Vacuum system MEDICIS

Jose A. Ferreira

MEDICIS Vacuum WP

Scope:

- Vacuum system of MEDICIS facility including (design, procurement and installation):
  - Gas recuperation system
  - Pumping system (turbo and primaries)
  - Ancillary lines
  - Controls
- Excluded:
  - Vacuum chambers, 3D integration and compressed air supply

MEDICIS Vacuum Specification

Pressure requirement:

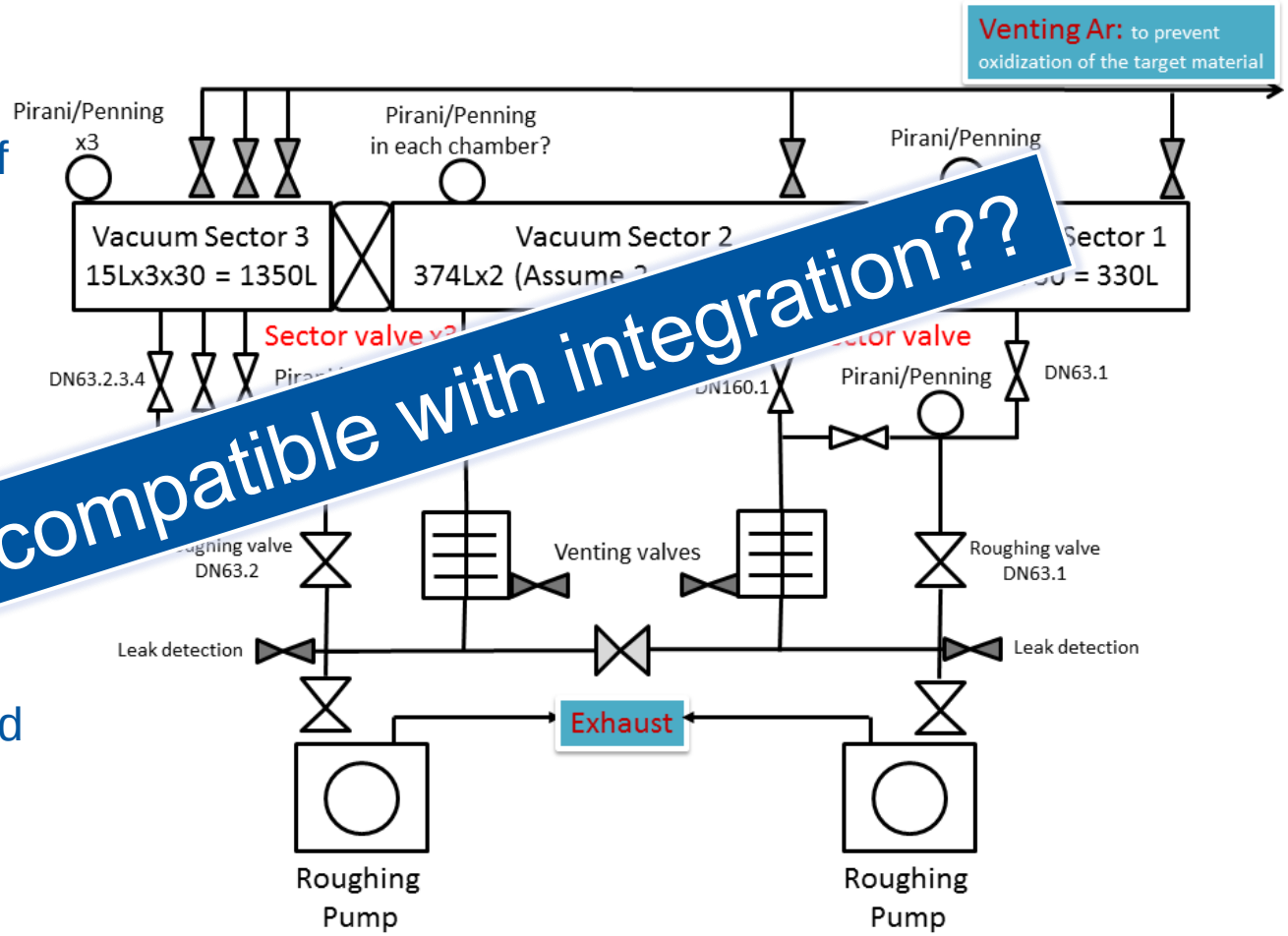
- ≈10^{-6} mbar frontend
- ≈10^{-7} mbar in separator and experiment
- Primary vacuum tightness <$2 \cdot 10^{-10}$ mbar·l/s
- Maximum gas loads:
  - 10^{-4} mbar·l/s frontend (24h)
  - 10^{-5} mbar·l/s separator (24h)

Radioactive gas recovery system:

- All ancillary lines leak tight <10^{-5} mbar·l/s (including backing lines and exhaust)

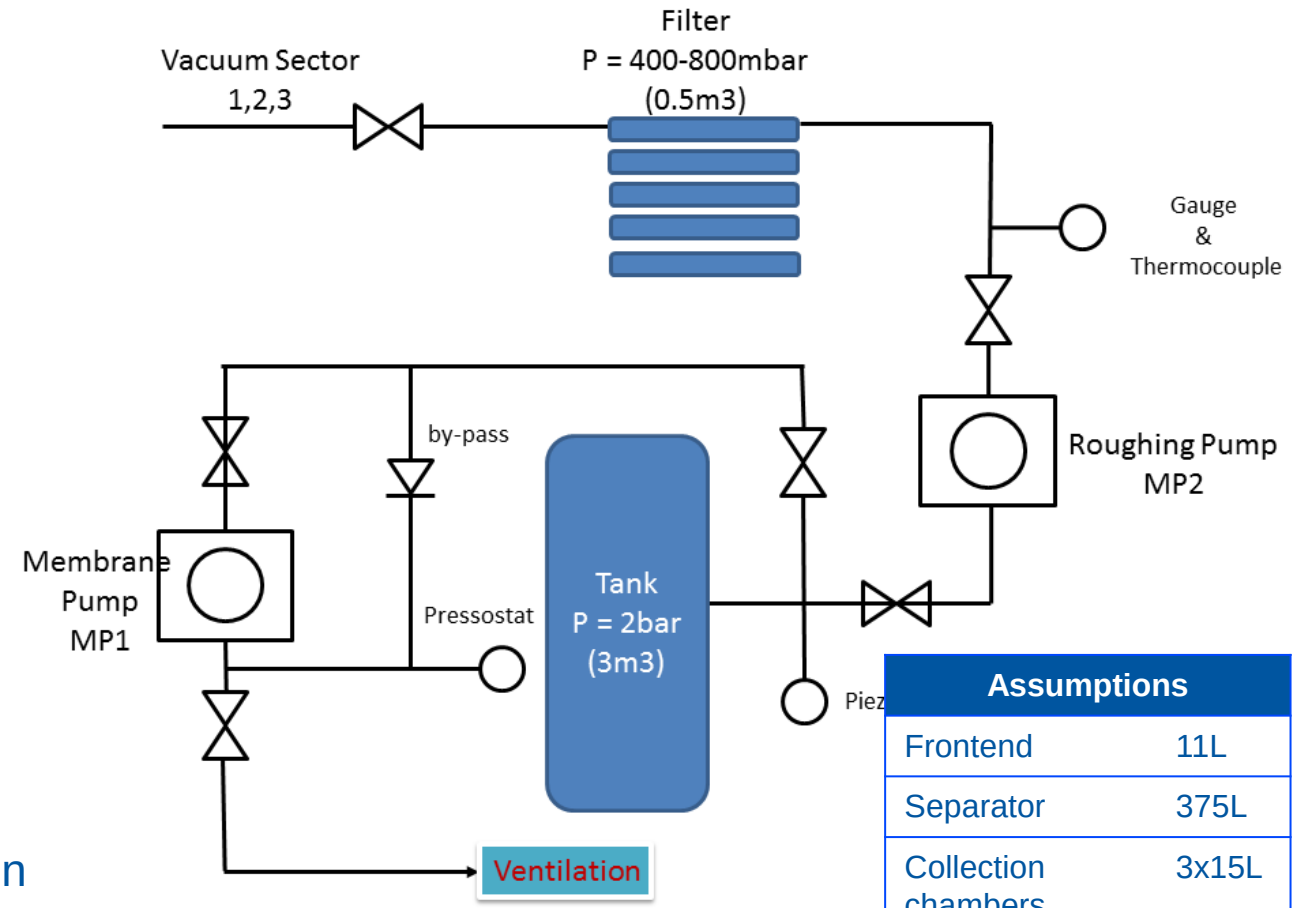
Proposed layout

- Reduced: number of components (two turbos and two primaries to pump three vacuum sectors)
- Redundancy: Operati… even … turbo … primary
- Vacuum sector 1 and 3 frequently vented
- Elastomeric seals (Viton / EPDM)



Gas recuperation system

- All ancillary lines under vacuum except accumulation tank
- Design for 30 venting/year
- Backing and roughing pumps dry or oil?
  - Oil → Filters radioactive contamination, but no treated waste and spill risk
  - Dry → No maintenance but higher radiation on exhaust
- Emptying should be interlocked by ventilation system



Assumptions	
Frontend	11L
Separator	375L
Collection chambers	3x15L

Equipment (Turbopumps)

TURBOVAC 1000

↑ Good experience in ISOLDE frontend with no maintenance
↑ Air cooled
↑ Mechanical bearings (no affected by magnetic fields)
↓ Recent experience in LINAC2 no satisfactory. Sensible to backing pressure

HiPace 700

↑ Good experience at CERN
↑ Air cooled
↓ Hybrid bearings (affected by magnetic fields >6mT)
↓ Maintenance required each 4 years

Equipment (Primary pumping)

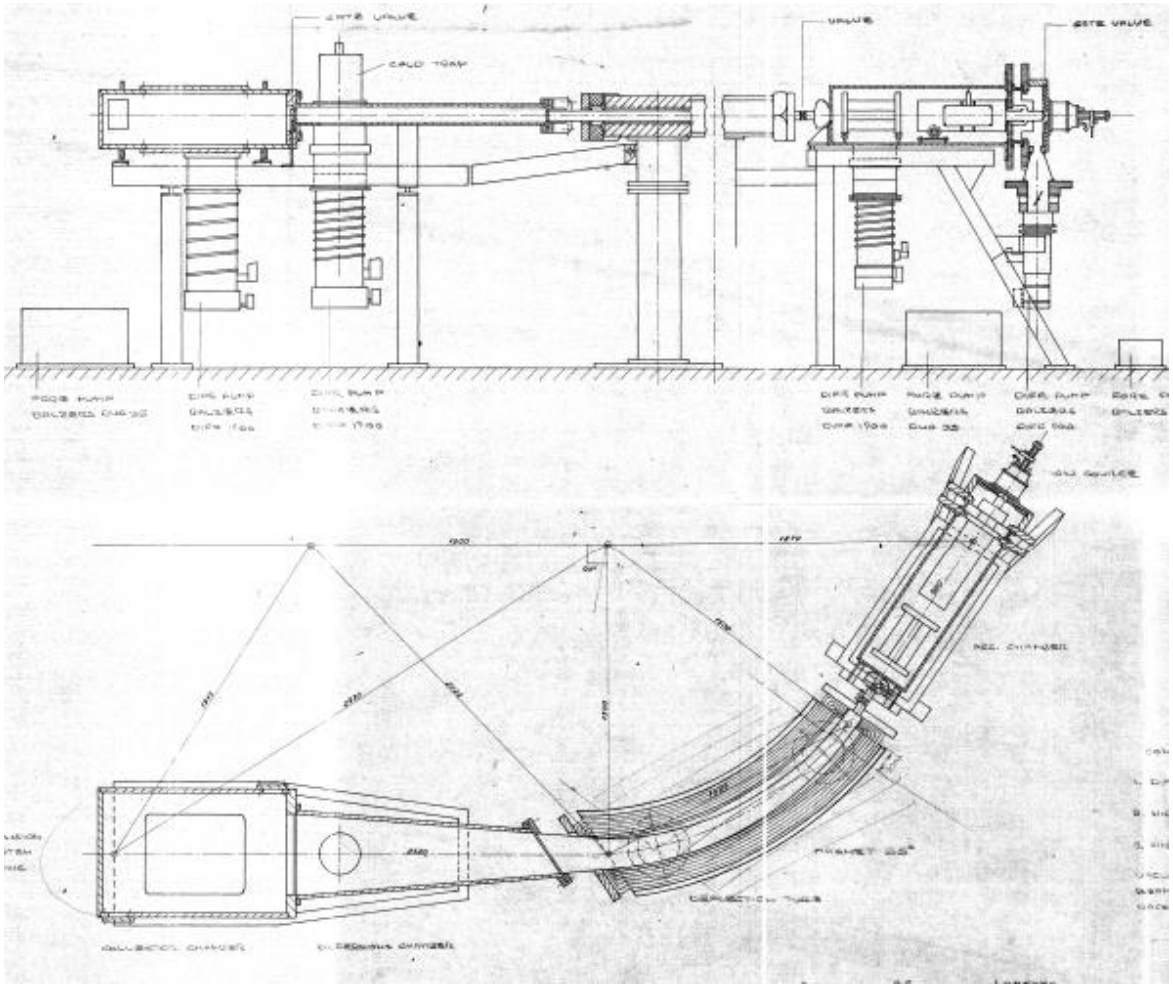
DuoLine 35M

- ↑ Hermetic pump (tightness 1e-6 mbar·l/s)
- ↑ Magnetic motor coupling (reduced risk of oil spill)
- ↑ Very good ultimate pressure <2e-3 mbar
- ↓ Oil needs to be replaced each year (contamination risk and waste)

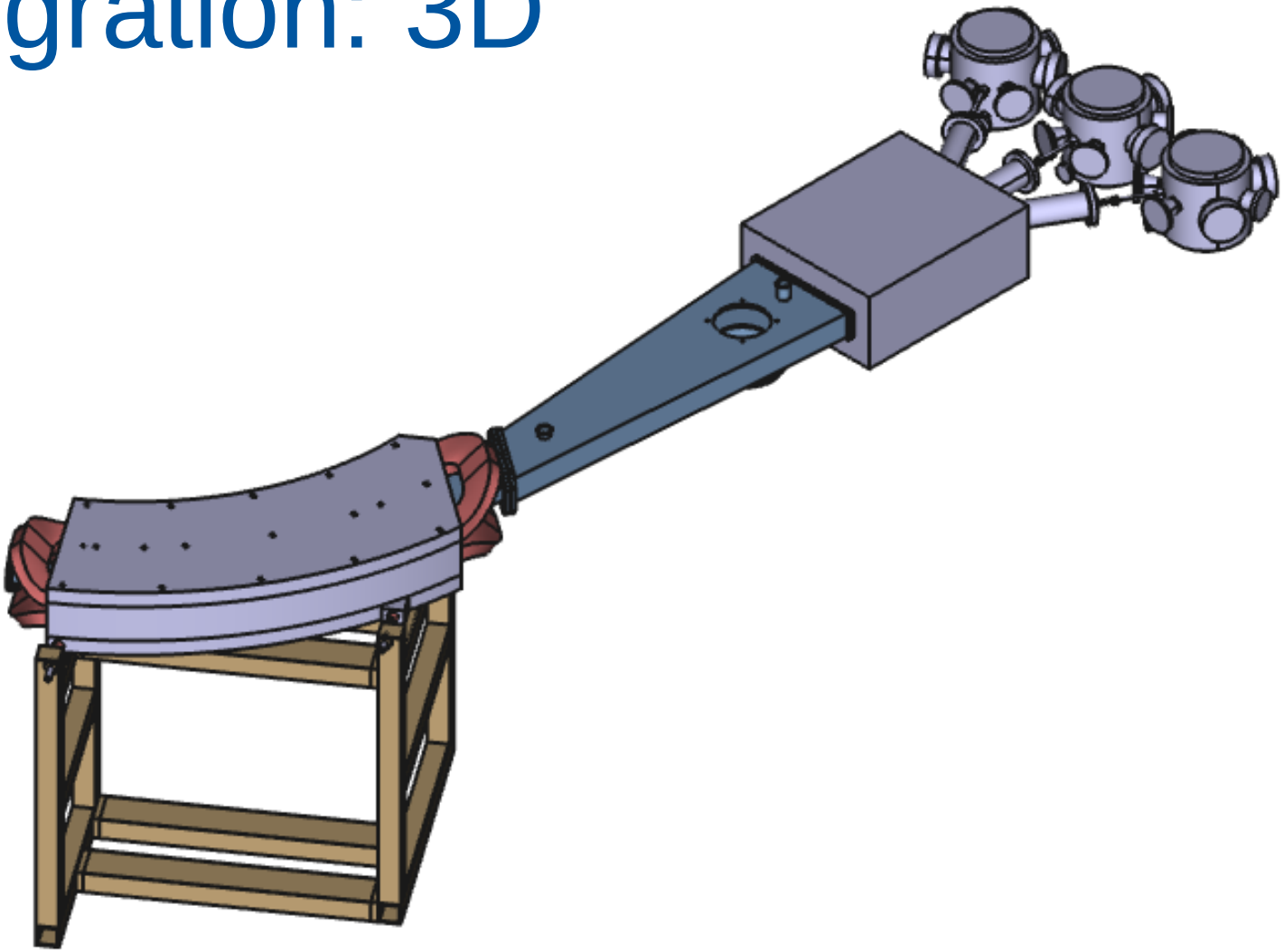
ACP28

- ↑ Hermetic pump (tightness 5e-7 mbar·l/s)
- ↑ No oil in contact with vacuum
- ↑ Reduced maintenance
- ↓ Ultimate pressure <3e-2 mbar
- ↓ No contamination “filter”

Integration: First drawings



Integration: 3D



Open questions

- Type, size and number of flanges available
- 3D integration of vacuum system (sector valves, volumes, etc.)
- Oil primary pumps / dry pumps (waste vs exhaust dose rate)
- VSC alarms supplied and received

➔ Fix final layout (before procurement)

<u>Procurement before end of June 2016 (installation end 2016)</u>

Cost estimate

Vacuum system

Item	#	Cost/each (CHF)	Cost sum (CHF)
Turbo-pump (Leybold 1000)	2	18858	37716
Roughing Pump (Dry ACP28)	2	10000	20000
Sector valve (S10 Elastomer Gate Valves)	4	5000	20000
DN63 Angle valve KF	1	1000	10000
DN160 S10 Gate valve (O-ring)	2	7000	14000
Venting valve (DN16 KF)	9	500	4500
Pirani gauge	7	1000	7000
Penning gauge	7	1000	7000
TPG300	3	5000	15000
Total Material cost	-	-	**135216**

Cost estimate

Exhaust system

Item	#	Cost/each (CHF)	Cost sum (CHF)
Roughing pump	1	10000	10000
Membrane pump	1	10000	10000
Angle valve (DN63 KF)	6	1000	6000
By-pass valve	1	1000	10000
Piezo gauge	1	1000	1000
Pressostat	1	1000	1000
Thermocouple	1	1000	1000
Filter (0.5m3)	1	5000	5000
Tank (St.St 304 3m3 Dia:1700 H:3040)	1	5000	5000
Total Material cost	-		**40000**

Cost estimate

Vacuum controls

Item	Cost (CHF)
Material (controllers, etc.)	85800
Cabling	20600
FSU	21000
PJAS	39600
Total cost	167000

Total cost 345 kCHF (better estimate when layout frozen)

Future operational needs

- Dedicated leak detector (contaminated) with modified exhaust for leak testing
- Spares: one turbopump, one primary pump, one diaphragm pump.
- Training of MEDICIS operators (regular venting and pumping operations) → ISOLDE op?
- VSC Piquet Service required?

Conclusion

- Open questions to be solved end of June 2016
- Procurement installation end 2016 beginning 2017.
- Total cost vacuum system: 345 kCHF
- Manpower 0,5 FTE
- Not included in vacuum WP: vacuum chambers and integration