Power Stability Expert

| Case Study |

UPFC for Nanjing Western Ring Grid

Flexible power flow control to optimize city grid operation

On Dec. 11th, 2015, NR Electric (NR) successfully commissioned the Unified Power Flow Controller (UPFC) system for 220kV Nanjing Western-Ring Grid. This is the first MMC based UPFC in the world. As the main contractor, NR is responsible for system analysis, design, supply and commissioning.

Main Parameter	Series Side	shunt Side
Converter Capacity (MVA)	2×60	60
Transformer Capacity (MVA)	2×70	2×60
Transformer ratio (kV)	26.5/20.8	35(1±2*2.5%)/20.8
Rated DC Current (A)	1000	1000
Rated DC Voltage (kV)	±20	±20

Table 1. System Data of UPFC for Nanjing Western-Ring Grid

Overview

Nanjing Western-Ring Grid powers many important loads through complex meshed network. With the rapid increase of electricity demands, the UPFC solution is chosen to optimize power flow and improve flexibility and controllability of the grid. Table 1 shows the general parameter of the installed UPFC.

Existing Problems

The Western-Ring network of Nanjing covers the main loads of downtown area. It is fed by two 500 kV substation at Longwangshan and Dongshanqiao. In present network there is severe overload situation on the 220 kV Xiaozhuang-Zhongyangmeng line at N-1 condition while the other line will be in light load conditions. In future network, the load unbalance issue aggravated.

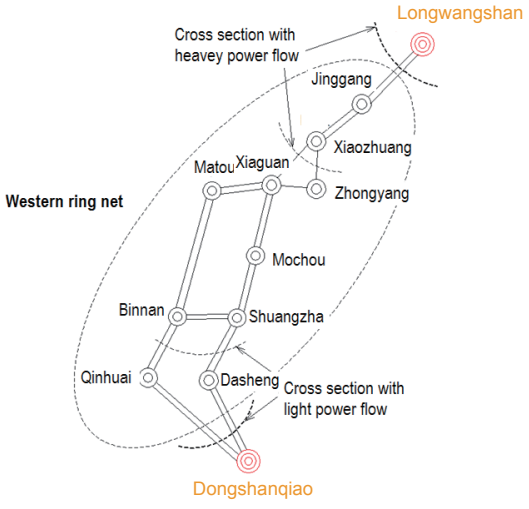

Figure 1. The Western-Ring Network

NR Solution

To solve the load unbalance issue, NR proposed the UPFC turnkey solution after a detail network study. As the main contractor, NR offers design, manufacturing and procurement, installation, site commissioning and maintenance. Civil and construction work are outsourced. Training service is provided for maintenance and operation personnel. The total delivery duration for the UPFC is about 10 months.

As shown in figure 2, besides transformers, the general structure of UPFC contains also a "back to back" MMC based voltage source converter. First converter (CONV1) is connected in shunt and the second one (CONV2) in series with the line. The shunt converter is primarily used to provide active power demand of the series converter through a common DC link. Converter 1 can also generate or absorb reactive power, if it is desired, and thereby provide independent dynamic shunt reactive compensation for the line. Converter 2 provides the main function of the UPFC by injecting a voltage with controllable magnitude and phase angle in series with the line via a voltage source.

Figure 2. Valve Tower of UPFC

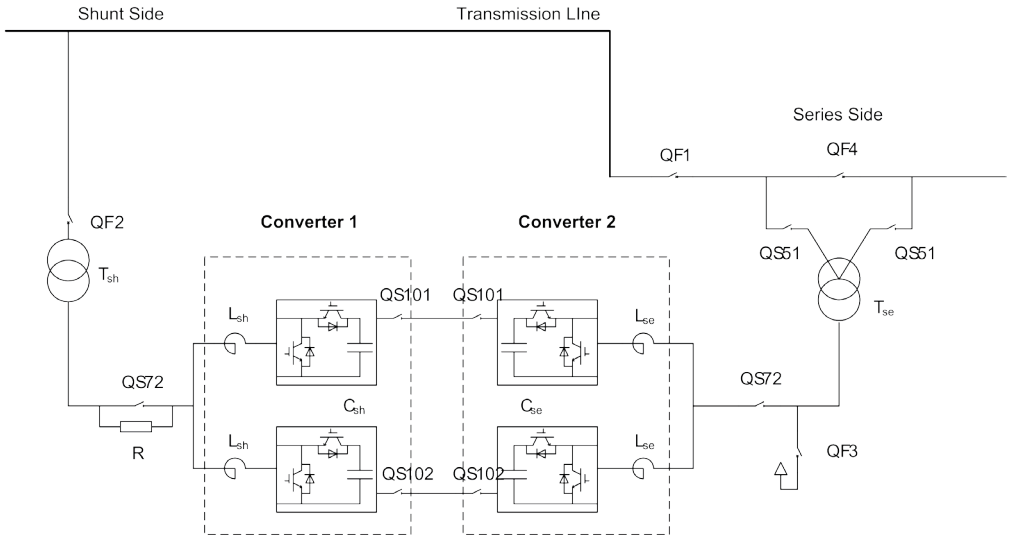

Figure 3. Simplified Single Line Diagram

Customer Benefits

After installation of the UPFC, the load flow unbalance issue is solved not only for the present network but also for future network conditions. The UPFC can also provide additional voltage control and dynamic reactive power support to the system.

After put into service, the adjustable transfer capability at key crossing sections reaches ±(300 – 400)MW in different developing phases. The whole UPFC system will save up to 80 Million dollars compared to build a new power cable tunnels in city center.

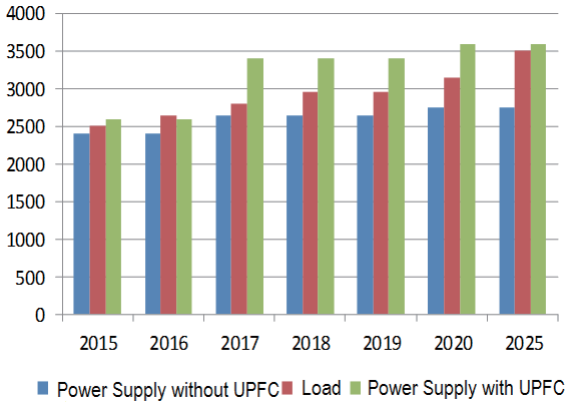

Figure 4. Power Supply Comparison

NR Electric Co., Ltd.
69 Suyuan Avenue,Jiangning Nanjing 211102,China
NRservices@nrec.com / NRsales@nrec.com