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Sjisjka & Mullbergs Wind Parks, Sweden

Case Study 114

Aspects of Sustainability

This project highlights the following:

Green Aspects

Energy

Carbon

Materials

Water

Local Impacts

Social Aspects

Human Resources

Corporate Community Involvement

Business Ethics

Health and Safety

Sjisjka & Mullbergs Wind Parks in northern and central Sweden are two of the largest on-shore wind parks in the country, which together annually generate approximately 450 GWh and were designed to minimize environmental impacts in terms of carbon, materials, water and local impacts.

The Sjisjka Wind Park

Sjisjka Wind Park is situated on Sjisjka Mountain above the Arctic Circle, about 50 km northwest of Gällivare and 30 km south of Kiruna. The wind park consists of 30 Vestas V100 2.6 MW wind turbines and was Sweden's third largest wind park at the time of construction. It has a total effect of 78 MW and annually generates around 200 GWh, or enough to fulfill the electricity needs of 43,000 households. Sjisjka Wind Park became fully operational in October 2012.

The park is owned and operated by Sjisjka Vind (Wind), which is an alliance between Skanska Infrastructure Development (50 percent), the wind energy developer O2 (25 percent) and regional energy company Jämtkraft (25 percent). The US$ 160 million wind park was constructed by Jemtska, a joint venture between Skanska and Jämtkraft, which was responsible for the construction and all infrastructure in and around the park, including 17 km of roads and connection to the electricity grid.

Sjisjka was only accessible by rail during construction and had only a 3-month construction (casting) period due to extreme climatic conditions during much of the year. The project was consequently designed to minimize on site construction activities by developing prefabricated concrete wind turbine gravity foundations. 380 prefabricated turbine foundation components were used in total. The foundations were designed to require less concrete and reduce costs compared with conventional foundations cast entirely on site. Each foundation included 16 18-ton wing wall prefabricated components that were assembled on site to form a 16 m wide "star type" foundation around a cast-in-situ central foundation, which includes anchor bolts for the wind turbine. Skanska also developed a smaller cast-in-situ turbine foundation that is secured into at least 11 m of bedrock by eight 370 ton post-tensioned rock anchors. The "Rockadapter" foundation is an octagonal shape of around 8 m in diameter.

Sjisjka is a Natura 2000 protected area in the

Skanska Color Palette™

Energy

Carbon

Materials

Water

Click here for more information

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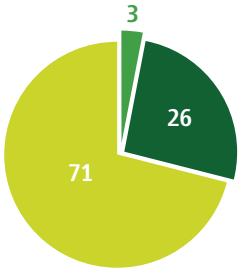

Mullbergs Wind Park Carbon Footprint

Materials – 71%
Project energy use – 26%
Transportation – 3%

Kaitums Forest Reserve. The project worked to minimize local environmental impacts in a sensitive mountain environment throughout its lifespan from construction to end-of-life dismantling by implementing a sustainability plan. The project also intends to demonstrate how cost-effective renewable energy can be generated through commercially viable green solutions and a lifecycle perspective. The Sjisjka wind park was nominated as Construction of the Year 2013 by the Byggindustrin publication – primarily due to the project's sustainability efforts in a sensitive natural environment and the substantial generation of renewable energy. The project supports the Swedish government's ambition to generate a greater proportion of its energy from renewable sources and to avoid the need to import fossil fuel based electricity from abroad. The Sjisjka area was previously identified as an area of national interest for wind energy by the Swedish Energy Agency.

The Mullbergs Wind Park

Mullbergs Wind Park is situated in the forests of southern Jämtland, in Bergs Municipality, central Sweden. The US$ 180 million wind park built on Skanska's experience from Sjisjka, including the development of a new efficient "doughnut" shaped foundation. Mullbergs includes 26 Siemens 113-3.0 MW turbines and has a capacity of 78 MW, designed to annually generate 247 GWh, sufficient for around 53,000 homes. The park is scheduled to be in operation by December 2013. Mullbergs Vind is owned by Skanska (50 percent) and Jämtkraft (50 percent) and construction will be undertaken by Jemtska.

Contributing Toward Sustainable Development

The Sjisjka and Mullbergs Wind Parks deliver clean and renewable energy to the Swedish electricity grid. During construction, the development of resource efficient turbine concrete foundations was vital in reducing the projects' carbon footprints. Sjisjka's carbon footprint was further reduced by incorporating recycled aggregate. The Sjisjka project did not create any waste and no potable water was used on site during construction. The Sjisjka Wind Park was designed so as to minimize local environmental impacts in a sensitive natural environment. Public disturbance was also minimized and accidents were avoided. The local economy was supported by employing regional construction workers and operational personnel, and by issuing financial contributions to the municipality throughout the lifespan of the project.

Green Aspects

Energy

Renewable energy generation

The Sjisjka and Mullbergs Wind Parks are together designed to annually generate around 450 GWh of renewable energy throughout their lifespan of 20 to 25 years.

Carbon

Carbon footprinting

The precast concrete elements used for the Sjisjka turbines had a carbon footprint of 179 tCO_2e and the cast in situ concrete a footprint of 358 tCO_2e. The use of resource efficient prefabricated components reduced the amount of concrete and the project's carbon footprint by around 30 percent compared with using purely cast in situ concrete. The use of excavation material on site reduced emissions from aggregate materials for road surfacing by around 40 percent. The aggregate that was imported was a waste product from the ore mining industry, which saved around 4,700 tCO_2e compared with sourcing general stone (based on 60,000 tons and 0.079 tCO_2e/ton).

Low-carbon rail transport was used to access and make deliveries to the site during construction. All the prefabricated components, aggregate, construction equipment and vehicles were brought to the site by train. A special rail bus was hired to transport employees to and from the site each day.

A carbon footprint was conducted for the Mullbergs Wind Park. It calculated that the project's embodied carbon, including the sourcing and manufacture of materials, transport to site and construction processes was 13,281 tCO_2e. Concrete and reinforcement steel were responsible for the greatest proportion of the project's carbon footprint.

A "doughnut" shaped foundation used on the Mullbergs project reduced embodied carbon by 30 percent, through reducing the quantity of concrete and steel reinforcement required by 60 percent and 15 percent respectively.

Materials

Environmentally responsible materials

The prefabricated and Rockadapter foundations used on the Sjisjka project required approximately 35 and 65 percent less concrete respectively in total than conventional foundations. The Rockadapter

foundations used around 115 m³ of in situ concrete in total. Each prefabricated foundation consisted of 115 m³ of prefabricated components plus 100 m³ of in situ placed concrete, compared to approximately 340 m³ of in situ concrete that would have been required for a conventional turbine foundation. The use of Rockadapter and precast foundations at Sjisjka saved approximately 4,300 m³ of concrete in total compared to conventional foundations. The need for 100,000 tons of aggregate materials on the Sjisjka project was met by using 40,000 tons of site-excavated materials and 60,000 tons of waste materials from the mining industry.

The Sjisjka team did not use any chemicals or substances that were classified as "Restricted" according to Skanska Sweden and AB requirements.

Waste management during construction

No waste was created on site during the construction of the Sjisjka project. Zero waste was largely achieved through the use of prefabricated foundations and by incorporating excavated materials back into the site in line with Natura 2000 designated site conditions.

Water

Water efficiency

No potable water was used on site during the construction of either of the wind parks. The use of prefabricated fundaments reduced on-site water use by 40 percent and 60 percent on the Sjisjka project and Mullbergs project respectively. Rainwater was harvested on site and water was sourced from nearby creeks.

Other Green Aspects

Minimizing environmental impacts during construction

The Sjisjka and Mullbergs construction sites were certified according to Skanska's internal Green Workplace (Grön Arbetsplats) environmental management system, which is aligned with Skanska Sweden's ISO 14001 certification. The system surpasses Swedish regulations in terms of emission standards for site machinery, the use of energy-efficient construction lighting, requirements for chemicals and waste management. In addition, the Sjisjka team used alkylate petrol to fuel smaller vehicles and machines, which reduces emissions of carcinogenic, persistent and toxic polyaromatic hydrocarbons (PAH) by around 90 percent compared with conventional fuel.

Jemtska conducted several seminars on minimizing environmental impacts for the Sjisjka team, suppliers and local residents from the nearby Sami (indigenous people of Northern Scandinavia) village of Girjas during the initial stages of the project. The team worked to minimize the space they used on site and a key measure was to base all workers in the town of Gällivare to avoid the need for extensive facilities to be established at the site. The project began before May so as to avoid disturbing established nests during the bird-breading season, including eagles, falcons and hawks. Trees were felled only when absolutely necessary, such as when constructing essential

site buildings. Post-construction observations have shown that the turbines do not disturb local wildlife, such as deer. Following their operational lifespan period, the turbines will be dismantled and the areas restored to their natural state as agreed with the Swedish Environmental Court.

Promoting electric vehicles

Skanska installed a permanent electric vehicle charging station on the Mullbergs site. The charging station is intended to allow visitors from the nearest city, Östersund, to use electric vehicles.

Social Aspects

Minimal public disturbance

Sjisjka is a very isolated site with the nearest dwelling 3 km from the wind park and the nearest settlement of Kaitum around 8 km south of the site. The project consequently involved minimal disturbance during construction and operation. The team worked with Sami reindeer herders in the area to minimize noise disturbance, including communicating when potentially noisy activities would take place and working around potentially sensitive herding periods. A limit of 40 dB was established throughout the construction and operational phases in accordance with the Swedish Environmental Court.

Occupational health and safety

There were no serious accidents during construction at Sjisjka and the Lost Time Accident Rate was zero. The Sjisjka team underwent pre-project safety briefings and specialized training, such as working at heights. First aid training was also provided due to the remote nature of the site. As a precaution, a nearby helicopter rescue team was informed of the project and was the first line of response in the event of an accident.

Economic Aspects

Regional workforce

Up to 100 workers were involved in the construction of both the Sjisjka and Mullbergs Wind Parks. The majority of the workforce was from the surrounding areas. The parks will employ around 10 full-time employees from the local areas to operate and maintain each site.

Financial community support

Approximately US$ 45,000 per year will be awarded to the Kiruna municipality by Sjisjka Wind throughout the lifespan of the Sjisjka project. The money is to be spent on initiatives to directly benefit the local communities, particularly the nearest villages of Killinge, Kaitum and Neitisuanto. There is a similar agreement on the Mullbergs project with the Rätan municipality.

Financial savings from efficient foundations

The use of prefabricated components significantly reduced the amount of on-site work compared with conventional foundations that are entirely constructed in situ. The use of precast and Rockadapter foundations at Sjisjka saved over US$ 2 million by reducing the construction schedule and the quantity of concrete required. For example, each precast foundation saved around 600 hours per foundation, and involved 24 percent less hours worked on site. The “doughnut” shaped foundation used on the Mullbergs project reduced costs by 30 percent compared with conventional foundations.

Learning From Good Practice

The development of prefabricated components for the Sjisjka and Mullbergs Wind Parks was key to the success of the projects. The components helped to reduce carbon emissions, construction costs and local environmental impacts, whilst also ensuring that the foundations could be laid within the 3-month weather window at Sjisjka.