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Protection of PFI Plant Installation by using MCCB and MCB

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ABSTRACT: *This paper presents the protection of PFI Plant Installation by using the circuit breaker element MCCB and MCB. Here MCCB and MCB are use as the alternator of HRC fuse. When the flows of current are crossing the rating limits on that moment MCCB and MCB will trip and disconnect as well as protect the circuit. If we use MCCB and MCB for PFI Plant Installation, it will be more applicable in our future life.*

Keywords: *Introduction, Methodology, Block Diagram, Working Principle*

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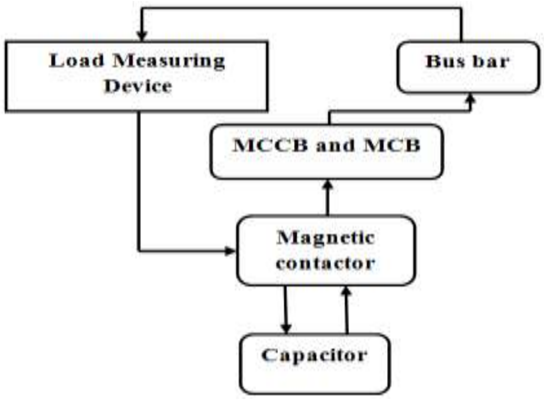
I. INTRODUCTION

In electrical engineering, the power factor of an AC electrical power system is defined as the ratio of the real power flowing to the load to the apparent power in the circuit [1]. Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the current and voltage of the circuit. Due to energy stored in the load and returned to the source or due to a non-linear load that distorts the wave shape of the current drawn from the source, the apparent power will be greater than the real power [12]. We know that most of the industries and power system loads are inductive that take lagging current which decrease the system power factor [2]. In an electric power system, a load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. The higher currents increase the energy lost in the distribution system and require larger wires and other equipment [11]. Because of the costs of larger equipment and wasted energy, electrical utilities will usually charge a higher cost to industrial or commercial customers where there is a low power factor [13]. For this reason we need improve the power factor.

If we use MCCB and MCB in PFI plant installation, no needs to repair MCCB and MCB after tripping. It removes the repair cost and anyone can operate it. MCCB and MCB automatically switch off the electrical circuit during abnormal condition of the network means in over load condition as well as faulty condition [14].

II. METHODOLOGY

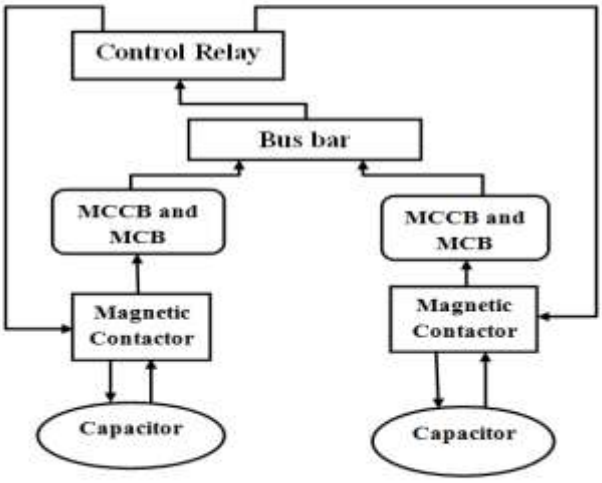


PFI use increase low inductive load. For this we need:

- Necessary capacitive load is increase according to the inductive load [3].
- MCCB and MCB are protecting the circuit from over current flow.
- Needs a load measuring device when the inductive load will decrease, it will select proper capacitive load for remove it.
- Necessary to use various rated of capacitor bank for proper power factor improvement [8].

III. BLOCK DIAGRAM

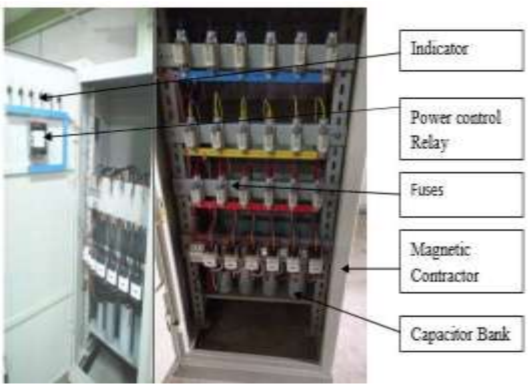
The block diagram of PFI plant installation is shown in below:



Generally, PFI plant installation has based on three basic methods. Here, installed Power factor improvement (PFI) plant installation based on Static Capacitor. It's known to us that if we connected the capacitor in parallel with rest of devices in PFI plant installation, then it works for the improvement of power factor. This static capacitor provides leading current which neutralize the lagging inductive component of load current, thus the power factor of the load circuit is improved by using static capacitor [4]. Some advantages of static capacitor method such as, little maintenance is required as there is no rotating equipment, less cost because of static capacitors, easy connecting arrangement with less weight, low losses in this arrangement [15].

IV. WORKING PRINCIPLE

Most of the power system loads of industries are inductive, its causes of lagging current which decrease the power factor [9]. When current is lagging, on that moment the power control relay sense the inductive loads and also select how many capacitive loads which needs to improve it. Then power control relay is supplying current to activate the magnetic contactor. It is connected with the different type of capacitor bank. Magnetic Contactor and capacitor bank have a specific rate. Capacitive load provides leading current to improve the power factor. MCCB and MCB disconnects by tripping when over current flow through the device.



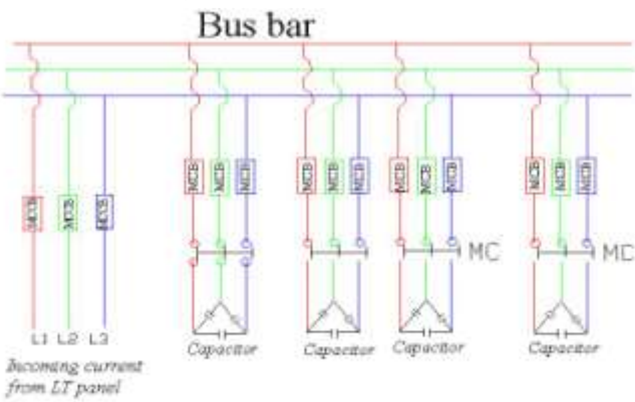


Figure: Power Factor Improvement Plant

Figure: PFI schematic diagram with MCCB and MCB

If we use a fuse in PFI plant installation for protection, here the main problem is when it disconnects the circuit by melting and then it's needed to repair those fuse which is costly and takes time [10]. But in case of MCCB and MCB, if it disconnects by tripping just no needs to repairing, only needs to turn on it by manually and also save the time and cost.

V. PFI RATING SELECTION

We select the PFI rating 60% of transformer power. It's a constant rating [5].

VI. CALCULATION OF THE REQUIRED CAPACITOR BANK VALUE IN BOTH KVAR AND FARADS

Example:
A Single phase 200V, 50Hz, motor takes a supply current of 60A at a P.F (Power factor) of 0.6. The motor power factor has to be improved to 0.9 by connecting a capacitor in parallel with it. Calculate the required capacity of Capacitor in both kVAR and Farads [6].

Solution:
Motor Input = P = V * I * Cos θ
= 200V * 60A * 0.6
= 7.2kW

From Table, Multiplier to improve PF from 0.60 to 0.90 is 0.849
Required Capacitor kVAR to improve P.F from 0.60 to 0.90
Required Capacitor kVAR = kW * Table Multiplier of 0.60 and 0.90
= 7.2kW * 0.849
= 6.1128 kVAR

To find the required capacity of capacitance in Farads to improve power factor:

We have already calculated the required capacity of capacitor in kVAR, so, we can easily convert it into Farads by using this simple formula,
Required capacity of capacitor in Farads/Microfarads
$C = kVAR / (2 \pi f V^2)$ in microfarad

Putting the values in the above formula
$= (6.1128 \text{ kVAR}) / (2 * \pi * 50 * 200^2)$
$= 4.8644 * 10^{-7}$
$= 0.49 * 10^{-6}$
$= 0.49\mu F$

VII. ALGORITHM

Step 1: Control relay takes the power supply from Bus bar.
Step 2: It measures the inductive current as well as selects the capacitive load and also supplies the electric power for turn on the Magnetic Contactor.
Step 3: Magnetic Contactor connected with capacitor bank & then it provides the capacitive load and again send it to Magnetic contactor.
Step 4: Magnetic contactor send the capacitive load to MCCB and MCB.
Step 5: In at last the MCCB and MCB provides the capacitive load to Bus bar.

VIII. RESULT

In case of that system, if MCCB and MCB disconnects by tripping, just no needs to repair, only needs to turn on MCCB and MCB by manually and also save the time as well as it reduce the cost. So, the system is more effective than the previous one for the protection of PFI plant installation.

IX. CONCLUSION

This PFI plant installation system uses for improves of inductive load by increasing the desired load [7]. So, it is needed to select the proper rating of capacitor bank for appropriate capacitive load as well as for the protection of PFI plant installation, we need to select an appropriate rating for MCCB and MCB. To use this PFI plant installation, it is possible to reduce consumer cost as well as saves our time.

Acknowledgement

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