
CUSTOMER CASE STUDY

# AVEVA facilitates Schlattner's impressive feats of engineering in the North Sea so they can create climate-neutral energy through offshore windfarms

**Schlattner**
**Industry - Engineering**

## Goals

- To build an offshore windfarm
- To help further the cause of renewable energy

## Challenges

- Conditions at sea were windy and dangerous
- The foundations of the structures built had to be able to sustain extreme weight

## AVEVA solution

- AVEVA™ Bocad Steel

## Results

- The wind farm was already supplying 200,000 households with electricity after the first phase of construction
- Germany now has a dependable source of wind energy

## Germany's energy turnaround is taking shape

Offshore wind farms in the North Sea now produce climate-neutral energy. The harsh environmental conditions that prevail at sea, however, make it necessary for the foundations to withstand extreme loads. The detailed engineering and planning of the tripods were completed by the Osnabrück-based Ingenieurbüro Schlattner with the aid of the AVEVA Bocad software, which is now AVEVA™ E3D Structural Design, and offers a host of extended capabilities.

## A good investment

Thirty metres below the surface of the North Sea, 80 tripods have been erected, forming the foundations of an offshore wind farm.

Over an area of 56 km2, 80 wind turbines are generating a total of 400 MW of power - without emitting one tonne of CO2 to the atmosphere.

All in all, the owner-operator, Trianel Windkraftwerk Borkum GmbH & Co.KG, made an investment of EUR 1.6 billion by the end of the final phase of construction. Thirty three municipal utilities and regional energy providers have joined forces with the Trianel municipal utility network, banking on renewable energy.

With the Trianel wind farm Borkum, the shareholders of Trianel will soon be able to provide their customers with green energy. After all, the North Sea's wind is something you can count on; with no obstacles such as mountains or buildings, it blows over the sea at speeds of up to ten metres per second.

## Complex inner workings

The 40 tripod-style steel foundations, weighing 36,000 tonnes (around three and a half times the weight of the Eiffel Tower), are now embedded in the sea floor. The three legs of each wind turbine need absolutely secure footing to withstand the winds and waves; they cannot afford to be literally thrown off balance. A single tripod is 30 metres tall, of which only a couple of metres are visible sticking out of the water. Together with a central tube mounted on top, the complete structure stands 50 metres tall.

While the dimensions and the tremendous weight of the tripods are impressive, the inner details are even more so. What looks like a compact steel giant is really a high-tech structure with numerous pipes, connections, lines, platforms and individual parts. It is the inner components that actually account for most of the weight.

Ingenieurbüro Schlattner GbR from Osnabrück, Germany, was hired by Offshore Wind Technology (OWT) GmbH to participate in the detailed engineering and planning of the gigantic tripod-style foundations used in the North Sea. Two variations, due to the locations at sea, and three variations according to their positioning to the transformer platform had to be prepared. In each case, the AVEVA Bocad Steel CAD (now AVEVA E3D Structural Design) software from Sulzbach-based AVEVA GmbH was an indispensable planning tool.

"I have been working with AVEVA Bocad software since 2000."

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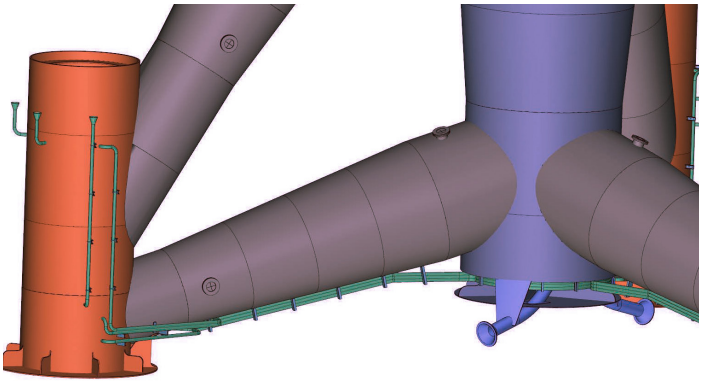
**Marit Bachmann,**
Engineer, Schlattner



## Bocad Steel does all the thinking

Bachmann received from OWT the structural analyses and the associated plans of the outer shell and the primary steel in pdf format, with all details concerning the materials, standards and regulations to be applied to the design of the connecting parts. First, this data had to be manually transferred to the system in order to develop the “inner workings” - the secondary steel - after creating the master data and classification systems.

One major challenge was to route all necessary piping collision-free, both through the central tube, which has a diameter of six metres and which tapers off at the bottom, and around the three legs, each with a diameter of approximately four metres.

Another complicating factor was that the piping had to be routed through the tripod at precise slopes and angles. The concrete pumping pipes are designed to be dual-redundant in order to be able to switch to the adjacent pipe in case of a blockage. Like swimming-pool slides, these pipes wind sinuously in and along the tripod. When the turbines are in service, the electrical energy must be transmitted from the point of generation at the rotor, through the superstructure and the tripod to the transformer platform. Power cables (12cm thick) connect the wind farm with the platform and then on to the mainland.

“Once I had designed the first tripod I was able to import and reuse the component and design data for subsequent modifications. For instance, if I had to change the orientation of a power cable’s outlet, AVEVA Bocad was already prepared and automatically adapted the surrounding architecture accordingly.”

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**Marit Bachmann,**
Engineer, Schlattner

Power cable routing also calls for skilled design, since any kinks or tight curves could cause problems. In addition to these main components, a great many ladders, platforms, flanges, braces, openings, welds and profile sections had to be created. Altogether, Bachmann had to plan, administer and document 3244 individual design elements for each tripod variation.

The amount of repetition between the tripod variations was relatively high, but connection points, fasteners and line orientations did change. AVEVA Bocad Steel generated the part lists for every variation on demand and exported the lists as Excel files.

## Detailed drawings at the press of a button

Once the general layout drawing had been completed, the software generated detailed drawings of the components at the press of a button, with all dimensions and connection points fully defined. Together with all associated information such as item numbers and assignment numbers, material specifications, geometric data, profile section details such as wall thickness and diameters, and all connections, this automation made Bachmann’s day-to-day work easier.

“The program did the work for me. In the case of very complex assemblies, some additional work was required, but I still saved a lot of time thanks to the software’s functionality.”

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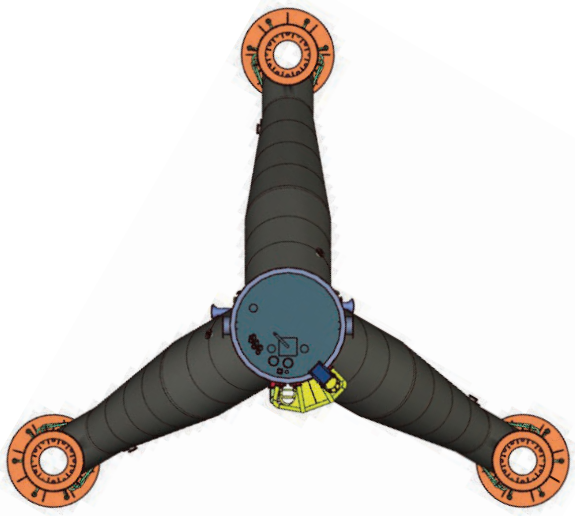
**Marit Bachmann,**
Engineer, Schlattner



Eight interface drawings showed the production engineers how and where the other assembly sections would meet and connect together. All details such as location, angle, orientation or connection points could be grasped at a glance. For instance, if a component consisted of different materials, AVEVA Bocad Steel would show this information with a different graphical representation.

With the click of a mouse button, the user can instantly switch between a 2D drawing and a 3D spatial representation at any time. This works with both individual elements and general overviews.

"My favourite tool in AVEVA Bocad is Open GL, which enables me to move around the inside of the tripod and see everything in 3D. So I can visually check that the lines run clash-free and that the dimensions are correct. This ability for the human eye to double-check the calculation by the software is crucial in my opinion."

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**Marit Bachmann,**
Engineer, Schlattner

The project was completed after one year of planning, with up to nine development drafts. Schlattner handed over the shop drawings and production data to Weserwind GmbH in Bremerhaven. AVEVA Bocad Steel supports the DSTV, DXF, DWG, SDNF and IFC data exchange formats. With AVEVA's technical support, design data was converted using the IFC and STEP standard interfaces and then sent to Weserwind, who used this data to construct the tripods – to a large extent by hand.

## New module supplements AVEVA Bocad Steel

Schlattner had already invested in three AVEVA Bocad Steel workstations. With its ten employees, the Osnabruck-based engineering company has completed many projects, ranging from industrial and commercial buildings through to components for offshore wind farms. Besides the tripods, Schlattner's engineers frequently plan and design platforms as well. While the majority of its customers come from Germany, Schlattner also handles a number of international projects. The AVEVA Bocad Offshore add-on was released in 2013 to make the work of offshore structure designers even easier.

Users can now design complex offshore structures and output all necessary data with less effort and better precision.