

# An Electronic Load Controller for Micro Hydro System

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**Abstract-** This paper presents different methods to implement GSM based smart village. Smart villages are rural communities which use innovative solutions to enhance their sustainability, built on local strengths and opportunities. The idea of smart village would help villages become self-reliable that can encourage foreign and domestic investors. Various techniques are also discussed, such as smart irrigation, safety, and soil testing, automatic street lights which are used for implementation of smart village.

**Keywords-** IoT, soil moisture, level sensors, waste management cloud computing, real time monitoring using GSM systems.

## I. INTRODUCTION

Distributed generators include induction and synchronous electrical generators as well as any type of electrical inverter capable of producing AC power. An emergency or standby generation system is designed so as to never electrically interconnect or operate in parallel with the utility system. An interconnected generation system is any generator or generation system that can parallel (or has the potential to be paralleled via design or normal operator control), either momentarily or on a continuous basis, with the utility system.

## II. TYPES OF DISTRIBUTED GENERATION

### 1. Wind turbine:

Wind is a free, clean and inexhaustible energy resource. It is abundant (1670) Trillion kWh/year over the land area of the earth) but unevenly distributed. Wind electric conversion system (WECS) generate electrical energy by converting the energy in moving air (wind) into mechanical energy first and then to AC electrical energy.

### 2. Small-hydro turbines:

Small hydro power (SHP) has been identified as one of the appropriate and environment friendly, renewable energy sources which can provide convenient and uninterrupted energy to remote rural villages, which are yet to be electrified.

### 3. Photovoltaic power generation:

Solar power is one of the first things that come to most people's minds when the subject of alternative energy comes up. Solar power first gained wide public awareness during the 1970's energy crisis, and solar technology has advanced substantially since then. With present-day rising electricity costs and available Federal Tax Incentives – there has never been a better time to invest in your power future.

### 4. Diesel generation:

Diesel plants are more efficient than any other heat engine of comparable size. These plants are cheap by way of initial cost, can be started and stopped quickly and can burn a wide range of fuels. A diesel plant does not require any warming period; it need not be kept running for a long time before peaking up loads.

## III. TYPES OF HYDRO-ELECTRIC SCHEMES

The objective of a hydropower scheme is to convert the potential energy of a mass of water, flowing in a stream with a certain fall to the turbine (termed the "head"), into electric energy at the lower end of the scheme, where the powerhouse is located. The power output from the scheme is proportional to the flow and to the head. The objective of a hydropower scheme is to convert the potential energy of a mass of water, flowing in a stream with a certain fall to the turbine (termed the "head"), into electric energy at the lower end of the scheme, where the powerhouse is located. The power output from the scheme is proportional to the flow and to the head.

Schemes are generally classified according to the "Head":-

- High head: 100-m and above
- Medium head: 30 - 100 m
- Low head: 2 - 30 m

These ranges are not rigid but are merely means of categorizing sites.

Schemes can also be defined as:-

- Run-of-river schemes
- Schemes with the powerhouse located at the base of a dam
- Schemes integrated on a canal or in a water supply pipe

### 5. Electronic Load Controller (ELC):

The proposed ELC is the combination of an IGBTs, a filtering capacitor, chopper, and a series dump load (resistor). The schematic diagrams of ELC-SEIG systems are shown in Figs. 6.2 for supplying three-phase loads with appropriately modified ELCs. The IGBTs converts the SEIG ac terminal voltage to dc. The IGBTs output has

the ripples, which should be filtered and, therefore, a filtering capacitor (C) is used to smoothen the dc voltage. An IGBT is used as a chopper switch. A suitable gate driver circuit has been developed that turns on the chopper switch when the consumer load on SEIG is less than the rated load and turns off the chopper switch when consumer load on the SEIG is at a rated value. When the chopper switch is switched on, the current flows through the dump load and consumes the difference power (generated power consumed power) which results in a constant load on the SEIG and, hence, constant voltage and frequency at the load.

The SEIG–ELC system consists of a three-phase delta-connected induction generator driven by the hydro turbine and an ELC. Suitable valued capacitors are connected across the SEIG such that it generates rated terminal voltage at full load. Since the input power is nearly constant, the output power of the SEIG is held constant at varying consumer loads. The power in surplus of the consumer load is dumped in a resistance through the ELC. Thus, SEIG feeds two loads in parallel such that the total power is constant, that is where is the generated power of the generator (which should be kept constant), is the consumer load power, and is the dump load power. This dumped power may be used for space heating, water heating, battery charging, cooking, baking, etc.

**6.Simulation of ELC -**

The MATLAB based model of the proposed controller along-with isolated asynchronous generators system. The main generating system consists of isolated asynchronous generators, excitation capacitors, voltage and frequency controller along-with balanced/unbalanced, linear/non-linear consumer loads. Figure shows the complete model of the proposed electrical generating system along with VSC control and chopper control. The universal bridge is used to model the voltage source converter for the controller and three phase loads. The proposed system is modeled using 7.5 kW, 415 V, 50 Hz, Δ-connected asynchronous machines to operate as isolated asynchronous generator (IAGs). Individual delta connected capacitor banks having rating of 2.51 kVAR are used for generating the rated voltage at no-load.

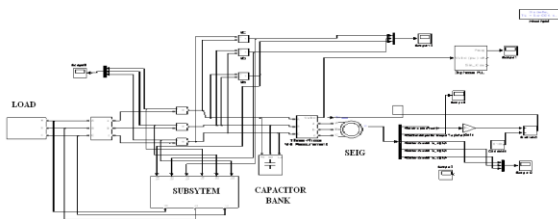


Figure1 simulation model for micro-hydro power generation along with the controller

**7.Simulation result:-**

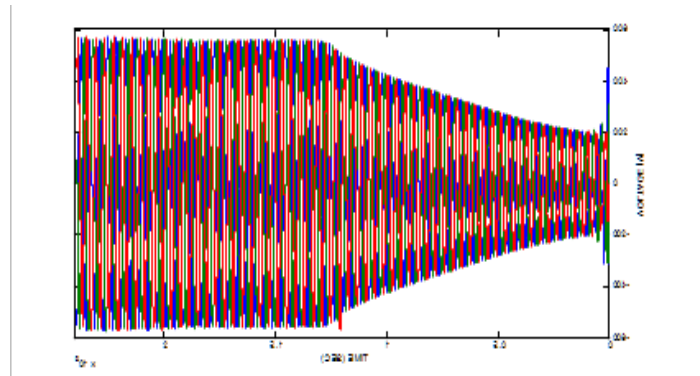


Fig.8.1 Waveform for source voltage (Vabc)

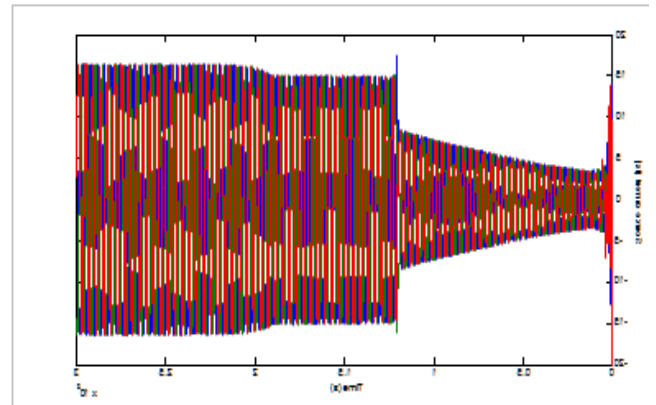


Fig.8.2 Waveform for source current (Ia)

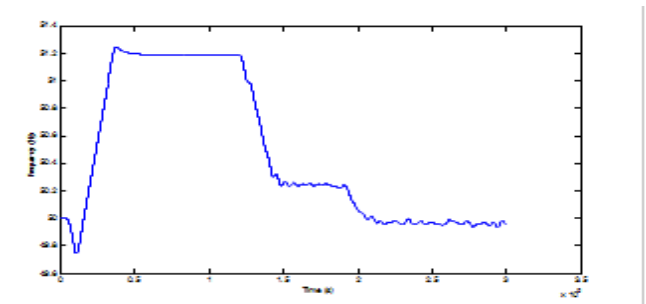


Fig.8.3 Waveform for frequency (Hz)

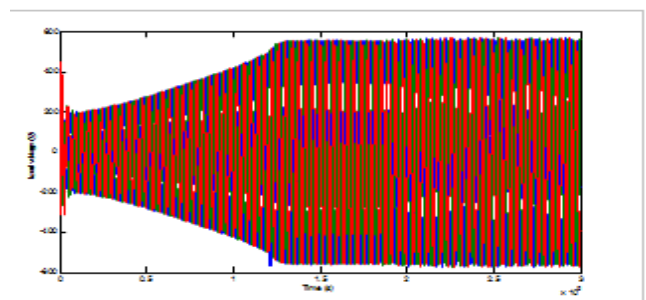


Fig.8.4 Waveform for load voltage (Vc)

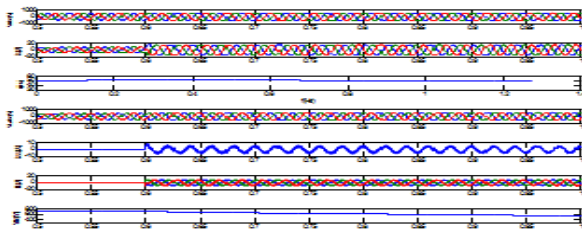


Fig 8.7 Waveforms of SEIG with ELC for resistive load

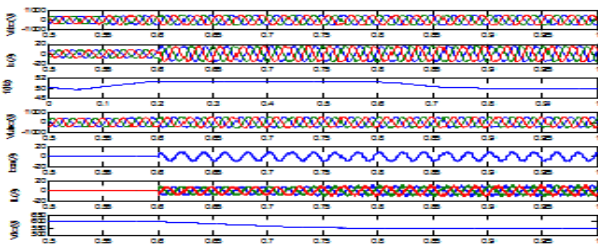


Fig 8.8 Waveforms of SEIG with ELC for inductive load

#### IV. CONCLUSION AND FUTURE SCOPE

The performance of the proposed controller has been demonstrated for isolated asynchronous generators in constant power application driven by hydro turbines. It has been observed that the controller is having capability of voltage and frequency regulation along with harmonic compensation and load balancing

For future improvement, there are several suggestions stated below can be continued.

- 1 Use higher rating generators to produce high voltage
- 2 Add storage system to store the generated power
- 3 Design of ELC for parallel operation of SEI
- 4 Testing of ELC should be done for dynamic as well as non-linear loads.

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