

Transmission & Substation Protective Relay & Control Training Rack for Engineering Laboratory

George Chaney Jr., Brianna McKinney, Charles Baskette, Aishwarya Gandhi

Advisor/Company Supervisor: Dr. Allen Morinec

Project Sponsor: FirstEnergy Foundation

Department of Electrical and Computer Engineering, Washkewicz College of Engineering
Cleveland State University

Introduction

The FirstEnergy Foundation sponsored this project for educating students to be **“Ready-to-Go Engineers”** in the Power Systems industry. The scope of this project was to construct a Transmission and Substation Protective Relay and Control Training Rack for the Washkewicz Engineering College’s Power Systems Laboratory.

Wiring Schematics

The relays that were used within the project were donated through the Schweitzer Engineering Laboratories’ University Program. The wiring of the AC Voltages for all relays within the first rack are arranged in parallel as shown in Figure [1] to conveniently allow 3-phase voltages to each relay.

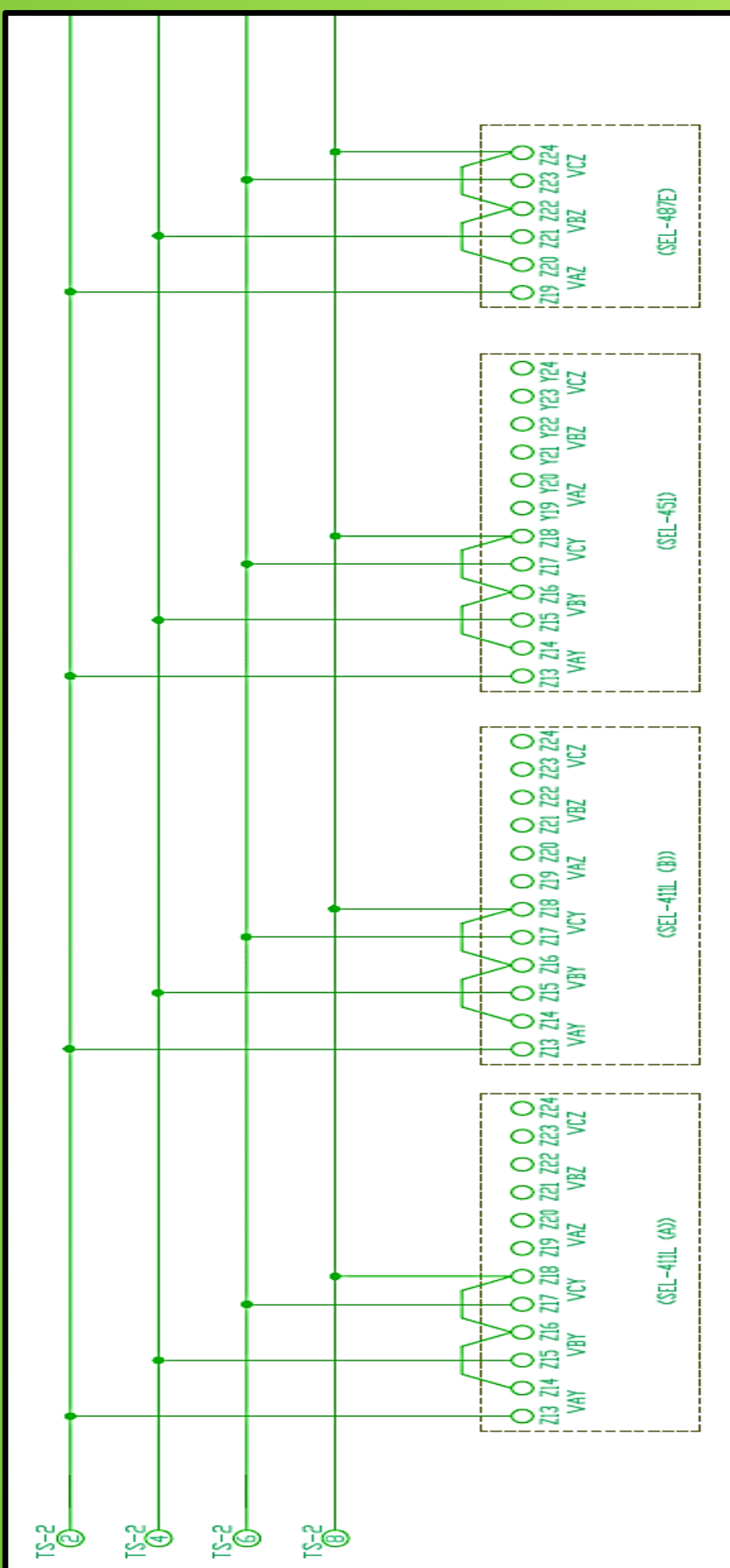


Figure [1]: AC Voltages Wiring Schematic

The AC Currents for the protective relay rack are wired in series to allow one test switch to supply 3-phase current to each relay as shown in Figure [3].

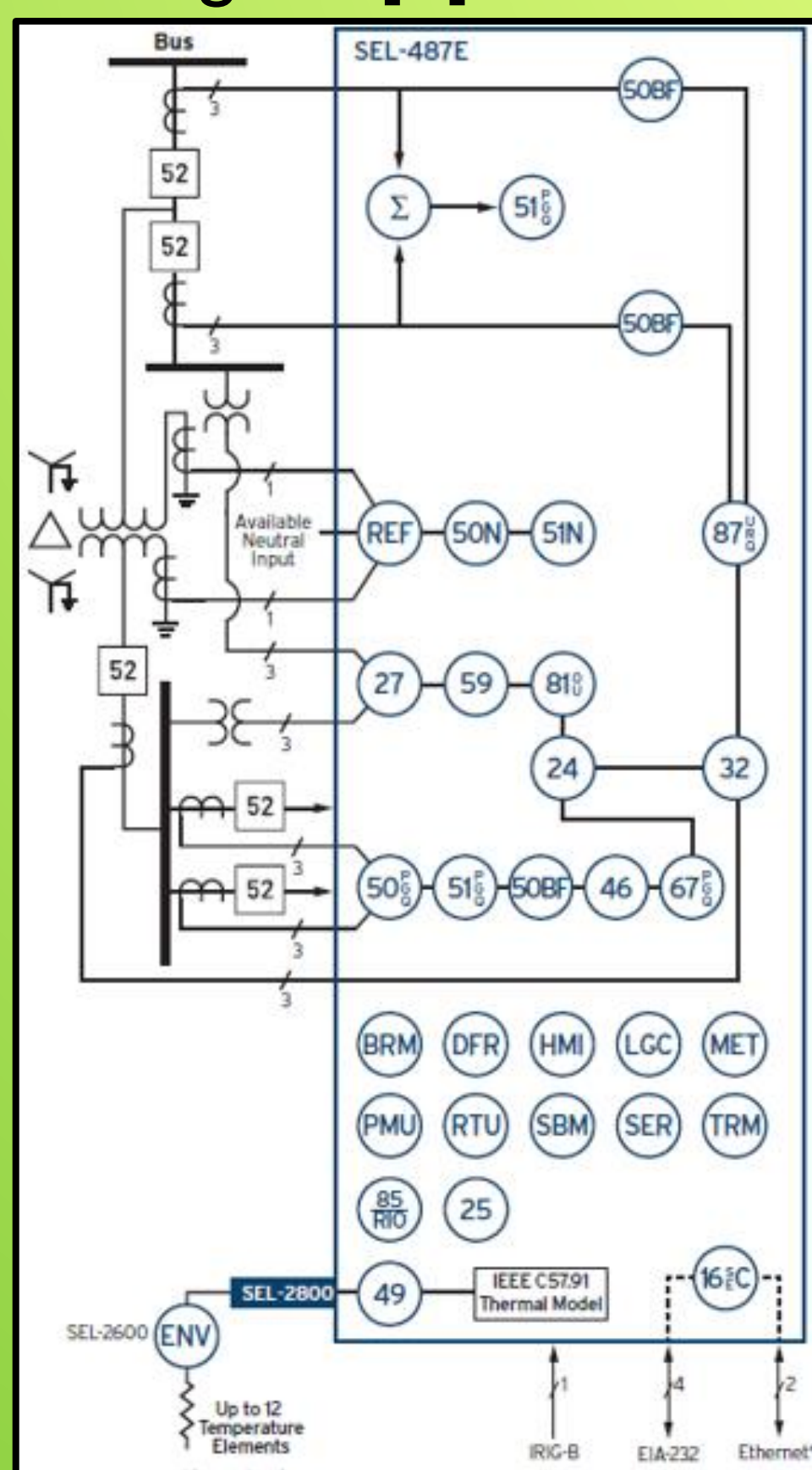


Figure [2]: Relay Functional Overview

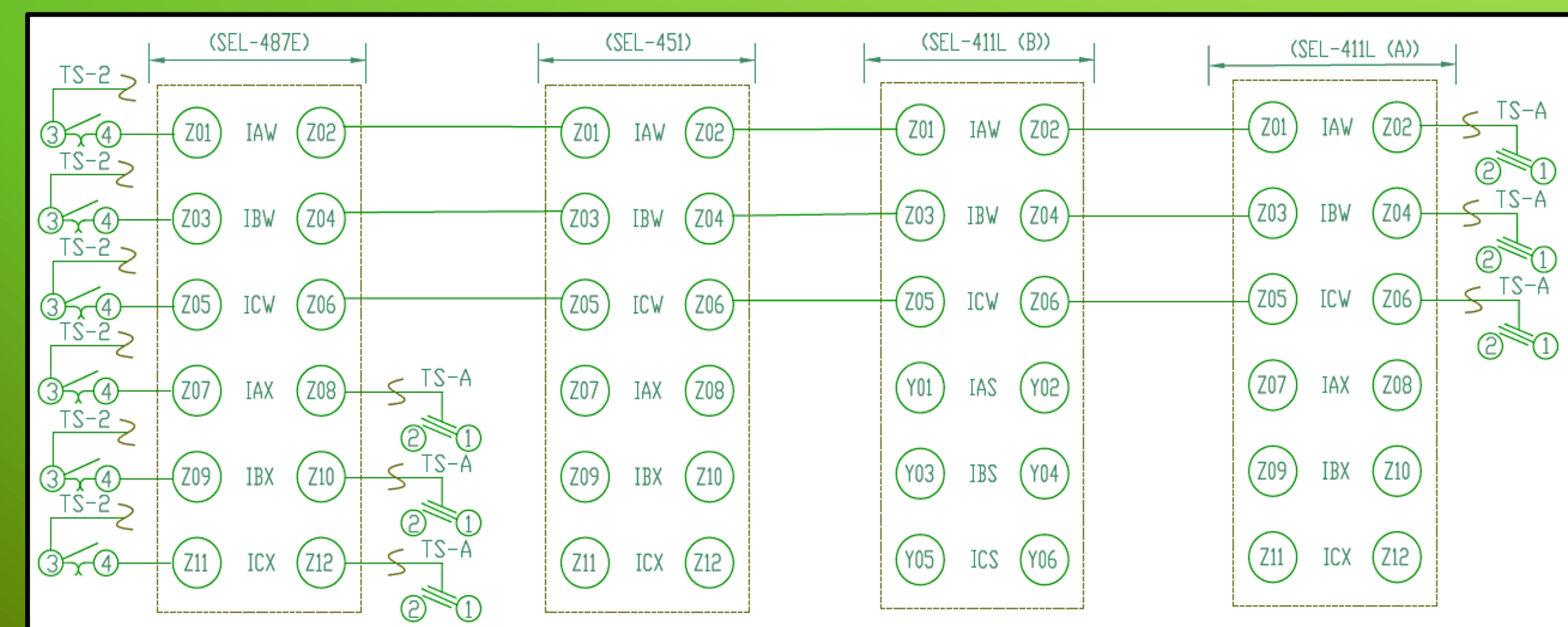
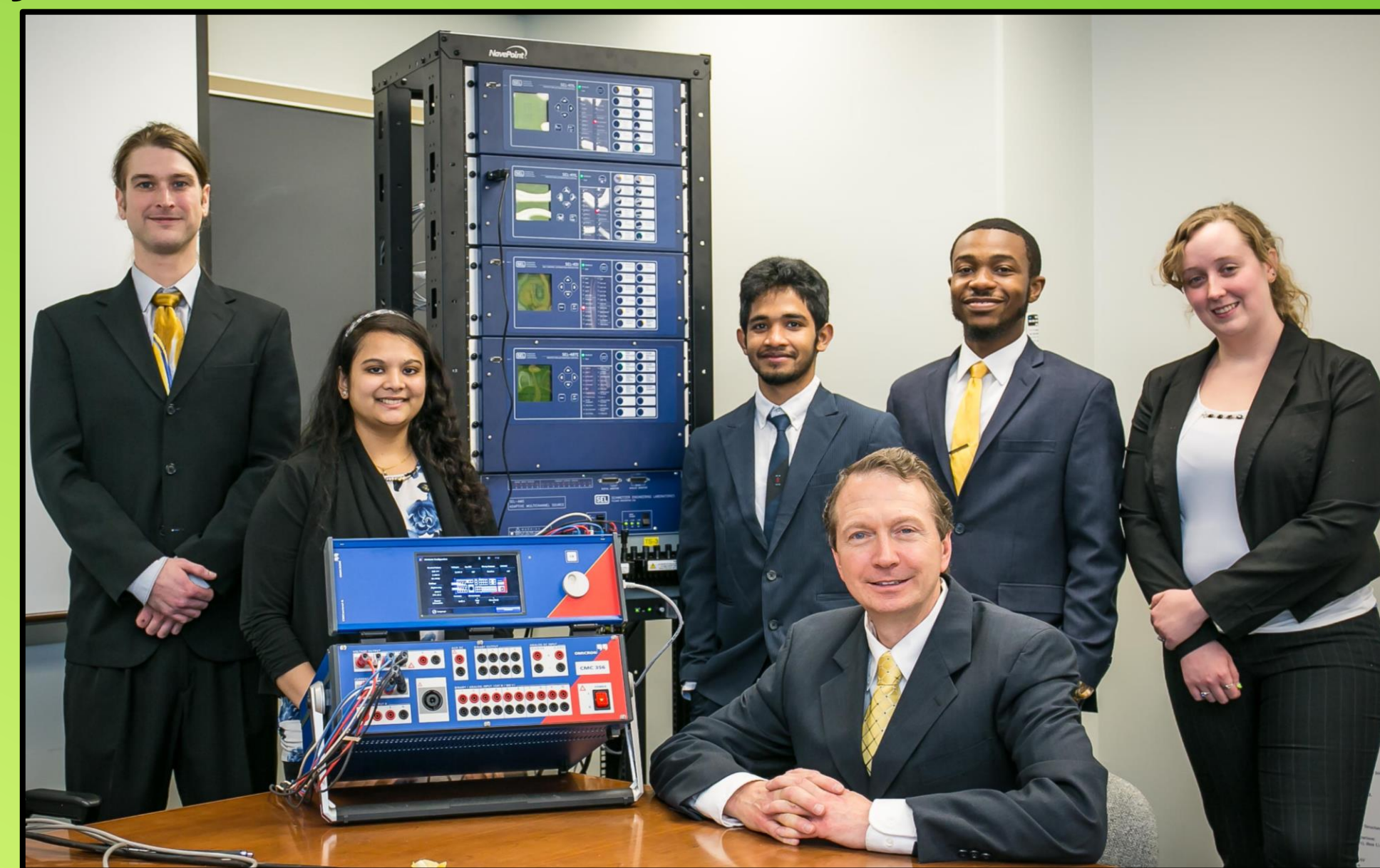


Figure [3]: AC Currents Wiring Schematic



Current Use and Simulations

The Transmission and Substation Protective Relay and Control Training rack is currently being used in the EEC 693: Power Systems II course offered at CSU. It is being used as a hands on training tool to teach technical skills to the students through simulations and design projects as shown in Figure [4] and [5]. The lab design projects include transformer protection as shown in the functional overview in Figure [2].

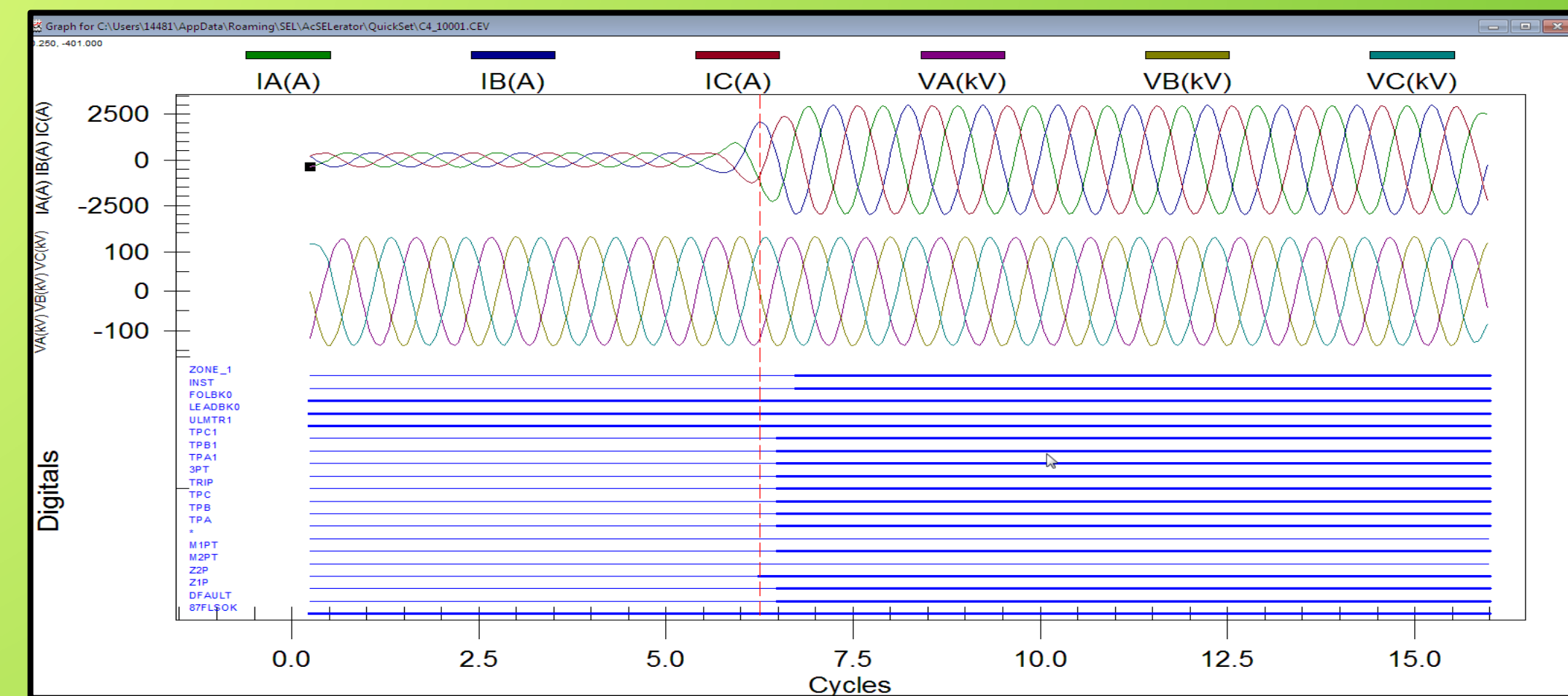


Figure [4]: Fault Oscillography & Event Analysis

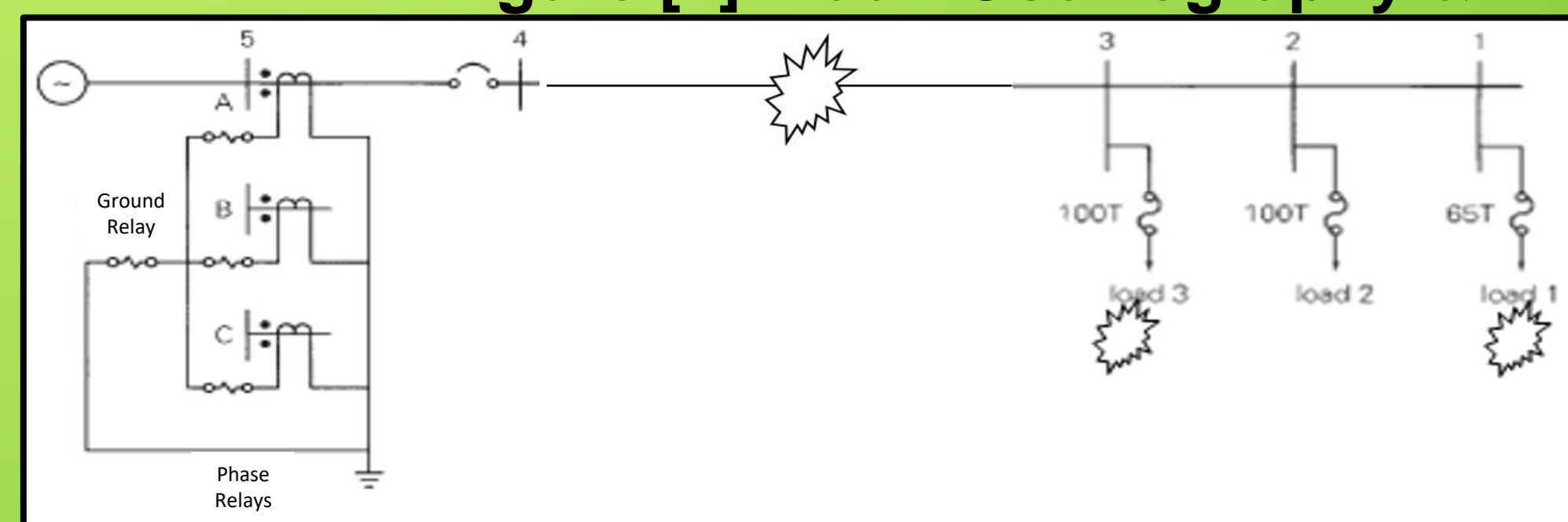


Figure [5]: Distribution Feeder Protection with Automatic Reclosing and Fuse Saving Scheme

Future Work

- GPS Synchrophasors
- Ethernet based Protection (IEC61850)
- SMART GRID
- Relay Cyber Security

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