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SIPROTEC 5 Application Note

SIP5-APN-017:
Stub Protection

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SIPROTEC 5 - Application:
SIP5-APN-017
Stub Protection

Content

1 Application: Stub Protection

1.1 Introducation

This application note describes the stub protection in a breaker-and-a-half application using SIPROTEC 5.

Most of the functions described in this application note are preconfigured in the template “1 ½ Circuit Breaker”.

The applicable SIPROTEC5 device Manual should be consulted for detailed information. The “Help” Function in DIGSI 5 as well as detailed application descriptions on various SIPROTEC 5 subjects can also be consulted.

1.2 Overview

With the breaker-and-a-half configuration an operating mode is possible whereby the feeder is out of service while both circuit breakers in the diameter remain closed. This is the case when ISO1 is open while CB1 and CB2 are closed in the single line diagram shown below.

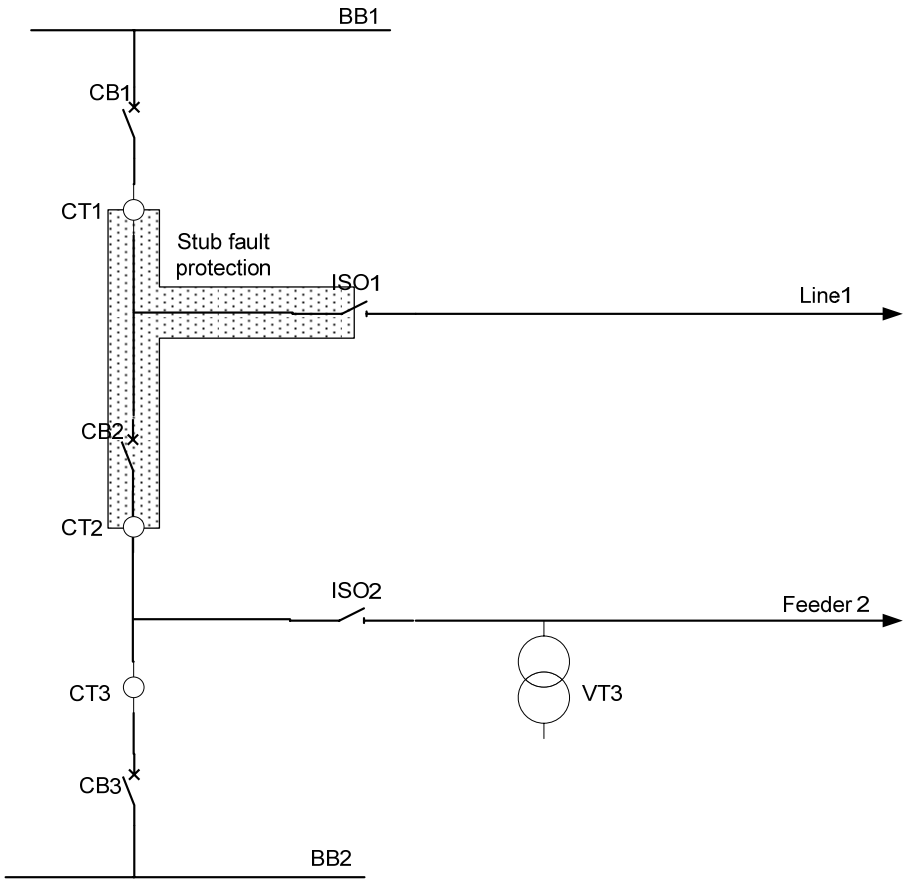

Figure 1: Single line diagram showing Stub Fault Protection

All faults in the zone between CB1, CB2 and ISO1 are stub faults. The Stub protection boundary is defined by the location of the current transformers as shown above.

The diagram below shows the Stub fault protection coverage when CT2 is on the other side of CB2.

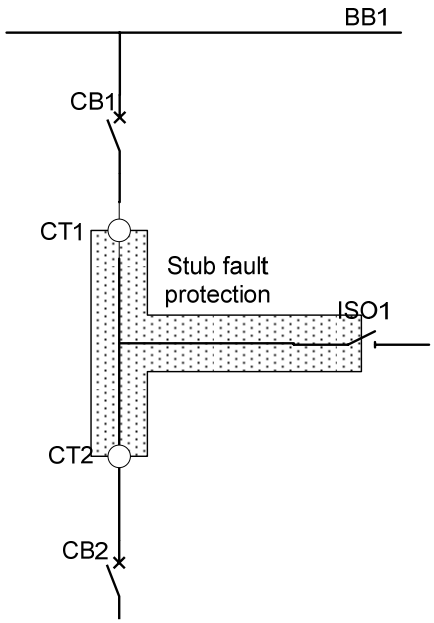

Figure 2: Stub Fault Protection with Current Transformers on the line side

A simple stub over-current protection would be suitable for single breaker (only one CT) applications. For 2 breaker (also 2 CT) applications a heavy through fault current and subsequent saturation of one of the CTs may cause mal-operation of a simple OC based sub protection. Here a stub differential protection is more suitable as it has current restraint characteristic that ensures stability even if only one of the CTs goes into heavy saturation during a through fault.

At the same time as activating the stub protection the feeder protection must also be conditioned to ensure that no mal-operation occurs at the local end. For this purpose the feeder differential protection at the local end is “logged out”.

1.3 Stub Fault Protection

The Sub Fault Protection (differential) is inserted in the FG Line. There are two stages, “normal” and “stub diff fast”. The stub diff fast is capable of very fast tripping for high fault currents.

It is not necessary to have a very sensitive setting of the stub diff as faults this close to the busbar have large fault current. It is more advisable to set the function above full load current for maximum security – see setting example below.

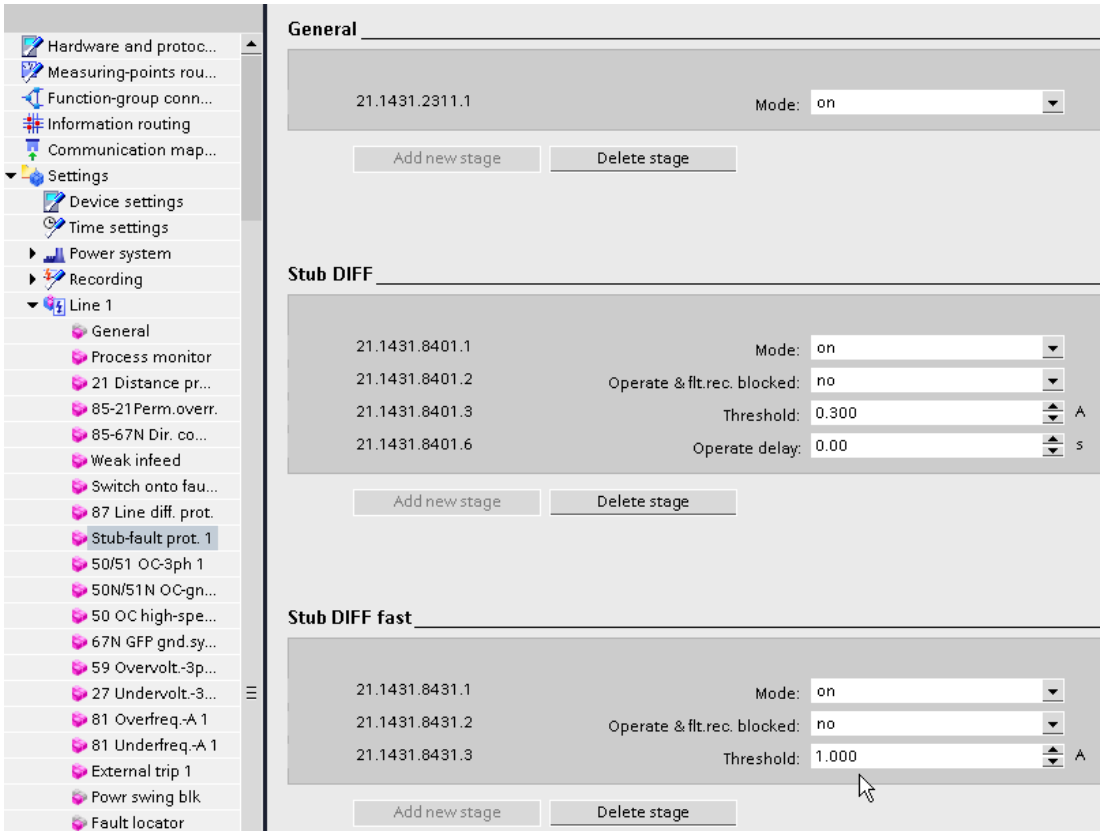

Figure 3: Settings of Differential Stub Fault Protection

The CT error settings influence the differential characteristic.

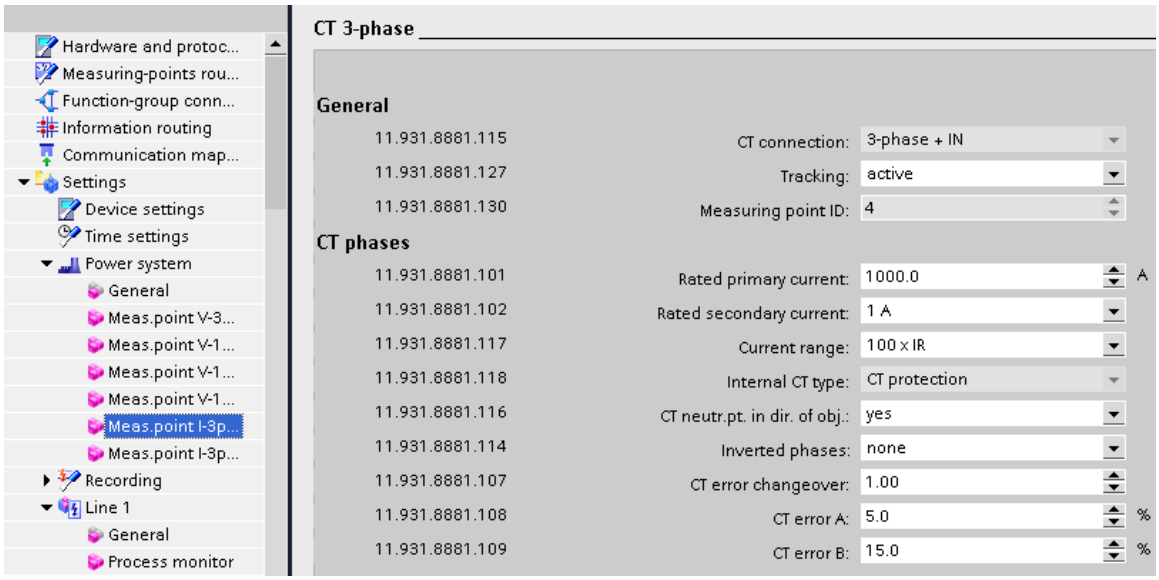

Figure 4: Settings of CT error

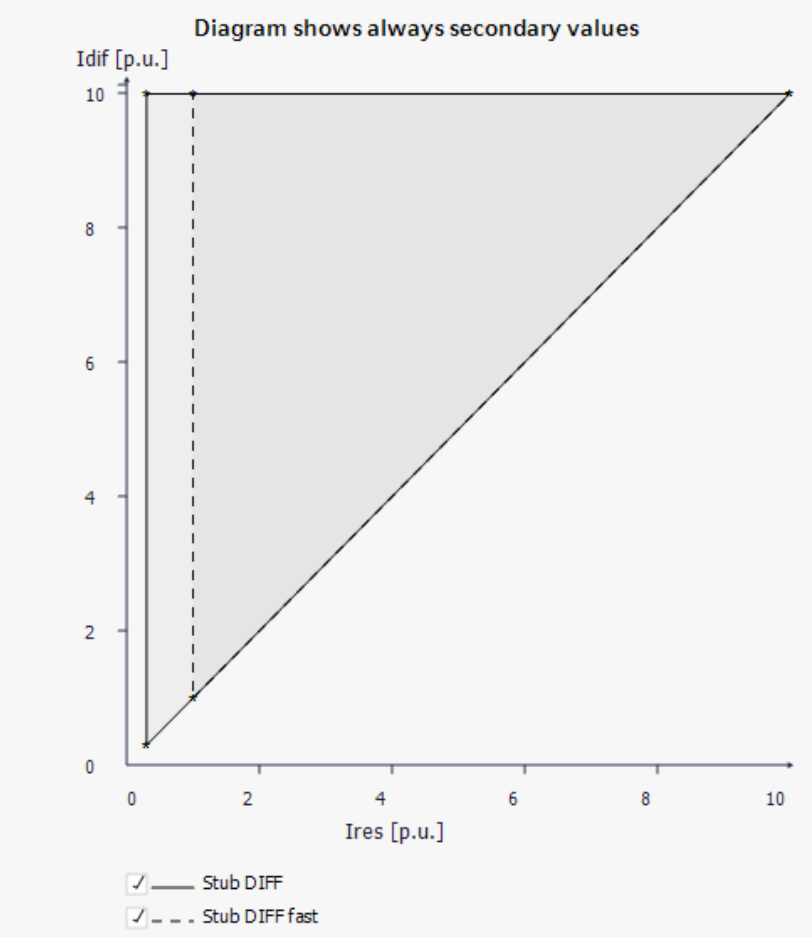

Figure 5: Characteristic of Differential Stub Fault Protection

The differential mode of operation is similar to the line differential function. It checks the two currents assigned to the FG Line. The set current transformer errors are used to calculate the restraint current. For a detailed description of the function please refer to the operating manual.

The Stub-Fault protection may only operate when the feeder disconnector switch is open. The status of the disconnector switch is derived via binary inputs connected to the auxiliary contacts of the disconnector. The disconnector switching state is available from the FG Disconnector:

Information			Source								
			Binary input								
			Base module								
Signals	Number	Type	1	2	3	4	5	6	7	8	9
(All...)	(All...)	(..									
Disconnector 1	601										*
Control	601.4201										
Interlocking	601.4231										
Disconnector	601.5401										*
>Acquisition blocking	601.5401.500	SPS									
>Reset switch statist.	601.5401.501	SPS									
Health	601.5401.53	ENS									
Position	601.5401.58	DPC									OH
Open command	601.5401.300	SPS									
Close command	601.5401.301	SPS									
Command active	601.5401.302	SPS									
Op.ct.	601.5401.305	INS									

Figure 6: Routing of Disconnector auxiliary contact

In the above example a normally closed auxiliary contact (closed when the primary contacts are open) in the disconnector is connected to binary input 9 of the base module. The type of this signal is a controllable double point (DPC) as it is primarily used as feedback information in the context of control and indication. Based on this feedback the FG Disconnector makes available the switching state (Disconnector Position open) which is routed to release the Stub-fault protection (General>Release function). This logical connection is preconfigured in a CFC included in the 1 ½ CB template as shown below.

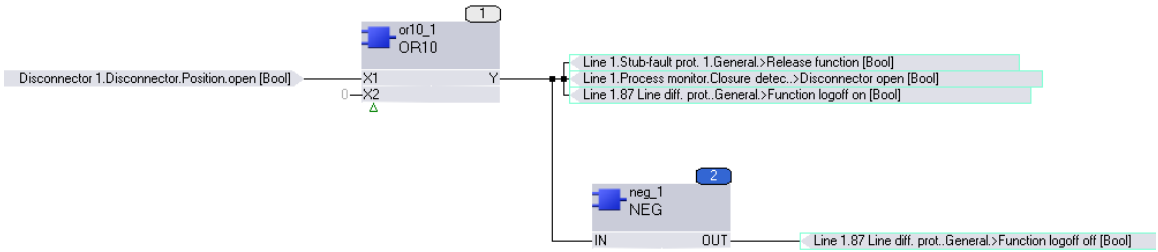

Figure 7: Routing of Disconnector auxiliary contact

In addition to releasing the Stub-fault protection, the above logic also logs out the local end from the Line differential protection. Depending on the used feeder protection functions it may be necessary to also block other protection functions (distance protection, directional earth fault, etc.) with the above logic.

1.4 Setting Example

The setting of the stub differential protection is done with the following consideration. In the event of incorrect status from the disconnector, e.g. indicating open when the line is still in service, the stub differential should not trip if the feeder current is equal to or less than nominal current. To satisfy this constraint, both stages are set with current threshold of 1A (nominal current).

As the stub protection is selective and not time graded with any other function the time delay for both stages is set to zero.

It makes sense to apply both stages with the same threshold as the fast stage uses a different algorithm to achieve very fast clearance of high current internal faults.

1.5 Conclusion

The Stub-Fault protection is essential for the protection of the section between the two circuit breakers when the feeder is taken out of service by opening the feeder disconnector switch.

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