

IMPLEMENTATION OF TRANSFER TRIP SCHEMES IN NUMERICAL OVERCURRENT RELAYS

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ABSTRACT

Numerical protection devices are much more than just relays. Actually they are small computers with protective functions complemented with others like control, metering, logic, logging and communication. These functions allow a big flexibility that enhances even more the functions built in by the manufacturers. This paper illustrates how protective functions that are not originally incorporated can be emulated and in particular the over/under reach feature associated to over current protection. The logic of implementation is well illustrated as well as the procedure to test the implementation as it was done in the LAPEM laboratories of Mexico.

KEYWORDS:

Numerical protection, Overcurrent relays.

1. GENERAL

Non unit protection such as that given by overcurrent and distance protection on transmission and distribution lines for many

years, has 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 back-up to protection located at substations further along the line. While there is a wide variety of intertripping schemes, only the more common ones will be considered here aiming 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, which favors the use of intertripping.

This paper presents some ideas to implement intertripping with directional overcurrent protection schemes similarly as it has been done in the past with distance relays. An illustration will be done using logic schemes on a relay produced

by BASLER ELECTRIC identified with the model BE1-951.

2. TRANSFER TRIP SCHEMES

2.1 UNDER-REACH WITH DIRECT TRIPPING

In this case, the settings of the overcurrent relay, which protects a line follow standard criteria as those 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.

2.2 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., pick up as well, 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 achieving a successful transfer trip. 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.

2.3 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 having seen the particular fault.

3. IMPLEMENTATION WITH THE BESTLOGIC IN THE BE1-951

The implementation of the PUTT/POTT with the relays BASLER BE1-951 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 than can be reset with a logic command or 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 graphics below. 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.

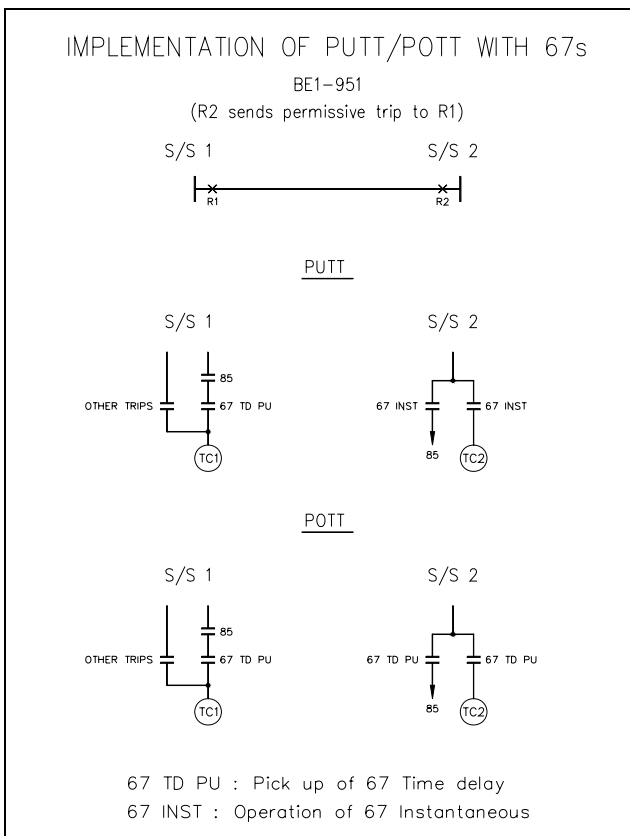


Figure 1. Relay contact arrangement at the sending and receiving ends

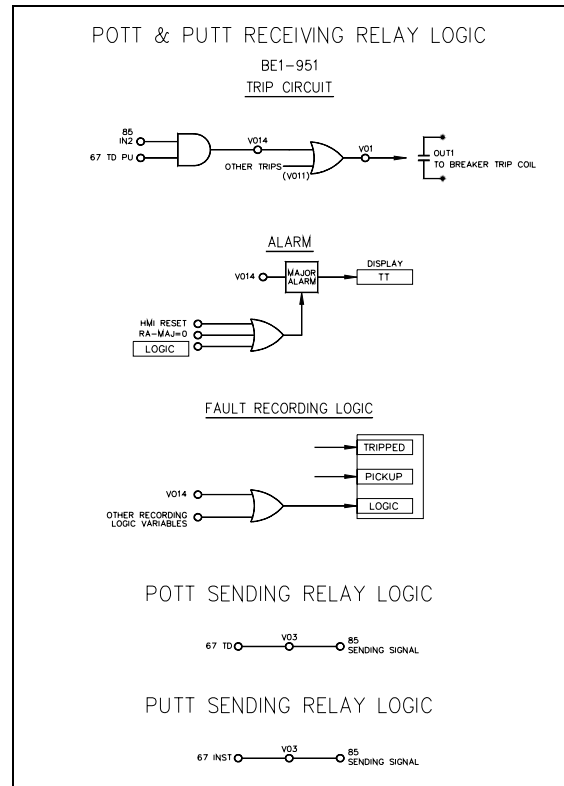


Figure 2 Logic diagrams at the sending and receiving ends

4. TESTING

The above procedures were implemented in the facility that owns the Laboratory of Testing of Electromagnetic Devices LAPEM in Irapuato, Mexico. For this a real 230 kV 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.

5. CONCLUSIONS

This paper showed how logic capabilities of numerical devices can be used to implement

protective functions that are not built in by the manufacturer. In particular, over/under reach feature associated to over current protection was implemented by using the digital input/outputs of a numerical relay. The overall implementation was done using a BASLER relay BE1-951. This process allows not only to implement the referred functions but also to illustrate the use of the capabilities of numerical devices to enhance even more the capabilities.

technical papers. Dr. Gers is a Chartered Engineer of the IEE and Member of IEEE.

6. BIOGRAPHY



Juan M. Gers obtained his B.Sc. in Electrical Engineer at University of Valle, Colombia, in 1977. In 1981 he finished his M.Sc. in Power Systems at the University of Salford in England and his Ph.D. in 1998 at the University of Strathclyde in Scotland where he undertook a research in Distribution Systems Automation.

Dr. Gers founded in 1981 the consulting company GERS S.A. in Colombia that opened in 2000 an affiliate in Florida called GERS USA. Both specialise in studies, designs and commissioning of electrical projects. He was lecturer at University of Valle for more than 20 years and Vice minister of Mines and Energy of Colombia in the second semester of 2002. He is co-author of a book entitled 'Protection of electricity distribution networks', published in 1998 by the IEE and is the author/co-author of over 30

