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Protection panel for three phase induction motor using numerical relay

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Abstract: The objective of the project is to design protection panel for three phase induction motor using numerical relay .Our project is based on the protection of three phase induction motor. A modern numerical motor-protection relay is designed to offer a wider range of function and more user-related possibilities for motor protection, supervision and control. The numerical relay can perform a full range of motor- protection function based on load current such as thermal overload, short-circuit, excessive start time, locked rotor, unbalanced, earth fault, loss of load. This protection panel includes a combined protection approach for three phase induction motor such as over current, short circuit, phase unbalancing ,earth fault and also single phasing fault.

Keywords: Numerical relay, three phase induction motor, overloading, phase unbalancing.

I. INTRODUCTION

.Now a day's above 90% motors used in industries are three phase induction motors .The failure of three phase induction motor protection system will results into loss of production, replacement of motor, cost of repair, cost of man hours. So it is important to protect the three phase induction motor. Various faults occur in three phase induction motors are thermal overloading ,single phasing ,ground faults ,over & under voltage, loss of load, voltage & current unbalanced. [3] There is one main disadvantage of conventional bimetallic thermal over load relay, as the rate of heating and cooling of bi-metal is affected by ambient temperature, the performance of the relay may differ for different ambient temperature. This problem can be overcome by using numerical relay. Numerical Relay includes programmable scheme logics, measurements, analogue output, trip statistics, switchgear monitoring, event records, fault records, oscillography. In this project we have designed a protection panel for three phase induction motor using numerical relay and tested the performance of panel. [3]

II. BLOCK DIAGRAM OF PROTECTION PANEL FOR 3 PHASE INDUCTION MOTOR USING NUMERICAL RELAY

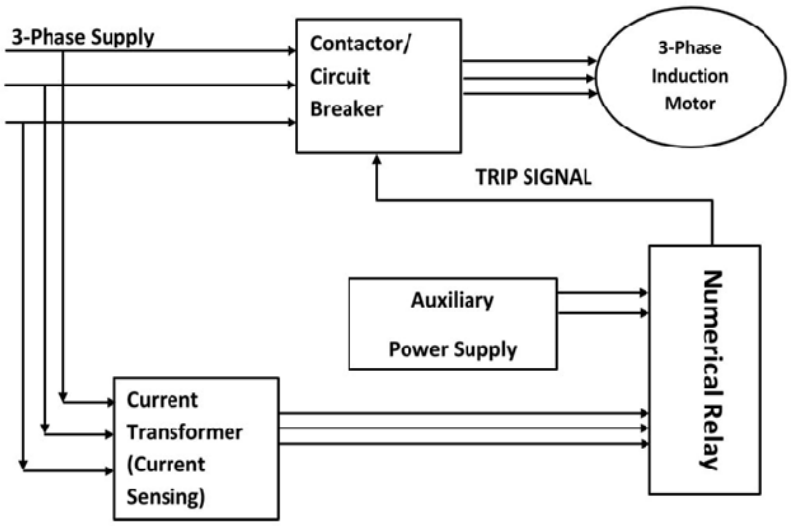

Fig. 1 Block diagram of protection panel

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Using current transformer , current of motor will step down and given to the numerical relay. Numerical relay will compare the actual current with set value. Trip signal will be sent from Numerical relay. So the coil of contactor will de energized and power to the three phase induction motor will be disconnected from supply.[1]

III. CIRCUIT DIAGRAM AND WORKING

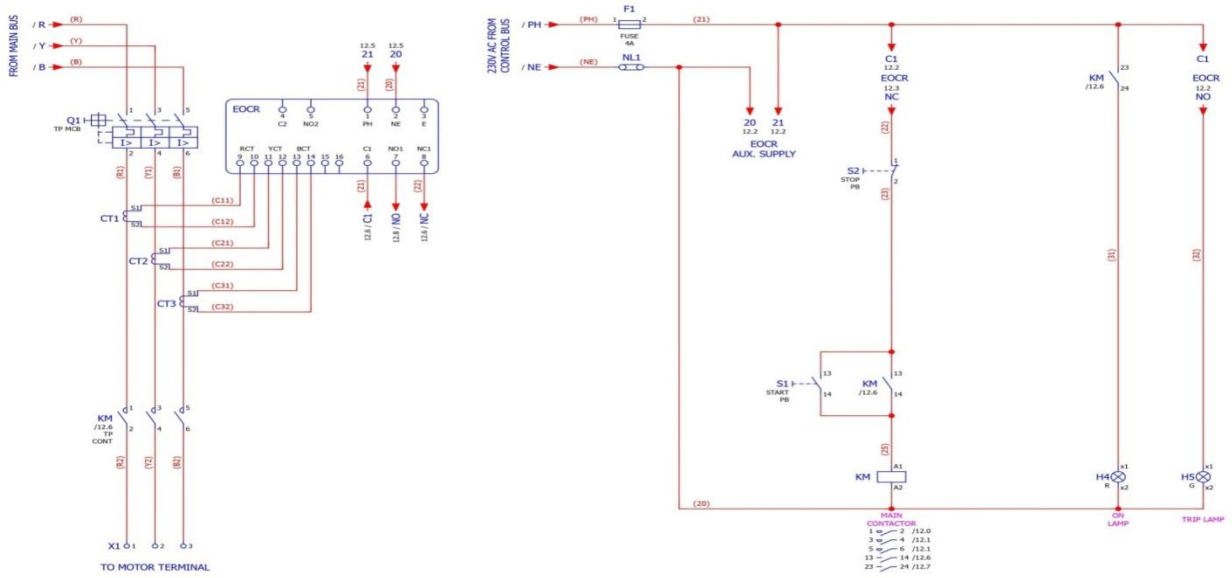

Fig. 2 Working of Protection panel for three phase induction motor using numerical relay

Three phase power supply is given to the induction motor with the help of MCB and main contactor. When any fault occurs in the motor then the fault is sensed by the relay. Numerical relay sends a tripping signal to the contactor so the coil of contactor will de energized and power to the three phase induction motor will be disconnected from supply.

IV HARDWARE COMPONENTS

A. NUMERICAL RELAY

Fig. 3 mPRO-200-V2 numerical relay[2]

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mPRO-200-V2 protective relay is an advanced numeric relay that provides multi protection and monitoring in compact enclosure. The relay offers reliable protection for LV and MV motors which are either operated via power contactors or power circuit breakers. [2]

B. **CONTACTOR**

Fig. 4 contactor[5]

Contactor is electrically controlled switching device. The contactor is used to give continuous supply to the motor through its hold on contact. The contactor coil is energized whenever the ON push buttons is closed under normal working condition. Coil of contactor will de energized as the trip signal is sent by numerical relay.

V TESTING ON THREE PHASE LAMP LOAD BANK

Protection panel using Numerical relay was initially tested on lamp load bank for various faults conditions with the help of three phase autotransformer [1] . The performance of protection panel using Numerical relay was tested for following tests:

1) Over current
2) Under current
3) Phase unbalancing
4) Single phasing

- **Overload (IDMT Characteristic)**

Measured Load current	Relay operating time	% IFL
5.25 A	260 Sec	105 %
6.50 A	130 Sec	130%
7.50 A	70 Sec	150%
10 A	30 Sec	200%
12.50 A	27 Sec	250%
15 A	19 Sec	300%
17.4 A	14 Sec	348%
24.50 A	8 Sec	490%

Common setting in relay	Protection setting in relay
Max rated current range selection= 60A	I>=5A
IFL=5A	Tinv>=5
T_{START}=8Sec	

Table 1 Overload (IDMT Characteristic)

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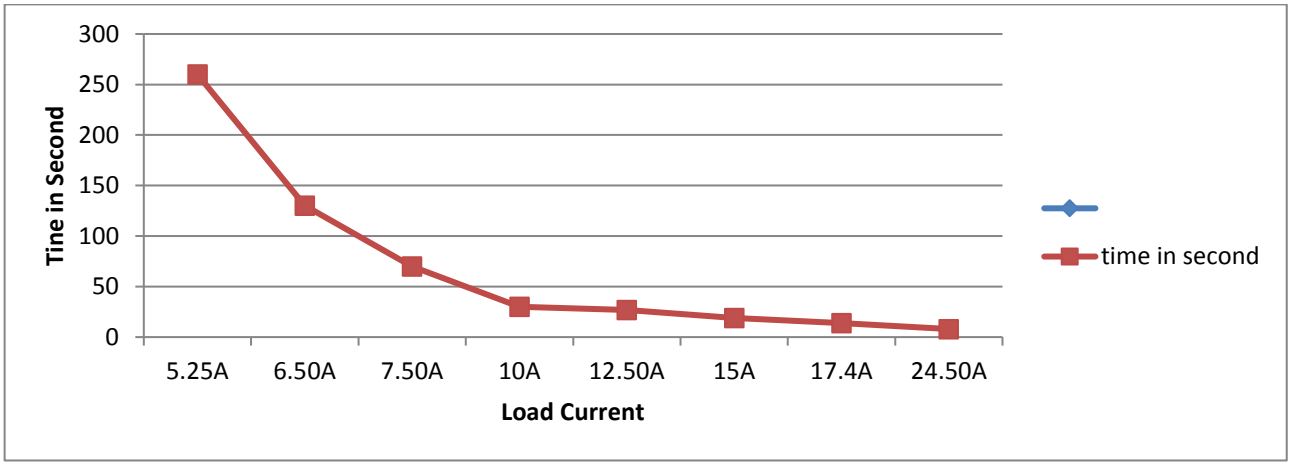

Fig. 5 Overload (IDMT Characteristic)

Fig. 6 Overload tripping status (IDMT Characteristic)

- **Overload (DMT Characteristic)**

Measured Load current	Relay operating time	% IFL
5.2 A	20 Sec	104%
6 A	20 Sec	120%
7 A	20 Sec	140%
8 A	20Sec	160%

Common setting in relay	Protection setting in relay
DMT	I>= 5A
Max rated current range selection =60A	Tstart = 1Sec
IFL=5A	DMT=20Sec

Table 2 Overload (DMT Characteristic)

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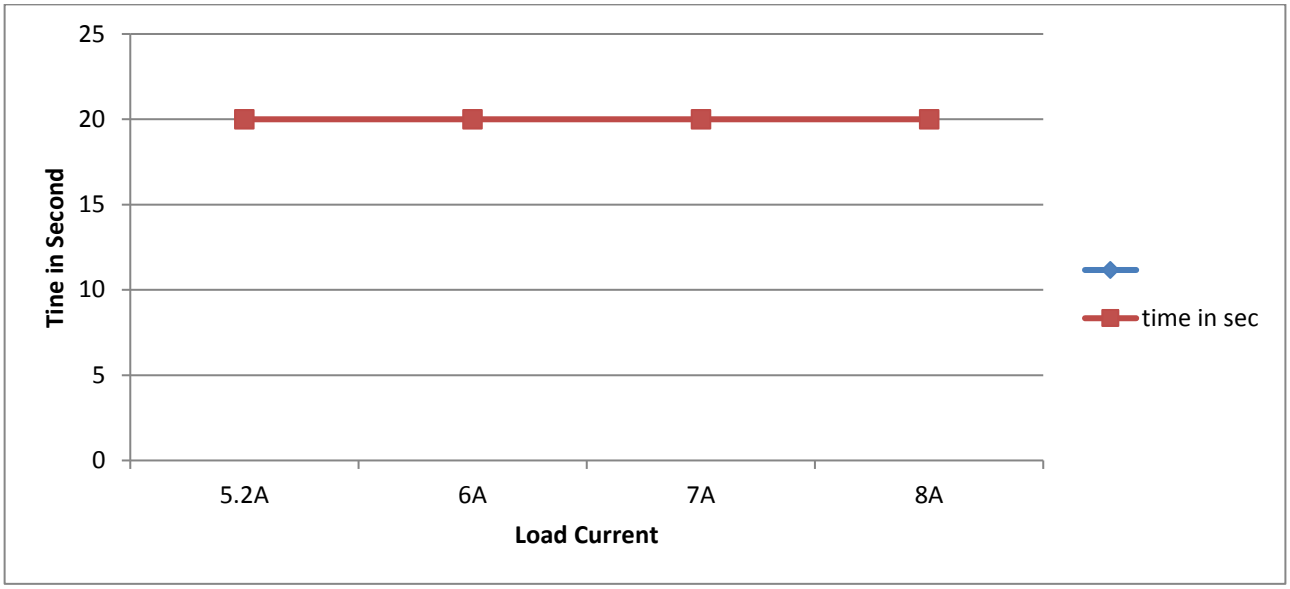

Fig. 7 Overload (DMT Characteristic)

- **Undercurrent (DMT Characteristic)**

Load Current	Time of Operation	% IFL
2 A	10 Sec	40%
1 A	10Sec	20%

Max rated current range selection=60A	I<=2.5 A
IFL=5A	T=10 Sec

Table 3 Undercurrent (DMT Characteristic)

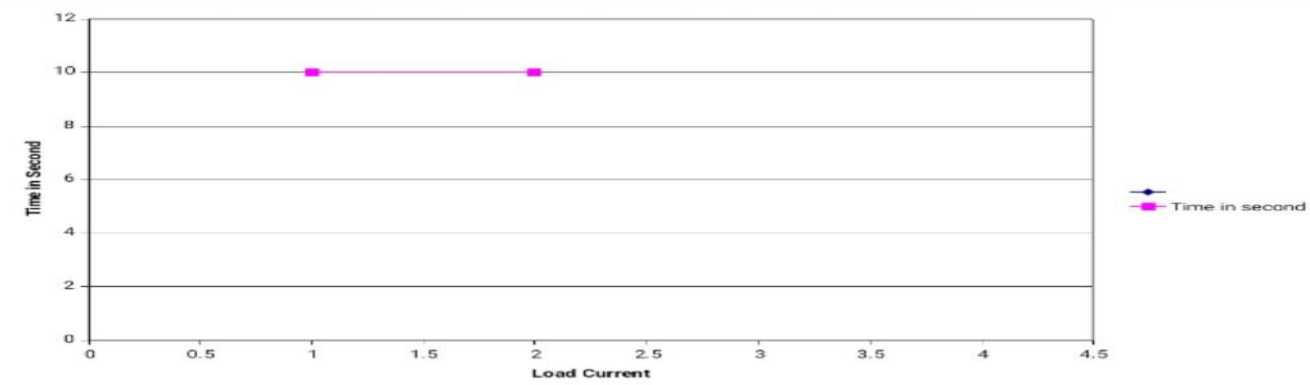

Fig.8 Undercurrent (DMT Characteristic) [5]

- **Phase Unbalancing:-**

% Unbalancing	Setting in relay IUB	Tripping status
37 %	25 %	Tripped status Phase Unbalancing and tripping time is 20 sec.

Max rated current range selection =60A	I>=5A Tins>=5 sec
IFL=5A	t>=20 sec
IUB=25 %	TIUB= 20 sec

Table 4 Phase Unbalancing (DMT Characteristic) [3]

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Fig.9 Unbalance tripping status

VI TESTING OF PROTECTION PANEL USING NUMERICAL RELAY ON THREE PHASE INDUCTION MOTOR

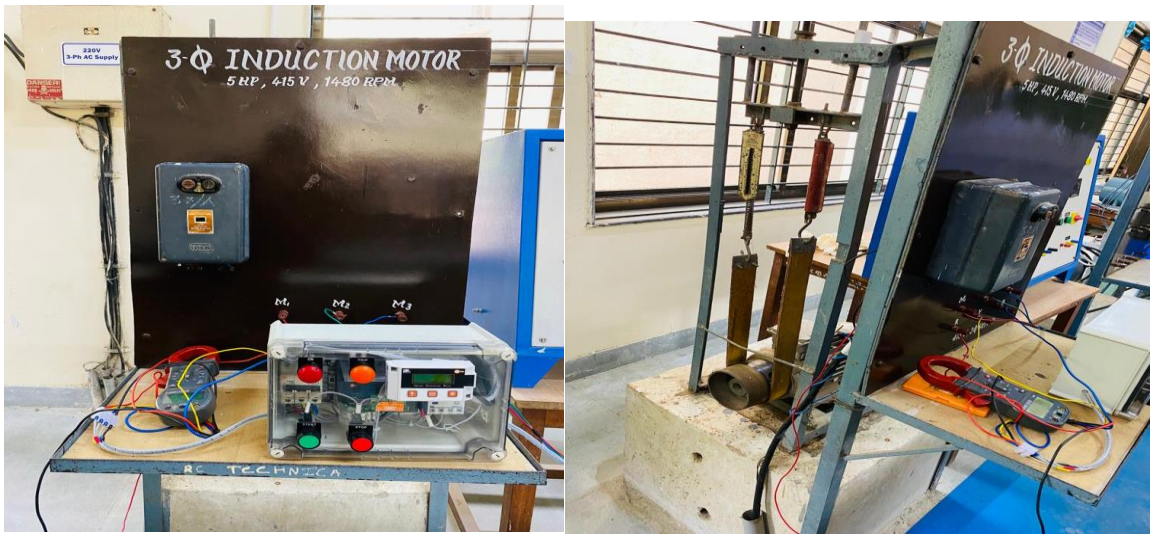

Fig.10 Testing of protection panel using Numerical relay on three phase induction motor

We tested Protection panel using Numerical relay on three phase induction motor (5 hp,415v,50Hz) for various faults conditions with the help of water cooled pulley belt arrangement mounted on the shaft of motor. The performance of relay was tested for following tests **:-**

1) Over current
2) Under current
3) Phase reversal
4) Single phasing
5) Block rotor test

Loading on induction motor varied by adjusting tension of belt.

- **Overload (DMT Characteristic)**

Load Current	Motor Tripping time in sec
1A	No tripping
2A	No tripping
3A	20sec
4A	20sec

Max rated current range selection =60A`	I>=2.5 A
IFL=5A	DMT=20Sec
Characteristic=DMT	

Table 5 Overload (DMT Characteristic)

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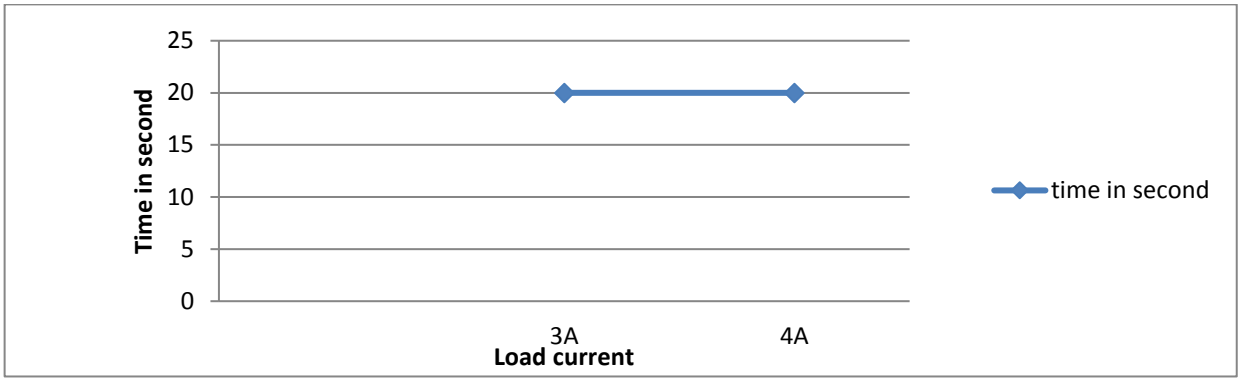

Fig.11 Testing on three phase induction motor

- **Phase Reversal**

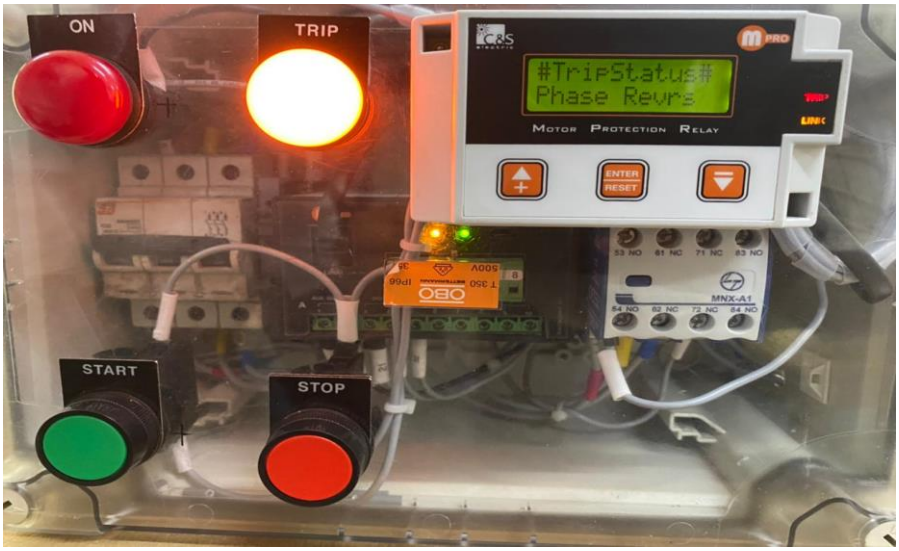

Fig. 12 Phase reversal tripping on three phase induction motor

Characteristic =DMT	I>=7.5A
Max rated current range selection =60A	t>=40sec
IFL=5A	Tinv>=5sec
	t>>=0.08sec
	TphRev=10sec

Table 6 Phase reversal tripping parameters

Due to phase reversal, relay tripped with status: Phase reversal at 10sec.

VII CONCLUSION

After worked on this project we can easily conclude that with help of numerical relay we get different features like self-checking of fault, self-monitoring, easily programmability, low burden and multiple functions. Numerical relay is different as compared to other relays because of by using numerical relay we have protected three phase induction motor for various the faults occurs in the motor.

ACKNOWLEDGEMENT

We are pleased to present "Protection panel for three phase induction using numerical relay". As our project and take this opportunity to express our profound to all those people who helped us in completion of this project. We would like to thank **Prof. Tushar A.** Patel for providing guidance and support, patience and faith.

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