

The 800 kV Yunnan – Guangdong UHV DC Project in China

From vision to reality

Today the worldwide first Ultra High Voltage Direct Current (UHV DC) project, Yunnan – Guangdong, China owned by China Southern Power Grid successfully passed the open-line-test at the substation Chuxiong located 1850 Meter above mean sea level, in LuFeng County of Yunnan province of China. It is a milestone in HVDC history. From first plans of building an UHV DC in 2005 the vision now became reality.

During this time the development of the $\pm 800\text{kV}$ UHV DC did not represent an unreasonable risk. Nevertheless challenges for new developments of DC equipment, manufacturing and testing facilities for e.g. converter valves, wall bushing, DC bypass breakers, DC disconnectors, DC arrestors, DC current and voltage measurement, DC capacitors etc. had to be managed.

High requirements on external insulation and testing levels, the relationship between internal and external stresses had to be handled. For transformers but not only, basic work has been needed in understanding short term and long term effects of DC stress and use of appropriated insulation grading and barriers. A coordinating R&D program in few key areas was necessary to ensure the availability of design for the first UHV DC equipment which was successfully handled by Siemens (information see [newsletter 09/10](#)).



Fig. 1: 3D Model of one substation of the Yunnan – Guangdong UHV DC

Then, in June 2007, Siemens has won the first UHV DC order worldwide from China Southern Power Grid Company, Guangzhou, to construct a high-voltage DC transmission (HVDC) system between the province of Yunnan in the southwest of China and the province of Guangdong on the south coast of the country, together with Chinese partners ([newsletter 07/07](#)). The system is the first in the world to transmit electricity at a DC voltage level of $\pm 800\text{ kV}$ (fig. 1). At the same time this project with a power transmission capacity of 5000 MW is the long-

Issue 0912

HVDC/FACTS - Highlights

distance HVDC link with the worlds highest ever power capacity which has been built. Anyhow even of new developments, significantly increase in size and quantity of supplied goods, the short delivery time remained a tough challenge for the project team.

Beginning with October 2007, Siemens started to announce on a regular basis successful passing of newly developed 800kV DC equipment. Most of these became type tested in the newly built 800kV testing facilities at Cologne. In August 2008 the type tests of Converter Valves was successfully finished at Cologne testing laboratories (see figure 2).

In the beginning of October 2008 Siemens announced the successfully passed final acceptance test at its transformer factory in Nuremberg of the world's first 800-kV transformer.

To upgrade transmission capacity, the operating voltages have been increased to 800 kV, 60 percent higher than the peak DC transmission voltage of 500 kV normal for today's HVDC transmission systems. This has been achieved by using many innovative solutions based on many years of experience in the construction of DC equipment converter transformers.

Now during the open-line-test the substation Chuxiong has been tested with 800 kV DC voltage. This test has proven the insulation and readiness for operation of the line, DC yard and sending station converter for the worldwide first 800kV DC technology. It was successful at the first go. Now the UHV DC (see figure 3) is going to be set into commercial operation in December, 2009.



Fig. 2: UHV DC Valve Tower in the Cologne testing laboratories



Fig. 3: UHV DC Sending Station Chuxiong in Yunnan, China