As part of the push to better protect the environment by establishing alternative energy sources for the future, offshore wind farms have become an increasingly popular approach for producing cleaner energy – particularly in Europe. These wind farms consist of a series of wind towers mounted on top of steel foundations that are driven into the seabed. Like offshore oil and gas platforms, these wind farms are exposed to harsh, corrosive conditions including seawater exposure, wet-dry cycles and temperature variations; and protective coatings are an effective way of shielding these structures from the conditions they face.

Topsides, jackets and other accompanying components for offshore wind farms have large dimensions and weights that cannot be accommodated within most paintwork facilities. Accessibility in terms of height and width is also a huge challenge with respect to safety. The design of scaffolding or the application of special cherry pickers has become a specialty in order to keep the production process under control.

This article describes shop coating the large steel jacket foundation members employed at the Thornton Bank Wind Farm project, recipient of the E. Crone Knoy Award at the SSPC 2014 Structure Awards.

**About Thornton Bank**

The Thornton Bank Wind Farm, owned and operated by C-Power N.V., is an offshore wind farm located 19 miles from the Belgian coastline on a sand bank in the North Sea. It consists of 54 wind turbines, which produce a total of 325 megawatts of power – enough for 300,000 families, according to the C-Power website.

Construction of the wind farm took place in three phases, beginning in 2007. The first phase included just six turbines, while the additional 48 were installed during the second and third phases. The third phase wrapped up in July of 2013, making the wind farm fully operational.

The wind towers are placed on top of steel jackets, which are driven into seawater that ranges from 12 to 27 meters (40 to 90 feet) in depth. The turbines stand 157 meters (515 feet) tall, and their rotors have a diameter of 126 meters (413 feet).

**Jacket Configuration**

During the second and third phases of the project, the contractor was responsible for fabricating and coating 48 steel jacket foundations for the wind turbine towers and one additional steel jacket foundation for an offshore transformer station. This fabrication required the use of large, modern blast and paint facilities before the parts could be loaded onto a barge and sent out for installation at the wind farm.

The jacket foundations consist of a steel jacket with four legs that is assembled in several different pieces including:

- The midsection (or transition piece) between the main jacket and the wind turbine tower section, upon which the rotors are mounted;
- The main jacket part;
- The pile stoppers (four per jacket), which connect the main jacket and the pinpiles; and
- Secondary steel elements such as anodes, boat landings and ladders.

In total, the contractor produced the 48 jackets over a two-year period. The steel jackets weighed a total of 27,840 tons and were painted using 96,000 liters (25,360 gallons) of epoxy and polyurethane coatings. In the end, the contractor logged a total of 32,000 man-hours for blasting and 144,000 man-hours for stripe coating, masking and painting.

**Blast and Coat Facilities**

The jackets for the Thornton Bank project were blasted and coated in the contractor’s three large blasting and painting facilities in Belgium: lemaants in Arendonk, Willems in Balen and Smulders Projects Belgium in Hoboken.

Secondary steel was coated at lemaants in Arendonk and the midsections were painted in Balen at the Willems facility. The jacket legs and bracings were welded together according to a 3D model and painted in the new paint shop at Smulders Projects Belgium in Hoboken after the midsections were secured to the rest of the jacket. These facilities have special features which are described as follows.

**Arendonk Facility**

lemaants in Arendonk has a workshop area covering over 50,000 square meters (538,200 square feet). In addition to components for offshore platforms and towers, lemaants produces parts for bridges and buildings. The blasting cabin is 40 meters (131 feet) long, 10 meters (33 feet) wide and 8 meters (26 feet) tall. The cabin is located next to the production hall so that transport carts can be driven directly into the blasting cabin. After blasting, these carts go to the paint shop through the back of the blasting cabin.

**Balen Facility**

The midsections for the Thornton Bank jackets were assembled, blasted and painted at Willems facility in Balen. This facility’s recently built paint shop covers 2,430 square meters (26,147 square feet). Inside, there is...
Suction device was also constructed, with a capacity of 85,000 cubic meters (3,011,775 cubic feet) per hour.

Hoboken Facility
The third and largest production facility is Smulders Projects Belgium, located in Hoboken. This facility is divided into three sections, including two production halls and a dry dock and storage yard.

The first production hall is 12,000 square meters (129,168 square feet). This hall contains blasting and paint workshops, with a roof that opens in eight sections so that parts can be lowered in using overhead cranes.

The blasting cabin is 44 meters (144 feet) long, 15 meters (49 feet) wide, and 15 meters high. Four blasters can blast manually, but there is also a robot that can take over the blasting work. The robot is used for items that have common dimensions and is controlled entirely by computer. The dust suction capacity amounts to 24,000 cubic meters (847,560 cubic feet) per hour.

This facility is mainly used to coat transition pieces for offshore wind farms. These transition pieces are placed on top of a monopile, which is drilled into the seabed. The transition pieces have an upper flange upon which the wind tower is mounted, as well as working platforms inside and boat landing areas on the outside. They are also equipped with J-tubes for electrical cables.

A typical transition piece weighs approximately 240 tons, has a 6-meter (20-foot) diameter and is 30 meters (98 feet) long. A transition piece such as this undergoes a NORSOK standard system treatment, which means that three coats are applied to the outside and two to the inside. (NORSOK is a Norwegian acronym for the Norwegian shelf competitive position, a project conceived in order to reduce implementation time and costs for construction and operation of offshore installations on the Norwegian continental shelf.)

By Ronny Van Poppel, Project Staff, Smulders Group

In-Shop to Offshore:
Shop Coating Steel for the Thornton Bank Wind Farm

After fabrication and coating, steel jackets were placed offshore at the Thornton Bank. All photos courtesy of Ronny Van Poppel, Smulders Group
The components are coated as soon as possible after the blasting check, which is conducted according to ISO 8501-1, “Preparation of steel substrates before application of paints and related products.” Dusting, taping and providing the necessary stripe coat are time-consuming processes that can only be done manually. The transition piece and its corresponding attachments must be coated properly; no single spot can remain insufficiently covered with paint. The tubular section, with attachments, is lifted into the blasting area and completely cleaned. It is then transported to the dedicated and conditioned paint area.

The 48 main jacket parts for the Thornton Bank project were primarily painted in the second production hall. At 14,720 square meters (158,387 square feet) and 35 meters (115 feet) high, this facility accommodates the largest of items. Inside, there is a blasting cabin with removable doors so that the heavy pieces can be transported from the blasting cabin to the paint shop. The roof opens providing access to the gantry crane allowing components weighing up to 500 tons to be lifted in.

The blasting cabin is 56 meters (184 feet) long, 26 meters (84 feet) wide and 23 meters (74 feet) high allowing four to six blast to work at the same time. The dust suction system operates at high efficiency affording blasters increased visibility. Cherry pickers are used to blast at heights and are placed between the items by the overhead crane.

The paint shop has the same dimensions as the blasting cabin and contains moveable scaffolding on each side which can be adjusted to fit the shape of the construction. Cherry
For 20 years, PSX® 700 polysiloxane coatings have protected assets in the world’s most demanding environments. This patented product combines the corrosion and chemical resistance of an epoxy with the finish of a urethane — properties that allow PSX 700 to be used in a two-coat system instead of a three-coat system.

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The contractor’s facilities had enough space to accommodate the largest items for blasting and coating, including the main jacket sections.

The Paint Spec
The paint specification, developed by the contractor and the coating manufacturer, called for two coats of a two-component, low-VOC, high-solids modified epoxy barrier coat, designed to give long-term protection, applied at dry film thickness of 375 microns per coat; and a topcoat of a two-pack, acrylic polyurethane finish, providing excellent durability and long-term “recoatability” with a dry film thickness of 80 microns.

SSPC Structure Award
In 2014, this project was awarded SSPC’s E. Crone Knoy Award at the annual Structure Awards ceremony. This award, named after the late founder of Tank Industry Consultants, recognizes coatings work that demonstrates innovation, durability or utility. It is given for outstanding achievement that may include...
excellence in craftsmanship, execution of work or the use of state-of-the-art techniques and products to creatively solve a problem or provide long-term service.

The complexity of the project, along with the challenges the contractor and subcontractors faced regarding production, worker safety and meeting deadlines, are among the reasons this project was chosen as the award recipient.

About the Author
Ronny Van Poppel is a project staff member for Smulders Group, a steel construction contracting company based in Belgium that specializes in wind turbine construction. He has almost 40 years of experience in the industry and is an SSPC Protective Coatings Specialist, an SSPC Bridge Coating Inspector and a NACE Level 3-certified Coating Inspector.
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