A Review on Motor Protection

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***Abstract*— The basics of motor protection principles are discussed in this study.Depending on the insulation, each motor is designed to run at a specified temperature. When this limit is reached, the product's life expectancy plummets. Supply system disruption, electrical imbalance circumstances, faults, load variation, and the climate can all contribute to overheating.To comprehend the notion of motor heating and how thermal protection for motors may be used to minimise motor life loss, it is critical to have adequate coordination between the creation of protection principles and the design of motors. This paper provides an overview of current motor protection technologies, with a focus on thermal motor protection.**

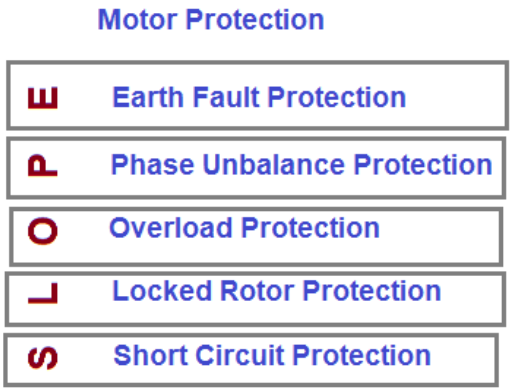
INTRODUCTION

There are two types of three-phase motors: induction and synchronous. The workhorse of most industrial systems are induction motors. Fans, blowers, conveyors, crushers, compressors, cranes, pumps, shredders, extruders, refiners, and chillers all require induction motors. Despite their toughness and ease of fabrication, motors have a high annual failure rate. The annual rate of motor failure is conservatively estimated at 3–5%, however in some industries, such as mining and pulp and paper, the percentage can be as high as 12%. Repair or replacement, removal and installation, and loss of production are all factors that contribute to the cost of motor failure. All failures can be classified into three categories. Electrical problems account for one-third of all failures, mechanical failures for another third, and other failures for the remaining one-third. Induction motors are commonly utilised in industry to satisfy a variety of needs. A motor failure or outage could result in a loss of production or compromise the plant's safety system. The motor protection strategy for HT and LT motors is nearly identical, with a few exceptions. Additional protection, such as Differential Protection, may be added.

The common motor protection provided for HT and LT motors are:

- Short Circuit Protection (50)
- Locked Rotor Protection or Blocked Rotor Protection (14)
- Over Load Protection (49)
- Phase Unbalance Protection (46)
- Earth Fault Protection (50N)

These protections can easily be remembered using word "SLOPE". The description of this "SLOPE" is shown below:



CTMM or Numerical Relays are used to implement the aforementioned five protection methods for HT motors (6.6 kV motors). Numerical relays are now preferred over CTMM relays because of the numerous benefits they provide. In LT motors, however, the aforementioned five precautions are applied in a different way. CTMM or Numerical Relays are employed in some circumstances if the LT motor's kW rating is higher (usually more than 75 kW). Setting for the five protections are put into the numerical relay and then tested to confirm that the settings are satisfying the protection intent.

Fuse and Motor protection relay (like L&T Make MN relay in conjunction withcontactor) are used for small LT motors (usually less than 75 kW). Fuse protects against short circuits.

Motor Protection

Motor Protection - A variety of protection systems are employed to keep electric motors safe. Motors are used in a variety of applications at varying levels. Induction motors are widely used in both household and industrial or commercial applications

1) Overload Protection:
2) Overcurrent Protection:
3) Low Voltage Protection:
4) Phase Failure Protection:
5) Phase Reversal Protection:
6) Ground Fault Protection:

- Overload Protection:Over-burden insurance is the sort of assurance which is against the mechanical over-burden conditions. The mechanical over-burden conditions can happen in an engine because of different reasons when an engine is in a running state. The over-burden circumstances can bring about the expanded temperature of the engine which can harm the engine. The assurance utilized for the over-burden conditions can disengage the engine in over-burden conditions from the principle power supply. Whenever the engine is over-burden because of any situation the windings of the engine arphote subjects to fire as the temperature of the engine is expanded in over-burden conditions and thus, the windings of the engine can be harmed. Additionally, assuming that the power source of the engine are covered and there is no point for the hotness outflow then the temperature of the engine increments as the engine continues to run this can likewise bring about harming the windings of the engine. The over-burden assurance units are trip if there should arise an occurrence of an over-burden condition and the stock of the engine is cut-off and the engine is shield from additional harm.
- Overcurrent Protection:Whenever an extreme measure of current went through the engine, the engine assurance unit trips. Circuit breakers and wires are use as insurance units for the various engines. Overcurrent insurance can shield work force from electric shock, the control hardware of the engine, the transmitters of the engine branch circuits and the actual engine from high flows.
- Low Voltage Protection: The security unit or the gadget is use to disengage the engine from the voltage source or the power source on the off chance that the voltage drops down beneath the appraised incentive for the engine. The engine works again at whatever point the voltage is equilibrium to the typical worth. Different insurance units have their own resetting focuses. Some insurance units physically reset. It consequently reset to ordinary following various calculations. Some assurance units reset to ordinary after some predefined time period. A few units can be reset to typical when the voltage balances out to its not unexpected worth.
- Phase Failure Protection: Stage disappointment security is use to insurance of engine in the event of any stage disappointment during the activity of the engine. It is regularly use in three-staged engines and upon disappointment, in any stage, the engine detaches from the power supply. An engine without stage disappointment insurance continues to run regardless of whether a stage fizzled in the circuit which can harm the engine or it can influence the activity of the engine. In the event that one stage bombed the other stage begins to convey more current to the circuit which can consume the engine or the circuit it is join with
- Phase Reversal Protection:It is an assurance method that is use to safeguard an engine from the stage inversion condition. Work inversion in an engine can happen because of various reasons which can cause security and functional issues. Assuming that two associations out of three associations of an engine are converse in some way the engine turns over pivoting the other way. Endless supply of the contrary turn of the engine, the security unit for stage inversion detaches the engine from the mains supply.
- Ground Fault Protection:Ground shortcoming assurance is use to safeguard the engine from various short out conditions. An extreme measure of current moves through the engine or the circuit in the event of the short out. Ground shortcoming assurance is use to detach the engine if there should arise an occurrence of any ground issue.

Small And Large Motor Protection Scheme

The electric engine is the most fundamental drive in the advanced period of industrialization. From fragmentary hp AC engine utilized for various home apparatuses to monster simultaneous engine and acceptance engine of up to 10,000 hp are utilized for various modern applications. It ought to be safeguarded against various electrical and mechanical flaws for filling its needs without a hitch. The engine qualities should be painstakingly thought to be in choosing the right engine security conspire. The abnormalities in motor or motor faults may appear due to mainly two reasons –

1. Conditions imposed by the external power supply network,
2. Internal faults, either in the motor or in the driven plant.

Small Motor Protection

For the most part, engines up to 30 hp are considered in the little classification. The little engine insurance, for this situation, is organized by HRC intertwine, bimetallic hand-off and under voltage transfer - all gathered into the engine contactor - starter itself. The most well-known reason for engine burnouts on LV circuit safeguarded framework is because of single staging. This single staging might stay undetected regardless of whether the engines are safeguarded by a customary bimetallic transfer. It can not be identified by a bunch of voltage transfers associated across the lines. Since, in any event, when one stage is dead, the engine keeps up with significant back EMF on its flawed stage terminal and henceforth the voltage across the voltage transfer is kept from dropping off. The troubles of distinguishing single staging can be overwhelmed by utilizing a bunch of three current worked transfers as displayed in the little engine assurance circuit given beneath.

Large Motor Protection

Large motors, especially induction motors, should be protected from:

1. Engine bearing failure
2. Engine overheating
3. Motor winding failure
4. Reverse rotation of the motor

This motor protection system needs to be configured to bridge high motor starting currents. This difficulty can be overcome by providing thermal overload relays. The starting current of the motor is high, but it is only present during starting, so there is no overheating effect at this current. However, the overheating effect occurs because the overcurrent due to mechanical blocking continues for a long time. Motor blocking protection can be provided by thermal overload relays. Stall protection can also be provided by another independent overcurrent timer. This timer only works after a certain predefined time if the overcurrent continues beyond that time. For plain bearings, a temperature sensor embedded in the bearing itself. This motor protection scheme is more reliable and more sensitive to motor bearing failures, as the motor's thermal endurance limit is significantly higher than the bearing's thermal endurance limit.

Common Motor Failures And Faults

It is critical to know and to comprehend engine disappointments and deficiencies to characterize the most appropriate insurance gadgets for each case. You likewise should be aware of significant terms connected with engine control and security. Being non-static machines engines are exposed to electrical and mechanical pressure. Engine disappointments come in three fundamental sorts: electrical, mechanical and mechanical that advances into electrical.

Common types of motor failure and faults are:

- Bearing failure
- Insulation breakdown
- Locked rotor
- Overheating
- Overloads (electrical and mechanical)
- Phase imbalance and any voltage imbalance will lead to an even higher currentunbalance.
- Running in reverse
- Shaft misalignment
- Vibration

- Overheating can happen from underestimating the engine, lacking cooling at low speed while utilizing variable speed drives (VSD), changes to the heap on the engine like stuck gear and hot encompassing circumstances.
- Protection breakdown, prompting consumed windings, suggest impede inside the engine or

inside the power supply circuit for the engine, and might be brought about by overheating, over-burdens and over voltages.

- Around 80% of electrical engine disappointments are a consequence of twisting harm in the engine stator and bearing issues.
- Bearing disappointment on engines can be a sign of the erroneous orientation for the application.
- An engine mounted upward requirements various heading then an engine evenly mounted. An engine driving a huge or multi-belt drive will require orientation that handle huge spiral burdens. An engine rushed to a misshaped base plate will bend.
- Orientation are generally little contrasted with other significant engine parts, making them especially powerless against harm and wear; a few investigations put the greater part of all engine disappointments on bearing breakdown, the vast majority of which result from nearly nothing or an excess of oil. One more critical reason for bearing disappointment is misalignment.
- Shaft misalignment will obliterate orientation a long time before their full working life. The engine shaft should be straightforwardly in-accordance with the shaft it driving must be accomplished utilizing accuracy arrangement strategies like laser.

Other Problems That May Occur With Motors Are:

- Water and dust ingress into the stator coils or the terminal housing leading to shortcircuits
- Soft foot motor feet bolted down out of level
- Wrong motor mounting or housing type
- Electrical or mechanical unbalance

Common Protection Of Large LV Motors And MV Motors Is Usually Done By The Following Protection Devices:

- Overload protection: 49
- Instantaneous phase overcurrent: 50
- Instantaneous earth overcurrent: 50N/50G
- Time delay phase overcurrent: 51
- Time delay earth overcurrent: 51N/51G

Very Large LV Motors And MV Motors Expensive, And It Is Usually Wise To Provide More Comprehensive Protection Schemes.

Such schemes include:

- Bearing temperature monitors and protection
- Differential protection
- Incomplete start sequence / long start time protection
- Negative phase sequence (phase reversal protection)
- Overheating protection
- Phase unbalance or phase failure protection
- Stall or locked rotor protection

Motor Protection Schemes Have Several Protection Functions To Consider:

- Motor horsepower rating and type
- Supply characteristics such as voltage, phases, method of grounding, and available short-circuit current
- Vibration, torque, and other mechanical limits
- Nature of the process
- Environment of motor, associated switching device
- Hot and cold permissible locked-rotor time and permissible accelerating time
- Time versus current curve when starting the motor
- Frequency of starting

The insurance transfers give principle security to simultaneous and nonconcurrent engines. They can be utilized for electrical switch and contactor-controlled engines in an assortment of drive applications, for example, engine drives for siphons, fans, blowers, plants and smashers.

Scope

- Motor protection and control for a variety of drives

Product Benefits

- Prevent damage to electrical motors
- Prevents disturbance to spread back into the grid

Product Features

- Application-specific standard configuration resulting in shorter relay setup and commissioning time
- Pre-configured solutions for utility distribution and industrial application

Advanced External MotorProtection Relays

More advanced external motor protection systems can also protect against overvoltage, phase imbalance, too many starts/stops, vibrations, PT100 temperature monitoring of stator and bearings, insulation resistance and monitor ambient temperature. Further, advanced external motor protection systems are able to handle the signal from built-in thermal protection.

CONCLUSION

Engine insurance circuit breakers play a vital part in electrical security, since the engines they safeguard have a wide assortment of uses in business structures and industry.

Offbeat engines, the most widely recognized sort of electric engine in modern and business settings, has exceptional security prerequisites that must be met by an engine assurance electrical switch. It is additionally conceivable to supplement MPCB with other insurance or robotization gadgets, for example, under-voltage security, clocks, and decreased voltage engine starters.

Satisfactory determination of the MPCB is key to give solid engine insurance. A small MPCB won't permit the engine to turn over, while a larger than usual MPCB may not be able to recognize over-flow conditions for the electric engine being safeguarded.

REFERENCE

[1] https://new.abb.com/medium-voltage/digital-substations/protection-relays/motor-protection-and-control#:~:text=Motor%20protection%20is%20used%20to,abnormal%20conditions%20must%20be%20prevented.
[2] https://www.electgo.com/motor-protection/
[3] https://electricalbaba.com/motor-protection/