

## Commissioning Plan Development

In an earlier article, we suggested that microprocessor-based relays have routine testing requirements significantly different from those of the discrete relays they replace. To summarize, the routine tests should verify only the measuring and control functions of the relay. In order for this recommendation to be adopted successfully, a high burden is placed on the commissioning tests to thoroughly verify the relay settings and connections that are assumed not to have changed during the maintenance interval. This article addresses the development of that commissioning plan.

The thorough commissioning plan encompasses the following areas:

- Wiring point-to-point verification
- Relay energization & setting
- AC Circuit verification
- Protection verification
- DC Function checks
- Relay interface checks
- Post energization checks

Taking each area in turn:

### **Wiring point-to-point verification**

After all new wiring is complete, point-to-point verification should confirm the continuity of each circuit. Test switches and control switch operation, contact positions (form-a vs. form-b) should be confirmed. Verify that AC circuits are grounded in a single point only, that all required equipment chassis grounds are installed, and that DC circuits are grounded only according to the design, generally at the battery charger. Check the PT and CT ratios against the single-line and three-line diagrams.

### **Relay energization & setting**

Prior to energizing the protective relays, check the magnitude and polarity of the DC sources and check the nameplate rating of the relay power supplies. Power supplies of some electronic equipment can be damaged if reverse-polarity DC is applied to the power supply. Most will be damaged if voltage greater than the rating is applied. After energizing the protective relays, confirm that the correct settings for the relay position have been loaded.

### **AC Circuit verification**

After relay energization, perform checks of the AC circuit polarity and phase rotation using the relays' own metering functions. Current circuit polarity is particularly critical in differential and directional relay applications.

## **Protection verification**

Using an appropriate relay test set, verify the settings and operation of all enabled protection functions. This step can be rather time consuming, as it is important to confirm not only the settings of the individual protection elements, but also that the operation of those elements results in the appropriate relay outputs. Care should be taken here: It is not necessary to test every feature offered by the relay, nor is this an acceptance test of the algorithms used within the relay. Instead, use this time to confirm that the relay logic settings and protection element pickup, reach, and time-delay settings yield the performance required by the protection scheme.

## **DC Function checks**

After confirming that each protection function results in the correct output operation, verify that each output operation yields correct results within the substation. Each breaker trip, breaker close, annunciator or lamp function must be verified. Ensure that each contact input is connected to its correct operating contact: breaker auxiliary contact, control switch, etc.

## **Relay interface checks**

Frequently, multi-function relays are applied with front-panel messaging functions, SCADA interfaces, or other communication or indication functions. Verify each of these functions in the course of the commissioning checks.

## **Post energization checks**

Finally, on initial energization of the protected apparatus, use the relay metering functions to confirm primary signal magnitudes and phase rotations.

The order of major components of the commissioning plan presented above was selected because it makes the plan easier to discuss. You may find that it saves time to combine certain steps or take them in a somewhat different order. Regardless, it is important to devise a plan, review it prior to execution, then evaluate it on completion to ensure that the relay is properly set and installed. A thorough commissioning plan properly executed will give you the opportunity to correct problems before they result in relay misoperations and give you the confidence in the installation that allows you to streamline future routine maintenance tests as well.