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Reducing the Gaps in Northern Water Infrastructure

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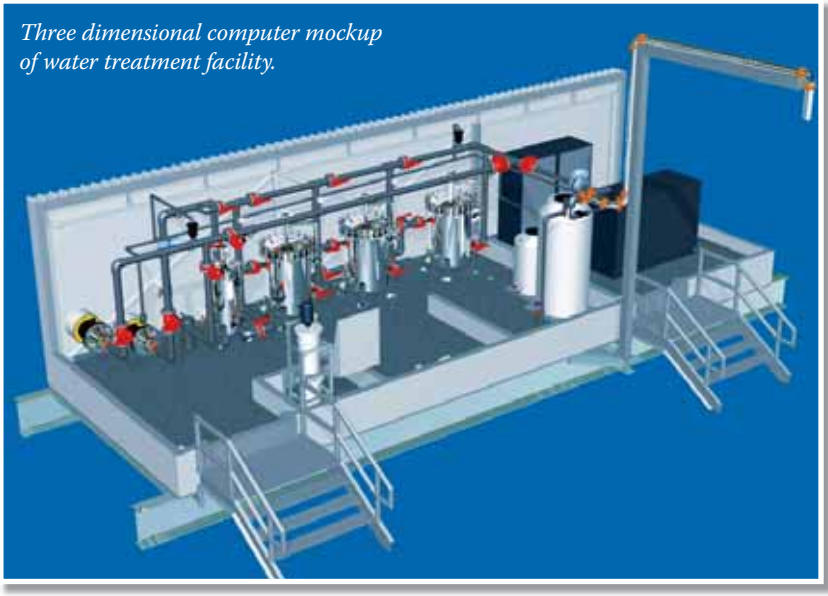
WATER TREATMENT FACILITY IN NUNAVUT

Cartridge filtration canisters in Taloyoak.



Three dimensional computer mockup of water treatment facility.

A challenge was set by the Government of Nunavut to provide the northernmost settlement on mainland of Canada with a self-contained, environmentally sound water treatment plant that will not only generate clean, pure water all year round, but will foster local development and help stave off climate change. This was the tall order faced by a project team consisting of Dillon Consulting Limited., BI Pure Water (Canada) Inc., Kitnuna Projects Inc., EA Energy Alternatives, Quilliq Energy and other local firms.

The Hamlet of Taloyoak is a community of 700 located on the shore of the Arctic Ocean at 69° 32' north latitude. Adding to the project's complexity was its "Triple Bottom Line" approach. Usually cost is paramount, but the Taloyoak water treatment project also had to give equal weight to social and environmental considerations. In particular, the Government of Nunavut requested a design with a minimal impact on the fragile northern environment.

To cut fuel emissions, ongoing costs, and to meet the project's environmental 'bottom line', the project team wanted to reduce dependence on diesel generators as much as possible. This would reduce not only the straight cost of the fuel, but also the added expense of shipping it from the south. As a result, solar and wind energy were chosen as the primary power source, since they are renewable, and non-polluting. A three power approach was taken to utilize the advantages of each power source. Alternative energy sources are prime power, with solar effective when there is sun and a wind turbine when there is wind. The main power source is grid power, as required in Nunavut by regulation, which supplies added stability to the system. Inside the water treatment plant is an emergency backup generator to supply emergency power when grid power is not available or when the alternative energy battery bank is low.

The solar power component of the Taloyoak treatment plant consists of forty-eight 175 Watt photovoltaic modules mounted on four support poles. Each bank of twelve solar modules is controlled 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 kW. On a sunny summer day, these cells can produce upwards of 40 kWh, equivalent to more than half a day of operating 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 a generator, almost 11 tonnes per month of CO_2 emissions to the atmosphere are eliminated. This corresponds to more than 130 tonnes of CO_2 reduction each year. The entire on-site power consumption is 60

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kWh per day, meaning that on an ideal day, up to two-thirds of total power usage can come from solar energy.

To supplement the solar system, a small wind turbine was installed on a 21 metre high tower. Wind power is proportional to the area that the turbine sweeps, the air density, and air velocity to the third power. Based on the mean wind speed in Taloyoak of approximately 7 m/s, the theoretical wind power is therefore 1.75 kW. Wind power does fluctuate depending on variables like wind speed, but if combined with energy storage batteries, it can help reduce dependence on fossil fuels. This helps to reduce CO_2 emissions even more.

Some of the renewable energy is used to heat the plant, but even so, the severe arctic weather required extra insulation. The walls have an insulation value of R30 and the ceiling is R40, using air tight, structural insulated urethane foam panels. The underfloor is also insulated to an R40 value.

The raw water supply is from an adjacent reservoir, which is filled each summer by melting snow. During winter the ice on the reservoir can be up to 3 metres thick. However, the insulated intake lines are installed below ten feet, and are heated to prevent freezing. The water quality objectives are for the treated water to have very low turbidity with a 4 log removal of virus species and a 2 log removal of cysts.

The water treatment system itself features cartridge filtration from 20 micron down to 1 micron Absolute, supplemented by chlorination to provide the required minimum residual level. Monitoring of water quality is accomplished by a manual chlorine analyzer. A return line to the reservoir allows recycling of the water if required.

The Taloyoak plant was assembled at the BI Pure Water facility in Surrey, B.C. and well tested before shipment. From Surrey, the modular system went by truck to Montreal, Quebec, and then north to Taloyoak on the sealift.

Providing Nunavut residents with relevant job skills was a key aspect in meeting the project's social objectives. Accordingly, BI Pure Water worked closely with local contractors for a successful installation phase, after which the few operational problems that surfaced were quickly identified and dealt with before the plant was commissioned.

The training plan for local staff went beyond the specifications in the tender

Unloading water treatment plant modular system in Taloyoak.

documents. BI Pure Water supplied its "Remote Monitoring and Trending" system for the warranty period. The system provides alarm reporting and data monitoring as well as trending of important parameters such as chlorine level, pressure differentials, pump speeds, flow, alarms and outputs from the turbidity and chlorine analyzer instruments. This information is available on computer screens in Taloyoak, and at the BI Pure offices in Surrey. Ongoing training is the result, with BI Pure staff available to help the operator diagnose problems in real time.

The water treatment system now providing clean, safe water to the people of Taloyoak is modern, efficient, and cost-effective. The system is also establishing a new benchmark for Nunavut water treatment facilities by incorporating environmental sensitivity through a reduction in fossil fuel use, and social responsibility through local skills development.