INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

Date :- 15.10.2025

Corrigendum – I

RFx No : 6100002351 PR No : 1000049476

Reactive Ion Etching Tool

Sr. No.	Online RFx Clause	Previous Clause	Changed Clause
1.	Bid submission End Date/Date & Time of submission (Online RFx clause)	16.10.2025 at 13.00	27.10.2025 at 13.00
2.	Bid Opening Date & Time (Online RFx clause)	16.10.2025 at 16.00	27.10.2025 at 16.00
3	Technical Specification	Revised Technical Specification uploaded on website, the same is attached	

Assistant Registrar

Materials Management Division

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

Powai, Mumbai 400076.

Item Description: Etching tool with utilities

a. ICPRIE tender specification
b. Utilities Tender Specification for ICPRIE system
c. Utilities Block Diagrams
d. Suppliers qualification Criteria

Scope of Supply

1. **ICPRIE System for Si Photonics related Application :-** This system will be utilized to etch Si/SiN /SiO2 /LiNbO3 and TiO2 for photonics related application and other related materials as this is multiuser facility

2. **Utilities on turn key basis : -** (Bulk Gases / Process Gases /Utilities /Scrubber/Exhaust /Chiller /Safety system):- Shared gas bank and other utilities for ICPRIE .

PR No. 1000049476 RFx NO. 6100002351

PART A : Supply and installation of ICPRIE system

Sr. No	Item description	Technical compliance (YES/NO)	Additional information (if any)
1	**Technical specifications for Load locked ICP-RIE System**		
	Process acceptance specifications for ICPRIE **a. Primary Applications:** Four out of four processes in Table 1 (Appendix 1) must be demonstrated at the time of system acceptance		
	b. Secondary Applications: System must be able to do following process I. The system must support the following: II. Metal etching (e.g. Ni, Cr, Al) using chlorine chemistry (Cl_2, BCl_3, Ar). III. Etching of III-V compound semiconductors (GaAs, InP, GaN) with smooth, low-damage profiles.		

	IV. Chamber, pumps, and components must be compatible with chlorine and boron trichloride gases (corrosion-resistant materials). V. Must be upgradable to Bosch Process (DRIE) capability with close-coupled MFCs for fast gas switching. VI. Must be upgradable to SOI etching with active notch control (software/hardware configurable).		
	Process Chamber • Aluminium process chamber machined from a single block (monoblock) of high-purity aluminium. • Anodized / corrosion-resistant finish compatible with both Cl-based and F-based chemistries. • Front/side flange thickness > 35mm with a viewport (quartz/sapphire) and a dedicated side port for optical emission spectroscopy (OES). • No internal welds or sealing joints permitted inside the process chamber to avoid contamination and virtual leaks. • Chamber shall be electrically heated to at least 60 °C to minimize polymer build-up and improve process stability. • Plasma source geometry and pumping arrangement must be designed to ensure uniform plasma density and uniform etching over the entire wafer across a wide parameter range. • One complete set of removable chamber liners shall be provided for chlorine chemistry; liners must be easily exchangeable for fluorine chemistry without chamber replacement or re-qualification.		
	System console • The main console shall house the turbo-molecular pumps, foreline roughing pumps, all pneumatic valves, and associated controllers. • The system must include comprehensive interlocks to protect both hardware and operator, including but not limited to: – Cooling water flow and temperature interlocks – Vacuum pressure interlocks for RF enable – Turbo pump speed / temperature monitoring – Gas flow interlocks (prevent gas introduction at unsafe pressure) – Chamber door / load-lock lid interlocks • In case of utility failure (power, water, compressed air), the system must automatically close isolation valves and maintain the process chamber under vacuum.		

	• System must vent using dry nitrogen when venting is required for wafer handling or maintenance to prevent moisture or particle contamination. • Electrical design must meet CE / IEC standards or equivalent for operator safety, with grounding and access interlocks to prevent exposure to high voltages during maintenance.		
	Substrate Electrode • Substrate electrode diameter ≥ 238 mm, suitable for direct loading of whole wafers up to 200 mm (8 inch) diameter and up to 7 mm thick. • Wafer temperature control by helium backside cooling with mechanical clamping. • Helium pressure must be a process parameter, programmable in recipe, pressure-controlled, and monitored via a mass flow controller (MFC). Real-time helium flow and pressure must be displayed on the system PC. • Mechanical clamping shall be continuous, using high-purity quartz or alumina rings specific to wafer size, and designed without consumable O-rings or seals for helium containment. • Clamping solutions must be provided for 3”, 4”, and 6” wafers, allowing direct loading without carriers. Clamps and carriers must be easily swappable and allow reproducible positioning. • System must allow direct clamping of full wafers to ensure good thermal contact and repeatability. • Supplier must include one carrier platen with 100 mm recess for small or irregular samples, made of high-purity graphite or silicon, compatible with helium backside cooling.		
	Electrode Heating & Cooling ● The electrode should be cooled by fluid chiller and heated by electrical heater ● Remotely controlled re-circulating heater/chiller unit suitable for electrode temperature control from -150^{0}C to + 150^{0}C with 0.5^{0}C accuracy. ● The full range of temperature control should automatically be controlled from the recipe without user intervention between the cooling and heating ranges. Switching between Chiller , LN2 and Heater should be automated via software ● As Suitable LN2 Dewar Should be provided along with the system .		
	Plasma sources ● **RIE** power supply to substrate electrode		

	• Power 600 W 13.56 MHz and directly coupled automatic tuning • It must be possible to - work in automatic matching mode - work in automatic matching mode with preset Capacitor positions (from the PC, for each step) - work with fixed capacitor positions (from the PC, for each step)		
	Top Electrode ICP Source suitable for up to 8-inch wafers Generator size at least 3000 W, 2MHz or 13.56 MHz with automatic matching system should be able to run plasmas up to this power. Suitable flange on top electrode for fitting a laser interferometer Helical/PTSA Type remote plasma ICP source with remote plasma , low damage etching. It must be possible to • work in automatic matching mode • work in automatic matching mode with preset Capacitor positions (from the PC, for each step) • work with fixed capacitor positions (from the PC, for each step		
	Atomic Layer Etching (ALE) Kit • System must have Low biasing kit to allow accurate control in the 2W- 30 Watt range • System Should have the ALE gas dose hardware capable of short 10 msec pulses , controlled, reproducible gas doses required for the ALE process		
	Vacuum system • Turbomolecular pump, min. throughput of 1300 l/s or higher, magnetic bearings and heated • Pump must be corrosion-resistant and compatible with Cl_2, BCl_3, and fluorine-based chemistries. • Dry backing pump, 90 m3/hr or better with N2 purge standby to allow N2 purge only when running the plasma process . • 200 mm VAT high vacuum gate and automatic throttle valve. Smaller throttle valves are not acceptable as they reduce the pumping throughput. • Suitable size heated CM gauge, temperature compensated Penning gauge • Vacuum Pipework with electrical heating up to 60° C		
	Gas-Box • System mounted Gas boxes for up to at least 12 MFC controlled gas lines, fitted with 10 MFC's as below and 2 empty spaces for future upgrades		

	o 4 hazardous lines and Metal sealed MFC) and with bypass lines (Cl , BCl_3, HBr, H2) o 6non-hazardous lines and viton sealed MFC) (O2 , Ar , SF6 , C4F8, CHF3 , CF4) ● Lines should be fitted with one electro-pneumatic isolation valve and in-line 2um filter ● BCL3 and C4F8 MFC's and by pass valves must be electrically heated inside the gas box. ● Lines should only made of SS316L EP polished tubes ● Only VCR fittings to be used on process gas lines . ● 2um inline filters ● 100mm vent port		
	Vacuum load lock ● Vacuum load lock with small volume < 10 liter ● Inter-chamber valve: Inter-chamber valve must be a slit valve of equivalent quality to VAT MonoVAT, with leak rate ≤ 1×10^{-9} mbar·L/s. ● Suitable independent dry pump of 14m3/hr pumping capacity ● On starting a process request from the PC, the wafer should be automatically loaded for processing and returned to the Loadlock and left under vacuum until the user is ready to retrieve it. Then manually the load lock vented and lid opened for unloading of the wafer.		
	Control System ● Computer controlled system with software based on Windows 10 or better ● Including an automatic leak check and automatic MFC check ● Main system controller must be: ● Programmable Logic Controller (PLC) ● The software should include full data logging capability of user-selectable run-time process parameters, to allow off-line verification and analysis of process conditions. ● The system should not have a limit to the number of recipes it can store. ● System tolerances should be editable by advanced user through the GUI. ● It must be possible to mount the gas pod and PC separately.		
	Log files ● Should have a Graphical display of any parameter ● Able to load in multiple steps and graph parameters		

	• Able to graph parameters in various ways – as measured value, measured value and set value, set value – measured value, derivative of measured value, set value bands with measured value. • Ability to load in multiple recipes (and compare them graphically) • Ability to display alarms and alerts associated with recipe steps loaded		
	Documentation • To be provided with the bid quotation: o ISO or equivalent quality conformity confirmation o Installation documentation o CE conformity confirmation declaration • To be provided with the system: o Operation and maintenance Manuals on CD, and OEM manuals.		
	Commissioning • The systems should be commissioned and demonstrated to meet four out of the four processes requested. • Recipes to be provided for all requested process with starting points and trend information.		
	Warranty of 1 year		
	Training **The vendor shall arrange minimum 5 day training, covering all processes and system configuration, along with fare, cost, and accommodation.**		
	The supplier eligibility criteria The bidder must confirm, that the system manufacturer runs his own clean room with at least 2 systems of the quoted type installed there. In total the suppliers own application lab must have min 10 etching systems and 20 process engineers and exist since min 10 years. Supply min 10 references of similar system. Spare parts must be available for min 7 years ex stock in India		

	Supplier must confirm that he runs a free of charge service hotline since min 10 years. Add the telephone number and email and persons on the hotline Telephone response time max 30 min. Guaranteed Onsite Site response time by OEM engineers in 2 working days		
	Future Upgrade Requirements (Field Upgradable): The system must be designed to support the following future upgrades, without requiring return to the manufacturer: a. It must be possible to add at least three (3) closely coupled Mass Flow Controllers (MFCs) (O2 , C4F8 , SF6) to the chamber to support the Bosch process, including the integration of all necessary software and control functionalities. b. The system must allow for future integration (field upgrade) of Optical Emission Spectroscopy (OES) or laser-based endpoint detection, as process requirements evolve. c. The system must be compatible with future process recipes involving alternative materials, such as metals and III-V compound semiconductors, to ensure versatility and extend process capabilities and our future requirements . The OEM must provide support and initial process start-point recipes as may be needed for these materials in future.		

Part B: Scope of work for utilities for ICPRIE system

1. **Gas distribution system** from Gas Cabinet, Manifold to the ICPRIE gas Box , system and as may be required to may systems functional .
2. **Chillers & Chilled Water line (Supply & Return)** for systems and Pumps as may be required to make system functional .

3. **One time supply of process and bulk gasses**
4. **Exhaust** work for the Gas Cabinets, Systems and Scrubbers.
5. **Dry bed Scrubber**
6. **Online UPS**

Sr. No	Item description	Technical compliance (YES/NO)	Additional information (if any)
1	**Gas Distribution System**		
	a. Gas Lines and Piping On-site gas line tubing & piping for all required gases shall be the responsibility of the supplier. The tubing & piping costs must be quoted. The utility area (where the gas cylinders must be kept) will be within 30 meters of the equipment. However, the vendor must quote for the required attachments (on per unit basis) and piping (on per meter basis). The supplier must ensure a completely safe and fool-proof mechanism for storage and supply of inert as well as process gases that may be highly corrosive, flammable and hazardous in nature. Hence, the gas distribution system has to be handled by experienced vendor / sub-vendor. The vendor / sub- vendor shall have at least 3 years of establishment in India. The Bidder shall submit contact details of minimum 1 reputed customers preferably Government. Where they have executed similar work for hazardous gases and other required gases during the past 3 years. Entire gas distribution system shall be SEMI- S2 compliant. Following is a summary of requirement on gas cabinet, supply panel manifold and piping. Any other requirement for ensuring safe operation may be brought out in the technical bid and the same may be quoted in the price bid. Indicative Installation layouts are provided at		

	the end (Appendix 2)		
	• All joints in panel shall be either orbital welded or face seal (VCR) connections. • Panel shall be tested and certified for Trace moisture & Trace oxygen content up to PPM level . • All component of the Manifold must be suitable for MOC with VCR connection • All panels must be Helium leak test at leak rate of 10E-9 mbar l/s. • All panels must be pressure tested as per SEMI standard. • All panels shall be supplied with 0.5 micron filter at inlet side and 0.003 micron filter at outlet. • Panel must be tested for up to 0.1um particle level • Panel must be assembled in class 100 or better clean room .		
2	**Gas Cabinets for Cl , BCl3 & HBr**		
	The gas cabinet and supply panel shall be equipped with the following features: • Suitable Tied Diaphragm Pressure Regulator with adequate flow rate. • Inlet & Outlet pressure gauge must be contact gauges. • Venturi operated purge-vacuum system to remove entrapped moisture before charging corrosive gases and suitable provision to ensure impurity free delivery of high purity gases to the process without any contamination. • Necessary isolation VCR diaphragm type valves for Pneumatic, Venturi, Purge and process gases. • Sample / He leak check port with NRV shall be provided. • High pressure vent for quick efficient purging of pigtail & high-pressure side of panel.		

		• Low pressure side of gas panel shell be equipped with pressure transmitter to monitor increase in pressure in case regulator failure . • Excess Flow switch must be provided. • Emergency shut off valve at the outlet that can be activated during any life safety warnings coming from process and facility conditions. The emergency shut off valves shall be pneumatically operated with external solenoid. • The supply panel shall be monitored for life safety situations. It shall, in the event of gas leak, exhaust failure, rate of rise and fire etc. take necessary actions to prevent damage and auto shut off shutdown during any exigency with alarm hooter. • Gas cabinet must have sprinkler. • Self extraction or diffusion type Gas leak detection system shall be used inside gas cabinet. • Gas cabinet shall have ROR sensor. • Gas cabinet shall have HMI panel with controller. • All the internals of components shall be electro polished with surface roughness of 10 micron. • Gas cabinet shall be designed to store one 47/50 liters gas bottles with provision to adjust the storage to accommodate smaller gas bottles as well • Enclosure shall be made of GI sheet with powder coated surface to avoid corrosion over the period of time and better protection from fire • Enclosure must have provision to connect with exhaust 4” circular and enclosure door must have cut-outs to ensure fresh air inlet from the bottom of the enclosure. • Inlet air filter must be provided for door		

	louvers. • The enclosure shall come with an exhaust port to meet the recommended exhaust flow rate. • Must have self-latching door compulsory for improved safety of the operator. • Safety glass viewing windows with ¼" wire reinforcement. • Panel must be tested for He leak check to 10^{-9}mbar L/sec • Panel must be tested for trace moisture /trace Oxygen to PPM level • Panel must be tested for up to 0.1um particle level • Panel must be assembled in class 100 or better clean room		
	Single Cylinder Gas Supply Panel for SF6, C4F8, CF4, CHF3, He, Ar, O2, N2 , H2 • N2 purging and high-pressure vent of gas lines carrying corrosive gases is mandatory. • Panels have high pressure isolation VCR diaphragm valve, • High pressure purge facility, • High pressure vent VCR diaphragm valve, • Process isolation VCR diaphragm valve, • Safety relief valve, • SS316L EP Tied Diaphragm Pressure Regulator with the adequate flow rate. • He leak check port shall be provided for H2 & CH4 • SS Pigtail made of SS316L EP tube with bull nose connectors as per cylinder standard. • All fittings shall be micro fittings and every components shall have VCR end connection • Panel must be tested for He leak check to 10^{-9}mbar L/sec		

	• Panel must be tested for trace moisture /trace Oxygen to PPM level • Panel must be tested for up to 0.1um particle level • Panel must be assembled in class 100 or better clean room		
	8x8 Semi-Auto changeover manifold For General Nitrogen & CDA shared: 1 No • Semi-Auto changeover Panels must have pressure regulator, high pressure isolation valve, high pressure vent valve, process isolation valve, Safety relief valve, • ½ inch out let line port • Must be able to deliver the flow of 200LPM GN2 • Each components must be of SS316L compression fittings • Inlet and outlet isolation valves, • Outlet Pressure Gauge • Non-return valve		
	Gas Stick for non-hazardous process gases (PN2): 3 Nos • Each component must be of SS316L EP VCR type. • Stick shall have one Pressure Regulator, • Inlet and outlet isolation valves, • Outlet Pressure Gauge • Non-return valve		
	Gas Stick for non-hazardous bulk gases (PN2): 5 Nos • Each component must be of SS316L compression fittings. • Stick shall have one Pressure Regulator, • Inlet and outlet isolation valves, • Outlet Pressure Gauge • Non-return valve		
	Tubing Material / Type: 30 Length for each line • 1/2" x 1/4" SS316L, electro-polished, coaxial Tube & fitting, 10µ Ra max. Tubing for hazardous gasses& Coaxial pressure switches shall be considered as required . (90 Meters)		

	• 1/4" OD X 0.035" WT Seamless EP tube, SS316L, 10µin Ra max tubing for nonhazardous process gasses. (300 Meters) • All Valves fitting for process gasses : SS 316 L EP – electro polished. End connection: VCR as required. • 1/2" OD x 0.049" WT Seamless tube, SS316L, tubing for GN2. (60 Meters) • 1/4" OD x 0.035" WT Seamless tube, SS316L, tubing for GN2. (100 Meters) • All Valves fitting for BULK gasses : SS 316 – electro polished. End connection: compression fittings type as required.		
	Line Heating : BCl3 and C4F8 lines must be electrically heated up to 50^0 C (30 Meters each line)		
3	**Water distribution system and Chiller for ICPRIE systems & Pumps** • 2 TR capacity chiller shall be supplied for systems cooling • Complete supply and return water line interconnecting tools and Pumps with isolation valve from respective tools to Chiller • Both supply and return water line shall be proper insulated to avoid heat loss. • Flow-meter shall be provided in return water line for tools and pumps . • SS304 Tube with Valves and Fittings for system connection.		
4	**Gases Supply one time supply of gases as per table 2 in appendix 3**		
5	**Exhaust for the Gas Cabinets, ICPRIE Systems , Pumps and Scrubbers along with blower (approx. 60 Meter length)** ● Complete Exhaust ducting		

	interconnecting gas cabinets outlets, systems outlet, pumps outlet with appropriate dampers. MOC of DUCT, nuts and bolts must be SS304, minimum 2 mm thickness. ● SS316L BA Tube for process exhaust with adequate fittings. ● Exhaust Blower shall be connected using metal exhaust duct and butterfly valve. ● Water line and vent line connections to be given to each Gas Cabinet ● Hazardous Gas lines vent shall be connected to scrubber. ● A suitable capacity blower must be supplied.		
6	**Dry Bed Scrubber** ● Systems should be supplied with a point of use scrubber for the abatement / disposal of Fluorine and Chlorine based byproducts. The scrubber should have followed: ● Chemisorption reaction based dry scrubbing technology or suitable wet scrubber ● At the outlet of scrubber, the Hazardous gas concentration should be below their universally accepted Threshold Limit Values (TLVs) ● At the outlet of the scrubber, it should have detectors to detect minimum gas concentration of their universally accepted TLVs. ● It should allow for safe refilling / replacement of cartridges / consumables when the lifetime of the granulates expires.		

	Acceptance and Testing: The equipment shall be installed conforming the specifications, utilities and safety which must be demonstrated in full in every aspect as specified above including its safety (Interlock system, Pressure, Leak check, O2 and moisture trace analysis, particle trace included, and any other important aspect of concern). The vendor shall certify the operation safety of all parameters upon successful installation of the equipment.		
	All Process gas lines shall undergo 5 step testing and validation as per the following parameters: ● **Pressure holds test (0 psi drop over 24 hours) using calibrated chart recorder** ● **Helium leak check (1x10^-9 mbar l/sec)** ● **Trace oxygen < 1 ppm** ● **Trace moisture < 1 ppm** ● **Trace Particle <0.1 micron**		
7	**Suitable Online UPS** A suitable **Online UPS** of **reputed make** shall be quoted for the ICPRIE system. The UPS shall meet the following minimum specifications: ● **Type:** Online Double Conversion UPS ● **Capacity:** Adequate to handle the full load of the ICPRIE system, including control electronics and power supply units ● **Backup Time:** Minimum of **30 minutes** at full load ● **Input Voltage Range:** 3 Phase 415V , 50Hz ● **Output Voltage:** Pure sine wave output, regulated and isolated ● **Isolation Transformer:** Included to ensure galvanic isolation and protection from electrical noise and transients ● **Efficiency:** High efficiency (≥ 70%) with low total harmonic distortion (THD) ● **Display:** LCD or LED display panel for input/output voltage, battery status, load percentage, and fault indications ● **Battery Type:** Maintenance-free sealed lead-acid or Li-ion batteries with proper housing and ventilation ● **Certifications:** ISO certified or equivalent compliance ● **Warranty:** Minimum 1 years for UPS unit and 1 year for batteries		

	Training **The vendor shall arrange minimum 5 day training, covering all processes and system configuration, along with fare, cost, and accommodation.**		
	Warranty for Gas Utilities Installation: • Supplier must provide a minimum 12-month warranty from the date of commissioning covering all installed gas lines, valves, MFCs, regulators, and manifolds against defects in materials, workmanship, and installation. • During warranty, supplier must provide free replacement or repair of defective components and onsite technical support. • Response time for warranty service must be ≤ 2 working days.		
	Supplier qualification criteria The supplier must ensure a completely safe and fool-proof mechanism for storage and supply of inert as well as process gases that may be highly corrosive, flammable and hazardous in nature. Hence, the gas distribution system has to be handled by experienced vendor / sub-vendor. The vendor / sub- vendor shall have at least 5 years of establishment in India. The Bidder shall submit contact details of minimum 5 reputed customer preferably from IITs or IISc or research labs where they have executed similar work for hazardous gases and other required gases during the past 3 years. The entire gas distribution system shall be SEMI- S2 compliant. Supplier must provide service and technical support for installation, commissioning, and troubleshooting for minimum 5 years. Must maintain stock of critical spare parts locally for at least 5 years. Must provide a hotline or point of contact for installation and operational support, with telephone response ≤30 minutes. The vendor should have a minimum annual turnover of 5 crore and should not have incurred any loss in the last 3 years.		

Appendix 1

Table 1: Primary Applications: All four processes must be demonstrated at the time of system acceptance

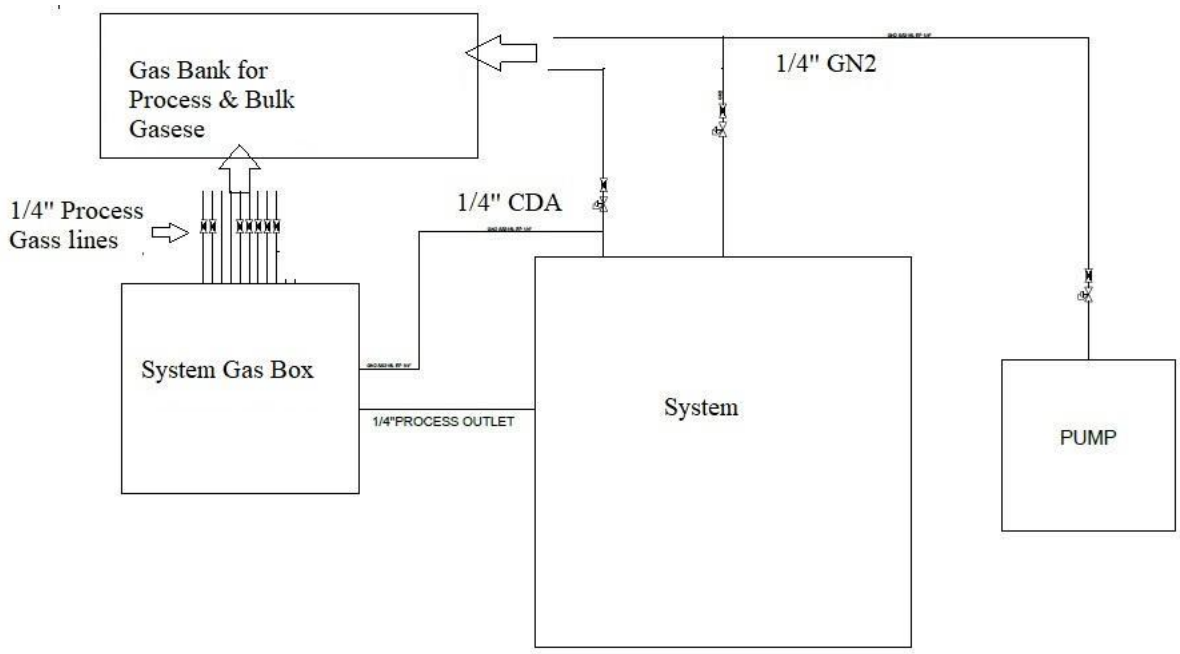
Parameter	Si ICP Etch	Process Ref 1 (SiO_2)	Process Ref 2 (SiN_x)	Process Spec 3 ($LiNbO_3$)
Etched Material	Si	SiO_2	SiN_x	$LiNbO_3$
Etch Mode	ICP	ICP	ICP	ICP
Substrate	Si	Si	Si	Si / $LiNbO_3$
Wafer Size	150 mm	150 mm	150 mm	150 mm
Feature Size/Type	> 5 µm trench	≥ 250 nm line with > 50 µm space	≥ 250 nm line with > 50 µm space	≥ 1 µm trench
Etch Depth	Up to 10 µm trench	< 100 nm	< 100 nm	Up to 250 nm
Etch Rate	< 200 nm/min	< 100 nm/min	< 100 nm/min	< 25 nm/min
Selectivity to Mask	> 5:1 (PR)	> 1:1 (PR)	> 1:1 (PR)	> 0.5:1 (PR), > 3:1 (Cr)
Profile	> 90° ± 2°	> 80°	> 80°	> 70° (Cr mask), > 60° (PR mask)
Within-Wafer Uniformity	< ±5%	< ±5%	< ±5%	< ±5%
Run-to-Run Uniformity	< ±3%	< ±3%	< ±3%	< ±5%

Appendix 2

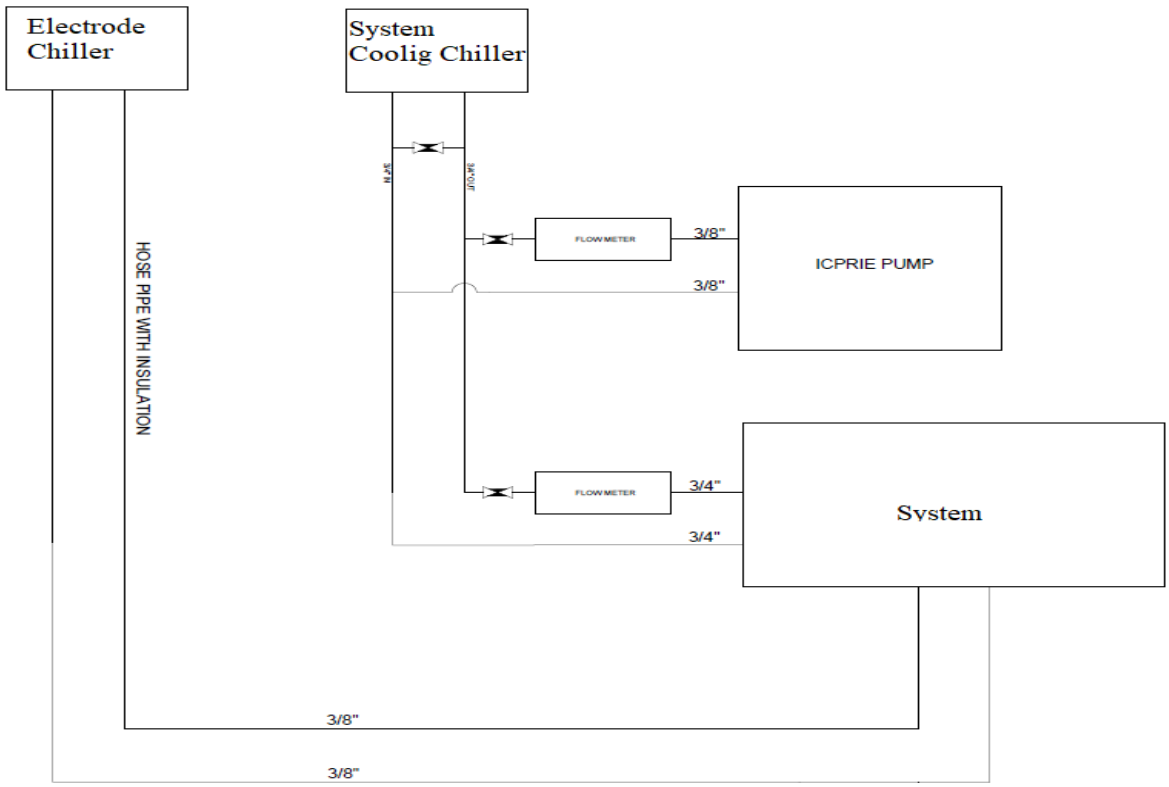
Proposed Installation Layout and P&ID diagram

a. Gas lines:- below is just indicative block diagram for **ICPRIE systems** with process gasses as below ,in shard lines VCR diaphragm valves must be provided to isolate systems.

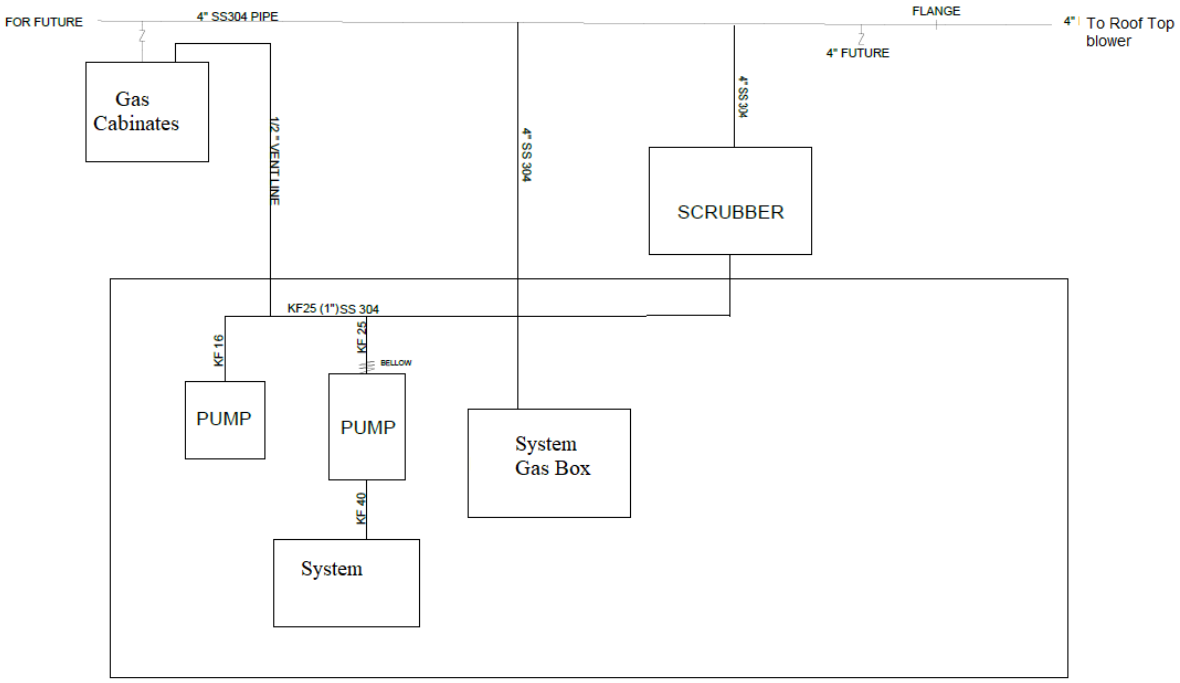
- **ICPRIE (ALE)Process Gasses :- Cl , BCl3 , HBr, H2, SF6, C4F8, CF4, CHF3, He, Ar, O2**
- **Bulk Gases GN2 & CDA**



b (i) Water lines :- below is just indicative block diagram **ICPRIE** water lines to be flowed



c. Exhaust :- below is just indicative block diagram for **ICPRIE system**



Approved Make:- Only approved Makes are allowed

S. No.	Components	Proposed Make
1	Gas Cabinets	Air liquide/ Norcimbus/VAYU/ UHP /KAS/ / Applied Energy/ **CCD Tubes-Dockweiler/Valex/Nanoclean/AGEM/Rotarex**
2	Gas Manifold for process gasses	Air liquide/ Norcimbus/VAYU/ UHP /KAS// Applied Energy/Swagelok **/CCD Tubes-Dockweiler/Valex/Nanoclean/AGEM/Rotarex**
3	Valve Manifold Panel (VMP)	Air liquide/ Norcimbus/VAYU/ UHP /KAS/ Applied Energy/Swagelok**/CCD Tubes-Dockweiler/Valex/Nanoclean/AGEM/Rotarex**
4	Pressure regulator in Gas Supply Panel/VMB/VMP/in process line	Rotarex/Tescom/Swagelok/ Aptech/Unilok

5	Valve in Gas Supply Panel /VMB/VMP/ in process line	Rotarex/Tescom/Swagelok/ Aptech/Unilok
6	Check Valve in Gas Supply Panel /VMB/VMP/ in process line	Rotarex/Tescom/Swagelok/ Aptech//Unilok/ Xinval
7	SS316L Tube	Valex/Dockweiler/WSG/
8	SS316L Fittings in Gas Supply Panel/VMB/VMP/ in process line	Swagelok/Parker/Rotarex/ Unilok/ Xinval
9	Filter in Gas Supply Panel.	Pall/Entegris/Swagelok/ TEM/Xinval
10	Gas Leak Detector in VMB and in process line	Honeywell/PROSENSE/Draeger/Cosmos/Rikin Keiki
11	Exhaust Sensor in VMB	Honeywell/CKD/DWYER
12	ROR in VMB	Honeywell/System Sensor
13	UVIR sensor in VMB	Honeywell/Rosemont/Sense-Ware/ Rezontech
14	Pressure Gauge in Gas Panel/VMB/VMP	Wika/WISE/ Reputed Make
15	Controller for VMB	Siemens / Allen Bradley/ ABB
16	Heat Tracer & Controller	Reputed Make
17	Exhaust SS304 Duct with damper & Fittings.	Reputed Indian Make
18	Dry Scrubber	Jupiter Scientific / CS clean / Centrotherm /IPI / GMC
19	UPS	Autometers Alliance Limited, Microtech , Luminous

Appendix 3

Table 2

Sr No	Gas	Purity	Qty(Cylinder)
1.	BCl3	Semiconductor Grade 5N	1
2.	Cl2	Semiconductor Grade 5N	1
3.	HBr	Semiconductor Grade 5N	1
4.	H2	Semiconductor Grade 5N	1
5.	O2	Semiconductor Grade 5N	1
6.	C4F8	Semiconductor Grade 5N	1
7.	CF4	Semiconductor Grade 5N	1

8.	CHF3	Semiconductor Grade 5N	1
9.	SF6	Semiconductor Grade 5N	1
10.	He	Semiconductor Grade 5N	1
11.	Ar	Semiconductor Grade 5N	1
12.	N2	Semiconductor Grade 5N	1
13.	GN2	Industrial Grade 3N	20