Working with the weather on solar power

Canadian Solar faced some interesting weather challenges in building one of Canada's largest solar power projects, the 100-MW Grand Renewable Solar project, but the company was all over things in terms of planning, scheduling activities appropriate to the weather.

By Paul MacDonald

As any American who has ever checked the weather forecast knows, Canada has plenty of weather. It would be very easy to lose track of just how many cold fronts head down to the U.S. from its northern neighbor every year.

So it really came as no surprise that the construction of Grand Renewable Solar—which, at 100 MW, was then the largest solar power project in Canada—saw its share of weather during construction.

Grand Renewable Solar is located in Haldimand County in the southern part of the Canadian province of Ontario, where it can easily get up to 90 degrees in the summer months—and with the high humidity, it can feel like 100 degrees-plus.

When it came to weather, the crews really saw it all."The weather was quite a challenge on this project," says Mark Feenstra, senior manager, Canada Region, Canadian Solar. Canadian Solar was the EPC on Grand Renewable Solar, and Feenstra was program manager for the project.

"Over its 12 months of construction, we pretty much saw every possible type of weather. The first spring we were out there, it started to rain and continued to rain, and there were many days of boots getting stuck in the mud."

The site was relatively flat agricultural land that had historically been used for grazing and annual row crops. The soil at the site was a heavy clay that created issues during wetter periods, both in the spring and fall.

"And during the winter, we had one of the coldest Februarys in quite a while. It was consistently below zero on the site," said Feenstra.

Feenstra noted that project planning was important to ensure that construction activities were completed in a seasonally appropriate manner. For example, grading, electrical trenching, and foundation construction were completed in the spring, summer, and fall to avoid frost issues in winter. The racking and module installation was completed in the winter.

Overall, Feenstra noted that planning was key to the successful completion of Grand Renewable Solar. "A tremendous amount of work goes into these projects," he says.

Feenstra and his Canadian Solar colleagues started work on the project in early 2013, negotiating the EPC agreement with the project ownership group: Connor, Clark & Lunn Infrastructure (CC&L), Samsung Renewable Energy Inc. (SRE), and the Six Nations of the Grand River Development Corporation.

Once the agreement was struck, they had to move ahead full tilt to meet the deadline of completing the project in 2015. Commercial operation of the project was achieved in March 2015.

Canadian Solar brings a good amount of experience and management horsepower to every project it undertakes. The company is an industry-leading vertically integrated supplier that can provide fully integrated solar power solutions, including project development, engineering, equipment supply, construction, and operations and maintenance. Canadian Solar says it is the number two solar company in the world, with current manufacturing capacity of 4.6 GWp annually.

Canadian Solar has developed and/or constructed 1.8 GWp of solar projects internationally (800 MWp of that in Ontario). This wealth of experience allows the company to execute projects efficiently and effectively, says Feenstra.

That said, each project brings its own set of challenges—and one of the early challenges of this project was finding a site large enough to build a utility-scale solar project in southern Ontario, a region that is fairly developed already.

"A typical solar project in Ontario at the time would be about 10 MW, which would require 80 to 100 acres," explained Feenstra. Finding an even larger contiguous piece of land in southern Ontario for a much larger project, close to transmission or distribution lines, was challenging.

Once the site is selected, development typically moves on to the next stage from there.

"There are extensive environmental and archeological studies that solar developers are required to complete over a period of two to three years before construction starts," explained Feenstra.

Solar projects in Ontario go through a rigorous process to receive Renewable Energy Approval from the Ministry of the Environment and Climate Change. The process includes environmental studies, archaeological assessments, public consultation, and municipal consultation. During construction, Canadian Solar adheres to the commitments in the Renewable Energy Approval and implements best management practices for the protection of the environment, including erosion and sediment control measures and wildlife monitoring.

There were some Ontario domestic content requirements for the Grand Renewable Solar project as well. Canadian Solar, which has manufacturing plants in the Ontario cities of London and Guelph, was a good fit for that.

"There was a lot of planning on the component manufacturing side," said Feenstra. "There was enough manufacturing capacity available, but working to slot 100 MW of solar panel module manufacturing into the production schedule is challenging.

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The Grand Renewable Solar project required 15 kilometers of access roads, and there was a lot of traffic on those roads. There were more than 450 workers on-site at peak times and about 10,000 truck deliveries throughout the construction process.

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"With the racking and pile suppliers, that material all had to be Ontario-manufactured and produced by capable manufacturers who had the capacity to produce for a project this size."

The project was being constructed at the same time as many other Feed-In-Tariff solar projects in Ontario, so material suppliers were quite busy. To mitigate risks, the company selected first-class suppliers and worked closely with them to ensure their delivery schedules would meet project staging deadlines. For this project, Sunny Central inverters were procured from SMA Solar Technology AG, and Cosma racking was procured from Magna International Inc.

Before any solar-related work began, the site required some grading work, installation of material storage areas, and construction of approximately 15 kilometers of granular access roads.

And there were a lot of trucks travelling those roads. Feenstra noted there were a lot of different subcontractors and people working on the site, and coordination of activities and component deliveries for such a massive solar project was very important.

"You're looking at when and where you need to place people, lay down materials, and plan work so contractors aren't bumping into each other. There was a lot of coordination required." There were over 450 workers on-site at peak times and about 10,000 truck deliveries throughout the construction process.

Fortunately, Canadian Solar had some solid construction partners. The prime subcontractors on the project were ABB Inc. (electrical subcontractor) and Bondfield Construction Company Limited (civil and mechanical subcontractor).

ABB provided a balance-of-system solution for Grand Renewable Solar made up of a broad range of power and automation products, including ABB's flagship automation platform for conventional power generation and renewable applications, Symphony Plus. ABB was also responsible for engineering, electrical installation, commissioning, and performance testing on the project.

Bondfield Construction did the civil work, including the foundation design and installation and mechanical installation work. Bondfield is a full-service construction company based in Ontario.

Feenstra reports that Bondfield did geotechnical testing, and they developed a pile design based on the results of test piles. "The piling work was an ongoing process," he explained. "There were a few areas of the site that were bedrock, so they required a different pile design."

Generally, though, from a geotechnical perspective, the site was ideal for trenching, pile foundations, and building foundations, with very

limited bedrock encountered. According to Feenstra, bedrock in other areas of Ontario has created issues for electrical trenching, racking foundations, and building foundations.

They also wanted to achieve efficiencies with the test pile driving. "When you are doing 100,000 steel helical piles on a site, every second you can reduce off installing a pile can deliver significant savings," he noted.

The testing approach continued with the equipment above ground.

"One thing we've learned from past experience in terms of racking and solar modules, and the wiring that goes with it, is to start with a sample rack," says Feenstra. "We build a rack that meets all the specs and requirements that are expected, and get all the parties involved in the project to review it. Once everyone is in agreement on the setup, we set it aside as a reference standard. If we have any issues down the road, we come back to that rack."

Canadian Solar CS6X-P modules were used for the project. These modules are the industry standard for utility-scale ground mount projects, said Feenstra. The 72-cell modules offer significant installation efficiencies for ground mount projects in comparison to a 60-cell module.

The racking supplier shipped the rails and boxes of clips, bolts, and associated racking parts directly to the project site.

Feenstra said their subcontractor, Bondfield Construction, knew that there was a more efficient way to assemble the racking than doing it in the field, especially if they had bad weather conditions.

"They built a fabrication shop on-site, where they essentially pre-assembled as much as they could of the racking system," he explained.

If Bondfield couldn't completely pre-assemble parts of the racking in the shop, they put it partially together and completed it, or tightened it up, in the field.

"They had a series of wagons set up at the fabrication shop, so they could drive the wagons through the building, load them up, and then drive the wagons directly to the field." The approach worked like a charm.

Overall, Feenstra says, Grand Renewable Solar was approached as a manufacturing assembly line process. The various subcontractors started at the same point on the site and followed the project site in the same order. This required constant coordination because if one subcontractor encountered issues, it would delay subcontractors following closely behind and slow the entire process.

Feenstra says the biggest challenge of the project was managing the many subcontractors and ensuring that this "outdoor" manufacturing assembly line continued to run efficiently in all weather conditions. This required careful attention to procurement, planning, and on-site coordination.

Added to that, the project location was very space constrained for material storage and parking. Temporary staging areas were created for parking and material storage, and as materials were used, these areas were then converted to solar arrays.

In terms of workers and training, the approach, like other aspects of the project, was methodical.

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"We started out with a small number of workers on the site, to see how it worked, and then slowly built up the workforce to a higher level. We did not want to have too many people out there and be bumping into ourselves and losing efficiencies," says Feenstra.

"The idea was to start with a relatively small crew and get them well trained on the process and the most efficient way of erecting the racking and panels. We then broke that crew up, added new workers, and set up new crews, so the original workers could train the new people coming in. Then we broke it up again and continued on that way.

"That way, we knew that every crew out there was meeting the quality levels we needed and had the training to do the work correctly." Efficiency was also important, considering some 445,000 solar panels were used on the project.

Quality control is important with every solar project, but perhaps even more so with a large project, like Grand Renewable Solar, because once things got going, the project progressed very quickly. If something was missed, it could be costly.

"We wanted to be right on top of things—if an issue showed up a couple of days later, the crews could already be a couple of hundred meters further into the project."

Adequate labor resources were available from local communities and at peak times from larger neighboring communities, including Brantford and Hamilton. The subcontractors were generally experienced solar constructors so they were able to quickly train the local labor forces.

Being close to major centers had a couple of advantages, explained Feenstra. In addition to providing a construction labor force, much of the equipment for the project came from Guelph, London, and the Toronto area, so the site location reduced shipping costs relative to projects in more remote areas in eastern or northern Ontario.

The project offered some economies of scale, Feenstra said. The fixed project costs (such as mobilization, permitting, management, and overhead) were spread over a relatively large project size (100 MW). Also, after a brief learning curve during the training and ramp-up period, the workforce became very efficient throughout the remainder of the 12-month construction period, creating additional efficiencies.

Canadian Solar had a relatively tight timeline for the project but delivered the project on budget and on schedule.

There was a special feeling of pride on completion of the Grand Renewable Solar project, says Feenstra. "It was a big project and a big accomplishment for us," he said. "We're all quite proud of the work we did with Grand Renewable."

While the Grand Renewable project was certainly big, Canadian Solar has since eclipsed that with the Kingston Solar Project in eastern Ontario. Both projects have similar ownership groups and are 100 MW alternating current (MW AC). However, Kingston Solar is a bit larger with 463,000 Canadian Solar modules compared to the 445,000 modules on Grand Renewable Solar. e