Technical specification for Rubber Injection Moulding Machine

Sl No	***Specification***	***Requirement***
1	*Purpose*	*To manufacture Polymer composite insulators by moulding place technology using the Injection moulding machine with Silicone rubber compound and FRP rods. Refer Annexure – I & II for GA drawing*
2	*Description of Operation*	*The FRP rod on which the metal part is already crimped shall be cleaned and after treating the required surface the component shall be taken up for Injection moulding. The required mould shall be mounted on the machine platen and shall be heated (electrical heating) to achieve requisite temperature. Mould release agent is sprayed and the FRP rod is placed in the mould, the top and bottom halves are closed. The HTV silicone rubber compound is injected into the mould and the sheds are formed. After the pre-set curing time, the component is released from the mould. For lengthy components injection is done by multiple shots.*
3.	*Scope of Supply*	*Complete equipment along with suitable clamping unit, Hydraulic unit, operation & control unit and associated accessories which includes erection and commissioning.* *Mould and Flow controlled Cold runner block as per specification given at 18.0 and 19.0 respectively* *Equipment to be supplied along with standard accessories. The list of standard accessories offered shall be provided in Techno-commercial offer Part - A.* *Detailed technical parameters of the equipment to be quoted are given in clause 13.0 of this specification.*
4	*Training*	*Two BHEL engineers are to be trained for acquaintance on operation and maintenance of the equipment at vendors' works during Pre-Dispatch Inspection. Further, training shall be provided to the operators during installation and commissioning at BHEL.*

5	*Inspection*	*The equipment shall be inspected in the vendors' works and injection molding as described above is to be demonstrated satisfactorily. The requisite raw material viz., FRP rods crimped with metal parts and silicone compound shall be supplied by BHEL. The Equipment to be dispatched only after final inspection and acceptance by BHEL*
6	*Utilities Requirement :*	*Information on requirement of various utilities such as power, compressed air, cooling water, handling facilities such as cranes are to be furnished in the Part – A : Techno-commercial bid.*
7	*Equipment Layout Plan*	*Information on the requirements for proper layout plan for installation and commissioning of the equipment and its associated accessories to be suggested by the bidders and the same to be provided in the Part – A : Techno-commercial bid.*
8	*Manufacturing process Control assistance:*	*Manufacturer has to assist BHEL in establishing suitable process control parameters during trial run of the injection moulding in the plant using the Silicone material provided by BHEL (specification of material is enclosed – Annexure IV)*
9	*Commercial Production capacity*	*Equipment has to be demonstrated for continuous satisfactory operation of 24 hours.*
10	*DATA acquisition System*	*Suitable DATA acquisition system to be provided along with the equipment for local/remote monitoring using computer interface.*
11	*Safety features*	*Bidders to provide the details of safety devices &features incorporated in the equipment.*
12	*Any other information*	*Supplier can furnish any other additional information, considering the overall requirements for better output*

13	*Clamping unit, Injection Unit and Hydraulic unit.*	***Clamping Unit*** *Installed Vertically**,** with hydraulic clamping and locking system.* *Clamping force : 6300 kN* *Heating platen size:800mm x 1700 mm minimum* ***Injection Unit*** *Injection volume : 12,500 CC* *Injection Flow rate : 300 to 320 CC/sec* *Opening Stroke(Day light) : Min 1100 mm* ***Hydraulic Unit*** *Hydraulic Unit compatible to the system specification shall be provided. The hydraulic system integration shall be with preferred make of components as in Slno 16 provided in this specification. Hydraulic unit shall be with electronically adjustable hydraulic pump and regulating valve for oil supply of the clamping unit and the injection unit. Proportional pressure and proportional flow delivery shall be incorporated.*
14	*Total connected load in KW*	*Bidders to specify*
15	*Operating Control unit*	*The control unit incorporating PLC controls interfaced with HMI for providing inputs to the equipment, operation of the equipment in auto & manual modes and display of process parameters with a mimic diagram shall be provided. The control unit shall provide information of fault codes and graphic displays for errors / faults / alarms. The indicative requirements of the control unit is described below, bidders may suggest additional / advanced features for improving the operational efficiency of the equipment. Some of the indicative features to be incorporated are :* *- Process data acquisition on USB interface.* *- Auto programming for reclamping function during cure time at pre-defined intervals.* *- Real time temperature trend graphics on HMI* *- Multi level software password.* *- Display of Production overview mimic on HMI*

		- I/O diagnostic in graphical fashion *- Display of actual and set process parameters.* *- Stroke measurement for injection cylinders via potentiometric transducers.* *- Stroke measurement for mould movement cylinders via potentiometric transducers.* *-Microprocessor terminal for closed loop control of Pressure.* *-Display unit shall be min 10" with touch screen* *- Variable adjustment of the machine sequence Through program input via HMI.*
16	*Preferred make of components*	*-PLC : Siemens, Schneider, ABB, Allen Bradley, OMRON* *-Hydraulic components: Vickers, Rexroth* *-Pneumatic components : Festo, SMC* *- Electrical components: L&T, Siemens, ABB*
17	*Basic Machine features*	*Basic Machine must comprise stable construction of the main RAM having mould opening and closing by vertical UP and down movement controlled by potentiometric transducers. Hydraulic movement must provide clamping force as specified.* *Machine must have stuffing box to feed silicone rubber, followed by mechanism to inject the required volume of the rubber in the mould placed at the centre of the machine on the platen through the nozzle from top. Volume of the material must be controlled by the potentiometeric transducers.* *Construction of this machine must have mechanism to cool various parts of the machine mainly plunger, the nozzle portion and any other area depending upon the design of the machine. Cooling provided in the machine must be oil based.* *Indicative construction features required are as mentioned below, however bidders may suggest any improved features :* *Oil temperation Unit for Injection Unit* *Oil temperation Unit for Cooling system* *Stock Temperature Indications for Injection unit*
		Vacuum device complete with pump integrated to the Injection Moulding Cycle in auto mode

		Digital display of vacuum pressure with PLC Interlock *Three Zones heating & controls in both heating platens.* *Core Puller arrangement to avoid warping of FRP rod during moulding* *Hydraulic and cooling arrangement of flow control CRB* *Silicone stuffing device with hydraulic opening and closing with volume matching the specification.* *Silicone rubber flow pattern FIFO type* *Safety curtain at front and rear end of the machine for operator safety.*
18.0	***Mould Specification (Refer Annexure III for Product drawing)***	
18.1	*Mould Description*	*Two cavity flexi-mould suitable for manufacturing of silicone based composite Insulators by Injection moulding of HTV solid silicone rubber.*
18.2	*Purpose*	*Mould to be used for formation of sheds for composite insulators as per drawing No 398714 30500 M by HTV silicone Rubber injection moulding. This mould shall have flexible arrangements to add and remove the inserts contributing the shed formation to manufacture the insulators of required length.*
18.3	*Scope of Supply*	*Design, manufacturing and supply of mould to manufacture composite Insulator as per Drawing No mentioned in slnio 18.2 consisting of following.* ✓ *Silicone nozzle point positioned at the top* ✓ *Silicone flow guide* ✓ *Flow controlled Cold Runner Block* ✓ *Insulation slab between Cold runner block and Top half of mould* ✓ *Top half of mould with flexi sheds arrangement, Heating Elements and thermo-couple arrangement, injection holes and internal ejectors* ✓ *Bottom plate with flexi sheds arrangements, vacuum connection to each shed of the insulator cavity and internal ejectors.* ✓ *Lifters for easy ejection of the component.* ✓ *Guide pins to keep the FRP rod at the center during injection moulding.* ✓ *Ejector frame to support overhand of insulator during injection moulding*
18.4	*Drawing Approval*	*Master list of drawings used for manufacturing/ assembly and detailed drawing of critical components are to be approved by BHEL before manufacturing.*

18.5	*Overall Dimensions*	*It should match to the Injection moulding machine with sufficient gap between the upper half and lower half of the mould to mount & remove components from the machine.*
18.6	*Injection Moulding Length*	*Mould shall be so designed to produce 1300 mm length of Insulator from both cavities simultaneously in one shot to ensure 400kV insulator in 3 shots.*
18.7	*Silicone flow guide*	*These guides are to make the silicone injection from the centre till the required cavity.* *There should be arrangement to use the mould in any combination so as to use any one cavity OR both cavities at any time.*
18.8	*Insulation slab between Cold runner block and Top half of mould*	*This insulation slab stops the heat transfer from the hot mould portion to the CRB Block.*
18.9	*Heating arrangement & Power Supply*	*Bidders to Indicate*
18.10	*Top half of mould with flexi sheds arrangement, Heating coil and thermo-couple arrangement, injection holes*	*Top half of this mould shall have arrangement for adding and removing the inserts which contributes the shed formation in Injection moulding.* *To heat mainly the top half of the mould (below CRB) heating elements shall be in built in the mould.* *Suitable Thermocouple arrangement for Mould temperature measurement & control must be Interfaced with the Machine control unit. Heating element and thermocouple connection must have plug IN type arrangement*
18.11	*Bottom plate with flexi sheds arrangements, effective vacuum connection to each shed of the insulator cavity*	*Bottom half of this mould shall have arrangement for adding and removing the inserts which contributes the shed formation in Injection moulding.* *Vacuum connections should be provided in the mould such that every shed is connected to vacuum and the suction point in the mould. Design of vacuum provisions shall be such that vacuum holes shall not get blocked.* *For ejection of component from the Mould without bending and shed damage, ejector pieces in the cavities must be provided in top and bottom halves of the mold.* *Support pins (sync with the injection moulding cycle software) to keep the FRP Rod at Centre without moving during injection moulding. This shall not leave any undulation on the finished component.*
18.12	*Material*	*Material used in mould should be – Base Steel C-45 OR equivalent Inserts in the mould should be Steel P-20 (Impax Supreme or Thruhard Hi Hard) OR NAK 80 or equivalent. Supplier should indicate the material of construction of mould, in their offer.*

18.13	*General*	*Alignment of All the sheds should be proper. Addition and Removal of inserts from the mould should be easy and must be able to add and remove inserts without removing mold from the machine.* *Tear groove must be provided around the article, in the inserts for easy removal of flash from injection molded component.* *Cavity surface should be induction hardened and treated, smooth to facilitate easy ejection.* *End inserts of Mold must be suitable to Metal fittings design.*

19.0 Flow Control CRB

19.1	*Purpose*	*It shall protect the runner channels to get heated up to avoid curing of rubber and facilitate controlled silicone rubber flow*
19.2	*Description*	*It shall consist of insulating plate , 3 zone heating arrangement.* *Machine CRP , Mold should be able to inject different volume of silicon at different injection point in the mold, through software without any manual adjustment.It must have feature to block individual Cold runner nozzle through machine control for fast cleaning and compound change. It shall keep the runner channels heated up and also control the flow of the silicone compound satisfactorily for mould settings for different length of cavities.*
19.3	*Scope of supply*	*Complete CRB system consisting of suitable silicone rubber flow control / valves ,Oil circulation pump, oil tank with electrical heaters for thermo control water circulation system for cooling including electrical piping and soft ware*
19.4	*Dimensions*	*Matching to Injection mould and machine platen*
19.5	*No of Nozzles*	*Minimum 8 nozzles*
19.6	*Total connected Load*	*Bidders to specify*

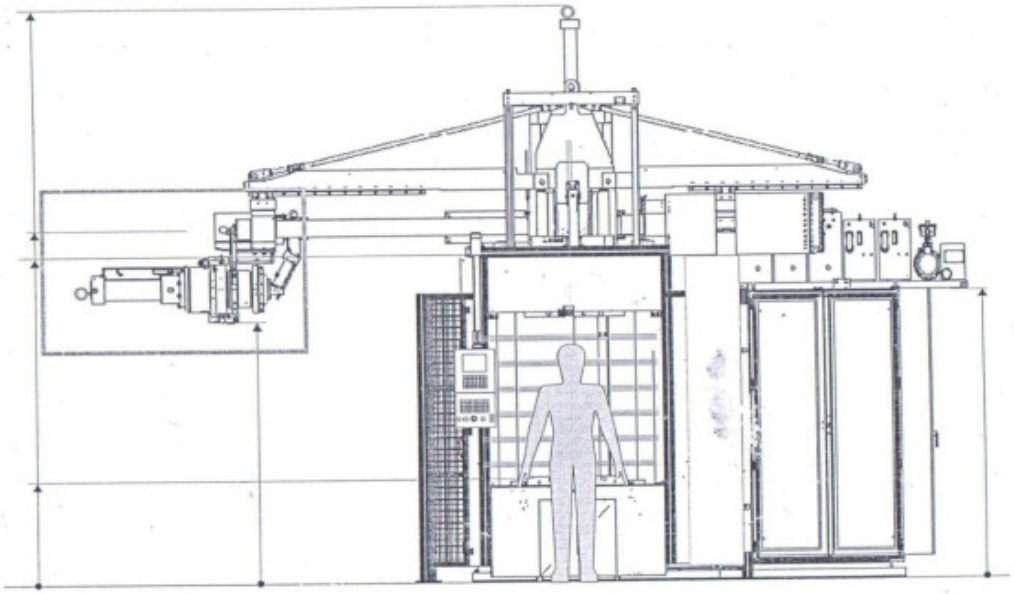
Note : 1. Any technical deviation should be brought out in a separate sheet
2. Offers must consist of basic Injection moulding machine, flow controlled CRB and mould. The offer will be summarily rejected for non compliance of this criteria.

***Qualification criterion**:*

Sl. No	***BHEL Standard Terms & Conditions***	***Supplier's confirmation Yes / No***	***If Yes , Documentary Evidence provided for Compliance***
1	*The vendor shall be an Original Equipment Manufacturer (OEM).Dealers have to submit authorisation certificate from OEM. Representative for techno-commercial discussions shall be necessarily from OEM's works*		
2	*The vendor shall have qualified personnel, their own adequate manufacturing / integrating and testing facilities for the equipment offered.*		
3	*The vendor shall have proven track record for manufacturing, supplying and successful commissioning of Injection Moulding Machine for manufacturing of Composite insulators with a clamping force of Minimum 5000 kN and Injection volume of 12500 CC, Injection moulding length of 1200 mm minimum per shot in 2 cavities, in the last 2 years*		
4	*The vendor shall submit audited balance sheet or tax returns or profit loss account for the last 3 years*		

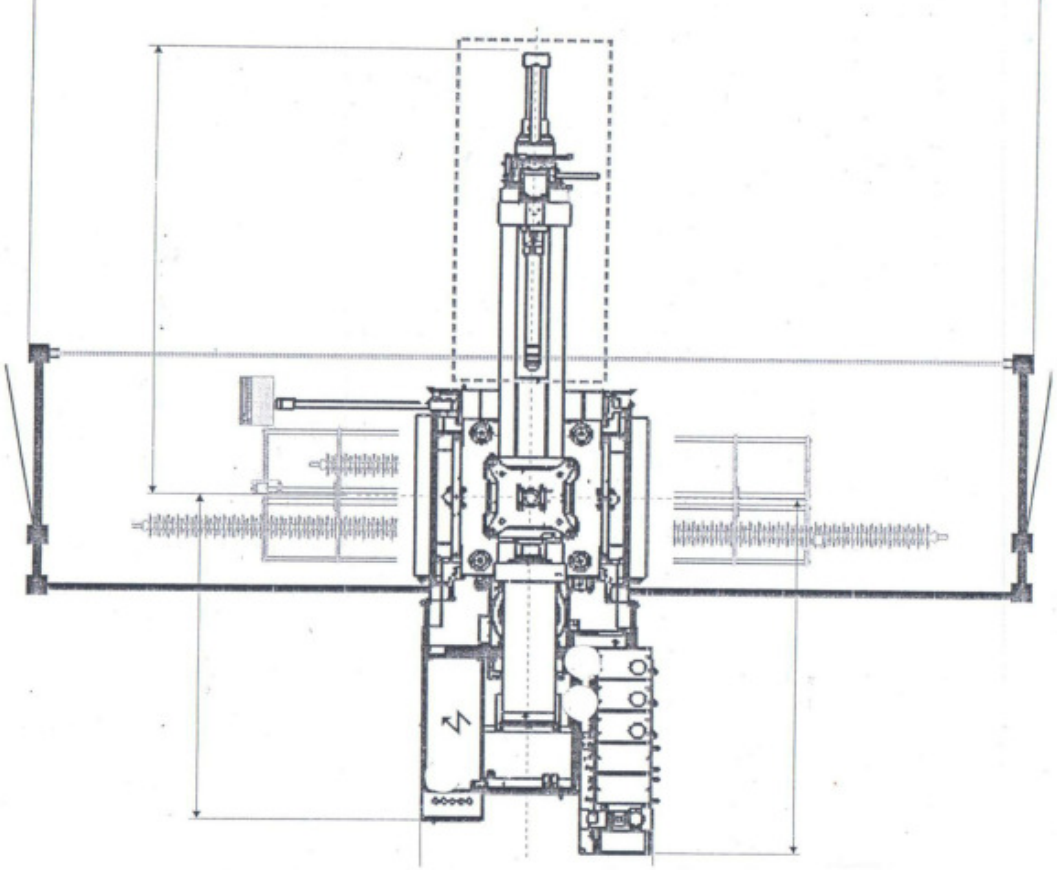
Annexure - I

GENERAL ARRAGEMENT OF INJECTION MOULDING MACHINE

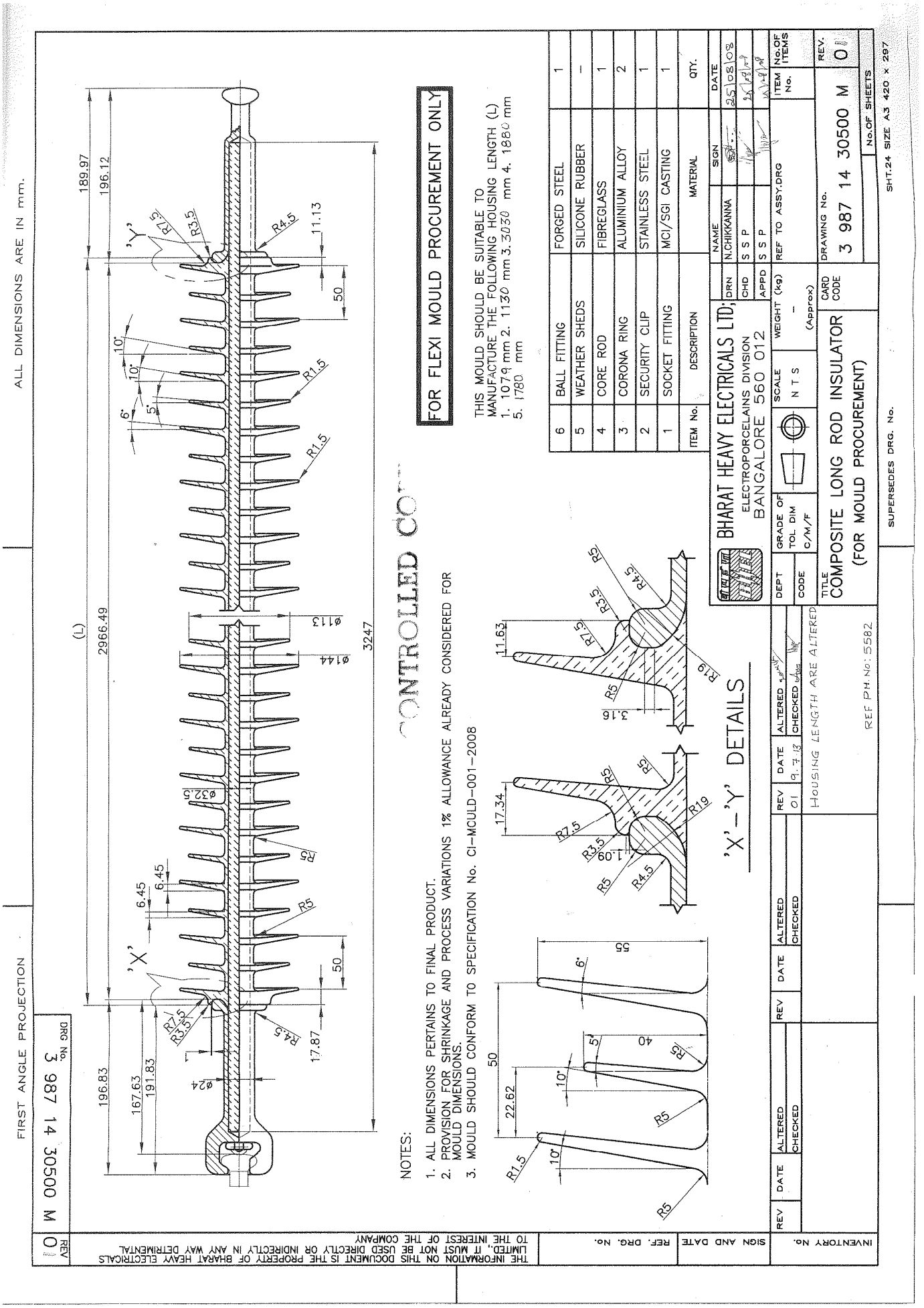


Annexure - II

GENERAL ARRAGEMENT OF INJECTION MOULDING MACHINE



EPD - BANGALORE	**Purchase Specification For Silicone Rubber Injection Moulding Machine**	**SPECIFICATION NO. EP-WEX-IM/2013-14**



BHARAT HEAVY ELECTRICALS LIMITED
ELECTROPORCELAINS DIVISION
BANGALORE 560 012

PURCHASE SPECIFICATION SILICON COMPOUND	DEPT : Composites SEC : EL/CI/SC/01 REV : 01 DATE : 29.06.2006 PAGE : 1 OF 1

1.0 Purpose : To manufacture Polymer composite Insulators by Mould in place technology using the injection molding machine for products such as Long rod Insulators up to 400 kV for transmission lines BOTH Tension and Suspension, using Silicone Rubber compound and FRP Rods.

2.0 Material preparation : HTV type silicone rubber having at least 40-50 % silicon by weight and ATH (Alumina Tri Hydrate) as filler . The Filler should be properly mixed with silicon compound to ensure the uniform distribution of same in the polymer by using proper additives. Thereafter, molding will be done. The material should confirm to the tests specified here in under. The sheath material shall have excellent Hydrophobic and anti-tracking properties.

Sl No	Test	Reference Specification	Specified Value
1	Resistance to tracking & erosion	IEC:60587/ASTM:2303	4.5
2	Tear strength (KN/m)	ASTM D 624-B	Min.12
3	Volume resistivity	IEC:60093	$2x10^{13}$
4	Resistance to weathering & UV	ASTM G53-96	No crack to be observed during test duration of 96 Hrs
5	Resistance to flammability	IEC:60707	Burning behavior to be checked
6	Arc Resistance	ASTM 495-1973	> 200 Sec
7	Specific gravity	DIN 52479/D 792	1.52- 1.58
8	Dielectric strength in kV/mm	ASTM D 149/IEC 60243	17.5
9	Hardness (Shore A)	ASTM D 2204	68 $\pm$ 7
10	Ultimate elongation	ASTM D 412	Min 100
11	Tensile strength	ASTM D 412	Min 40 kg/sq mm
12	Limited Oxygen index	ASTM D 2863	40% min.

Sr Dy General Manager
Quality & Composites

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