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HIGH VOLTAGE DIRECT CURRENT (HVDC) TRANSMISSION SYSTEMS FOR ALASKA

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The Denali Commission has funded development of an emerging energy technology that aims to reduce the cost of electrical interties for Alaska's villages. Large-scale HVDC is a proven technology used around the world to move power, but utility-grade HVDC systems of the very small size needed to connect Alaska's villages are not yet commercially available. This project is developing a small-scale HVDC power transmission system that will lower the cost of village interties, thereby reducing village energy costs.

Work on this project began in 2008 with a feasibility analysis of the technology and concept. Design and testing of the power equipment is currently in progress, and will be completed later this year. By October 2011, all of the critical elements necessary to build a low-cost HVDC intertie will be developed.

HOW DO INTERTIES REDUCE COSTS?

Most of Alaska's villages individually make electricity from small diesel gensets. This approach lacks economy of scale, making it hard to lower costs. Connecting villages increases the scale of the electric system, making more lower-cost energy solutions practical, such as:

- *Larger, more efficient, lower unit-cost diesel generators*
- *Larger wind farms located in better wind areas*
- *Consolidated utility operations/management*
- *Centralized or regional biomass or coal plants*
- *Consolidated bulk fuel facilities*
- *Geothermal developments*
- *Fewer, larger hydroelectric projects*
- *Local gas fields*

WHY HVDC?

HVDC interties can be less costly and more reliable than alternating current (AC) interties. HVDC can also be used in places where AC cannot, such as long-distance submarine cables. Cost savings of 15 to 50% are achievable with this HVDC technology, compared to costs on recent remote Alaska AC interties. The advantages that enable these cost savings include:

- Fewer wires aloft. Three-phase AC systems require three or four wires. An HVDC system using ground return needs only one wire aloft. Fewer wires means less force on the poles. Also, there is no need for the cross-arms that keep the wires from touching, reducing complexity and cost. The result is longer spans, fewer poles, less hardware, less wire, and lower cost.

- Submarine or buried cables. HVDC can use submarine or buried cables for long-distance transmission, something AC transmission cannot always do. In many parts of the state, cables may be a better technical or economic solution than overhead lines.

- Asynchronous interties. HVDC has no phase or frequency, so there is no need to synchronize village grids before connecting them. This can make an HVDC network simpler to manage than an AC network. Multi-terminal HVDC systems are still in development, but once commercialized, their simplicity is expected to provide an advantage over AC for small remote grids.

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- Renewable Energy. HVDC can be a superior intertie system for some renewable energy technologies that have fluctuating power output. These include wind, hydrokinetic, and similar technologies that harvest intermittent energy resources.

- More Local Energy Resources. Lower cost interties enable villages or remote grids to reach farther out to local energy resources, increasing the number of potential affordable local energy solutions. A small hydro site 10 miles from a village may be affordable with HVDC, but not with an AC intertie.

WHAT'S NEXT?

The next step to commercialize this technology is to build a functional demonstration intertie in Alaska. This intertie will be operated to evaluate performance of innovative aspects of the system, collect data for future projects, and most importantly to demonstrate that this HVDC system is a proven, utility-grade, low-cost intertie option that works under Alaska conditions.

Polarconsult is currently evaluating potential utility partners for demonstrating this technology, and expects to have a demonstration site and partner by the end of February 2011.

The cost of the demonstration phase will depend on the location and particulars of the demonstration project. Preliminary budgets for two demonstration scenarios are provided below:

- Build a short section of new AC distribution line, operate as a HVDC link for testing, revert to AC after demonstration is completed. *(assumes good access to project, on the road system)* — $1,100,000

- Build a new 20-mile HVDC intertie between two villages, operate as HVDC for testing and evaluation, continue as HVDC permanently. *(assumes project is located in Bristol Bay or similar region)* — $4,300,000

The demonstration phase of this project is scheduled to get underway in the winter of 2011 / 2012. This is contingent upon finding a site and funding compatible with this schedule.

FOR MORE INFORMATION...

View the Project Website at:

http://energy-alaska.wikidot.com/high-voltage-direct-current-transmission

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