ANNEXURE I

Specification & scope of work for " Multi Component Gas Separation test Rig"

1. Design, supply, assembly and commissioning of the "Multi-component gas separation Test rig" as per the schematic layout given in Drawing No: CTI/CDM/09/CO2/01 Dt: 08-08-2009 and the specifications for the of components listed in Annexure II.

2. The system should be installed and commissioned in CTI lab in BHEL, Bangalore and demonstrated for the operations.

3. Design, supply, assembly, commissioning and testing of this Experimental set-up for 'multi-component gas separation test rig' should be as per latest applicable national/international standards including applicable legal & safety regulations.

4. Hydrogen and methane being highly inflammable & explosive gas is required to be handled carefully. Accordingly all equipment / parts forming the hydrogen gas facility are required to meet international standards / specifications so as to make the systems highly reliable. However, in case of oxygen, carbon-dioxide, Argon and nitrogen gases, indigenous components of reputed make and conforming to Indian standards and regulations can be used.

5. The complete gas handling system including piping, regulators and other associated items are to be designed so as to result in optimum efficiency of cylinder gas usage. Therefore, considering the pressure required at the user end and other pressure drops in the system, system should be designed in such a manner that BHEL should be able to use more than **85 %** of gas contained in filled cylinders.

6. Besides above, the supply and installation of required instrumentation including safety instruments like flashback arrestors, regulators, pressure

gauge, vent valves, pressure relief valves shall also be in the scope of this contract. Connections from individual cylinders to manifold end shall be of stainless steel lined / reinforced Flexible Hoses to enable easy adaptation to the cylinders of various capacities available in the market.

7. The scope of work also includes securing arrangement of individual cylinder with rigid frame to avoid their accidental falling after their installation on battery banks including protection against incident of earthquake etc.

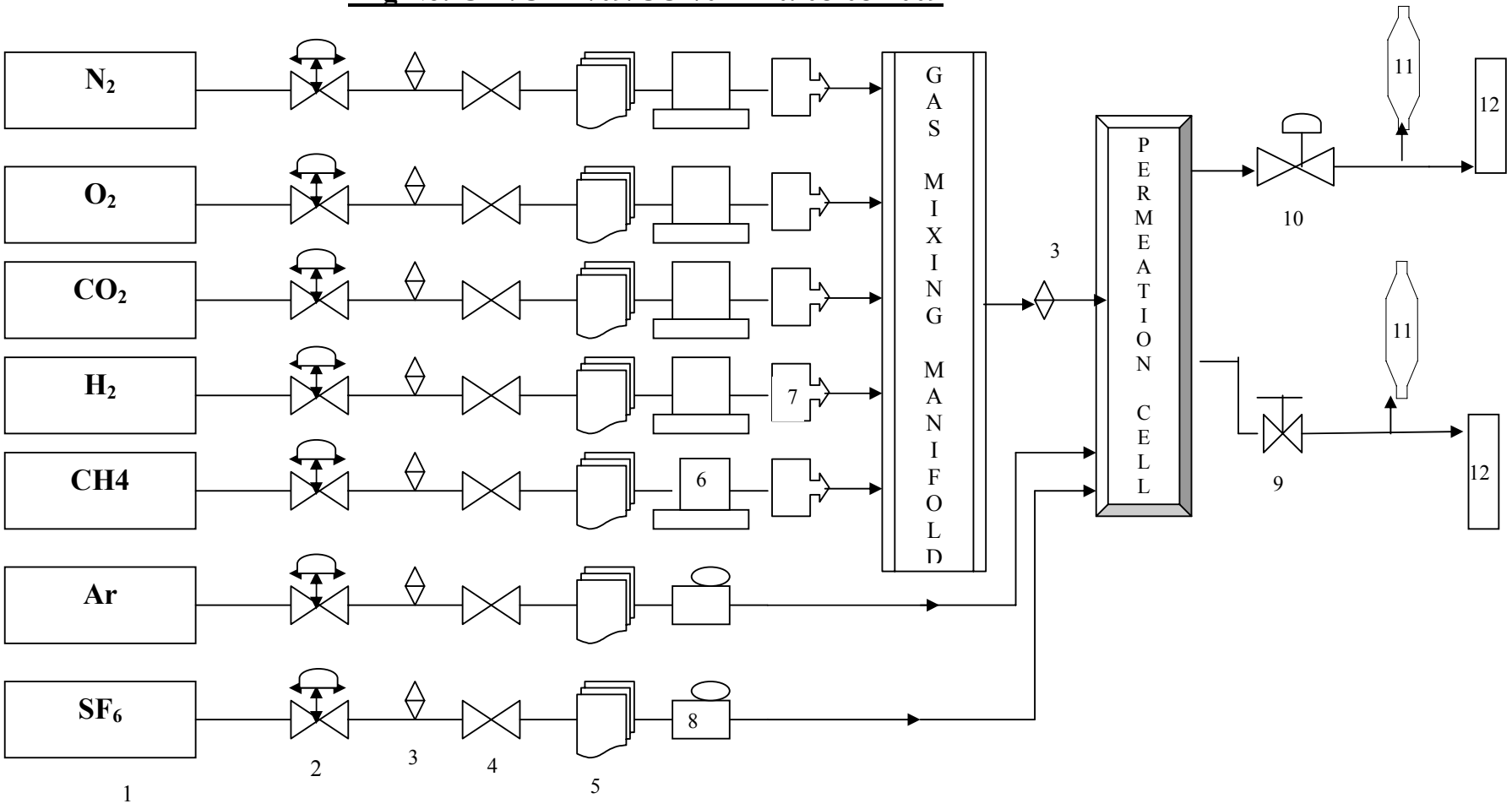
8. As mentioned earlier, the above system is required to be suitably designed so that the flow of various gases at required dynamic pressure as specified and is achieved with minimum left over gas quantity in cylinders. Entire system should be demonstrated for Zero Leakage guarantee for 48hrs.

9. Some minor modifications may be required to be carried out at the time of commissioning of entire system which is also included in the scope of this contract.

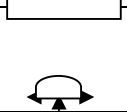
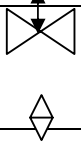
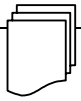
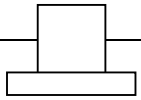
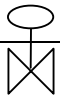
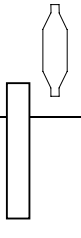
10. The required training on various aspects of handling, storage and operation of explosive gases & facilities including safety aspects.

11. Any other items / services required for ensuring the successful testing, commissioning and operation of above facility is also included in the scope of this contract without any additional cost.

Drg No: CTI/CDM/09/CO2/01 Dt: 08-08-2009



SCHEMATIC LAYOUT FOR MULTI-COMPONENT GAS SEPERATION TEST RIG

Part No	Symbol	Part Name
1		Gas cylinder
2		Single stage Pressure Regulator
3		Point of use regulator
4		ON/OFF Value
5		Filter
6		Mass Flow Controller
7		Non-returnable valve
8		Metering valve
9		Needle valve
10		Back Pressure Regulator
11		Sample bottle collectors
12		Digital flow meter

ANNEXURE- II

List of components for Multi component gas separation test rig

Part No	Part Name	Specifications	Quantity
1.	Gas cylinders	BHEL SCOPE	
2.	Regulators for CO_2, N_2, H_2, O_2, Ar, CH_4, SF_6 gases	Single stage Stainless steel Regulator for high flow high purity applications with shutoff valve, purge valve, Accuracy better than 1% [All the regulators are arranged in a compact panel with respective colour code for gases] 0-200bar(Primary Gauge) 0-35bar(Secondary Gauge)	7
3.	Point of use regulators with shut off valve fitted in the panel	0-35bar (Inlet Pressure) 0-20bar (Outlet Pressure)	8
4.	On/Off valve		7
5.	In-line Filter for dust removal	5μm	7
6.	Mass Flow Controller [CO_2, N_2, H_2, O_2, CH_4]	0-100Lpm 0-20bar	5
7.	Non-returnable valve	0-100Lpm 0-20bar Cracking pressure 0.23 bar	5
8.	Metering Valve	0-20bar 0-100Lpm	2
9.	Needle valve	0-20bar 0-100Lpm	1
10.	Back Pressure Regulator with pressure gauge	0-20bar Stainless steel 0-100 Lpm	1
11.	Sample bottle collectors with PU connectors	0.5-liter capacity Stainless steel 1-liter capacity Stainless steel	2 2
12.	Digital Flow meter	For CO_2, N_2, H_2, O_2, Ar, CH_4, SF_6 gases 0-100Lpm	7
13.	Gas Mixing manifold	Dia=1/2" L=18-24" Stainless steel	1
14.	Flash back arrester Hydrogen and Methane		2
15.	1/4" SS tubing	Stainless steel	50mt
16.	Flexible tubing 1/4"	Reinforced	2mX4no
17.	Gas leak sensors with alarm and hooter	H_2,CH_4,SF_6	1
18.	Permeation cell	BHEL SCOPE	