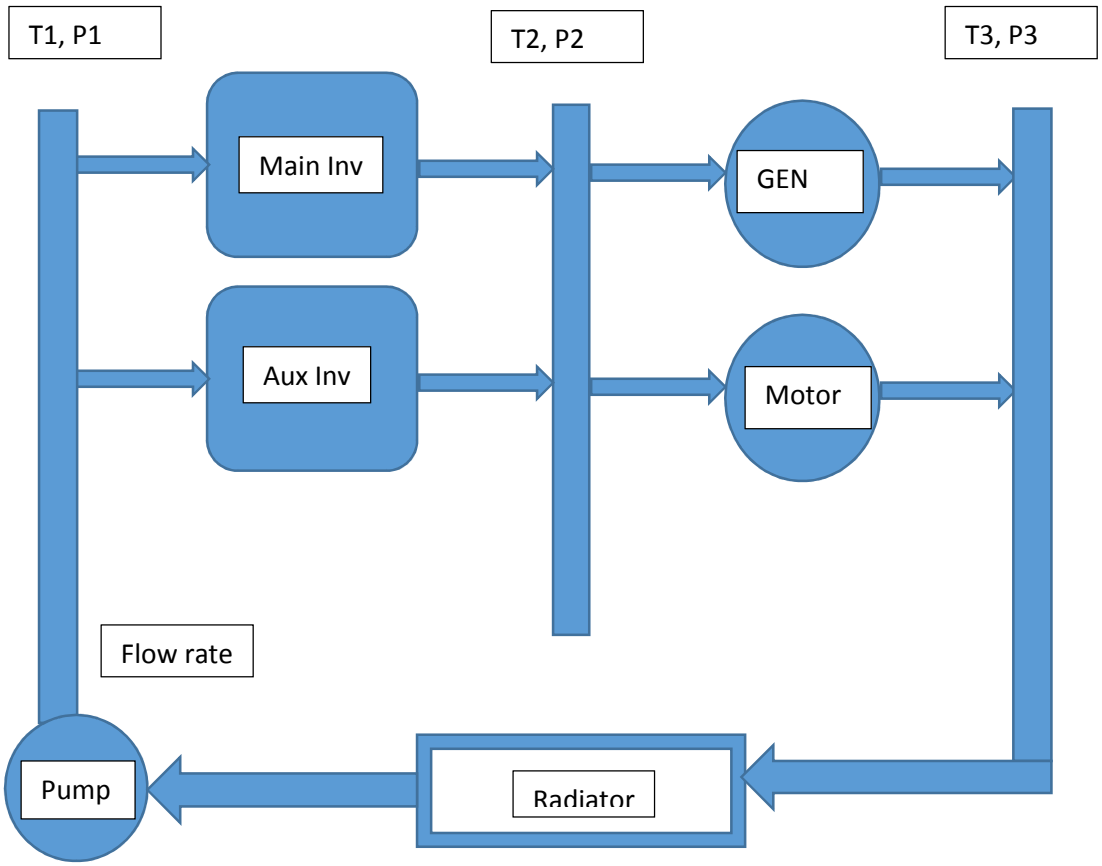
Traction inverter for testing the Traction Induction motor and Permanent Magnet Motor for electric vehicle Application		
S.No	**Description**	**Rating / Requirement BHEL**
1	**Application**	The liquid cooled 3-Ph traction grade inverter is being planed to use In a test setup where the developed induction motor and permanent magnet motor is under test.
2	**Scope of supply**	
	A). Traction inverter with controller	The Liquid cooled traction inverter system broadly classified into IGBT power module and the DSP based controller. The IGBT stack shall consists of DC link capacitance, 2-level 3-Ph inverter with gate drivers, individual line current sensors, DC link voltage sensor and temperature sensors for stack & PCB. The DSP based controller shall be a Texas Instruments make DSP processor with a provision to interface from external. All the power terminals of DC link (positive and negative) and 3-Ph line terminals shall be brought out. The control interface I/O signals which are configured with DSP shall be brought out to a single connector. The total system has to be enclosed in a container meeting to IP67 enclosure. The water cooled circuit (inlet and outlet) shall be brought out for connecting with the cooling system.
	B). Drive Control software with HMI interface for induction motor and permanent magnet motor	The scope also includes the drive control software for the V/Foperation and sensored or sensor less vector control operation of both induction motor and permanent magnet motor. The HMI should also be part of the control sotware for monitoring and changing the system parameters.
3	**Quantity of supply**	1. Traction Grade Inverters with controller - 3 No's 2. Complete Drive control software along with HMI - 1 set. 3. Special tools - 1 Set (As optional)
4	**Continuous Power**	170 kVA
5	**Peak Power Output**	220 kVA for 10 sec for every 5 minutes duration.
6	**Input DC Voltage range**	500 VDC to 750 VDC
7	**Operating frequency Range**	5 Hz to 500Hz
8	**Type of Cooling**	Liquid Cooling
9	**Switching frequecny**	operating switching frequency is 6 kHz
10	**DC Capacitance**	minimum of 1.25 mF
11	**Enclosure**	IP67
12	**Control supply for electronics**	18- 32 V
13	**Communication to external world**	The DSP controller should have CAN Interface communication and RS-232.
14	**Configured Interface DSP signals to external world**	The Interfaced Signals shall cover the following signals 1. Resolver signals for position estimate of Machine. 2. Encoder for speed sensing of the machine. 3. Motor temperature. 4. Digital Input & Output two each. 5. Analog Input & Output two each. 6. Two set of CAN communication signals. 7. Power supply. The signals termination has to be mentioned in the offer.
15	**DSP programming**	The DSP processor shall have the provision of developing a software for drive control application by the user.
16	**Gate driver Circuit**	The inverter shall be supplied with compatible gate driver circuits with dv/dt and di/dt protections.
17	**Hydraulic & Temperature data of cooling system**	The supplier should mention the hydraulic data like flow rate, pressure, pressure drop and temperature details like input temperature, temperature gradient etc. The cooling system arrangement is given in annexure-1.
18	**Protection features**	The inverter system shall have the protection functions against the DC overvoltage, over current and temperature limits
19	**Drive control Software**	**The drive control software for operation of both induction motor and permanent magnet motor**
	A). Features of Drive Control Software	The drive control software is for both induction motor and IPPM motor. The drive control software shall have the latest vector control with sensor or sensorless control feature, V/F control, Catch on fly and other drive control features. The software shall have the provisions to change the control loop PI gains, ramp-up/down and feeding the machine parameters. The software shall run with different ratings of motors by only changing the motor parameters.
	B). HMI system	The HMI software shall be a windows based application software. The HMI software shall have the provision of programming the control software by the user, monitoring the parameters of the inverter and also monitor the waveforms (like a scope). The CAN communication configuration has to be enabled or established using the software.

	General	
1	**Size and weight of the inverters**	The inverters size and weight shall be as less as possible. The weight should be less than 35 kG and the size should fit into 500 x 500 x 200 mm (LxBxH).
2	**Instruction Manual**	The supplier shall provide the hard copy of the instruction, troubleshooting and commissioning manuals
3	**Warranty**	The supplier shall provide the warranty of 18 Months from the date of supply or 12 months from the date of commissioning, whichever is earlier.
4	**Tools for maintenance**	If any special tools are required for assembly and maintenance purpose, the same shall be offered seperately.
5	**Test reports**	Prior to Inspection, test reports of the inverter testing has to be submitted, based on the submitted test reports the BHEL will decide whether to carry out the inspection or not.
6	**Inspection**	Inspection shall be carried out to witness the drive control operation on one of the motor and inverter thermal design. If the facility is not available, the same shall be carried out at BHEL R&D, Hyderabad.

Annexure -1

Liquid Cooling System Arrangement of IGBT based 3Ph Inverter System



Note:

The design Consideration of the inverter has to be mentioned i.e.. Inlet temperature, pressure drop, flow rate of the liquid at ambient temperature.

T1: Inlet temperature; P1: Pressure at the inlet

T2: Outlet Temperature; P2: Pressure at the outlet

ΔT : Temperature Gradient;

ΔP : Pressure Gradient: