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BIG, BIGGER, BIGGEST
Iv-Groep
Engineering Company with a Passion for Technology
In our line of work, an important part of the challenge is being involved in big business.
Wanting to improve all the time is a very human trait. If you think about it, it’s quite strange really. We are apparently not easily satisfied with what we have or what we have achieved. It always has to be bigger or faster. It’s the essence of sport; setting records. That is precisely what makes sport so fantastic, yet the same applies to us personally. Runners always aspire to run their lap faster than the last time. It gives you an enormous kick if you keep beating your personal best. No matter whether you’re into running, cycling or golf, you will never forget that special day, like the one when you hit a hole in one.

We all encounter a push for improvement in most aspects of our private life, work life and in politics. Take Donald Trump for example, you would expect a wise and sensible man to be President of the United States, one who does not allow himself to be tempted by feelings of this kind. But I cannot think of anybody else who attaches so much value to ‘being the biggest’. Examples of just how much he wants to be the best is what seems to be the attraction of most of the visitors to his inauguration, such as owning the largest tower (Trump Tower, of course), being the richest of the rich and having the world’s most beautiful women around him. Should we regard this as pitiful, or simply a very human trait? Perhaps we are looking here at a truly very ‘human’ president. Is that actually the basis of his success?

These thoughts came to my mind when I was asked to write the foreword for this Ivormatie with the subject of big, bigger, biggest. In our line of work, an important part of the challenge is being involved in big business. The biggest wind farm, the tallest hangar, the largest sea lock, the biggest tower and the biggest ship: you can read about all of these projects in this edition of Ivormatie. So close to the time when we all go on holiday, I would like to wish you all a great time, make something big of it.

Rob van de Waal
Managing Director, Iv-Groep
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SURROUNDED BY GIGANTIC AIRCRAFT AND AIRCRAFT COMPONENTS
KLM Royal Dutch Airlines was established in 1919. Today, KLM is the world’s oldest international airline still operating under its original name. The airline took an enormous step in 2004 when it merged with Air France and became part of the Air France-KLM group. Although the companies cooperate closely with each other, KLM continues to fly all over the world under its own well established Dutch name. KLM Engineering & Maintenance is the part of KLM that maintains the company's aircraft. At Amsterdam’s Schiphol Airport, KLM E&M offers the entire maintenance process, ranging from pre-flight checks at Schiphol Centre through to regular maintenance checks in the hangars at Schiphol-East. KLM E&M also maintains and repairs engines and components.

Ivormatie Magazine went to see project leader Don de Jong of Iv-Industrie to learn about the kind of work Iv carried out for KLM E&M when stripping and cleaning a bay in Hangar 14.
Don, we are standing in a gigantic hangar. When we came in, the first thing we saw was a Boeing 747. Where exactly are we?

We're at Schiphol-East. This is the site of the old Schiphol Airport. We're in Hangar 14. This was built in the early 1990s and consists of three different bays, each measuring 80 metres wide, 100 metres deep and 30 metres high.

As you saw when we entered, bays 1 and 2 are performing maintenance on different aircraft. A thorough service (called a C check) is a type of scheduled maintenance for aircraft prescribed by the engineering department of KLM and the manufacturer, that must be carried out after a certain number of flying hours and/or landings. Bay 3, which is where we are now, was an aircraft decoration bay until recently.

What happens in an aircraft decoration bay?

Roughly 850 aircraft have been painted, coated and/or given various decorations here. But KLM E&M stopped decorating aircraft in this hangar in July 2016. Due to changed market conditions, it was no longer in line with KLM E&M’s vision of the future.

You might be interested to know that the final aircraft sprayed here was a KLM Boeing 777. It was completed in June last year, especially for the Olympic Games. For one time only, some of the KLM blue made way for a touch of orange. This Boeing 777 is used for scheduled flights and for events to promote the Netherlands. To paint this plane it took 335 litres of paint, 100 rolls of painter’s tape and 1000 metres of protective plastic. If you look around now you won’t see a trace of this anymore.

We're in an empty hangar right now. So what exactly happened here over the past year?

KLM E&M stopped spraying aircraft. The decoration bay had to be made ready for future use. KLM E&M asked Iv-Industrie to write the specifications and to oversee the project. Iv-Industrie worked on removing the electrical installations (lighting) and media connections (compressed air), and on cleaning the bay. Various cranes equipped with teleplatforms used to be suspended from the roof of the bay. The platforms could be moved in all kinds of positions to enable the sprayers to work on all the different sections of an aircraft.
An aircraft obviously extends a long way up from its wheels and without cranes it would be impossible or difficult to reach certain parts. The teleplatforms and the suspension system were completely dismantled. The same goes for the technical installations.

From October to mid-December 2016, a total of 300 tons of steel were disassembled and removed from the bay. It was a lot of hard work for two-and-a-half months. The end-result was that the bay was handed over at the agreed time.

What will the function of this hangar be in the future?
The intention is to move the external logistics center to this empty space and thereby realise the new central warehouse of Component Services. Here, airplane parts of many aircraft types for KLM and its external customers will be stored in high-rise warehouses. Bay 3 has ample space for this because it’s 30 metres high. The official opening of the cleaned bay was on 23 December 2016. The key was formally handed over to Component Services by Airframe (the part of the company responsible for aircraft maintenance). Repurposing this bay fits in well with the company’s sustainability ambitions and also helps to reduce the distance between sites as well as the number of locations, enabling Component Services to improve the efficiency of its processes.

Why did they need an engineering firm for this project?
What does KLM E&M do well? The maintenance of aircraft, engines and aircraft components. Stripping and cleaning a place like this involves all kinds of aspects that KLM E&M does not usually do on a daily basis. An engineering firm like Iv-Industrie possesses thorough knowledge of market players that can take on such a project, and is highly experienced in managing projects of this kind.

Why did KLM E&M choose Iv-Industrie?
Iv-Industrie has a reputation of being a result-focused company and this was an important reason for KLM E&M to choose Iv-Industrie. KLM E&M wanted everything to be arranged properly without any problems arising; a good timing and within budget are key. They were looking for a company with a single point of contact that would make sure the right people came on board.

At Iv-Industrie we have many years of experience with similar projects, and for different kinds of specialised knowledge we can draw on the experience of our sister companies. For example, bay 3 was completely scanned for this project by colleagues at Iv-Infra using terrestrial 3D laser scanning allowing an accurate starting position to be put onto paper. Additionally, our colleagues at Iv-Consult, the part of Iv-Groep that specialises in steel and mechanical engineering, are currently working on the maintenance of the gigantic doors of Hangar 14.

How do you look back on the bay 3 dismantling project?
It has been a highly positive experience and I’m very pleased with how it turned out. KLM E&M and Iv-Industrie are both satisfied with how the project went and with the ultimate result. We were able to carry out an exciting project and completed it by the agreed time to everybody’s complete satisfaction.

What is it like to work for a client like KLM E&M?
We have several large clients, but KLM E&M is definitely a very prominent one. I always get a smile on my face from working between gigantic aircraft and aircraft components. Also, all
the projects that we have carried out and are carrying out for KLM E&M are challenging from an engineering point of view. What’s more, a brand like KLM E&M obviously imposes stringent requirements. Everything has to be done in a controlled manner and making mistakes is simply not an option. We really enjoy working with a client that attaches so much importance to quality.

KLM E&M really gives you the feeling that we are all in this together and you quickly become one of the team and are made to feel welcome every time. I think that’s important. You’re meant to achieve something through your work but it’s also important to enjoy it, otherwise it becomes very difficult to reach your goals. All in all, KLM E&M is such a great client to work for.

'We really enjoy working with a client that attaches so much importance to quality'
PIONEERING SPIRIT IN FULL SWING
The first successful high seas lift has already been carried out with the lifting system for offshore platforms aboard the Pioneering Spirit. In August 2016, the ship launched the first tests at sea. And successfully, which led the Pioneering Spirit to Norway where the 13,500-tonne Yme mobile offshore production platform was dismantled. Less then a year later, Shell’s Brent-Delta platform was delivered back to land. Never before was such a large platform removed by one ship. The 24,000-tonne topside of the platform was lifted at the end of April 2017; it took only ten seconds to completely lift the platform. A world record in the field of lifts!
The Pioneering Spirit is a unique ship from Allseas. Allseas is a Swiss offshore company with an engineering and project management office in Delft and is one of the world's largest companies in the field of installation of offshore pipelines and associated subsea constructions. The Pioneering Spirit is the largest ship in the world. Its dimensions are as big as two super tankers and in area equal to eight football pitches. In addition to installing and removing topsides and substructures of large offshore platforms in one piece, the vessel is also deployed to install large pipelines for oil and gas transportation. In close cooperation with Allseas, Iv-Consult has been working on Allseas' test platform and the Tilting Lift Beams design of the Jacket Lift System (JLS). Iv-Consult has also been involved in the design of the Stinger. Project Manager Michael de Zwart calls the design of the JLS 'special.' 'It's purely about research and development; when everything is new it makes it challenging and unique! Cooperation between Iv-Consult and Allseas was crucial, and was successful! We worked hard with a team from different disciplines.'

A new life for the test platform
For the installation and removal of offshore energy or production platforms and topsides, Allseas' vessel Pioneering Spirit is equipped with the Topside Lift System (TLS). Iv-Consult worked on the design and engineering of the removable steel test platform, consisting of a jacket substructure on suction caissons and a separate steel topside with water ballast.

For testing the functionality of the TLS beams Iv-Consult designed two structures. The first structure is a full scale single beam steel foundation at the Keppel Verolme yard in the Botlek in Rotterdam for testing on shore. The foundation was similar to the rail support system used on the Pioneering Spirit. The second structure is the already referred to test platform for testing the TLS beams following installation on board of the Pioneering Spirit. 'A test installation design for such a complex ship is not easy,' says Lead Engineer Jan de Graaf. 'Up until the very last moment, the design and operation have been adjusted and optimised. I really like the last minute quick switches!'

The TLS consists of 2 sets of 8 retractable, motion compensated lifting units that are installed on both bows of the vessel. Together, the 16 beams are able to support, lift and install platforms up to 48,000 tons of weight in one single lift. Both the systems' operational speed and the bearing load are unique; the motion compensated system because it allows working during short periods with bad weather and the bearing load as it reduces the risk of having to cut heavy platforms into smaller, lighter pieces.

After completion of harbour and offshore trials with the topside in the beginning of August 2016, Pioneering Spirit successfully fulfilled her first real jobs with the TLS: the removal of Repsol's Yme MOPU platform and removal of Shell's Brent Delta platform topside. But these successes do not mean the end for the test platform: After all, from every operational effort, new experience is gained and the need for updating and testing of the system remains. Therefore in the beginning of May 2017 the test platform was reinstalled again at the original location in the North Sea. There it will stay in function until 2019 or 2020 waiting for the Pioneering Spirit to do her testing activities with the TLS.

Much bigger than we think
If we think of a test model, we think of a small model that is by no means large. The test platform, on the other hand, is of a very different category. Think of big, bigger, and biggest. The 60 metres length of the Allseas test platform is comparable to a building of almost 17 floors.
The function of the test platform is to work as a platform mule for the TLS system to simulate real life (de-)installation scenarios. Special feature is that the jacket substructure and topside of the platform are assembled from parts of an existing N.W. Hutton Field production platform (build in 1980). The original structure was divided in a midsection and two equal end sections. The midsection formed the basis of the topside; the end sections were twisted, welded together and extended with a newly designed steel structure to form the basis for the jacket substructure. Michael: ‘The test platform is also very durable. After all, tons of steel have been reused from other platforms and buoyancy tanks that would otherwise be disregarded.’

On top of the topside platform four buoyancy tanks, filled with water, are mounted that are used for ballast and testing weight. For the (de-)installation of lifting equipment and the operation of the ballast tanks, (boat) platforms and ladders are attached to the legs, between the topside platform box girders and on top of the tanks. Yoke connection provisions are designed below the outer parts of the box girders and leg meeting units (LMUs) are integrated in the lower part of the legs to form the connection with the supporting jacket substructure.
Beams of the Jacket Lift System similar to the Euromast

One of the main contributions of Iv-Consult in its collaboration with Allseas for the Pioneer Spirit consists of the construction design of the Jacket Lift System (JLS), including all connectors for external interfaces. In addition to the levers, Iv-Consult was also involved in the design of the tailpiece. Each beam of the Jacket Lift System has a length comparable to the height of the Euromast in Rotterdam. Iv-Consult has gained its rich experience through design of specialised and innovative constructions. For the design activities, a comprehensive automated BIM environment has been created, showing all links with third parties. The BIM environment is used for clash checks, optimisation of structures, routing of electrical systems, instrumentation and maintenance and manufacturing processes. It always shows the latest information. As a result, the whole process functions more efficiently.

Stinger

From the beginning, Iv-Consult was also involved in developing the stinger. Allseas implemented the design and Iv-Consult played a role in producing the detailed design as well as of certain parts of the stinger. The drawings were carried out at the Allseas offices in cooperation with Allseas engineers. The stinger has an overall length of approximately 140 metres and consists of three sections, each with a length of around 50 metres. The stinger sections can hinge in relation to each other to create a rough curve (polygon). Five or six roller boxes are fitted to each section of the stinger. Each roller box is individually adjustable in height. This enables the required pipe curve to be created.

Length of each beam of the JLS is comparable to the height of the Euromast
The stinger must be accessible at all times for settings, inspections and maintenance, even on the open sea. This required the fitting of large numbers of stairs, ladders and walkways in order to reach all points safely.

The Pioneering Spirit can continue working even in heavy weather, with the stinger extending far in front of the ship below the water line. The stinger and the walkways on it are capable of withstanding the large hydrodynamic loads that occur under these conditions. These accesses were developed by Iv-Consult in close consultation with Allseas. Iv-Consult used the Inventor software program at its Papendrecht office to work out the detailed designs for many of the accesses.

**Ins and outs of the Pioneering Spirit**

The twin-hulled vessel is 382 metres long and 124 metres wide. At the bow is a slot, 122 metres long and 59 metres wide, that enables Pioneering Spirit to straddle a platform and remove entire topsides (up to 48,000 tonnes) in a single lift using eight sets of horizontal lifting beams. Two tilting lift beams for the installation and removal of jackets (up to 25,000 tonnes) will be located at the vessel’s stern. Complementing the lifting systems is a 5000 tonnes special purpose crane for additional lifts such as lighter topsides and jackets, modules and bridges.

As a result of her unique lifting capacity, Pioneering Spirit will significantly reduce the amount of offshore work associated with platform installation or decommissioning, largely moving this work to shore, where it is cheaper, safer and more environmentally friendly.

**Iron Lady and Bumblebee aboard the Pioneering Spirit**

Ever heard of the Iron Lady and Bumblebee? Both can be found aboard the Pioneering Spirit. Of course, this is not about former British Prime Minister Margaret Thatcher nor is it about the popular character from the hit movie Transformers. Iron Lady and Bumblebee are two large pontoons especially built for the transfer of jackets and topsides to and from the Pioneering Spirit. Iron Lady (200 metres long and 57 metres wide with its relatively shallow draught will enable loading and unloading of structures to and from the yard when the water depth at the quayside is insufficient for the Pioneering Spirit. The transfer of structures between Pioneering Spirit and Iron Lady will take place in sheltered water close to the yard. When the Pioneering Spirit is deployed to place or remove topsides from platforms, the stinger is removed from the bow section and brought on board the Bumblebee, a pontoon especially built for this purpose.
UNIQUE OPERATIONAL ADVANTAGE
Escher was awarded a contract for the design and delivery of five flares for the Liwa Plastics Industries Complex (LPIC) project in Suhar, the Sultanate of Oman. 'We are proud that we have won this contract and that we can be a part of this prestigious project,' says Hans Mark Bunschoten, Managing Director at Escher. 'Our track record of more than 50 years with derrick supported flare systems contributed to a competitive design and thanks to this design, we have secured this project.' He added.
The flares to be designed and delivered will be supported by two derrick structures. Three of the flares will be supported by one common derrick structure with a height of 170 metres while the other two flares will be supported by one common derrick structure with a height of 100 metres. Each derrick is equipped with a (multiple) retractable gas riser system. This system offers a unique operational advantage allowing one flare tip or riser to be removed for maintenance or inspection while the other flares remain in operation.

**About Liwa Plastics Industries Complex (LPIC) project**

LPIC is a project designed to process light ends by way of steam cracking, a type of thermal cracking achieved at very high temperatures. The light ends originate from Orphics’s refinery in Sohar and the aromatics production location. Additionally, natural gas liquids (NGLs) extracted from currently available natural gas supplies are optimised. The concept is concentrated on rerouting elements of existing production in combination with additional raw materials in order to deliver high value polymer products for the local and international markets. Following completion of LPIC, plastics production will have increased by one million tonnes, giving Orpic a total of 1.4 million tonnes of polyethylene and polypropylene production by 2019.

**About Orpic**

Orpic (Oman Oil Refineries and Petroleum Industries Company SAOC) is one of Oman’s largest companies and one of the most rapidly growing businesses in the Middle East oil industry. Orpic’s Refineries in Sohar and Muscat (together with the Aromatics and Polypropylene Plants in Sohar) provide Oman and the rest of the world with fuel, chemicals, plastics, and other petroleum products. To continue to meet the needs of Oman, and the international markets, Orpic is undertaking three strategic growth projects known as: Muscat Sohar Product Pipeline (MSPP - 2017), Sohar Refinery Improvement Project (SRIP - 2016) and Liwa Plastics Industries Complex (LPIC - 2020). In alignment with the company’s strategy, these projects will add value to the Oil and Gas resources of Oman.
Borssele
Hollandse Kust (zuid)
Hollandse Kust (noord)
TenneT has taken on HSM Offshore and Iv-Oil & Gas for the Borssele Alpha offshore transformer station: a model of Dutch ingenuity.

The Dutch Government is pressing ahead on building five offshore wind farms that will rank among the largest in the world, with major cost reductions being achieved step-by-step. Not only is this good for the transition to renewable energy, but also for the energy bills of residential and business consumers, as well as the Dutch economy.
The development of offshore wind farms has already created around 4,000 jobs in production, construction and research. The figure is expected to increase to 10,000 jobs in 2020. The first wind farm, currently under construction, is Borssele. The farm consists of two parts, Borssele sites I and II, and Borssele sites III and IV. Together, the two wind farms have the capacity to generate 1,400 megawatts of green energy, enough to supply electricity to two million households. After construction of Borssele, three more wind farms, each with a capacity of 700 megawatts, will follow in the coming years off the coast of North and South Holland provinces. The five farms will jointly supply a total of 3,500 megawatts of energy, sufficient for more than five million households. This will make a significant contribution to attainment of the target laid down in the Energy Agreement to generate 16% renewable energy by 2023. In terms of size, this is a unique project.

Sites I and II of the Borssele wind energy zone have been awarded to DONG Energy Borssele 1 B.V. and sites III and IV to Blauwwind II c.v., a consortium consisting of Eneco, Diamond Generation Europe (a wholly-owned subsidiary of Mitsubishi), Shell and Van Oord. These companies are responsible for generating the energy and transmitting it up to the offshore HVAC transformer substation. TenneT is responsible for the offshore grid connection.

**Offshore grid connection**

To be able to transport the generated electricity from sea to land as efficiently as possible, it is necessary to use the highest possible voltage. The purpose of the offshore HVAC transformer substation is to collect the energy generated by the wind turbines and convert it to the highest possible voltage in a safe manner, enabling transmission of the electricity to the shore as economically as possible.

TenneT is responsible for the offshore grid connection. The Borssele Offshore Grid consists of two HVAC transformer substations yet to be built (called Alpha and Beta), which will be located near the wind farms. Each platform will operate two sites with wind turbines and supply 700 megawatts via two 220 kV export cables (AC, or alternating current). In total there will be four 220 kV cables with a diameter of 250 millimetres that will run via the Western Scheldt to land over a distance of 61 kilometres. They will land close to the existing Borssele high-voltage substation. At the onshore station, the voltage will be increased from 220 kV to the 380 kV of the national high-voltage grid. The onshore station will be enlarged by creating extra space for the transformers to convert 220 kV to 380 kV. Via the national 380 kV high-voltage grid, the wind energy will find its way to Dutch households and companies.
At the start of 2017, TenneT TSO b.v. awarded the EPCI contract for construction of the Borssele Alpha offshore transformer substation to HSM Offshore, with the intention of also awarding Borssele Beta. The contract provides for the design, procurement, construction, transport, installation and commissioning of the platform. HSM has contracted Iv-Oil & Gas to design the platform, handle all procurement, and integrate the high-voltage components supplied by TenneT and all balance-of-plant materials. Iv-Oil & Gas will also be HSM’s partner in the commissioning phase of the project. Integration of the high-voltage components is an important part of the overall project. Joulz is involved as a high-voltage specialist. Iv-Oil & Gas has worked with HSM on numerous platform projects in recent years. The two companies cooperated in 2002 on their first offshore substation for Horns Rev A in Denmark. Now, more than 15 years later, the two companies have established an exceptional track record when it comes to offshore substations. The superb construction quality of the offshore structures by HSM supplemented by the exceptional technical knowledge of offshore steel by Iv-Oil & Gas results in a model of Dutch ingenuity when applied to projects of this scale. This, we may be very proud of.

Borssele Alpha offshore transformer substation

The topside of Borssele Alpha is made up of four decks, each one half the size of a football pitch (58 metres × 32 metres), and extends 25 metres upwards. The topside will weigh approximately 3,800 tons. It is like a gigantic power outlet. The topside will be placed on a jacket weighing 2,900 tonnes with skirt pile foundation in water 30 metres deep. The platform will be provided with equipment of wind farm owner DONG and of the Directorate-General of Public Works and Water Management (Rijkswaterstaat) for the purpose of regulatory enforcement.

The project officially got underway in February 2017. Installation of the jacket is scheduled for the third quarter of 2018 and transfer of the entire platform has been planned for the third quarter of 2019, after which TenneT will put the substation into service. A tight project lead time requires experienced companies, short lines of communication, good collaboration and fast decision-making. For that reason, the entire project team is based at a single location so as to work alongside each other on the project.
Stringent requirements for availability and reliability
From an engineering point of view, the stringent availability and reliability requirements laid down by TenneT represent the biggest challenge in the project. TenneT requires availability of 99.964% of the grid connection. In practical terms, this means that the unmanned transformer substation may not be out of service for more than 3.15 hours per year. Besides the obvious financial consequences of unavailability, an important goal of TenneT is to put wind firmly on the map as a reliable source of energy. The substation will be certificated entirely by DNV GL in respect of three parts, namely the topside, the jacket and the foundation.

Wind as a reliable energy source

A single standard for the five new Dutch wind farms
Borssele Alpha is the first offshore transformer substation to be designed and constructed according to the standard defined by TenneT for the five transformer substations for the new offshore wind farms in the Netherlands. TenneT is building five identical substations. Worldwide expertise was brought together and has resulted in a unique AC transmission system, in which all knowledge currently available has been applied. It has been designed in a way that will make a maximum contribution to lowering the costs of offshore wind energy, with minimal impact on the environment. A ‘lean and mean’ approach was adopted. This standardisation will substantially reduce the development, construction and maintenance costs. The optimum scale has been set at 700 megawatts. The turbines will be connected directly to the TenneT platform, so in total fewer platforms will be needed. Two cables will connect the platform to the onshore grid.
Offshore substations

As wind farms in the Netherlands and Belgium are located relatively close to the coast, the energy does not need to be converted to direct current, using an HVDC converter substation. Examples are the Iv-Oil & Gas-designed DolWin Alpha HVDC converter substation and the HelWin Beta HVDC converter substation located in the German part of the North Sea. An HVDC converter substation converts alternating current to direct current. The direct current is then carried by cables to an onshore station that converts the direct current back to alternating current. The conversion process minimises the loss of energy during transmission of electricity from offshore wind farms to land. However, the Borssele wind farm is located so close to land that a HVDC connection is not necessary (which is also more expensive).

Another cable will connect two platforms in a single wind zone to maximise security of supply. A permanent backup diesel generator will not be necessary on the platform now, and this again reduces platform operating costs. These are the first substations in the world with a connected voltage of 66 kV instead of 33 kV. This means that less cable is necessary and less energy will be lost. Iv-Oil & Gas is proud to work on the first phase of these five offshore transformer substations.
The Lidl supermarket chain is known for its sustainable approach in the field of supermarket buildings and distribution centres. In 2016, Lidl opened its sixth distribution centre in Waddinxveen, The Netherlands. This new distribution centre has obtained the highest BREEAM-NL sustainability score of 'Outstanding'. But Lidl doesn't stop here, by the end of 2017; the first foundations will be laid for a seventh distribution centre in Overbetuwe, which will be partly self-sufficient and energy-neutral. This, together with the BREEAM-NL score 'Outstanding' makes this establishment the most sustainable distribution centre in the Netherlands. Iv-Bouw is involved in the project as an installation consultant.
Iv-Bouw was commissioned in 2015 to design the installations of Lidl’s seventh distribution centre in The Netherlands. Earlier built distribution centres of the supermarket chain are already very sustainable due to the presence of solar panels, LED lighting, catchment of rainwater and responsible building materials. But this new distribution centre is taking it a step further.

The original wish of Lidl Nederland was to make the building completely self-sufficient. Iv-Bouw initially conducted extensive research into how to make this large scale achievable. During this research phase, energy supplies (windmills and PV panels), energy consumption (through process cooling, offices and distribution centres) and energy storage have all been discussed. In addition to these factors, the cost of energy storage has also been investigated.

Because the building is dependent on sun and wind energy, this energy must also be stored in order to compensate the times when contributions from the natural elements are less optimal. The building will be storing millions of euros of products, largely in refrigeration and freezing cells. These should of course be kept cool at all times. Should a power failure occur, not only can the products suffer damage, but also the entire operation. The supermarkets must be stocked; therefore an emergency power supply and an electrical connection for the event of an energy shortage are necessary. A more complex factor is to calculate how much storage capacity is needed. ‘Weather data and the amount of sun and wind have to be studied in order to estimate how much storage is needed,’ says head of department Jaco Mooijaart. Of course, there must be a sufficient amount of stored energy, but not too much, because the storage medium is also a large expense. The greatest challenge is the enormous storage capacity required.

The investigation has shown that the energy storage for the entire distribution centre was too expensive to carry out. For example, in order to realise a fully self-sufficient distribution centre, 10,000 kWh of batteries and 300,000 kWh of H2 (hydrogen) would be needed. This result has led Lidl Nederland to make a decision to build only the office division of the centre self-sufficient. To realise this, a space is reserved for a flow battery. In addition, a windmill will be installed on the site of 2,500 kW (with an option of a second installation). 4,000 m² of solar panels together with a heat/cold storage in the foundations will provide sufficient electrical and thermal energy for the distribution centre. The surplus of energy from the windmill and the solar panels will be returned to the electricity grid. Due to the choice of no longer making the entire building self-sufficient, it is not expected to use the study completed by Iv-Bouw. The techniques are not yet such that a building of this scale can be completely self-sufficient. ‘This is certainly on the rise and is intensely under development, but at this time it’s not quite at the point it should be,’ says project manager Dion van Bommel and head of department Jaco Mooijaart.

The size of the building played a major part in the choice of making only the office division self-sufficient. The distribution centre of over 55,000 m² will be built on a site of approximately 16 hectares along the A15 motorway near Oosterhout. This Lidl distribution centre is larger than the other six in the Netherlands. ‘Lidl would like to expand further. The hall in the original plan was 12 metres high but has now been increased to 22 metres,’ Dion says. In addition, the distribution centre has been designed to ensure a possibility of an expansion of 10,000 m² in the future. These together will result in the distribution centre being able to process more goods. The handling of goods in and out of the distribution centre will be 40% higher than seen at the other centres of Lidl Nederland.
By comparison, the Waddinxveen distribution centre is intended to supply approximately 70 Lidl supermarkets. The new distribution centre will be able to supply approximately 120 Lidl supermarkets. Such increased storage capacity of goods also means greater transport movement in and out of the distribution centre. Lidl wants to limit the number of movements to and from the stores as much as possible as Lidl does not have separate refrigerated/freezer trucks. Lidl addresses this by using pre-cooled containers wherein the refrigeration and freezing products can be transported. One truck can deliver all the products that a Lidl supermarket needs. Lidl has developed a well-designed logistics plan for this distribution centre. 'The entire setup of such a distribution centre begins with an optimised goods flow.' Lidl couples the supply of products with the discharge of packaging and further waste. The trucks that deliver the products to Lidl stores also return the waste from that store back to the distribution centre. This process is designed to enable the waste to be efficiently separated into containers and prepared for recycling. After this process, the waste will be discharged from the distribution centre to the correct location.

The team of Iv-Bouw, consisting of eight experts, takes a look back on an interesting and especially technically challenging project. And, although Lidl did not opt for a fully self-sufficient building, the study and research beforehand was very educational. 'I have been used to working with solar panels, windmills and underground storage, but I have never experienced the combination of these three together,' Dion says. The end of this project is slowly coming into view. Iv-Bouw will be involved until implementation begins. After a long decision-making process, the implementation of the new distribution centre will begin in the third quarter of this year and will be launched into operation at the beginning of 2019.
GRAND IN LOCK DESIGN
MORE THAN 80 YEARS LATER: AN EVEN BIGGER SEA LOCK
When looking back to 29 April 1930, IJmuiden, a city in the Netherlands, marked a big event: the new Noordersluis sea lock officially opened by Queen Wilhelmina. Steamship Johan van Oldenbarnevelt has the honour of being the first ship to pass through the lock. The opening is largely addressed, and so it should be! Because with a length of 400 metres, a width of 50 metres and a depth of 15 metres, the Noordersluis is currently the largest sea lock in the world. As a small country, the Netherlands can be proud of this. Now 87 years later on behalf of Rijkswaterstaat, IJmuiden is working hard on the construction of an even bigger sea lock. Iv-Infra is commissioned by the contracting consortium OpenIJ to design the new gates and its moving mechanism. Pieter van Lierop, Manager Steel & Movable Structures at Iv-Infra and Design Manager at OpenIJ, explains the details of this project.
Pieter: ‘The realisation of the new sea lock can justly be named a ‘megaproject’. By the end of 2019 the lock must be operational. Commissioned by Rijkswaterstaat is consortium OpenIJ, consisting of BAM-PGGM, VolkerWessels and DIF, responsible for designing, building, financing and the maintenance of the new sea lock for the coming 26 years. In January 2016, construction began. Since then, work has been carried out according to an extremely tight schedule. The tight planning is just one of the many challenges in this project. The design of the sea lock must meet strict requirements which for an engineering company like Iv (who enjoys complex challenges) makes it really exciting to work on such a huge project like this. We can really express our passion for technology here as projects like these force us to think out-of-the-box and that always leads to great results.’

The new sea lock in IJmuiden is not only a technical excellence but also an aesthetic showpiece for the Netherlands. The lock complex serves as a primary flood defence, which means not only must the sea lock keep the area around Amsterdam well accessible to the ever-increasing sea-going vessels but also plays an important role in protecting a part of our country from high water and rising sea levels over the next 100 years. Rijkswaterstaat (Directorate-General for Public Works and Water Management) has demanded that the flood defence function of the sea lock must be 100% guaranteed. The new sea lock will be built between the existing locks and lies in a characteristic environment. The existing lock complex will largely remain open to shipping and road traffic during construction. The challenge is therefore to adapt the new sea lock appropriately into this characteristic area and to keep inconvenience to shipping and road traffic and surroundings to an absolute minimum. In addition, the stability of the Noordersluis and the Middensluis, which are situated next to the new sea lock, must be guaranteed at all times.

**Grand dimensions**
The new sea lock in IJmuiden will be in terms of length (500 metres) and width (70 metres) the largest sea lock in the world. With these dimensions, it can allow passage for the world’s largest ships. The lock gates, measuring 72 metres in length and 11 metres in width will be the longest in the world. The new lock gates will be 24 metres high, which is 7 metres shorter than the lock gates Iv designed for the renewed Panama Canal. This is related to the water level difference, which is greater in Panama.

**A lock for a century**
The new sea lock in IJmuiden will be built as ‘future-proof’ as possible. At an altitude of 8.85 metres above sea level, it is the intention that the Netherlands can proceed with it for at least the next century. It will be a double lock with identical gates at the inner head (the gate at the canal side) and the outside head (the gate at the sea side). Because the entire lock will be built at a higher altitude it means that both gates can also serve as flood protection. The advantage of this construction is that only one reserve gate is needed. The sill level of the lock will be at 18 metres below NAP. The IJ channel will also be deepened, making it possible for ships (regardless of tide) to pass in and out of the lock independently. In the current situation, ships can only pass at high tide resulting in waiting times for deep-sea vessels. In the future, these ships will also be able to pass through the lock at low tide which will strengthen the international competitiveness along the port of Amsterdam and the Noordzee Canal.
A unique design
The lock gates and the moving mechanisms determine greatly the functionality of a sea lock. There is no standard solution and because the requirements and the spatial preconditions differ from lock to lock, it means each lock requires a unique gate design. This was also the case with the new IJmuiden sea lock where the design of the rolling gates was dictated by the required robustness and RAMS performance, the surrounding conditions and the space constraints.

Pieter: ‘The limited width within which the new gate bays and the rolling or sliding gates had to fit proved to be a difficult design challenge. Rolling gates with a conventional cable drive (as used with virtually all large navigation locks) had to be disregarded and instead, innovative solutions were explored. When the new sea lock is operational, it must be 99% of the time available for shipping. Moreover, a sufficiently reliable concept had to be developed, one requiring minimal maintenance effort. This ruled out sliding gates that move by gliding over hydrostatic sliding bearings or due to insufficiently proven technology. The new sea lock will have rolling gates designed according to the ‘wheelbarrow principle’. The gate will rest on a lower roller carriage on the well side and on an upper roller carriage on the gate recess side. This has the advantage that the rail track structure at the sill does not need to be extended into the gate recess and that the rails on the gate recess walls will be easily accessible for maintenance.

The upper roller carriage will also serve as a road surface on which onshore traffic can drive on and off the lock gate. The upper roller carriage houses the machine room for the transmission drive. The gate will be moved by six hydraulically powered drive wheels and two pin tracks on each side of the gate recess. A similar compact drive was used for the flood defence system in the Nieuwe Waterweg.'
Gate structure
The lock gates hold water on both sides and comprises two retaining shell sheets, with horizontal sheeting sections in between at the height of the deck slab, the water chambers and the levelling pipes. The combination of functions in these sheeting sections requires minimal use of steel. Vertical lattice structures provide dimensional stability and distribute loads. In fact, the gate structure could be described as a girder resting on two supporting points, whereby the differential head load is borne over the height of the vertical buffers. The gate will only start to bear down upon the concrete sill in the event of extremely high water levels and will behave as a triangularly mounted structure. A spring sheet at the location of the sill will ensure a good seal at every differential head.

At the location of the roller carriages, the gate will be positioned centrically on rubber roller bearings. These allow the gate to make a horizontal movement causing the gate to be pressed against its buffers in the event of a differential head load without exerting a load horizontally on the roller carriages and rails. During opening and closing, the gate will be guided horizontally by means of polyethylene guide strips fitted at different levels on both long sides of the gate and also in the rail beam structure at sill level of the gate bay.

Flotation system
To limit the load on the roller carriages and rail structures, the gate will be equipped with a large rectangular flotation system over the entire length and width of the gate. The flotation system is compartmentalised to form separate air chambers, ballast tanks and passages. There are special ballast tanks to compensate for marine growth and sedimentation. All ballast tanks can be emptied in the event of a gate change, after which the gate will float upwards allowing transportation. 'Lowering tanks' on the four corner points of the gate will ensure extra stability.
Below the flotation system there are sixteen levelling openings that can be closed by means of hydraulically powered steel gate valves. The decision to incorporate levelling through the gate instead of by short culverts was again the result of limited space on the side of the Noordersluis lock in combination with the vulnerability of the existing lock structure.

Robustness
The gates were designed to be more collision-resistant than required by Rijkswaterstaat. In the event of ship collisions, the gate structure will undergo plastic deformation in a way that stops short of cracking the shell sheeting. Computational analyses that simulated various collision scenarios demonstrated that the lock gate is sufficiently robust.

All hydraulic and electrical installations in the gate have been placed outside the collision-sensitive zone. For the same reason, the 16 levelling valves, each with its own hydraulic cylinder, have been placed at the centre of the gates to prevent the slide guides from sustaining deformation in the event of a collision. In the event of a leak, the air chambers have been compartmentalised in order to limit a loss of buoyancy to a maximum of 10%. In such a situation, the lock gate will still be able to function.

Special facilities in the lock gate
Environmental conditions
The presence of floating waste, marine growth and sedimentation can lead to accelerated wearing of the rail tracks, thus impairing the availability of the lock. To prevent this as much as possible, special facilities have been fitted in the lock gate. At the front of the lower roller carriage, a bull bar and dirt scraper have been fitted to the door structure so as to push into a collector well any obstacles encountered on the rail structure and in the guide beam as the door moves forwards. Additionally, a jet pipe will blow sand and sedimentation from the rail track.

The top of the flotation system in the gate is smooth to prevent the accumulation of sediment. Also built into the design, is the possibility of keeping the water in the gates in motion by means of so-called agitators or mixers. To ensure that neither the upper nor the lower roller carriage becomes overloaded over time due to accelerated growth or sedimentation, they will be provided with load sensors (load cells) that will be continuously monitored. If there is an increase in the serviceable weight, it will be possible to respond alertly by pressing ballast water out of the compensation tanks.
A total of six drive wheels (two of which may fail) have been used, consisting of two drive trains each with three hydraulic motors. Each drive train is affixed to the gate by means of a push and pull bar and mounted with pendulums on the upper roller carriage to allow accurate setting for good loadability on the pins. The movement in the horizontal plane is necessary to allow the drive train to follow the pin track in all positions, without the structure of the upper roller carriage needing to follow it exactly. Due to the major differences in navigable levels, the recess walls can undergo horizontal deformation by several centimetres. The drive trains are pressed against the pin tracks via guide rollers by

Drive mechanism
Several systems were examined and compared with each other when designing the drive mechanism of the lock. Multiple drive systems were evaluated in respect of technical incorporability, maintainability, LCC and reliability. Due to the very limited space usable in the gate recess, the decisive criterion was incorporability. It was decided to use a double pin track with hydraulically powered drive wheels affixing the pin tracks on the recess side so as to limit damage caused by a collision. Collision damage would be much greater if the drive wheels were to be positioned on the upper roller carriage.
Team OpenIJ present on location in South-Korea during construction

Construction of the lock gates
At present, the steelworks of the lock gates are being built in South Korea. This is a complex task due to the strict implementation requirements and tight dimensional tolerances. For this reason, during the construction an OpenIJ team is present on location and the design team from the Netherlands is continuously involved in the manufacturing process.

The dismantle and application of the mechanism, electrics, lighting and the lower and upper trolleys will take place in mid-2018 in the Netherlands. By the end of this year, the lock gates will be transported by ship to the Netherlands. Once the doors have arrived, they will be transferred to the OpenIJ logistics centre, where they will be further dismantled, the technology will be implemented and the gates will be tested. If everything goes according to schedule, they will be ready for use by the end of 2018 and will be placed in the lock. Aside from the technical complexity, there have been a number of technical aspects that have made this project a huge challenge. During the tender phase, we have gathered all the necessary knowledge and have been able to make an integral design that will eventually deliver exactly what the client has requested.

means of a pressure bar with springs. Each drive wheel is powered by a hydraulic motor fitted directly to the axle of the drive wheel. The hydraulic generator sets have been placed in a watertight machine room.

The hydraulic drive system behaves like a differential with six output axles. As soon as the top of the closed gate makes an angular rotation due to high water or a collision, both drive trains can move forwards and backwards relative to each other.
The Södertälje lock in the Södertälje Canal (Built in 1819 and completely renovated in 1924) is the youngest lock in Sweden to be renewed and will be done so without interrupting marine traffic! The lock in the Södertälje Canal is situated between Lake Mälaren and the Baltic Sea. The project consists of the extension and widening of the lock chambers, the construction of two new lock heads and lock gates plus a new bascule bridge. The client is the Swedish Maritime administration and the project is performed by Züblin Scandinavia AB in partnering with the client.

Special lock gate with a special construction method
As requested by the client, a special type of lock gate will be used: a segment gate made of duplex steel (a type of stainless steel). This type of gate is seldom used for locks in The Netherlands. The door is partly circular, rotates around a horizontal axis and is also used for the levelling of the chamber. In addition, the gate can hold water in both directions. Another unique feature of this project is that the lock heads will be built at the side of the existing canal, after which they will be moved to their final position as complete structures. As a result, the canal can remain available for shipping as long as possible during construction.
Expert in locks
Iv-Infra has varied expertise in the field of locks and was approached by MH Poly to form a joint venture under the name of S3P. The joint venture will further develop the lock heads, moving operation and lock gates together with the bascule abutment. Recently, Iv-Infra has completed the design of the lock gates of the new Panama Canal and provided support during construction and commissioning. Rob van Bodegraven, Director of Iv-Infra, is proud of yet another beautiful international lock system project. ‘We have been working for many years with different types of lock systems both in The Netherlands and abroad. This project is another great challenge, which we look forward to undertaking together with MH Poly.’

Mälaren Project
The current lock in the Södertälje Canal was built in 1819 and has a chamber length of 135 metres and a width of 20 metres. Based on permitted ship dimensions, the lock is the largest lock in Scandinavia. The differential head of the current lock is 78 centimetres under normal conditions and 2.26 metres (including waves) under extreme conditions. The construction of a new lock is necessary to meet the growing volume of marine traffic. Over the years, not only the amount of shipping has increased but also the size of the seagoing vessels. The new lock will have a width of 25.3 metres and a length of 170 metres. The renewal of the lock is part of the large-scale Mälaren Project and serves as a pilot for the renewal of other locks in Sweden.
THE MASTERCLASS
SUBMARINE DESIGN:
A DEEP DIVE INTO THE
COMPLEX WORLD OF
SUBMARINES
The Netherlands has a unique marine cluster in which navy, knowledge institutes and companies jointly design and build naval vessels. All the disciplines needed to develop and design a naval vessel are represented within this cluster. The strength of this cooperation has among other things been proven with the submarines of the Walrus Class, which may rightly be called one of the best submarines in the world. Thanks to the combination of operational maritime experience and high-tech marine construction, the Netherlands may enjoy the privilege of acquiring the most modern marine ships at an attractive price. In order to maintain the strong innovative position the Dutch marine cluster enjoys, continuous development of knowledge is being accumulated. For example, Nevesbu recently introduced its own Masterclass Submarine Design.
With a submarine history dating back to 1935, Nevesbu is the oldest shipbuilding engineering company in the Netherlands. Soon after its establishment, Nevesbu acquired its first export project: the design of the 1000-tonne submarines Sep and Orzel. At that time Nevesbu was still located in The Hague. ORP Orzel and ORP Sep were the beginning of a rich submarine history. Since then, the specialist knowledge acquired by Nevesbu in Dutch and foreign submarine projects has been transferred and renewed through the generations. This combination has resulted in the knowledge institute that Nevesbu is today.

Spying on the Russians at 1.5 metres

One of the submarines Nevesbu has designed is the Dutch Walrus Class, which replaced the Dolphin Class in the 90's. Did you know that during the Cold War, the Walrus Class submarines were the master spies of the Mediterranean? Operating in shallow water is something that unlike the Walrus Class, few other submarines are capable of doing. The Walrus Class submarines have special ‘stealth technologies’ whereby once submerged are invisible, virtually noiseless and therefore very difficult for ships, aircraft and other submarines to detect. The submarines can therefore stay under water for longer periods while carrying out their duties. For example, a Walrus Class submarine was once able to approach the Russians within 1.5 metres without them detecting its presence. In the book ‘In het diepste geheim’ (In the deepest secret) former crew member Johan Kragten writes: ‘We knew everything about the unknown Russian ships and submarines. I have always had the feeling that the Dutch were way in front of all other marines.’

‘The devil is in the detail’
The special performance of the Walrus Class submarines was made possible by the innovations in the design. Submarines belong to one of the most complex engineering platforms. Wahyu Schiks, Team Leader Naval Engineering at Nevesbu explains why: ‘Designing submarines is not something you can learn at university like designing surface vessels. This experience really needs to be gained in practice. Submarines are deployed for various important missions. The demands made on the design are often contradictory and need to be brought back into balance, we call this designing the requirements. Limiting noise and vibration, for example, requires extra space and energy. These are two things that are always critical in a submarine. We often say ‘the devil is in the detail’. The overview and insight needed to see the connection between the different requirements and to assess the impact of design choices on subsections is one of the focuses of the Master Class Submarine Design. At the Master Class Submarine Design we dive deep into the complexities of submarine design which allows us to map everything involved. To critically evaluate the requirements and to make an efficient and sound design, an engineer must consider factors beyond their own discipline. You must have insight into all relevant disciplines and understand how your own design work can affect the work of other disciplines and vice versa. Despite the complexity you can work more efficiently and quicker to get a balanced design by referring to the dialog in these instances.’
The Master Class Design consists of multiple modules with subjects such as design features, system design, auxiliary systems, power supply and distribution, hydrostatic and dynamic properties, sensors, weapons and communication systems. Each module is led by an expert in that particular field.

Submarines must be 'invisible'

Cubic metre battle

An important requirement for every submarine is to be ‘invisible’ which is also one of the most complex challenges when designing submarines. Because submarines need to be invisible, they usually have a relatively small length of approximately 60 metres. Wahyu: ‘When you consider that all systems must be integrated and that the crew (sometimes consisting of 60 men) needs to be accommodated for both a living and working space for weeks or months at a time, the available space is very limited. It’s a huge design challenge. Did you know that a Walrus Class submarine consists of 500,000 parts? This is three times more than a frigate. The design of a submarine and system integration is an immense cubic metre challenge as for the crew; the submarine is their ‘home’ and workplace.’
Prepared for the future
Submarines have a technical life of more than 30 years, provided that they are modernised and maintained. This means that the design must be innovative and future-proof. Also, for at least 30 years or longer, submarines must be able to operate at the highest level. 'You must always think about what the next step could be and what will make your design even better. At Nevesbu we also conduct continuous research into specific submarine components.'

Researching innovations is a continuous process

In one of the Master Class sessions recently organised by Nevesbu, a crew member from the Dutch Defence explained extensively about life aboard a submarine and how you go about your work in a submarine, the kind of challenges they face and what is really needed. This kind of insight is essential to providing the best solution for the end users and is something that must be central to each design. The living situation must be as optimal as possible, without compromising other requirements. The interaction between people and engineering (human factor engineering) is of utmost importance. For example, on existing Walrus Class boats, the command centre has been completely rebuilt in order to optimally use new sensors that were operationally needed.
Complete knowledge for designing and building submarines in a single collaboration

The Master Class Submarine Design is not the only initiative of Nevesbu to be constantly expanding its knowledge. Nevesbu also actively participates in the Dutch Underwater Knowledge Centre (DUKC). The DUKC is a unique collaboration aimed specifically at maintaining and developing knowledge in submarines. The Ministry of Defence together with several companies from the Dutch industry and research institutes participate in this. To increase knowledge, the DUKC partners are continuously involved in the maintenance of submarines and future replacement programs whereby forward thinking and innovation are important factors. Various study projects are also being conducted to identify problematic areas whereby the construction of new submarines may encounter problems. One of the DUKC’s success projects is the prolongation of the Walrus Class. The cooperation led to optimal risk reduction and cost savings for the Royal Navy.

Every navy with submarines wants an affordable submarine that is efficient in use and can be maintained at minimal cost. This can only be achieved if there is sufficient knowledge regarding the use and maintenance of the submarine, the crew’s training and usage, the design of critical systems (automation, hydraulics, operating systems, weapon storage and reloading systems, etc.) and the integration of systems and components in a complete and safe shipping arrangement. System integration is a critical aspect of submarine design and risk management. This capacity is especially necessary in view of the demanding and narrow design and construction margins that apply to a submarine. Together, members of the DUKC possess all of this knowledge and can provide complete design and construction of submarines.

and innovations. In addition, we pay close attention to the lessons learned from previous projects, this way we can apply these points to current and future projects. The Master Class Submarine Design is a nice platform for further discussion and new insights. We have also had a number of sessions where specialists from fellow companies like RH Marine and TNO have zoomed into their disciplines to make the whole picture of submarine design as complete as possible. An engineering company works together with the commissioner, the construction yard, equipment suppliers and installers and any subcontractors involved in the design of submarines. The more knowledge you have of all these disciplines, the more efficient you can work and the better the result,’ says Wahyu.
Centralisation of waste water transport systems is occurring more often in the water treatment sector. The Rivierenland Water Authority in the Netherlands has decided to centralise its treatment facilities in the Land van Heusden and Altena region. In the new situation, all waste water will be transported from the Aalburg, Eethen and Dussen plants to the sewage treatment plant at Sleeuwijk and the old sewage treatment plants (STPs) will be closed down. This operation requires the Sleeuwijk plant to be expanded, which will also require new discharge lines to be laid and transit pumping stations to be installed close to the old sewage treatment plants. Following the expansion of the Sleeuwijk plant, there will be enough treatment capacity to serve 64,000 inhabitants.

Iwan explains: ‘The tendering phase of this project was very special because this method isn’t generally used very often.’ The way of phasing the conversion of the treatment plant was a particularly important factor and is precisely what Iv-Water specialises in. There was absolutely no doubt that the treatment plant had to remain in service. You can’t simply turn off a treatment plant for a year while the construction work is carried out. Various modifications need to be executed within an existing situation while the plant is in operation. Phasing of a project like this is even more risky because in addition to all that is visible, there is a lot of underground infrastructure present in the form of cables and pipes.'
Click with the contractor
A special side of this project is the ‘click’ with the contractor. Iwan explains; ‘This is the first time we’ve cooperated with this group of contractors, but we have many similarities in terms of character. It’s great to work with contracting group G. Van der Ven Aannemingsbedrijf and Pannekoek GWW because we have the same mind-set: namely practical and pragmatic. The integration within the project is also important, because the work of the different disciplines has to be harmonised. To do this we are using Interdisciplinary Checks (IDCs) whereby sitting down regularly with each other and organising sessions ensures that the purification will ultimately perform its work.’

Complete waste water chain all in one project

Major project
Given its in-house knowledge and experience, it is hardly surprising that Iv-Water is involved with all aspects of this projects waste water treatment chain. The multidisciplinary nature and interface management make this type of project an exciting challenge for every engineer. Another special feature is the convergence of the entire waste water chain which is why it was necessary to staff the project with two different project teams. One of the teams has been tasked with designing the transport systems (i.e. the pumping station and discharge line) and the other with the treatment process. It is expected that the centralisation will be completed by mid-2019.

Discharge lines exceeding 26 kilometres
The new pumping stations must be connected to a newly-laid transport pipeline. All the treatment plants will remain fully in service while construction is underway. The water that arrives for treatment will go to a pumping station from where it will be fed through a discharge line to the central treatment plant. Iv-Water has designed many kilometres of pipelines for the purpose of being installed below ground level. However, because the pipelines will run through a public area, the terrain must first be surveyed. Assessors will be sent out with surveyor’s rods and cameras to map out all obstacles, bridges, ditches and buildings. The engineers will then determine the route of the pipelines and exactly where and how deep the pipelines must be laid. Finally, the contractor will examine the drawings and use them to order the required materials for laying the pipelines.

Complete 3D design
Iv-Water is currently immersed in the design process which must result in a final design for the building contractors. This will be followed by the detailed civil engineering plan whereby colleagues from Iv-Infra will be making a significant contribution. The designs are now at an advanced stage for the pumping stations, the discharge lines and the treatment plant at Sleeuwijk. The designs for the treatment plant, pumping stations and discharge lines were produced entirely in 3D. This is a first for Iv-Water as previously this was always done in ‘flat’ 2D. The advantage of designing in 3D is when one of the disciplines is adjusted, the entire design is modified ensuring all involved are working with the most current design. Especially with complex challenges such as designing a purification system, it is convenient to proceed by means of a 3D model as it responds quickly to changes.