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Implementation of Overvoltage and Under voltage Protection

Ashis Patra[1], Tarun Shrivastava[2], Sadhna Soni[3], Rakesh Damor[4]

Associate Professor, Electrical, Madhav Institute of Technology and Science, Gwalior, India[1]

Assistant Professor, Electrical, Madhav Institute of Technology and Science, Gwalior, India[2]

UG Student, Electrical, Madhav Institute of Technology and Science, Gwalior, India[3,4]

Abstract: The project aims to form a low voltage and high voltage indicator. The system will save costly electrical and electronic appliances from the adverse effects of very high and low mains voltages. A project has been proposed on simulating an overvoltage and under-voltage protector, with the hardware. The advantages of our project are -Wide single supply voltage range 2.0 V DC to 36 V DC, Very low supply current drain (0.8mA) independent of supply voltage, low input bias current 25mA.,Input common-mode voltage range includes ground, differential input voltage range adequate to the facility supply voltage.

Keywords: Power Quality, Overvoltage, Under voltage.

I. INTRODUCTION

A Overvoltage is defined as a rise within the r.m.s. value power Quality," IEEE Std. 1159-1995, of the voltage up to level between 1.1 pu to 1.8 pu at June1995[2], Power quality is defined as "The concept of power frequency for periods starting from a half cycle to a powering and grounding sensitive equipment in minute and a voltage which is below the optimum a way suitable for the equipment". operational or rated value of a component, circuit or device is named an under voltage. Such a voltage may within the previous couple of decade power quality has become an produce as an example a malfunction or failure of customer important issue since many equipments are semiconductor equipments. In computers and similar devices, under based and controlling is finished with power electronic voltages can result in data losses. equipments. All the equipments were heating, lighting and Protection against sudden overv oltages in substations could be a motors, which weren't very sensitive to voltage variation. vital a part of the reliability of power systems. The degree of surge protection afforded to a station is governed by the reliability required and also the economics to get such reliability. Since major stations generally include strategic and highly valuable power equipment, surge protection is crucial to avoid or minimize major system disturbances likewise as major equipment failures. Transient overvoltage occurring in our installation can cause operational breakdown and also cause failure in industrial and household equipments moreover. Transient overvoltages in power systems could also be caused thanks to several reasons of which those occurring because of lightning strikes or switching operations of inductive or capacitive loads. The substations are protected in such the way that lightning never falls directly 2 over it, rather the travelling waves arising because of lightning at a foreign point aloof from the substation, travels into the substation through the towers and incoming transmission lines. Given the course of the thesis, a study of the transient overvoltages and undervoltage and its corresponding effects on the substation and household equipments is dole out and modeled in hardware, including the protection of the device

II. POWER QUALITY AND ITS PROBLEMS

According to Institute of Electrical and Electronic Engineers (IEEE) Recommended Practice for Monitoring within the past the term reliability and quality was same as because there have been no power electronic equipments and every one the equipments were linear in natureCauses of Power Quality Problem Some common disturbances which can cause power quality problems are listed below:

- Operation of non-linear and unbalanced loads,
- Failure of kit, e.g. transformers and cables,
- Wrong maneuvers in distribution substations and plants.
- Lightning and natural phenomena,
- Formation of snow on line, storm etc.

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• Energization of capacitor banks and transformers,
• Switching or start-up of huge loads e.g. Induction motors In systems where overhead lines are predominant, natural phenomena are to blame for the bulk of faults in transmission and distribution systems, especially lightning [2, 3]. in essence, a lightning stroke could be a transient increase within the voltage along the road. However, an arc is made between the phase hit by the stroke and ground and consequently the voltage is depressed to zero. When unbalanced loading is completed on a system it causes an unbalance voltage within the phases, which ultimately creates power quality problem. This unbalance voltage increases rotor heating because of negative sequence magnetic flux generated within the stator winding. the most reason behind power quality problem is that the short fault occurring within the distribution side. This contact can cause a large increase within the system current and consequently an outsized drop within the impedance of the provision system [1]. A. Effects of Power Quality Problem Poor power quality has many harmful effects on power grid devices and goods. whether or not there's no occurrence of failure of the equipment, there'll be losses and heating within the equipment which is able to ultimately reduce the lifetime of the equipment. These effects are so dangerous that it's not visible until failure occurs within the equipments.
• The effects of poor power quality on capacitors, rotating machines, cables and transformers, fuses, and customers' equipment creates heating, noise, poor performance etc.
• Premature failure of distribution transformer because of heating will be caused by harmonics. • Due to sudden rise in voltage and/or current, failure of power grid components and customer loads can occur.
• When harmonics are added to the availability voltage equipment could receive high value of instantaneous voltage and will be vulnerable to failure. This high voltage may force electronic components of power grid to work within the saturation, producing additional harmonics and disturbances.

III. OVERVOLTAGE

An Overvoltage is defined as a rise within the r.m.s. value of the voltage up to tier between 1.1 pu to 1.8 pu at power frequency for periods starting from a half cycle to a second as shown in fig.

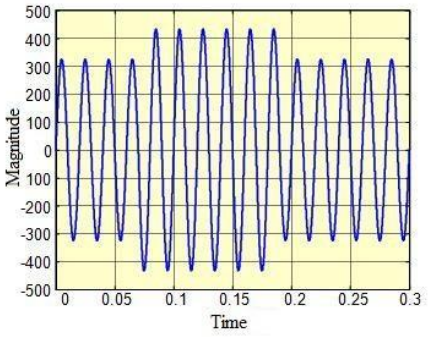

Fig. 1: Overvoltage

Overvoltage are less common than undervoltage but they also arise thanks to glitches. Overvoltage can occur thanks to single line to ground fault, which successively will raise the voltage of the opposite phases. It may cause thanks to disconnection of heavy industrial loadsswitching on the capacitor banks [2]. This is generally due to ungrounded or floating ground delta systems, where a change in ground reference would give voltage rise to the ungrounded system.

Type of Overvoltage	Duration	Magnitude
Instantaneous	0.5 – 30 cycles	1.1 – 1.8 p.u.
Momentary	30 cycles – 3 secs	1.1 – 1.4 p.u.
Temporary	3 secs – 1 min	1.1 – 1.2 p.u.

Table II Classification of overvoltage according to IEEE 1159

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Causes of overvoltage are mainly because of energization of capacitor bank. It also can be generated by sudden load deduction. thanks to the disconnection of load there's a sudden reduction of current, which can create the voltage , $v = L\frac{di}{dt}$, where L is that the inductance of the road. The effects of overvoltage are more severe and destructive. it should cause the electrical equipment to fail, because of overheating caused by high voltage. Also electronic and other sensitive equipment are liable to malfunction.

IV. UNDERVOLTAGE

Under voltage is described as a surprising drop withinside the root imply square (r.m.s.) voltage and is commonly characterised via way of means of the remaining (retained) voltage. Undervoltage is thus, quick period discount in r.m.s. voltage, brought about especially via way of means of quick circuits, beginning of big cars and device failures.

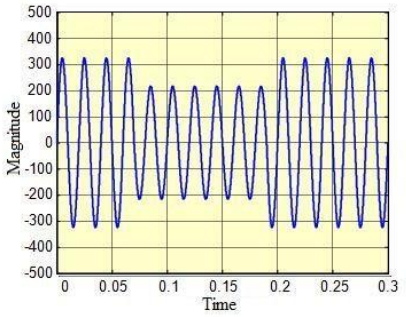

Fig. 2.Undervoltage

Furthermore, Undervoltage can be categorized via way of means of their period as proven in Table-1.TABLE II Classification of Undervoltage according to IEEE

Type of Overvoltage	Duration	Magnitude
Instantaneous	0.5 – 30 cycles	0.1 – 0.9p.u.
Momentary	30 cycles – 3 secs	0.1 – 0.9p.u.
Temporary	3 secs – 1 min	0.1 – 0.9p.u.

Under voltages are the maximum not unusual place energy disturbance whose impact is pretty excessive mainly in commercial and big business clients which includes the harm of the sensitivity equipment and lack of each day productions and finances. Examples of touchy equipment are Programmable Logic Controller (PLC), Adjustable Speed Drive (ASD) and Chiller control. Undervoltage on the device terminal maybe because of quick circuit fault loads of kilometers away withinside the transmission device.

A. Causes of Undervoltage

There are numerous reasons for which Undervoltage is created in device voltage:

1. Closing and Opening of Circuit Breakers: When the circuit breaker of a segment is opened suddenly, then the road which it's miles feeding may be briefly disconnected. The different feeder traces from the equal substation gadget will act as aundervoltage.
2. Due to Fault: Undervoltage because of fault may be important to the operation of a electricity plant. The importance of undervoltage may be identical in every segment or unequal respectively and it relies upon on the character of the fault whether or not it's miles symmetrical or unsymmetrical.

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3. Due to Motor Starting: Undervoltage because of motor beginning are symmetrical for the reason that induction vehicles are balanced 3 segment loads, this could draw about the equal excessive beginning modern in all of the phases.
4. Due to Transformer Energizing: There are specially reasons of undervoltage because of transformer energizing. One is regular gadget operations which consist of guide energizing of a transformer and any other is the reclosing actions. These undervoltages are unsymmetrical in nature.
5. Equipment Failure: Failure of electrical gadget happens because of insulation breakdown or heating or brief circuit etc.
6. Bad Weather: Lightning moves withinside the electricity line purpose a good sized range of undervoltages. A line to floor fault happens while lightning moves the road and keeps to floor.

7. Pollution: Flash over takes location while there may be typhoon withinside the coastal regions, in which the electricity line is included with salt. This salt formation acts as an excellent conductor of power and faults occur.
8. Construction Activity: Generally all electricity traces are undergrounded in city areas, digging for doing basis paintings of homes can purpose harm to underground cables and create undervoltages.

B. How undervoltage may be prevented

An underground voltage relay which gets rid of a motor from carrier while low-voltage situation develops, in order that the motor will now no longer draw immoderate modern, or which prevents a big induction or synchronous motor from beginning beneathneath low-voltage situation.

V. CIRCUIT DIAGRAM OF THE HARDWARE MODEL

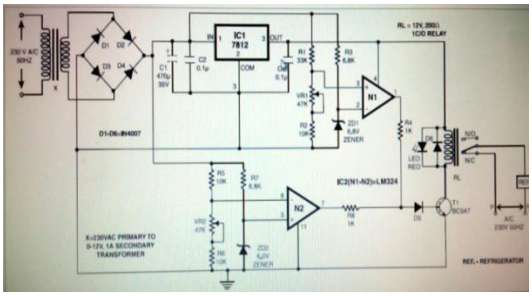

Fig 3: Circuit Diagram

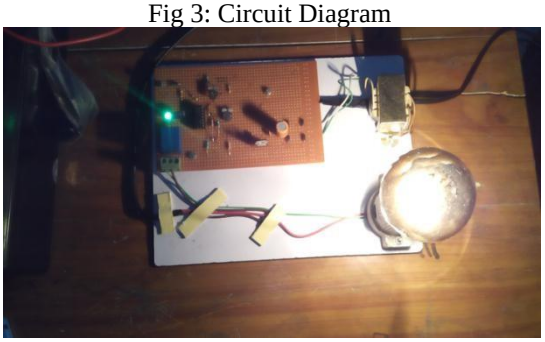

Fig 4: Hardware Model

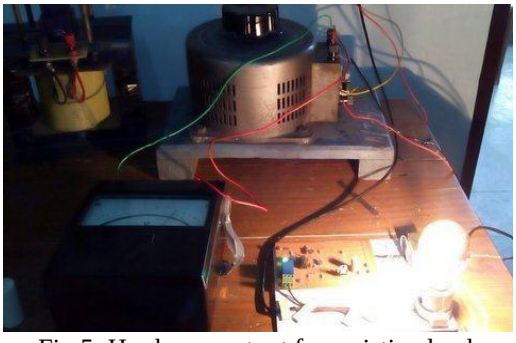

Fig 5: Hardware output for resistive load

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VI. HARDWARE DESIGNING AND OUTPUT RESULTS

This circuit protects refrigerators and other electronics appliances from over and under voltages. By the name itself we can say that if the input voltage is more or less than the required voltage then the electrical appliance gets turned off and it gets disconnected from its respective power supply. This voltage protection circuit is designed to develop a low voltage and high voltage tripping mechanism to protect a load from any damage. In many of the homes and industries fluctuation in AC mains supply take place frequently. The electronic devices get easily damaged due to the fluctuations. To overcome this problem, we can implement a tripping mechanism of under/over voltage protection circuit to protect the loads from undue damage.

Source	230 V, 50 Hz,
Single phase transformer	Ideal, K=23:1
Single phase diode bridge	Ideal
Capacitor	0.019 F
Resistive load	120 Ω
D.C. voltage source (Relay operation)	12 V
Relay with 1 NO and 1 NC changeover switches.	Coil voltage= 12 V, Operating voltage= 10 V

TABLE III The specification of the test system

A. RESISTIVE LOAD

he layout of hardware for resistive load is achieved through connecting a bulb of fifty Watt. The bulb glows withinside the restriction of 150V to 230V. If the voltage is going down under 150V than it's miles a case of undervoltage and if it exceeds 230V than it's miles a circumstance of over voltage. The limits of running voltage may be modified the usage of the 2 potentiometers related withinside the hardware. . So the relay lets in the deliver voltage to be fed to the load.OPERATING VOLTAGE: (150-230)

B. CAPACITIVE LOAD

The design of hardware for capacitive load is done by connecting a capacitor of 2.50µF±5%. The LED glows in the limit of 148V to 200V. If the voltage goes down below 148V than it is a case of undervoltage and if it exceeds 200V than it is a condition of over voltage. The limits of operating voltage can be changed using the two potentiometers connected in the hardware.

C. INDUCTIVE LOAD

The design of hardware for inductive load is done by connecting a choke coil. The LED glows in the limit of 148V to 230V. If the voltage goes down below 148V than it is a case of undervoltage and if it exceeds 230V than it is a condition of over voltage. The limits of operating voltage can be changed using the two potentiometers connected in the hardware.

VII. CONCLUSION

It has been discussed that Undervoltage and overvoltage problems are very common and can create problems for consumer goods and industrial applications. So a system has been modeled using relay and comparator and it is found to be good in disconnecting the supply when if sees any of the above problems.

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FUTURE SCOPE OF DEVELOPMENT

Apart from the simulation of the software of this project in PSIM we can further extend or upgrade the operation of this protection device in the following ways: Although we are applying 1 phase power supply in the prepared hardware, the implementation of the hardware can also be done applying 3 phase power supply. The concept in future can be extended by integrating an alarm which sounds when voltage fluctuations occur. It can also be interfaced with a GSM modem to convey alert message to the user via sms to take appropriate actions.

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