Medium Voltage DC Investigation for Remote Communities

Manitoba HYDRO INTERNATIONAL

Remote communities, such as those located in Northern Canada, have long been dependent on diesel generation as their power source.

This method of generation is associated with significant disadvantages:

- Limited electrical service (no electric heat)
- High operating costs related to fuel and transportation
- Challenges associated with transportation and limited access
- Negative environmental impact of diesel emissions

It is highly desirable to provide an access to alternative energy sources or con- nection to the grid for these remote communities in order to reduce their depen- dency on diesel fuel. As a part of this initiative, Manitoba Hydro International Ltd. (MHI) proposes investigation of the feasibility of Medium Voltage DC to inter- connect remote communities in North America and elsewhere in the world.

Diesel Generator Example

Medium Voltage DC

While typical AC electrical circuits require three phases (wires), Medium Voltage DC ("MVDC") is a two-wire DC system designed using the latest advances in the Voltage Source Converter (VSC) DC technology. This unique design offers the following advantages:

Capital Cost Saving

Reduces pole, wire, and hardware investments due to design simplicity (smaller towers and wires than for an AC interconnection)

Improved Efficiency

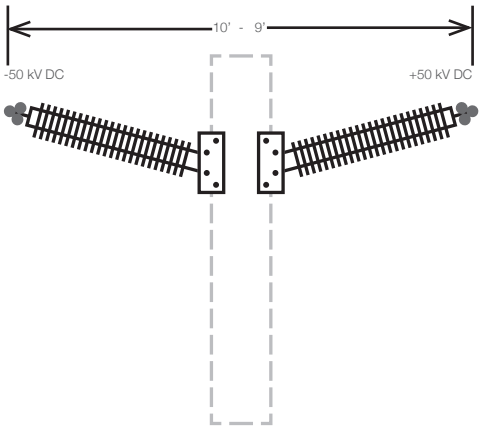
Allows energy providers to reduce electrical losses over long distances due to DC, reduced voltage levels, and multi-terminal capability

Scalable Transmission

Allows energy providers to increase the load based on growing energy needs

Quality of Life Improvement

Provides an opportunity to extend fibre optic cables to remote communities, thus establishing an optical communication system and enabling access to high speed Internet, remote education, and medical services



Hypothetical Tangent Pole for MVDC Symmetrical Monopole Intertie Line

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Proposed MVDC Development

Typical commercial Voltage Source DC systems operate at large currents (2,000 - 5,000 Amps) and high power levels. The majority of remote communities, however, have low loads (1-10 MW). In order to address a poor match of power system rating and requirement, a new Medium Voltage DC technology is proposed.

In contrast to conventional DC systems, MVDC requires high voltages levels but very low-current transmission. For example, +/- 50 kV at 10 Amps is equal to 1 MW of energy transfer, enough to address the needs of most remote communities.

MVDC proof of concept has been demonstrated by an investigation of interconnection of remote villages in Alaska.

For more information, please see “HVDC Transmission System for Remote Alaska Applications: Phase I” report prepared for Denali Commission of Alaska.

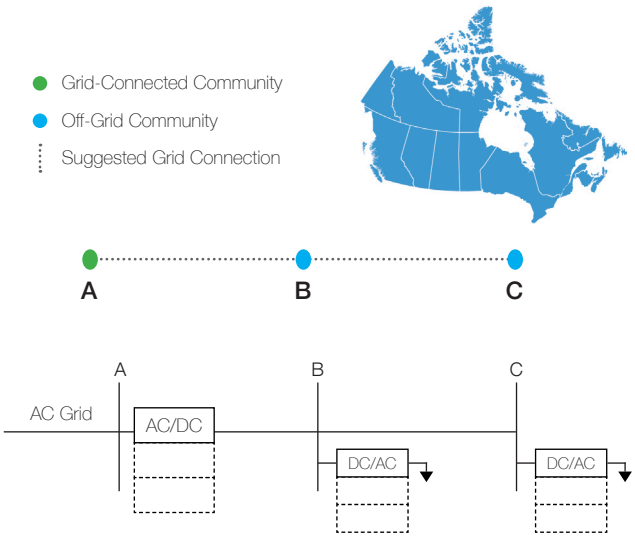

Figure 1
Schematic AC to DC Interconnection

138 kV AC Link (100-200 MW of Energy Transfer)

Applications

Medium Voltage DC represents a viable alternative to AC interconnection to provide power to remote communities around the world. While these communities typically have low loads (1-10 MW), a high voltage AC grid (for example, 138 kV) is required due to long interconnection distances. Such AC systems could transfer 100-200 MW of energy, far in excess of what is required. Using MVDC offers a cost- efficient, scalable method of achieving benefits of interconnection.

Implementation

Development of the suggested MVDC system for remote communities is proposed to be conducted by MHI in collaboration with interested parties.

The development plan is proposed to include:

- Development program for new low-current VSC MSC valves
- Development program for cost-effective transmission line design & installation suitable for remote conditions

Manitoba Hydro International Ltd. is a world leader in power system simulation innovation and applied engineering solutions. As the developers of the world-renowned PSCAD™/EMTDC ™ software, we recognize the importance of collaborative partnerships and technologies in the global power industry.

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Accessible formats available upon request.

mhi.ca