International Journal of Electrical and Electronics Engineers
Volume 17, Issue No. 01, Jan-June 2025
ISSN (O) 2321-2055
ISSN (P) 2321-2045

AUTOPOWER SWITCHING OF HV SUBSTATION (USING SOLAR, WIND, GREEN HYDROGEN AND MAINS)

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ABSTRACT

The Purpose of this project is to design a system that provides a nonstop power supply to the load. This uninterrupted power is deliver to the load by using renewable energy sources such as wind, solar, & green hydrogen, which are being used in worldwide. Additionally, this system is designed to reduce the maximum load on mains, which affects the continuous power supply. The system primarily utilizes AC mains while trying to fulfill the energy demand through power generated by renewable sources. In this project, minimal manpower is required as the system operates automatically. Since renewable resources are used, the system is both environmental friendly and independent.

Keywords: Mains, Solar, Solid State Relay switching, sine wave inverter, pic controller

INTRODUCTION

Nowadays, electricity consumption is increase as the population grows, leading to rise in electricity demand and resulting in excessive load on Mains. [1,2] To address this, we can reduce the excessive load of mains by using alternative power supplies. For these alternative power supplies, we are using predominantly renewable energy, which helps to reduce fuel consumption & is both ecofriendly and cost effective. The main power switching can be done using PIC controller & Solid-state relay. Microcontroller perform a crucial role in distributing continuous power to the grid. [5,3] It also fulfils the energy demand according to the peak load. In this project, we are mainly prioritizing solar, wind, and green hydrogen sources, so the AC mains will remain off. If all three of these sources fail to feed power to the load, the supply switches to mains.

PROBLEM STATEMENT

When demand electricity increases, it can put strain on power systems, which can lead to volatile prices and negative effects on power generation as well as demand of electricity increase it can lead to burning fossil fuels, nuclear energy and which can have limited sources and also can pollute environment. Sometimes to meet the energy demand ac mains goes under high pressure which will affect the system. To fulfil the above problem we can switch the power supply by using the microcontroller and Solid State Relays.

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OBJECTIVES

- To save the depletion of non-renewable resource.[7]
- To encourage the use of environmental friendly power.[7]
- To provide nonstop power to the load.
- To reduce manpower and for safety purpose.[1]
- Fulfilment of energy demand according to peak hours to users.
- To reduce the load on AC mains.
- Fulfilment of energy demand according to peak hours and load.

METHODOLOGY

Block Diagram-

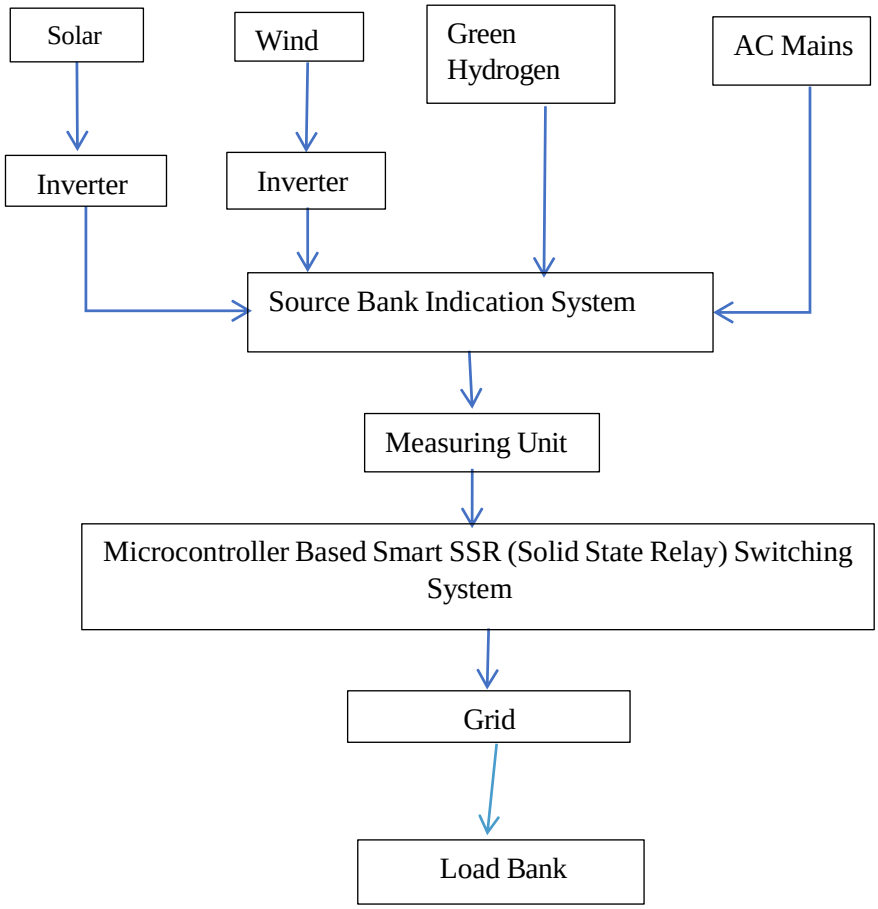

Figure 1- Block Diagram

WORKING

Renewable resources generate the power, which is pure DC. This DC power is turn into AC power into inverter, and the power is then delivered to the source bank indication system, which shows the availability of the power sources. This power is measured by the measuring unit, which consist of all the necessary measuring equipment such as ammeter, voltmeter etc. The measuring unit sends the signal to a microcontroller based smart solid state

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relay switching system. PIC controller senses the power and sends it to the Solid-state relay for switching. If solar is unavailable, the system switches to the wind system. If wind system is unavailable, it switches to the green hydrogen system. only when green hydrogen fails to provide the power does the system switch to the AC mains. This system can also used to fulfill the energy demands based on peak load times. For example, if energy demand is high in the morning time, solar power will supply the load. If energy demand is high in the evening, the system switches to the wind system, and if wind system fails, it switches to the green hydrogen system. The figure below show the hardware circuits of microcontroller and panel no.1, where the all sources are connected. figure1 shows the microcontroller, and figure 2 shows the panel where all sources are connected with inverter and solid-state relay.

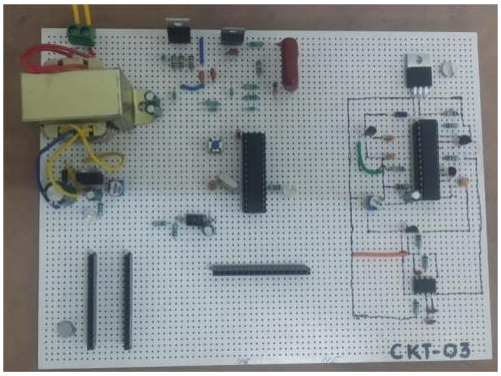

Figure 2: Microcontroller based system

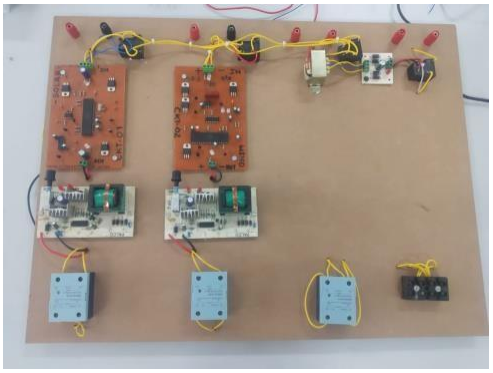

Figure 3: Sources connected to solid state relay Circuit

COMPONENTS USED

1.Digital Meter- AC 0-10 Amp Ammeter & AC 0-500 V Digital Volt Meter(4)

Digital Meter

Digital meter is an electronic device used to measure and display various types of data, such as electrical voltage, current, power, energy consumption, or other physical quantity.

2.Solid State Relay- I/P AC-O/P AC Optocoupler based solid state relay current rating amp (3)

Solid State Relay

Solid state relay (SSR) is a type of electronic switch that operates by applying an external alternating current or direct current voltages to its control terminals. Unlike mechanical relays, it contains no moving components, making it a more reliable, faster, and efficient option for switching operations.

3.Inverter – 230 volt,50Hz,50watt inverter(2)

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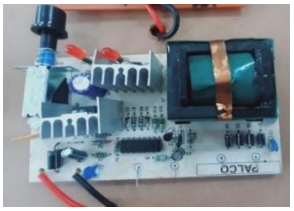
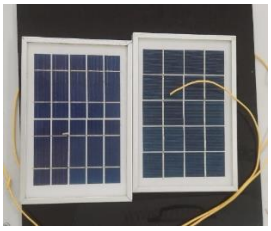


Sine wave inverter

A sine wave inverter is a kind of power inverter that transforms direct current (DC) into alternating current (AC) with pure sine wave output. It is highly preferred because it generates a clean and smooth waveform that closely resembles the AC power provided by the utility grid.

4. Solar Panel- 12V,20Watt mono crystalline type PV cell (1)



Mono crystalline type PV cell

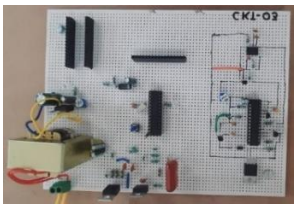
Monocrystalline solar panels are a type of photovoltaic module made from single crystal silicon. they are known for their high efficiency and uniform appearance. they have long durability upto 25-30 years or more.

5. Wind - 12V BLDC generator.

DC generator

DC Generator is an electrical device that transforms mechanical energy into direct current electrical energy. It works based on principle of electromagnetic induction, which states that an electric current is produced when a conductor moves through a magnetic field. The generator DC power is then delivered to the inverter through a charge controller, ensuring a stable supply.

6.PIC Controller- ATMEL 328P-PU Microcontroller based switching circuit (1)



Microcontroller based switching circuit

It is an popular microcontroller from microchip technology. It is a brain of overall system which decides when to on or off the supply.

1. Grid - 5Amp 3 Phase neutral copper wire based grid (1)
2. Load Bank - Resistive type 500watt 230v AC load bank

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3. Indicator - AMD Based 230v AC 22mm panel mounted indicator.

FLOW CHART

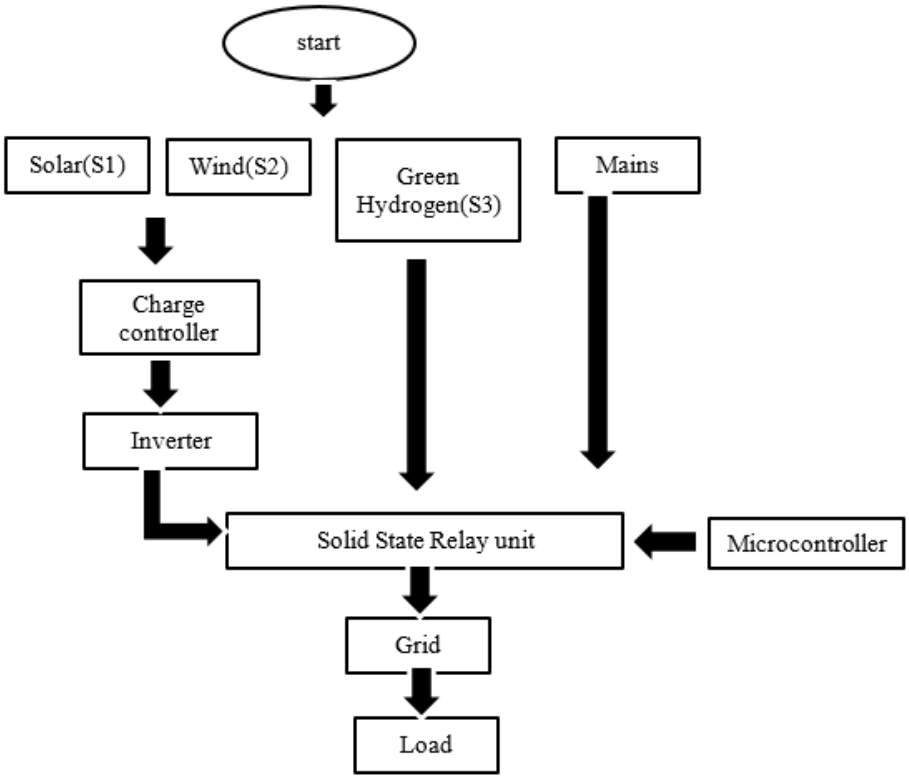
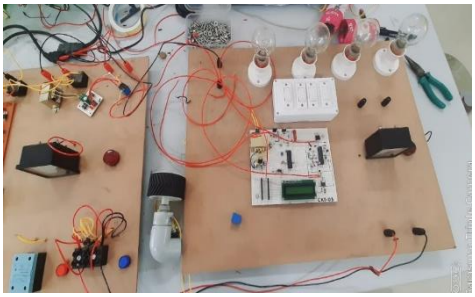
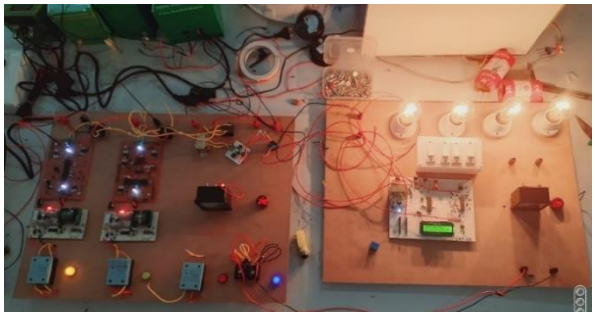


Figure 1- Block Diagram

ANALYSIS & RESULT



Project model



Result

This project run successfully and provides uninterrupted power supply to the load. During this process initially continuous supply provided to load by the solar, wind & green hydrogen that time mains remain off, if these three sources are fails to provide power then and then only its switches to mains.

Source	Solar	Wind	Green hydrogen	Mains
SSR based Automatic switching	On	Off	Off	Off
	Off	On	Off	Off
	Off	Off	On	Off
	Off	Off	Off	On

Table 1- Result of system

CONCLUSION

The proposed system enhances the reliability, sustainability, and efficiency of the mains power supply. We have successfully achieved the objectives of this project. As global energy demand increases due to limited energy generation, worldwide because of low energy generation which is depend upon fuels basically so using renewable energy. we can fulfill our needs towards the energy generation or to save the no renewable energy sources. And by using them as alternative of mains we can fulfill the energy demand and can lower the load on AC mains. By operating this system on renewable energy we can reduce the dependency on conventional electricity i.e., Mains.

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