IFE Chamber Vacuum System

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Abstract/Requirements

Develop an IFE Target Chamber Vacuum System employing commercial off the shelf (COTS) components to minimize cost. Evaluate different vacuum technologies to meet system specifications while maintaining operational and maintenance costs at a minimum. Meet system requirements employing high efficiency turbo molecular pumps backed by roughing pumps, thus providing a cost effective solution. Employ components which have good operational history in similar type environments. Design system to transition to tritium operations with minimum modification.

System Specifications*

Target Chamber
Inner radius = 6.5 m
Outer radius = 7.3 m
Target chamber volume = 1,150,346 liters
Toroidal duct volume = 145,141 liters
Total volume (without beam ports) = 1,295,487 liters

Target Chamber Pressures
Operational base pressure = 0.5 mtorr
Gas load = 141 torr-liters/sec
Total system in-leakage = 1x10-5 torr-liters/sec

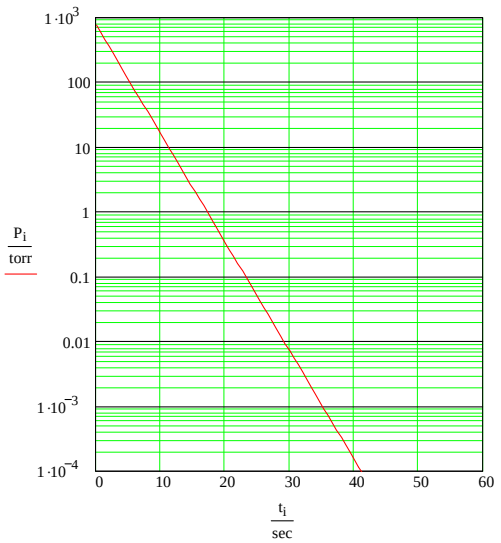
Vacuum Pumping System – Target Chamber
TMP pumping ducts = 60
TMP's (Varian-V 6000) = 2/duct
TMPS's total =120
TMP backing pumps (Kinney KMBD-2000) = 1/6 TMP's
Backing pumps total = 20

Vacuum Pumping System – Beam Ports
TMP's (Varian-V 2000 HT) = 1/beam port
TMPS's total =60

Target Chamber TMP Magnetic Shielding
Magnetic shields = 1/target chamber TMP
Magnetic shields total = 120
Shield design for external 1 kgauss field
TMP shielded to less than 50 gauss

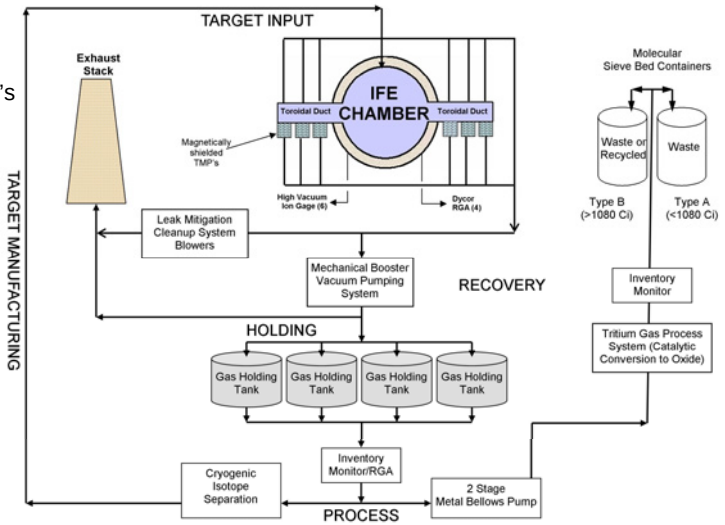
System parameters will change as IFE chamber design matures.

IFE Chamber Molecular Loading

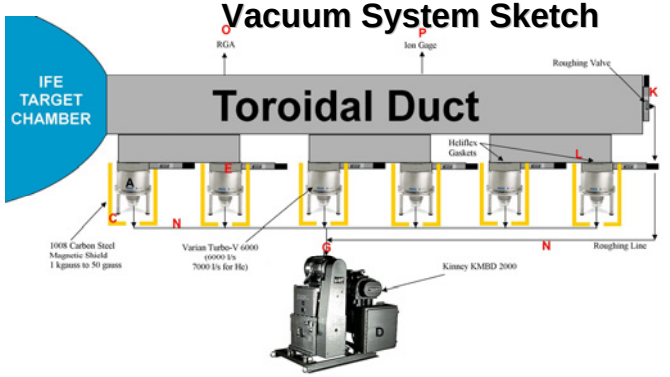


Rise in pressure from 0.5 mtorr to 1.4 mtorr @ 5 hz rep rate

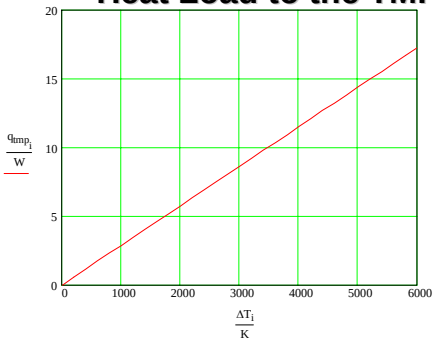
IFE Chamber Vacuum System and Interface



Vacuum System Sketch



Heat Load to the TMP's



Component Cost Estimate

Key	Equipment Name	Unit Cost	Qty	Total	Qty Discount	Discount Total	Total
A	Varian Turbo-V 6000 (on target chamber)	$ 70,000.00	120	$ 8,400,000.00	20%	$ 1,680,000.00	$ 6,720,000.00
B	Varian Turbo-V 2000 HT (on each beam tube)	$ 25,000.00	60	$ 1,500,000.00	20%	$ 300,000.00	$ 1,200,000.00
C	Magnetic Shielding (only on Turbo-V 6000)	$ 1,000.00	120	$ 120,000.00	0%	$ -	$ 120,000.00
D	Kinney KMBD -2000 Backing Pumps	$ 41,000.00	20	$ 820,000.00	20%	$ 164,000.00	$ 656,000.00
E	TMP/Target Chamber Isolation Valves (VAT valves, 20" throughput)	$ 20,000.00	120	$ 2,400,000.00	20%	$ 480,000.00	$ 1,920,000.00
F	Beam Tube (TMP) Isolation Valves (VAT valves, 10" throughput)	$ 12,000.00	60	$ 720,000.00	20%	$ 144,000.00	$ 576,000.00
G	Roughing Valves (between TMP exhaust/Kinney Inlet)	$ 8,000.00	20	$ 160,000.00	20%	$ 32,000.00	$ 128,000.00
H	Gate Valves (after Kinney discharge)	$ 8,000.00	20	$ 160,000.00	20%	$ 32,000.00	$ 128,000.00
I	Dycor RGA (0-200 AMU w/ pumping system)	$ 23,000.00	4	$ 92,000.00	5%	$ 4,600.00	$ 87,400.00
J	Instrumentation and Control	$ 200,000.00		$ 200,000.00	0%	$ -	$ 200,000.00
K	Target Chamber Isolation Valves (for roughing pump interface-VAT valves, 8" throughput)	$ 8,000.00	10	$ 80,000.00	10%	$ 8,000.00	$ 72,000.00
L	Heli-Flex Seals	$ 500.00	380	$ 190,000.00	5%	$ 9,500.00	$ 190,000.00
M	Gas Holding Tanks (10 m³)	$ 150,000.00	4	$ 600,000.00	0%	$ -	$ 600,000.00
N	Interfacing Piping	$ 250,000.00		$ 250,000.00	0%	$ -	$ 250,000.00
O	High Vacuum Ion Gage	$ 5,000.00	6	$ 30,000.00	0%	$ -	$ 5,000.00
	Totals			$ 15,722,000.00		$ 2,854,100.00	$ 12,852,400.00