Taloyoak water treatment facility.

WORKING TOWARD WATER RESILIENCE IN TALOYOAK, NUNAVUT

The design, build, and installation of a package water treatment plant always presents challenges, but few can match the project completed in Taloyoak, Nunavut. While water system resilience is still an evolving term in the far north, the Government of Nunavut has taken a leadership role in working to provide the northernmost settlement on mainland Canada with a self-contained, environmentally- sound, water treatment plant. The project objective was not only to generate clean water all year round, but also foster local development and reduce contributions to climate change.

The village of Taloyoak is an isolated community of 700 people located on the shore of the Arctic Ocean at 69° 32' north latitude, 2,000 kilometres north of Edmonton. This distance creates accessibility challenges, in addition to challenges associated with the extreme cold. Added to these challenges were a "Triple Bottom Line" objective established by the Government of Nunavut. Usually cost is paramount, but the Taloyoak water treatment project also had equal weight given to social and environmental considerations. The Government of Nunavut requested a design with a minimal impact on the fragile northern environment.

Since there are no roads to Taloyoak, construction materials arrive each September on the annual sealift. An alternative – but considerably more expensive – delivery method is air freight, but this has significant size limitations. To further complicate matters, power generation in the high Arctic is normally provided by diesel generators, which means that fuel must also be transported to the community on the annual sealift.

To cut fuel emissions, reduce fuel supply costs, and meet the project's environmental "bottom line", the project team wanted to reduce dependence on diesel generators as much as possible. In response to these objectives, solar and wind energy were selected as the primary power sources, since they are renewable and non-polluting. A four-point approach was taken to utilize the advantages that each potential power source has to offer. The alternative sources of power for the community were community diesel-generated power, an onsite diesel generating system, solar power and wind power. The community diesel generated power provides added stability to the system, and a power supply for the periods without sun or wind. The onsite diesel power system is inside the water treatment plant and provides additional resiliency for emergency power.

The solar power component of the plant consists of 48 photovoltaic modules, 175 watts each, mounted on four support poles. Each bank of 12 solar modules is con-

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trolled by a sun-tracking device, allowing them to continuously follow the sun at an ideal angle. The combined solar modules have a total power rating of 8.4 kilowatts (kW), which, on a sunny summer day, produce nearly 40 kWh (kilowatt hours) of power.

Some of the solar power will be used to charge a battery bank made up of 48 batteries installed in the building. By using solar energy rather than relying solely on diesel generated power, more than 130 tonnes of carbon dioxide are not discharged into the environment each year. The entire on-site power consumption is 60 kWh per day, which translates into two-thirds of the total power supply potentially coming from solar energy.

To supplement the solar system, a small wind turbine was installed on a 21-metre-tall tower. Based on a mean wind speed in Taloyoak of approximately seven metres per second, the estimated wind power is 1.75 kW. Wind power generation does fluctuate, depending on wind speed and other variables, however, combined with energy storage batteries, it may provide a steady source of power.

The raw water supply for the treatment plant is Canso Lake, a 20-hectare lake 3.2 kilometres northeast of the community, which is seasonally recharged during the spring runoff. Despite ice thicknesses on the lake that may exceed two metres, the insulated and heated intake pipelines do not freeze.

The water treatment system process itself utilizes cartridge filtration with a 20-micron initial filter followed by a one-micron filter. Supplemental chlorination is used for disinfection and to provide a residual level of chlorine for the trucked water delivery system.

Providing Nunavut residents with relevant job skills was another key aspect necessary to meet the project's social ob-

Operation of truckfill system at Taloyoak water treatment facility.

jectives. The contractor worked closely with local labour resources for a successful construction phase. Operations training for the local staff followed the construction.

The training plan for the staff went beyond the normal expectations specified. A Remote Monitoring and Trending system was used throughout the warranty period. The system provided alarm reporting and data monitoring, as well as trending of important parameters such as chlorine levels, pressure differentials, pump speeds, flow, alarms and outputs from the turbidity and chlorine analyzer instruments. This information is available on computer screens in the Taloyoak operator's office, and at southern locations through the power of the internet. Ongoing training has been one of the results of using this system, with contractor resources available to help the operator diagnose problems in real time.

The water treatment system has been providing clean, safe water to the people of Taloyoak; however, operating alternate energy systems has been challenging because specialized maintenance knowledge is required. The alternate energy systems have had considerable downtimes as the "hiccups" of the new technology are worked through. Despite these hiccups, the Taloyoak water treatment facility is raising the bar for facility resiliency of water treatment systems in Nunavut.

Solar panel for water treatment facility in Taloyoak