



Protective Relay Testing – Verification and Documentation of Protective Settings

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In today's world of protective relay testing, protection and control (P&C) technicians often overlook or disregard one of the most important steps of testing protective relays. Verifying that the protective relay operates as intended, protective elements pickup/dropout and time as specified, and that the protective relay inputs and outputs (I/O) operate per the design of the associated protective control scheme. These are the core testing criteria when it comes to successfully testing a protective relay. However, the verification and documentation of the device's protective settings is of the same importance and often is not performed.

What are protective relay settings and where do they come from?

Protective relays settings, operational magnitudes and time delays, are derived from a protective relay coordination study. An engineer tasked with the creation and development of the coordination study develops this document which defines the parameters of how the protective relay should perform and operate within the associated power system. The coordinating engineer ensures that the equipment and system is sufficiently protected against faults while maintaining system uptime by ensuring that the protective device closest to the fault will operate.

How are these protective relay settings provided?

The protective relay settings are typically provided in one of two formats, depending on the applicable protective device. For the case of first generation electromechanical protective relays and single function solid-state protective devices, the settings typically are provided by actual hardcopy or a paper coordination study or setting table format. P&C technicians are tasked with navigating the coordination study or table document to find the correct field and data that applies to the protective device under test. For modern microprocessor-based protective relays, the settings are typically provided electronically via an electronic setting file. This electronic setting file typically contains all the protective settings and logic needed to properly coordinate and implement the protective device into service. The file type and extension will be manufacturer dependent, based on protective relay type. Additionally, these electronic setting files typically require proprietary software and communications between a user's personal computer (PC) and the associated protective relay to view or load the settings files.

For both formats of protective relay setting files (paper and electronic), care and caution should be utilized to ensure that the P&C technician is working off the current revision, or version, of the protective settings. Just as with the fluidity of electrical drawings, relay setting files and coordination studies typically go through several revisions and changes during the implementation and commissioning of a project. Staying abreast to the changes in setting files is critical to the proper verification and documentation of relay settings.

How are these protective relay settings verified?

The verification process is also contingent on the relay setting format and the type and style of protective device that the settings are being implemented into. For the case of electromechanical and solid-state protective relays, the P&C technician would reference the coordination study or setting table, as described above. The P&C technician would verify that the protective relay is set in accordance with the coordination study by utilizing physical adjustments on the protective relay via taps, time dials, potentiometers, dip switches, etc. Adjustments and calibration to these physical inputs would be made as necessary to ensure the protective relay is set properly. For the case of microprocessor-based protective relays, the P&C technician would reference the electronic setting file, also described above. The P&C technician would load the electronic setting file into the protective relay or verify that the file currently loaded in the protective relay matches the specified electronic settings. Further, most microprocessor-based protective relay manufacturers typically have a software feature that allows a user to compare two electronic setting files for differences. This can be a very useful tool when verifying that a protective relay is has the correct settings.

How are these protective relay settings documented and classified?

For documentation purposes, protective relay settings can be categorized into three groups. The first category of settings are the engineer provided coordination study, setting table, and/or electronic setting files. These can be referred to as the 'As-Provided' settings. These are the settings that are being implemented and verified, ensuring that the current and most up to date revision is being utilized.

The second category of settings are the protective relay settings found in the protective device, prior to start of testing. These can be referred to as the 'As-Found' settings. These are the baseline settings from which start of work can be compared.

The third category of settings are the protective relay settings that were left in the protective device subsequent to the completion of testing. These can be referred to as the 'As-Left' settings. These serve as documentation for the project and can be utilized for reference comparison for future maintenance testing.

It is imperative that the P&C technician properly manages and documents all three categories of setting files.

What Standard addresses the importance of Verification and Documentation of Protective Relay Setting Files?

New protective relay devices within greenfield projects and installation or upgrade of protective relays in existing brownfield project sites fall under the InterNational Electrical Testing Association (NETA) Acceptance Testing Standard, ANSI/NETA ATS - 2017. Existing protective relay devices that are being tested for maintenance or troubleshooting purposes fall under the InterNational Electrical Testing Association (NETA) Maintenance Testing Standard, ANSI/NETA MTS - 2019. Both the NETA ATS and MTS standards address the importance of verifying and ensuring protective relays are set in accordance with the coordination study. The NETA ATS and MTS standards also stress the importance of documenting 'As Found' and 'As Left' setting files for the purposes of subsequent and future comparison.

Regardless of the time constraints or difficulty in obtaining the proper relay setting documentation during a commissioning or shutdown, turnaround, or outage (STO) project, it is imperative that P&C

technicians verify and document the protective relay settings for the devices they are tasked with testing. A protective relay that is improperly set or programmed with incorrect parameters could lead to mis-operation during normal steady state conditions or even failure to operate during a fault condition. A protective relay is not truly functional, tested, and ready-for-service until it has been verified in accordance with the coordination study and properly documented through completed test data sheets and associated test reports.

In summary, the verification and documentation of a protective device's settings are of the same importance as the testing of functional protective elements of a protective device. Without proper settings, the protective device will not operate as designed. ANSI/NETA ATS – 2017 and ANSI/NETA MTS – 2019 address the importance of verifying and ensuring protective relays are set in accordance with the coordination study and stress the importance of documenting 'As Found' and 'As Left' setting files for the purposes of subsequent and future comparison. Regardless of the time constraints or difficulty in testing a protective relay, it is imperative that P&C technicians verify and document the protective relay settings for the devices they are tasked with testing.