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13.05.2019

## Department of Physics

### Corrigendum3

**Tender Reference no:** PHY/JKRT/035/2019  
**Name of the Item:** Design and Installation of Gas Distribution System  
**Corrigendum details:** Updated Technical Specification

The technical specification for the above mentioned tender has been revised. Please submit your bids before 17.05.2019 by taking updated technical specifications into account.

**All other terms and conditions remain the same.**

**Tender Inviting Authority:**

वरिष्ठ प्रबन्धक (परियोजना क्रय)  
SENIOR MANAGER (PROJECT PURCHASE)  
आईसी एवं एसआर केन्द्र / Centre for IC & SR  
आईआईटी मद्रास / I.I.T. MADRAS-600036

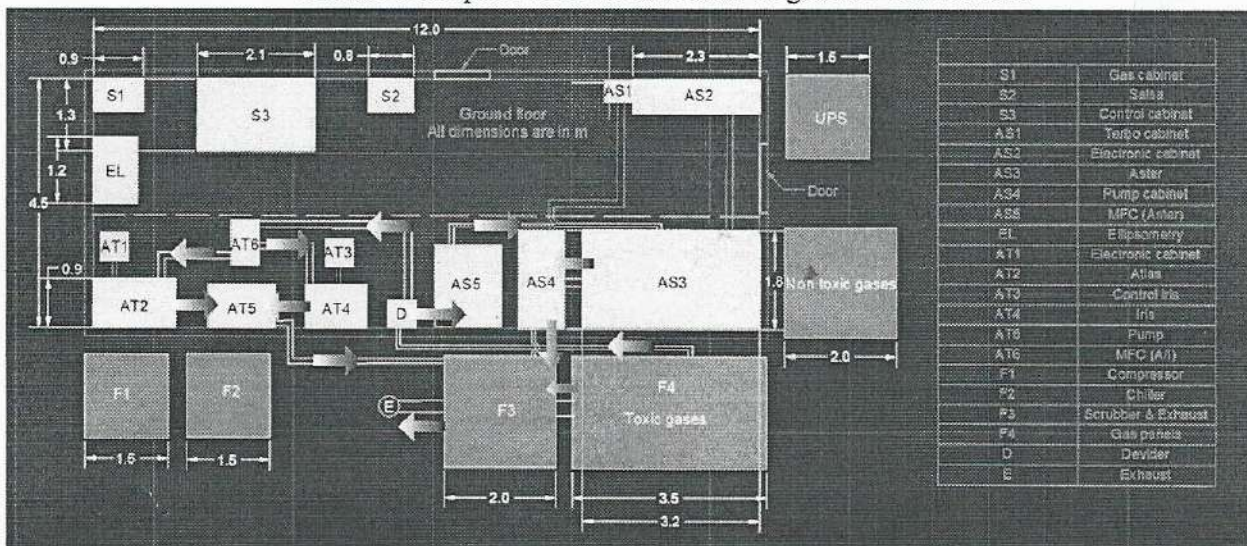
## Technical Specifications for Design and Installation of Gas Distribution System

It is proposed to Design and Install a High-Value Gas Distribution System for the delivery of Toxic, Inflammable and Inert gases (SiH<sub>4</sub>, H<sub>2</sub>, PH<sub>3</sub>, CH<sub>4</sub>, NH<sub>3</sub>, TMB, GeH<sub>4</sub>, General N<sub>2</sub>, He+N<sub>2</sub>, Ar, and CO<sub>2</sub>) for deposition equipments like multi-chamber PECVD and sputtering system. Gas Cabinets, EP and BA SS316L tubing, Coaxial SS tubing, Coaxial Pressure Switch Assembly and Exhaust Ducting are required for the same. The design should also include SCADA and PLC based automated monitoring and control of Gas Supply with emergency shutoff procedures in case of leaks. **Following installation, the gas line+connections need to be tested and validated for pressure hold test, for 24 hours, Helium leak, upto 1 X 10<sup>-9</sup> He mBar lit sec<sup>-1</sup>, trace moisture, tested upto 5 PPM impurities, trace Oxygen, tested upto 5 PPM and particles, upto 0.1 micron level. We have (previously used and certified) all gas panels, leak detectors, MFC cabinets, dividers, and PLC. We will prefer to use these existing items after the re-validation (validation charge will be paid by IIT Madras). Bidder should also quote these (gas panels, leak detectors, MFC cabinets, dividers, and PLC) as an optional item. In case, if some of the existing items do not work, bidder can change and use new ones according to the design requirement.**

A brief description of requirements is given below. The floor plan with intended gas line connections is illustrated\*.

**Note-** Quantities of the item given below are approximate, it can be less or more according to the design requirement. Bidder can come up with their own design for the gas distribution system. Actual billing would be based on actual consumed quantities. Thus, the bidder should quote a total price based on the quantity given in the table along with per unit price of these items.

\*Ground floor plan with the directions of gas line connections



S.No.	Description	Specification	Quantity
<b>Supply of equipment for gas delivery</b>			
1.	Semi-automatic gas cabinets for SiH <sub>4</sub> , PH <sub>3</sub> , TMB, GeH <sub>4</sub> , CH <sub>4</sub> , NH <sub>3</sub> , and H <sub>2</sub>	SEMI-S2 Approved and certified by TUV/BV/ATEX/ equivalent gas cabinet of the third party	No of cabinets can be chosen based on gases compatibility
2.	Re-validation of Gas panels: (1) Silane (2 Nos) Phosphene+Hydrogen (1 No), (3) Argon (4 Nos), (4) Trimethyl boron (1 No), (5) Germane (1 No), (6) Disilane (1 No), (7) Ammonia (1 No), (8) Methane (1 No), (9) Hydrogen (2 Nos), (10) Carbon Dioxide (1 No), (11) Helium(5%)+Nitrogen (1 No), (12) General Nitrogen (1 No)		17 Nos
3	Venturie/ Vacuum Generator	To attach to the gas panels externally, with fittings and spares	7 Nos
4	High pressure (150 Bar) single cylinder gas panel for gas cabinets panel pressure testing and purging	Semi-Compliant	1 Nos
5	Pressure regulators, size 1/4" NPT end	SS 316L	3 Nos
6	Diaphragm valves, 1/4" compression end	SS 316L	3 Nos
7	Ball valves, 1/4" compression end	SS 316L	3 Nos
<b>Tube lines for gas delivery from source to the point of use (Note- tube length given below is approximate, it can be less or more according to the design requirement.)</b>			
8	Coaxial tube for toxic gases, size 1/2" X 1/4", the thickness of inner tube wall 0.35" for SiH <sub>4</sub> , PH <sub>3</sub> , GeH <sub>4</sub> , NH <sub>3</sub> , and TMB	SS 316L EP	90 MTR
9	Tube, size 1/2", tube wall thickness 0.49" for ultra-pure gases (Purity 99.9999%)	SS 316L EP	50 MTR
10	Tube, size 1/4", tube wall thickness 0.35" for ultra-pure gases (Purity 99.9999%)	SS 316L EP	120 MTR
11	Tube, size 1/2", tube wall thickness 0.49" for Ar, CO <sub>2</sub> , and N <sub>2</sub>	SS 316L BA	60 MTR
12	Tube, size 1/4", tube wall thickness 0.35" for Ar, CO <sub>2</sub> , and N <sub>2</sub>	SS 316L BA	90 MTR
13	Point of use gas sticks for high-pressure inert gases	SS 316L	8 Nos
14	Gas tube fitting, MOC (includes glands, gaskets, male and female, nuts, tee points, reducers, fitting for tubes like tee, terminators, sleeves, etc.)	SS 316L EP	1 Lot
<b>Safety system</b>			
15	PLC based central control panel with PC and SCADA. We have PLC; the existing PLC can be used with PC and SCADA.	Should have AI/AO cards, SMPS and communicate with all the gas delivery	1 Set

		equipment's, GLD's and other field instruments	
16	Re-validation of the Existing PLC		1
17	We have a gas leak detectors for SiH <sub>4</sub> , PH <sub>3</sub> , TMB, H <sub>2</sub> , GeH <sub>4</sub> , CH <sub>3</sub> , and NH <sub>3</sub> . We prefer to use these the existing gas leak detectors.	Should be installed in each gas cabinet, gas cabinet room, gas divider, MFC cabinets, process room, pump cabinets	24 Nos
18			
19	Signal cables for GLD's, field instruments and gas delivery equipment's		1 Lot
20	Manual call point/emergency push bottoms and alarm hooters. In addition, emergency push switch for electrical lines only		1 Lot
21	Pressure switch for all the lines with vacuum contact gauges. Signal from switches must be interlocked with PLC system to take proper shut-off action during emergency		8 Nos
22	UVIR sensor	In the SiH <sub>4</sub> gas cabinet and VMBs or MFC cabinet	2 Nos
<b>Scrubber and exhaust system (Note- size and quantity of exhaust ducts and dumpers are approximate; it can be less or more according to the design requirement)</b>			
23	According to our floor diagram, a centralized gas scrubber should be installed to treat all toxic gases. The duct material is SS 304 from tools upto scrubber. From scrubber to outside exhaust PP FRP duct material will be used.	With a high level of safety during operations	1 Nos
24	8" exhaust duct made of 2 mm thick with elbows, tees, flanges, and other fittings	SS 304	20 RM
25	6" exhaust duct made of 2 mm thick with elbows, tees, flanges, and other fittings	SS 304	20 RM
26	4" exhaust duct made of 2 mm thick with elbows, tees, flanges, and other fittings	SS 304	20 RM
27	2"/3" exhaust duct made of 2 mm thick with elbows, tees, flanges, and other fittings	SS 304	15 RM
28	Exhaust dampers/Butterfly valves- size 2"	SS 304	4 Nos
29	Exhaust dampers/Butterfly valves- size 4"	SS 304	4 Nos
30	Exhaust dampers/Butterfly valves- size 6"	SS 304	2 Nos
31	Exhaust dampers/Butterfly valves- size 8"	SS 304	2 Nos
32	Flexible bellows for equipment isolation of respective size, 4", 3", 2", and 8"		8 Nos
33	Exhaust blower, capacity at least 3000 CFM, static pressure of 30 MM WC with exhaust stack, different pressure gauge, flow detector, and auto switch over in emergency condition.	Anti-corrosive material (one is the main exhaust and the other as the	2 Nos

		backup.)	
34	Tube Clamps	MOC SS with PVC/PP inserts	400 Nos
35	Unistruts for the support structure		1 Lot
36	Cylinder holding structure with cylinder strap	MS with powder coated	3 Nos
37	Cable tray/conduits for single cables, anchor bolts, nuts etc.		1 Lot
<b>Scope of the work</b>			
38	Installation of all gas delivery equipment's, scrubbers etc.		1 Lot
39	Installation of ultra-high pressure gas lines using orbital welding technology		1 Lot
40	Installation of gas leak detectors, complete safety system with cable, cable trays, and control panel		1 Lot
41	Installation of electrical cables and cable connection to equipment's		1 Lot
42	Installation of exhaust duct and blower with support structure and clamps		1 Lot
43	Pressure hold test for gas lines and gas delivery equipment is at the site (gas cylinders to MFC cabinets and process pumps to scrubber outlet)	Certified upto 1.5 times of the working pressure by keeping the system under pressure using ultra-high pure N <sub>2</sub> for 24 hours without a drop in pressure	15 Loops
44	He leak test for the gas line (gas cylinders to MFC cabinets and process pumps to scrubber outlet)	Certified upto the leak rate of 1x10 <sup>-9</sup> He mBar lit sec <sup>-1</sup> .	13 Loops
45	Trace oxygen analysis inside the gas delivery tube lines (gas cylinders to MFC cabinets and process pumps to scrubber outlet)	Certified upto 5 PPM level of impurity	13 Loops
46	Trace moisture analysis inside the gas delivery tube lines (gas cylinders to MFC cabinets and process pumps to scrubber outlet)	Certified upto 5 PPM level of impurity	13 Loops
47	Particle count analysis inside gas delivery tube lines (gas cylinders to MFC cabinets and process pumps to scrubber outlet)	Certified upto the particle size of 0.1 micron	13 Loops
48	The exhaust connection should be from tools to process pumps and pumps to scrubber and exhaust	3000 CFM	

**Optional items (Bidder should give quote these as optional items)**

S.No.	Description	Specification
1	Gas panels for SiH <sub>4</sub> , PH <sub>3</sub> , TMB, GeH <sub>4</sub> , CH <sub>4</sub> , NH <sub>3</sub> , (5% He+95% N <sub>2</sub> ), H <sub>2</sub> , CO <sub>2</sub> , Ar, and H <sub>2</sub>	Semi Compliant
2	3 outlet stick, manual valve manifold boxes (VMB)	Semi-Compliant

	for SiH <sub>4</sub>	
3	PLC for central control panels	
4	Gas leak detector for SiH <sub>4</sub> , PH <sub>3</sub> , TMB, H <sub>2</sub> , GeH <sub>4</sub> , CH <sub>3</sub> , and NH <sub>3</sub>	Should be installed in each gas cabinet, gas cabinet room, gas divider, MFC cabinets, process room, pump cabinets
5	Re-validation of existing MFC cabinets	2
5	Testing and Validation from MFC cabinets to process chambers	He leak test <1.10 <sup>-6</sup> mbar l/s
6	Revalidation of the existing gas detectors: (i) Hydride type (ii) Ammonia, (iii) Hydrogen	19 (EIT make), 5 (COMPURE make)

**Specifications of Major Items:**

The bidder must include all required information in the Technical Bid.

S. No	Details
1	<p><b><u>Safety and Automation:</u></b></p> <ul style="list-style-type: none"> <li>The primary focus of this project should be on the Safety aspects.</li> <li>The safety interlocks, auto-shut off systems etc. should be of the highest standard, and should be specified in the P&amp;ID of the design.</li> <li>The design should also include modification of SCADA and modification of PLC based automated monitoring and control of Gas Supply with automated emergency shutoff procedures.</li> <li>The PLC Cause-Effect logic should be provided for the entire system.</li> </ul>
2	<p><b><u>Gas Leak Detectors for Toxic, Corrosive, Flammable gases:</u></b></p> <ul style="list-style-type: none"> <li>Gas leak detectors should take continuous reading of the gas level.</li> <li>The output will have Visual Alarm, Power and Fault lights as well as back lit LCD with all gas readings and events.</li> <li>For new ones, the cartridge will come with calibration certificate.</li> </ul>
3	<p><b><u>Testing and Validation should be from cylinders to MFC cabinets and pump to scrubber outlet</u></b></p> <p>It is required to do the complete testing and validation of the installed system. The system should be tested and validated for the following.</p> <ul style="list-style-type: none"> <li>Pressure – 24 hrs hold test. The entire installation should be validated for Pressure Decay test as per ASME standards.</li> <li>Helium Leak – minimum 1x10<sup>-9</sup> mbar He Lit sec<sup>-1</sup>. Helium leak testing should be carried out with dry vacuum pump having leak detection capability up to 1 X 10<sup>-11</sup> mbar He Lit sec<sup>-1</sup>.</li> <li>Trace Moisture – Less than 5 PPM of impurity. This will be conducted at all hook-up points using analytical equipment having capability to measure as low as 500 ppb moisture. Bidder to provide evidence of having done these tests in the previous installations. Test certificates and data sheet of analytical instruments used for the same should be provided along with latest calibration certificate.</li> <li>Trace Oxygen – Less than 5 PPM of impurity. This will be conducted at all hook-up points using analytical equipment having capability to measure as low as 500 ppb Oxygen. Bidder to provide evidence of having done these tests in the previous installations. Test certificates and data sheet of analytical instruments used for the same should be provided along with latest calibration</li> </ul>

	<p>certificate.</p> <ul style="list-style-type: none"> <li>• Particles – 0.1 micron and above. Post Trace Oxygen and Trace Moisture analysis, all the Gas lines will be tested for particle contamination before charging the Process Gas. Particle counter should have capability of measuring particle size as low as 0.1 micron using High Pressure Diffusion Device. Bidder to provide evidence of having done these tests in the previous installations. Test certificates and data sheet of analytical instruments used for the same should be provided along with latest calibration certificate.</li> <li>• Bidder must have own or rented Analysers to carry out the above tests and validations. A third party can be used for the testing and validation of the system at the bidder's expense, provided they satisfy the above criterion.</li> </ul>
	<p><b>Technical Specifications for Semi-Automatic Gas Cabinet</b>  In present tender, we intend to use Gas Cabinet for Gases which are Toxic, Corrosive and Pyrophoric.</p> <ul style="list-style-type: none"> <li>• Gas Cabinet must be 12 Gauge cold rolled steel powder coated with fire resistance for 90 minutes</li> <li>• Must have self-latching windows (having view glass) and self-latching doors. This will provide better safety for the operator during manual operation of the gas cabinet.</li> <li>• There must be key operated to provide authorised access.</li> <li>• Must have Georgian wire safety view glass.</li> <li>• Metallic cylinder support brackets.</li> <li>• Inlet air filter for louvers</li> <li>• Cabinet must have wax coated or temperature dependent sprinklers.</li> <li>• The gas cabinet must come equipped with UVIR sensors for SiH<sub>4</sub>, ROR sensor, water sprinkler as per the description is given in gas leak detection unit which will shut-down the gas cabinet in case of emergency. There is provision for attachment of electrochemical sensors for gases</li> <li>• Exhaust safety monitor unit to be placed, so that gas cabinet will auto shut down during failure of the exhaust.</li> <li>• Cabinet must have HMI screen to monitor locally and have Hooter, alarm system. This should be integrated with PLC and SCADA.</li> <li>• Gas Cabinet HMI must have following functions incorporated Leak detector, UVIR, ROR, Cylinder weighing scale, excess flow switch, high pressure and low-pressure indication and readings, empty cylinder notification.</li> </ul>

**Bid Evaluation Criteria**

The bidder must include their statement and proof of compliance for the below in the Technical Bid.

S.No	Details
1.	Should have installed gas distribution system involving Toxic and Hazardous gases like Silane, methane, Germane, Ammonia, and Hydrogen using co-axial SS 316L EP tubing for IITs/similar institutes/universities or reputed Government R&D centers or Private Industries.
2.	Must have own or rented analyzers to measure trace oxygen (min 10 ppb), trace moisture (min 10 ppb) and sub-micron particles (minimum 0.1 micron) before

	commissioning the pipe lines.
3.	Must have stainless steel clean room compatible tools for handling components in the project.
4.	Vendor must have high radius benders approved for semiconductor gas piping.
5.	Must have used Ultra High Purity Argon purifier with impurities of oxygen less than 100 ppb, moisture less than 100 ppb, total hydrocarbons less than 100 ppb. During installation vendor must use purifiers to achieve the purity level of welding gas.
6.	People must be trained to do the validation.
7.	Should have experience and demonstrated design capability for safe Gas Distribution System.
8.	Should be well versed to use instruments like pressure switch, gas leak detectors, pressure transducers and vacuum venturis.
9.	The vendor should have understanding of JSA (Job Safety Analysis), MAPP (Major Accident Prevention Plan) and PSR (Pre Start up safety review) for effective project implementation.
10.	The vendor must have done 3 similar projects in nature for customers in semiconductor manufacturing involving gases like SiH <sub>4</sub> , PH <sub>3</sub> , GeH <sub>4</sub> , NH <sub>3</sub>
11.	Vendor must have implemented SCADA/Gas Management software involving emergency responses and shut down procedures using Cause Effect Logic duly approved by Safety Engineer.
12.	Bidder to submit the cause effect matrix for the proposed equipment's in line with Gas Hazard.
13.	Vendor must have trained team to service trouble shoot Gas Cabinet, VMB, PLC programming and associated equipment. Necessary evidence from existing customers in India for having supported Gas Cabinets Maintenance and Troubleshooting should be enclosed. Vendor must submit letter from customers confirming that similar gas cabinets (similar makes of gas cabinets) are installed by vendor and the system is running successfully since last 3 years minimum and satisfactory service support is been provided by vendor.
14.	Vendor should demonstrate capability and experience of installation of Gas cabinet, VMB, Abatement equipment, VMP for Ultra High Purity gases with references from at-least 3 customers
15.	Must provide training to operate gas cabinets and other equipment to run the facility safely. Training must be provided by OEM only.
16.	Vendor must provide authorization certificate from the Principal.
17.	Customer feedback letters indicating the quality of work and satisfactorily working of gas cabinets from at least 3 customers in India
18.	List of customers, projects done with contact address, phone number, and email etc., Necessary site visit to any of the projects mentioned in your reference may be conducted at our discretion and accordingly Technical capability rating will be given to bidders.
19.	A technical presentation session by each bidder will be needed before the financial bids are open.



**List of approved OEM's for various components, equipment's required in the Project**

S. No	Description of Components / Equipment	Makes (or equivalent, TUV/BV/ATEX certified gas cabinet)
1.	Gas Cabinets	<ol style="list-style-type: none"> <li>1. Air Products</li> <li>2. Ceres</li> <li>3. KAS Tech</li> <li>4. Applied Energy</li> <li>5. Norcimbus</li> <li>6. Air Liquide</li> <li>7. AGEM</li> </ol>
2.	Valve Manifold Box (VMBs)	<ol style="list-style-type: none"> <li>1. Air Products</li> <li>2. KAS Tech</li> <li>3. Ceres Technologies Inc.</li> <li>4. Matheson Gas</li> <li>5. Applied Energy</li> <li>6. Norcimbus</li> <li>7. Air Liquide</li> <li>8. AGEM</li> </ol>
3.	SS 316L Gas panels	<ol style="list-style-type: none"> <li>1. Air Products</li> <li>2. Ceres</li> <li>3. KAS Tech</li> <li>4. Applied Energy</li> <li>5. Norcimbus</li> <li>6. Air Liquide</li> <li>7. AGEM</li> </ol>
	Inert Gases and Flammable Gases	
4.	POU Gas Stick	<ol style="list-style-type: none"> <li>1. Air Products</li> <li>2. KAS Tech</li> <li>3. Ceres</li> <li>4. Applied Energy</li> <li>5. Norcimbus</li> <li>6. Air Liquide</li> <li>7. AGEM</li> </ol>
5.	SS316L Valves and fittings	<ol style="list-style-type: none"> <li>1. Parker USA</li> <li>2. Daja</li> <li>3. Swagelok USA</li> <li>4. Carten</li> <li>5. Gas Arc</li> <li>6. Dhruva</li> </ol>
6.	Regulators	<ol style="list-style-type: none"> <li>1. Tescom</li> <li>2. AP-Tech</li> </ol>

		<ol style="list-style-type: none"> <li>3. Veriflo</li> <li>4. TFK</li> <li>5. Drastar</li> </ol>
7.	Tubes (BA and EP)	<ol style="list-style-type: none"> <li>1. Valex USA</li> <li>2. Dockweiler Germany</li> <li>3. Sandvik Sweden</li> </ol>
8.	Gas Detection System	
	Gas Leak Detectors (SIL 2 certified)	<ol style="list-style-type: none"> <li>1. Honeywell</li> <li>2. Draeger</li> <li>3. Bionics</li> <li>4. Cosmos</li> <li>5. Riken Keiki</li> </ol>
	PLC & SCADA	<ol style="list-style-type: none"> <li>1. Honeywell</li> <li>2. Bionics</li> <li>3. Draeger</li> <li>4. Cosmos</li> <li>5. Allenbradley</li> <li>6. Siemens</li> <li>7. ABB</li> <li>8. Moviecon</li> <li>9. Wonderware</li> </ol>
	3 Core Flexible shielded Cable	<ol style="list-style-type: none"> <li>1. Polycab</li> <li>2. LAPP</li> <li>3. ManCab</li> <li>4. Varsha</li> <li>5. Finolex</li> </ol>
	100 mm GI Cable Tray	<ol style="list-style-type: none"> <li>1. Reputed Indian Make</li> </ol>
9.	Dry Scrubber	<ol style="list-style-type: none"> <li>1. KAS Tech</li> <li>2. Edwards Systems</li> <li>3. CS Clean, Germany</li> <li>4. Centrotherm</li> <li>5. ATMI Inc</li> <li>6. AGEM</li> <li>7. DAS</li> </ol>
10.	Exhaust Blower	<ol style="list-style-type: none"> <li>1. Alpha Projects</li> <li>2. Pilani Enviro Tech</li> <li>3. Any Reputed Indian Company</li> </ol>
11.	Exhaust Ducting and Dampers	<ol style="list-style-type: none"> <li>1. AKI</li> <li>2. SE Products</li> <li>3. Any reputed Indian Company</li> </ol>
12.	Pressure Switch and Gauges	<ol style="list-style-type: none"> <li>1. Wika</li> <li>2. Waree</li> </ol>

		<ol style="list-style-type: none"> <li>3. Tescom</li> <li>4. USG</li> <li>5. TE</li> <li>6. I2N</li> <li>7. Baumer</li> </ol>
13.	Flash Back Arrestor	<ol style="list-style-type: none"> <li>1. Super flash</li> <li>2. Witt</li> </ol>
14.	Point of Use (POU) filter	<ol style="list-style-type: none"> <li>1. Entergis</li> <li>2. Pall</li> <li>3. Saes Getters</li> <li>4. AGEM</li> </ol>
15.	Support System	
	Unistrut Channel	<ol style="list-style-type: none"> <li>1. RSSIPL</li> <li>2. Divine</li> <li>3. DKNV</li> <li>4. Hilti</li> </ol>
	Tie Rods 8 mm	<ol style="list-style-type: none"> <li>1. Reputed Indian Make</li> </ol>
	Tube Clamps	<ol style="list-style-type: none"> <li>1. AKI</li> <li>2. Stauff</li> <li>3. AGEM</li> <li>4. Any reputed Indian Company</li> </ol>
	Anchor Fasteners	<ol style="list-style-type: none"> <li>1. Hilti</li> <li>2. Any reputed Indian Company</li> </ol>
	Unistrut Support System Hardware and accessories (Nuts, Bolts, L plates, Straight Plates. All GI items)	<ol style="list-style-type: none"> <li>1. Hilti</li> <li>2. Reputed Indian Make</li> </ol>