GF-09 : GENERATOR SELF-BALANCING DIFFERENTIAL GROUND FAULT PROTECTION

Generator self-balancing differential ground relay protection is a method for detecting stator ground faults on solid or resistance-grounded three-phase generators. Stator-to-ground faults are the most common generator faults [1]. These faults can cause generator damage resulting in both repair costs and down time.

During a stator-to-ground fault it is important to trip the generator instantaneously. Since fault currents continue to flow inside the generator until they decay to zero [1], a generator trip should initiate a complete shut down. This requires tripping the main and field circuit breakers and closing the prime mover throttle valve. Since this application detects only faults internal to the generator there is no need to provide time-delay coordination with downstream relays.

To detect a ground fault in the generator windings, phase and neutral leads are passed through a current-transformer (CT) window positioned close to the generator output terminals. As shown in Fig. 1. The CT is connected to a protective relay such as a Littelfuse Startco SE-700-series Ground-Fault Monitor.

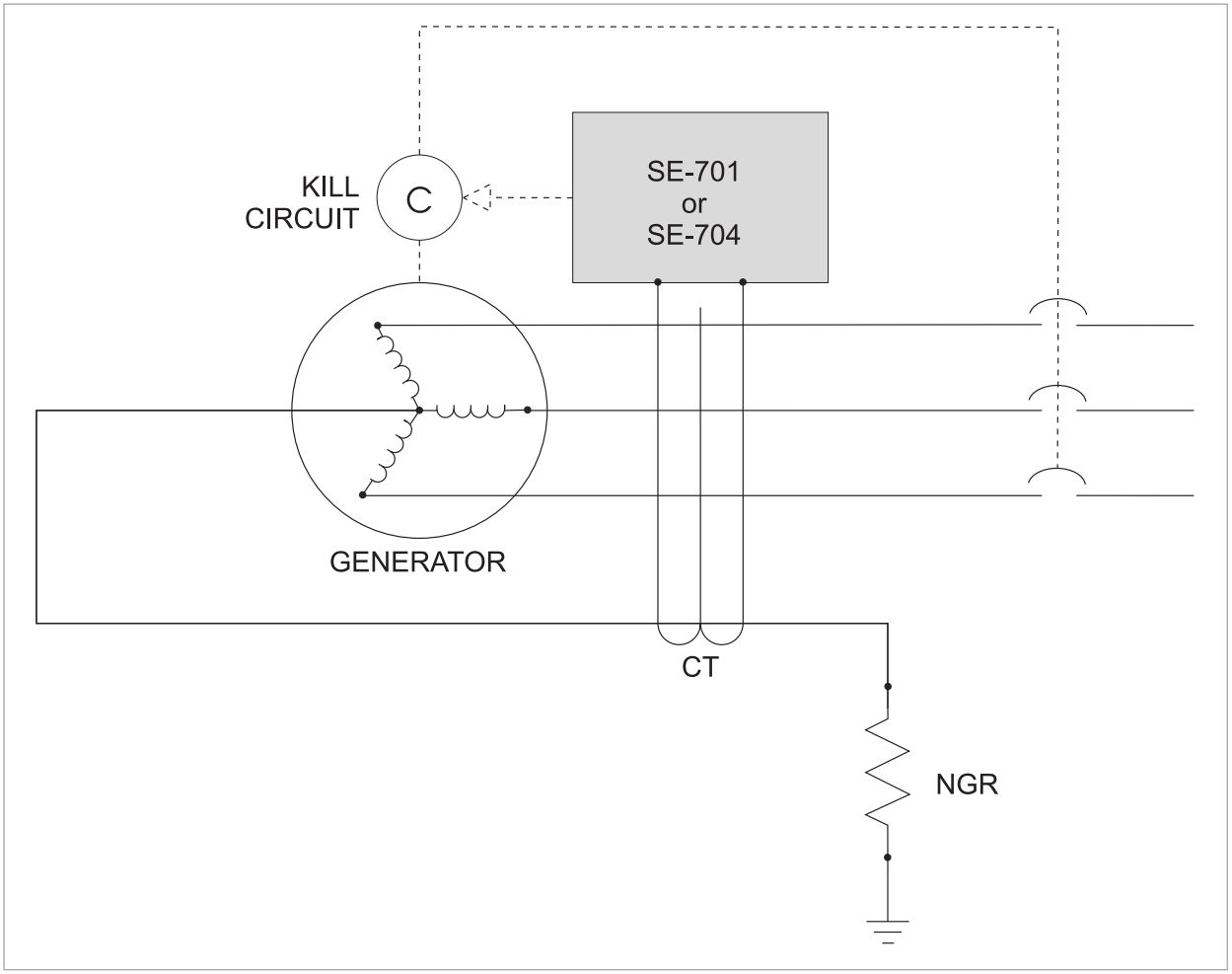

Figure 1: Differential Self-Balancing Ground-Overcurrent Protection Circuit

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A ground fault occurring on the load side of the CT will not cause the SE-701 to trip because fault current returns through the CT window. See Fig. 2.

A ground fault in the generator will cause the SE-701 to trip. See Fig. 3.

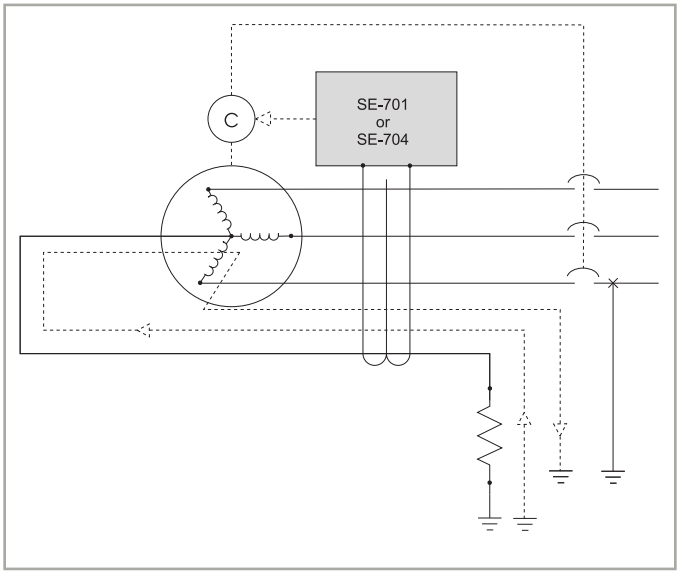

Figure 2: Load-Side Ground Fault

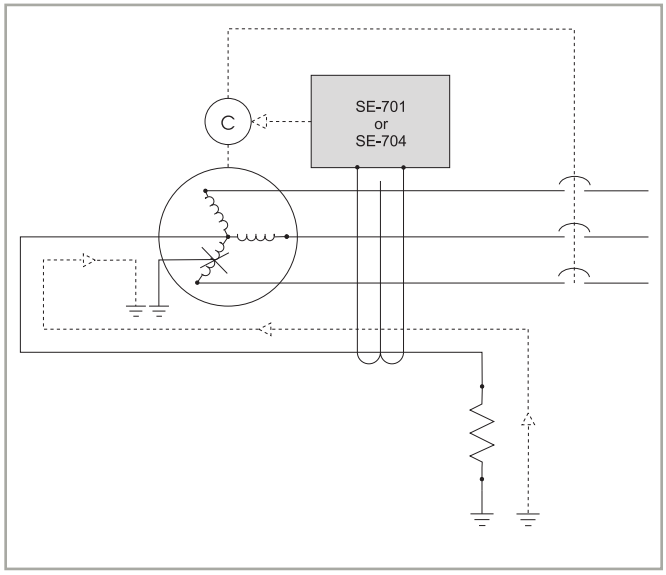

Figure 3: Generator-Winding Ground Fault

Ideally, differential ground-overcurrent protection is used in conjunction with high-resistance grounding. High-resistance grounding limits ground-fault current to a level that will limit machine damage. Research has shown that a generator can withstand fault currents of 10 A indefinitely without iron burning [2]. In high-resistance-grounded systems, neutral-grounding-resistor (NGR) monitoring is recommended [3]. SE-325 and SE-330 NGR monitors detect ground faults and NGR failures. See Fig. 4.

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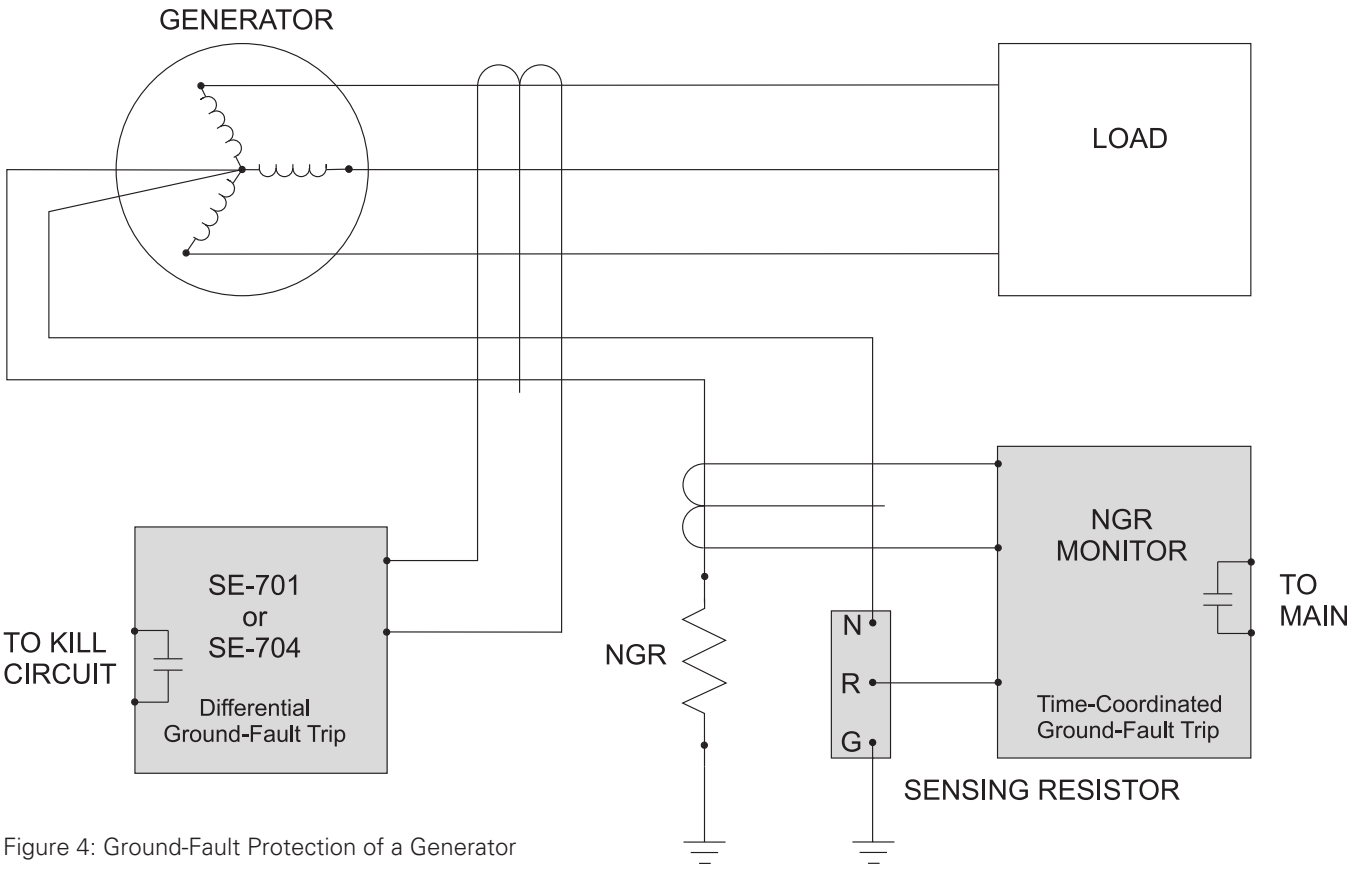

Figure 4: Ground-Fault Protection of a Generator

References

[1] P. Pillai et el, "Grounding and Ground Fault Protection of Multiple Generator Installations on Medium-Voltage Industrial and Commercial Power Systems, An IEEE/IAS Working Group Report", 57th Annual Conference for Protective Relay Engineers, 2004

[2] D. Shipp and F. Angelini, "Characteristics of different power systems neutral grounding techniques: fact & fiction," in Conference Record of IEEE IAS Annual Meeting, 1988.

[3] G Paulson and M. Savostianik, "Monitoring Neutral-Grounding Resistors—An Update", Presented at MESC Conference, 2003

Bibliography

1.IEEE Guide for Generator Ground Protection, IEEE Standard C37.101, 1993.

2.P. Pillai et el, "Grounding and Ground Fault Protection of Multiple Generator Installations on Medium-Voltage Industrial and Commercial Power Systems, An IEEE/IAS Working Group Report", 57th Annual Conference for Protective Relay Engineers, 2004

3.D. Shipp and F. Angelini, "Characteristics of different power systems neutral grounding techniques: fact & fiction," in Conference Record of IEEE IAS Annual Meeting, 1988.