

SECTION-C

Tender Notice No. IPR/TN/PUR/TPT/ET/19-20/23 Dated 02/08/2019

Specifications of 320kW IGBT based power supply

Introduction:

This power supply is a high current low voltage supply operated in current source mode of operation. It has to supply power to a highly dynamic plasma torch load for generating plasma arc. The detailed specification of power supply is given below:

S. No.	Particulars	Specifications
1	Inputs	3 phase, 415V \pm 10%, 50Hz
2	Output a) Open circuit voltage b) Full load voltage c) Full load current d) Resolution e) Source type	450V DC 200V DC 1600A (Current should be adjustable from 50A to 1600A with resolution of 1A) 1 A Constant current (Independent of the load voltage)
3	Interlocks a) Cooling water temperature (External) b) Water flow c) Stack temperature d) Over voltage e) Over current f) Single phasing g) Emergency Off h) Panel door	All Sensors' NO/NC input will be provided by IPR for interlock purpose except overvoltage, over current, single phasing, emergency off and panel door interlocks. The vendor should demonstrate the functioning of these interlocks using dummy inputs of 0 to 5 V /NO /NC as applicable. The interlocks operation should be implemented using PLC (Programmable Logic Control) and HMI (Human Machine Interface). Calibration certificate of all sensors and meters will have to be submitted along with the delivery of the power supply.
4	Meters & display a) Input Voltage b) Input Current c) Output Voltage d) Output Current e) Water Temperature f) Digital Multifunction Energy Meter g) Stack temperature	All reading should be displayed on HMI. The kW, kVA, PF, V, I readings should be displayed by Energy meter on front panel.
5	Indications a) R, Y, B indications b) All interlocks status c) Mains ON	Indications should be implemented through HMI.

SECTION-C

Tender Notice No. IPR/TN/PUR/TPT/ET/19-20/23 Dated 02/08/2019

	<p>d) Power supply ON/OFF</p> <p>e) All switches ON/OFF indications</p>	
6	<p>Switches</p> <p>a) Push button On</p> <p>b) Push button Off</p> <p>c) Emergency Off</p> <p>d) Input voltage selector switch</p> <p>e) Input current selector switch</p>	<p>The on/off provision should also be done through external control through 5V TTL except emergency switches. Other On/Off should be controlled through PLC and HMI.</p>
7	<p>Current setting pot</p>	<p>The current setting should be done through HMI. The current setting should also be possible through external control through TTL.</p>
8	<p>Grounding</p>	<p>The positive output terminal along with the panel body should be grounded.</p>
9	<p>External control</p>	<ol style="list-style-type: none"> 1. A 5V TTL should be provided for external cut off. 2. Current control should be possible through 0-5V or 0-10V external analog signal.
10	<p>Input and Output cable</p>	<ul style="list-style-type: none"> ■ Flexible copper conductor. ■ Both input and output cables should be of 10 meter length each with Fire Retardant etc. and should be of appropriate ratings as per the suitable IS standards for power cables. Vendor should mention the current ratings and IS standard of cable in the quotation for input and output cables.
11	<p>Input Power Factor</p>	<p>0.85 or better</p>
12	<p>Efficiency</p>	<p>90% or better</p>
13	<p>Output current on plasma load</p>	<p>The output DC current should be always within $\pm 0.5\%$ of the set value. The ripple should be demonstrated by vendor one time during pre-dispatch inspection using oscilloscope for all ranges of current on plasma load.</p>
14	<p>Cooling</p>	<p>IGBT heat sink cooling should be done using water cooling. The inlet and outlet connection port (manifold) should be provided in case of water cooled. The chiller and compressor unit should be supplied by vendor as a part of this power supply unit. Water inlet and outlet should be through properly tight and mounted manifold. The vendor will have to demonstrate one time continuous 24 hours operation of power supply at full load on resistive dummy load. The resistive load for testing and the electrical power should be arranged by vendor only.</p>

SECTION-C

Tender Notice No. IPR/TN/PUR/TPT/ET/19-20/23 Dated 02/08/2019

15	MCCB	MCCB of suitable rating with shunt release coil should be provided on the power supply panel.
16	Acceptance Criteria	<p>Factory Acceptance Test (to be done in presence of IPR's representative) :</p> <p>(A) <u>The list of test preceding the arc load test:</u></p> <ul style="list-style-type: none"> a) The power supply will be tested at full load i.e. 200V and 1600A on resistive load first. b) The output current should be within $\pm 0.5\%$ of the set value. c) The power supply at full load will be tested for min. 24 hours with monitoring point b on resistive load. d) All interlocks will be checked on resistive load test. e) The output current and voltage should be cross checked using standard clamp on meter and multi meter. f) The provision of varying the load resistance online during the testing should be provided by vendor. <p>(B) <u>The list of test with the actual arc load:</u></p> <ul style="list-style-type: none"> a) Two graphite electrodes will be provided by IPR for load test. b) This test will be done for min. 8 hours continuous operation for two consecutive and successful operation of power supply. c) All interlocks will be checked again. d) The output current should be within $\pm 0.5\%$ of the set value. e) Instead of providing the set point of the temperature controller, the power supply should be interlocked at maximum number and the same should be mentioned in user's manual. <p style="text-align: center;">Site Acceptance Test</p> <p>Vendor would demonstrate the operation of power supply at IPR's premise on actual plasma arc load continuously for 8 hours at full load for 3 consecutive times. All the parameters and interlocks checked during FAT would also be tested during SAT.</p>
17	Users Manual	Vendor should supply user's manual mentioning sequence of

SECTION-C

Tender Notice No. IPR/TN/PUR/TPT/ET/19-20/23 Dated 02/08/2019

		operation, bill of material, circuit diagram, wiring diagram with ferrules, trouble shooting chart, preventive maintenance chart etc.
18	Warranty	Vendor should provide one year warrantee of the complete unit from the date of commissioning at IPR.
19	Panel support	Panel (Cabinet) should be mounted on heavy duty caster wheels; Panel should also have provision for lifting the panel from the top. Panel door should be mounted on appropriate hinges for smooth movement of the door. The sheet of the panel should have appropriate gauges as per the IS standards for electrical panel. Vendor should provide the panel details for approval within 20 days from receipt of purchase order for approval in terms of foot print and color of the panel. Panel should be powder coated. The color of panel should be ash grey or light blue with matt finish. All fasteners in the panel should be made of SS 304.
20	PLC and HMI	Vendor should provide PLC and HMI of reputed company and CE certified company such as Allen Bradley, Siemens, and Schneider etc. Vendor should also supply programming software and soft copy of the PLC and HMI program for operating this power supply. Vendor should provide following extra points for future use in each power supply unit: <ol style="list-style-type: none"> 1. Digital output: 20nos. 2. Digital input: 20 nos. 3. Analog output: 1 nos. 4. Analog input: 1 nos. 5. Temperature input (R type) : 4nos 6. PWM output (8 kHz or higher): 2 nos. The DC power supply to PLC should be 24V, 10A rating through SMPS. 1A fuse through proper housing connector should be used in all input and output lines of PLC except temperature input.
20	Ambient operating temperature	The vendor should confirm that the ambient temperature for designing the power supply should be considered as 50 Deg C
20	<p>Working Details of Power Supply:</p> <p>The power supply will generate plasma arc of max 320 kW power at 200V and 1600A. The plasma arc will be generated across the graphite electrodes as shown in the figure 1. The power supply continuously checks for all the interlocks for healthy operating conditions. If any interlock is found unhealthy, the power supply panel cut off the power to the plasma arc and indicates the particular fault status on the HMI. This power supply is a constant current source power supply i.e. the load current is constant at set value (Set through HMI) irrespective of the load voltage (It means that the power supply can work under short circuited output conditions also). The switching frequency of SMPS link can be decided by</p>	

SECTION-C

Tender Notice No. IPR/TN/PUR/TPT/ET/19-20/23 Dated 02/08/2019

	<p>the vendor so as to meet the efficiency of the power supply and to maintain the continuous plasma arc.</p> <p>The electrode movements are controlled by separate motorized mechanism provided by IPR. The electrodes get short circuited in the beginning to initiate the plasma arc. Once, the current starts flowing, the electrodes are separated apart through control mechanism. The voltage is built up by separating the electrode. Once the voltage reaches to the set value, the electrode movements are stopped. The arc remains at this voltage and set current value continuously. The power supply is based on SMPS (Switch mode power supply) topology which uses the high frequency link in DC to DC conversion for better regulation, better efficiency, compact size and easy control. All cable routing inside the penal including power cable should be as per IS standards.</p>
21	<p>All electrical bought out components should be of standard companies having CE certification for the components. All the components' ratings and the wiring should be as per IS standards.</p>

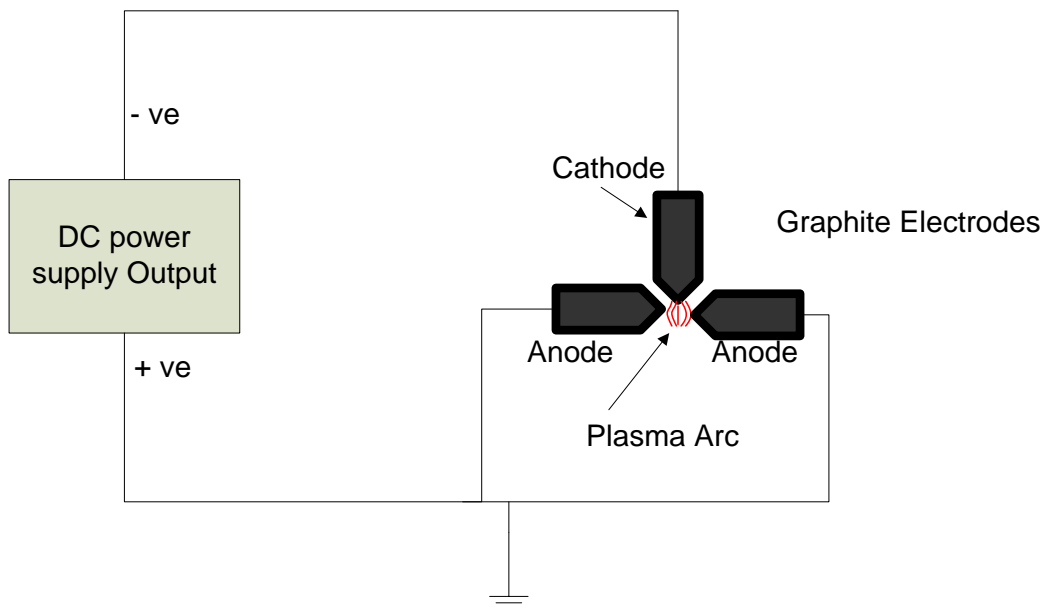


Figure 1: Plasma Torch (Graphite Electrodes) Set up connected to 320kW IGBT based DC power supply.