PROJECT SUMMARY

The City of Kimberley, BC, wanted to become a "Green" community. Morrison Hershfield, in the role of Consulting Engineer, helped the City and its contractor realize their vision of building a unique dual tracking 1 megawatt solar photovoltaic plant in the area of its former but now abandoned zinc mining operation. The community now mines renewable energy from the sun at the appropriately named SunMine, the largest solar project of its kind in Canada.

INNOVATION

The City of Kimberley BC wanted to go "Green" by building a one of a kind renewable energy project on a former "brownfield" site, where a lead-zinc mining operation was once situated. Morrison Hershfield is proud to have helped the City and its Contractor realize this transformational dream.

SunMine is a 1 megawatt, dual tracking solar photovoltaic plant. All of the solar panels track the movement of the sun throughout the day, tilting and panning for maximum energy production. It is the largest dual tracking solar project in Canada, the first solar project in BC to be owned by a municipality and the first of its kind to have a purchase agreement with BC Hydro, selling energy directly to the province's grid.

Morrison Hershfield as Consulting Engineers provided electrical engineering design, structural engineering, technical advisory services and field services for this groundbreaking project. The solar plant covers an area of approximately 200m X 300m. There are 96 sub-arrays each with 42 solar panels. Each sub-array resembles a large table 12m long X 6m wide on a single 5m support pedestal. There are 4,032 solar panels and hundreds of precisely coordinated power and control cables.

The project was not without challenges. The plant is situated on very rocky, sloped terrain, making construction very difficult. The dual tracking system presented further challenges in terms of engineering the controls and synchronization. Design and construction took wind and snow conditions into consideration. The control of the panel movement incorporates automatic positioning of the solar panel sub-arrays (tables) to horizontal (flat) position during high winds. If snow accumulates on the sub-arrays during this time, they automatically go into a vertical position to dump the snow before returning to their angled position to start tracking the sun again.

The power from the solar panels is channeled via 32 inverters which convert DC power to AC power. The power from the inverters is further fed through a 1000 kVA transformer to step up the voltage to 7,200 volts. In order to connect this power to the grid, a 1 km long overhead pole line was constructed on the rocky hills from the solar photovoltaic plant area to a power substation. The substation further steps up this voltage to 69 kV for connection to the BC Hydro grid. The project's many regulatory, coordination and technical challenges were resolved using many innovative techniques uncommon to the consulting engineering industry.

COMPLEXITY

The solar photovoltaic plant is built on very challenging terrain. The construction of such a plant requires the excavation of numerous trenches for cable installation and excavation of large and deep holes in the ground for structural support. These activities are very difficult to perform on sloped, rocky land, making construction very complex. Construction machinery had to be carefully placed and expertly maneuvered to ensure safe operations. Another complication was the lack of a power source due to the project's remote location. A temporary source had to be brought in so that power tools could be used during construction.

The dual tracking system of the solar photovoltaic plant makes the solar panels track the sun in tilt position and in azimuth position (pan and tilt motion) for maximum energy production. The controls for the system had to be synchronized for all 96 sub-arrays, which are the solar panel tables comprised of 42 solar panels each, mounted on 5m pedestals. In the winter on a windy day the sub-array tables move to horizontal (flat) position to mitigate wind load. If in this position snow is accumulated on the table it moves to a vertical (upright) position to dump the snow before returning to tracking the sun.

The controls for such a system are extremely complex and had to be precisely engineered, coordinated, calibrated and tested. There are hundreds of power and control cables that are buried and not visible. Small amounts of power generated from the solar panels is channeled from the outputs of the inverters to the drive motors of the dual tracking system. There are 96 control panels and 32 inverters in the field. All of the wiring and controls are precisely coordinated such that solar tracking synchronization is achieved.

The connection of power from SunMine to the BC grid added another level of complexity in that long hours of innovative problem solving and constant communication were required to overcome the many technical, regulatory and legal hurdles that arose throughout the project. As a result, the system now functions as intended, and the project was successfully completed

SOCIAL & ECONOMIC BENEFITS

The City of Kimberley initiated a plan to build and showcase a renewable energy solar photovoltaic plant and have worked with project partners to achieve the social and economic benefits that they knew this unique project would bring to the community. The completion and subsequent operation of SunMine has transformed the image of the City of Kimberley from being a small tourist community with a history of mining operation to one that is serious about sustainability. Kimberley prides itself in having a history of resilience and forward thinking when it comes to creating its own future. Now the community boasts the largest dual-tracking solar photovoltaic plant in Canada.

Economic benefits include the fact that the energy generated by this plant is equivalent to providing electricity to approximately 250 homes. Building large power plants is costly and most regions prefer distributed generation topology. This project fits into the distributed generation topology and provides a small but clean energy injection into the BC Hydro grid. Another direct benefit is that by selling all of the electricity from this plant to BC Hydro, the City will be generating revenues that will be injected back into the community. Based on a rate of $0.08 per kWh, the potential revenue to the City is in the order of $150,000 per year.

Aside from economic benefits achieved through energy generation, SunMine is expected to benefit the regional economy through increased visibility and awareness as well as providing a competitive edge for future renewable energy initiatives.

ENVIRONMENTAL

SunMine demonstrates the commitment of the City of Kimberley to sustainability. The project provides numerous environmental benefits to the community and beyond, including, the provision of clean energy and greenhouse gas reduction. Sunmine is also the first re-development of a large reclaimed mine site into a solar farm in Canada. This is an innovative use of such brownfield sites which are often not suitable for other kinds of development without significant rehabilitation.

Based on statistical data obtained from Environment Canada and the U.S. Environmental Protection Agency, the greenhouse gas equivalent of generating electricity by traditional coal fired and gas fired plants is approximately 0.00059 metric tons per kWh. The statistical data for the operation of the solar photovoltaic plants shows the average number of hours the sunlight is available per day is about 5 hours. Based on this data, the amount of greenhouse gases that are displaced by the SunMine project is approximately 1,000 metric tons per year.

Greenhouse gases are mainly comprised of carbon dioxide (CO_2). According to the US Environmental Protection Agency, one vehicle produces 4.75 metric tons of CO_2 in a year. So if SunMine displaces approximately 1000 metric tons of CO_2 per year, it is estimated that the SunMine project is equivalent to removing approximately 210 vehicles from the streets of BC.

In general, renewable energy results in reduced greenhouse gases and contributes to reduced air and water pollution, improved air quality and is a positive step in fighting climate change.

CLIENT NEEDS

The City of Kimberley originally planned to build a 2 megawatt solar photovoltaic plant. The technology used in this project is relatively new and there are many uncertainties about the cost and the success of such a design, so after further study, the City decided to downsize the plant to 1 megawatt.

Morrison Hershfield provided Consulting Engineering services to the City's Construction Company and was instrumental in executing the successful engineering, procurement, construction and commissioning of the SunMine project, currently the largest project of its kind in Canada.

There were numerous technical and regulatory challenges during the design, construction and commissioning, such as BC Hydro's strict requirements on providing reactive power and on providing accurate Protection and Control Engineering of the power systems. A specialist in Protection & Control engineering was engaged for the final settings of the relays. Morrison Hershfield provided engineering services during many iterations of the design and installation documents. Approximately 1 km long overhead power line had to be built in the valley to connect the solar photovoltaic plant to a nearby power substation.

There were many parties involved in the project, namely: City of Kimberley and their Engineer, High Voltage Contractor, Photovoltaic Contractor, High Voltage Consultant, BC Hydro and Equipment Suppliers from the U.S., Germany and Canada. Morrison Hershfield provided engineering support throughout the project including acting as engineer of record and providing final sign off documents for the City and BC Hydro after having successfully met the needs of the City and its Contractor.

SunMine capitalizes on Kimberley, British Columbia's clear and sunny conditions using its innovative design to maximize performance benefits. It is an excellent use of a former brownfield site and a model for future solar energy initiatives in BC.

Photo Courtesy of City of Kimberley and SunMine