Detecting Power Grid Synchronization Failure on Sensing Bad Voltage or Frequency

Prakhar Pandey[1] Sawan Kumar Sharma[2]
[1]Student [2]Assistant Professor
[1,2]Department of Electrical & Electronics Engineering
[1,2]Pranveer Singh Institute of Technology, Kanpur, Uttar Pradesh, India

Abstract— In this paper, we present the development of a system to detect the synchronization failure of any external supply source to the power grid on sensing the abnormalities in frequency and voltage. There are several power generation units connected to the grid such as hydel, thermal, solar etc. to supply power to the load. These generating units need to supply power according to the rules of the grid. These rules involve maintaining a voltage variation within limits and also the frequency. So it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. This prevents in large scale brown out or black out of the grid power. So, it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. The microcontroller monitors the under/over voltage being derived from a set of comparators and a standard Arduino is used to vary the input voltage to test the functioning of the paper. A lamp load (indicating a predictable blackout, brownout) being driven from the microcontroller in case of voltage/frequency going out of acceptable range. Further the project can be enhanced by using power electronic devices to isolate the grid from the erring supply source by sensing cycle by cycle deviation for more sophisticated means of detection.

Key words: Power Grid, Voltage, Frequency

I. INTRODUCTION

The project is designed to detect the synchronization failure that means in power distribution systems, the power grid station gets supply from different feeder stations like a thermal power station, a wind power station, a solar power station etc. For within limits and also the frequency. This prevents in large scale brown out or black out of the grid power. So it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. In case these limits are exceeded and the demand for power is more than the demand for supply, it results in grid failure. In such situations, the feeder unit is completely disconnected from the grid, causing islanding situation. Thus synchronization is needed between the grid and the feeder unit. This paper defines a way to detect the variations in frequency and voltage of the power supply from the feeder unit to determine the synchronization failure. Here a frequency variation detection system and a voltage feasible transmission, the frequency and voltage of the AC supply should be within the limits as decided by the grid. There are several power generation units connected to the grid such as hydro, thermal, solar etc. to supply power to the load. These generating units need to supply power according to the rules of the grid. These rules involve maintaining a voltage variation variation detection system are used. For frequency variation, voltage variations, and for the current variations we use the sensors here. In case of any voltage, frequency variations, the lamp is switched on .of any external supply source to the power grid on sensing the abnormalities in frequency and voltage.

II. LITERATURE OVERVIEW

A. Islanding

Islanding is a critical and unsafe condition in which a distributed generator, such as a solar system, continues to supply power to the grid while the electric utility is down. This condition is caused due to an excessive use of distributed generators in the electrical grid. Solar power generators, wind generators, gas turbines and micro generators such as fuel cells, micro turbines, etc. are all examples of distributed generators. The fact that anyone could supply electricity back to the grid causes the problem of islanding. It is a condition in which a distributed generator like solar panel or wind turbine continues to generate power and feed the grid, even though the electricity power from the electrical utility is no longer present. Also it exposes utility workers to life critical dangers of shocks and burns, who may think that there is no power once the utility power is shut down, but the grid may still be powered due to the distributed generators. To avoid this problem, it is recommended that all distributed generators shall be equipped which devices to prevent islanding. The act of preventing islanding from happening is also called ant islanding. Islanding causes many problems, some of which are listed below:

1) Safety Concern

Safety is the main concern, as the grid may still be powered in the event of a power outage due to electricity supplied by distributed generators, as explained earlier. This may confuse the utility workers and expose them to hazards such as shocks.

2) Damage to Customer's Appliances

Due to islanding and distributed generation, there may bi-directional flow of electricity. This may cause severe damage to electrical equipment, appliances and devices. Some devices are more sensitive to voltage fluctuations than others and should always be equipped with surge protectors.

3) Inverter damage

In the case of large solar systems, several inverters are installed with the distributed generators. Islanding could cause problems in proper functioning of the inverters.

B. Blackout

Two severe power blackouts affected most of northern and eastern India on 30 and 31 July 2012. The blackout on 31 July is the largest power outage in history. Reasons of black out

- Inter-regional power transmission corridors due to multiple existing outages (both scheduled and forced) Weak High loading on 400 kV Bina–Gwalior–Agra
- Link inadequate response by State Load Dispatch
- Centers (SLDCs) to the instructions of Regional Load Dispatch Centers (RLDCs).

This system is applicable for Solar Power Plant where frequency varies; frequency and voltage parameters should match with the Power grid. Microcontroller having various applications by changing the program. This research work seeks to design automatic and efficient fault detection and location system for both overhead and underground power transmission network system using both existing and commercially proven communication technology to quickly and accurately pin point faulted sections of a transmission system.

III. COMPONENTS USED

- TRANSFORMERS
- DIODES
- VOLTAGE REGULATOR
- 555 TIMER
- OP-AMP
- RESISTORS
- CAPACITORS
- RELAY
- LAMP
- MICROCONTROLLER (At89s52/At89c51)
- POTENTIOMETER
- LAMP
- TRANSISTORS
- 16X2 LCD PANNEL
- LM358
- LM339

IV. WORKING

This system is based on a microcontroller of 8051 family. The microcontroller monitors the under/over voltage being derived from a set of comparators. As the frequency of the mains supply cannot be changed, the project uses a variable frequency generator (555-timer) for changing the frequency, while a standard variac is used to vary the input voltage to test the functioning of the project. A lamp load (indicating a predictable blackout, brownout) is being driven from the microcontroller in case of voltage/frequency going out of acceptable range. Further the project can be enhanced by using power electronic devices to isolate the grid from the erring supply source by sensing cycle by cycle deviation for more sophisticated means of detection.

A. Voltage Sensing Part

The microcontroller is connected to the zero voltage sensing circuit to ensure the frequency of the supply is at normal frequency of 50Hz. A Voltage Regulator is used to get variable voltage. Initially both the presets are adjusted such that both the output pins of the OPAMP IC are at normal low and normal high level. At this point the lamp is glowing as the voltage is in the range. The Voltage Regulator is adjusted so as to get the input AC voltage more than the normal value. Now the normally high pin of the OPAMP IC will go low, giving an interruption pulse to the pin of the microcontroller. The microcontroller accordingly sends a high logic pulse to switch off the relay driver, which in turn de-energizes the relay driver making the lamp to turn off. Similarly when the Variable Regulator is adjusted so as to get input AC voltage less than the normal value, at some point, the normally low pin of the OPAMP IC goes high and the microcontroller on receiving this interruption, sends a high logic signal to the relay driver to switch off the relay and hence the lamp which stops glowing

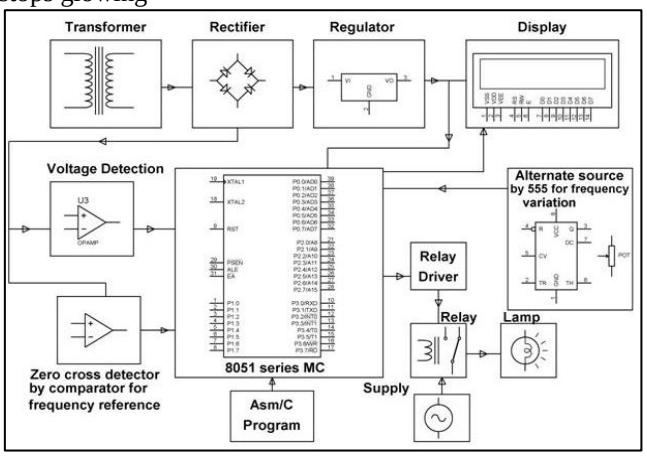

Fig. 1: Block Diagram

B. Frequency Sensing Part

The Voltage Regulator is adjusted such that the AC input voltage is at its normal value. The microcontroller pin is connected to the output of the 555 timer through a PNP transistor. The timer works in a stable mode to produce signals at frequencies which can be adjusted using the variable frequency. This output is connected to the internal timer of the microcontroller which accordingly calculates the frequency of the frequency, the relay driver is triggered, which in turn energizes the relay and the AC supply is given to the lamp which turns off once the frequency of the pulses goes beyond the normal frequency or less than the normal.

V. ADVANTAGE

- Here we can use, beyond the acceptable range could be used in that power houses where different supply sources are connected parallel together to fulfill the energy demand.
- By using this system, the consumer load could be automatically shifted to another source of energy.
- This system is more compact and reliable as compared to the manual system.
- It secured the power of the grid coming from different power stations by detecting the abnormal conditions of frequency and voltage beyond its acceptable.
- It prevents the synchronization failure between power grid and feeder.

VI. ACTUAL OVERVIEW

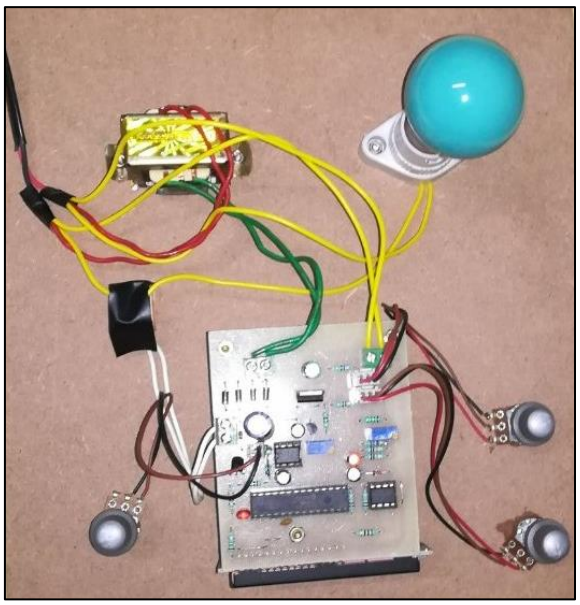

Fig. 2: Actual Project

VII. CONCLUSION

This research is motivated by the need to protect the power grid system. To develop a system to detect the synchronization failure of any external supply source to the power grid on sensing the abnormalities in frequency and voltage. There are several power generation units connected to the grid such as hydro thermal, solar etc. If any deviation from the acceptable limit of the grid it is mandatory that the same feeder should automatically get disconnected. This prevents in large scale brown out or black out of the grid power by sensing abnormalities of voltage and frequency. This project is based on the microcontroller that are having lot of advantages by changing programming. So that alternate arrangements are kept on standby to avoid complete grid failure.

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