Automatic Single Phase and Three Phase Load Balancing Based on Transformer

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Abstract— This paper will introduce an Automatic load balancing system based on transformer. The system converts single phase AC voltage into three phase AC voltage and designed to be used at incoming of three phase line. The result illustrate that it is able to boosts the least phase voltage and distribute single phase and three phase load and in addition it retains voltage regulation and stability in all three phase.

Keywords: Load Balancing, Transformer, Voltage Stability, Power Supply

I. INTRODUCTION

A wide variety of commercial and industrial electrical equipment require three phase power. Three phase power is a common form of electrical power supply for larger electrical installations. Three phases distribution systems suffer from power fluctuations and non-zeros neutral currents due to unbalanced loads. The unbalanced loading in distribution systems mostly occur due to the following reasons.

1) Single phasing of three phase power supply.
2) Unequal sharing of single phase load on three phase loads.

Many of small industries of rural areas are supplied by three phase, but the small scale industries don't get the supply by 24 hours most of the time. They are supplied by single phase for 12 hours and by three phase for 12 hours.

When electricity board provides single phase supply in place of three phase supply fed to small scale industries the load there becomes unbalanced at this condition and works improperly. Here we consider R phase is strong, Y phase is weak and B phase is null. At single phasing condition voltage in R- phase is 230 V, voltage in Y-phase is 110-140 V and B becomes null (0 Volt).This results in slow operation of the machines.

Hence to overcome the above problems, the Y-phase is boosted from 110 V to 230 V using step-up transformer and continuous power supply for 24 hours is given to the industry.

II. LITERATURE REVIEW

In [1] Automatic Three Phase Load Balancing System by Using Fast Switching Relay in Three Phase Distribution System. In this scheme single phase load is balanced only for domestic purpose.

In [2] an intelligent consumer's load transfer scheme is proposed that dynamically reduces voltage unbalance (VU). In this scheme to minimize VU in the distribution feeders, consumers loads are transferred from one phase to another without disconnection of phases.

In [3] Scott transformers are used in a low voltage radial feeder to balance the distribution system. In this scheme, unbalanced 3 phase power supply is converted to unbalanced 2 phase supply and then converted back to a balanced 3 phase power supply using Scott transformers.

A new 3phase electric spring (ES) circuit can also be used to decreases power unbalance in a 3-phase system as proposed by [4].

In [5] a new phasing identification system is proposed that measures voltage phase of underground distribution transformers at the secondary side to determine the phase load and indicate unbalancing. However, no proposal is given to reduce the unbalancing.

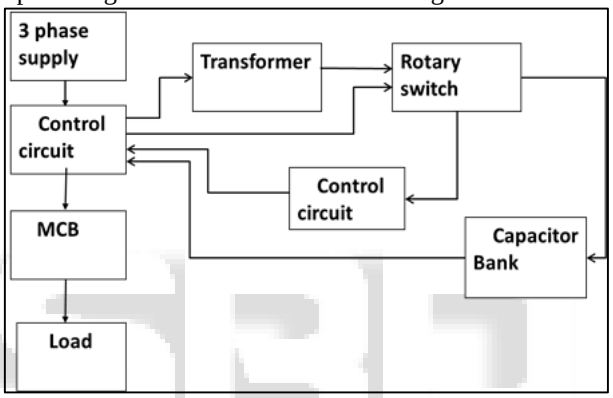

Fig. 1: Block Diagram

III. SYSTEM DESCRIPTION

The designed system is used when single phasing problem occurs in rural areas. R phase we get strong, Y phase we get weak and B phase we get null in this problem. We get three phase supply by using such components like transformer, capacitors, relays, contactors, circuit breakers, ON/OFF rotary switch, two position rotary switch

Transformer is used for boosting purpose. We get 230 volt from 110/140 volt by using this step up transformer. Capacitors used for phase displacement purpose. And is used for power factor improvement. Capacitors are placed in between transformer output and B phase.

Relays are used for sensing the voltage in strong phase and weak phase. When the weak phase is sensed it is feed to transformer for boosting purpose. It also sense the fault and send command to circuit breakers to trip the circuit. Contactors are used for make and break the supply lines running to a load or to repeatedly establish and interrupt an electrical power circuit. ON/OFF rotary switch is used for supply is given to the system. Two position rotary switch has two position first is single phase load balancing and second is three phase load balancing.

Current transformers measures the value of current in the phase and displays it on the digital meter. MCB are used for safety and protection purposes of the equipments.

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IV. SYSTEM WORKING

The system operates during the single phasing conditions. When single phasing condition occurs the system gets in working condition. The supply here is then given to the incoming MCB and to the control circuit. The phase R is given directly to load as we assume it of 230 V. Control circuit detect the voltages in two phases and supply it further. The control circuit consists of two contactors and two relays for the phases B and Y respectively. When the phase voltage in Y phase is detected below 140 V the Y phase relay gets operated and supply is given to the contactor, where the NO terminals are changed to NC and is given to the transformer for boosting purpose. The Transformer step up the voltage from 140 V to 230 V and it is supplied to the load through the MCB. When the phase voltage in B phase is detected to zero volt, the relay of B phase gets operated and supply is given to contactor where the NO terminals changes to NC. Here some load on B phase is distributed on R phase. Using this system the balanced voltage on the three phases are obtained at the output. And hence single phase load balancing takes place. Similar operation is performed for the three phase load balancing system. Capacitors are used for phase angle displacement and power factor improvement.

V. CONCLUSION

Industrial load is connected to three phase distribution network. The three phase distribution system suffers from unbalancing due to single phasing conditions. To overcome this problem, distribution system requires equal sharing of load on each phase. When equal sharing is obtained, due to which 3-phase unbalancing, energy losses, discontinuity of power supply is reduced. The automatic three phase load balancing system is possible by the proposed hardware which is transformer based hardware. In addition, it retains voltage regulation and stability in the all three phase.

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