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NR STATIC VAR COMPENSATOR SOLUTIONS

Enhancing Power Quality for Saving Future Assets



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Reactive Power

Key to better power quality and dynamic stability

A weak power grid usually suffers from the voltage drop due to heavy loads. Many industry loads, like mining machine and electric furnace, always generate large amount of harmonic currents, heavy voltage flickers and drops. These problems can easily interrupt power supplies, lower product quality and even reduce productivity.

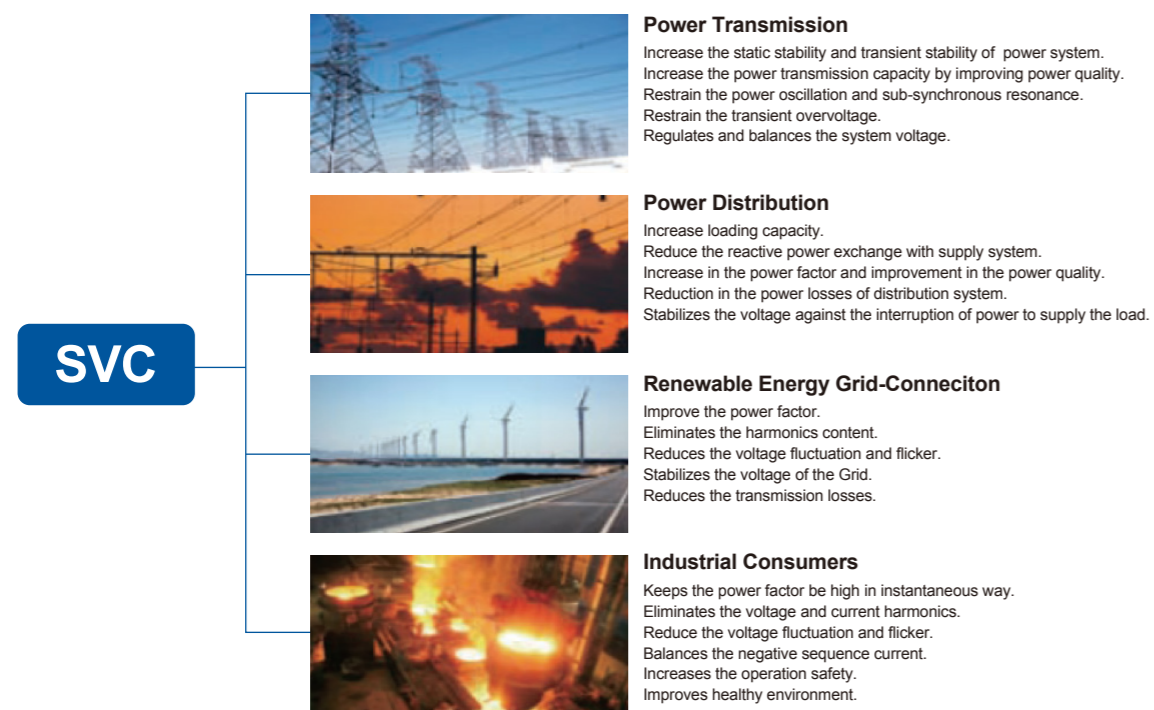
To assist utility and industry customers improve power quality, NR Electric offers Static Var Compensator (SVC) to regulate reactive power and voltage so as to improve power quality in a very short period. SVC is part of Flexible Alternative Current Transmission System (FACTS) family. It supplies precise and adjustable reactive power to system. SVC is so far a field-proven solution to solve power quality and reliability problems worldwide.

Field Proven SVC Solution

A cost-effective solution to balance voltage & current

SVC is basically a shunt connected static Var generator whose output is adjusted to maintain or control specific power variable. One of the major reasons for installing a SVC is to improve dynamic voltage control and thus increasing system load ability.

Compared with traditional reactive power compensation methods, the thyristor-based SVC system can supply dynamic reactive power in a short response time, helping utility customers solve stability problems, such as maintaining voltage balance, reducing voltage flicker and improving power quality.



Power Transmission

- Increase the static stability and transient stability of power system
- Increase the power transmission capacity by improving power quality
- Restrain the power oscillation and sub-synchronous resonance
- Restrain the transient overvoltage
- Regulates and balances the system voltage

Power Distribution

- Increase loading capacity
- Reduce the reactive power exchange with supply system
- Increase in the power factor and improvement in the power quality
- Reduction in the power losses of distribution system
- Stabilizes the voltage against the interruption of power to supply the load

Renewable Energy Grid-Connection

- Improve the power factor
- Eliminates the harmonics content
- Reduces the voltage fluctuation and flicker
- Stabilizes the voltage of the Grid
- Reduces the transmission losses

Industrial Consumers

- Keeps the power factor be high in instantaneous way
- Eliminates the voltage and current harmonics
- Reduce the voltage fluctuation and flicker
- Balances the negative sequence current
- Increases the operation safety
- Improves healthy environment

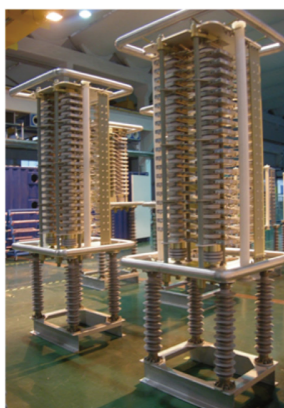
Convincing All-around Advantages

Experts from NR Electric have done deep researches on power electronics technologies to present an efficient and reliable SVC system to clients. The PCS-9580 SVC system employs many advanced technologies, such as free-floating press-stack, parallel cooling pipe, quick response and flexible control algorithm. The typical valve voltage levels are 6kV, 10kV, 20kV, 27kV, 33kV, 66kV, with capacity ranging from 3Mvar to 360Mvar.

Available for Severe Operation Environment

Mechanical characteristics of components can affect the total operation performance of a SVC system. To achieve better mechanical performance and long lifecycle, NR Electric uses Polyvinylidene Fluoride (PVDF) to produce the main pipes of valve cooling.

The cooling sub pipes in each thyristor level have high mechanical strength, chemical stability, well electrical insulating property, abrasive resistance, age resistance and incombustibility. The cables and optic fibres connected to thyristor valve groups are all made of flame-resisting materials.



Model Based Design & Compact Structure

Limited space is always a problem which bothers most of our clients. NR Electric concerns investors' demands and uses compact valves structure with vertical and free-floating press stack configuration. The compact valve structure has advantages of small space occupation, low construction cost, easy site installation and maintenance.

Innovative Protection Algorithm to Avoid Thyristor Breakdown

A series-connected thyristor can be damaged by high voltage stress if it is not properly triggered, causing extra maintenance or components replacement. To avoid these drawbacks, NR Electric designed the unique overvoltage protection algorithm with configurable threshold value to protect different types of thyristors. So far, this overvoltage protection circuit has been widely utilized in SVC systems and HVDC transmission systems due to its stable and reliable performances.

Advanced Thyristor Triggering Technology

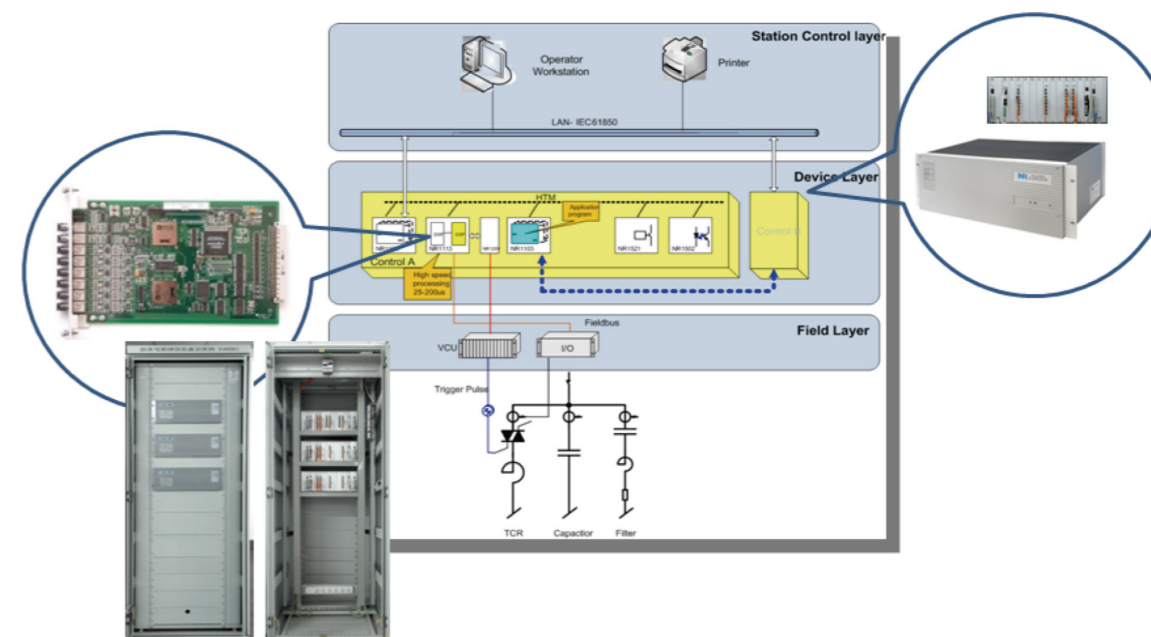
NR Electric's SVC uses Electrically Triggered Thyristor (ETT) technology which has been field-proven in thousands of projects for a long period. It achieves dynamic regulation to satisfy reactive power demands and restrict voltage fluctuation.

Triggering pulses are generated by valve control unit (VCU) and sent to Thyristor Control Unit (TCU) via fibre optical cable. The TCU integrates forward overvoltage protection and reverse recovery protection in a sealed metal box installed on the wing plate of heat sink. ETT takes full use of semiconductor advantages that it has separated triggering unit, strong anti-interference ability and easy maintenance.

High-Performance Protection & Control System

The control & protection system of PCS-9580 SVC adopts NR Electric UAPC platform, which also has been applied to HVDC control & protection system, FACTS control & protection system and digital substation protection & control system.

- Short response time to reduce compensation capacity and increase compensation effect
- High accurate angle control
- Redundant design to ensure operation reliability
- Integrated fault recording and harmonic monitoring
- Flexible system update and spare parts replacement
- Available for installation in switchgear cabinet



Project Process & Execution Expertise

Turnkey Service

To ensure the total performance, NR Electric offers turnkey service to solve clients' exact specifications. Our turnkey service covers consulting, design, supply, installation, commissioning, training and operation.

Professional System Design & Analysis

NR Electric believes that each project has its own specific requirements. For tens of years, relying on groups of experts, NR Electric is dedicated to offering customized and cost-effective solutions to each single project. We work with utility and industrial customers to study the technical problems they are facing, tailoring a SVC system that can truly improve power quality and bring investors benefits.

Our professional SVC R&D group analyses each specific project. Based on analysis results, NR Electric offers complete solutions to clients including SVC installation locations & capacity and optimal control strategies.

Strict Project Management

NR Electric considers an effective project management can facilitate the successful implementation of a project, avoiding potential risks and saving engineering budget. For these reasons, NR Electric has built a well-trained project management team to manage and supervise each progress during project implementation. Our experienced project managers work closely with clients and have gained high reputations for their hard works.

Certificates and Test

NR electric is one of the internationally accredited certified and testing groups. The company has its own certification and test labs for HVDC/EHVAC instruments test. NR electric' s SVC TCR/TSC type test is also approved according to IEC standard.

The advanced test facilities can assist to achieve the optimized results, such as installation capacity & location, system configuration and control strategies, finally resulting in better system performance, reasonable power distribution and optimal harmonics filtering scheme.



Case Study

In the several past years, NR Electric has offered PCS-9580 SVC system to more than one hundred projects worldwide, covering different application fields such as industries, power utilities, electrified railways, wind farms and solar farms. The largest installed capacity reaches 900Mvar at 400kV voltage level with configuration of TCR+TSC+FC branches in Mozambique.

Power Factor Control & Voltage Support for Steel Plant of Changzhou

The steel plant installs large size of load with income transmission line of 220kV. These loads include 80MVA Electric Arc Furnace (EAF), 18MVA Ladle Furnace (LF), 16MVA Ladle Furnace, 12MVA Ladle Furnace and other auxiliary loads. Electric arc furnace loads severe affect the power supply quality of both steel plant and external power grid. NR Electric won this bidding to provide the SVC system rated 100Mvar with 2nd, 3rd, 4th, 5th filter banks to solve power quality problem.



Outdoor filter banks



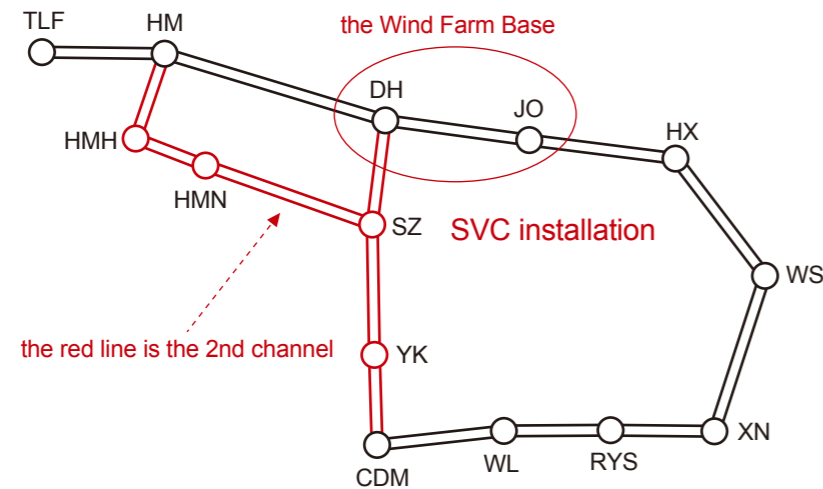
Indoor thyristor valve

Customer Benefits

- Power factor is improved from 0.71 to 0.93
- Voltage flicker is limited to 0.34
- Reactive power consumption from grid is reduced

Voltage Regulation & Power damping control for 750kV Shazhou Substation

Duhuang, a fortress of ancient Silk Road now becomes an important power transmission hub in western China. Large amount of renewable energy is transmitted from Dunhuang to other parts of China to satisfy the increasing electricity consuming demands. To connect renewable energy to a 750kV power grid, State Grid of China (SGCC) has established an electric power corridor from Xinjiang to Northwest of China. This transmission grid covers many stations, like HaMi, ShaZhou, Yuqia, ChaiDamu, etc. This kind of long-distance power transmission requires strong voltage supports. NR Electric supplies large capacity of SVC solution rated from -360Mvar to + 360Mvar to accommodate this demand.



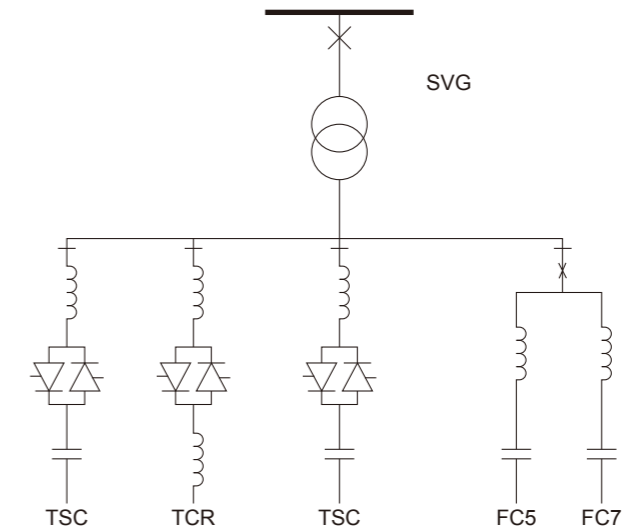
Wind farm base SVC installation

Customer Benefits

- Voltage fluctuations on 750kV buses have been reduced significantly.
- The range of voltage fluctuation is improved from 20kV~25kV in local substation to 10~12 kV in adjunction substation.
- Voltage stability limits are enhanced and the tie-line transmission capacity is increased from 200MW to 800MW depending on system operation conditions.
- System damping is improved significantly by specific damping control strategy and algorithm.

Voltage Support for Powering Mexico Grid

NR has successfully inducted its Static Var Compensator of Reactive Power (CEV) solution at Nuevo Vallarta Substation of Mexico with a nominal capacity of 150 MVar (capacitive) to 50 MVar (inductive) in a 230kV Power Transmission grid. The main purpose of the CEV at Nuevo Vallarta is voltage & stability control of the 230 kV grid under steady and transient conditions.

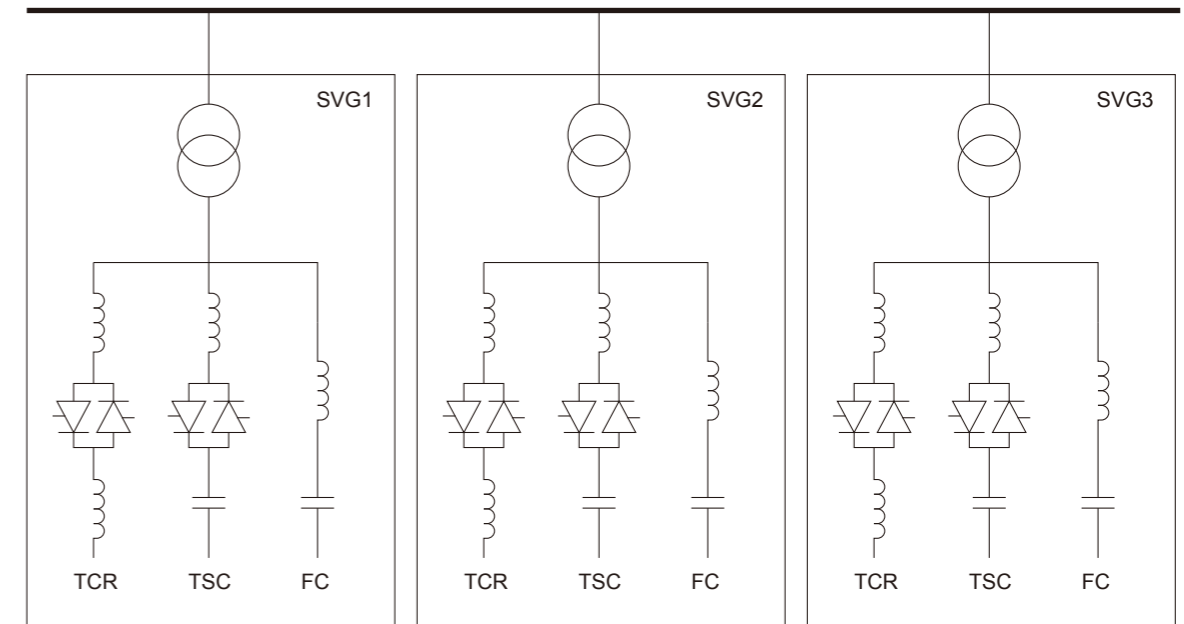


Simplified Mexican Grid SLD

Ethiopian Grid Voltage Supported by NR

The Great Ethiopian Renaissance Dam (GERD) - Dedessa - Holeta 500kV power transmission project is programmed to transmit power of 6000MW from the future GERD hydroelectric power station through two 500kV double circuit transmission lines to the new Dedessa, then Holeta substations and then through a 400kV line from Holeta to Sebeta II, Holeta to Sululta II and Holeta to Akaki II existing substations. The project GERD is designed in such a way to supply power to the Ethiopian national grid and the two corridors, especially the Southern Sudan corridor and the Northern Sudan corridor.

This current power grid is very weak and the voltage fluctuation along the transmission line remains to be solved. A 900Mvar SVC system from NR will be installed in the 500kV Holeta station to supply power oscillation damping, so as to enhance dynamic voltage performance and improve power grid stability.



Ethiopian Grid SLD

Voltage Support for Powering Grid in Brazil

It is vital to maintain voltage strength and stability at 500kV Gentio Do Ouro substation in Brazil as an electricity-transporting support point. There are two voltage levels 500kV and 230kV in the substation to make it work as an important intertie point with great regional influence.

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

