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1 SETTING EXAMPLE

1.1 System data

The setting is based on the data:

- 110 kV, 50 Hz
- A 110 kV cable with a length of 10 km.
- Cable charging current at nominal voltage 50 A / phase
- Maximum load current 500 A
- Current transformer ratio:
- Terminal A 1000/1 A
- Terminal B 800/1

1.2 Setting considerations

The minimum operate current that can be used is 2.5 time the charging current.

This give a minimum operate current $2.5 \times 50 = 125$ A primary.

The maximum load current allow a differential nominal current (I_{nominal}) of 500 A. This current is not to be mix up with the REL nominal current.

The minimum differential operate current (I_{MinOp}) is setable 20-150 % of the differential nominal current (I_{nominal}).

Choose differential nominal current (I_{nominal}) 500 A.

A minimum operate current of 125 A require a differential operate current (I_{MinOp}) of $125 / 500 \times 100 = 25\%$.

The differential nominal current (I_{nominal}) is the rated current I_r multiplied with the current transformer matching factor (CT_{Factor}).

$(I_{\text{nominal}}) = I_r \times CT_{\text{Factor}}$

Terminal A $CT_{\text{Factor}} = 500 / 1000 = 0.50$

Terminal B $CT_{\text{Factor}} = 500 / 800 = 0.625$

With the current transformer complying with the requirement according to the "Users Guide" the default setting: $IDiffLv1 = 40\%$, $IDiffLv2 = 60\%$ and $ILv1/2Cross = 500\%$ are used.

The default setting $I_{\text{MinSat}} = 300\%$ is normally used. When the current transformer have a margin 3 time to the required saturation voltage $E_{2\text{max}}$ according to the current transformer requirement the I_{MinSat} can be increased to 500 %.

The evaluating criteria can be set either 2 of 4 or 3 of 4. The 3 of 4 give a higher security against unwanted tripping due to disturbances in the message transmission but increase the operate time with 5 ms. The security against false tripping is very high also when 2 of 4 is used. The 3 of 4 is recommended to be used only at very low quality communication.

One of the terminals must be given the master roll and the other being the slave (this is required for the measurement of the message transmission delay).

Observe: The differential nominal current (I_{nominal}) must be identical at both terminals, but that means not that the CTFactor must be equal.

The settings IMinOp, IDiffLv11, IDiffLv12, ILv11/2Cross and IMinSat should be set equal in both terminals.

1.3 Naming of message

The message transmitted between the REL line differential protection has to be positively identified by the protections in each terminal to establish the communication necessary for operation (trip at internal fault and avoiding false operation).

One of the terminals must be master in a system for measurement of the communication time between the terminals. Therefore one of the two terminals has to be set as the master and the other as a slave. Communication can only be established between a master and a slave.

Additional to the setting master/slave the terminals are numbered 0-31. Each REL terminal is given an individual number and set to only accept messages numbered with the opposite REL terminals number.

When communication system is used where the telegram can be crossed or directly bridged over a communication node in case of fault in the communication equipment it is important that all REL protections not can establish communication with other the opposite terminal. If communication is established between other REL relays then the one at the opposite terminal of the line unwanted trip can occur.

The relays at the two terminal on a line shall be given different identity numbers. To avoid an introvert communication if the message is echoed in the communication equipment.

Parallel lines shall not be given number that at cross talk can result in communication with false partner.

Lines terminated at a communication node shall be given identities, that communication between the relays and the false remote terminals not can be established when the communication node is bridged.

The identity number 0-31 and the master/slave setting give 64 individual identities that has to be used to eliminate communication at a cross talk in each communication link and at bridging of a communication nodes.

1.4 Setting

	Terminal A	Terminal B
Current transformer ratio	1000 / 1 A	800 / 1 A
CTFactor	0.50	0.625
IMinOp	25 %	25 %
IDiffLvl1	40 %	40 %
IDiffLvl2	60 %	60 %
ILvl1/2Cross	500 %	500 %
IMinSat	300 %	300 %
Evaluate	2 of 4	2 of 4
DiffSync	Master	Slave
TerminalNo	1	2
RemoteTerminalNo	2	1