TECHNICAL SPECIFICATION

FOR

100 kVA, 400 V, 20 kHz, SINGLE PHASE, SINE WAVE HIGH FREQUENCY POWER SUPPLY (HFPS) UNIT

INSTITUTE FOR PLASMA RESEARCH
BHAT, GANDHINAGAR – 382 428
GUJARAT, INDIA

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1. SCOPE OF SUPPLY

The scope of supply includes design, manufacturing, testing at manufacturer's works and supply, installation, acceptance testing of 100 kVA, 400 V, 20 kHz, Single Phase, Sine Wave High Frequency Power Supply (HFPS) unit at Institute for Plasma Research (IPR), Gandhinagar including all accessories and documentations as per the detailed technical specifications (including annexures) mentioned in this tender document.

2. SCOPE OF WORK

The scope of work includes, but not limited to, the following main tasks:

a) Design of high frequency power supply as per technical specifications specified in Section-4.
b) Submission of detailed engineering design report/documents, Quality Plan and detailed schedule as mentioned in Section-7 for IPR's review and approval.
c) Material procurement, fabrication, and assembly of the unit as per functional requirements.
d) Arrange the stage wise inspections as per agreed Quality Plan and implementation of modifications (if any).
e) Perform the Factory Acceptance Tests (FAT) as per approved acceptance test procedure complying the specifications as specified in Section-6.1
f) Upon receipt of dispatch clearance note from IPR, Pack and Deliver the power supply unit at IPR site as per Section-7.
g) Installation and interface/integration of power supply unit with input AC supply, Local/Remote control interface etc. (Refer Section-7).
h) Perform the Site Acceptance Tests (SAT) as per Section-6.2.
i) Provide operational and instruction manuals with full technical details. (Refer Section-7).
j) Provide training of the operation and maintenance for minimum 2 people at IPR.
k) Provide FAT and SAT reports with all tests results, to the IPR before final acceptance.
l) Provide technical support / supervision as required during HFPS unit Integration with other sub-systems (including control system interface, output connection etc.) and Commissioning of DC Power Supply (DCPS) system as per Section-6.3.
m) Provide technical support as per warranty clause.

3. APPLICATION DESCRIPTION

The 100 kVA, 400 V, 20 kHz, Single Phase, Sine Wave HFPS is intended to supply fixed frequency AC supply to Single phase, Centre-tap, Step-up (80 kVA, 400 V / 25kV- 0-25 kV RMS) ferrite core High Voltage (HV) Transformer which is connected

to Symmetrical Cockcroft-Walton (CW) Voltage Multiplier Unit to generate 500 kV, 100 mA, 50 kW DC power output. The load connected to this shall be DC Particle Accelerator OR Resistive Load Bank (for performance testing). The output voltage of CW-Multiplier unit shall be control and regulated from HFPS unit as shown in Figure-1.

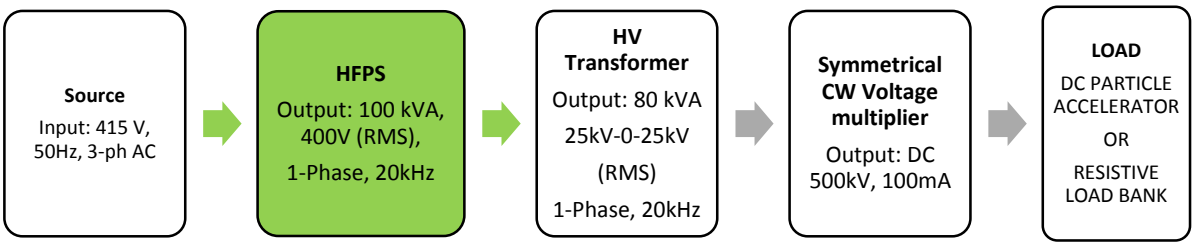

Figure 1: General Block Diagram of 500 kV, 100 mA DC Power Supply (DCPS)

4. TECHNICAL SPECIFICATIONS

The HFPS unit shall be designed and manufactured as per the technical specifications defined in Table-1.

Table 1: Technical Specifications

Sr. No.	Parameter	IPR Requirement
4.1	Input Specification	
a)	Input Line Voltage	3-Phase, 415 V ± 10%
b)	Input Frequency	50 Hz ± 3%
c)	Input Power Factor	≥ 0.9 (lagging)
d)	Input fault level	25 MVA
e)	Operating Temperature Range	0 ºC to 50 ºC
f)	Relative Humidity	10 % to 90 %
4.2	Performance Requirement	
a)	Nominal output Power	100 kVA
b)	Nominal output Voltage	400 V, Single Phase
c)	Nominal output Frequency	20 kHz
d)	Output voltage waveform	Sine wave
e)	Output voltage range	0 V to 400 V
f)	Output voltage regulation range	10 % to 100 % of nominal value OR Better
g)	Output voltage set resolution	2.5 % of nominal value OR Better

h)	Output voltage line regulation		≤ 1 % (for input voltage variation in the range of 415 V ± 10%)
i)	Output voltage load regulation		≤ 1% (for load variation from no load to full load)
j)	Output voltage stability (Long term for 8 hours of operation)		≤ 0.5 % after 1 hour warm-up (for input voltage variation in the range of 415 V ± 10%, at full load and upto 5 ^{o}C temperature variation within the specified operating temperature range)
k)	Duty		Continuous
l)	Overall efficiency		> 90%
m)	Cooling		Forced air cooling
4.3	Protection		
a)	Input side		i. Over / Under Voltage ii. Soft Start iii. Suitable circuit breaker (with over load, short circuit and earth fault adjustable protection settings)
b)	Output side		i. Thermal Overload ii. Short circuit iii. Over voltage (and any other as required for reliable operation of the unit)
4.4	Power supply termination		
a)	Input Cable type and length		1.1 kV grade XLPE Cable (maximum length 25 meters)
b)	Output Cable type and length		suitable copper conductor (maximum length 10 meters)
c)	Cable entry		Top only
4.5	Local Control and Monitoring Requirements (as per Annexure-I)		
a)	AC Input ON/OFF	To connect/dis-connect HFPS unit from mains supply	MCCB/Switch/Pushbutton with clear visual indication
b)	Control Mode Selection	Local/Remote	Selection switch with key
c)	Emergency shut-down	To shut-off power supply unit	Emergency Pushbutton with key
d)	HV DC ON/OFF	To connect/dis-connect HFPS unit from HV DC (CW-Multiplier)	HV DC ON/OFF switch with clear visual indication

e)	HV DC reference signal settings	To set HV DC (CW-Multiplier) parameters with coarse and fine variation	Provision for setting CW-Multiplier parameters (0 to 10 V signal linear) with Pushbutton/Touchpad
f)	HV DC protection settings	To set/configure HV DC protection threshold value	Provision for adjustable setting CW-Multiplier protection signals- i. Over current (OC) ii. Over voltage (OV)
g)	Power supply reset	To reset the unit to initial condition	Pushbutton/Touchpad
h)	Alarm		A continuous loud audible alarm shall be triggered in case of any fault/trip.
i)	Interlocks		Provision of two numbers of separate interlocks TTL signals to turn-off the power supply unit externally with clear indication of Open/Close status.
j)	Measurement / Metering		Display of measured parameters - i. Input Voltage, Current, Frequency, Power, and PF ii. HF Power Supply Output AC Voltage (rms), Current (rms), Frequency, Power. iii. HV DC (CW-Multiplier) Output Voltage and Current. (provision to be provided) Minimum resolution to nominal value
k)	Industrial Touch Panel Display (HMI)		Common Screen of suitable size to display important parameters, alarms, temperature etc. of integrated power supply system
l)	Local Control Panel Design		IP55 Degree of Protection
4.6	Remote Control and Monitoring Requirements		
a)	Computer		Industrial PC
b)	Digital Interface		Ethernet or RS-232/485 digital interface to be implemented.
c)	Graphical User Interface (GUI)		Lab-view GUI software based application to be provided

d)	Interface signals to be implemented (Digital and / or Hardwired)	Major measurement, status, control (ON/OFF/RESET), and programming/configuration of reference voltage / protection settings etc…
4.7	Applicable Standards	EN 61010 – 1 / IEC 60146 and other as applicable

5. TECHNICAL REQUIREMENTS

5.1 General:

a) The bidder holds the responsibility of design, manufacturing, factory acceptance testing, installation, site acceptance testing of 100 kVA, 400 V, 20 kHz, Single Phase, Sine Wave High Frequency Power Supply (HFPS) unit at the IPR (purchaser) site as per the detailed technical specifications mentioned in this tender document.

b) The HFPS unit shall be operated within it rated output voltage and power and integrated with other sub-system as shown in Figure-2 of Annexure-I to generate upto 500 kV, 100 mA, 50 kW DC Power to accelerate positive ion beam as per the scheme mentioned in Section-3.

c) The design of HFPS unit shall take into consideration the inductive coupling offered by DCPS sub-systems viz. HV Transformer, CW-Multiplier and load. The tentative leakage inductance of HV Transformer is 15% ± 10% tolerance. The actual reflected parameters of DCPS sub-systems as may be required to design the HFPS unit shall be provided during detail engineering.

d) The HFPS unit should be of industrial grade and robust in nature, which shall endure all the high voltage conditions.

e) Suitably rated protective devices and filters shall be employed against the input power lines voltage transients and to reduce harmonics in power lines.

f) The HFPS unit shall be designed to operate in closed loop. The actual voltage feedback signal from CW-Multiplier unit (0 to 500 kV) shall interface with HFPS unit controller for controlling the DCPS output voltage. The controller shall be properly tuned to provide a fast-feedback control.

g) Soft-start shall be present on the input side to alleviate turn-on stress.

h) The HFPS unit shall manage the drifts associated with temperature in control amplifiers, feedback loops, dividers, current shunts, control and monitoring signals, so as to ensure performance integrity.

i) Grounding/Earthing: The HFPS unit shall have suitable grounding, which ensures safer operation of the system under normal and abnormal conditions. All the lines

of power, control (analog and digital) shall be properly terminated to their respective returns.

5.2 Electrical:

a) All the termination (electrical cables entries) points shall be easily accessible to reduce the complexity while operation, alteration and maintenance activities.
b) All the current carrying parts shall be separated by physical barriers to ensure safety. All the terminals except AC earth shall be electrically isolated. Fuses and Circuit-breakers provided shall be easily accessible and properly rated so as for easy replacement.
c) There should be a clear and prominent "DANGER" Marking at the terminal block.
d) All insulated conductors except those within the confines of a PCB assembly, shall be of the suitable ratings, which are enough to withstand the maximum current and voltage during overload and/or fault/abnormal conditions.
e) All wiring shall be neatly secured in position and adequately supported. Where cables/wires pass through the metal panel; suitable size of cable glands shall be used. All the wires and cables used shall be of low smoke zero halogen fire retardant as per IS 1554 and IS 694 or IEC 61034 with latest amendments and they shall be properly rated to prevent excessive heating. Proper indication on cable shall be provided for all the cables.
f) The associated AC, DC connections, control, alarms and interface cable connecting the unit shall be connected/disconnected easily without causing any interruption in the supply and damage to load or other circuits. All live parts AC, DC, and control, alarm and monitoring cables interconnecting the units shall be easily disconnected by plugs and connectors.

5.3 Assembly and Mounting arrangement:

a) The HFPS unit enclosure shall be made up of rigid and self-supporting structure of suitable steel sheet/profiles and shall be free of sharp edges/corners. The structural strength of the unit shall be such as to withstand its ultimate mechanical load without any deformity. The base of unit shall ensure uniform floor loading. The gauge of steel that is used for the fabrication of HFPS unit shall not be less than 2.5 mm (minimum).
b) Lifting facilities shall be provided by removable eyebolt located at the top of the unit or by any other means which ensure the portability. Top of the unit shall be fully covered except for ventilation and/or cable entries. The necessary arrangement for fixing the unit on the floor shall also be provided.
c) The enclosure sides of the HFPS unit shall have suitable ventilating arrangements. Each air flow vent shall be covered by a gill to prevent the entry of foreign material

larger than 2 mm. The front and rear door (if provided shall be of hinged type and shall have proper arrangement for ventilation.

d) The HFPS unit shall be designed for easy maintenance and installation. The unit mounting arrangement shall be such as to provide easy access from front, rear and top for installation and maintenance activities.
e) The HFPS unit shall be made standalone with a rigid framework with bottom clearance of 100 mm for ease of transportation.
f) All the doors of the HFPS unit shall be equipped with the cabinet locks with keys (either distinctive or same for all doors). All the doors shall be provided with neoprene rubber gasket to make the panel compartments dust proof.
g) Cooling: Ample number of exhaust/blow fans with proper ratings should be employed; these fans should be of die-cast aluminium painted black with grills.
h) The bidder shall ensure good workmanship while manufacturing/fabrication process of the HFPS unit.

5.4 Control, Protection and Monitoring:

a) The HFPS shall be operable in local and remote mode.
b) In local mode, HFPS unit shall be integrated with other sub-systems viz. HV Transformer, CW-Multiplier unit of DC Power Supply (DCPS) System and Load and operated from Local Control Panel. In this mode, all the control functions at the local panel should be enabled. The DCPS shall be operated manually in person with local controls and the HFPS unit shall comply with the control and monitoring requirements specified in Section-4.
c) The HFPS local controller shall derive over voltage and over current signals from the interfacing feedback signal received from CW-Multiplier for disabling the pulses to HFPS power circuit.
d) Local control panel as part of scope of supply of HFPS unit shall be preferably located outside the high voltage area for personnel safety and accessibility during operation. The distance between power panel and control panel of HFPS unit shall be maximum of 15 meters.
e) In remote mode, the HFPS unit shall be operated remotely through external controller/Computer. The interfaces shall be of hardwired signal and digital through Ethernet / RS 485/232. The hardwired signals for AC Mains ON/OFF/RESET and HV ON/OFF/RESET/OK of potential free contract shall be provided. Analog/Digital programming of the output voltage of DCPS system and monitoring of output voltage and current shall be done via 0-10 V signal. In this mode all the local panel controls should be disabled apart from L/R selector and emergency switch. The HFPS unit shall comply with the control and monitoring requirements specified in Section-4.

f) Remote control computer as part of scope of supply of HFPS unit shall be located about 20 meters from the power panel.

g) The HFPS unit shall have provision to inhibit high voltage output in less than 60 microseconds in case of major faults. In case of any alarm or trip signal activation the local controller shall disable the gate pulse to IGBT.

h) HFPS local controller shall follow the state transition steps as depicted in Figure-3 of Annexure-I.

i) Various protections setting viz. for over voltage, over current etc. incorporated in HFPS unit shall be user settable.

j) The HFPS shall have automatic crossover from constant voltage to constant current regulation mode to provide protection against overload, arcs and short circuits. The power supply should trip with over current protection, if the operational current is higher than the set over current, for ensuring safe operation.

k) The HFPS unit shall have a dedicated controller either of DSP/FPGA/any other type of advance controller capable of meeting the specified functional specifications without failure.

l) The HFPS unit may also consider PLC based slow controller for interfacing with status monitoring or slow signals received from other sub-systems of DCPS.

m) Suitable touch panel computer can be used to deploy human machine interface (HMI) application for harsh industrial environment with extended temperature range of -20 ^{o}C to 60 ^{o}C shall be provided in Local Control Panel.

n) The touch panel computer shall display various major parameters of HFPS unit and other sub-systems of DCPS viz. AC Mains Voltage, Current, Power, Power Factor, HV output voltage current, faults, alarms, history, soft command buttons etc. configuration parameters, threshold values and data between Local controller and touch panel shall be shared.

o) Tentative scheme of HFPS unit interface with other sub-system of DCPS is shown in Figure-4 of Annexure-I also the list of various interfacing signals within the HFPS unit and field signals is also given in Annexure-I. The details shall be submitted and proposed by bidders during the design phase after the award of contract.

6. ACCEPTANCE TESTS

6.1 Factory Acceptance Tests (FAT):

The following are some major tests that are to be performed by the supplier to demonstrate compliance of the HFPS unit as per the contract specifications prior to the shipment. All the related test equipment, fixtures, measuring instruments, test-setup etc., shall be arranged by the supplier. Supplier shall submit a FAT template to IPR for review and approval. The details of the test template and testing procedure shall be done on mutual agreement after the award of contract. IPR representative shall witness the FAT at manufacturer's works.

a) Heat run test for 8 hours of continuous operation and its stability measurements at rated output voltage and current/power. During this test, temperature raise of crucial power components shall be monitored / recorded.
b) Test for efficiency at rated voltage and current/power.
c) Test for checking voltage at crucial test points inside the HFPS unit along with its output voltage and current/power calibration.
d) Protection and Interlock test to check the inhibition of the output in less than 60 microseconds.
e) Functional tests for effective operation and protection of HFPS unit. Different faults like over voltage, over current, over temperature and regulation errors shall be checked.
f) Burn-in test on control circuit.
g) Test for checking Ethernet / RS232/485 interface communication for remote control operation.

The detailed test report including the test results shall be prepared by the supplier and submitted to purchaser for approval/ acceptance for dispatch clearance.

6.2 Site Acceptance Tests (SAT):

After the installation of HFPS unit at IPR site the SAT shall be performed in-line with FAT by the supplier. IPR at its discretion may prescribe all or a reduced subset of FAT tests to be performed at the IPR site.

After the completion of SAT, the detailed test report including the test results shall be prepared by the supplier. The representative IPR and Supplier shall jointly sign the SAT test reports.

6.3 Integrated Testing & Commissioning:

ONLY TECHNICAL SUPPORT / SUPERVISION TO BE PROVIDED

Upon complete installation and integration of each sub-system/unit (including HFPS Unit, HV Transformer, CW-Multiplier Unit, and Load) of DCPS system, the

commissioning tests of integrated system shall be performed to verifying the stability and functionality of the complete 500 kV, 100 mA DC Power Supply System. The DCPS will be connected to 3-Phase 415 V input line and tested upto 500 kV, 100 mA DC on resistive load bank. During the tests all functions shall run concurrently and equipment/devices shall run in continuous mode. The integrated system tests shall include but not limited to the following tests:

- Heat run test shall be carried out within rated parameters for 8 hours of continuous operation. During this test crucial performance parameters mentioned in the specification like voltage regulation, input power factor, overall efficiency etc., shall be checked.
- Operational check of the feedback control loop with proper tuning of controller.
- Operational check of the disabling of driving pulses of the semiconductor devices through injection of all the tripping commands as specified in this tender document.
- Checking of all monitoring and controlling parameters as listed in this tender document from Local control panel and Remote PC.

7. CONTRACT MANAGEMENT

7.1 Contract Execution Schedule:

The required delivery schedule for all the deliverables is ***on or before 8 months from the date of approval of design and drawings submitted by the bidder after the award of contract***. A preliminary project execution schedule which meets the overall delivery duration with major activities and milestones shall be submitted along with the bid. However, the bidder should submit a detailed project execution schedule which meets the targeted delivery time after award of contract. This project execution schedule may include; design, component procurements, manufacturing, FAT, delivery milestone, installation and SAT etc.

7.2 Quality Assurance Plan (QAP):

The HFPS unit shall be manufactured in conformance with the international and/or national standards/codes to assure the quality and reliability of the HFPS unit. Bidder should specify all the applicable standards followed. Bidder shall prepare a QAP or a manufacturing inspection plan which ensures the operational quality of the deliverables items under this contract. The same shall be submitted to IPR of its review and approval. QAP shall provide details of inspections/tests that will be carried out at various stages of the contract like design, engineering, procurements, manufacturing, assembly and testing.

7.3 Engineering Design Report (EDR):

After the award of contract, supplier should submit an Engineering Design Report (EDR) for the HFPS unit and Dummy Load based on the technical proposal submitted during the bid for IPR approval. This report shall include following minimum submission documents -

a) Design calculations (electrical, thermal, mechanical etc.) and simulation reports including selection, and sizing of components shall be submitted
b) Engineering design and drawings including GA drawings and electrical schematic drawings.
c) Control block and schematic diagrams indicating Local / Remote controller interface etc.
d) Cabling diagram and cable schedule with proper terminal block numbering.
e) List of all accessories, and bill of materials (BOM).
f) Test certificates and data sheets of all the bought-out major components viz. semiconductor devices; heat sinks, passive components like capacitors, resistors, inductors; current/voltage measuring sensors, protective elements, etc. used for making of HFPS unit shall be provided.

7.4 Factory Acceptance Tests (FAT):

FAT shall be performed by the supplier to demonstrate compliance of the HFPS unit as per contract specifications before effecting the shipment, as per Section-6.1.

7.5 Operating and Instruction Manual:

The supplier shall submit 3 sets of document / technical literature in English language with complete layout, GA Drawings, detailed block diagrams and circuit diagrams of its assembly with test voltages at different test points of the unit. All aspects of installation, operation, maintenance and troubleshooting instructions as specified below shall be covered in this manual.

a) Safety measures to be observed in handling of the equipment.
b) Illustration of internal and external mechanical parts.
c) Precautions at the time of installation, operation and maintenance.
d) Procedures for trouble shooting, replacement and routine/preventive maintenance.
e) Steps of remedial measures for troubleshooting the faults.
f) Required Test Jigs and fixtures.
g) Test instruments, test fixtures, accessories and tools required for maintenance and repair.
h) List of replaceable parts used with the sources of procurement.
i) A table giving details of sizes and dimensions of cable used
j) Remedial steps for typical faults.

7.6 Material Dispatch/Packing and Delivery:

After the review and approval of FAT report, a Dispatch Clearance Note shall be issued to supplier by IPR. All the deliverables (hardware and documents) shall be dispatched only after receiving a dispatch clearance note from IPR. However, a mere clearance issued by IPR will not relieve the supplier from the liability of proper functioning of HFPS unit at IPR Laboratory.

Appropriate safe packing, transportation (including Insurance) to IPR site are under the scope of the supplier, which shall include (but not limited to) a necessary list of documentation and appropriate packing, markings, labelling for the deliverables items. It must be noted that IPR shall not be liable for any of the damages cause during transit of the deliverables. The detailed packaging and transportation scheme shall be submitted to IPR well in advance.

7.7 Site Description:

The laboratory/delivery site is located in the **Institute for Plasma Research Campus, Near Indira Bridge, Bhat, Gandhinagar – 382 428, Gujarat, India**. The laboratory, where the HFPS unit is to be installed is situated at ground floor level in IPR New Auxiliary Building.

7.8 Unloading and Storage:

Bidder is responsible for unloading of the HFPS unit and Accessories at proper locations at the site and verification of unit for damages and short supplies, making good all such damages and short supplies. The HFPS unit, Dummy Load and accessories shall be stored at Bidder's responsibility until final acceptance and taking over by IPR.

7.9 Installation:

Bidder is responsible for installation of the following items-

i. HFPS unit.
ii. Local Control Panel and Remote PC.
iii. Laying and termination of all type of interface cables viz. PVC insulated control cables, fibre optic cable, communication cables etc. between the HFPS / Local Control Panel / Remote PC. (within the scope of supply as per Annexure-I)

Any material or accessory which may not have been specifically mentioned but which is necessary shall be supplied at no extra cost to IPR.

7.10 Site Acceptance Tests (SAT):

SAT shall be performed by the supplier to demonstrate compliance of the HFPS unit as per contract specifications after effecting the installation, as per Section-6.2.

7.11 Final Acceptance:

A final acceptance note shall be issued by IPR to the supplier after successful completion of SAT (and after resolving issues completely, if any) at site and submission of "As-built" marked-up drawings incorporating all modifications/changes made during manufacturing, testing and installation of the HFPS unit. The date of issuance of final acceptance note shall be considered as the date of final acceptance.

7.12 Training:

The supplier has to arrange technical training of two representatives from IPR either at manufacturing site or at IPR mutually agreed upon to familiarize about various sub-systems, operation and maintenance of this power supply. The cost of travel and stay (if any) will be borne by IPR.

7.13 Warranty:

Supplier should provide a minimum of one year standard warranty for all the deliverables (HFPS unit and all its accessories) thereof from the date of final acceptance issued by IPR.

Additionally, an optional one year extended warranty from the date of expiry of above specified minimum warranty is to be quoted separately.

Annexure-I

HFPS UNIT INTEGRATION AND INTERFACE DESCRIPTION

HFPS unit as mentioned in Section-3 and shown in Figure-2 below shall be integrated at site with HV Transformer, CW-Multiplier to generate 500 kV, 100 mA DC Power output. The DC Power Supply shall be connected to Resistive Load Bank for integrated testing and commissioning of 500 kV, 100 mA DC Power Supply (DCPS) system.

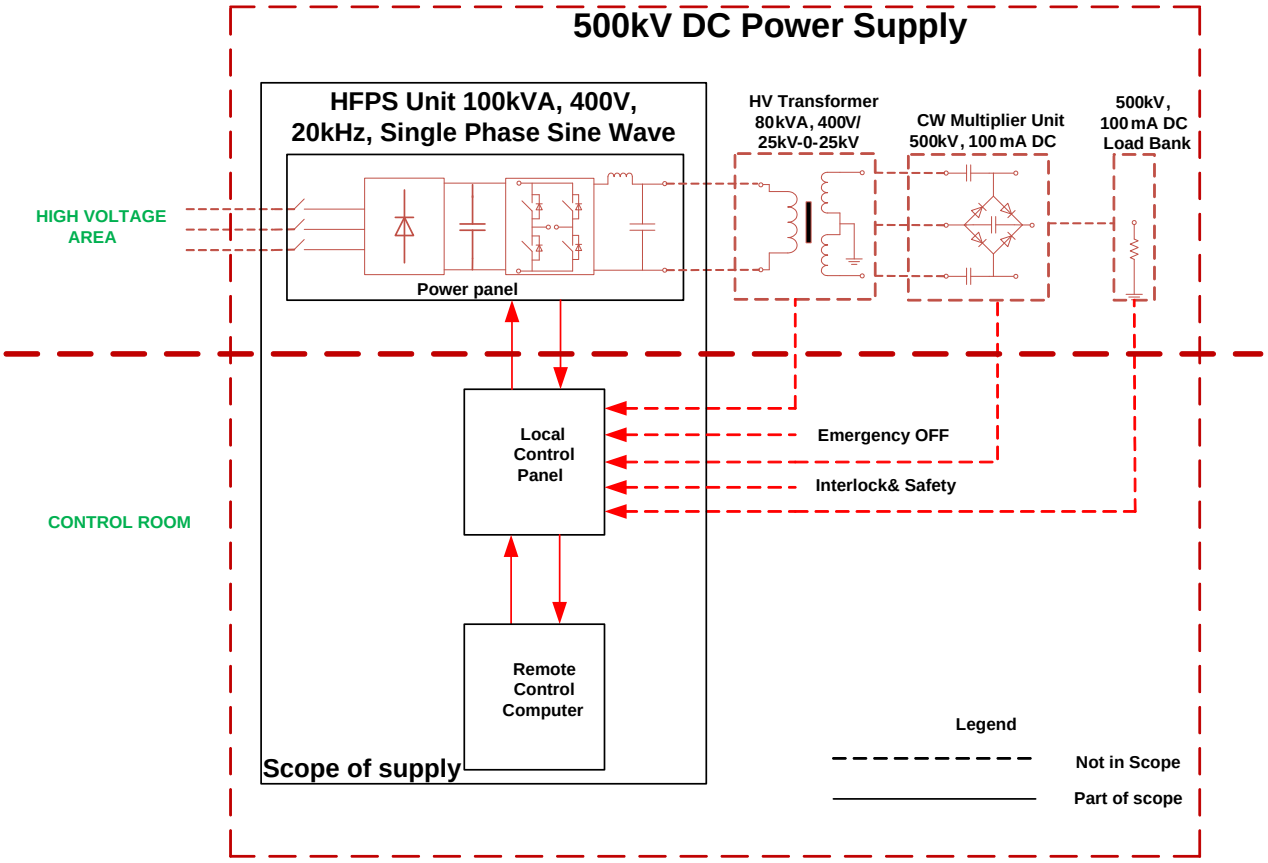

Figure-2: HFPS Unit Integration Diagram

The HFPS unit shall follow the state transition steps as shown in Figure-3 below.

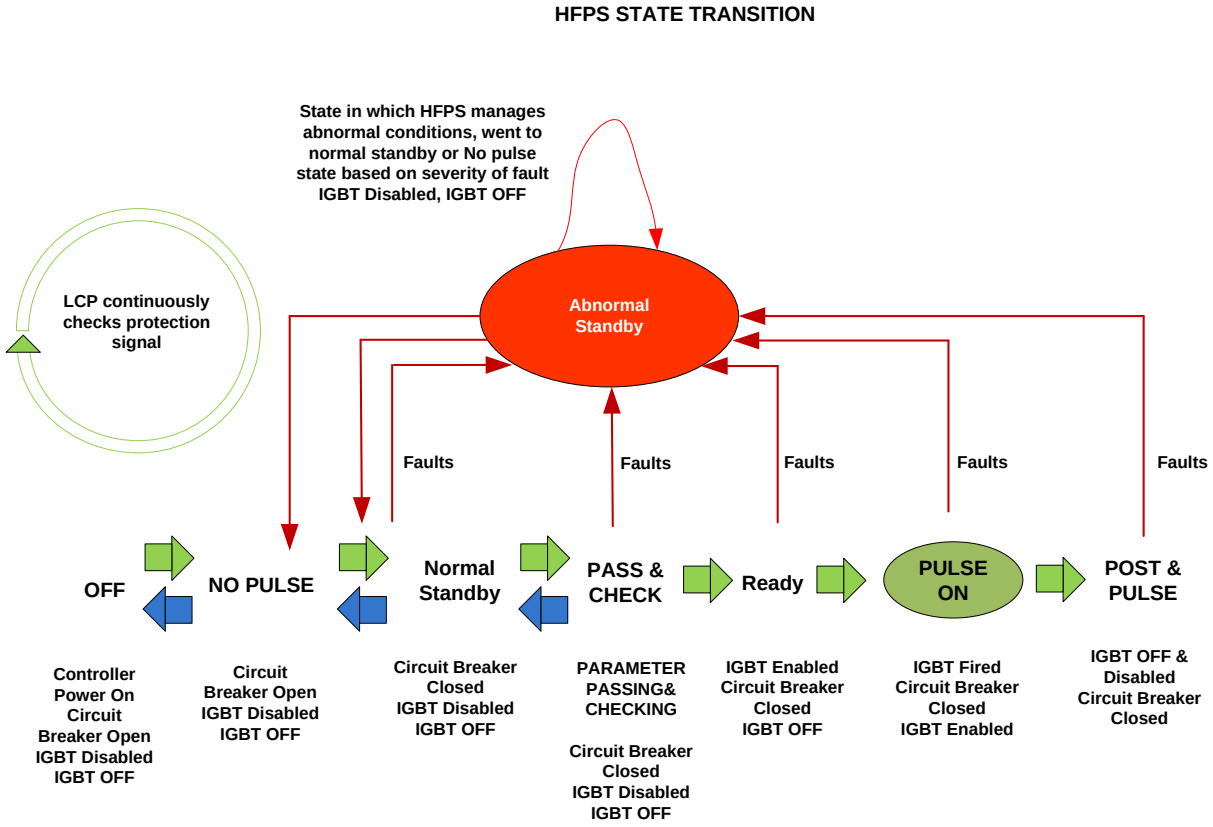

Figure-3: HFPS Unit State Transition

The interface within HFPS unit and between HFPS unit and other sub-system of DCPS (field) is shown in Figure-4 below.

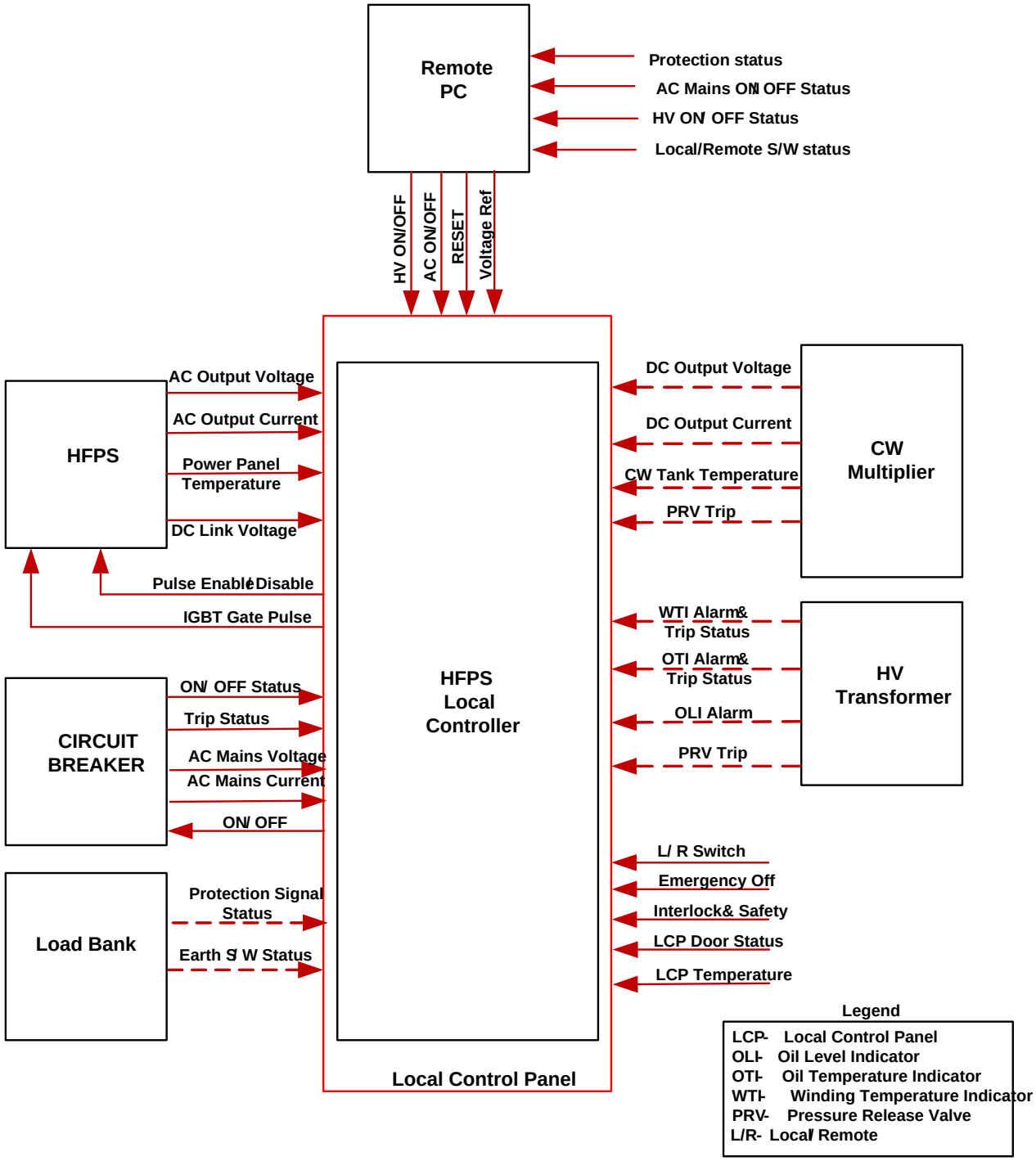

Figure-4: HFPS Unit Field Interface Diagram

The Table-2 below lists the minimum signal interface requirement. The exact number and description (physical type and signal type) of analog and digital signals shall be decided during detail engineering. The HFPS local controller shall have minimum 20% spares provision for interface signals.

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Table 2: Interface Signal List

Sr. No.	Signal	Physical Type	Signal Type	From	To
1.	Interface within HFPS unit i.e. between HFPS Power Panel and Local/Remote Controller				
a)	Thyristor/IGBT Gate pulse			Local Controller	HFPS Power Panel
b)	AC Mains Voltage	Wired	0 – 10 V	HFPS Power Panel	Local Controller
c)	HFPS DC link voltage	Wired	0 - 10 V	HFPS Power Panel	Local Controller
d)	HFPS AC output voltage	Wired	0 – 10 V	HFPS Power Panel	Local Controller
e)	HFPS AC output current	Wired	0 – 10 V	HFPS Power Panel	Local Controller
f)	HFPS Power Panel Temperature sensor	Wired	4-20 mA	HFPS Power Panel	Local Controller
g)	Local / Remote Switch status	Wired	PFC	LCP	Local Controller
h)	Power enable/disable	Wired	PFC	LCP	Local Controller
i)	Door status switch	Wired	PFC	LCP	Local Controller
j)	Local Control Panel Temperature sensor	Wired	PFC	LCP	Local Controller
k)	Emergency OFF	Wired	PFC	LCP	Local Controller
l)	Interlock & Safety	Wired	PFC	LCP	Local Controller
m)	HV DC Reference Input	Wired		LCP	Local Controller
n)	Protection settings: Over voltage and current threshold	Potentiometer		LCP	Local Controller
o)	AC Mains Circuit Breaker ON/OFF/Trip Status	Wired	PFC	HFPS Power Panel	Local Controller

p)	Circuit Breaker ON/OFF operation request	Wired	PFC	Local Controller	Circuit Breaker
q)	IGBT pulse enable/disable OR HV DC ON/OFF	Wired	PFC	Local controller	HFPS Power Panel
r)	IGBT pulse			Local controller	HFPS Power Panel
s)	AC Mains ON/OFF status	Wired	PFC	Local Controller	Remote PC
t)	HV DC ON/OFF status	Wired	PFC	Local Controller	Remote PC
u)	HFPS Protection Trip status	Wired	PFC	Local Controller	Remote PC
v)	Local/Remote Switch status	Wired	PFC	Local Controller	Remote PC
w)	AC Mains ON/OFF operation request	Wired	PFC	Remote PC	Local Controller
x)	HV ON/OFF operation request	Wired	PFC	Remote PC	Local Controller
y)	DCPS Reset	Wired	PFC	Remote PC	Local Controller
z)	Reference Voltage	Wired	0-10 V	Remote PC	Local Controller
aa)	Communication Link		Ethernet / RS484/232	Remote PC	Local Controller
2.	Interface between HFPS unit Local/ Remote Controller and sub-systems of DCPS				
a)	CW-Multiplier DC output Voltage	Wired	0-10 V	CW-Multiplier	Local Controller
b)	CW-Multiplier DC output Current	Wired	0-10 V	CW-Multiplier	Local Controller
c)	CW-Multiplier HV tank temperature sensor	Wired	4-20 mA	CW-Multiplier	Local Controller
d)	CW-Multiplier HV tank pressure sensor	Wired	4-20 mA	CW-Multiplier	Local Controller
e)	CW-Multiplier HV tank pressure relief device trip	Wired	PFC	CW-Multiplier	Local Controller
f)	CW-Multiplier HV tank temperature sensor trip	Wired	PFC	CW-Multiplier	Local Controller
g)	HV Transformer Buchholz Relay (Alarm & Trip)	Wired	PFC	HV Transformer	Local Controller
h)	HV Transformer WTI (Alarm & Trip)	Wired	PFC	HV Transformer	Local Controller

i)	HV Transformer OTI (Alarm & Trip)	Wired	PFC	HV Transformer	Local Controller
j)	HV Transformer MOG (Alarm)	Wired	PFC	HV Transformer	Local Controller
k)	HV Transformer Pressure Relief Valve (Trip)	Wired	PFC	HV Transformer	Local Controller
l)	Load Bank protection signal status	Wired	PFC	Load Bank	Local Controller
m)	Earth Stick Monitor status	Wired	PFC	Earth Stick	Local Controller

Annexure – II

TECHNICAL BID COMPLIANCE

Bidder must submit along with the bid the following documents –

a) Conceptual technical proposal including GA drawings, Block Diagrams etc.
b) Thermal analysis and basis of components selection
c) Tentative Bill of material (BOM)
d) Proof of concept/topology together with simulation report/results
e) Suggested spares.
f) Data sheet (Table – 3) duly filled in data against each parameter. Just filling "complied" shall not be accepted, the actual value have to be indicated.
g) Tentative contract execution schedule defining major activities / milestones

During the evaluation of technical bids, IPR shall review the submitted technical proposal and may seek further clarifications/discussions with the bidder to ascertain feasibility or viability of the same. If the proposal is found to be incapable of meeting the technical specifications, the bid shall be technically disqualified.

Table 3: Data Sheet

Sr. No.	Parameters	Unit	Bidder's Data
1.	General		
a)	Name of Manufacturer		
b)	Input Line Voltage	Volt	
c)	Input Frequency	Hz	
d)	Input Power Factor	≥	
e)	Operating Temperature	^{o}C	
f)	Relative Humidity	%	
2.	Design		
a)	Design Topology/Configuration	Provide tentative schematic design drawing and simulation results	
b)	Nominal output Power	kVA	
c)	Nominal output Voltage	Volt	
d)	Nominal output Frequency & Phase	kHz, Single/Three Phase	
e)	Number of output phases	Single/Three phase	
f)	Output voltage waveform		
g)	Output voltage range	Volt	
h)	Output voltage regulation range	%	
i)	Output voltage set resolution	%	
j)	Output voltage line regulation	%	

	(for input voltage variation in the range of 415 V ± 10%)		
k)	Output voltage load regulation (for load variation from no load to full load)	%	
l)	Output long term (8 Hrs.) voltage stability (for input voltage variation in the range of 415 V ± 10%, at full load and upto 5 °C temperature variation within the specified operating temperature range)	%	
m)	Duty	%	
n)	Overall efficiency	%	
o)	Cooling	Forced / Natural Air	
p)	Power Panel Design (Degree of Protection)		
q)	Applicable Standards	List all interface signals to be implemented	
3.	Protection		
a)	Input side	List all protections provided	
b)	Output side	List all protections provided	
4.	Termination		
a)	Input Cable type and length (in meters) provided		
b)	Output Cable type and length (in meters) provided		
c)	Cable Entry	Top/Bottom	
5.	Power Panel Overall dimensions & shipment weight	Meters / kg	
6.	Local Control Panel Design		
a)	Make and Type		
b)	Mode of Operation	Local/Remote	
c)	Control Mode	Open / Close Loop	
d)	Controller Type, Manufacture		
e)	Interface hardwired signals	List all monitoring and control interface signals to be implemented	
f)	Industrial Touch Panel Display (HMI) provided: if yes		

	Type, model no. , make, processor, memory, screen display size. etc…		
g)	Local Control Panel Design (Degree of Protection)		
h)	Cooling	Forced/Natural Air	
i)	Dimension & Shipment Weight	Meter / kg	
7.	Remote Control Design		
a)	Computer Type, model, make, processor, memory (RAM/Hard disk), monitor size etc…		
b)	Digital Interface / Protocol	(Ethernet / RS-232/485)	
c)	Graphical User Interface (GUI)	Software application	
d)	Interface signals (Digital and / or Hardwired)	List all monitoring and control interface signals to be implemented	