

**ANNEXURE -1**  
**SCOPE OF WORK FOR CRYOGENIC NITROGEN PLANT INCLUDING LIQUID OXYGEN RECOVERY UNIT**

(Consisting of Air Compressor, Refrigeration Unit, Drying Unit, Distillation column, Heat Exchangers, Expansion Turbines, LOX recovery Unit, Storage Tanks etc., as per Customer Tender)

|   | ITEM DESCRIPTION                                                                          | BASIC ENGG          | DETAILED ENGG       | Manufacturing & Supply | ERECTION  |
|---|-------------------------------------------------------------------------------------------|---------------------|---------------------|------------------------|-----------|
| 1 | <b><u>SERVICES required from Technology provider</u></b>                                  |                     |                     |                        |           |
| A | FEED(Front End Engineering Design) DOCUMENTATION FOR THE ENTIRE NITROGEN GENERATION PLANT |                     |                     |                        |           |
| B | HAZOP STUDY                                                                               |                     |                     |                        |           |
| C | PGTR                                                                                      |                     |                     |                        |           |
| 2 | <b><u>COLD BOX CONSISTING OF</u></b>                                                      |                     |                     |                        |           |
| A | DISTILLATION COLUMN                                                                       | Technology Provider | Technology Provider | BHEL-HPVP              | BHEL-HPVP |
| B | TRAYS/PACKINGS IN COLUMN                                                                  | Technology Provider | Technology Provider | Technology Provider    |           |
| C | BRAZED ALUMINUM EXCHANGERS                                                                | Technology Provider | Technology Provider | BHEL-HPVP              |           |
| D | LIQUID SEPARATOR INSIDE COLD BOX                                                          | Technology Provider | Technology Provider | BHEL-HPVP              |           |
| E | LIQUID OXYGEN RECOVERY UNIT                                                               | Technology Provider | Technology Provider | BHEL-HPVP              |           |
| F | COLD BOX CASING                                                                           | Technology Provider | BHEL-HPVP           | BHEL-HPVP              |           |
| G | PIPING INSIDE COLD BOX                                                                    | Technology Provider | Technology Provider | BHEL-HPVP              |           |
| H | CRYOGENIC VALVES                                                                          | Technology Provider | Technology Provider | BHEL-HPVP              |           |

|          |                                                                                       |                     |                     |           |           |
|----------|---------------------------------------------------------------------------------------|---------------------|---------------------|-----------|-----------|
| 3        | EXPANSION TURBINES<br>a) Air expansion turbine<br>b) Waste nitrogen expansion turbine | Technology Provider | Technology Provider | BHEL-HPVP | BHEL-HPVP |
| 4        | CRYOGENIC PUMPS                                                                       | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| 5        | LIN tanker loading pumps                                                              | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| 6        | LOX tanker loading pumps                                                              | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| <b>5</b> | <b>AIR COMPRESSION UNIT</b>                                                           |                     |                     |           |           |
| A        | AIR SUCTION FILTER                                                                    | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| B        | AIR COMPRESSOR WITH MOTOR                                                             | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| <b>6</b> | <b>AIR PRE-COOLING UNIT</b>                                                           |                     |                     |           |           |
|          | REFRIGERATION UNIT                                                                    | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| <b>7</b> | <b>AIR DRYING UNIT</b>                                                                |                     |                     |           |           |
| A        | ADSORBER VESSELS                                                                      | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| B        | ACT. ALUMINA & MOL. SIEVES                                                            | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| C        | REGENERATION HEATER (Steam / Electrical)                                              | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| <b>8</b> | <b>INSTRUMENTS</b>                                                                    |                     |                     |           |           |
| A        | DCS/PLC                                                                               | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |
| B        | CONTROL VALVES                                                                        | Technology Provider | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP |

|          |                                         |                     |           |           |           |
|----------|-----------------------------------------|---------------------|-----------|-----------|-----------|
| C        | SAFETY VALVES                           | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| D        | FLOW ELEMENTS                           | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| E        | ANALYZERS                               | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| F        | INSTRUMENTS                             | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| G        | Electrical cables and Instrument cables | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| <b>7</b> | <b>OTHER ITEMS</b>                      |                     |           |           |           |
| A        | PIPING OUTSIDE COLD BOX                 | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| B        | AIR VENT SILENCER                       | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| C        | NITROGEN VENT SILENCER                  | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| D        | LIQUID DRAINS VAPORIZER                 | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| E        | Civil Foundation design                 | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| F        | Structures                              | BHEL-HPVP           | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| G        | MANUAL VALVES                           | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| H        | INSULATION MATERIAL                     | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| I        | Storage Tanks                           | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| J        | Atmospheric vaporizers                  | Technology Provider | BHEL-HPVP | BHEL-HPVP | BHEL-HPVP |
| K        | 3 D Modelling                           | BHEL-HPVP           |           |           |           |

|   |                         |                     |                                             |           |           |
|---|-------------------------|---------------------|---------------------------------------------|-----------|-----------|
| K | Documentation           | Technology Provider | Technology Provider<br>AND<br>BHEL-<br>HPVP | BHEL-HPVP | BHEL-HPVP |
| 8 | CIVIL & STRUCTURAL      |                     |                                             |           |           |
| A | Civil Foundation design | BHEL-HPVP           | BHEL-HPVP                                   | BHEL-HPVP | BHEL-HPVP |
| B | Structures              | BHEL-HPVP           | BHEL-HPVP                                   | BHEL-HPVP | BHEL-HPVP |
| C | Platforms & Ladders     | BHEL-HPVP           | BHEL-HPVP                                   | BHEL-HPVP | BHEL-HPVP |