Application Note

Underfrequency Load Shedding Schemes, Upgrade Aging GE, ABB, and Basler Relays

Limitations of Aging Relays

There are thousands of distribution underfrequency load shedding schemes in service today that use aging GE and ABB (Westinghouse) and Basler frequency (81) relays. These include products such as the General Electric CFF and SFF relays and the ABB KF and MDF relays, and Basler BE1-81 and BE1-IPS100 relays. In addition to age, many do not include "undervoltage inhibit" capability to prevent false underfrequency operation for specific load aggregation, and many do not include remote communications capability.

For example, if a radial distribution bus suddenly is separated from its source and a large portion of the load is induction motors, voltage and frequency at the distribution bus can take longer to decay as a result of the back emf from the motors as they spin down. For this condition, frequency can decay faster than voltage, which causes the frequency relay to misoperate, tripping the feeder breakers and disrupting automatic load restoration when the bus source is restored. Voltage supervision of the underfrequency load shed element ensures that voltage must be above a particular threshold to allow the underfrequency element to operate. Modern frequency relays include an undervoltage inhibit function that helps prevent misoperation due to this condition and include remote communications to report operations information.

Basler Upgrade Solution

Basler Electric is well known for its upgrade capability, and this is no exception. The upgrade of aging underfrequency protection can be accomplished by replacing existing products with a Basler BE1-FLEX multifunction relay system. With specific mounting plates, when needed, the BE1-FLEX can replace virtually any underfrequency relay on the existing panel using the existing cutout (see Figure 1). This application was originally Electromechanical, was once upgraded to the BE1-IPS100, and can again be upgraded to the BE1-FLEX. All without panel cutting, providing generations of protection with minimal effort. No panel change out is required. This greatly reduces the cost associated with "rip and replace" solutions, which can be three to five times that of upgrading the existing panel. It's fast, professional, and efficient, and allows more upgrades for a fixed budget amount.

Figure 1 - Two BE1-IPS100 relays with S1 Double-Ended Configuration and Mounting Plates

Application

The BE1-FLEX (see Figure 2) first was designed for Intertie Protection applications, which include multiple over, under, and rate of change frequency elements for islanding protection and, as a result, has found widespread acceptance in Under Frequency Load Shedding (UFLS) applications. See Figures 3 and 4 for sample underfrequency logic diagrams that meet bus or individual feeder circuit applications.

Figure 2 - BE1-FLEX

A single BE1-FLEX can be configured to monitor up to 8 voltage sources, each of which can be mapped to any of the frequency elements. Frequency measurement from multiple voltage sources with trip outputs in series can be used to further enhance security of the UFLS protection scheme. The BE1-FLEX also includes directional or nondirectional Instantaneous and Inverse Time over-current protection, directional over/underpower with 1-3, 2-3, or 3-3 tripping capability, automatic reclosing, sync check with conditional voltage control, metering, sequential events, oscillography and standard DNP and Modbus communication protocols - everything a utility needs for feeder protection in addition to UFLS and UVLS - all for under $2,300.
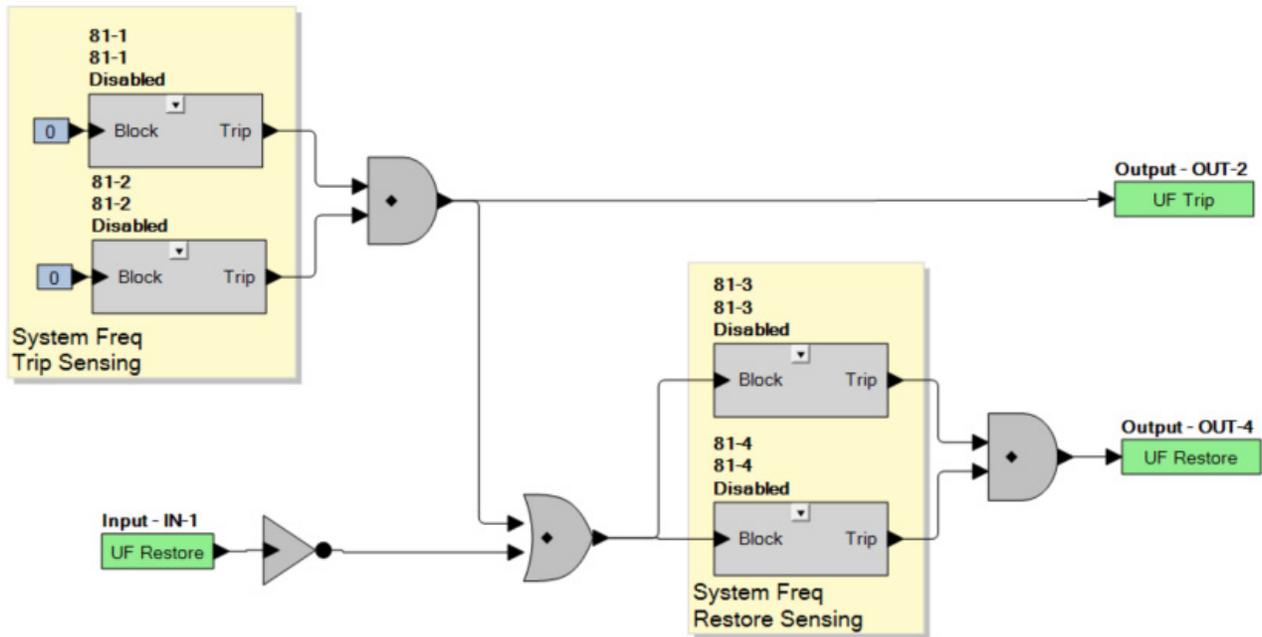

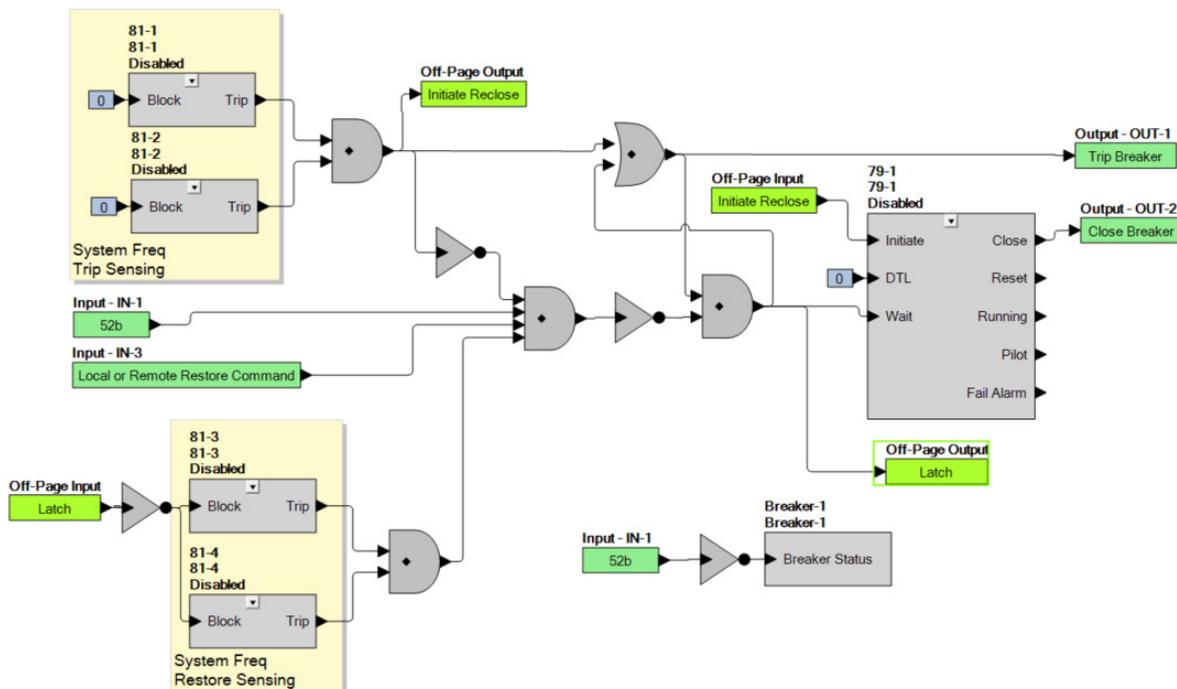**Figure 3 - Underfrequency Load Shed Bus Application**

Figure 4 - UF Load Shed, Circuit Level Application, Manual or Auto Close from SCADA or Local Restore

How It Works

Basler Electric's BE1-FLEX Protection, Control and Automation System uses a zero cross technique to provide accurate, reliable measurement of line frequency. At each zero crossing, the 81 element setting is compared to the measured frequency. For the 81 element to transition to a picked-up state, the measured frequency must exceed the pickup setting for three consecutive zero crossing measurements (3 cycles security check). The rate of frequency change function varies the number of cycles pending the magnitude of disturbance. The purpose for using this method is to increase the relay's security against false trips that could result from rapid voltage level changes or transient conditions.

Upgrade Examples

The GE-CFF and SFF models in M1 and M2 cases can be replaced with the BE1-IPS100 or BE1-FLEX using adapter plate 9108551029, and the ABB-KF in an FT-21 case can be replaced with the BE1-IPS100 or BE1-FLEX using adapter plate 9108551021. The ABB-MDF in an FT-32 case can be replaced with the BE1-IPS100 or BE1-FLEX using adapter plate 9108551022. Figures 5 through 8 show an example (front and rear shots) of a GE SFF upgrade to the BE1-IPS100.

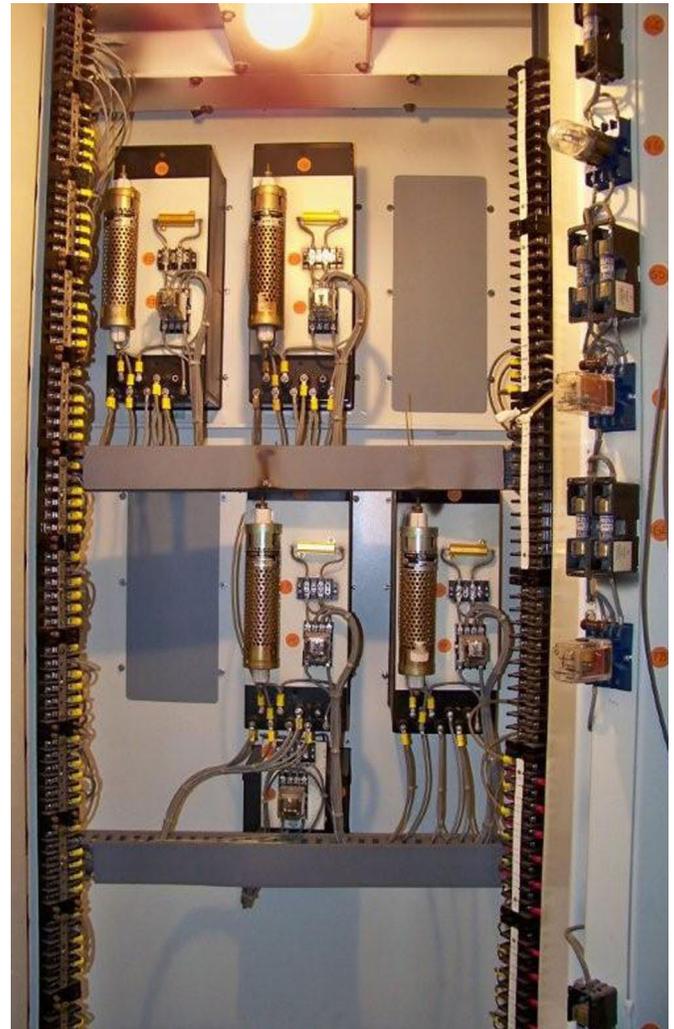**Figure 5 - General Electric SFF relays and ABB TD-5 relay before upgrade**

Figure 6 - Rear view before upgrade

Figure 7 - Basler BE1-IPS100 on mounting plate after upgrade
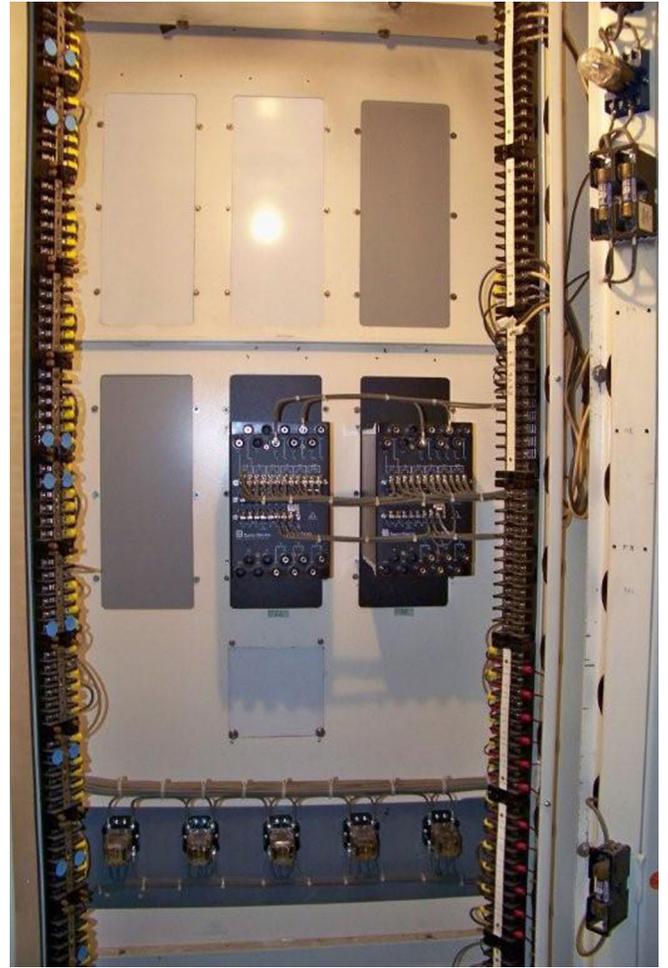

Figure 8 - Rear view after upgrade

For More Information

For detailed information on the BE1-FLEX, please visit the Basler Electric website at www.basler.com to download product bulletins, instruction manuals, and BESTCOMS*Plus*® software. You can contact Basler's Technical Support or Application Specialists at +1 618.654.2341 or by email to info@basler.com.