


INTER PLANT STANDARD – STEEL INDUSTRY		
 IPSS	<b>SPECIFICATION FOR LINE            COMMUTATED THYRISTOR            CONVERTORS (FIRST REVISION)</b>	<b>IPSS: 1-10-020-15</b>
	Corresponding IS does not exist	

## 0. FOREWORD

- 0.1 This Inter Plant Standard has been prepared by the Standards Committee on Electrical Components and Equipment, IPSS 1:10 with the active participation of the representatives of the steel plants and established manufacturers of thyristor convertors and was adopted in September 2015.
- 0.2 Inter Plant Standards for steel industry primarily aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment (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/types from those mentioned in this standard, for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.
- 0.3 While formulating this standard, assistance has been drawn from the following publications :
- i) IEC 146-1-1(1991-04)
  - ii) IEEE Standard 444 (Part-I):1973

## 1. SCOPE

- 1.1 This interplant standard covers the requirements of line commutated thyristors convertors.
- 1.2 Individual devices and components incorporated inside the panels shall conform to relevant IS or IPSS specification.

## 2. TERMINOLOGY

- 2.1 For the purpose of this standard, the definitions in IS 1885 (Part 17) :1979 'Electrotechnical vocabulary : Part 17 Switchgear and controlgear (first revision)' shall apply.

### **3. SITE CONDITION**

- 3.1 The normal site conditions shall be as per IPSS:1-02-020-84 'Basic parameters for standardization of steel plant equipment'.

### **4. ENCLOSURE**

- 4.1 The thyristor cubicles shall have IP54 degree of protection for assemblies without cooling fans and IP30 for assemblies with cooling fan. Assemblies with cooling fan shall be provided with dry cleanable filters.

### **5. POWER SUPPLY SYSTEM**

- 5.1 The thyristor converter equipment shall be suitable for operation from the following power supply system :

- a) Rated voltage : 11 kV/6.6 kV/ 3.3 kV/ 415 V, 3 phase ac;  
230 V, single phase
- b) Voltage variation : +10%, -15%
- c) Rated frequency : 50 Hz+ 4%,-6%

- 5.2 Suitable stepdown/isolation transformers shall be used as required. The transformer secondary voltage shall be selected based on the rated dc voltage of the drive motor.

### **6. RATINGS**

- 6.1 Each converter shall have an assigned value for rated current and shall have appropriate duty class as per IEC 146-1-1(1991-04) depending upon the application.

- 6.2 In the absence of any specific requirement, the thyristor convertor shall meet the requirements of duty class-IV of IEC 146-1-1(1991-04) namely :

- 100% continuous
- 125% for 2 hours
- 200% for 10 sec

- 6.3 The rated direct voltage shall be maintained at all values of current upto the rated direct current for the specific limits of ac system voltage available at the line terminals of the converter.

## 7. EQUIPMENT DETAILS

- 7.1 The converter shall be 1-phase, 4 pulse or 3 phase, 6/12 pulse; fully controlled, reversible/irreversible as specified bridge comprising circulating current free thyristor converter with digital regulation comprising the following:
- i) Mineral oil-filled/dry type stepdown/isolating transformer capable of sustaining overloads to match the thyristor converter overload duty.
  - ii) Circuit breaker with solid state/microprocessor based protective relay having the following features :
    - adjustable over current setting and trip time setting,
    - adjustable under voltage trip,
    - adjustable short circuit current and trip time setting,
    - instantaneous short circuit current setting,
    - earth fault current and trip time settings.
  - iii) The converters shall have full self-diagnostic features and pulse presence monitoring.
  - iv) R.C. snubber circuit across the thyristor.
  - v) dc reactor where required to reduce the rate of current rise and achieve discrimination between thyristors/fuses and dc HSCB.
  - vi) Electrically/manually operated isolating unit for disconnecting the load circuit.
  - vii) In case of isolated converter units, supplied from different power sources the synchronising power supply shall be sourced from the secondary of the isolating transformer. In case of a number of converter units fed from the same power supply system and used for the same on line process, the synchronising power supply may be taken from a central distribution panel.
  - viii) Fully controlled bridge of suitable output with isolating transformer for adjustable dc motor field current and incoming circuit breaker with suitable static protection and with auxiliary contact and shunt trip coil, unless otherwise it is specified for semi-controlled/uncontrolled bridge for field supply.
  - ix) The class of protection for thyristor converters shall be as per IEEE 444. For large high power converters dc high speed circuit breakers (dc HSCB) with electronic overload short circuit protective devices and electronic dynamic tripping device shall be provided to clear faults induced external to the thyristor device. Proper

discrimination shall be maintained between thyristor cell fuses and dc HSCB. HSDCCB shall be provided for convertors beyond 1000 A dc. For lower rating, HSDCCB shall be provided if specified by the purchaser.

- x) Solid state field loss protection device.
- xi) Thyristor units in parallel with individual fuse monitoring and protection.
- xii) Surge protection device for ac (primary & secondary of transformer) and dc (field circuit).
- xiii) Indicating digital meters for input voltage and current, output dc voltage and current, motor speed, input control reference, output control reference, field voltage and current. Wherever more than one bridge is used in parallel, separate ammeter arrangement shall be provided for each bridge.

## 7.2 *Alarm and annunciation for first event display for*

- Main power On/Off
- Control supply On
- Auxiliary On
- dc breaker tripped
- Earth fault
- Over current/over-load
- Over voltage
- Under voltage
- Thyristor failure
- Thyristor fuse failure
- Field loss
- Negative sequence
- Tacho feedback loss
- Grid protection
- Fan failure
- Phase loss
- Surge suppresser failure
- Over speed wherever applicable
- Synchronising power supply failure
- Regulation power supply failure

## 7.3 **Indication** : LED indication for

- ac Main power On/Off
- Presence of pulse
- Field On
- Aux healthy

- Fan healthy
- ac breaker On/Off
- dc breaker On/Off
- Converter ready
- Forward/reverse pulse released
- Emergency stop

#### **7.4 Protection to be provided for**

- Input phase failure
- Phase sequence
- Transient over voltage
- Under voltage
- dc earth leakage/earth fault
- Synchronising supply failure
- Device protection against di/dt and dv/dt
- Field loss
- Fan failure
- Over load
- Over current through reed based grid protection

(This protection senses the ac/dc bus flux corresponding to the bus current through reed relay mounted on ac/dc bus and finally suppress the forward and reverse pulses or shift the pulses to inversion or to trip ac/dc breakers through shunt trip coil).

- Over voltage
- Over speed
- di/dt protection
- dv/dt protection
- Any other motor or converter protection as required by the user

**7.5 Type of braking** – Regenerative or dynamic or both depending upon the application.

**7.6 Type of reversal** – Armature voltage through forward and reverse thyristor converter, unless otherwise specified. During reversal blocking signal for opposite bridge shall be provided.

**7.7 Type of control** – Armature voltage and field current control with tacho/emf feed-back.

**7.8** Adjustable current limit feature.

**7.9** Adjustable maximum speed, acceleration and de-acceleration rate.

## **8. REGULATION**

Micro processor based digital regulation shall be provided with following features :

- 8.1 Linear acceleration and dc-acceleration.
- 8.2 Normal, jogging and threading facilities
- 8.3 Interlocking facilities with other drives
- 8.4 Tacho feedback, voltage feedback & IR compensation facilities as the case may be.
- 8.5 Provision for isolation of any signal from other sources
- 8.6 Remote annunciation with computer interface
- 8.7 Process controller interface
- 8.8 Converter should accept digital and analog signal from other drives wherever required.
- 8.9 Converter should give digital and analog signal to other drives wherever required.
- 8.10 Provision for checking the converter in manual regime.
- 8.11 Current feedback facility.

## **9. MECHANICAL DESIGN & CONSTRUCTION**

### **9.1 General**

- 9.1.1 The control panel shall be designed and manufactured to give efficient and reliable service in steel plant where continuity of operation is of prime consideration.

### **9.2 Mechanical Design**

- 9.2.1 Sheet steel used for fabrication of metal cabinet for control panel shall be of cold rolled type and of thickness not less than 2 mm. Non-load bearing side may be of 1.6 mm thick sheet.
- 9.2.2 The cabinet shall be of base mounting design and shall be provided hinged door at front and with removable hinged door at back with good latching system operated by a front handle.

- 9.2.3 Durable gaskets shall be provided for all doors and covers and for all partitions between adjacent units. The gasket shall be of sponge rubber or synthetic rubber and shall be adequately secured. Barrier shall be provided between power equipment and control equipment.
- 9.2.4 A base channel/frame of minimum 50 mm height and 3 mm thickness shall be provided.
- 9.2.5 Removable cable gland plate shall be provided at the bottom. The plate shall be undrilled unless specified otherwise.
- 9.2.6 All bolts, nuts and other hardware shall be metric size and all metallic parts used shall be cadmium/zinc coated.
- 9.2.7 Anti-vibration pads shall be provided for the panels in mobile equipment.

### **9.3 Thyristor Cubicles**

- 9.3.1 The thyristor modules with fuses, R.C. snubbers and other components shall be housed in one cubicle cooled by a separate low noise ventilation fan adequately rated to dissipate the heat.
- 9.3.2 The ventilation fan shall be equipped with air flow monitoring units so as to monitor in case of loss of ventilation.
- 9.3.3 Other components such as ac & dc power packs regulating and control equipments shall be located in separate cubicles namely trunking or current regulator.
- 9.3.4 The bus bar shall be copper arranged at the back and suitably braced.
- 9.3.5 All control connection shall be of plug-in type. The sockets should be of spring loaded type with locking devices.
- 9.3.6 The components shall be so mounted that various sections are easily accessible from the front.
- 9.3.7 Terminal facility for monitoring dc current & voltage waveform shall be provided
- 9.3.8 Adequate number and size of lifting hook/angles shall be provided at the top of the panel structure for handling the panel.
- 9.3.9 Clearance, creepage and isolating distances shall be in accordance with clause 6.1.2 of IS 8623 (Part 1) : 1993 ` Low voltage switchgear and controlgear assemblies : Part 1 Requirements for type-tested & partially type-tested assemblies (*first revision*)'/IEC 60439-1(1992-12) `Factory

built assemblies of switchgear and controlgear for voltages upto and including 1000V ac and 1200 V dc : Part 1 General requirements’.

## **10. PANEL WIRING**

- 10.1 Clause 6.0 of IPSS:1-10-010-84 “General requirements for control panels for cranes (with amendment 1)” shall apply.
- 10.2 For regulating and other electronic circuits, wiring shall be of PCB back plane type or wire wrapping type.

## **11. TERMINATION**

- 11.1 Clause 6.0 of IPSS:1-10-010-84 shall apply.
- 11.2 Plug-in type electronic cards shall have connections through plug and receptacle arrangement.
- 11.3 The connection shall be ploy carbonated glass grided nylon with gold plated pins for good electrical contacts specially with low voltage and weak current signals.
- 11.4 The connectors shall be mechanically polarised to prevent wrong insertion of the modules/cards, if specially asked for.
- 11.5 The electronic cards shall be provided with identification plates, test point brought out for checking input/output parameters, signals monitoring at critical points along with suitable handle for drawing out the cards.
- 11.6 The cards shall be housed in regular bins which shall be a metal rack with hinged swivelling arrangement conforming to the dimension as given in IEC 50297-1(1986-09). The electronic cards shall be provided with self-locking screws to secure them firmly in the bins with sufficient space between them for electrical isolation and proper cooling.

## **12. EARTHING**

- 12.1 Provision of clause 9 of IPSS:1-10-010-84 shall apply.
- 12.2 The body of each plug-in module shall be connected on separate terminal of plug to common earth bus.



### **13. TEST**

13.1 The converters shall be tested as per IEC 146-1-1(1991-04). The tests shall include but not limited to the following :

#### *13.1.1 Tests at Manufacturer's works :*

- Visual inspection
- Insulation test
- High voltage test
- Functional test
- Light load test
- Power loss/power efficiency test
- Full load and temperature rise test

#### *13.1.2 Tests at site :*

- Visual inspection
- Insulation test
- Functional test
- Light load test
- Full load test with motor
- Checking of protection system
- Checking of inter-locking system
- Checking of annunciation system

13.2 Test certificates of all tests carried out shall be furnished.

### **14. DOCUMENTATION**

14.1 The following documents, in ten sets shall be furnished along with the equipment :

- i) Test reports/certificates
- ii) Card details containing card drawing with component details and PCB layout
- iii) Operation and maintenance instructions
- iv) Detailed schematic and wiring diagram
- v) The supplier shall handover one set of corrected reproducible and two sets of drawing floppies covering detail drawings after commissioning.
- vi) Drive parameters listing to be furnished after commissioning.
- vii) Complete hardware/software detail on CD-ROM.
- viii) Trouble shooting and fault finding.

### **15. INFORMATION TO BE FURNISHED**

15.1 The provision of clause 10 of IPSS :1-10-010-84 shall apply.