PCS-9250

AC Electronic CT/VT and Optical CT

To keep pace with the increasing demands of transmission capacity and rising system voltage, NR Electric has pursued advanced research on electronic CTs,VTs and optical CTs to ensure maximum reliability and availability in the applications of metering and protection relays. ECTs/EVTs have the advantages of no magnetic saturation, none ferromagnetic resonance, large dynamic measuring scope, wide frequency band and compact structure.

NR Electric's electronic CTs/VTs and optical CTs are suitable for both gas- insulated switchgears (GIS) and air-insulated switchgears (AIS). Furthermore, they have been tested in the laboratory and been successfully put in-service in real substation applications worldwide.

Electronic CT/VT in GIS Application

The electronic CT/VT for GIS can be applied to the 110kV (220kV, 330kV or 500kV) gas insulation switch for measuring primary current and voltage. The output signals are sent to digital measuring devices, bay control units and protective relays. Electronic CT/VT can be installed both indoors and outdoors.

Electronic CT/VT in GIS application are composed of the following three parts:
Main Body: the main body includes transformer tank, adjustable shell, basin-type power insulator, primary conductor, built-in current and voltage sensor. The space between primary conductor and the transformer tank is filled with SF6 insulating gas.

Primary Sensor: the primary sensor is composed of two duplicated sensors, each of which includes one low power CT (LPCT), one air core coil and one coaxial capacitor voltage divider.

Remote Terminal Unit (RTU, also named primary converter): the electronic CT/VT for GIS is composed of two duplicated RTUs. These are used to receive and process output signals of low power CTs, air core coils and the capacitor voltage divider. The output signals of RTUs are transmitted to merging units through optical fibers. Primary sensors and RTUs are all installed at the high voltage side with a duplicated configuration.

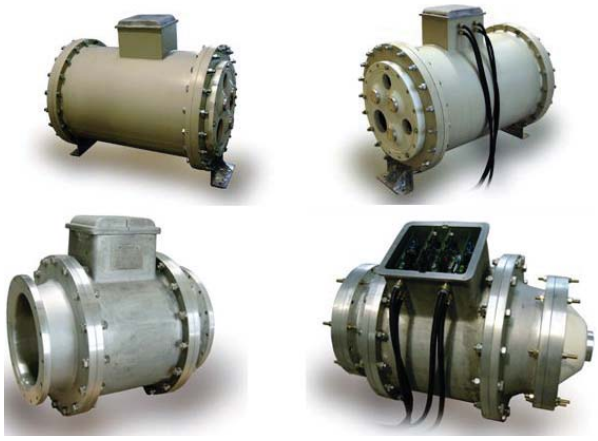

Figure 1 Electronic CT/VT in GIS Application

Optical CT in GIS Application

The optical CT for GIS adopts Faraday magneto-optic effect to realize current measurement, it can be applied to 110kV (220kV, 330kV or 500kV) gas insulation switch. The output signals are sent to digital measuring devices, bay control units and protective relays. Optical CT can be installed both indoors and outdoors.

Optical CT in GIS application is composed of the following three parts:
Main Body: the main body includes transformer tank, adjustable shell, basin-type power insulator and primary conductor, etc. The transformer tank is grounded and can be equipped with current sensor and other components. The adjustable shell is mainly used to make the optical CT suitable for GISs of different manufacturers. The primary conductor is fixed on the basin-type power insulator, and the space between the primary conductor and the transformer tank is filled with SF6 insulating gas.

Sensing fiber ring: it is composed of multi-turn winding of sensing fiber and is used to sense the current to be measured. The sensing fiber has a small size and light weight, it can be

integrated into the GIS tank (built-in type), or be separately placed outside the tank (external type), so the installation method is flexible. Sensing fiber ring is located outside the SF6 gas chamber and it dosen't affect the insulation performance of GIS. The number of fiber rings for each transformer can be configured according to engineering requirements.

Sampling unit: it is generally placed in control cabinet, and is mainly composed of optical path module and signal processing circuit. Sampling unit is used to transmit the polarized light signal to the sensing fiber ring, receive the modulated optical signal with the primary current information from the sensing fiber ring, calculate the primary current value, and send the current value to merging unit through optical fiber.

Figure 2 Optical CT in GIS Application

Electronic CT/VT in AIS Application

Electronic CT/VT in AIS application can be applied to 110kV (220kV, 330kV or 500kV) substations for primary current and voltage measurement. The output signals are sent to digital measurement devices, bay control units and protective relays. Electronic CT/VT can be installed both indoors and outdoors.

Electronic CT in AIS Application

ECTs in AIS application are composed of the following four parts:
Primary sensor: The primary sensor is composed of one low power CT, two air core coils and one HV current energy acquisition coil. It is installed at the high voltage side.

Dual remote electronic modules: Each dual remote electronic module is located at the high voltage side. It receives and processes output signals for low power CT and air core coils. Remote electronic modules produde digital optic signals as their output.

Optic insulator: The optic insulator is composed of a solid prop composite insulator with eight built-in multimode optical fibers. Of these, four are used to transmit laser and digital signals, the other four serve as standby optic fibers.

Merging unit: Merging units are placed in the control room to provide laser power supply and receive three-phase current and voltage signals. The output of merging unit is sent to the protection and control devices using IEC60044-8 or IEC61850-9-1/2 protocols.

Figure 3 Electronic CT in AIS Application

Figure 4 Electronic VT in AIS Application

Electronic VT in AIS Application

EVT in AIS application is composed of the following three parts:
Capacitor voltage divider: The capacitor voltage divider converts high voltage into low voltage signals and sends them to the remote modules for processing. It also can be used as a communication carrier device.

Dual remote electronic modules: Dual remote electronic modules are located at the low voltage side. They receive and process the output signals of capacitor voltage divider. Remote electronic modules produce series digital optic signals as their output.

Merging unit: Merging units are placed in control rooms to receive three-phase voltage signals. The output of merging units is sent to the protection and control devices using IEC60044-8 or IEC61850- 9-2 protocols.

Electronic CT/VT Groups in AIS Application

Electronic CT/VT groups are integrations of ECTs and EVTs used in AIS application. The device is composed of the following four parts:
Primary current sensors: Primary current sensors are placed at the HV side. They include one low power CT, two air core coils

and one HV current draw-out coil.

Dual remote electronic modules: Dual remote electronic modules are located at the high voltage side. They receive and process the output signals of low power CTs and the air core coil. Remote electronic modules produce series digital optic signals as their output.

Capacitor voltage divider: The capacitor voltage divider converts high voltage into low voltage signals and sends them to the remote modules for processing. It also can be used as a communication carrier device.

Merging unit: Merging units are placed in control rooms to provide laser power supply and receive three-phase current and voltage signals. The output of merging units is sent to the protection and control devices using IEC60044-8 or IEC61850- 9-2 protocols.

Optical CT in AIS Application

The optical CT for AIS adopts Faraday magneto-optic effect to realize measuring current, it can be applied to 110kV (220kV, 330kV or 500kV) open-type substation. The output signals are sent to digital measuring devices, bay control units and protective relays. Optical CT can be installed both indoors and outdoors.

There are two types of optical CTs in AIS application, independent type and integrated type. For independent-type optical CT, its sensing fiber is located on the top of optical fiber insulator. For integrated-type optical CT, its sensing fiber ring is installed inside Disconnecting Circuit Breaker (DCB), and its insulation is achieved by insulation column of DCB. The integrated-type optical CT has the advantages of small occupied area, low in construction investment and maintenance, etc.

Optical CT in AIS application is composed of the following three parts:
Sensing fiber ring: is composed of multi-turn winding of sensing fiber and is used to sense the current to be measured. The sensing fiber doesn't need to be energized and has good anti-interference ability, small size, light weight, flexible installation type. The number of fiber rings for each transformer can be configured according to engineering requirements.

Optical fiber insulator: is a composite insulator with embedded polarization maintaining fiber. It is used for ensuring the insulation between HV side and LV side and transmitting the measured current information induced by the sensing fiber ring to LV-side sampling unit. Optical fiber insulator can be designed as suspended type or column type, it has no oil and no gas, and the insulation is simple and reliable.

Sampling unit: is generally located in outdoor cabinet, and it is comprised of optical path module and signal processing circuit. Sampling unit is used to transmit the polarized light signal to the sensing fiber ring, receive the modulated optical signal with the primary current information from the sensing fiber ring, calculate the primary current value, and send the current value to merging unit through optical fiber.

Figure 5 Optical CT in AIS Application

Technical Data

Type	OCT/ ECT/ EVT for GIS and AIS			
Max. operation voltage Um(kV)	126	252	363	550
Withstand voltage (kV)	230	460	510	740
Lightening impulse withstand voltage (kV)	550	1050	1175	1675
Switching impulse withstand voltage (kV)	\	\	950	1175
Rated primary voltage (kV)	110/ √3	220/√3	330/√3	500/√3
Rated primary current (A)	100~4000	100~4000	100~4000	100~4000
Short time thermal current (kA), 3s	40	50	50	63
Rated dynamic current (kA)	100	125	125	158
Accuracy limit factor	20, 30, 40	20, 30, 40	20, 30, 40	20, 30, 40
Environment temperature	-40°C~+70°C	-40°C~+70°C	-40°C~+70°C	-40°C~+70°C

Type		OCT/ ECT for GIS and AIS		EVT for GIS and AIS	
Transmission protocol		IEC 61850-9-2LE			
Secondary output	Type	Digital			
	Port	Current measurement	Current protection	Voltage measurement	Voltage protection
	Accuracy	0.2S(ECT) 0.2 (OCT)	5TPE	0.2	3P