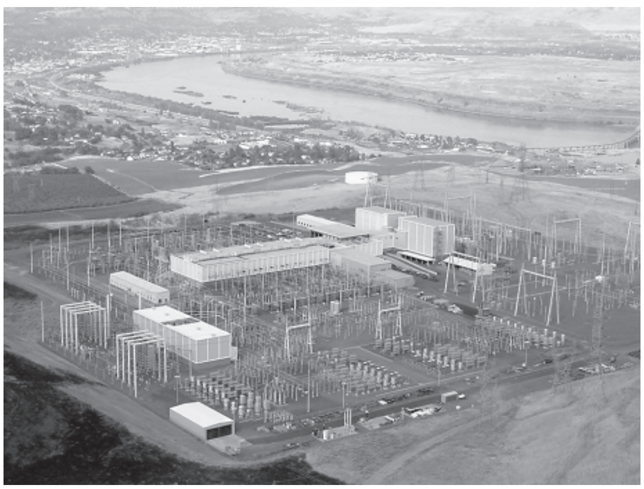
October 2005

Celilo Converter Station

The Pacific High-Voltage Direct-Current Intertie was the first commercial direct-current transmission system built in the U.S. It connects the Pacific Northwest through an 846-mile (1,354-kilometer) line with the Pacific Southwest, with terminals at Celilo in The Dalles, Oregon, and Sylmar, near Los Angeles, California. Converter stations at each end of the line change alternating-current electricity to direct current and back.



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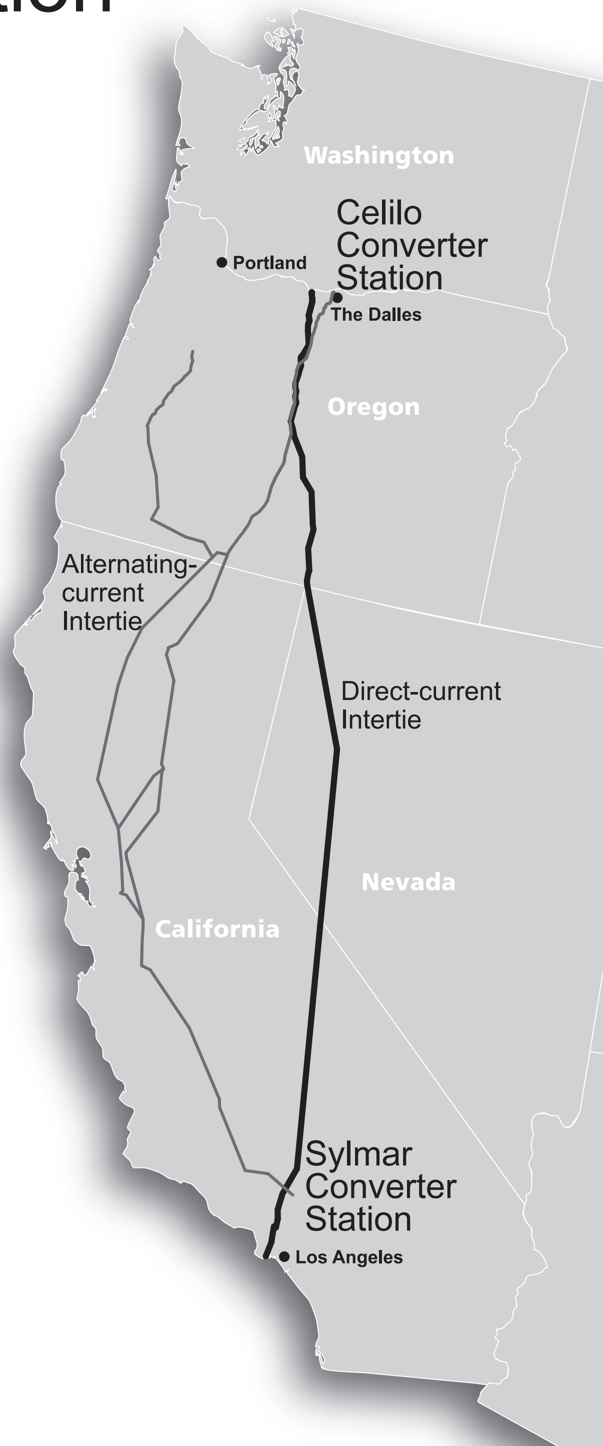

The Pacific Intertie is one of the nation's longest transmission systems. The DC intertie carries up to 3,100 megawatts.

History

The Pacific HVDC Intertie has been expanded or upgraded five times since it was built in 1970. The original intertie had a capacity of 1,440-megawatts and used mercury arc converter valves.

In 1982, intertie capacity was uprated to 1,600 MW by increasing the current, taking advantage of design margins in the equipment.

Pacific HVDC Intertie Expansions and Upgrades

	Original 1970	Uprating 1982	Upgrade 1985	Expansion 1989	Modernization 2004
Total Capacity	1,440 MW	1,600 MW	2,000 MW	3,100 MW	3,100 MW
DC Voltage	+/-400 kV	+/-400 kV	+/-500 kV	+/-500 kV	+/-500 kV
DC Current	1,800 amps	2,000 amps	2,000 amps	3,100 amps	3,1000 amps

The 1985 upgrade project added two 100-kilovolt thyristor valve groups in series with the mercury arc groups, increasing the voltage from 400 to 500 kV. This raised the capacity to 2,000 MW.

In 1989 an expansion project increased system capacity to 3,100 MW by adding two new twelve-pulse converters to operate in parallel with the mercury arc valve groups and the 100-kV thyristor valve groups using the same transmission line.

The latest station upgrade was completed in June 2004. The modernization project replaced the last of the original vacuum-tube mercury arc valves with solid-state silicon-based thyristors. The original equipment had lasted more than twice its expected life through careful operation and maintenance. Now, Celilo should continue to keep the DC intertie humming at 3,100 megawatts for another 35 years or so.

The modernized Celilo is cooler, safer and ecologically improved. The new thyristors eliminate reliance on mercury for power conversion. Asbestos has been removed from the station. Old, noisy, maintenance-intensive air-cooling has been replaced with an efficient, closed loop water-cooled system. Chemical use for water treatment and overall water consumption by the station has been significantly reduced. Improved fire protection and lighting also contribute to making Celilo a safer place to work.

What is direct current and why use it?

Electricity can be sent by direct current or by alternating current. DC flows steadily in one direction. AC changes direction in the wire 60 times a second.

AC dominates the power scene for everyday use. Almost all electrical devices in American homes and businesses work on alternating current because of the ease of interruption and transformation.

DC is the most economic method of delivering large amounts of power across long distances. While the conversion process requires expensive equipment at each terminal, power losses on DC transmission are lower for distances of 400 miles or more, so more power is delivered. DC power can flow in either direction and both terminals operate as either converter (AC to DC) or inverter (DC to AC) as power deliveries are scheduled. In addition, DC requires only two suspended conductor cables, AC needs three which means that DC towers and conductors don't cost as much as AC.

BPA has three AC intertie lines to Northern California. One advantage of AC intertie lines is that they are tapped for many delivery points along the way. Presently, DC lines cannot be tapped. So, AC lines are more flexible because they can distribute power at various points.

The DC intertie was originally built to capitalize on hydropower production in the Northwest during spring and early summer runoff by supplementing fossil fuel generation at the Southwest end of the line. Steam generation is not as load responsive as hydropower. Today, the DC intertie serves as a redundant transmission system, acting like a shock absorber between the Northwest and Southwest systems and making the entire system – alternating current and direct current – more reliable.