



## **The complete story about the Pacific Intertie HVDC Link – up until 2013**

**At the beginning of the 1960s, major hydropower resources were being exploited on the Columbia River in the north-western United States. The Federal authorities, who own the power resources in the north, were able to offer electricity at rates so far below the production costs in Los Angeles as to make long-distance transmission economical. At that time ABB had already completed a number of HVDC projects, having developed the technology over several decades. The US authorities were consequently interested in introducing this technology in the USA.**

**Over the years ABB has been heavily involved in the Pacific HVDC Intertie, from the first contact in 1965, major expansions and rebuildings. The fifth order will be put in service in 2016.**

### **First order 1965: The largest ABB project with mercury-arc valves.**

In 1965 ABB was awarded a contract together with General Electric for two converter stations for a 1440 MW,  $\pm$  400 kV transmission scheme, the Pacific Intertie. Although the technology was well established by then, the contract nevertheless represented a challenge to both the owners and the suppliers, since the line voltage, the line length and the line current were greater than for any previous HVDC project, making it the most complex yet. The site chosen for the northern terminal was The Dalles, Oregon, which lies close to several large power stations on the Columbia River, with Bonneville Power Administration (BPA) as owner. The southern terminal was located at Sylmar, in the northern tip of the Los Angeles basin. Sylmar is owned by five utilities, with the Los Angeles Department of Water and Power (LADWP) acting as the managing and operating agent.

The mercury-arc valve formed the basis of ABB's HVDC development work in the 1960s. When the contract for the Pacific Intertie was signed in 1965, 4-anode valves of this type for 125 kV and 1200 A, with two 6-pulse converters in series, were in operation. The bold step was now taken to adopt 6-anode valves designed for 1800 A and 133 kV per converter and with three groups in series, for a transmission scheme rated  $\pm$ 400 kV, 1440 MW.

ABB's undertakings for the Pacific Intertie contract in 1965 included system studies and system responsibility, the manufacturing and supply of the converter (mercury-arc) valves plus special apparatus and the control equipment, and also the commissioning.

The transmission scheme entered into operation in 1970, but shortly after this (in 1971) the San Fernando earthquake devastated the Sylmar converter station. The station building was severely damaged, as was much of the equipment, and it was not until 1973 that the station was rebuilt and operation could be restored. After a few years of operation, the owners decided to make use of the inherent capacity of the equipment and raise the transmission rating to 2000 A and 1600 MW.



## **Second order 1982: Rising the voltage to 500 kV**

Up until the first energy crisis in the mid-1970s, power consumption was increasing strongly. A number of projects aimed at securing the long-term supply of power to Los Angeles were outlined. These were necessary not only to meet the demand, but also because it was desired to close down a number of older, uneconomical local power stations and to reduce dependence on oil-fired and gas thermal plants. It was against this background that it was decided to investigate new projects and also the possibility of raising the capacity of existing transmission schemes.

Eventually it was agreed to raise the line voltage of the Pacific Intertie. This led to the creation of the Pacific Intertie Upgrade (PIU) project for which ABB received the order.

The PIU essentially consisted in putting a 100 kV 6-pulse thyristor converter in series with the three mercury arc converters in each pole. The upgrade was commissioned in 1985.

## **Third order 1985: Extending the transmission rating to 3,100 MW**

In 1985 another contract was awarded to ABB for the extension of the PI transmission rating from 2,000 to 3,100 MW. This project was called the Pacific Intertie Expansion (PIE). New 1,100 MW converter stations had to be installed in parallel with the existing stations and the current in the DC line was raised to 3,100 A

## **Fourth order 2002: Rebuilds Sylmar into a single bipolar converter station for 3,100 MW**

The Sylmar Converter Station's mercury arc valves sustained damage during the January 1994 Northridge earthquake. Furthermore, the mercury arc valves were nearing the end of their designed life. In 1999 the Sylmar Partners (Los Angeles Department of Water and Power (LADWP), Southern California Edison (SCE), and the Cities of Glendale, Burbank, and Pasadena) decided to build a 500 kV, 3,100 MW converter at the existing Sylmar East facility.

This was achieved by upgrading and modifying the existing Sylmar East converters from 1,100 to 3,100 MW and by using the existing control building and valve halls and as much of the existing equipment as possible. ABB was awarded the contract in 2002 and the station was put into service in 2004.

## **Fifth order 2012: Refurbishment and upgrade of the Celilo station**

To secure the reliability of this major power supply to California, Bonneville Power Administration (BPA) decided to make a complete upgrade of the existing HVDC converter station Celilo. The voltage was raised to  $\pm 560$  kV and the capacity to 3,800 MW. The Celilo Upgrade optimizes the use of the existing infrastructure with increased capacity plus the desired increased reliability.

For ABB, the upgrade includes valves, control and protection system, cooling, transformers, harmonic filters. ABB was awarded the contract in 2012 and the commissioning year will be in 2016.