

Application Note

Upgrade Solution for Transformer Protection

Power transformers in power plants and substations across the globe are protected by aging electromechanical transformer differential and overcurrent relays (Figure 1). Overexcitation and zero sequence voltage protection, normally associated with power plant step-up transformers, also is provided by aging electromechanical or early vintage static technology.



Figure 1 - Vintage electromechanical protection is common in power plants

For transformer differential and backup applications, the ABB-HU and GE-BDD single-phase differential relays and ABB-CO and GE-IAC single phase and ground overcurrent relays are most likely to be in service (Figures 2-5). An aging population of ABB-TPU and GE-STD differential relays is also in use and may require replacement. A variety of products have been used over the years for overexcitation and zero-sequence protection.

Basler Electric offers the state-of-the-art digital BEI-FLEX relay designed to fit existing panel cutouts for electromechanical products and panel-mount designs for aging digital products. This allows the user to “upgrade” existing protection without the need for large-scale capital projects, saving time and money. The user still derives the same protection, reporting, and communications benefits normally associated with a complete panel replacement.

For in-service testing, FT test switches or equivalent are required and are easily added to one of the blank plates used to cover the empty phase differential cutouts.

Why Upgrade?

Electromechanical relays, while providing reliable and effective protection, have high maintenance requirements, have no self-testing or event recording capability, and only have a local flag for trip indication. At extra cost, external sensing devices can be added to the electromechanical trip circuit to provide input to a fault or sequential events recording system, but do nothing to reduce maintenance requirements or improve the relays’ ability to self-check.



Figure 2 - Single Phase BDD



Figure 3 - Single Phase HU

Upgrading electromechanical relays with a three-phase BEI-FLEX results in a significant improvement in protection reliability, reduces or eliminates maintenance, and provides continuous self-testing with the capability for immediate notification of relay system trouble. As an added benefit, metering, sequential events recording, oscillography and substation automation protocols are included.

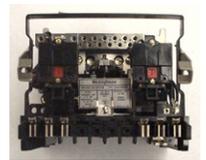


Figure 4 - CO Relay

Applying the BEI-FLEX also improves inrush security. Traditional 2nd and 5th harmonic restraint units operate on the ratio of harmonic current to total operate current versus the ratio to only the fundamental operate current used by the BEI-FLEX. For this reason, the relay provides greater security



Figure 5 - IAC Relay

for inrush and overexcitation with the same harmonic inhibit ratio settings used with traditional differential relays.

An additional benefit for power station transformer applications is the voltage/frequency based protection elements standard in all versions of the BEI-FLEX. This is significant in that overexcitation protection (24) and zero-sequence protection (59N) are included, which eliminates the need for separate products. The 24 can be set to protect for transformer and generator overexcitation, and the 59N can be used to detect grounds on delta systems. O/U voltage (27/59P), negative-sequence voltage (47), and O/U frequency protection are also included.

How to Upgrade

The BEI-FLEX case fits in ABB-HU FT31, FT42 and GE-BDD M1/M2, L2 panel cutouts with no panel drilling or cutting by using an already designed adapter plate. The relay is available in two escutcheon plate options:

- Option 1 for the larger GE L2 and ABB FT42 cases
- Option 2 for GE M1/M2 and ABB FT31

No cutting or drilling is necessary as long as the correct size plate is specified when ordering.

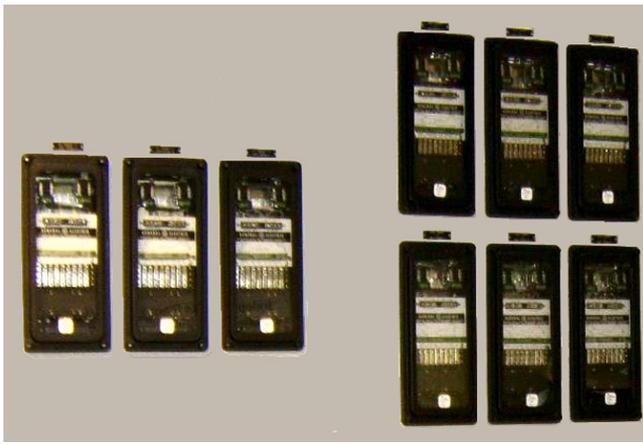


Figure 6 - BDD electromechanical transformer differential relays

When the CT and transformer connection information is entered into the BEI-FLEX, it automatically applies the required compensation. Adding the CT ratio and winding voltage allows for automatic calculation of the restraint taps (also can be applied manually). Settings that are fixed in the electromechanical relays are fully adjustable in the BEI-FLEX, allowing the user to “fine tune” settings for a specific application.

In addition to differential, the BEI-FLEX replaces existing electromechanical transformer overcurrent relays,

both phase and ground, providing backup transformer protection and easily accepting the settings from the replaced relay within the same device.

The BEI-FLEX fits in the GE-IAC (S1) case cutout without cutting, drilling, or mounting plates. Adapter plates can be ordered to mount the relay in a GE S2. The dimensional consistency allows the BEI-FLEX to be mounted into the existing differential or overcurrent relay position pending operations preferences. It is not uncommon to have electromechanical relays mounted high in the air. With the BEI-FLEX, the relay can typically be installed into the most convenient slot.



Figure 7a - BDD Upgrade: Step 1 - Remove existing relays and install test switches, if needed.



Figure 7b - BDD or HU Upgrade: Step 2 - Install Basler BEI-FLEX

By removing three single-phase BDD or HU relays and replacing them with a single BEI-FLEX, a complete retrofit of the differential and overcurrent transformer protection package is accomplished. A second BEI-FLEX or other Basler Electric digital relay such as the BEI-11r can be included if a backup relay is desired. This results in a complete transformer protection upgrade and adds SER, oscillography, metering, and communications. Also, using the 24 and 59N voltage protection elements for power plant transformer applications eliminates more aging single function products.

The Relay System

The BEI-FLEX (Figure 8) is a full-featured, microprocessor based, multifunction system that provides percentage differential protection with harmonic restraint with up to 28 current inputs. Three phase, ground, and negative-sequence overcurrent protection with control, voltage and frequency protection, breaker failure for up to 4 breakers, breaker monitoring for 4 breakers, transformer monitoring, and metering functions are included in an integrated system with several communications options. As the BEI-FLEX can be configured as desired, high contact sensing and programmable output counts are available.



Figure 8 - BEI-FLEX

The BEI-FLEX meters all phase and sequence currents. Adding voltage sensing potential to the relay allows for metering real and reactive power, power factor, voltage and frequency, to name a few.

The BEI-FLEX supports DNP3 Level 2, Modbus®, Synchrophasors, IEC61850 and other protocols for integrating the new relays into an existing SCADA system, providing control and monitoring capabilities.

BESTCOMSPlus and BESTlogicPlus make setting and customizing relay functionality simple and easy. BESTCOMSPlus is a user-friendly interface that allows for easy setup of any of the protective and control functions available in the BEI-FLEX (Figure 9). BESTlogicPlus allows the user to customize relay logic to suit individual application needs. The BEI-FLEX includes a complete complement of timers (62), virtual switches (43), user definable input and outputs and a wide variety of control logic capabilities such as latches and timers.

For More Information

For ordering assistance, contact your local Basler sales representative or visit www.basler.com.

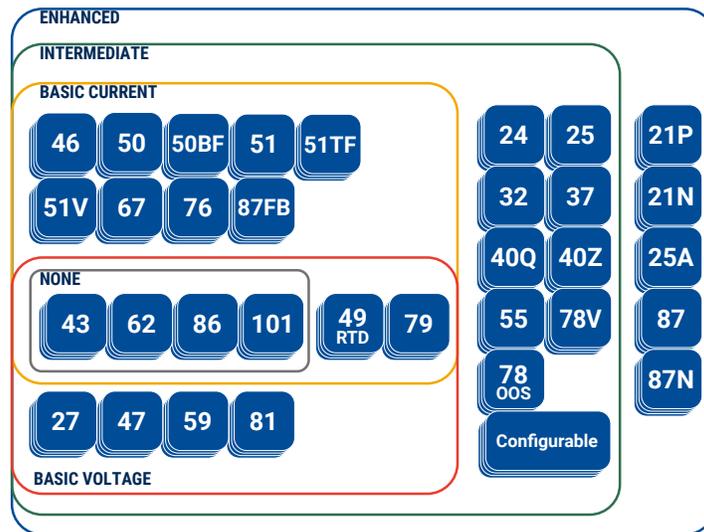


Figure 9 - BEI-FLEX Control Functions

NOTE

Basler Electric attempts to make settings and configuration updates as easy as possible for the user. However, product enhancements, updates, and feature additions may create differences between devices. It is recommended that all settings are reviewed and system performance is verified. It is not the intention of this document to identify all changes or differences between devices. For more information, please refer to the appropriate instruction manual. If there are questions or concerns, contact our Technical Sales Support staff for assistance.



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