

## **An Alternative to the 34.5-kV Line to Bayfield**

A proposal to spend \$26 million to extend a second 34.5-kV line from the Ashland Area north to Bayfield is under review. The project is based on keeping the Bayfield Substation 34.5-kV voltage above 90% of nominal when the system is intact at summer peak, and to prevent loss of service in the greater Bayfield-Washburn Region if the existing 34.5-kV line goes out south of Barksdale (or Washburn).

An alternative solution could be a solar generation expansion with battery backup in the Bayfield Area. Here are some thoughts:

### **A Better, Wetter and Sunnier, Solution Washburn-Barksdale Reliability**

This area has about 8 MW of summer load, about 80 percent of which is in Washburn.

One alternative to a land line would be a second 34.5-kV source to Washburn via submarine cable from the east side of Ashland, where a 34.5-kV pole line from Gingles Substation runs south of Highway 2 in the vicinity of L&M Supply. An underground line across Highway 2 and through a City of Ashland park to the city bike path where the new line would connect to a submarine cable is one option. The submarine cable would cross Chequamegon Bay east of the Ashland Water intake and proceed north to Washburn to a location southwest of the fishing pier, where it would connect to an underground cable that would connect to the existing Xcel Tap Line about a block west of Washburn Iron. Estimated cost \$16 million including an additional substation by the washburn sewage treatment plant.

This option would eliminate the need for the proposed 115-kV and 34.5-kV substations at the north and south ends of the proposed new line totals, saving about \$14 million. It would also eliminate the need for the two new substations.

The new underwater line would protect Washburn and Barksdale load from all single-contingency line outages. It would also raise the voltage at Washburn for normal and contingency conditions. Under system-normal conditions, it would also raise the voltage at Bayfield. It would permit use of capacitors at Washburn and perhaps even at Bayfield.

Because it would raise normal voltage at Bayfield, it would permit rebuilding of older sections of the old north coast 34.5-kV system from Bayfield west to Iron River.

It would achieve all of these benefits with an estimated savings of about \$10 million overall in terms of transmission cost.

## Bayfield Region Reliability

The Bayfield Region includes Bayfield, the Town of Bayfield, Bayview, Red Cliff, the Town of Russell, and the Town of La Pointe (Madeline Inland, which is in Ashland County). The summer peak here is about 9 MW, much higher than winter peak, about 8 MW at Xcel's Bayfield Sub and 1 MW at BEC's Bayfield Sub along Star Route.

At summer peak, the existing 34.5-kV line from Cornucopia cannot support all of the Bayfield Area load by itself, much less the Washburn and Barksdale Area load too.

However, with a new submarine cable into Washburn, the apparently vulnerable Bayfield Area load for the worst contingency, loss of the Washburn to BEC Bayfield segment of the present 34.5-kV line, would be 9 MW, not 17 MW.

The actual vulnerability would be about 8.5 MW as some large BEC customers (members) in the West Red Cliff Area, including the UWSP Aquaculture Facility and Red Cliff Health Center, are interruptible. These customers have diesel generation which they have agreed to operate during transmission outages.

### **A Solution for the Bayfield Region**

The original proposal provided a 34.5-kv line to Bayfield. Here is an alternative.

1. Solar-plus-storage facility or facilities: 5 MW of solar capacity and 10 MWh of battery storage at one or two locations in the Bayfield Region. This facility would provide up to 5 MW to restore the system.
2. Red Cliff casino generation: 1 MW of diesel generation to operate in an outage situation
3. BEC Barksdale-to-Bayfield trickle charge: up to about 0.5 MW of load transfer from Barksdale to Bayfield via BEC's existing distribution line after the big customers near Red Cliff are interrupted, if necessary using an upgraded voltage regulator to keep voltage within limits for BEC Bayfield Substation customers
4. Cornucopia 34.5-kV AC trickle charge: up to about 3 MW of power from Cornucopia to Bayfield at peak via existing "piano wire" line<sup>1</sup>

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<sup>1</sup> The effectiveness of the Cornucopia tie is currently limited by the length of the line from Iron River and its relatively high impedance (with small conductors on some segments). As more line segments west of Bayfield are rebuilt this impedance will decline, and the ability of the line to support Bayfield will increase somewhat. That ability is also constrained by the 115-34.5-kV transformer at Iron River. Currently, the Bayfield-Cornucopia line has a very small conductor. It is operated normally open at the Bayfield end according to Jason, Xcel's transmission engineer at the August 30 informational meeting. A response to an outage of the 34.5-kV source to Bayfield could involve transferring BEC load to Barksdale, starting and running the Red Cliff generators, bringing back some feeder load, turning on the solar storage to bring back more feeder load, and then closing the tie to Cornucopia to bring back the rest of the feeder load. As load

## Power Restoration

With the measures outlined above, power could be restored rapidly after a worst-case outage.

When the system is below peak demand or there is significant solar output at the time of an outage, the second and third measures outlined above would not be needed to restore service. The solar energy storage facility, with some help from the Cornucopia line, would be adequate.

## Clean Energy Benefit

Under this scenario the solar-plus-storage facility would help turn the lights back on in Bayfield, but every day, even cloudy days, it would be producing local clean energy, reducing Xcel's carbon footprint and minimizing energy losses on the Xcel transmission system. Bayfield is at the northern end of that system. Xcel experiences significant losses in pushing energy to the ends of its Wisconsin system. Some of that energy is generated in places as far away as the Twin Cities and even Southwest Minnesota. Losses almost certainly exceed 10 percent and may approach 20 percent at peak times. Solar projects tend to produce during times when electric use and losses are above average creating savings for all involved.

A solar project, especially coupled with battery storage, would provide grid-support, called ancillary services, that include load regulation and voltage support, and add value to the grid.

The entire region would benefit both in terms of reliability and loss reduction and in terms of transitioning toward more sustainable energy. There would be considerable good will and a good pilot, in a small setting for Xcel to explore and consider.

A large solar-plus-storage facility would be well received in the region and enhance the public image of all entities involved. Both Xcel and BEC would likely benefit. To the extent that Dairyland could purchase power from a solar facility, it would also generate good will for Dairyland.

## Conclusion

A benefit of the solar-plus-storage facility in addition to the submarine cable to Washburn is that the "wet and sunny" approach would permit deferral of the more

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would decline, the Red Cliff generation could be discontinued and the solar battery discharge could be reduced from the 5 MW level. This restoration scenario conservatively assumes no solar output. At summer peak, especially using single-axis tracking collectors, there normally would be solar output, so restoration would be easier. The outage might be avoidable altogether after the lines west of Bayfield are rebuilt if the line to Cornucopia is left normally closed and the solar facility battery is designed to automatically back up the line from the south.

expensive transmission solution Xcel has identified, avoiding about 25 miles of above-ground line and approximately a \$10 million net utility investment while also reducing transmission losses and improving reliability in serving the Bayfield Area.

Robert H. Owen, Jr.  
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