TIP 400: Evaluate Fiber Optic Current Sensors for Use on the BPA System

Context

Fiber Optic Current Sensors (FOCS) are a type of Non-Conventional Instrument Transformer (NCIT). The FOCS technology has evolved into being of practical use for primary metering and relaying current measurement in several worldwide distribution and transmission facilities.

Description

A light load current, a high fault current and a nominal load current will be applied to the primary of the Fiber Optic Current Sensors while measuring the secondary current quantities outputted from their respective merging units. The results will be recorded and their rated accuracy will be verified.

Nominal load current will be applied to the primary of the FOCS under test while measuring its secondary current quantities during capacitive switching operations and staged fault testing at a 500kV BPA substation. The secondary current quantity will be evaluated for its accurate reproduction of the primary current quantity

Why It Matters

Fiber Optic Current Sensors used with their companion merging units, (which output IEC 61850 sampled values), supports extreme event hardening of transmission facilities in the following ways:

Reduce risk of extended disruptions of critical transmission assets, services, and functions due to extreme events: Free standing and retrofit Fiber Optic Current Sensors are significantly lighter and smaller than their iron core counterparts. This puts less mechanical burden on the free standing current transformer (CT) footings and power circuit breaker footings. Less substation real estate is also required for implementing FOCS technology.

Human Safety: Prevent injury and loss of life: One of the technology characteristics of the Fiber Optic Current Sensors is the absence of iron cores or secondary windings which create the hazardous CT secondary energy that all too often causes injuries or casualty. The output of the current sensors are either a light signal encompassed in a fiber optic cable or a low voltage output in direct proportion to the primary current on the bus.

Reduce system restoration times: By not requiring Current Transformer ratio changes upon transmission line or bus re-configurations due to the wide dynamic current measurement range of Fiber Optic Current Sensors, we eliminate the need for our field engineers to conduct CT phase identification, ratio, burden and meggar testing as is done when Current Transformer ratios are changed in the field.

Goals and Objectives

The focus of this project is to evaluate the relaying performance accuracy to IEC 60044-8, Instrument Transformers – Electronic Current Transformers in both quiescent and environmentally noisy environments. Also confirm the FOCS manufacturer's transient performance specifications by reviewing events of a real 500kV system that averages 10 faults a year.

Deliverables

Project deliverables will include results from tests performed on the two Fiber Optic Current Sensors in a final report that includes the following:

1. Confirmed metering and relaying current measurement accuracy;
2. Confirmed fault transient performance specifications;
3. Determination of the effects of series and/or back to back shunt capacitor switching induces unintended current loops in the FOCS primary and secondary circuitry;
4. Determination of the effects of back-to-back shunt capacitor switching and whether it causes undesirable FOCS and Merging Unit operation;
5. Measurements and record of real time data from staged fault testing of the installed FOCS.
6. Compare revenue meters quantities recorded from traditional CTs with meter quantities recorded from amplifiers from FOCS.

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Project End Date: September, 2021

For More Information Contact:

BPA Project Manager:
Aaron Martin, Electrical Engineer-TEZP
akmartin@bpa.gov

Technology Innovation Program Manager
Cindy Polsky
chpolsky@bpa.gov

Reports & References

[1] Leon Kempner Jr. BPA Structural Engineer (TEL), Seismic Subject Matter Expert, Co-Chair IEEE 693 - *Recommended Practices for Seismic Design of Substations*, lkempnerjr@bpa.gov