Science Creates Miracle   Innovation Takes Future

Wanlida

Static Var Compensator - MCR TYPE

High-voltage Dynamic Reactive Power Compensation Device

ZHUHAI WANLIDA ELECTRIC CO.,LTD.

Name of Stock: Wanlida   Share Code: 002180

Company Profile

Zhuhai Wanlida Electric Co., Ltd was founded in 1991, located in Wanlida Relay Protection Industrial Park with a total area of 50,000 square meters of Science and Technology Innovation Coast, High-tech Zone, ZhuHai City. It was listed in Shenzhen Stock Exchange on November 13, 2007, (Name of Stock: Wanlida; Share Code: 002180) with a registered capital of 83,322,000.000 RMB. It is a domestic professional high-tech enterprise integrated in design, production and sale in Substation comprehensive automatic systems, Medium voltage variable frequency drive (HV Inverter), HV&LV SVG, HV dynamic reactive power compensation Device (SVC) , HV&LV Active Power Filter, Flexible AC Transmission Systems, New Energy Power Generation Equipments Converter, Fault Current Limiter etc, at the same time, it is also a well-known manufacturer and leading enterprise in Substation comprehensive automatic systems and the fields of power electronics.

The company was certified as Key Software Enterprise under the National Layout, China Outstanding Enterprise, GuangDong Province Outstanding Enterprise, Zhuhai Top 10 Private Enterprise and AAA-credit enterprises.

Zhuhai Wanlida Electric Co., Ltd is committed to becoming the most famous Electric Power Automation Enterprise and the most reliable partner in electric power automation markets.

Science Creates Miracle, Innovation Takes Future.

Functions

- Improve power factor and reduce line loss caused by reactive power
- Restrain and eliminate harmonic, reduce voltage fluctuation, flicker and distortion, stabilize voltage, strengthen system damping, restrain minor synchronous harmonic resonance existing in power generations system of steam turbine, dampen power oscillation.
- Micro-electronics control system, no need of mechanical switch; fast response time and no-step control.

Application industrial fields

A complete set of SVC system can be used to generate constantly varied inductive and capacitive reactive power with fast response time. So far, SVC system has been extensively used in electric power system and industrial field.

Rolling Mill

The big reactive impulsion caused by rolling mills and other industrial symmetric loads may lead to the following problems to the power grid:

◎ The voltage drop and fluctuation, which may result in malfunction of electric equipment and reduce the productive efficiency.

◎ Low power factor.

◎ The harmful high-order harmonic waves in the driving devices, typically 5th, 7th, 11th, 13th and side-frequencies, which will cause serious voltage distortion.

Wanlida's SVC of MCR type can solve those problems perfectly. It can maintain a stable bus bar voltage, reduces the harmonic currents substantially and enhances power factor over 0.98.

Electric Arc Furnace (EAF) and Ladle Furnace

The electric arc furnace and ladle furnace are typical non-linear and erratic loads in the power grid, causing a series of adverse effects to the power grid:

◎Result in serious three-phase unbalance of the power grid, and cause negative-sequence currents.

◎Produce high order harmonics, such as coexist of 2nd, 4th even harmonics and 3rd, 5th, 7th odd harmonic, which make severe voltage distortion become more complicated.

◎Serious voltage flickers

◎Low power factor

The best way to solve the problems mentioned above is to install fast-acting reactive power compensation device (SVC). The response time of Wanlida's SVC is less than 10ms, which can meet the strict technical demand. The SVC can supply reactive current rapidly to electric arc furnace and ladle furnace and stabilizes the voltage level in the power grid, then the output of the metallurgical active power can be increased, and the impact of flicker can be minimized. The separated phase compensation function of SVC can eliminate the three-phase unbalance caused by electric arc furnace and ladle furnace. The filtering devices of the SVC, can remove the harmful high order harmonics so as to improve power quality, then the power factor can be increased through providing capacitive reactive power to the system.

Static Var Compensator - MCR TYPE

Electric Railway Traction Substation

While protecting the environment, the electric locomotive also causes serious pollution to the power grid. As the electric locomotive is powered by single phase power system, which not only causes serious three-phase unbalance and low power factor but also generates negative-sequence currents. Currently, the only way to solve the problem is to install SVC system at appropriate locations along the railway. The SVC is able to balance the three-phase by means of single-phase compensating and to increase the power factor through filter capacitor. Wanlida's SVC is capable of solving this problem perfectly at minimum cost.

Hoists and Other Heavy Industrial Loads

The hoists and other heavy industrial loads may cause the following effects to the power grid when they are at working state:

◎ Cause the voltage drop and voltage fluctuation in the power grid.
◎ Low power factor.
◎The harmful high-order harmonic currents.

Wanlida's SVC can solve above problems perfectly and help customers obtain the following benefits:

◎Increase the power factor by dynamic reactive power compensation.
◎Eliminate the voltage distortion caused by harmonic.
◎Stabilize the voltage and reduce the voltage fluctuation and flicker.
◎Balance the three-phase load current and eliminate the negative sequence current.
◎Increase the operation safety of impact loading equipment and its adjacent electrical equipment.

Long Distance Power Transmission

The power grid tends to have larger capacity and longer distance, in the case of long-distance AC transmission, due to the influence of Ferranti Effect, the voltage in the middle of transmission lines will rise which will limit the transferred power. The capacitive power along the long distance power transmission lines is in proportion to the cable length and the square of voltage, so it will be terribly surprising for capacitive current power to ground, which results in the voltage rising of 1.5 to 2 times of rated voltage at the end of transmission line and then causes badly result. The power utility usually install shunt reactor to compensate capacitive current to ground to solve voltage rising at the end of transmission lines, but if the shunt reactor is of fixed capacity, it will be removed from compensation system once inductive current is over desired capacitive current to ground. As usual, the operation of shunt reactor connected in parallel to transmission line wants a very high demand for switch, but until now, it is still very difficulty to solve the over-voltage surge caused by reclosing of switch, as a result, it results in bad over-voltage accidents. However, the SVC of MCR type of Wanlida can solve those problems; it can regulate reactive power of transmission line dynamically and fast. The SVC of TCR can not be directly installed in transmission lines with over 35KV, but the SVC of MCR can be installed in extra-high voltage and ultra-high voltage transmission lines directly, and it has no need of action of switching. So the SVC of MCR type is able to improve transmission and distribution performance of the power system remarkably. It should be installed at one or several proper points in the power grid in order to maintain a balanced voltage under different conditions and achieve the following purposes:

◎Stabilize voltage of a weak system
◎Reduce the transmission losses
◎Enhance transmission capability and make existing power grid more efficient
◎Improve transient stability
◎Increase the resistance in the small interference
◎Improve system damping
◎Enhance the voltage control and stability
◎Restrain the power oscillation and the sub-synchronous resonance

Wind Power Plant

The output power of generator is always fluctuated frequently because of variable wind power. At present, the popular asynchronous wind generator (including Doubly-Fed Type) needs to absorb parts of inductive reactive power to build magnetic fields, the paralleled capacitor banks can realize compensation, but the stepped switching capacitor banks can not meet fast and dynamic reactive power compensation demand caused by variable wind power, sometimes, if the capacitor banks can not meet reactive power compensation in time, the wind generator will absorb reactive power from the upper power grid, which will result in low power factor of upper power grid and then cause voltage fluctuation, so the state grid put forward the < Regulations on State Grid Corporation Wind Farm Grid Access Technology (Amendment)> based on voltage fluctuation, flicker, frequency deviation, harmonics and lacking reactive power:

a). No matter what kind of operation modes, wind power plant must ensure that the reactive power has essential adjustment capacity; the capacity must be the reactive power range generated under the rated power factor of 0.98(lead to lag). The reactive power of wind power plant can be able to realize dynamic and continual adjustment, and ensure adequate reactive power capacity to adjust the voltage at the point of interconnection of wind power plant to normal level.

b). For wind power base with over 1000MW, the adjustment capacity of reactive power at single wind power plant must be the reactive power range generated under the rated power factor of 0.97(lead to lag).

c). For wind power plant connected into public power grid through voltage step-up station, the configured capacitive reactive power can compensate reactive power loss on output transmission line under the full load, and the configured inductive reactive power can compensate charging reactive power to the ground on output transmission line under the no-load.

d). The reactive power capacity range of wind power plant can be confirmed through research on accessing wind power plant to public power grid, but it must meet the above demands.

The SVC of MCR can solve the above problems to meet the demand of utility.

Secondary Substation (66KV to 110 kV)

In the regional power grid, the stepped switching capacitor banks are used to compensate the system reactive power and increase the power factor. But they are only able to provide the capacitive reactive power, and unable to realize rapid and accurate adjustment according to the load variation, so sometimes they provide much more reactive power than the actual desired reactive power, which will result in over voltage of the bus bar and damage the electric equipment and destroy system stability.

Because the SVC of TCR can not be directly installed in subtransmission lines with over 35KV, Wanlida's SVC of MCR will be most suitable for subtransmission, Wanlida's SVC system is able to compensate with capacitive and inductive reactive power rapidly and accurately. It solves the problems of reactive feedback effectively. In addition, when a new SVC system is installed, the existing fixed capacitor banks can be utilized by adding a MCR, which requires the minimum investment. It is the most effective way to improve the power quality of the local power grid, the detail benefits is as below:

◎Reduce the reactive power exchange with system and improve system stability

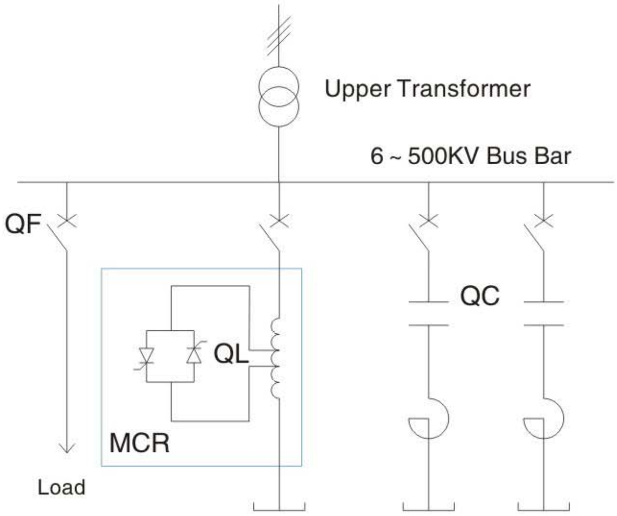
◎Rapidly and continuously compensate the reactive power, increase the power factor and improve the power quality.

◎Reduce the power losses of distribution system

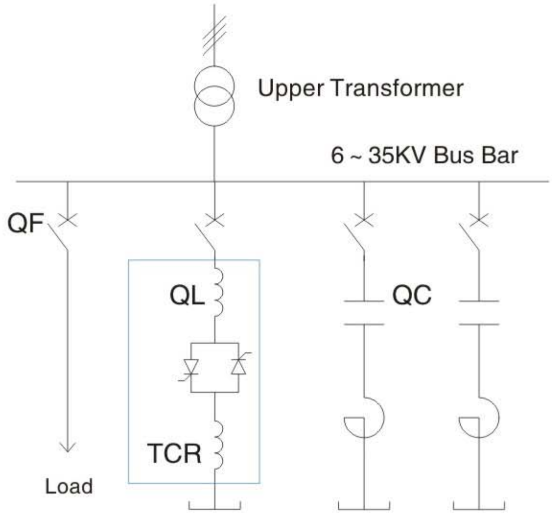
◎Used in combination of stepped switching capacitor banks to reduce the damage caused by frequent switching of capacitor bank.

The comparison between MCR and TCR

Primary Theory Diagram:



Primary Circuit Diagram of SVC with MCR



Primary Circuit Diagram of SVC with TCR

From the above diagram, the main difference is at blue section.

The SCR of SVC with MCR is coupled with reactor through iron core; it just needs to withstand lower voltage of 380V, so it has a very high stability.

The SCR of SVC with TCR is connected in series to high voltage main circuit; it needs to withstand high voltage and big current, so it is easy to damage.

Items	SVC of MCR	SVC of TCR
Response time of SCR	<10ms	<10ms
Entire response time	100~300ms	40~200ms
Harmonic contents	5th<2.6%, 7th<1.5%, 11th<0.6%, 13th<0.3%	5th<5.0%, 7th<2%, 11th<1.0%, 13th<0.7%
Voltage withstanding of SCR	Small, no need to connected in series	Big, need to connected in series
SCR heating	Small, no need of water cooling device	Big, need water cooling device or heat pipe cooling
Installation site of SCR	Outdoor cabinet	Indoor
Independent adjustment	Yes	Yes
Maintenance	Free of maintenance	Complicated maintenance
Reliability	25 years of no faults operation time	Easy to burn for SCR
Over–load capacity	1.5 times	No
Electromagnetic Pollution	No	The main reactor generates strong alternating magnetic fields, it is harmful to health
Noise	70–72db	Below of 62db
Active power loss	0.5%~0.8%	0.5%~0.8%
Floor space	Small	Big

The dynamic compensation theory of SVC of MCR type

From the left diagram on above primary circuit diagram:
QF: Impact reactive power of load
QC: Capacitive reactive power supplied by fixed capacitor bank on bus bar---Constant
QL: Inductive reactive power supplied by magnetically controllable reactor---Dynamic adjustment
The most important is to control the pass angle of the thyristors prospectively to obtain the needed currents in order to provide the needed reactive power of QL.
Therefore, the system must try to satisfy the equity:
QS=QF+ (QL-QC) =0, so that the power factor is a constant and there will be no fluctuation of the voltage, here, QS is generated reactive power on bus bar.

Why choose SVC of MCR Type

- High reliability: The SCR is installed in low voltage circuit, not in main circuit, so, the withstanding voltage is just 1% of main circuit voltage.
- Low harmonic contents: THD is below of 5%, which comply with related national criterion, if the multiple connections are adopted, the THD can be reduced below of 1.2%.
- Small dimension: the dimension of MCR is about 2/5 of TCR.
- It can be able to connect in high voltage power grid, the cost and floor space are reduced dramatically.
- Fast response time(100~300ms), it can fully meet the demand of dynamic reactive power compensation of power equipments.
- No need of cooling devices, which reduce the fault rate, maintenance cost and floor space.

The specification of MCR and installation

Capacity (Kvar)	L*W*D	Weight	Cooling Mode	Radiator
630	2500X660X1280	4180	Air cooling	Fan(Back up)
1250	2800X800X1280	6990		
2000	3200X1000X1360	10020		
3150	3600X1000X1600	13000		
5000	4000X1200X1800	16900	Oil cooling (oil-immersed self-cool)	Oil-immersed self-cool and fan cooling
6300	4500X1600X2200	21600		
10000	6000X1800X2600	26000		
20000	7000X2000X2800	16000*3		
30000	7600X2200X2800	22000*3		
50000	8500X2400X2800	28000*3		
80000	9000X2500X2800	39000*3		

Note: It will be re-designed if compensation capacity is over 80000Kvar, and the dimension of unit capacity will be reduced. The above data are just for reference, the actual dimension may have a little difference.

Installation: Oil-immersed reactor can be installed in outdoor or indoor fields, and dry-typed reactor is usually installed in indoor floor; The thyristor cabinet needs indoor installation; it should be close to reactor; The capacitor bank can be installed in outdoor or indoor fields.

Static Var Compensator - MCR TYPE

The advantage of MCR-typed SVC

The MCR-typed SVC was based on traditional saturation reactor technology; it was put forward by Russia scientists. They introduced the concept of magnetic valve creatively to just make the small section of iron core saturation, which solved the high harmonic problems caused by traditional saturation reactor, because all iron cores in traditional saturation reactor are excessive saturation, then result in nonlinear harmonic. At the same time, the SVC of MCR type reduced the dimension, weight and noise of entire system; it has many advantages, such as: low harmonics, fast response time, high voltage withstanding level, stable operation, small floor space and long service life. Therefore, the SVC of MCR type is quickly spreading in Russia, Ukraine, America, India, China and other countries. It plays a very important role in improving power quality, decreasing reactive power loss, stabilizing power grid voltage and enhancing the reliability of power grid operation.

Because MCR-typed SVC adopted advanced micro-electronics technology, it can regulate reactive power demand and compensation on bus bar accurately:

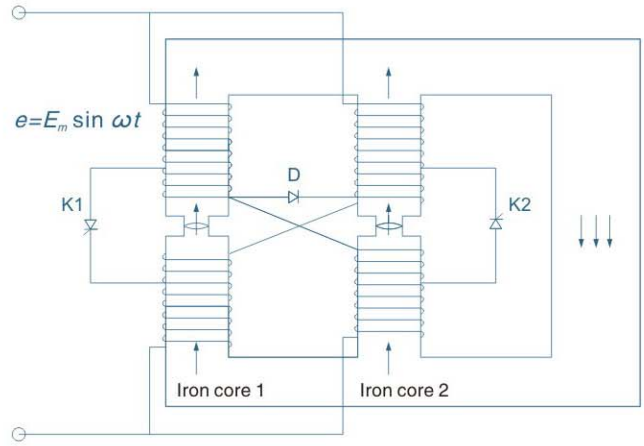
◎The inductive reactive current in main circuit can be adjusted through changing low voltage DC to regulate main circuit impedance fast and smoothly, meanwhile, through cooperating with capacitor bank paralleled in bus bar, reactive power compensation demand can be realized on bus bar, and dynamic response and improved power factor can stabilize bus bar voltage.

◎Choosing reactor parameters properly connected in series with capacitor bank, the compensation on fundamental wave can be obtained, and the harmonic also can be filtered.

Because the SVC of MCR is free of frequent switching from mechanical parts, then it avoids surge and over-voltage impact caused by MSC, which enhances the reliability and the service life of the equipment, as well, protects the other instruments.

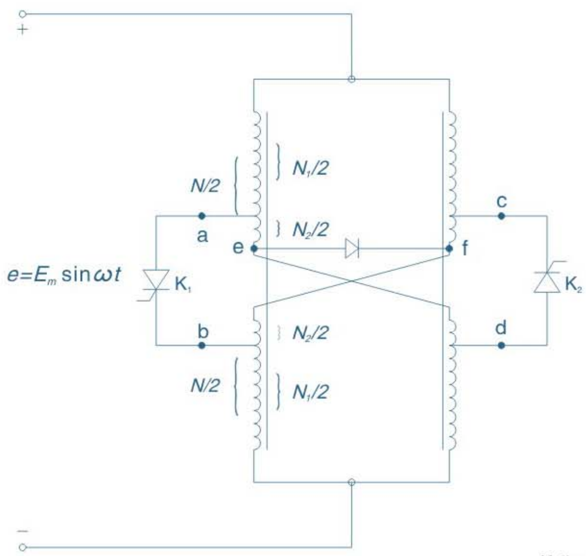
The SVC of MCR type fully absorbed advantages and functions of TCR-typed SVC by comparison; it solved the problems of smooth regulation which can not be realized by MSC and TSC, and also overcome some disadvantages of TCR-typed SVC. Because the reactor is connected to high voltage main circuit directly in series, it must stand extra high voltage and ultra high voltage. At present, the highest voltage of reactor in our country reach to 1000KV, and the maximum capacity reach to 320MVar. The reactor also has over-load function; it will not generate big damage to system except heating, while, the thyristors in TCR-typed SVC is connected to high voltage circuit directly, the over-voltage will result in faults and break. So it is very stable for MCR-typed SVC to operate under the high voltage circuit with free of maintenance.

The working principle of MCR (take single-phase MCR for instance)

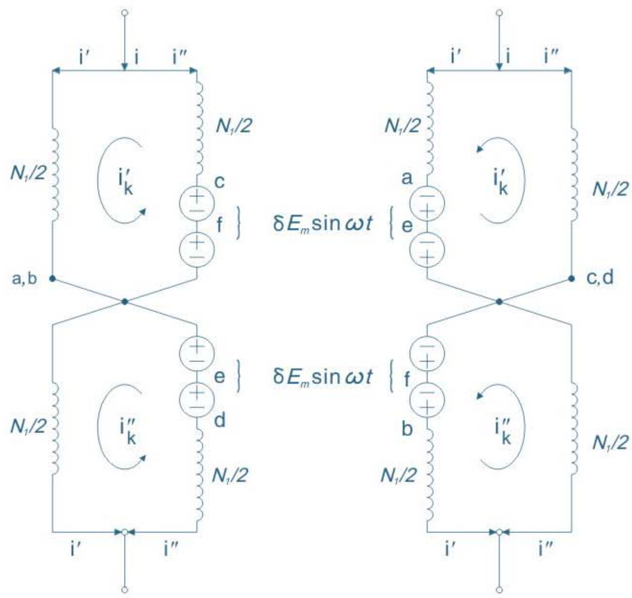


Structural Scheme Of MCR

From the left structural scheme of MCR, we know that the main iron core of MCR is divided into same two parts, the sectional area is Ab, the length is l, and there is a small section for each half of iron core, the sectional area is Ab1 (Ab1<Ab). For each half of iron core, there are two turns windings of N/2 (the number of turns are N for each half iron core), and there is also a tap with tap ratio of δ =N2/N(N=N1+N2) for each half iron core, they are connected with SCR K1 and K2, the upper tap and the bottom tap on different iron cores are cross connection, then are parallel in grid power supply. The freewheeling Diode D bestrides the intersection.



Equivalent Circuit Diagram Of MCR



The conduct diagram for K1 and K2 in turn

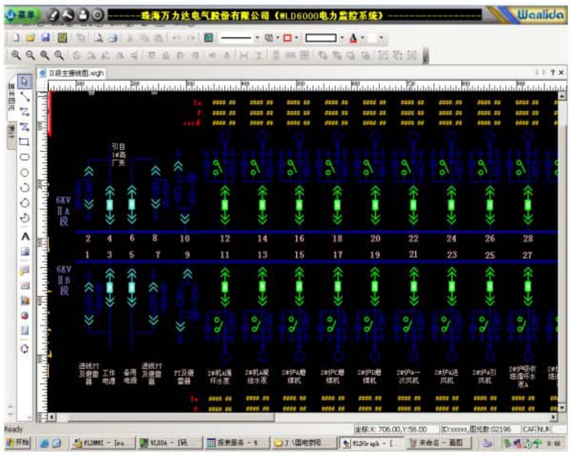
From the equivalent circuit diagram of MCR, if both K1 and K2 did not conduct, the reactor is like a No-load transformer because of its symmetrical structure. If the voltage of power supply is in positive half cycle, K1 stands forward voltage, K2 stands reverse voltage, in case K1 is triggered to conduct (same potential for point a and point b), power supply voltage is coupled by windings with a tap ratio of δ to windings of N2 to supply direct current, the equivalent circuit diagram is as below:

If the power supply voltage is in negative half cycle, when K2 conducts, the DC will be generated to circuit, and the current direction is same with one when K1 conducts. Therefore, the conduct of K1 and K2 in turn will generate full-wave rectification during one power frequency cycle, and then, the freewheeling diode will maintain current flow. Through adjusting the trigger angle of SCR, the control current will be changed, then, the degree of magnetic saturation of reactor iron core will be regulated, as a result, the inductance of controllable reactor can be smoothly adjusted. The SCR just withstands low voltage, it is safe and stable, and this is the technology advantage compared with TCR. AC component and DC component are in same windings, this saves the cost of copper line, at the same time, just the small section iron core during operation are saturated, most of iron core are not saturated, which enhanced the magnetic permeability of iron core and reduced the cost and dimension.

System Configuration

A. The control system with high-rate response

Controller Panel



Optional software(remote control)

The control system adopted microelectronic and full digital chip to monitor power quality data in real-time, and through high-rate operation, output corresponding reactive power dynamically the load wants. It applied advanced AC wave analysis technology to ensure accuracy of setting value and stability of operation even under the severe power conditions such as strong interference, harmonics etc. The controller has RS485, RS232 communications interfaces and LCD display screen with Chinese and English, it is very easy to operate, meanwhile, the controller has the functions of monitoring, control, data back-up, check and data conversion storage, it also can carry on real-time analysis for current, voltage, active power, reactive power and reactor current of the compensation devices and harmonic filtering system, at the same time, it has many protective functions of over-voltage, under-voltage, over-current, voltage sampling lost, external access faults, inner faults and three-phase current unbalance etc.

The optional operating software has visual system circuit displaying and operating interface, it can display three-phase reactive power, three-phase active power, current, power factor, working state of SVC with MCR type, desired power factor and set value, which is convenient for users to realize remote monitoring and communication regulation.

B. Magnetically Controllable Reactor

It adopted saturation reactor with iron core and paralleled in high voltage main circuit to provide inductive reactive power. There are two kinds of reactor for selection, one is dry-type reactor with epoxy resin, and the other is oil-immersed reactor, they both have the advantages of small dimension, small noise and low harmonics.

C. Low voltage SCR Module

It adopted mature low voltage SCR triggering technology and rectification modules, the triggering mode is phase-shift trigger, which adopted complex programmable logic device to trigger control, calculate control with high precision, so the circuit is simple and reliability is very high;

The closed-loop control adjusts DC excitation current of magnetically controlled reactor precisely to change impedance of MCR smoothly, and then realizes dynamic and real-time reactive power compensation. The thyristors are imported from abroad; trigger circuit is isolated by optical fiber, and high voltage circuit is also isolated fully with low voltage circuit by high voltage insulation optical cable, so the operation is very safe and stable.

The configuration of advanced BOD protection module enhances the operation safety of equipment; meanwhile, the function of fault self-lock protection makes it more safety for usage.

The low voltage thyristors are of small dimension and lower heating, it is no need of cooling devices of TCR-typed SVC.

D. FC Capacitor Circuit

The FC capacitor circuit consists of capacitor, series reactor and resistor used by high-pass filter branch, it can be divided into 2nd, 3rd, 4th, 5th, 6th, etc higher-order harmonics pass according to system requirement, and it can compensate capacitive current of fundamental wave, at the same time, it can realize dynamic reactive power compensation of the system through combination with MCR.

The Required Questionnaires for customer about the SVC of MCR type

Series No	Contents
1	Application fields, load types, load characteristics and desired compensation capacity (We can help customer calculate compensation capacity according to load characteristics)
2	Power supply system diagram; Onsite layout; Altitude and Temperature etc
3	The point of common coupling for harmonic measurement
4	The maximum and minimum short–circuit capacity at the point of common coupling; Proportion of maximum own demand to power supply capacity at the PCC (or provide admissible current limit value of harmonic at PCC)
5	Main transformer capacity; The proportion of rated primary voltage to rated secondary voltage and the percent of impedance voltage
6	The cable specification, cross section and length from main transformer to PCC (calculate line impedance)
7	If the capacitor compensation devices has existed already, please indicate: installation location, capacity, rated voltage, connection mode and reactance ratio etc.
8	If the SVC has existed already, please pay attention to mutual disturbance; Know respective sampling point of control object and relationship between compensated loads.
9	Background harmonics, flicker (We can measure at site), and other harmonic sources
10	Harmonic contents: if the project was brought into operation, we can measure at site; if not, the customer should provide: total capacity of power consumption devices and detail parameters of power equipments generating harmonics, such as: rectification pulse numbers, rectification type, SCR rectification or diode rectification? The capacity of harmonic sources and quantity.
11	The average monthly active power, reactive power and desired power factor after compensation; the semiannual actual consumption of active power, reactive power; operation time and power factor under all kinds of loads; power devices adding conditions.
12	The operation voltage of power grid under the light load, heavy load, normal loads and late–night load.

Frequently Asked Questions

1. The SVC of MCR type adopted iron core reactor, while TCR–typed SVC adopted air–core reactor, if the loss of MCR–typed SVC is higher than the loss of SVC with TCR type?

At first appearance, it seems that the loss of MCR–typed SVC is higher than the loss of SVC with TCR type because of its iron core, but after respective loss analysis, we found:

a. Iron loss is lower compared with entire loss of SVC: the entire loss of SVC is composed of iron loss, line loss (copper line loss and aluminum line loss) and SCR heating loss, the iron loss is not over 5% of entire loss; the iron loss of ordinary transformer includes magnetic hysteresis loss and eddy current loss, the magnetic hysteresis loss takes up about 80%, while, the eddy current loss takes up 20%, because the working state of magnetically controlled saturation reactor drifts off the zero flux point, it avoids magnetic hysteresis loss, therefore, the iron loss of MCR is just 30% of ordinary transformer iron loss, in addition, iron loss is just 20% more of line loss, so, the iron loss of MCR is very low.

b. The main loss of SVC are line loss and SCR heating loss, the line loss of MCR and TCR is as below: First, TCR with air–core adopted aluminum lines, MCR with iron core adopted copper lines, the resistance of aluminum is bigger than the resistance of copper, so the heat of aluminum is also bigger. In addition, in terms of line length, we know from the impedance formula of reactor: X=ω*u*n2 *S/L, that the square of line length is in inverse proportion to magnetic permeability of medium under the same voltage and capacity. The magnetic permeability of iron core is 2000~8000times of air magnetic permeability, so the aluminum line of air–core reactor will be many times of copper line of iron core reactor under the same capacity (MCR also has a air gap, but it is very small and just about several centimeters, and most of magnetic circuits conduct in iron core). The longer the aluminum line is, the more the line loss is, in case the line loss need to be decreased, the line cross section will be increased, which will result in more investment, the cost performance is very lower.

c. The SCR of TCR is connected in series to high voltage main circuit and wants high power capacity; it will generate heavy heating, so the complex and expensive cooling devices are inevitable, while, the SCR of MCR is working under the low voltage and small power, it is no need of cooling devices except that the capacity of MCR–typed SVC is over 50Mvar, air cooling devices are enough.

In conclusion, the loss of MCR–typed SVC is very low and just about 1/2 of TCR–typed SVC.

2.The SVC of MCR type adopted saturation reactor with iron core, does it generate big noise?

No matter transformer or reactor, they both generate noise, but the main reason of noise is not because of saturation (but of course, the higher the magnetic density, the bigger the noise, but it can be decreased or eliminated by technique improvement), it depends on manufacturing process. At present, the transformer technology in China is becoming more and more advanced; the noise of big transformer is decreased below 70db, it fully complies with State Environmental Protection Standards. We cooperate with the first–class transformer/reactor manufacturer to control the reactor noise below 70db.

Static Var Compensator - MCR TYPE

Execute Standards

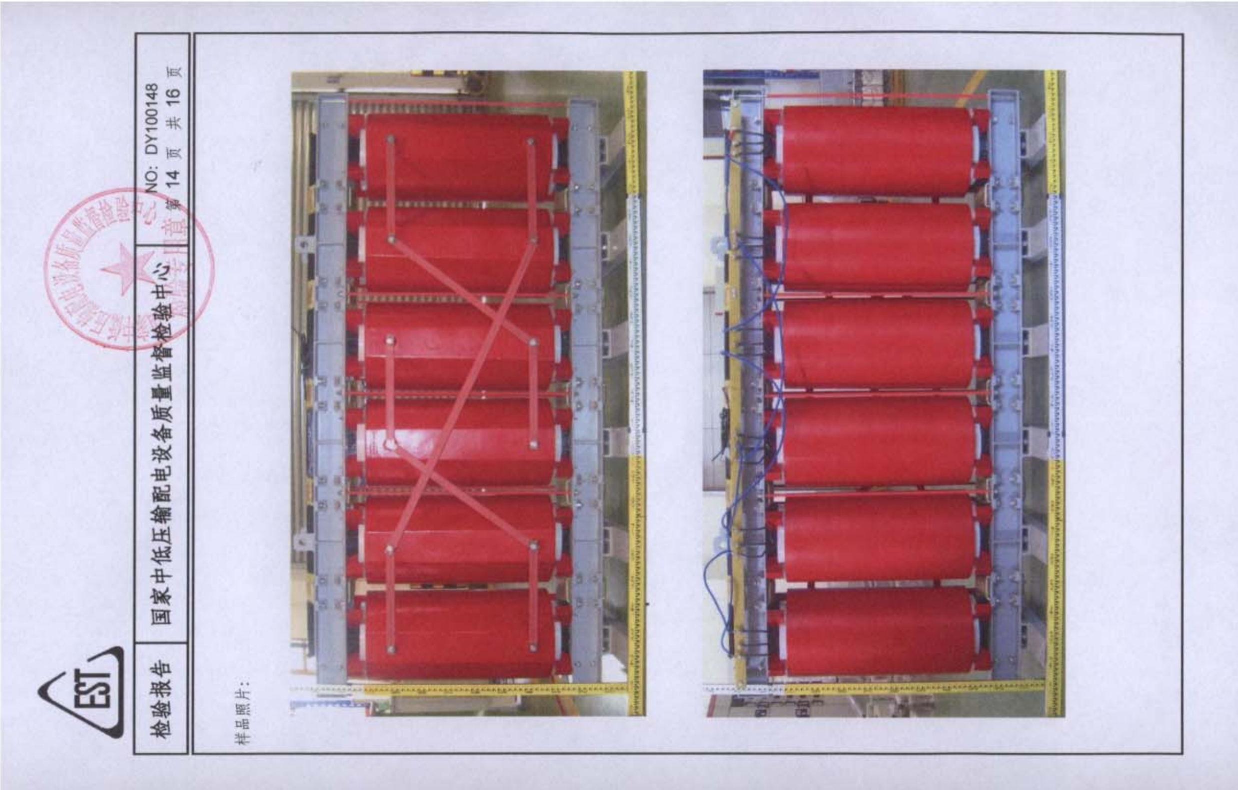
Standards No	Standards Description
——GB / T 20298 – 2006	The functional specification of Static var compensator
——GB / T 20297 – 2006	Static var compensator field tests
——DL / T 1010.1 ~ 1010.5	Section1 to section5 of High voltage static var compensator
——Gb10229 – 1988	Reactor
——Gb12325 – 1990	Quality of electric energy supply–––Admissible deviation of supply voltage
——Gb50227 – 95	Design Standard of Parallel Connection Capacitor Device
——GB / T14549 – 1993	Quality of electric energy supply–––Harmonics in public supply network
——GB / T15543 – 1995	Quality of electric energy supply–––Admissible three–phase voltage unbalance factor
——GB / T15945 – 1995	Quality of electric energy supply–––Permissible deviation of frequency for power system
——Gb1208 – 97	Current transformer
——Gb12326 – 90	Quality of electric energy supply–––Admissible voltage fluctuation and flicker
——GB / 311.1 – 5 – 86	High–voltage insulation coordination and experimentation technology
——GB3983.2 – 89	High voltage shunt capacitor
——DL / T604 – 1996	Specification of high–voltage shunt capacitor installations for order
——Gb15166 – 1994	High voltage fuse for protecting single shunt capacitor
——JB / T8970 – 1999	Discharge coil for high voltage shunt capacitor
——ZBK48004 – 90	High voltage AC filter capacitor
——GBT7328 – 87	Determination of transformer and reactor sound levels

Model Specification

W MCR – SVC – □ / □ / □

- □ (third): F – Single – phase Respective Compensation; G – Three – phase Concentrated Compensation
- □ (second): Voltage Level KV
- □ (first): Capacity kVar
- SVC: Static Var Compensator
- MCR: Magnetically Controllable Reactor
- W: Zhuhai Wanlida Electric Co., Ltd.

Test Report — in China National Quality Supervision and Testing Center for Mid-low Voltage Transmission and Distribution Equipment


检验报告　国家中低压输配电设备质量监督检验中心　NO: DY100148
第 14 页　共 16 页
样品照片:


№ DY100148
2009002873Z
CNAS L0153
(2009)国认监认字(348)号

检 验 报 告

产品名称　MCR 型 SVC 用磁饱和并联电抗器
型号规格　WMCR-400/10
受检单位　珠海万力达电气股份有限公司
检验类别　委托

国家中低压输配电设备质量监督检验中心

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