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**Specifications of 100kW IGBT based power supply**

| <b>S. No.</b> | <b>Particulars</b>  | <b>Specifications</b>  |
|---------------|---|--|
| 1             | Inputs  | 3 phase, 415V, 50Hz  |
| 2             | Output<br>a) Open circuit voltage<br>b) Full load voltage<br>c) Full load current<br><br>d) Resolution<br>e) Source type  | 300V DC<br>125V DC<br>800 A (current adjustable from 50A to 800A with resolution of 1A)<br>1 A<br>Constant current (Independent of the load voltage)   |
| 3             | Interlocks<br>a) Cooling water temperature<br>b) Water flow<br>c) Stack temperature<br>d) Over voltage<br>e) Over current<br>f) Single phasing<br>g) Emergency Off<br>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. Vendor should also provide a 5V TTL for external communications. This includes all analog control of power panel. |
| 4             | Meters & display<br>a) Input Voltage<br>b) Input Current<br>c) Output Voltage<br>d) Output Current<br>e) Water Temperature<br>f) Digital Multifunction Energy Meter<br>g) Stack temperature | DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>0 – 50 Deg C (with set point control)<br>With kW, kVA, PF, V, I readings<br>0 – 100 Deg C (with set point control)   |
| 5             | Indications<br>a) R, Y, B indications<br>b) All interlocks status<br>c) Mains ON<br>d) Power supply ON/OFF<br>e) All switches ON/OFF indications  | All the indicators should be of reputed company and CE certified.  |
| 6             | Switches<br>a) Push button On<br>b) Push button Off<br>c) Emergency Off   | The on/off provision should also be done through external control through 5V TTL except emergency switches.  |

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|    | d) Input voltage selector switch<br>e) Input current selector switch |   |
| 7  | Current setting pot  | A pot on the panel should be provided to set the required output current between zero to full load current. The current setting should also be possible through external control through TTL.   |
| 8  | Grounding  | The positive output terminal should be grounded along with the panel body.  |
| 9  | External control   | A 5V TTL should be provided for external cut off and current control.   |
| 10 | Input and Output cable   | <ul style="list-style-type: none"> <li>■ Flexible copper conductor.</li> <li>■ Both input and output cables should be of 10 meter length each and should be of appropriate ratings as per the suitable IS standards for power cables.</li> </ul>  |
| 11 | Input Power Factor   | 0.85 or better  |
| 12 | Efficiency   | 90% or above  |
| 13 | Current Regulation   | Current should be always within ( 1% of the set value   |
| 14 | Cooling  | IGBT heat sink should be water cooled. The inlet and outlet connection port (manifold) should be provided. The chiller and compressor unit should be supplied by vendor. Water inlet and outlet should be through properly tight and mounted manifold.  |
| 15 | MCCB   | MCCB of suitable rating with shunt release coil should be there on the power supply panel.  |
| 16 | Acceptance Criteria  | The pre-dispatch inspection will be carried out by the IPR engineers. The power supply would be tested for 8 hours continuous operation at full load i.e. 125V and 800A on the plasma torch supplied by IPR at the time of testing. The vendor should arrange the required electrical power capacity for testing of power |

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|    |  | supply at its premise.  |
| 17 | Users Manual   | Vendor should supply user's manual mentioning sequence of operation, bill of material, circuit diagram, wiring diagram with ferrules, trouble shooting chart, preventive maintenance chart etc.   |
| 18 | Warrantee  | Vendor should provide one year full warrantee of the complete unit from the date of installation and 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 to 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 | <p><b>Working Details of Power Supply:</b><br/>                     The power supply will generate plasma arc of max 100kW power at 125V and 800A. 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 panel. This power supply is a constant current source power supply i.e. the load current is constant at set value (Set through current control knob on the front panel) irrespective of the load voltage (It means that power supply can work under short circuited output conditions). The switching frequency of SMPS link can be decided by the vendor so as to meet the efficiency of the power supply and to maintain the continuous plasma arc.<br/>                     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,</p> |   |

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|    | 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 should be as per IS standards. |
| 21 | All switches, meters and controller should be of standard companies having CE certification for the components. All the components ratings and the wirings should be as per IS standards.   |

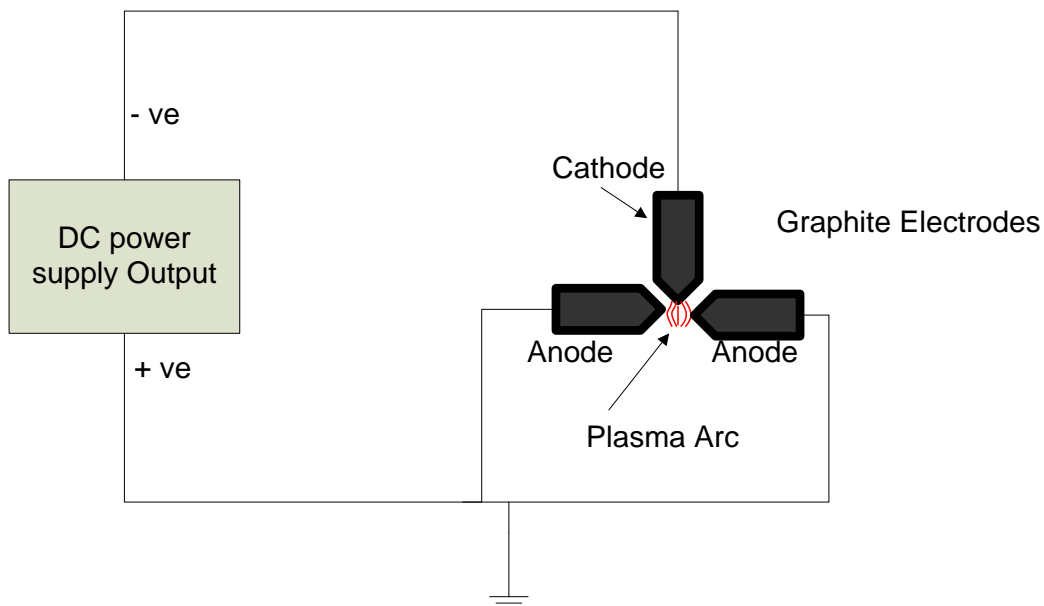


Figure 1 : Plasma Torch (Graphite Electrodes) Set up connected to 150kW DC power supply ( IGBT based)

**Factory Acceptance Test:**

1. The power supply will be tested at full ratings (125V, 800A) for continuous 20 hours operation on graphite plasma arc load at vendors premise. IPR will supply the electrodes arrangement for testing.
2. Vendor will have to make all necessary cooling arrangements for power supply.

**Site Acceptance Test:**

1. Vendor will demonstrate the power supply operation at full load (125V and 800A) for 20 hours continuous operation on graphite plasma arc load arranged by IPR.
2. The input cables will be arranged by IPR. The out cables are in the scope of vendors supply. The ratings of the cable should be as per IS standard.

| Sr. No. | Parameters  | Technical Specification of IPR   | Technical Specification of Vendor |
|---------|---|--|-----------------------------------|
| 1       | Inputs  | 3 phase, 415V, 50Hz  |                                   |
| 2       | Output<br>a) Open circuit voltage<br>b) Full load voltage<br>c) Full load current<br>d) Resolution<br>e) Source type  | 300V DC<br>125V DC<br>800 A (Current should be adjustable from 50A to 800A with resolution of 1A)<br>1 A<br>Constant current (Independent of the load voltage)   |                                   |
| 3       | Interlocks<br>a) Cooling water temperature<br>b) Water flow<br>c) Stack temperature<br>d) Over voltage<br>e) Over current<br>f) Single phasing<br>g) Emergency Off<br>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. Vendor should also provide a 5V TTL for external communications. This includes all analog control of power panel. |                                   |
| 4       | Meters & display<br>a) Input Voltage<br>b) Input Current<br>c) Output Voltage<br>d) Output Current<br>e) Water Temperature<br>f) Digital Multifunction Energy Meter<br>g) Stack temperature | DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>DPM (3 ½ digit)<br>0 – 50 Deg C (with set point control)<br>(with kW, kVA, PF, V, I readings)<br>0 – 100 Deg C (with set point control)   |                                   |

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| 5  | Indications<br>a) R, Y, B indications<br>b) All interlocks status<br>c) Mains ON<br>d) Power supply ON/OFF<br>e) All switches ON/OFF indications | All the indicators should be of reputed company and CE certified.  |  |
| 6  | Switches<br>a) Push button On<br>b) Push button Off<br>c) Emergency Off<br>d) Input voltage selector switch<br>e) Input current selector switch  | The on/off provision should also be done through external control through 5V TTL except emergency switches.  |  |
| 7  | Current setting pot  | A pot on the panel should be provided to set the required output current between zeros to full load current. The current setting should also be possible through external control through TTL.   |  |
| 8  | Grounding  | The positive output terminal should be grounded along with the panel body.   |  |
| 9  | External control   | A 5V TTL should be provided for external cut off and current control.  |  |
| 10 | Input and Output cable   | <ul style="list-style-type: none"> <li>■ Flexible copper conductor.</li> <li>■ Both input and output cables should be of 10 meter length each and should be of appropriate ratings as per the suitable IS standards for power cables.</li> </ul> |  |
| 11 | Input Power Factor   | 0.85 or better   |  |
| 12 | Efficiency   | 90% or above   |  |
| 13 | Current Regulation   | Current should be always within $\pm 1\%$ of the set value   |  |

|    |                     |   |  |
|----|---------------------|---|--|
| 14 | Cooling             | IGBT heat sink should be water cooled. The inlet and outlet connection port (manifold) should be provided. The chiller and compressor unit should be supplied by vendor. Water inlet and outlet should be through properly tight and mounted manifold.  |  |
| 15 | MCCB                | MCCB of suitable rating with shunt release coil should be there on the power supply panel.  |  |
| 16 | Acceptance Criteria | The pre-dispatch inspection will be carried out by the IPR engineers. The power supply would be tested for 20 hours continuous operation at full load i.e. 125V and 800A on the plasma torch supplied by IPR at the time of testing. The vendor should arrange the required electrical power capacity for testing of power supply at its premise.   |  |
| 17 | Users Manual        | Vendor should supply user's manual mentioning sequence of operation, bill of material, circuit diagram, wiring diagram with ferrules, troubleshooting chart, preventive maintenance chart etc.  |  |
| 18 | Warrantee           | Vendor should provide one year full warrantee of the complete unit from the date of installation and 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 to 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 |  |



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|    |                             | panel should be ash grey or light blue with matt finish. All fasteners in the panel should be made of SS 304.   |  |
| 20 | Certification of components | All switches, meters and controller should be of standard companies having CE certification for the components. All the components ratings and the wirings should be as per IS standards. |  |