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SDO FlexiCDP

FAULT DETECTION SYSTEM FOR CABLE SECTIONS IN MIXED HV LINES

Preliminary

1. PROTECTION OF HIGH VOLTAGE MIXED LINES

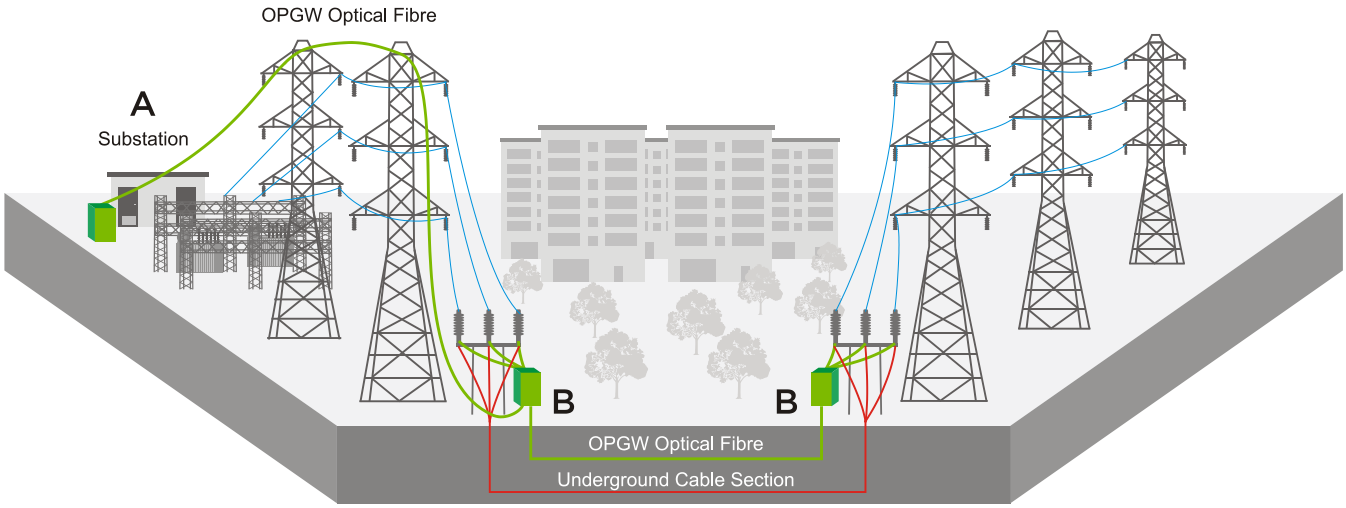
High Voltage transmission lines that combine overhead lines with underground cable sections are known as Mixed lines. When transmission lines cross urban or industrial areas and both technical and environmental requirements allow, it is common utilities to place these cables underground.

In case of fault in a mixed line, the challenge is to determine if it occurred in the overhead line or the underground cable section. Faults in underground cable sections are typically permanent so it is desirable to block the re-close command for the circuit breaker in order to avoid further damage.

There are two basic use cases with mixed HV lines:
1) Mid-line application: cable section in the middle of the line.
2) Line entry application: cable section terminated at a substation.

Figure 1 illustrates the mid-line application.

The reliability of the SDO FlexiCDP system is equivalent to a classic differential protection scheme, with the advantage of minimizing the required infrastructure, simplifying the installation and reducing the cost by a factor of 10.



› Figure 1: Application of the SDO FlexiCDP for detecting faults in underground cable sections of mixed lines.

Signal Processing and Fault Detection unit

A SDO-CDP - Block 79

Flexible Optical Current Sensors

B

2. KEY ASPECTS OF THE SDO FlexiCDP

- Fault detection based on 100% reliable traditional differential protection algorithms.
- Remote current measurement using passive, flexible optical sensors based on Faraday Effect.
- Current measured values for the differential algorithm are transmitted to the closest available substation, which can be several kilometres away from the location of the sensors, by means of the optical fibers available on the OPGW cable.
- SDO CDP electronic terminal unit is located in the substation and is in charge of processing the six (6) optical signals coming from the optical sensors, as well as executing differential algorithm, resulting in activation of a digital relay output with the command of Block Re-Close (Block 79), in case of the fault occurring in the underground cable section.

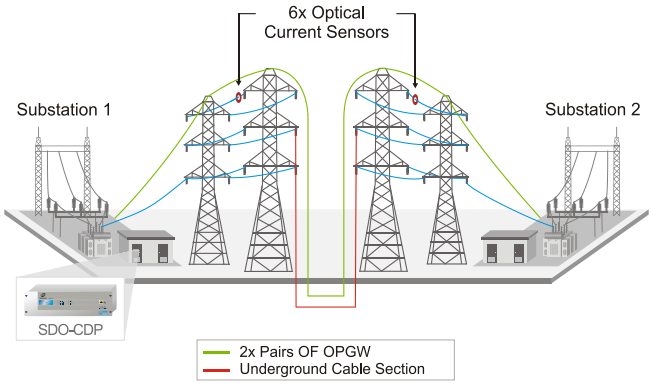
3. MAIN ADVANTAGES

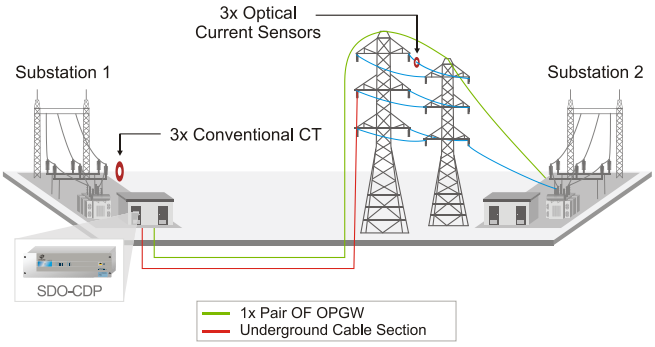
- Reliable fault detection in mixed lines to determine if the fault occurred in the underground or overhead section.
- Improved line availability allowing for the reclosing in case of transient faults occurring in the overhead section.
- Drastically reduces CAPEX by a factor of 10 as compared to conventional differential protection schemes.
- No use of land and no civil work needed for installing equipment such as; instrument transformers, protection relays, communication devices, auxiliary power supply, surveillance, etc. in the overhead to underground transition points.
- No alterations to the overhead-underground transition points.

4. KEY FEATURES

- Remote current measurement using passive optical sensors. No active components that require power supply.
- Maintenance free and non-intrusive installation.
- Protection zone includes possible faults in the cable termination bushings.
- Optical sensors do not saturate and are fully linear, simplifying implementation of differential algorithm.
- Flexible optical sensors for easy installation around the cable bushing without the need for breaking the line.
- Signal processing and fault detection unit (SDO CDP) located in the closest available substation, which can be several kilometres away from the current sensing points.
- Current measurements from the optical sensors are transmitted through the standard single-mode optical fibers available in the OPGW cable.
- The output of the system is a digital relay contact activated when the fault occurs in the cable section or in the terminal bushing.

5. SYSTEM COMPONENTS





Mid-line Application
6 x Optical Current Sensors
2 x OPGW optical fiber pairs
1 x Electronic terminal unit for signal processing and fault detection

Line Entry Application
3 x Optical Current Sensors
1 x OPGW optical fiber pairs
1 x Electronic terminal unit for signal processing and fault detection

DESCRIPTION OF COMPONENTS

Flexible Optical Current Sensors

- Fully passive optical current sensor, consisting of optical fiber and optical fiber components only.
- The sensor itself is an all dielectric cable, 18 meters in length and 7 mm in diameter, connected to an optical splice box with dimensions 520x220x150 mm and a weight of 6.50 Kg.
- Both the splice box and all the fixing elements are standard components and normally used in OPGW installations, allowing for easy installation without making any alterations to the overhead-underground transition point.

SDO-CDP: Signal Processing and Fault Detection Unit

All functions of the FlexiCDP system are executed by the central SDO-CDP signal processing and fault detection unit.

- Interfaces remote optical current sensors.
- Three analog inputs are available for conventional CT inputs used with the "Cable Entry" mixed line application.
- Optical signal processing.
- Implements current differential algorithm.
- Auto re-close Block (79) signal in case of a fault occurring in the cable or bushing.

Standard 3U device for installation in 19" rack, with dimensions 482x287x133 mm.

For more information:

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