Cascade Renewable Transmission Project

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Chris Benson
PowerBridge

Corey Kupersmith
Sun2o Partners
What is HVDC?

HVDC = High Voltage Direct Current

- AC power from the Grid is converted (rectified) at an HVDC converter station near generation
- DC power is transmitted over long distances directly to another HVDC substation near the load center
- DC power at that station is inverted back to AC power and is sent back into the Grid

Two Terminal HVDC System
Why HVDC?

- Controllability of power flow / reactive power
- Low losses over long distances
- Long underwater routes can be used (>50 miles)
- Newer HVDC converter stations provide massive voltage support to surrounding AC Grid at each HVDC substation
- No wildfire risk in submarine/underground cable applications
- No visual impacts along cable route
- High reliability
- Connect asynchronous AC networks
- Black Start capable
# HVDC Submarine Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Country</th>
<th>Miles</th>
<th>Rating</th>
<th>Voltage</th>
<th>Online Date</th>
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<td>ElecLink</td>
<td>UK-France</td>
<td>32</td>
<td>1000 MW</td>
<td>320 kV</td>
<td>2022</td>
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<td>North Sea Link</td>
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<td>BorWin3</td>
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<td>800 MW</td>
<td>300 kV</td>
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<td>Hudson*</td>
<td>NJ/NY, US</td>
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<td>345 kV</td>
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<td>400 MW</td>
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<td>330 MW</td>
<td>150 kV</td>
<td>2003</td>
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</table>

*Projects developed and operated by PowerBridge*

**Note:** There are many more HVAC aboveground and submarine cables worldwide, notably for offshore wind. One particular advantage of HVDC is the ability to transmit large quantities of energy over long distances underwater.

Over 150 HVDC projects in operation worldwide including the Pacific DC Intertie, which, while an aboveground line, originates in The Dalles, OR.
HVDC Submarine Cable

The main power cable is less than 6 inches in diameter; two cables are bundled with a fiber optic cable for burial in the riverbed.

The “jet plow” is towed by a barge or ship. Water jets in the plow blade create an 18-inch-wide trench by fluidizing the sediment while the cable is simultaneously laid into the trench, and the sediment settles back down over the cable.
\begin{itemize}
\item 65-Mile-Long, 660-MW HVDC cable linking PJM electricity market with Long Island Power Authority ("LIPA")
\item 51 miles of cable buried undersea, 14 miles underground; two converter stations
\item Completed June 2007 – under budget and ahead of schedule
\item $650M total cost, financed in the private capital markets, with investment grade rating
\item Financing based on a 20-year Firm Transmission Capacity Agreement with LIPA
\item Learn more by visiting project website \url{www.powerbridge.us}
\end{itemize}
CRTP Route Summary

Overview

- 1,100 MW line rating
- VSC HVDC System
- ~100 Miles underwater and underground
- Bridge the Cascade Mountains while minimizing environmental impact

Western Interconnection (Harborton)

- Converter Station with direct connection to PGE's Harborton Substation outside Portland
- Deliver renewable energy located east of the Cascades into Portland and up the I-5 corridor to Seattle

Eastern Interconnection (Big Eddy)

- Converter Station with direct connection to BPA's Big Eddy Substation outside The Dalles
- Source abundant renewable energy in the heart of BPA's transmission network
Cross Cascades Constraint

BPA Renewable Interconnection Queue Analysis (MW)

- West of Cascades Resources: 0.8% of Total
- East of Cascades Resources: 99.2% of Total

BPA ATC Less Pending Queue on Cross Cascades South (MW)

- Demand for Cross Cascades Transmission begins to exceed available supply
- New Transmission is needed to deliver east of Cascades renewables to west of Cascades load centers

Source: BPA ATC Less Pending Queue as of 12/21/2021, BPA Active Generator Interconnection Queue as of 12/21/2021. Includes interconnection requests Received, In Study, and Completed Study. Does not include Withdrawn or Energized projects or any proposed stand alone Battery Energy Storage projects.
Conclusion

- The Cascade Renewable Transmission Project is now in the permitting stage, planned for completion in Q4 2027

- For further information about the Project, please visit http://www.cascaderenewable.com

- Chris Benson: cbenson@powerbridge.us

- Corey Kupersmith: corey@sun2o.com