Generator Stator Intermittent Ground Fault Test Instrument - Version 2.0

Nick Loehrke, Nader Safari-Shad, Owen Bauman,
Electrical and Computer Engineering Department
University of Wisconsin-Platteville
Platteville, WI 53818, USA
loehrken@uwplatt.edu
safarisn@uwplatt.edu
baumano@uwplatt.edu

Mason Kobliska
Huff Family Innovation Center
College of Engineering, Mathematics and Science
University of Wisconsin-Platteville
Platteville, WI 53818, USA
kobliskam@uwplatt.edu

***Abstract*—The paper describes an improved design and fabrication of a novel intermittent ground fault (IGF) test instrument used in industrial generator stator ground protection. The improved instrument allows staging and acquisition of IGF data with higher precision and reliability. The instrument also enables more effective testing and validation of IGF detection algorithms contributing to the prevention of catastrophic generator stator ground faults and enhancing grid reliability.**

***Index Terms*—Generator stator ground fault protection, and subharmonic voltage injection-based (64S) scheme.**

I. Introduction
II. IGF Test Instrument - Version 1.0
III. IGF Test Instrument - Version 2.0
A. Load Switch Circuit Module
B. Power Supply Module
C. Battery Management System Module
D. Microprocessor Unit
IV. Enclosure Design and Fabrication
V. Functional Testing
VI. Conclusion
References

I. Introduction

Synchronous generators are critical to the stability and reliability of the power grid, making their protection against electrical faults essential for national security.

The most common generator fault is the stator single-phase ground fault which often begins as an IGF. IGFs are characterized by high transient currents and overvoltages that can cause severe damage to insulation and generator components, potentially escalating into more severe faults and resulting in costly repairs and downtime [1] - [5].

Reports of stator IGF have sparked a renewed interest to develop reliable IGF detection schemes [6] - [8]. Specifically, [8] reports on development of a novel test instrument called 64S/87S-TI Version 1.0 by which stator IGF can be safely emulated on real-world generator stator neutral grounding circuits. Acquisition of such fault data enables protective relay engineers to analyze the performance of IGF detection schemes and assess their reliability.

The goal of this paper is to report on the upgrades enhancing the functionality of the 64S/87S-TI Version 1.0. The primary upgrades include redesigning the electronic circuitry to incorporate a custom power supply, battery management system, and improved load switch topology. The Arduino UNO microcontroller (MCU) used in the 64S/87S-TI Version 1.0 is also replaced with an STM32 MCU, offering increased processing power and flexibility. Additionally, the instrument enclosure is completely redesigned using a combination of extruded aluminum and CNC machined panels to ensure resilience to physical stresses.

References

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