WSP

SAINT-PHILÉMON WIND FARM

CANADIAN CONSULTING ENGINEERING AWARDS 2016

PROJECT INTRODUCTION: MAXIMIZING CLEAN ENERGY PRODUCTION

The Saint-Philémon community wind farm project, with a power of 24 MW, was the first project of this scale to be directly connected to the Hydro-Québec Distribution network. The wind farm is designed to maximize energy production while respecting significant technical constraints and various sensitive issues related to the biological, physical and human environment. Receiving strong support from the population, this project has a positive economic impact for all of the municipalities in Bellechasse Regional County Municipality and for the municipality of Saint-Philémon. In addition to carrying out comprehensive engineering activities, WSP had the mandate to manage construction for this project. The firm therefore assisted the client in procurement and commissioning activities. This initiative is the result of an outstanding collaboration between all stakeholders.

THE APPROACH OF THE CONSULTING ENGINEER

FIRM SELECTION METHOD

The Saint-Philémon wind farm project was selected in December 2010 by Hydro-Québec Distribution (HQD) in the third wind energy tender issued in April 2009. Parc Éolien Saint-Philémon S.E.C. (Saint-Philémon Wind Farm S.E.C.) thus signed an electricity purchase agreement with the state company for a 20-year period.

The result of a public-private partnership uniting the Ontarian company Capstone Infrastructure, Bellechasse Regional County Municipality and the municipality of Saint-Philémon, Parc Éolien Saint-Philémon S.E.C. gave WSP a complex, multi-faceted mandate through a mutually-agreed transaction.

Having worked on this mountain in the past with other clients, WSP had an excellent knowledge of this site. The mandate was negotiated between WSP and Capstone, which holds 51% of the limited partnership (Parc Éolien Saint-Philémon S.E.C.). Partners from the local and regional community (Bellechasse Regional County Municipality and the municipality of Saint-Philémon) collectively invested 49% from their own capital.

WSP is a leader in wind energy project engineering. For over 25 years, WSP's team of wind energy specialists has developed technical expertise that has been put to use in hundreds of wind projects.

ADDED VALUE

Developing a wind farm is a challenging venture and the developer needs to be supported by a specialist at every stage of the project. In addition to undertaking comprehensive engineering activities, WSP managed construction and assisted the client in procurement activities.

Feasibility studies had already been carried out for this project by the developer before WSP became involved, yet right up until the final design WSP acted as a local resource and facilitated the on-site relationship between the Ontarian client (Capstone) and the consultant in charge of wind studies. This collaboration had a major impact on the smoothness of operations, making the search for optimal solutions at all levels easier. Through its previous work with wind farm owners, contractors, lenders and turbine suppliers, WSP has acquired a solid reputation for its value-added services as well as for the quality and professionalism of its personnel. The breadth and depth of WSP's expertise allow the firm to use a holistic approach, both insightful and practical. The client was able to rely on a permanent on-site team for the full duration of the project without any staff turnover. This is certainly an added for all the project's stakeholders.

Very early on during the identification phase of the project, WSP had already carried out anemometric data collection for another client several years before. This data provided the firm with important knowledge about the climate and the specific conditions that affect the site.

The client appreciated the various technical opinions for the wind turbines positioning and the preliminary engineering that WSP provided. These opinions were given thanks to the validation in the field of cartographic information compiled and analyzed by others. WSP also went in the field to validate important information, for example which routes could be used for off-road vehicles and the impacts the avoidance of this project could have on the natural habitat (bird species, etc.).

Due to WSP's significant field experience, the client was informed of the impact of the very specific climate conditions that are associated with a high frequency of ice, particularly on the mountainside.

WSP also digitally modeled the three-dimensional wind flows for each turbine using specialist software. The results of this modeling allowed the wind turbine supplier to confirm the suitability of the turbines according to various wind parameters (angle of attack, gusts, turbulence, etc.).

WSP was in charge of many aspects during the engineering stage:

- Finalizing the localization of the turbines
- Completing the structural and electrical design as well as the design of the civil engineering infrastructure
- Organizing the tender process and agreements with suppliers
- Planning the maintenance of the wind farm
- Collaborating with other consultants in the planning of environmental management
- Monitoring during construction and operation

During construction, WSP assumed the role of resident Owner's Representative in charge of construction and supervision for all disciplines. Moreover, WSP actively participated in the start-up of all sectors and of the switching station.

Active role in the commissioning of the wind farm, WSP also worked closely with Hydro-Québec to carry out testing while connected to the network, such as wavelength quality testing, the 48-hour turbine test, etc.

MANAGING HUMAN CAPITAL

RESOURCES SELECTION AND TEAM MAKEUP

The WSP Energy team has been involved in developing wind energy projects of all sizes for over 25 years. The discipline-specific teams that we offer for our projects are useful for working together and have developed their own comprehensive, consistent methods of resolving challenges. Teams are allocated to the implementation of the project as required and are formed taking into account the specific issues relating to the project.

Indeed, the specific responsibilities, structure, personnel and number of people involved in the project are thought out according to the services to be provided and to ensure changeover if necessary. Experts have additional skills and always work in close collaboration.

The Project Manager for Saint-Philémon, Mathieu Laflamme, was selected not only for his technical expertise but also his managerial capabilities. Mathieu has been working in the wind energy sector since 2002. Between 2002 and 2006, he worked directly in the field on the construction of all wind farms built during this period in Quebec. From 2006 to date, Mr. Laflamme has been involved at different levels in 35 out of 39 projects built or underway during this time in Quebec and in several others around Canada and the United States. He is the expert in his field and we are proud to have him on our team.

Mathieu is able to count on a multi-disciplinary team that has been participating in wind projects for many years. When an entire team has developed its skills over a period of over 10 years – and also collectively – they set themselves apart through their efficiency, versatility, innovative methods and constructive approach. The team's strength on this project resided in its integrated approach. The client felt reassured and it had a significant impact during the execution of this project. The synergy between resources was optimal since it was founded on respect, recognition, complementarity, teamwork and a determination to meet the challenge.

The WSP team was active from the start of the project through its specialists in wind energy resource analysis in Montreal and Calgary, including Jean-Marie Heurtebize and Errol Halberg. The detailed design of the access route area was also carried out very early on and to the great satisfaction of the client by Patrick Béland and Luc Giguère. Jean-François Vallée conducted the electrical engineering for all of the project's electrical. The Electrical team was composed of Mathieu Gagné, Maxime Beaulieu, Luc Landry and Frédéric Bélanger. A team comprising François Laliberté-Riverin, Alain Charette and Mathieu Laflamme prepared the tender documents and assisted the client in selecting the General Contractor for the work. WSP was in charge of designing and supplying the wind tower measurement for the project.

This phase was led by Patrick Audet. He was assisted in the execution in the field by François Sabourin. While the work was being done, several our engineers worked simultaneously on the design of different infrastructures for some of the project's other stakeholders:

- Nicolas Simon's team was in charge of design of foundations and wind turbine towers for the supplier Enercon.
- Jonathan Gagné's team designed the project power line for Hydro-Québec Transport).
- A team from the Laval office carried out work for Hydro-Québec Telecommunications.

A team for the overall management and supervision of construction was finally put in place. Several stakeholders who worked on prior phases took part in the construction phase due to the proximity of the project site to WSP's offices in Quebec.

TEAM MOBILIZATION AND MOTIVATION

The project team had a strong nucleus of resources who have been employed by WSP for a number of years and are used to working together.

As part of the project, the Project Manager guaranteed his permanent on-site presence for all engineering and commissioning stages. He had a major role to play in ensuring the cohesiveness of the team and stakeholders at all levels. While several factors contributed to the success of the project, key elements were the involvement of stakeholders and the support for the project, which were brought to fruition through the implementation of means of communication that made it possible to encourage dissemination of information, collaboration and engagement.

The project already had the population's support. The consultation, collaboration and even engagement of citizens as regards the project promoted its social acceptation. It should be noted that work had been carried out in advance by the project developers, even before the submission of bids and the selection of the Saint-Philémon wind farm project by Hydro-Québec Distribution was revealed during a public meeting. This open-house event was held on March 24, 2010 to explain the wind project to the community and collect comments from citizens on the subject. A second meeting took place on March 15, 2011, following acceptation of the project by Hydro-Québec Distribution. Following the submission of the environmental impact study, consultations continued to be held with the population and the Saint-Philémon Wind Liaison Committee, including a public information session that took place on March 12, 2012. These consultation activities allowed citizens to express their concerns and discuss their interests with representatives of the partners and those in charge of the environmental impact study.

In December 2013, a BAPE (Office of Public Hearings on the Environment) public information evening attended by the contractors sufficiently reassured the population. Nevertheless, a Liaison Committee had been established to follow the evolution of the project. A website was developed, complete with a periodical newsletter, on the progress of the work.

WSP ensured cooperation with stakeholders by participating in the Monitoring Committee, which included representatives of the population, and by holding site meetings, a workers' lunch, as well as by promoting the hiring of local suppliers and workers.

This was the first major wind project to be directly connected to the Hydro-Québec Distribution network. A real challenge for the project team which significantly contributed to the positive energy that emerged for the success of the project.

OCCUPATIONAL HEALTH AND SAFETY

As Owner's Representative, WSP had the responsibility of implementing the Occupational Health and Safety (OHS) program. An OHS representative was appointed and WSP hired an external firm that supplied a loss prevention officer and security guards on site.

We take regulatory requirements and OHS best practices very seriously. A specific project plan drawn up in collaboration with the General Contractor was used as a guide during the execution and monitoring of the project. This plan ensured risks identification and verification. It also allowed to follow up on and confirm that control measures had been carried out, and whether the prevention program was completed. All of this was approved by the Project Manager. The project was carried out using a detailed response plan. Employees, contractors and/or sub-contractors had to comply with the necessary OHS requirements from the start to the end of the project. The training specified in the welcome program, manual and specific procedures resulting from the ASET (Safety and Environmental Analysis of Work) was implemented and respected. At all times, it is essential that employees also know the procedure to follow in the event of any incident, accident or even manifestation of pain.

As required by regulations, site committees were held with worker representatives. These meetings were led by WSP's OHS representative. In addition, each site meeting contained an OHS component that was dealt with as a priority over other points. One of the specifics of the project consisted of organizing a workers' lunch, with the help of the contractor, to thank them for their work and raise awareness of on-site OHS. In total, over 200,000 hours/workman were done in 9 months on the site and no lost-time incidents arose.

Since the project was situated on public land, it was impossible to deny site access to non-workers. With the aim of guaranteeing the safety of non-workers who wished to access the site, we installed a security booth at the entrance to the project where all route users had to stop and identify themselves. If the user was not a worker on the site, the security officer would explain the risks linked to the use of the on-site routes and ask users for their cooperation. An information leaflet was also distributed to users and a complete register of the entries and exits was put in place to ensure that all users left the site safely.

During design of the project, the owner made sure not to place the users of the forest some risks were identified. The various dangers were identified and the risks minimized for all users. Additionally, the routes of the paths in the Massif du Sud Regional Park were analyzed and reorganized as needed to ensure that the ice throw generated by the wind turbines did not endanger users. Furthermore, we have put in place a comprehensive and highly detailed signage ensuring that users of the paths were aware of the dangers of nearing the wind turbines in the winter season.

ADDITIONAL PROJECT DETAILS

COMPLEXITY

With a power of 24 MW, the project comprises 8 Enercon E82 wind turbines, of 3 MW each. The construction of the Saint-Philémon wind farm began in December 2013 and the farm was capable of producing 100% of its capacity at the end of December 2014. The commercial commissioning with Hydro-Québec was completed on January 15, 2015. The project included the installation of the wind turbines and their infrastructures (foundations, road, electrical network) as well as the implementation of transport links and a 25-kV switching station to integrate the wind farm's electricity production into the Hydro-Québec network.

The challenges of its execution lay especially in establishing the needs with Hydro-Québec for the interconnection of the project to a distribution line, compounded by the short time frame for conducting the detailed engineering, tenders and construction – all within 17 months.

This wind farm is the first large-scale project (of over 5 MW) to be directly connected to the Hydro-Québec Distribution network. This exploit required exemplary work from the team of electrical engineers and technicians, particularly in the monitoring of the contractors. This work also needed special attention when changes were required at the time of integrating the switching station and the collector network. We ensured coordination during testing in a factory and on the site of the equipment and control and automatism (MER), as well as SCADA, HMI and industrial computing. WSP assumed coordination of the contractor during commissioning. We were also responsible for coordinating with the various Hydro-Québec stakeholders.

The construction and maintenance of the wind farm required access routes to be put in place. To do this, the project had to plan the use of 11.4 km of roads to enable the transport of components and the construction of various infrastructures. The design and construction of the access route to the site was the most complex from a civil engineering perspective. The challenge lay in designing an access route that met the criteria to allow delivery of wind power components. These criteria included compliance with a maximum gradient of 10% and minimum curve radius of 28 meters. The access route was to go through an area with a difference in altitude from 170 meters to 1100 meters, with gradients of up to 30%. A specific design with a hairpin section had to be drawn up and built exploiting the design criteria to the full.

The project also had environmental constraints, particularly due to the presence of a protected bird species, the Bicknell's thrush. The positioning of the wind turbines thus became important for the preservation of their habitat.

A CLEAN AND SUSTAINABLE SOLUTION TROUGHOUT

Wind energy has proved itself to be a clean and sustainable source of energy. However, the methods used for the design and production of a wind farm still need to reflect this will to carry out a green project. We configured the farm in order to maximize energy production while taking into account the technical constraints and limitations linked to the biological, physical and human environment.

To satisfy the electrical constraints linked to the low integration capacity of the two electrical networks to which the wind farm needed to be interconnected, the project's electrical engineers – with the collaboration of Hydro-Québec – had to develop a system capable of limiting the inrush current. The primary purpose of this system was to limit the current generated by the energy from the turbine's transformers – the aim being to limit fluctuations in voltage in the residences hooked up to the power lines the turbines are connected to.

The system allows the operator to run one or several turbines at any one time, while adhering to Hydro-Québec's operational criteria. Complex and costly electrical systems existed on the market that could have been used to try to solve the problem of the weakness of the network, yet these systems did not offer the flexibility and robustness required by the client.

We had to be mindful of the impacts on wild birds, particularly the Bicknell's thrush. Following the environmental analysis, some wind turbines were relocated in order to protect their natural habitat. During deforestation, respect for the nesting period of the birds was of utmost importance.

FONCTIONNALITY

The favorable attitude of the community towards the project is an important part of its success. Since 2009, representatives of the contractor, of Bellechasse Regional County Municipality and of the municipality of Saint-Philémon have maintained in contact with the population and the main stakeholders from local and regional groups to ensure the harmonious development of the Saint-Philémon wind project within the community.

The success of this project both on an economic level – through its consequences for the community – and on a technical level was guaranteed by the quality of the wind power resources and the partnership with the community. All aspects of this project respond to the Quebec government's desire to foster economic development, especially by encouraging the direct involvement of communities. The farm has been in operation since 2015 and has already shown real economic benefits. In August 2015, an initial positive balance sheet demonstrated that the eight wind turbines on the farm were performing better than initially expected. For the first seven months of activity – from January 1 to July 31, 2015 – the overpayments to be distributed stood at $1,735,950. The 20 municipalities – including Saint-Philémon – each received a check for $28,050, amounting to an overall sum of $934,989.

The municipality's involvement in the setting up of a community wind project encouraged greater acceptance from the population. This made it possible for part of the profits generated from use of the wind energy to be kept in the region and is an alternative solution to building a commercial wind project provoking environmental or social concerns.

BUDGET

WSP respected the authorized budget for all professional services. The engineering-related fees were even lower than anticipated at the outset. The project was carried out under adverse climate conditions and the team had to prove their vigilance so as not to exceed the authorized budget for construction management.

An initial budget of $1.2M had been allocated to WSP for the execution of its full mandate of design, role of Owner's Representative and supervision of the work. We completed the work with only $1.1M, even with the realization of several additional related tasks and the delay caused by Hydro-Québec.

We were able to minimize construction costs by optimizing the designs and working closely with the different contractors. This enabled the lowest possible construction costs to be obtained, despite the various unforeseen and unforeseeable circumstances that go hand in hand with the construction of a wind project. This control of costs allowed the client to carry out the project within the anticipated budget allowance and thus ensure the partners a return on their investments.

SCHEDULE

The 20-year electricity purchase agreement with Hydro-Québec Distribution set out penalty clauses in case of a delay in commissioning. At the outset, the scheduled date of commissioning was December 1, 2014. It was recognized that Hydro-Québec was responsible for a delay in the implementation of the transport links and the date was postponed until February 1, 2015. The farm was finally commissioned on January 15, 2015 – 15 days after the original date set by Hydro-Québec.

SUSTAINABLE DEVELOPMENT

SOCIAL ACCEPTANCE

The main issues related to the human environment were the potential impacts on the landscape and on the sound climate, as well as the economic consequences promoting local and regional development.

To create a solid partnership around the project, a number of meetings were held between the various stakeholders. At the request of a group of citizens from Saint-Philémon, a Liaison Committee was established with the stakeholders and users of the environment before the construction and start of operation of the wind farm. The objective of this Committee was to determine measures to reduce the impacts of the wind farm with a view to promoting its installation to the community. The Committee is still active even though construction has finished, since it discusses all sensitive aspects relating to the wind farm, such as the construction impact on the municipality and on the recreational and tourist activities of the Apalachee Regional Park. It also takes note of any complaints about the project, particularly those relating to television reception. The results of all of the monitoring conducted by Parc Éolien Saint-Philémon S.E.C. have to be submitted to the Committee, who can make these available to any interested party. Failing this, Parc Éolien Saint-Philémon S.E.C is obligated to set up appropriate reductive measures and compensation in order to restore the situation.

Excellent work was carried out with the populations before construction eve began. For us, social acceptance was a key criteria and the engineering was conducted taking into account all of the comments from the Saint-Philémon Wind Steering Committee. This is notably reflected in the final positioning of the wind turbines. One turbine had to be relocated to an alternative site after being judged too close to residences by the Committee. The alternative site, which complies with regulations, was able to meet the demands of certain citizens and the Steering Committee. The positioning of the wind turbines was conducted taking into account a range of criteria seeking to ensure the productivity of the farm and also to reduce or eliminate the anticipated impacts on the environment, residents and users of the area.

The initial Saint-Philémon wind farm project envisioned the installation of 12 wind turbines, each with a capacity of 2 MW. Keen to limit the impacts on places and on the environment, the managers of Capstone opted for the construction of 8 Enercon wind turbines, of 3 MW each.

WEALTH CREATION

The municipality's involvement in the setting up of a community wind project made possible that profits generated from the use of the wind energy to be partially kept in the region. It is also an alternative solution to building a commercial wind project that would create environmental or social concerns.

The economic impact of the project has been positive for all of the municipalities in Bellechasse Regional County Municipality. The project allows local communities to reap direct financial benefits. The farm has been in operation since 2015 and has already shown real economic benefits. In August 2015, an initial positive balance sheet demonstrated that the eight wind turbines on the farm were performing better than initially expected. The partnership structure envisaged by Bellechasse Regional County Municipality also enables its smallest municipalities to collect revenue from this regional project. According to Regulation 214-11, 60% of the leftover net revenue of the Bellechasse Regional County Municipality is to be shared equally between its over 20 constituent municipalities rather than in proportion to their standardized property value.

The project is also beneficial to Matane Regional County Municipality and Gaspésie–Îles-de-la-Madeleine administrative region due to the requirement for regional components imposed by the tender of investing the equivalent of 30% of the cost of the turbines in this region.

The impact of the wind farm in terms of job creation and economic impacts has been immensely positive. Local workers and contractors were hired, particularly for the construction of roads and transport of materials. Self-employed truck drivers were also hired for the operation of all kinds of heavy machinery, for landscaping activities, as electrical contractors and for the maintenance of the vehicle fleet.
The indirect economic benefits during construction and operation have been seen in the local restaurant and hospitality sector, as well as in the trade of products and services. The setting up of an operations and maintenance center has now created five permanent jobs.

APPROPRIATE USE OF RESOURCES

Important monitoring was conducted to measure and control the impacts of the project on the landscape and the sound climate. The main issues related to the natural environment were the impacts on wild birds, particularly the Bicknell's thrush. The environmental analysis of the project introduced the following reductive measures, which were put into place during the construction phrase:

- Environmental monitoring at all times while work was being carried out
- Control of surface water runoff
- Use of dust suppressants and application of a transport plan
- Application of the Regulation on standards of intervention in public forests (RNI) and the Sound practices guide: forest roads and installation of culverts (no new water crossings)
- Avoidance of the nesting period of birds for deforestation
- Hiring of local workers
- Establishment of a Monitoring Committee made up of stakeholders in the environment

Environmental monitoring was carried out during the operation phase, with respect to the following, for example:

- Birds
- Bats
- Sound climate
- Landscape
- Regional and Quebec components

IMPACT ON THE PROFESSION

IMPACT ON THE IMAGE AND PRACTICE OF THE PROFESSION

By focusing on the development of wind energy in its recent energy strategy, the Quebec government not only sought to expand the renewable energy sector but also to use the enormous wind energy potential of the province as a tool for social and economic development. While the development of this sector has immense potential, projects do not always have the support of the population, often through fear of the impact on the environment and thus on the residents' quality of life.

Given that the Saint-Philémon project has a community dimension, to some extent, this facilitated social acceptance. Stakeholders had a real desire to adapt the project to the local context. We are certain that the role played by the engineers involved in the project particularly shaped the project to meet the needs of the local community. Our ability to establish good interpersonal relationships with the client, as well as to really understand the needs of the local community and analyze the social and environmental aspects of engineering-related activities contributed to the performance of the project and the sense of pride that has followed within the community. The promotion of renewable energy, through design and construction respectful of health, safety, the environment and landscape, makes the Saint-Philémon project a positive reference for the image of the profession. It also helps to promote the realization of renewable energy projects within the profession. This project will encourage young engineers to take more interest in carrying out wind projects.

DISSEMINATION OF THE CONTRIBUTION TO THE PROMOTION OF THE PROFESSION AND HOW WE HAVE BENEFITED

In September 2015, WSP's national Marketing and Communications team launched a digital campaign with the aim of promoting the success of the WSP brand. Entitled "World of Possibilities", the campaign highlighted the way in which WSP engineers and specialists are able to see an infinite number of possibilities where some only see obstacles. This innovative vision held by the company is also supported by a micro-site specially created for the occasion. There are a number of example projects on there that are indeed extraordinary, all conducted by WSP.

The Saint-Philémon wind farm project appears in the list of celebrated projects. First and foremost on the micro-site there is a video presenting the technical challenges of the mandate and their resolution. Comprehensive and dynamic, this video especially illustrates how we harnessed the wind potential. Finally, the micro-site also includes a vast gallery of photos and some statistics about the project.

The marketing campaign won gold at the prestigious MarCom Awards in the "Digital Media, Microsite Service" category. This digital campaign emphasized the passion, innovation, attention, assurance and unity WSP engineers demonstrate in the projects they carry out on an everyday basis. The diffusion of the video and promotion of the micro-site thus certainly help to promote the profession.