1.0 INTRODUCTION:

The development of magnetic sensors and hard magnetic thin films program setup at Surface Engineering Division, NAL Kodihalli campus is under progress. This activity involves development of magneto resistive thin films sensors for magnetic field sensing applications and Nano – structures hard magnetic thin films respectively. The development of these magnetic sensors, photolithography with line width of 5 µm shall be carried in clean room. Also to avoid micron size of dust particles during contamination during pre and post deposition processes it is proposed to establish Class10000 clean room facility at SED Division.

The building consists of Ground + 1 floor (the first floor is under construction). The area to be air-conditioned with Class10000 clean room is around 270 sq. ft. at ground floor. It is proposed to install 11.0 Tr capacity condensing unit having 2 no. of 5.5 Tr. capacity compressors connected suitable capacity air handling unit having pre- filter, micro vee filter and blower section. The system shall be designed so, that one compressor will be in operation and other shall be as standby. The necessary GI sheet metal ducting with insulation and HEPA filters to remove 0.3 microns from air streams with an efficiency of 99.007 % has to be provided. Also wall panel suitable for clean room application made out of GI powder coated sheet steel with in-fill thermocoal. The necessary clean room garments and laminar flow systems having class-100 facility shall be provided as required.

The details of work to be taken up are as specified in the schedule of work. The specified works in the schedule of quantity are provisional. This may vary as per the site requirement during detailed engineering.

The following data to be considered to achieve the requirement.

2.0 DESIGN DATA :

2.1 Outside conditions:

2.1.1	Summer	39 deg C
2.1.2	Monsoon	29.4 deg C
2.1.3	Winter	20 deg C

2.2 Inside conditions:

2.2.1	Summer	20 ± 2 deg C
2.2.2	Monsoon	20 ± 2 deg C
2.2.3	Winter	20 ± 2 deg C

2.2.4 **Relative Humidity 55 ± 5%**

2.3 **Details of data required to design AC system:**

2.3.1	Area to be Air-conditioned	:	260 Sq.ft.
2.3.2	Room Location	:	Ground Floor
2.3.3	Total Height of ceiling	:	8 ft.
2.3.4	Occupancy	:	03 Nos.
2.3.5	Fresh Air	:	To be designed by the vendor.
2.3.6	Selected air quantity	:	3500 CFM
2.3.7	Total Equipment Load	:	5 kW
2.3.8	Air conditioning capacity required	:	11.00 Tr. having multiple compressors.
2.3.9	Operation of the proposed plant	:	10hr x 5days.
2.3.10	Standby	:	100% with one condensing unit having multiple compressors to be connected double skinned AHU with suitable system.

3.0 SCHEME

3.1 Design, supply, installation, testing and commissioning of 11.0 Tr. capacity air-cooled condensing unit comprising with 2 no. of 5.5 Tr. capacity compressors interconnected with double skin air handling unit (AHU) suitably. The AHU shall be designed suitably for connecting 2 circuits of compressors from one condensing unit as one at operation & one at standby as required achieving the above designed conditions with necessary ancillary works shown in scope of work. The class10000 clean room has to be designed and performed as per BS 5295-1989 (or latest version) / ISO class-7, 14644-1,2,3.

4.0 DRAWINGS

4.1 The layout plan of area to be air-conditioned is enclosed.

4.2 No other drawings shall be made available. **The contractor / vendor / firm shall visit the site or discuss with the Engineer-in-charge for any other site particular that he may need before submitting the tender.**

4.3 Drawings have been prepared showing the area to be air-conditioned & space allocated for the equipment. Adequacy for the installation of condensing unit, AHU etc for the equipment offered should be checked and confirmed by the tenderer.

4.4 The contractor / successful bidder shall prepare detailed working drawings & execute the work as per working drawings approved by the Engineer-in-charge.

4.5 The scope of work and their quantities mentioned in the schedule of work is tentative. This will be measured as per the final design and site requirements at the time of execution.

Modified Schedule of quantities as discussed and accepted on pre-bid conference held on 02.05.2011

NAL / 01 / E of 2011-2012

Name of the work : Providing Class10000 Clean Room facility for Surface Engineering Division at NAL, Kodihalli.

All the vendors had informed to read the specifications as follows under each item and quote accordingly in the price bid. All the vendors may note that this annexure shall be signed and enclosed along with technical bid.

SCHEDULE OF QUANTITIES

SCOPE OF WORK:

Sl.No	Description of the item.	Qty	Unit	Description of the items shall read as
(1)	(2)	(3)	(4)	(5)
1	Supply, installation, testing and commissioning of outdoor type, air cooled condensing unit of capacity 11.0 Tr. comprising of 2 nos. of 5.5 Tr. rated scroll / rotary compressors suitable for operation on 415V, 50Hz AC supply. The condensing unit shall be installed on suitable size of MS iron angle frame / civil constructed base frame as required.	1.	No.	**No change from the original specification.**
2.	Supply, installation, testing and commissioning of outdoor type air cooled DX version double skin type AHU with 43 / 50 mm thick Insulated Panels, sandwiched between inner skin of SS-304 and outer skin of pre-plasticized / pre-painted GSS sheets, with thermal break, with inlet and outlet volume control damper, modular construction. Unit shall be mounted on anti vibration mounts. Each section should be properly sized to accommodate various components of the following: **Inlet / Mixing Section:** • Low Leakage extruded aluminum aerofoil type return air and fresh air with G-4 Filter dampers suitable for manual & motorized operation. • Flanged type washable Inlet filters F-6. • Hinged service door. **Cooling Coil Section:** • SS-304 insulated condensate tray. • Hinged service door (optional If require).			Supply, installation, testing and commissioning of outdoor type air cooled DX version double skin type AHU with 43 / 50 mm thick Insulated Panels, sandwiched between inner skin of SS-304 and outer skin of pre-plasticized / pre-painted GSS sheets, with thermal break, with inlet and outlet volume control damper, modular construction. Unit shall be mounted on anti vibration mounts. Each section should be properly sized to accommodate various components of the following: Inlet / Mixing Section: • Low Leakage extruded aluminum aerofoil type return air and fresh air with G-4 Filter dampers suitable for manual & motorized operation. • Flanged type washable Inlet filters F-6. • Hinged service door. Cooling Coil Section: • **Dual coil system for individual connection of 2nos compressors for running the system independent / whole at a time as required.**

(1)	(2)	(3)	(4)	(5)
	Supply Fan Section: • Fan section with Plug type Centrifugal / BDB fan with flow measuring pressure ports. • Hinged service door with safety switch. • Lamp, Switch & Wiring. **Fine filter section:** • Hinged service door with safety switch. • Pressure Measurement points fitted • Pre-filter section with filter (10 microns). • Micro-vee section with filter(5 microns) **Discharge plenum:** • Extruded aluminum airfoil blade dampers at supply air outlet (suitable for manual and motorized operation). • Fire Damper at supply air outlet with on / off type motor (spring return). **Air Handling Unit:** • Blower section with BDB fan. • 6 rows deep cooling coil section with SS drainpipe. AHU 1 / 3500CFM / 125 MM S.P / 5HP / 4Pole or suitable capacity as required. The AHU with internal shin as SS -304 shall be designed suitably for connecting 2 circuits of compressors from condensing unit as one at operation & one at standby. The AHU shall be installed on necessary civil foundation or MS angle frame using necessary expansion bolts, fasteners etc., as required.	01	No.	• SS-304 insulated condensate tray. • Hinged service door (optional If require). Supply Fan Section: • Fan section with Plug type Centrifugal / BDB fan with flow measuring pressure ports. • Hinged service door with safety switch. • Lamp, Switch & Wiring. Fine filter section: • Hinged service door with safety switch. • Pressure Measurement points fitted • Pre-filter section with filter (10 microns). • Micro-vee section with filter(5 microns) Discharge plenum: • Extruded aluminum airfoil blade dampers at supply air outlet (suitable for manual and motorized operation). • Fire Damper **with fusible link** at supply air outlet with on / off type motor (spring return). Air Handling Unit: • Blower section with BDB fan. • 6 rows deep cooling coil section with SS drainpipe. AHU 1 / 3500CFM / 125 MM S.P / 5HP / 4Pole or suitable capacity as required. • The AHU with internal shin as SS -304 shall be designed suitably for connecting 2 circuits of compressors from condensing unit as one at operation & one at standby. The AHU shall be installed on necessary civil foundation or MS angle frame using necessary expansion bolts, fasteners etc., as required.
3.	Supply, installation, testing and commissioning of following sheet metal ducting made of (GSS ducting) with MS flanges and RTV sealant. The duct shall be fixed rigidly on ceiling using necessary GI hooks, fasteners etc and also necessary rigid supports for the ducts shall be provided wherever required as per site conditions.			

(1)	(2)	(3)	(4)	(5)
3.1	24G (0.63mm thick)	46	Sq.M	**Change in quantity.**
3.2	22G (0.80 mm thick)	138	Sq.M	
3.3	Aluminium flexible ducting	12	RMT	
4.	Supply, installation, testing and commissioning of insulation on supply air duct with 13 mm thick cross linked expanded polyethylene insulation with one face self adhesive & one side aluminium foil faced. The necessary insulation and protections shall be provided for the duct exposed outside the room as required. Also necessary rigid supports shall be provided wherever required.	115	Sq.M	Supply, installation, testing and commissioning of insulation on supply air duct with 13 mm thick cross linked expanded polyethylene insulation with one face self adhesive & one side aluminium foil faced. The necessary insulation and protections shall be provided **with aluminium cladding** for the duct exposed outside the room as required. Also necessary rigid supports shall be provided wherever required.
5.	Supply, installation, testing and commissioning of insulation of return air duct with 9 mm thick cross linked expanded polyethylene insulation with one face self adhesive & one side aluminium foil faced. The necessary insulation and protections shall be provided for the duct exposed outside the room as required. Also necessary rigid supports shall be provided wherever required.	115	Sq.M	**No change from the original specification.**
6.	Supply, installation, testing and commissioning of HOODED TYPE MINI PLEATE FILTERS (High efficiency particulate air) designed to remove particles down to 0.3 microns from air streams with an efficiency of 99.997 %. The filter matrix shall be specially treated glass fiber media with machine pleated GEL SEAL filter complete with terminally mounted aluminium anodized housing with volume variable distributor DOP port with protective mesh size 915 mm x 610 mm x 150 mm as required.	6	No.	Supply, installation, testing and commissioning of HOODED TYPE MINI PLEATE FILTERS (High efficiency particulate air) designed to remove particles down to 0.3 microns from air streams with an efficiency of 99.997 %. The filter matrix shall be specially treated glass fiber media with machine pleated GEL SEAL filter complete with terminally mounted aluminium anodized housing with volume variable distributor DOP port with protective mesh size 915 mm x 610 mm x 150 mm as required. **The size of the filters shall be designed to suit the total CFM required for achievement of design condition. Hence, size of filters shall be designed accordingly.**
7.	Supply, installation, testing and commissioning of return air risers grilles with volume control damper operated from front as required.	1.4	Sq.M	**- No change -**
8.	Supply, installation, testing and commissioning of Control valves for condensing units and other accessories as follows: ➢ Expansion valves. - 1No. ➢ Hand shut off valves - 2No.			**- No change -**

(1)	(2)	(3)	(4)	(5)
	➢ Catch all dryers - 1No. ➢ Thermostat - 1No. ➢ 230V strip heaters as required to achieve / maintain RH. First charged refrigerant gas as required.	1	Lot	
9.	Supply, installation, testing and commissioning of refrigerant piping of suitable size for suction and liquid line and interconnection between condensing units and AHU including all necessary clamps, bolts, all accessories etc as required.	22	RM	Supply, installation, testing and commissioning of refrigerant piping of suitable size for suction and liquid line and interconnection between condensing units and AHU including all necessary clamps, bolts, all accessories etc as required. **The refrigerant pipe line shall be measured in one length (i.e, both suction and discharge) and copper pipe shall be hard drawn only.**
10.	Supply, installation, testing and commissioning of magnaelic gauge, humidity controller and thermostat with necessary control wiring and digital temperature indicator shall be provided as required. All the measuring / indicating instruments shall be calibrated and necessary calibration certificates shall be furnished at the time commissioning.	1	No.	Supply, installation, testing and commissioning of magnaelic gauge, humidity controller and thermostat with necessary control wiring and digital temperature indicator shall be provided as required. All the measuring / indicating instruments shall be calibrated and necessary calibration certificates shall be furnished at the time commissioning. **The instrument shall be calibrated by third party information for calibration shall be provided by vendor.**
11	Supply, installation, testing and commissioning of Motor Control Centre (MCC) for condensing units, air handling units, & heaters. The MCC shall be provided with following: ➢ 1No. 63A, 3P, 16kA MCCB with thermal magnetic releases and shunt releases as an incomer. ➢ 2 No of DOL starter provided with suitable rated MPCB for the rating of 11Ton condensing unit. ➢ 3No. of 16A, 2P, MCBs and suitable rated contactors for the heaters. ➢ Set of LED type indication lamps. All the above components shall be incorporated on suitable size of enclosure made out of CRCA sheet steel with necessary painting etc. Suitable VFD for AHU motor, the necessary control logic shall be designed to for the safe operation of condensing unit, AHU for maintaining the temperature and RH, presser sensors to be introduced in the clean room area with necessary synchronization with VFD and interlocks etc as required. The remote and			**No change from the original specification.**

(1)	(2)	(3)	(4)	(5)
	local operation facility shall be incorporated with selector switch. The fire / smoke dampener shall be inter-locked with incomer so, that the incomer MCCB shall be switched off automatically during the fire / smoke detectors actuates. The necessary copper control and power cables connecting between MCC feeders to condensing unit, AHU and heater banks or any other accessories incorporated in the clean room facility shall be provided by the vendor as per the site requirement. However the necessary cable with switchgear for powering the MCC will be provided by NAL. Suitable size & core of copper conductor armoured cable for AHU & control cables for instrumentation, interlocks shall be provided as required. The entire control logic and GA shall be got *approved before* fabrication.	1	No.	
12.	Supply, installation, testing and commissioning of Air shower of size 1700mm (W) x 1000mm (D) x 2200mm (H) made out of CRCA sheet with powder coated paint. The air shower shall have the following features: ➢ Suction filter. ➢ Supply filter. ➢ Blower motor of suitable rated. ➢ Accessories like door closer, door handles, air jet nozzles etc. ➢ Safety requirement like rotor switch with door indicator at entry and exit, rotor switch with door indicator for emergency ON / OFF from inside, cabin lighting, electromagnet for door interlocking at entry – exit and sensor plate for door interlocking at entry-exit doors as required. The size of the air shower mentioned above is tentative. If, any changes in dimensions as per the site requirement is acceptable. The firm shall be design the air shower as per the site requirement. The GA and controls scheme shall be got approved before fabrication.	1	No.	**No change from the original specification.**
13.	Supply and installation of 50 mm double skin EPS walkable false ceiling panel made out of 0.63 mm thickness powder-coated GI sheet with mounting accessories.etc all complete. The necessary cutouts of suitable size shall be made ready in false ceiling panel for fixing of diffusers / HEPA filters / lighting fixtures / fire or smoke detectors as per the site	30	Sq.M	**No change from the original specification.**

(1)	(2)	(3)	(4)	(5)
	requirements. The false ceiling panel shall be designed to suitable for Class 10000 clean room application as per standard practice as required. The plan shall be got approved before fabrication.			
14.	Supply and installation of 80 mm double skin wall partition made out of 0.8 mm thick GI sheet with EPS as infill with floor track and conduits for electrical / network lines/ telephone lines etc, all complete shall be provided. Also necessary double glazed glass view window of size 600 mm x 600 mm at one / two places as required suitable for clean room application shall be provided in the panel as per standard practice and site requirements. The plan shall be got approved before fabrication.	80	Sq.M	Supply and installation of **100 mm** double skin wall partition made out of 0.8 mm thick GI sheet with EPS as infill with floor track and conduits for electrical / network lines/ telephone lines etc, all complete shall be provided. Also necessary double glazed glass view window of size 600 mm x 600 mm at one / two places as required suitable for clean room application shall be provided in the panel as per standard practice and site requirements. The plan shall be got approved before fabrication.
15.	Providing and fixing aluminum coving with aluminium backing section as required.)	100	RMT	**No change from the original specification.**
16.	Providing and laying of PVC Vinyl flooring of 1.0 mm thickness as required.	25	Sq.M	Providing and laying of PVC Vinyl flooring of **2.0** mm thickness as required.
17.	Supply, installation testing & commissioning of 40 mm thick honeycomb emergency single door with panic bar along with view glass suitable for clean room application shall be provided as required.	1	No.	**No change from the original specification.**
18.	Providing, supply & fixing of return air risers of capacity 500 CFM each has to be inbuilt in the wall / ceiling panel as required.	6	Nos.	**No change from the original specification.**
19.	Supply of apron with mask caps and shoe hood as complete set made of Nylon as per clean room norms shall be provided.	6	Nos.	**No change from the original specification.**
20.	Supply, installation, testing and commissioning laminar flow work station of size 4' x 2' x 6' with class -100 facility made out of CRCA powder coated sheet steel all complete as per standard practice shall be provided as required.	1	No.	Supply, installation, testing and commissioning **vertical** laminar flow work station of size 4' x 2' x 6' with class -100 facility made out of CRCA powder coated sheet steel all complete as per standard practice shall be provided as required.
21.	Testing, Commissioning and Validation of the following tests of Class-10000 clean room as per applicable standards as required. ➢ Air balancing test. ➢ Pressure balancing test ➢ Temperature & RH test ➢ Filter integrity test ➢ Particle count test ➢ Complete balancing of entire facility ➢ Documentation charges If any tests need to be required for the acceptance of class - 10000 applications as per the applicable standards the same shall.			

(1)	(2)	(3)	(4)	(5)
	be carried out by the firm / vendor without any extra costs.	1	Lot	
22.	Earthing with G.I. earth plate 600mm x 600mm x 6mm thick including accessories, and providing masonary enclosure with cover plate having locking arrangement and watering pipe etc(but without charcoal or coke and salt) as required.	2	Sets	**No change from the original specification.**
23.	Extra for using salt and charcoal for G.I electrode as required.	2	Sets	**No change from the original specification.**
24.	Providing and fixing of 25mm x 6mm thick G.I. strip to be laid in ground / surface as required**.**	20	M	**No change from the original specification.**

ACCEPTABLE MAKES

Sl no.	Description	Manufacturer
01	Air-cooled Package & Ductable Split Units	Blue Star / Voltas / ETA / DIAKIN /CARRIER-Toshiba
02	Compressor Type (Package)	Hermetically Sealed Scroll
03	Compressors make	Copeland / Kirloskar Copeland / Tecumseh or as per manufacturer recommendations
04	G.I. Sheets	Sail / Jindal
05	Vibration Isolators	Resistoflex/ Emarald/ GERB
06	Fibre Glass Insulation	U.P.Twiga /OWENS CORNING
07	Diffusers / Linear Grilles	RAVISTAR / OPELLA / TRISTAR/ Dynacraft / **Met craft / Ajanta / Air Master.**
08	Power Cables	Nicco / Gloster / Universal / National / Polycab / RR Kabel / LAPP India.
09	Control Cables	Nicco / Gloster / Universal / National / Polycab/ RR Kabel / Lapp India
10	Electrical Panel Manufacturer	ENCONPASS / Load Controls / Louts power gear / Dynam.
11	Switches / Fuses/ SDFUs/ Contactors/ Relays/ Pushbuttons	Siemens / GE / Schneider / ABB
12	Current Transformers	AUTOMATIC ELECTRIC/ KAPPA/ C&S
13	Toggle Switches/ Selector Switches	Kaycee / Salzer-LT / Siemens
14	Ammeter/ Voltmeter	AE/ IMP/ MECO/ Conzerv
15	Indication Lamps	L&T / Siemens / BCH
16	Fire - Dampers/ dampers	CARYAIRE / RAVISTAR / OPELLA
17	Expanded Polystyrene (TF Quality) Insulation of Roof slab	Beardsel / Lloyds / ESKAY Kaycee / METTUR-BEARDSELL
18	PVC piping for drain	Oriplast

Time period for completion : 3 (Three months)

Signature of the contractor with date & seal