



Setting-less Protection: Field Demonstration

Final Project Report

T-56G

Power Systems Engineering Research Center

*Empowering Minds to Engineer
the Future Electric Energy System*



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PSERC Publication 18-03

March 2018

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Acknowledgements

This targeted PSERC research project was funded by EPRI. We express our appreciation to EPRI, and especially to Paul Myrda, Technical Executive for his support and guidance. We also express our appreciation for the support provided by PSERC's industrial members, EPRI members, and the National Science Foundation's Industry / University Cooperative Research Center program.

The authors wish to recognize the graduate students at the Georgia Institute of Technology who contributed to the research and creation of project reports:

- Yuan Kong
- Boqi Xie
- Jiahao Xie
- Chiyang Zhong

Executive Summary

This report is part of a series of research projects for the purpose of rethinking the overall protection and control of modern power systems. In prior projects the concept of “setting-less” protection has been introduced. Setting-less protection based on dynamic state estimation is an emerging technology that effectively uses advances in the protection and control infrastructure of modern power systems to improve protection. The two major advantages of the new technology are: (a) it drastically reduces complexity in present day protection and control systems, and (b) it does not require coordination among the protection of various protection zones. This protection approach uses simplified settings consisting of the operating limits of the devices in the protection zone. It does not require coordination with any other protection functions of nearby protection zones and therefore drastically reduces the complexity of protection and control systems. The dynamic state estimation approach requires complex analytics to be performed on data acquired by the data acquisition system of the setting-less relay. However, the complex analytics are transparent to the user.

The setting-less protection method has been thoroughly tested in the laboratory with hardware in the loop and improved. Two field installations and field testing are under way. At the time of writing of this report, the field demonstrations have not been completed due to installation delays beyond the control of the research team. Therefore this report does not include field results. The report describes the present status of the setting-less protective relay and presents use cases that demonstrate the process of preparing and installing a setting-less relay.

The report is organized as follows. Chapter 1 provides an introduction and elaborates on the need for new protection approaches.

Chapter 2 provides a description of the implementation of the setting-less protective relay.

Chapter 3 provides a description of the steps required to prepare and install a setting-less relay. Specifically, the relay requires a high fidelity model of the protection zone associated with the relay as well as the measurements, their location and type. No coordination with other relays is required. The steps to prepare the high fidelity model, to define the measurement system and import this information into the setting-less relay is described in this section. Naturally, these procedures are fully automated.

Chapter 4 describes testing procedures of the setting-less relay in the laboratory with hardware in the loop. The laboratory is described in some detail and several examples of setting-less relay testing are provided.

Finally, chapter 5 provides a use case for the on-going field testing of the setting-less relay. The use case describes all the steps for preparing the required data for the protection zone of the relay, uploading the data to the relay and making the setting-less relay functional.