



Arc Protection



Breakthrough solution to reactive power compensation

Typical Applications



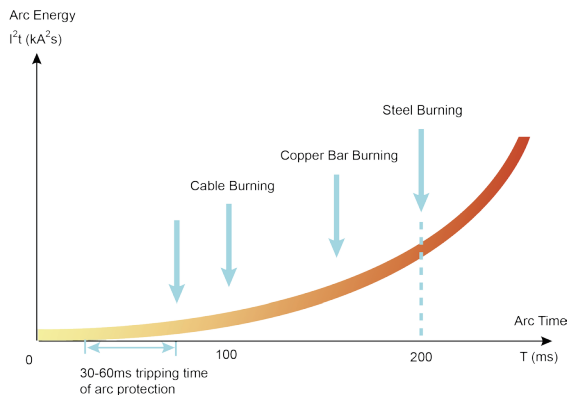
The fault probability in distribution system is much higher than that in transmission system, and most of faults in switchgear accompanies with arc flash. Arcing is caused by the breakdown of the air due to the voltage exceeding the air potential between one electrode and another. The most common consequence of switchgear faults in distribution system is arc flash. There are various reasons causing arc faults in distribution system, including numerous outgoing feeders, insulation aging, loose connection due to vibration, primary circuit breakdown of bus VT, accident/incorrect human operation, insufficient mechanical distance, and harm by animals, dirt, fluid, etc.

Arc is very dangerous and damaging due to its high temperature, high radiation energy, high speed and high light intensity.

- High Speed of Arc: up to 300m/s
- High Temperature of Arc: up to 20,000 °C
- High Radiant Energy of Arc: up to 40MW in peak
- High Intensity of Arc Light: >2,000 times of ambient light

It may cause severe asset damages and personnel injuries when arc fault evolves uncontrolled:

- Switchgear explosion due to rapid expansion of gas
- Burnout of copper bar, aluminium bar and cable due to high temperature
- Severe vibration to switchgear resulting in loosening connection
- Personnel injury due to high temperature, strong light, harmful gas, spatter of fragments and sound of explosion



Arc Burning Time	Extent of Equipment Damage
35ms	No apparent damage, restoration is normally allowed after the check of insulation resistance
100ms	Minor damage, check cleanliness or make minor repair before equipment is put into service
500ms	Serious damage, site personnel may be seriously hurt. It is necessary to replace part of equipment

Typical Applications



Traditional solutions for the distribution busbar fault include:

- Use incoming line overcurrent protection to trip fault. Typical operation time of this protection is normally 500ms to 1s. Therefore, tripping takes too long, equipment damage is serious, and equipment may even be burnt out, affecting production.
- Use zone interlocking scheme of overcurrent relays to clear the arc fault. Typical operation time of this protection is 100 to 150ms. And the high-reliable communication is required among the relays because the protection is based on communication.
- Use high-impedance/numerical busbar current differential protection. Typical operation time of this protection is 30 to 50ms. However, since CT saturation occurs easily in distribution, this protection has the possibility of mal-operation. Further, in some applications, the busbar protection is very difficult to satisfy the bay number in distribution system. Therefore, application of independent busbar protection is limited.

To ensure the safety of personnel and asset, the high-speed protection to quickly clear arc fault is urgently required.

The PCS-9656 Arc Protection provides fast protection for switchyard in substation, power plants and industrial enterprises. In case of short circuit fault in switchgear, the arc faults in protected area which is covered by arc sensors, can be quickly cleared via arc protection, avoiding harm to personnel and asset. The arc protection uses arc sensors to detect the arc light caused by short circuit faults.



(a) PCS-9656 Arc Protection



(b) Arc light sensor

PCS-9656 Arc Protection can acquire the incoming line current via AC current inputs and arc flash signals via locally installed arc sensors to reliably discriminate the arc faults. Up to 12 current inputs can be integrated in one unit. It can also receive digital current data from Merging Unit (MU) via IEC 61850-9-2. It integrates the protection calculation, tripping output, event recording, and human-machine interaction etc. This device can be installed in a protection panel or local switchgear.

Typical Applications

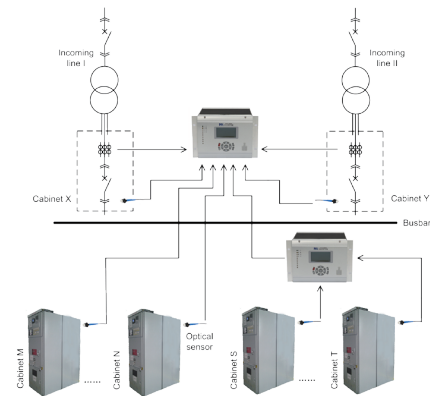


PCS-9656 Arc Protection adopts the modular structure and supports up to 24 arc sensors in one unit. The modular structure makes the on-site replacement much easier. Among the units, the point-to-point communicate can be set up via optical fibers to realize the arc protection with over 24 arc sensors. Up to 12 current inputs are integrated in one unit for incoming line current acquisition. Flexible hardware configuration based on modular structure can be tailored according to specific site requirements.

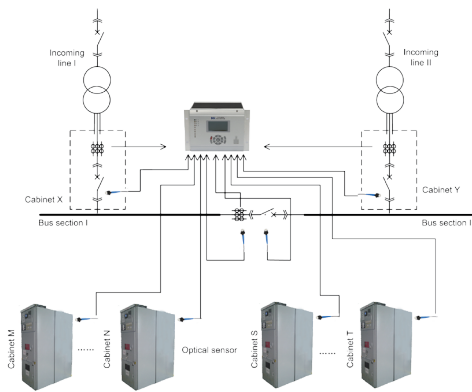
Single-unit or multi-unit arc protections are supported by PCS-9656 relays. Single-unit protection can integrate up to 24 arc sensors, as well multi-unit protection can integrate over 24 sensors. Series connection of units can be performed to realize protection with 24+ arc sensors, constituting multi-unit arc protection. Up to 3 point-to-point optical ports in one unit are supplied for series connection among units.

Typical applications are as follows:

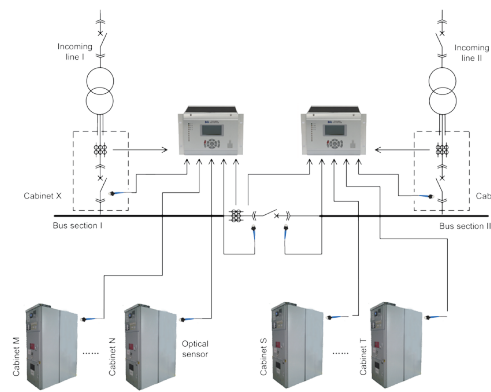
- Single Busbar
Quantity of PCS-9656 units can be flexibly configured to realize single-unit or multi-unit protection according to the sensor number.
- Single Busbar with Section, Up to 24 Sensors
- Single Busbar with Section, Over 24 Sensors



(a) Single busbar application



(b) Single Busbar with Section, up to 24 Sensors



(c) Single Busbar with Section, over 24 Sensors

Functions



Protections

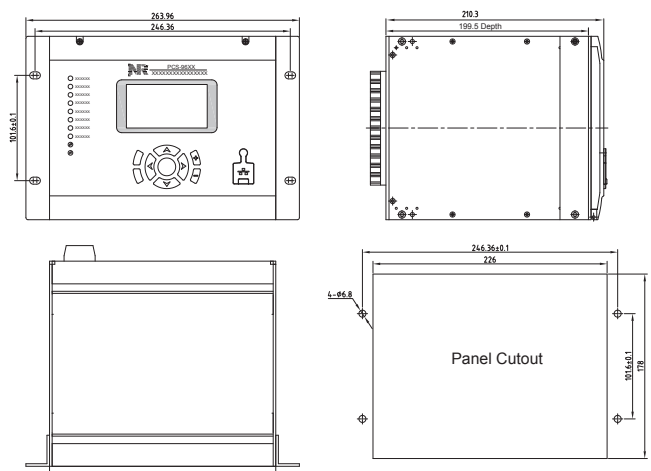
- Arc Protection
- Up to 6 Breaker Failure Protection (50BF)

Monitoring

- Arc intensity supervision
- CT failure supervision
- Transferring/Receiving module supervision
- Self-Diagnostic
- Fault Recording
- 64 trip reports
- 1024 self-diagnostic reports
- 1024 BI-change-of-state reports
- 1024 logging reports
- 1024 SOE
- 64 fault records with oscillograms compatible with COMTRADE

Dimensions

PCS-9656 arc protection adopts standard 4U (height) 9.5-inch (wide) case which can be installed in a panel or switchgear.



Features



- The relay fully supports IEC61850 standards, including IEC 61850-8-1 MMS/GOOSE and IEC61850-9-2 (Sampling Value), suitable for process bus application, satisfying future smart grid development.
- The innovative technology of deviation of power frequency component (DPFC) is adopted in this relay. The current criteria is based on DPFC technology using the change-of-current to guarantee the fast detection of fault current.
- The relay provides both single-criteria (arc) and dual-criteria (current and arc) to guarantee fast and reliable operation. When dual-criteria enabled, typical operation time (including output relay time) is less than 10ms.
- The passive optic sensor based on photometry cosine principle is made by optic frequency selection bandpass thin-film technology, to realize none-power-supply and strong immunity against interference.



Features



- Arc sensor monitors ambient light intensity during normal service state. This device can automatically and continuously track ambient light, to realize self-adaptability to different environments.
- Fault point locating function is provided in this relay. Fault position and fault information can be displayed in LCD.
- Flexibility and expandability are supported by this relay. Visualized programming logic and flexible modular configuration are provided, to adapt to different application requirements.
- Tripping outputs adopt high-speed contact using combined IGBT and output relay, the delay time of output contact is less than 1ms. As well, the pure output relay contact can also be supplied according to customer specification.
- The tripping outputs can be configured via tripping matrix. And the tripping zone can be set according to the specific application. The relay will trip different zones sequentially, to minimize the outage range.
- Up to six breaker failure protections (50BF) are integrated in this relay. Breaker failure criteria can be selected as circuit breaker positions and/or feeder currents via setting.
- Clock synchronization is supplied, supporting clock pulse input, communication message and IRIG-B.
- Continuous self-diagnostic test is integrated in this relay, including hardware/software self-diagnostic, communication monitoring and arc sensor connection monitoring.
- Up to four 100Mbps Ethernet ports or two RS-485 serial ports are provided for SCADA communication, complying with IEC 61850-8-1 MMS/GOOSE, IEC 60870-5-103 and DNP 3.0
- Directly control outputs without current/voltage injection is supported to make on-site maintenance easier.
- Up to 64 trip reports, 1024 self-diagnostic reports, 1024 change-of-state reports, 1024 logging reports and 1024 SOE are provided.
- Up to 64 fault oscillograms compatible with COMTRADE format are provided, including AC quantities, Binary Inputs/Outputs and arc intensity.

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