INTER PLANT – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR MOTOR PROTECTION OF ac MOTORS THROUGH MICRO PROCESSOR BASED RELAY** CORRESPONDING IS DOES NOT EXIST	**IPSS: 1-04-052-11**

0 FOREWORD

0.1 This interplant Standard has been prepared by Standard Committee on Switchgear & Controlgear, IPSS1:4 with the active participation of representatives of steel plants, reputed consultancy organizations & established manufacturers of electrical relays and was adopted in February 2012.

0.2 Interplant Standards for steel industry aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories and provide guidance in indenting stores (or while placing orders for additional requirements) by individual steel plants for exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among those mentioned in this standard, for the purpose of company standards deviation in technical requirement.

0.3 In the preparation of this standard, assistance has been derived from the following :

a) IS 12083 (Part 1): 1986 Specification for Electrical Relays - Part 1 : Contact Performance

b) IS 3231 (Part 2) : Sec 3 : 1987 Electrical relays for power system protection: Part 2 Requirements for principal families, Section 3 General requirements for thermal relays

c) IS 13947 (Part 4) : Sec 1 : 1993 /IEC Pub 947-4-1 : 1990 Specification for Low-Voltage Switchgear and Control gear - Part 4 : Contractors and Motor-Starters - Section 1 : Electromechanical Contactors and Motor Starters

d) IS 2705 (Part 3) : 1992 Current transformers: Part 3 Protective current transformers

1. SCOPE

1.1 This Inter Plant standard covers the performance requirements of Microprocessor based Relays used for protection of ac motors for all abnormal conditions.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definition given in IS 1885 (Part 9): 1992/IEC 50-446: 1983 Electrotechnical Vocabulary: Part 9 Electrical relays, IS 1885 (Part 10) 2008 /IEC 60050-448: 1995 Electrotechnical Vocabulary - Part 10: Power System Protection, IS 5834: Part III: 1981 Specification for electrical timer relays industrial purposes - Part III: Electronic

3. APPLICATION

3.1 These relays are in general used to protect continuous duty ac motor against thermal overload, Prolong start, Motor Stalling, Short circuit, Earth fault, Negative phase Sequence, Loss of load and Number of start Limit in specific duration, based on motor size (refer Point 5).

4. SERVICE CONDITION

4.1 Temperature:

a) *Operative range:* -10 deg to +55 deg
b) *Storage and Transport*: -25 deg to +70 deg

4.2 Humidity: Mean value per year < 75% relative humidity, on 56 days of the year 93 % relative humidity

4.3 Enclosure: Protection: at least IP 50

4.4 Ambient Air: The ambient air may contain fair amount of conductive dust.

5. SELECTION

5.1 Relay shall have minimum protection features for different capacity of the 3 phase induction motor, to be selected as per **Table -1**.

TABLE - 1

Motor capacity / Protection	Between 5kw to 15 kW	Between 15kw to 30 kW	Between 30kw to 110 kW	Above 110 kW
Thermal Protection	✓	✓	✓	✓
Earth Fault protection		✓	✓	✓
Unbalance /Negative sequence Protection			✓	✓
Lock rotor protection			✓	✓
Prolong start				✓
Short circuit protection				✓
No. of start limit				✓
Under Voltage protection				✓
Loss of Load				✓
RTD influenced protection				✓

(✓) mark: Required protection feature

6. CONSTRUCTION

6.1. The Relay shall be of block type construction and designed so as to prevent accumulation of dust which may cause short circuit between power terminals or ground.

6.2. Breaker mounted Relay shall be used only for 30 kW and below motors.

6.3. It shall be possible to reset the relay from outside without opening the panel or relay cover.

6.4. Relay shall have minimum two potential free contacts, one for tripping the breaker and another for annunciation purpose. Relays having number of start limit function shall have one NC contact also which shall be added in closing circuit to prevent closing if number of start of a motor crosses the specified limit.

6.5. Relay shall have indication to show the healthiness of the same.

6.6. Relay construction shall be of such type that testing of the same can be possible at site without affecting the other feeders.

7. OPERATIONAL REQUIREMENT & ACCURACY

7.1. The relays shall be suitable to protect motors as per protection features selected based on motor size.(refer Table No.1)

7.2. For motor of capacity 110 kW and above, Earth fault protection shall be provided preferably through Core Balance Current Transformer but in absence of CBCT it can also be provided through residual connection. However, stabilizing Resistance of suitable value shall be provided in case of residual earth fault connection. Recommended value of stabilizing resistance is 300 ohms in case of 1A CT and 30 ohms in case of 5A CT.

7.3. Typical setting criteria for Motor protection is given in **Appendix 1 & 2.**

7.4. Number of start limit protection contact shall be provided in closing circuit either through Relay or PLC to block the closing.

7.5. For motor of capacity 110 kW and above, starting of motor shall be detected either through breaker contact or through current input or through both.

7.6. Under Voltage protection for motors shall be provided through separate under voltage Relay with time delay if the feature is not available in the motor protection Relay. Under voltage protection shall not trip motor for PT fuse failure condition.

7.7. Protection relays for motors of 30 kW and more capacity shall have current history recording or disturbance recording or both features at the time of tripping.

7.8. Accuracy:

Protection Threshold	:	± 5%
Time delays	:	± 2 % with a minimum of 10 ms

8. RATINGS

8.1. Current input to relays (using CT Input) for motor protection shall be of 1A or 5A or both as per CT ratio specification in motor feeder.

8.2. CTs used for relays shall provide the complete trip characteristics up to 10 times the setting range without saturation of CT. Recommended minimum CT is of 5P20, 5VA class.

8.3. Auxiliary supply for all type of relays shall be as specified by the user. Typical range of auxiliary supply is mentioned below :

a) 24V-60V dc
b) 48V-150V dc
c) 130V-250V dc
d) 100V-250V ac

9. RELAY PROTECTION

9.1 Auxiliary power of the relay shall be given in the relay through proper fuse.

10. CONTACT

10.1. Minimum two potential free contacts shall be provided for tripping and annunciation purpose.

10.2. One NC contact shall be provided in the relay which is used in the closing circuit of the motor for providing No of start limit protection.

11. TERMINATION

11.1. The contact of the relay shall be suitable for connecting cable of 2.5 mm^2 and 4 mm^2 stranded conductors in case of CT wires.

11.2. The contact of the relay shall be suitable for connecting cable of 1.5 mm^2 and 2.5 mm^2 stranded conductors in case of control wires

12. TEST

12.1 General inspections:

a. Examine the relay to see if there has been any possible deterioration after installation.

b. Verification of the model number of relay.

c. Verification of external wiring corresponds to the appropriate relay diagram or the assembly diagram.

d. When the relay is withdrawn from its case, use a continuity tester to check if the current short-circuits (phases and earth CTs) between the terminals indicated on the wiring diagram are closed.

e. Check the value of the auxiliary supply voltage. The value measured shall be between 0.8 and 1.1 times the auxiliary supply nominal voltage indicated on relay.

12.2 Accuracy and calibration test:

a. Validation of measurements

b. Validation of the protection features with specified time delays

c. Validation of the Relays binary input and outputs.

12.3 Relay Earthing: Check if the earth connection of the case is used to connect the relay to a local earth bar. With several relays present, make sure that the copper earth bar is properly installed for solidly connecting the earthing terminals of each case.

13. MARKING

13.1 Each relay shall be provided with a name plate marked within the following information in durable manner and located such that it is clearly visible in mounted position:

a. Manufacturer name, and type
b. Year of manufacture
c. Reference of IS
d. Setting Indication or value
e. Terminal marking

f. Serial number / year of manufacture

All other technical details of the relay shall be given in a separate manual which shall include the following details

a. Overall dimension and mounting details
b. Pickup value and drop off value of current
c. Wiring diagram
d. Thermal curve showing operating current versus operating time characteristics at rated ambient temperature
e. Procedure for maintenance

APPENDIX – 1

Typical Setting of Composite Motor Protection through Numerical Relay

Sl. No	Protection	Brief description	Typical setting	Remark
1.	Thermal (Overload) Protection	It is provided to protect the motor from excessive heating	Current (*ITH*)=Full load Heating Constant(T_h)=as per motor thermal curve Cooling Constant(T_r)=As per motor thermal curve	Cooling constant (T_r) is provided as a multiple of heating constant. Typical setting is $T_r = 3 \times T_h$
2	Prolong Start Protection	It is provided when Start Time<Safe Stall time	a)Current setting(I) = 2*full load current b)Time setting(T) should be greater than starting time less then cold stall curve	
		It is provided when Start Time>Safe Stall time	It is provided through additional speed sensing device	
3	Stall Protection	It is provided for protection against stalling of motor after successful start	a) Current setting(I) = 2*full load current b)Time setting(T) should be greater than starting time less then Hot stall curve	
4	Short Circuit Protection	It is provided to cater major stator fault or terminal fault	Current Setting(I)=120% of starting current Time Delay(T)=100ms	It is provided for the motor which is fed through circuit breaker

5.	Earth Fault Protection	It is provided when low resistance earthing is provided in the system	a)In case of residual connection :10 % of the CT rated primary current, 100 ms time delay b)In case of CBCT typical setting is 30 % of minimum E/F current of the system, 100 ms time delay	
6	Earth Fault Protection	It is provided when high resistance earthing is provided in the system	Sensitive earth fault with typical setting of 125% of single phase capacitive charging current	
7	Negative phase sequence protection	It is provided to protect motor in case of un balance	a)Alarm is provided at 20% of FLC with a time delay of 30s b)Tripping is provided at 30% of FLC with a TMS of 1.0 for the IDMT element	
8	Bearing failure	It is provided to protect motor against bearing failure	Protection is provided through external RTD. Output of the RTD is taken into Relay	This is provided in case of sleeve bearing
9	Under voltage protection	It is provided to protect motor from stalling in case of under voltage	A definite time under voltage with setting 70% of nominal voltage with time delay of 0.5 to 3 sec.	
10	No. of Start Limit	It is provided to restrict motor starting in a given period of time	Typical setting is as per motor data sheet	
11	Loss of load protection	It is provided to protect motor in case of loss of load condition	It is implemented with help of low forward power relays elements with interlock in starting	

APPENDIX – 2

Typical Characteristics of Motor Protection