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Simulation of Hydro Generation Connected to Non Linear Loads using Neural-Network-Based Load Controller

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ABSTRACT

This paper deals with a neural-network (NN)-based integrated electronic load controller (IELC) for an isolated asynchronous generator (IAG) driven by a constant-power small hydro uncontrolled turbine feeding three-phase four-wire loads. The proposed IELC utilizes an NN based on the least mean-square algorithm known as adaptive linear element to extract the fundamental component of load currents to control the voltage and the frequency of an IAG with load balancing in an integrated manner. The IELC is realized using zigzag/three single-phase transformers and a six-leg insulated-gate bipolar-transistor-based current controlled voltage-source converter, a chopper switch, and an auxiliary load on its dc bus. The proposed IELC, with the generating system, is modeled and simulated in MATLAB environment using Simulink and Simpower System toolboxes. The simulated results are validated with test results on a developed prototype to demonstrate the effectiveness of IELC for the control of an IAG feeding three-phase four-wire linear/nonlinear balanced/ unbalanced loads with neutral-current compensation.

Keywords-Active power filter (APF), ANN, integrated electronic load controller (IELC)

I .INTRODUCTION

BECAUSE of increasing concerns for the growing demand of electrical energy and the fast depletion of fossil fuels, the need for low-cost stand-alone generating plants becomes inevitable in remote locations. Electricity generation from locally available small hydro heads, wind, and solar-energy sources is an alternate solution for environment-friendly energy generation.The reduction in cost may be obtained by utilizing run-of-the-river schemes and an integrated electronic load controller (IELC) to regulate the inherent voltage and frequency in isolated asynchronous generators (IAGs) for small hydro applications. The asynchronous generators are preferred as compared with synchronous generators due to the advantages of low cost, ruggedness, brushless-rotor construction with least maintenance, and no requirement for a dc supply. As the asynchronous machine is isolated, its reactive power is supplied by a voltampere reactive (VAR) generating unit connected across its terminals, which is generally met by capacitor banks. The rating of a capacitor bank is so selected that when driven at rated speed, it should produce the rated voltage at no load . Major setbacks of such stand-alone small hydroelectric power generation systems are the regulation of terminal voltage and frequency under load perturbations compared with any other conventional generators, along with power-quality problems. Therefore, the use of an IELC with a suitable control scheme becomes necessary for an uncontrolled small hydro turbine-driven generator for power generation

In this paper, the control strategy is a neural-network (NN)- based least mean square (LMS) known as adaptive linear element (adaline) algorithm of an IELC, which has capability of controlling the voltage and its frequency in an integrated manner. The adaline is used

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