



Case Study

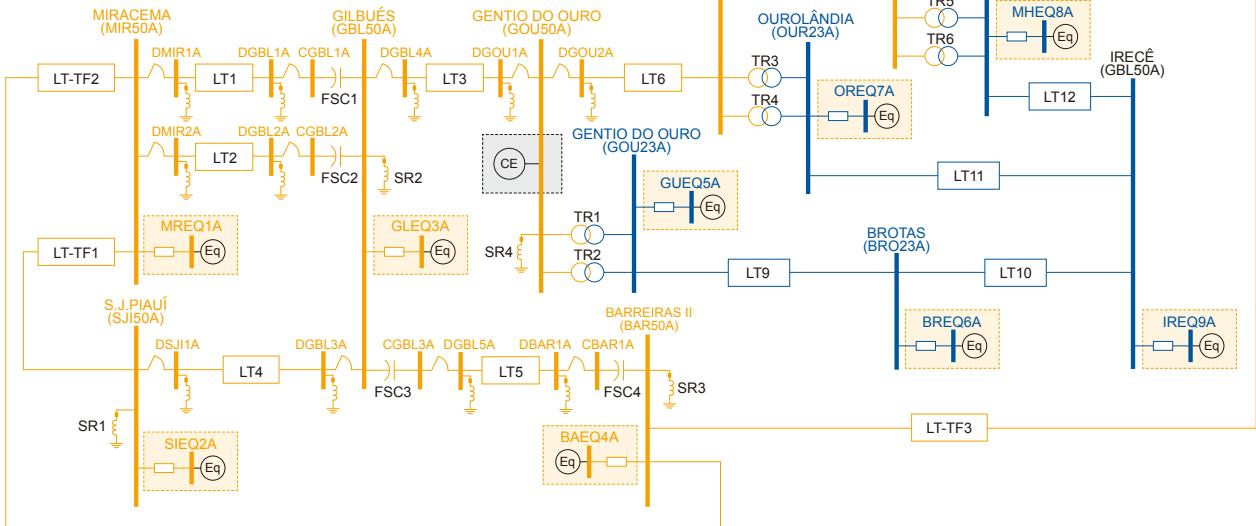
## NR's Static Var Compensator

Brazil SVC Operation for Strong Voltage Support and Power Transmission

# Project Overview

It is significant to maintain voltage strength and stability at 500kV Gentio Do Ouro substation in Brazil as an electricity-transferring support point.

There are two voltage levels 500kV and 230kV, in the substation that function as an important intertie point with great regional influence.



Network structure nearby SVC installation

A dynamic reactive compensation is required here for a great deal of power flow transmission needs strong voltage support. Moreover, power oscillation caused by unexpected faults is also a key factor to affect stable power transmission and regional grid stability.

So, one Static Var Compensator/SVC is installed to control and stabilize the 500kV voltage with a rated reactive power range of -100Mvar to +200Mvar.

NR provided protection, control and automation products with well-proven technologies that have been widely applied in thousands of projects worldwide including HMI (NCS) system, BCU, Fault record, Station manager and generator-transformer protection equipment. There are two transformer, startup & standby transformer.



Aviation view of SVC system

## The Challenge

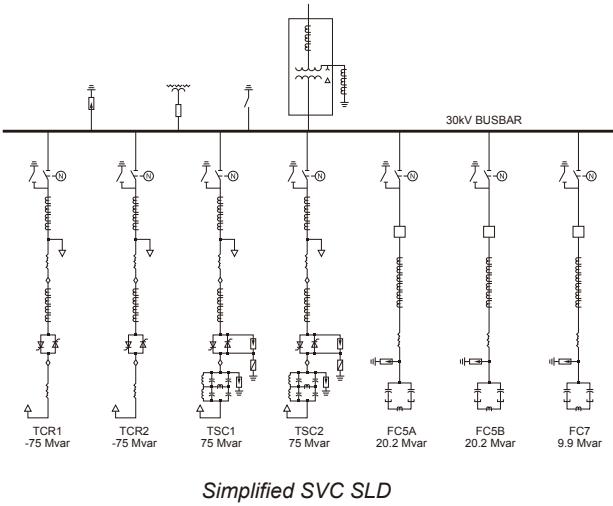
There are many series compensation at 500kV transmission lines nearby 500kV Gentio Do Ouro substation. Furthermore, a future coupled wind farm will access the grid by this substation. A SVC operating at MORRO DO CHAPEU substation is electrically adjacent here as well.

So the SVC installed at 500kV Gentio Do Ouro substation must take into consideration the interaction with series compensation and the control coordination with nearby SVC.

NR has delivered and optimized such SVC solution since network transient analysis had been conducted on the harmonic impedance, insulation coordination, transformer energizing, auto anti-hunting and control strategy, with ATP software and RTDS simulator.

## The Solution

NR has designed the Gentio Do Ouro II SVC configuration as follows. SVC consists of two TCR branches with each rated at 75.0MVar, two TSC branches with each rated at 75.0MVar, three Harmonic Filter Capacitor branches with two 5th filter branches rated at 20.2MVar each and one 7th filter branch rated at 9.9MVar. The Gentio Do Ouro II substation is connected to a 500kV Power Grid and the PCC (Point of Common Coupling) of the installed SVC is connected on the same bus voltage level. The step-down transformer couples the PCC voltage to 30kV operational voltage to feed all SVC branches as secondary side. The Gentio Do Ouro II SVC single line diagram is represented in the figure.



### Thyristor Valve

As the core part of a SVC system, a thyristor valve comprises several anti-parallel thyristors and associated auxiliary components with vertical open structure in press stack assembly, which is triggered via optical electrical unit with water cooling as inner-loop cooling method.

Thyristor valve offers ease of installation and maintenance, which reduce onsite installation work load as all the modules are factory assembled.



Onsite thyristor valve

### Water cooling system

PCS-9510 is an enclosed water cooling system, which is used for heat removal produced by the high power electronic units and transmitting the heat to the outside ambient air.

This water cooling system mainly consists of main cooling circuit, water treatment circuit, pressure stabilizing system, water replenishment device, cooling medium, heat exchanger and so on.

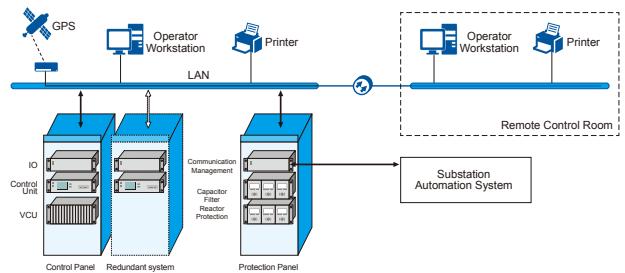
NR's water cooling system has widely been applied in HVDC, SVC, STATCOM, Synchronous condenser and other power electronic based products, with perfect performance to ensure the minimum water temperature at the inlet of the high power electronic unit when the whole system in operation.



Onsite water cooling system

### Protection, Control, and Monitoring system

PCS-9580 control system uses NR produced uniform UAPC platform. This platform possesses user-friendly machine environment for convenient function extension and supporting remote maintenance. The control system adopts several DSPs and operates coordinately in parallel, which makes the system respond quickly, control accurately and can meet the requirements for quick SVC system adjustment.



Hierarchical and distributed structure

Flexible communication mode is provided with Ethernet communication interface. Power industry communication standard IEC60870-5-103 and new generation substation communication standard IEC61850 are supported.

The main control functions can be offered as follows.

- Voltage control
- Reactive power control
- Open-loop susceptance control
- Negative sequence control
- Power oscillation damping function
- Undervoltage control function
- Overvoltage control function
- Regulator gain supervision and its gain optimization
- Auto anti-hunting function
- Current limitation strategy
- Auxiliary control functions



On-site protection & control panels



On-site operator's HMI screenshot



On-site transformer monitoring status screenshot

*“SVC has proven to be an economical and effective solution for boosting power transmission & distribution capacity and also been a wide-accepted means to stabilize voltage and damp power oscillation.”*

Dr. Jacky Zhao  
Senior Product Manager  
NR Electric

## The Benefits

The electricity trend is towards larger power networks, longer transmission lines and higher consumption. Then, power transmission & distribution system will require more efficient operation. Moreover, transient stability will be a limiting factor on power transmission capacity.

NR delivered SVC system has done exactly these at a lower cost.

- Grid stabilized voltage
- Power swing damping
- Higher transient stability limit
- More flexible voltage control
- More convenient monitoring and operating
- Compact footprint and reliable performance

## End-User Excellent feedback

NR SVC technology has been achieving optimum improvement in power transmission at 500kV Gentio Do Ouro substation. Furthermore, there has been more stable voltage even at presence of SVCs and series compensation operating adjacent to the substation, by means of optimized SVC control and operating strategy.

Easy-operating HMI and well-training service have brought the field operators the convenience to monitor and maintain the SVC system.

*“NR not only delivers SVC equipment but also the customized network analysis and well-training services. Robust project delivery and convenient maintenance provide more and more ease to our customers.*

Chengbo Li  
R&D Engineer  
NR Electric

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