



Hardware-in-the-Loop (HIL) Testing for Protection Relays

Confidence in Modern Power Grid Protection

The integration of renewable energy sources is increasing power system complexity and variability. Hardware-in-the-Loop (HIL) testing is essential to verify protection relays and ensure reliable, safe, and optimized protection schemes before deployment.

Why HIL Testing

HIL testing allows realistic validation of complete protection systems by:

- Testing all fault and operating scenarios in real time
- Verifying relay coordination, communication, and settings
- Reducing commissioning risks and deployment uncertainties

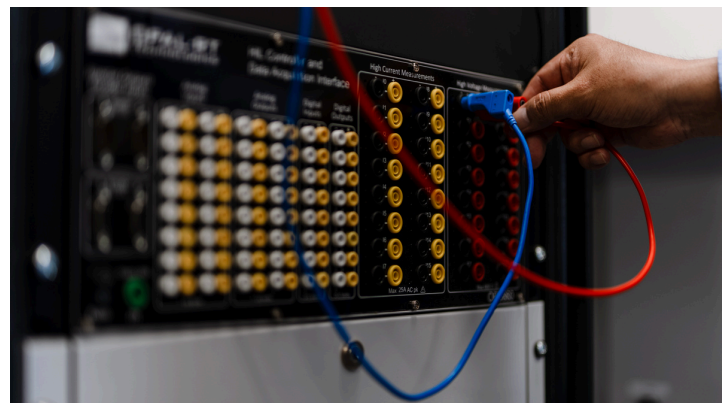
Unlike traditional playback tests, HIL closes the loop between simulation and hardware, enabling real-time interaction between the power system model and protection relays.

How It Works

A real-time simulator models the electrical network and generates analog voltage and current signals. These signals are amplified and injected into the protection relays, which respond as they would in a real grid. Relay actions feed back into the simulation, enabling realistic dynamic assessment.

HIL Testing at KEMA Labs

As an independent laboratory, KEMA Labs performs HIL testing using a real-time simulator, with models developed in advanced simulator software packages. Signals are amplified by annually calibrated amplifiers, enabling accurate testing of multiple protection devices under real-world conditions.



World-class Labs Where Innovation Sparks Energy Excellence

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