramline that will run from Stationsplein over the widening of the Sint Nicolaas Bridge. The tunnel is to be designed using a walls-roof construction method, whereby the roof will be realised first and later the tunnel underneath. The foundations of the tunnel will be made of steel and are designed in such a way that, should it be decided in the future to build the metro Oostlijn (East Line), removal will be fairly straight forward. Iv-Infra created the structural design for the bicycle parking facility. This involved close cooperation with Geo2 Engineering for the geotechnical design of the construction pit and the foundations of the entire project, and with wUrck, the party responsible for the architectural design of the bicycle parking facility. The main contractor, Max Bögl, will realise project 'De Entree' together with twelve partners. "It's very nice to work together with so many different parties as one team", says Hans. "We consult a lot with each other and coordinate everything, which has resulted in a good collaboration".

New tram infrastructure

The entire tram infrastructure will be renewed on Prins Hendrikkade and Stationsplein. This will include the rails, points, point management and overhead lines to the tram stops. A design had already been provided by the GVB for the alignment of the tram. This was the leading design for the road infrastructure. Iv-Infra has further developed the tram design in 3D to provide insight into any potential clashes with other elements in the area, thus allowing the design to be adjusted accordingly.

> The design was coordinated with the various interface parties during the elaboration of the final design.

Wider bridge

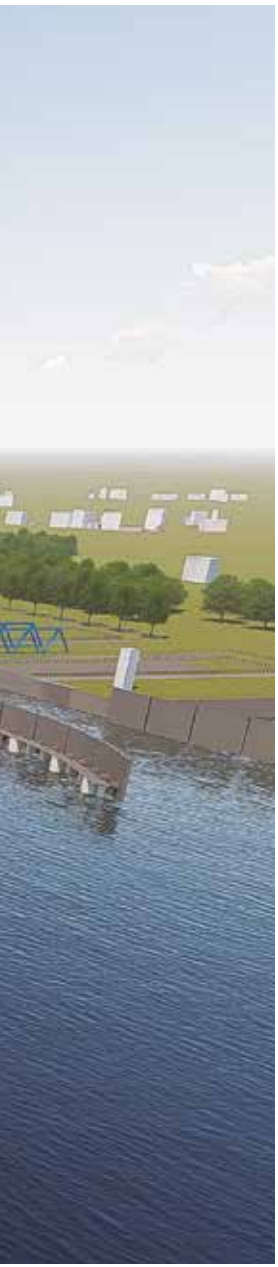
There are various bridges leading from Stationsplein to the city centre. The access bridge in the middle, at the height of the Victoria Hotel, will be widened. The existing access bridge is relatively slender. Given that the available construction height between the free space for navigational passage and the required height for the tramway construction on top of the widening is limited, precast prestressed concrete girders will be used for the widening. When finished, the widening will not be visible, and the passage height will remain the same. The advantage of using precast concrete is that a slenderer construction can be achieved in a shorter construction time, therefore also reducing the environmental hindrance.

Source: wUrck

Clash analysis requirements

Because of the many different disciplines and stakeholders involved in this project, interface management is the most important design task; for which a targeted approach was chosen. Together with the municipality of Amsterdam, clash analysis requirements have been established to realise the final design in a shorter space of time. All requirements have been critically considered and with the help of context diagrams, an inventory of the design interfaces has been prepared. Subsequently, the planning interfaces between the various design assignments were established during lean sessions. The design was coordinated with the various interface parties during the elaboration of the final design. Fixed control measures have been determined for the inventoried interfaces. The monitoring of this is integrated into the systems engineering tool within Relatics. Additionally, regular substantive coordination consultations have also taken place. The condition for the completion of the final design was the managing of all interfaces. This was guaranteed by internal reviews and clash control based on the combined 3D models in BIM. "During the current phase of the implementation design, we continuously test the partial designs against the integral final design", explains Hans. "This is how we ensure that the integrality of the entire project is guaranteed when the individual design tasks in the implementation design phase are further elaborated."

Source: Sassevaart (impression, no definitive design)



Lock complex Terneuzen: unique collaboration between Flemish and Dutch companies

"It's an extensive project, we have been working on it since 2016 and it has a number of interesting challenges", says Jeremy Augustijn, Senior Project Manager at Iv-Infra, about the new lock complex in Terneuzen.

Let's first dive into the history of the lock complex in Terneuzen. From the project organisation for the New Lock in Terneuzen, we have learnt that the Ghent-Terneuzen Canal was constructed between 1823 and 1825, which ensured a passage between the Western Schelde estuary (Westerschelde) and the port of Ghent. Two navigation locks were later constructed at Terneuzen. One of eight metres wide and the second of twelve metres wide. Over the years, the locks have been improved and enlarged a number of times. The current complex consists of three locks. The oldest, Middle Lock, was opened in 1910 and was last renovated in 1986. At the end of the 1960s, extensive work led to two new locks: the Eastern Lock (also known as the inland navigation lock) and the Western Lock (the sea lock). The Western Lock is the only lock that is suitable for larger sea-going vessels. This lock is 290 metres long, 40 metres wide and has a cill-level of 13.5 metres. At the very most, the Western Lock can take a limited-length Panamax vessel.

> The plan is that in 2022 the first ship will pass through the New Lock.

New Lock

The port areas of Ghent and Terneuzen are of great economic importance and the lock complex in Terneuzen provides access to these ports. The New Lock will ensure better access and a smoother connection from the Western Schelde estuary to the Ghent-Terneuzen Canal and beyond. With the arrival of the New Lock, which will replace the old Middle Lock, larger sea-going vessels of Neo Panamax size will be able to pass through. The capacity of the locks will also be increased, which will reduce the waiting time for inland vessels. The plan is that in 2022 the first ship will pass through the New Lock. The client is the Flemish-Dutch Scheldt Commission. Contractor combination Sassevaart (a collaboration between BAM, DEME, Van Laere and ENGIE), Iv-Infra's client, will design, construct and maintain the New Lock for two years. "It's very special that both the client and the contractor are a combination of

Flemish and Dutch parties", says Jeremy. "It creates a special vivacity, working with so many different companies and cultures."

> During the construction, a temporary passage canal has been constructed: the Kapitein Rooibos Canal.

Construct and maintain without hindrance

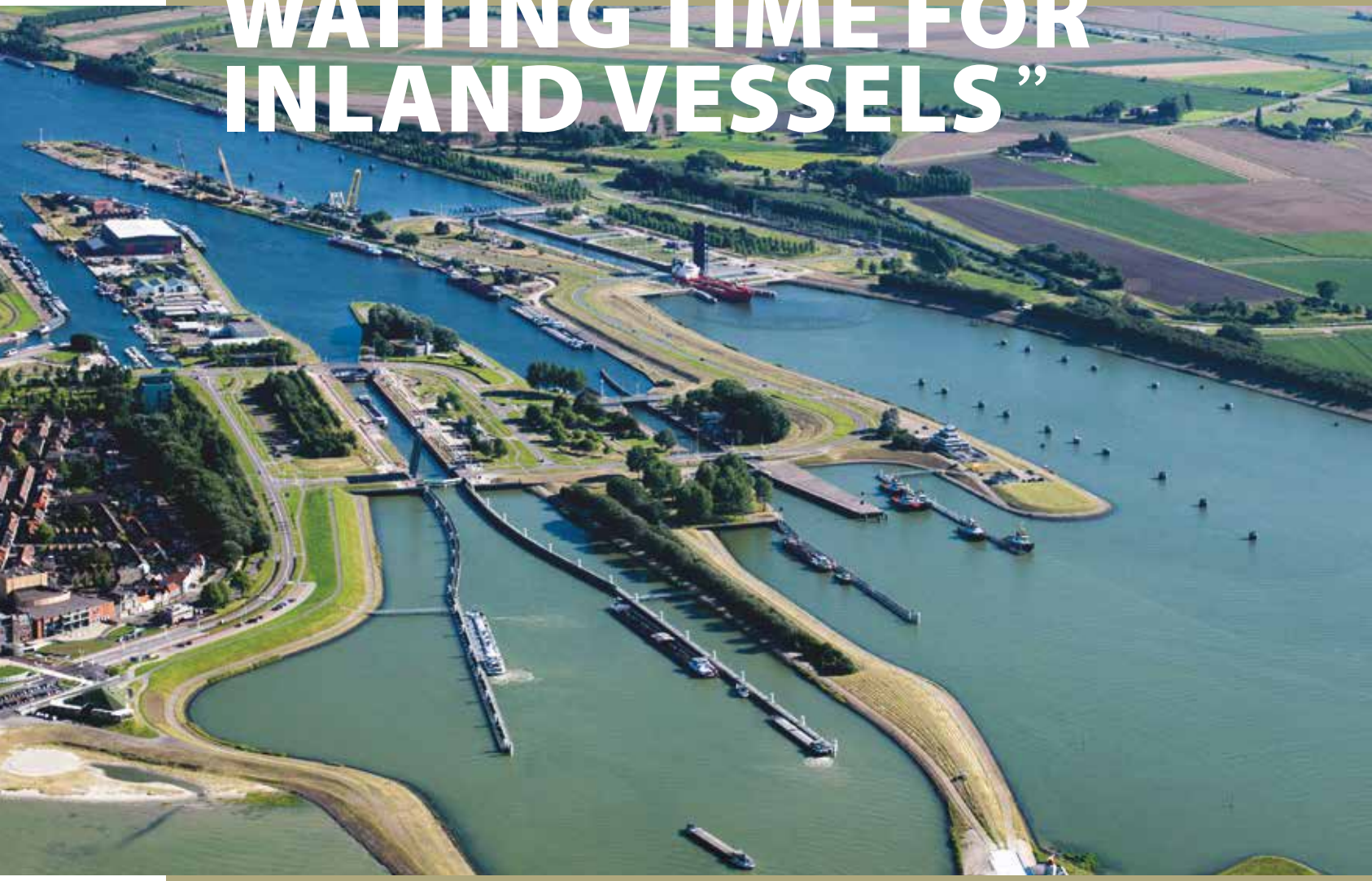
"Neighbouring countries, Belgium and the Netherlands, share several similarities but the differences in the way in which work is conducted makes an international project like this one very interesting. In the Netherlands for example, the functional specification is generally provided, and much is left to the market. The Belgian government prefers to outline everything as in a traditional specification. For example, they have been building lock gates for years, based on earlier designs, with minor improvements, adopted from experience", explains Jeremy. "To comply with the wishes set out by the tendering guidelines as much as possible, a combination of a construction method with the least possible inconvenience to inland navigation and the best possible maintainability of the complex were the main focuses. These were important EMVI criteria. Throughout the construction period, shipping and passage must continue as normal with as little hindrance as possible, and, of course, flood protection must be guaranteed in all phases. During the construction, a temporary passage canal has been constructed: the Kapitein Rooibos Canal. This will allow continued functionality of the current Middle Lock during the construction of the New Lock. To meet the strict requirements regarding maintenance, we will work with sustainable materials and allow for maintenance to take place with minimal hindrance for shipping and road traffic. The registration price is, of course, also important. To be able to make an offer as competitive as possible, the lock heads and the construction pits were compactly designed and the lock gates, only eight metres wide, are relatively narrow compared to those of comparable locks. In terms of strength this doesn't pose a problem, however, it does present challenges in the floating stability. Ballast has now been added to the underside of the gate to achieve sufficient floating stability when floating the gate for maintenance."

> The maintenance facilities consist of closure panels with which the gate recess can be converted into a dry dock.

Locks and levelling valves

In this project, Iv-Infra is responsible for the design of the four lock gates, the two bridges and levelling valves; everything including the operating mechanisms and maintenance facilities. The lock gates, a type of rolling gate, are rectangular steel constructions of 25 x 58 x 8 metres and weigh around 2,000 tonnes each. The gates are double-retaining and consist of two skin plates, with horizontal stiffeners on the outer side, a deck slab, a buoyancy tank and at the bottom, a horizontal truss frame. The outer ends of the gates are provided with vertical truss frame constructions. The lock gate is supported vertically on an upper trolley and a lower

“REDUCING THE WAITING TIME FOR INLAND VESSELS”



Aerial photo of the complex prior to construction

trolley, which run on rails in the chamber and in the lock head to open and close the gates. The upper trolley is connected to a winch system that is located in a cellar behind the lock gate. The gate is guided horizontally by means of six centrally positioned guide wheels. Under normal circumstances, these will provide a rolling guidance of the gate, but under extreme circumstances, such as the occurrence of large (vessel induced) waves, they will be pushed back in their suspension, leaving only sliding contact on the so-called overload blocks.

> The New Lock in Terneuzen will have dimensions with which Neo Panamax ships can be passed.

The maintenance facilities consist of closure panels with which the gate recess can be converted into a dry dock: suspension yokes for hanging the gate, a collision beam around the closure panels for protection in the event of a collision and a bicycle/pedestrian bridge over the gate recess.

The levelling valves (two sets of four and one reserve) are placed in the two levelling valve houses. The gates are approximately 3 x 6 metres and are equipped with wheels. The valve bears its horizontal forces through wheels that run over rails arranged in the designated slots. Hydraulic cylinders above ground level are responsible for driving the mechanism. The hydraulic and electrical installations are located in cellars above the levelling valve house.

Integral design

"The tender was in 2016 and we have been working on the designs since 2017. The technical design is complete, and we are now busy with the implementation phase", explains Jeremy. "A total of around twenty people from Iv worked on the project and in peak times around fifteen people at the same time. Our design team is part of a larger integral design team. Therefore, coordination is needed between all the different disciplines. Not only technical disciplines, such as geotechnics, hydraulics, civil engineering and mechanical engineering, but also the aspect disciplines such as management and maintenance, system integration, machine safety, cybersecurity, reliability/availability and work preparation. This requires a well-coordinated team, a clear organisation and consultation structure, and the necessary tools." For this project, it was decided to have the technical disciplines and aspect disciplines work together in a matrix organisation. The Relatics program includes all requirements, interfaces and risks that the designs must be tested against.

> Much still needs to be done before the first ship can pass through in three years' time.

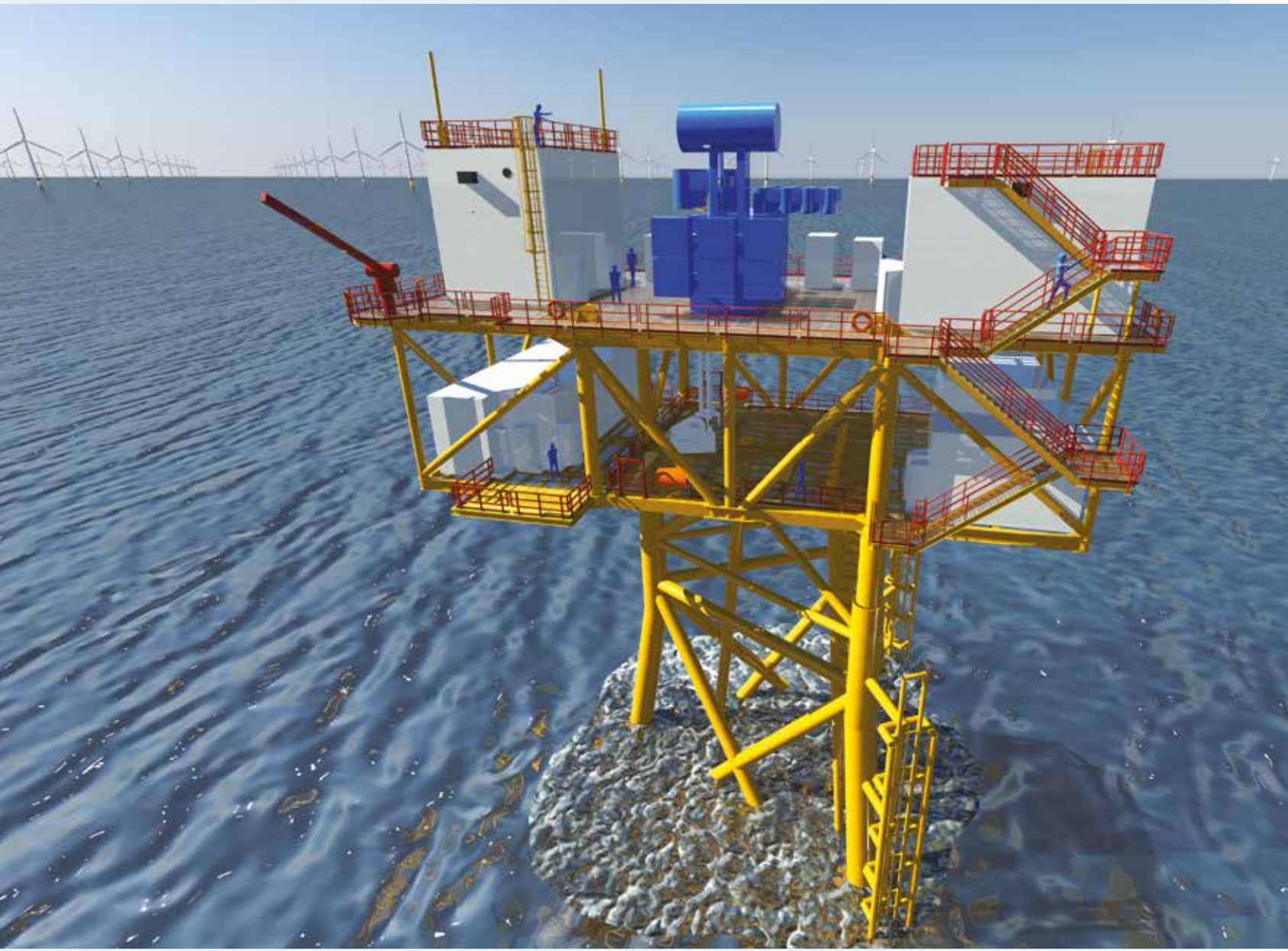
The New Lock in Terneuzen will have dimensions with which Neo Panamax ships can be passed. The lock will be 427 metres long, 55 metres wide and 16.44 metres deep. The chamber is to be the same size as the single lock chamber of the complex in the Panama

Canal, for which Iv also provided the design. "I was involved as a technical project manager in the Panama Canal project. It was a huge challenge and a proper world project! Not only in terms of size and international co-operation but mainly because of the strict requirements that were imposed on the design at the time. Was this again the case? It certainly is! Many of the requirements are comparable, but each project has its own specific details. The requirements are certainly just as strict, it's especially important in this project that during the realisation phase, the flood protection, availability for waterway traffic, the discharge capacity and the availability for road traffic are maintained. Again, a fantastic project of which we are pleased to be a part of."

Implementation in Terneuzen and China

The Kapitein Rooibos Canal (the temporary passage canal) is now in operation and the new lock plateau has been covered. The technical designs, steel and mechanical engineering are complete, and the gates and bridges are currently being constructed in China, under the supervision of the Sassevaart project team. When these are ready, they will be shipped to Terneuzen. Much still needs to be done before the first ship can pass through in three years' time. Jeremy looks forward to it: "We have worked on so many locks, but it's still a fantastic feeling when everything is finished, and it all works just as intended."

Aerial photo of the complex during construction. Source: Mario Vermeirssen – droneteam Rijkswaterstaat



Strength of the wind

Light, smart and comprised of individual modules. Iv-Offshore & Energy attracted attention with a new concept for an offshore HVAC substation platform, which is later to be found at thirty kilometres off the coast of Scotland and placed in the seabed at a depth of fifty metres.

Euphoria? "Well, it was certainly celebrated following our victory of winning this project for the British offshore wind farm *Neart Na Gaoithe*", say Fedor van Veen, Tender Manager, and Norman Hoogeveen, Project Manager at Iv-Offshore & Energy. Fedor: "We haven't ever received an offshore wind assignment from the UK before." That has now become a reality, and with a completely new concept.

Light, smart and simple

Norman: "Time and time again, we were hearing - certainly from the English market - that our designs were technically very good, but relatively heavy and expensive. Taking this into consideration, we set to work." The key question was: how can we make a light, smart and simple High Voltage Alternating Current (HVAC) platform? The solution: a transformer platform with only the minimum required auxiliary systems, built on a solid base structure that can be assembled with the help of less heavy and separate modules. Technically, exactly as the customer wishes.

Wikipedia page

The offshore wind farm already has its own Wikipedia page. 'Neart Na Gaoithe' (meaning 'strength of the wind' in Gaelic) has an area of 105 square metres, is thirty kilometres off the coast and fifty metres deep, located just north of the Scottish city of Torness. An additional challenge is that the wind farm must be built on a partly rocky and partly muddy seabed which is not a particularly easy location for constructing a wind farm. But that's how it works nowadays; there was still some space there. Because of the busy marine traffic, a large wind farm cannot simply be installed just anywhere in the North Sea. Furthermore, pipelines and electricity and internet cables have been run almost everywhere over the seabed.

Half a million households

In 2009, the initial idea for the wind farm was: 125 units of the 3.6 MW wind turbine or 75 units of the 6 MW wind turbine, which would collectively generate 420 to 450 megawatts of electricity. Enough to simultaneously supply half a million households with electricity. Eventually, the French EDF Group obtained the permit for the wind farm and issued a concept study for other parties, ultimately won by Iv-Offshore & Energy together with General Electric (GE).

"We first took a fresh look at the original design", says Fedor. "A consideration was whether we should opt for one or two transformer platforms. Two is more expensive, but on the other hand...if it's decided to build only one substation, for example, longer cables will be needed to connect all the wind turbines to the central platform. And those cables aren't exactly cheap either. For several reasons, EDF preferred the option of two smaller platforms with the lightest and simplest possible design", says Fedor. "After all, the lighter the platform, the cheaper and the easier it is to install. To put the platforms and wind turbines in place, a crane vessel must be reserved during the study phase, two years in advance. With the chosen concept, the turbine foundations and the platforms can be installed using the same ship, considerably limiting the contractual risk for the customer."

> A substation looks very much like a labyrinth of pipes and tubes.

The design

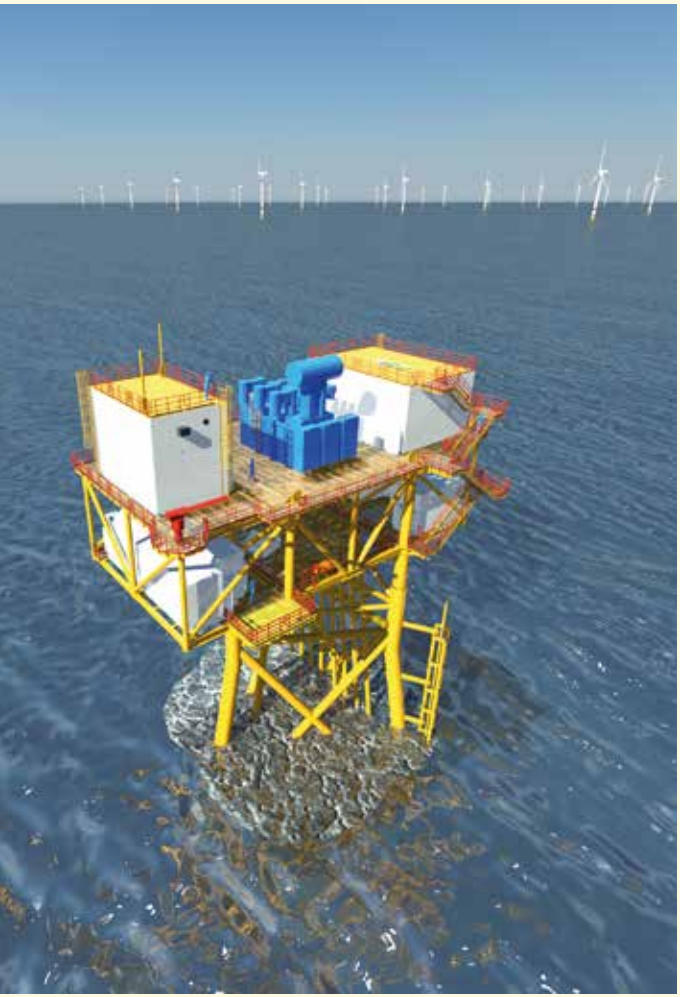
In the United Kingdom, it is the general rule of thumb that substations must be as simple as possible. They are purchased by the wind farm developer, who has the legal obligation to resell the substations to the Offshore Transmission Owner (OFTO), the party responsible for the transportation of the electricity. "This works differently in our country", says Norman. "Here, the net operator usually buys the platform, and then determines the operational and maintenance requirements." The difference can be seen in the design.

Iv-Offshore & Energy's design for the 'Neart Na Gaoithe' wind farm ultimately consists of 54 wind turbines, each generating 8 megawatts of electricity; quite different from the original idea. Wind turbines are becoming increasingly powerful. Electricity generated by the turbines is carried via sixteen subsea cables and will arrive at the two identical substations with a voltage of 66 kilovolts. Here, the electricity is 'collected' and converted to a voltage of 220 kilovolts to minimise transportation losses. This power is then transported to the onshore station via two (export) subsea cables. Extensive coordination is needed with the various involved parties (among which wind farm owner EDF and cabling contractors) for the installation of the necessary technical facilities at the substations, such as the laying and connecting of the subsea cables. A substation looks very much like a labyrinth of pipes and tubes. There are kilometres of electricity cables and electrical boxes full of wires and software that keep the primary process and all auxiliary systems (area heating and emergency power supplies) in the air.

> Construction of the 'Neart Na Gaoithe' platforms will start at the end of 2019.

HVAC or HVDC

The flexible plug & play concept that we are applying to the 'Neart Na Gaoithe' wind farm is particularly suitable for HVAC platforms. HVAC platforms are usually placed close to the coast due to high power losses when alternating current is transported offshore over a long distance. Since areas near the coast are gradually filling up, the need for High Voltage Direct Current (HVDC)



stations at sea continues to grow. There is still space available for wind farms there, but this requires larger and more expensive installations, both at sea and ashore. However, from approximately eighty kilometres off the coast, HVDC is the most economical solution.

In increasingly deeper water

Larger wind farms, with even larger and heavier wind turbines for generating more power, in ever deeper water. That's the trend. There are now eight offshore HVDC stations in use worldwide. Iv-Offshore & Energy was involved in the design of three of these substations: BorWin alpha, DolWin alpha and HelWin beta. "We're good at designing such complex platforms. This is partly due to our knowledge of offshore constructions and the multidisciplinary engineering experience we have accumulated in the oil and gas market", says Fedor.

Construction of the 'Neart Na Gaoithe' platforms will start at the end of 2019. This is when the first shipment of steel will arrive at HSM Offshore in Schiedam. Completion is scheduled to take place in 2021. An average of forty employees will be working on the design for more than a year and a number of Iv-Offshore & Energy employees will also be continuously present on site.


PROTEC

Recycling water to produce process water from condensate

"For a number of years now, Iv-Water has had substantial ambitions in the 'industrial water' market. This is why, among others, we have entered into a partnership with Industrielinqs", says Paul Kloet, Head of Department at Iv-Water. "On behalf of this partnership, David van Baarle, Chief Editor of Utilities, wrote an article for the trade magazine Utilities about the water recycling project at FrieslandCampina. This project, to which Iv-Water has contributed, is a good example of how 'circular thinking' offers opportunities, not only for achieving ambitions in sustainability but also where economic motives are concerned. In short: enough reason to also publish this article in this edition of Ivormatie."

In recent years, the FrieslandCampina site in Borculo has grown considerably. However, the company aspires to protect the environment and limit its water footprint. Experts from the company figured out that the discharged condensate could be relatively easily extracted from the steam installations and recycled into process water. Iv-Water was the designated coordinator of the entire project and supervised the process from tender to completion.

FrieslandCampina's growth seems unstoppable. The company was already one of the largest dairy co-operatives in the world, but after the milk quota was abolished in 2015, some of the member dairy farmers, through the co-operative of the same name as the owners of FrieslandCampina, went on to produce much more milk.

> More specifically, we want to save around three hundred thousand cubic metres of water per year at the production location in Borculo.

At the same time, the demand for infant nutrition in the Netherlands increased. The production location of the co-operative in Borculo has therefore expanded considerably in recent years. For example, the new baby powder production site was put into production in 2015 and the company has plans for a new production location for the mixing and packaging of milk powder. A down-side to the success of the company is that the local water footprint has increased considerably. The site in Borculo uses water for drying the raw material whey into milk powder and a lot of water is used for the cleaning of equipment. In the meantime,

water intake has become so great that it is strategically and socially desirable to limit this. To date, part of the return condensate is discharged to surface water. Gradually, the idea arose to reprocess this water into process water. Senior Project Manager, Sjoerd Hofstee of FrieslandCampina: "FrieslandCampina makes considerable investments in adapting its processes to be more sustainable. In terms of energy, we use here in Borculo, among other things, pyrolysis oil and biogas for steam generation. For water usage, our company-wide ambition is to use the same amount or less water per tonne of product as in 2010. More specifically, we want to save around three hundred thousand cubic metres of water per year at the production location in Borculo."

> We wanted to work with a party that could find the best solution for our specific demand in a technology-independent way.

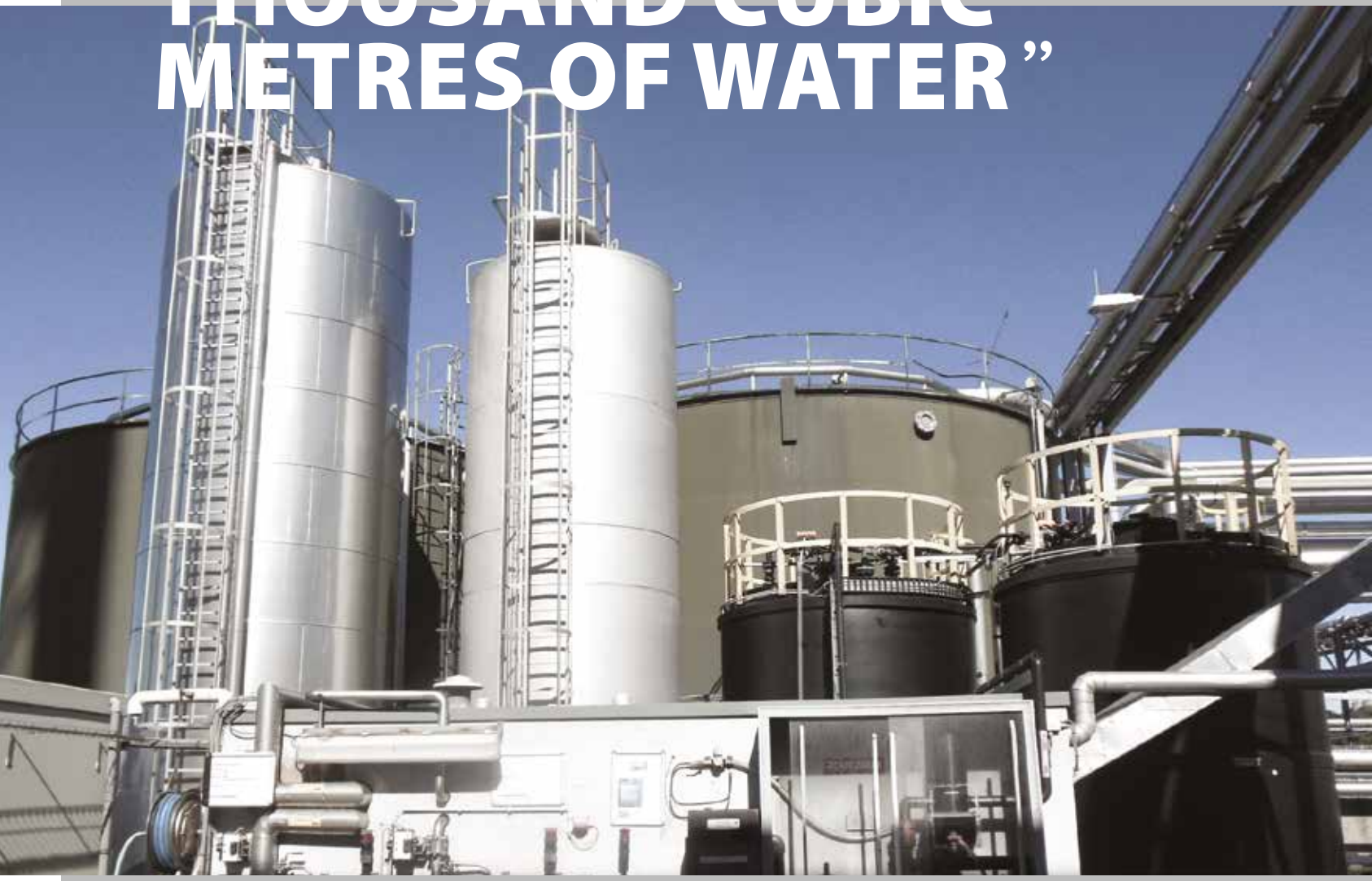
Black box

Sjoerd: "Here in Borculo, we extract fresh water from the subsurface flow and obtain drinking water from Vitens. However, there are limits to this. If we continue to grow in Borculo, we will reach the maximum permitted annual quantity of extracted groundwater. So, we needed to search for alternative water supply. Currently, we are using a large amount of water for steam production, which after releasing its heat, condenses and is returned. By processing this returned water, most of the condensate can be used again in the process. Despite the organic contaminants, the quality of this water is so good that with a limited number of purification steps we can again achieve water that is equal to that of drinking quality. We, therefore, decided to investigate whether we could turn this into a business case. Of course, we always critically consider the balance between economy and ecology, but from a strategic point of view, we calculate with lower margins and longer return on investment periods for sustainability projects." For the engineering, Sjoerd approached Iv-Groep: "The conductivity of the return water was the starting point for our search into the best technology for producing process water. We knew what the quality of the water was to start with, and the quality required for our processes. In our opinion, we needed a black box to get from quality A to quality B. The most complex part of this was the integration of a new installation into a site under development. We were therefore mainly looking for an engineering company that could lead the process from start to finish. Many of the well-known engineering companies in the water world are developing their own water purification technologies and concepts. The risky part of this is that these companies may unfoundedly opt for using their own technology. On the contrary, we wanted to work with a party that could find the best solution for our specific demand in a technology-independent way, could integrate this technically into the existing process and supervise the tendering and construction process. Iv-Water met these requirements."

Recycling water

Ronny Faasen, Project Manager at Iv-Water is responsible for this innovative water recycling project.

“SAVING THREE HUNDRED THOUSAND CUBIC METRES OF WATER”



"We released FrieslandCampina's request into the market and assessed the submissions on a number of quality criteria, whereby price was just as important", said Ronny. "As stated, FrieslandCampina uses flexible financial key figures for sustainability initiatives, but a good balance between price and quality had to be established. This didn't mean saving money on technology, but instead, save money by riding alongside a number of other projects that were running at the same time."

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Ultimately, Iv-Water, in consultation with FrieslandCampina, opted for the submission of RWB Water. RWB's suggestion was to first pass the water through an organic sludge on a carrier system, which will remove the first batch of organic contaminants. The remaining organic contaminants are then captured by a microfiltration system with ceramic membranes. Ceramic membranes are easier to clean chemically (without degrading their effect) than the polymer variants, and they also have a longer lifespan than polymer membranes. Finally, a reverse osmosis step follows, which removes salts and therefore lowers the conductivity. The water is now of the desired quality and is subsequently supplied to FrieslandCampina's piping system.

Clever combination

Ronny: "Iv-Water immediately began with the integration of a treatment plant on the FrieslandCampina site. For example, the return water pipeline had to be tapped and other pipelines also laid or diverted. As part of our EPC (Engineering, Procurement & Construction) role, we also supervise all the civil engineering for the installation, such as foundations and structures. Another good example of where sustainability and cost savings go together is the fact that we were able to reuse a building, which was released from another project, as new accommodation for the microfiltration system." The reverse osmosis installation is situated in another building that FrieslandCampina previously constructed for similar installations. "This multifunctional use of space again reduces project costs", says Ronny. Iv-Water also creatively adapted the project planning. Ronny: "We were able to ride alongside another, larger project that was in progress at approximately the same time. This allowed us to blend our work activities in such a way that the daily work of FrieslandCampina experienced as little inconvenience as possible. The planning of the larger project was leading for planning time slots for placing installations and connecting or integrating installations into the existing production environment."

> We have already taken a considerable step in reducing the water footprint, but more can still be done.

Success

The purification system is now in operation. Ronny: "In March we were able to transfer the installation to the operators of FrieslandCampina, with which we successfully completed a project of two years from the outset. These two years were from the initial idea to the handover. The actual construction time was much shorter. The majority of the installations were supplied as complete modules so that only the connections had to be performed on-site. And of course, adapting the piping required quite some time and knowledge of engineering." The water is still being used in applications whereby it doesn't come into direct contact with the product, such as the production of steam, cooling water for the cooling towers and for the iced water generator. But Sjoerd doesn't exclude the possibility that in the long term, other processes may also use this water. "The quality of the water is the same as that of drinking water", says Sjoerd. "I can imagine that in the long term, this water can be used more widely. The treatment plant is currently constructed at a capacity of fifty cubic metres of water per hour, but part of the return water is still being discharged. We could, therefore, in the long term, expand further with a second installation. There is enough space and because a proportion of the new pipes are already oversized, a second installation can easily be integrated. We have already taken a considerable step in reducing the water footprint, but more can still be done."

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