Application Note

Implementation of a POTT/PUTT Function with BESTlogic™ in a BE1-951

Overcurrent and distance protection, used on transmission and distribution lines for many years, have proved to be a very reliable form of protection, notwithstanding the limitation that its coverage does not protect the whole of the circuit, compared to unit protection schemes such as differential protection. With rapid, reliable and economic communication links now available, this limitation can be overcome by providing links between the relays at each end of the line and adding intertripping to non-unit protection schemes. In addition, non-unit protection has the advantage of being able to act as backup to protection located at substations farther along the line. While there is a wide variety of intertripping schemes, only the more common ones will be considered here, particularly their implementation with BESTlogic. As with any protection system, the selection of any particular scheme depends on the criteria adopted by individual utilities, the communication links available, and the importance of the circuits being protected. Ultimately, it is the fact that these schemes can rapidly clear faults at the far end of the line that favors the use of intertripping.

Here are some ideas to implement intertripping with directional overcurrent protection schemes and specifically with the BESTlogic in the BE1-951, similarly as it has been done in the past with distance relays.

Transfer Trip Schemes
Under-reach with Direct Tripping
In this case, the settings of the overcurrent relay that protects a line follow the standard criteria established by most utilities. When the relays operate, they initiate a signal that is sent along the communications link to trigger an immediate tripping at the other end of the line. The scheme is simple and has the advantage of being extremely fast; however, it has the disadvantage that it may set off undesirable circuit breaker tripping if there is any misoperation of the communication equipment.

Permissive Under-reach Intertripping (PUTT)
This scheme is similar to the one described in the previous subsection but differs in that the overcurrent relay at the receiving end must detect the fault, i.e., also pick up, before the trip signal is initiated. The advantage of this scheme is that spurious trip signals are blocked. In this case, the relay at the receiving end looks for signals sent from the remote end, which are initiated by the operation of the 67 instantaneous. Since this unit does not cover the whole line length, some under-reach exists, yet a successful transfer trip is achieved. In some cases, it is necessary to include a time delay to the tripping command from the remote end, particularly when there are double circuit lines fed by one source located at one end of the lines.

Permissive Over-reach (POTT)
With this arrangement, the operation is very similar to that referred to above, except that sending the trip signal from a relay to the other end is carried out as a result of the time delay unit operation. Since this unit does cover the whole line length, some over-reach exists. Again, tripping of the relay that receives the signal is dependent on its pickup also having seen the particular fault.

Implementation with BESTlogic in the BE1-951
The implementation of the PUTT/POTT with the Basler BE1-951 relay can be achieved easily, using the capabilities of BESTlogic. In the case of the PUTT scheme, the sending signal is taken from the 67 instantaneous at the sending end via the VO3 and then through the communication channel. The receiving end takes that signal to an AND gate that also receives the operation of its 67 time delay. If both signals are positive, the trip goes through the virtual output VO14 to be added to the trips collected at virtual output VO11, which in turn go to virtual output VO1.

In the case of the POTT scheme, the sending signal is taken from the 67 time delay unit at the sending end via the VO3 and then through the communication channel. The receiving end performs exactly as in the case above.

In both cases, the virtual output VO14 also is recommended to raise a major alarm that can be reset with a logic command or by working through the HMI. On the other hand, the same virtual output VO14 should be taken to the logic block of the fault recording block if a fault record is required. All the instructions are shown in the figures on the reverse. Figure 1 shows the relay contact arrangement at the sending and receiving ends to implement both PUTT and POTT. Figure 2 shows some logic diagrams of the trip circuit, alarm, fault recording function, and sending relay logic for the POTT and PUTT schemes.

Testing

The above procedures were implemented in the facility that owns the Laboratory of Testing of Electromagnetic Devices (LAPEM) in Irapuato, Mexico. For this implementation, a real 230kV with reactive compensation was simulated. The testing was very successful and proved the capability of the BE1-951 relays as well as the validity of the POTT/PUTT schemes mentioned here.
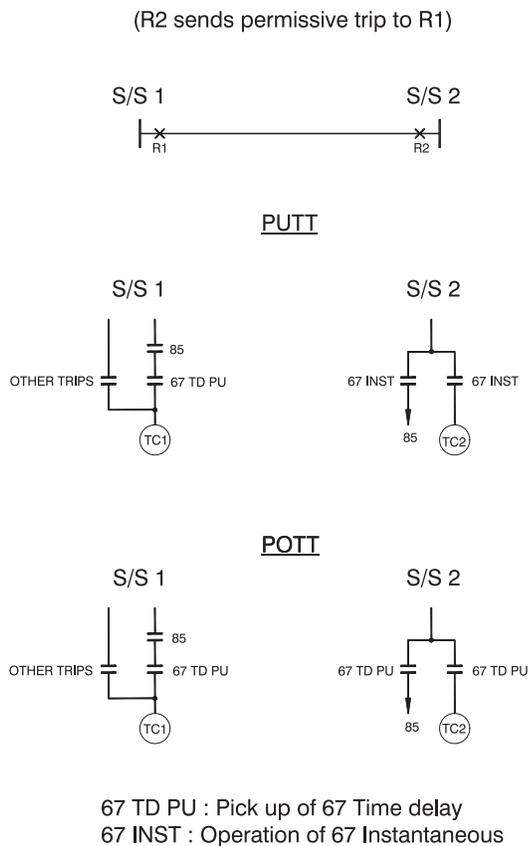

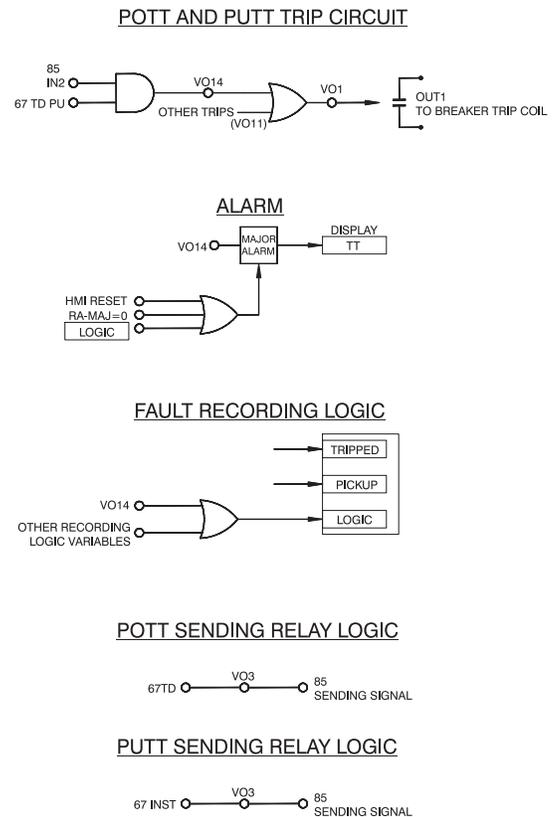**Figure 1 - Relay contact arrangement at the sending and receiving ends**

Figure 2 - Logic diagrams at the sending and receiving ends