

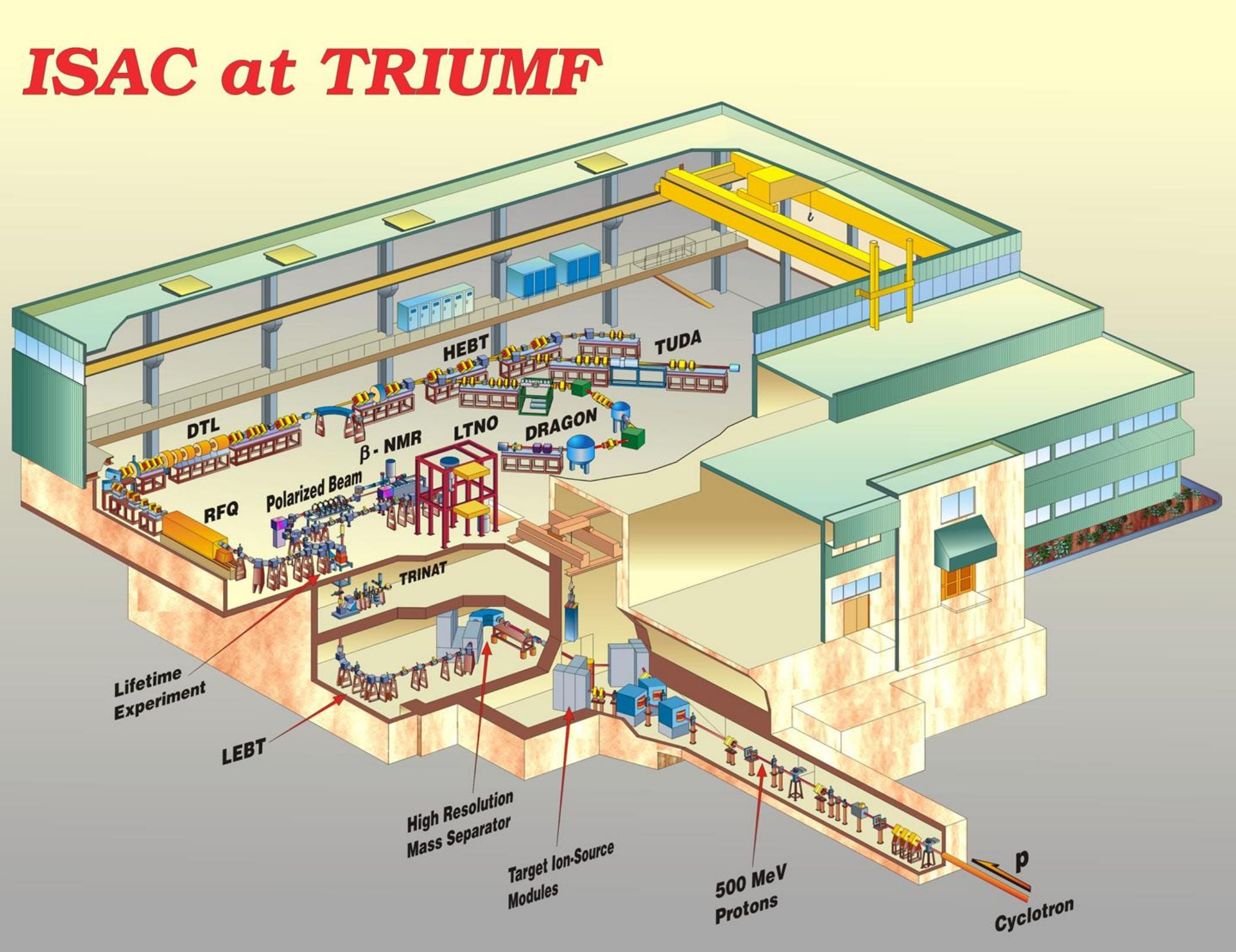
Scroll pumps “on demand” usage for reduction of operating costs

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Abstract : TRIUMF is Canada's national laboratory for particle and nuclear physics and accelerator-based science. The facility produces and delivers a variety of beams to targets and experiment stations through beam lines. The total length of beam lines operating at TRIUMF is about 700 meters. The vacuum in these beam lines is supported by turbo pumps backed by scroll pumps. There are more than 114 scroll pumps operating continuously and TRIUMF spends more than 50 days of maintenance related activities per year.

A new mode of operation, permitting the usage of the scroll pumps only when they are needed was proposed, tested and it is in process of implementation. Under the new mode of operation the pressure in the backing line of a turbo pump is permitted to rise to 500 mTorr before turning on the scroll pump and evacuating the backing line. The savings in reduced maintenance activities and electrical power consumption are expected to exceed 50%. Details of the new operating mode are presented.



Project Motivation

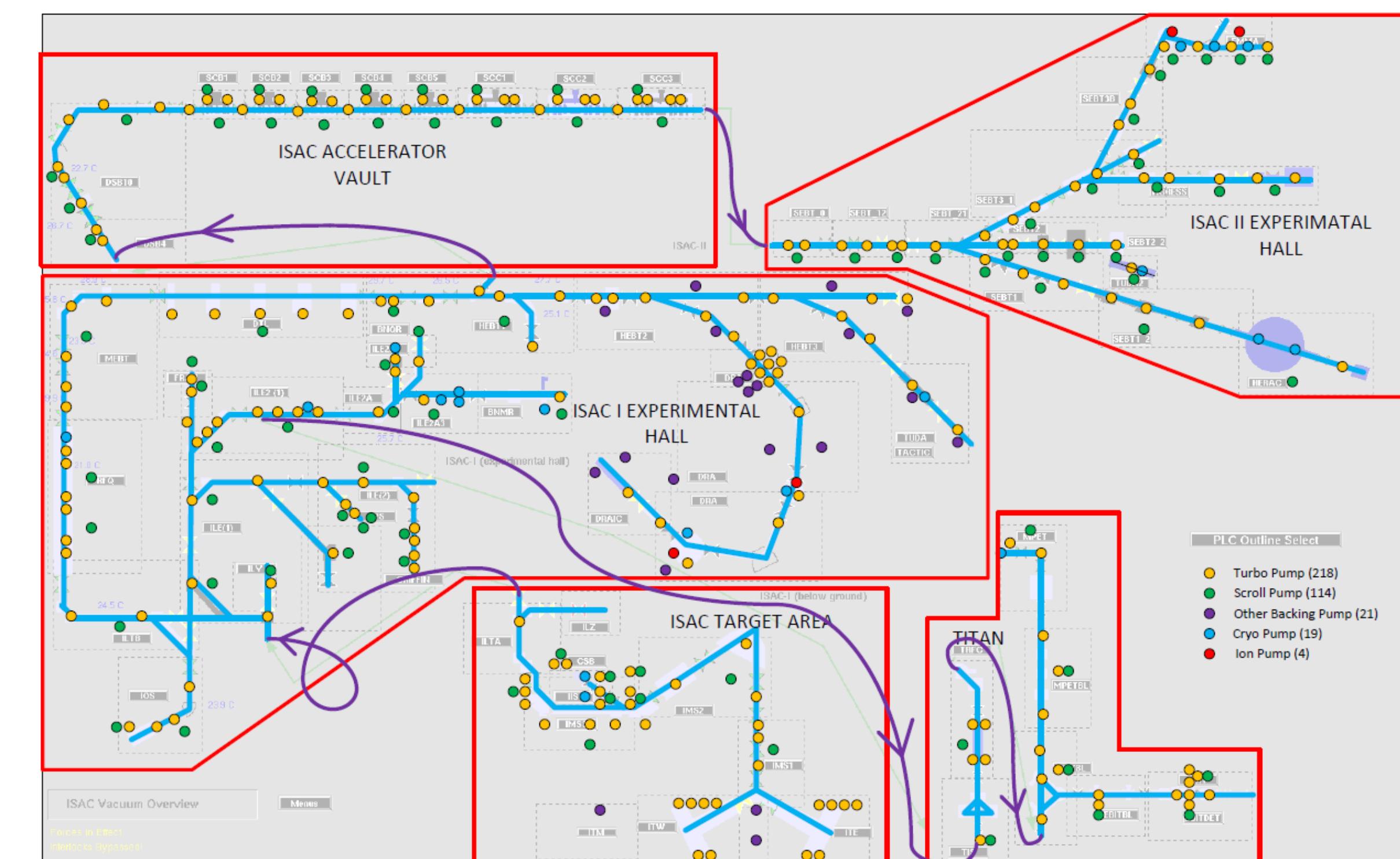
Reduce the operating cost of running 114 scroll pumps by:

- Reducing electrical power consumption
 - Reducing maintenance frequency
 - Reducing maintenance cost
- Free technician time for present projects

Implementation activities:

- Proposal approval – done
- Modify interlocks logic - done
 - Test on line – done
- Implementation – in progress

ISAC scroll pumps locations

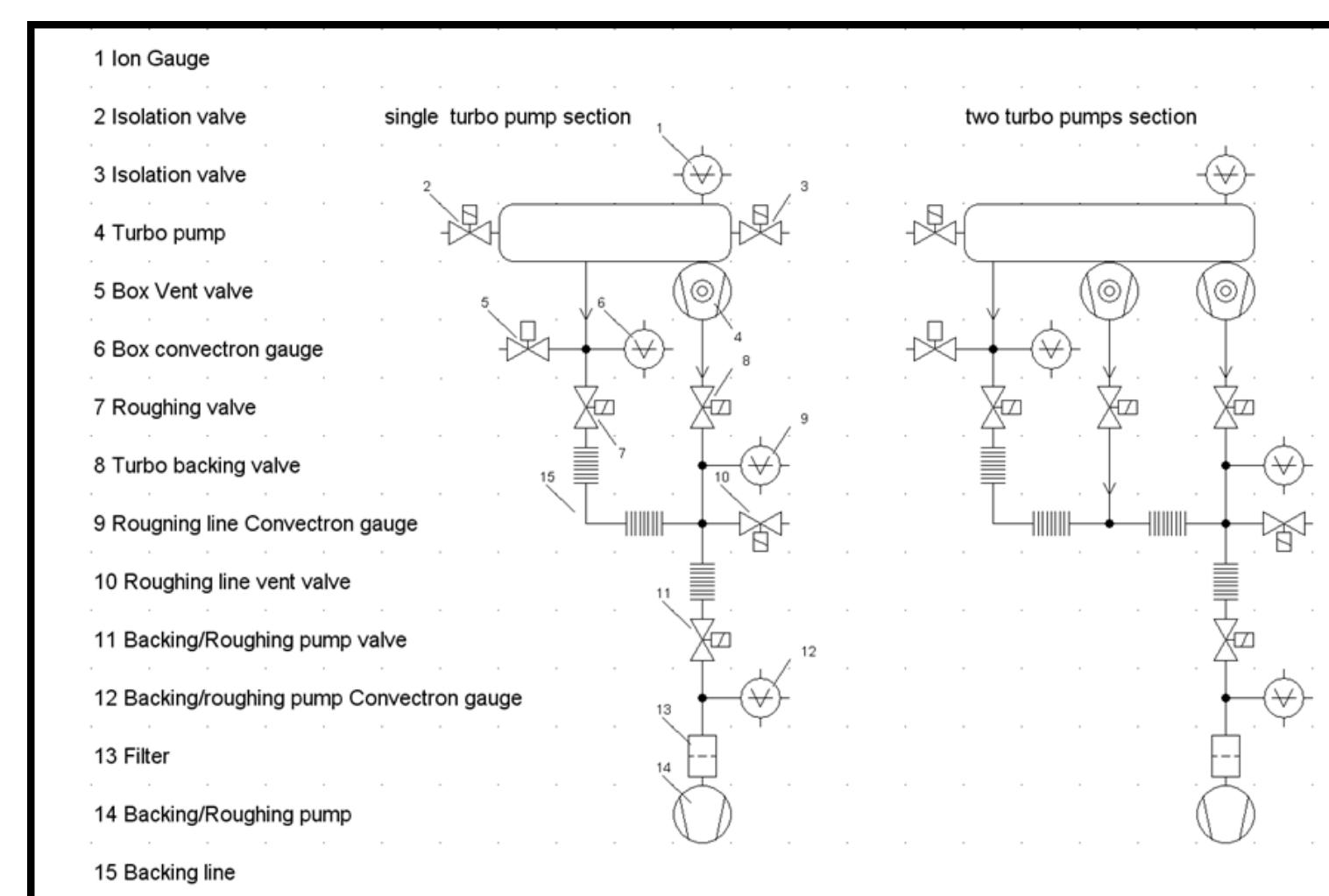


Proposal

Let the pressure in the backing line of turbo pump rise to 500 mTorr, before opening the baking pump valve and re-evacuating the backing line. During the time the pressure rises to 500 mTorr, the scroll pump is turned off and isolated from the backing line.

The level of backing pressure a turbo pump can tolerate without losing its performance or suffering reduction of its operating life was chosen after consultation with the turbos manufacturer. For different size pumps the tolerable backing pressure is between 3 - 8 Torr before compression to start decreasing.

- Currently ISAC backing pumps run continuously
- An “on-demand” pumping would reduce electrical consumption
- Reduced scroll pump operation hours would reduce manpower used to maintain pumps
- **Change ONLY to interlocks logic is required**



Electrical power consumption and potential savings

Year	Cost
1	\$38,000
2	\$42,000
3	\$46,000
4	\$50,600
5	\$55,800
Total	\$232,000

Power consumption per pump:
0.56kW

Electrical costs:
\$0.057/(kW·hr) + 10%/year

Running the pumps 50% of the Time results in potential savings of **\$116,000 over 5 years**

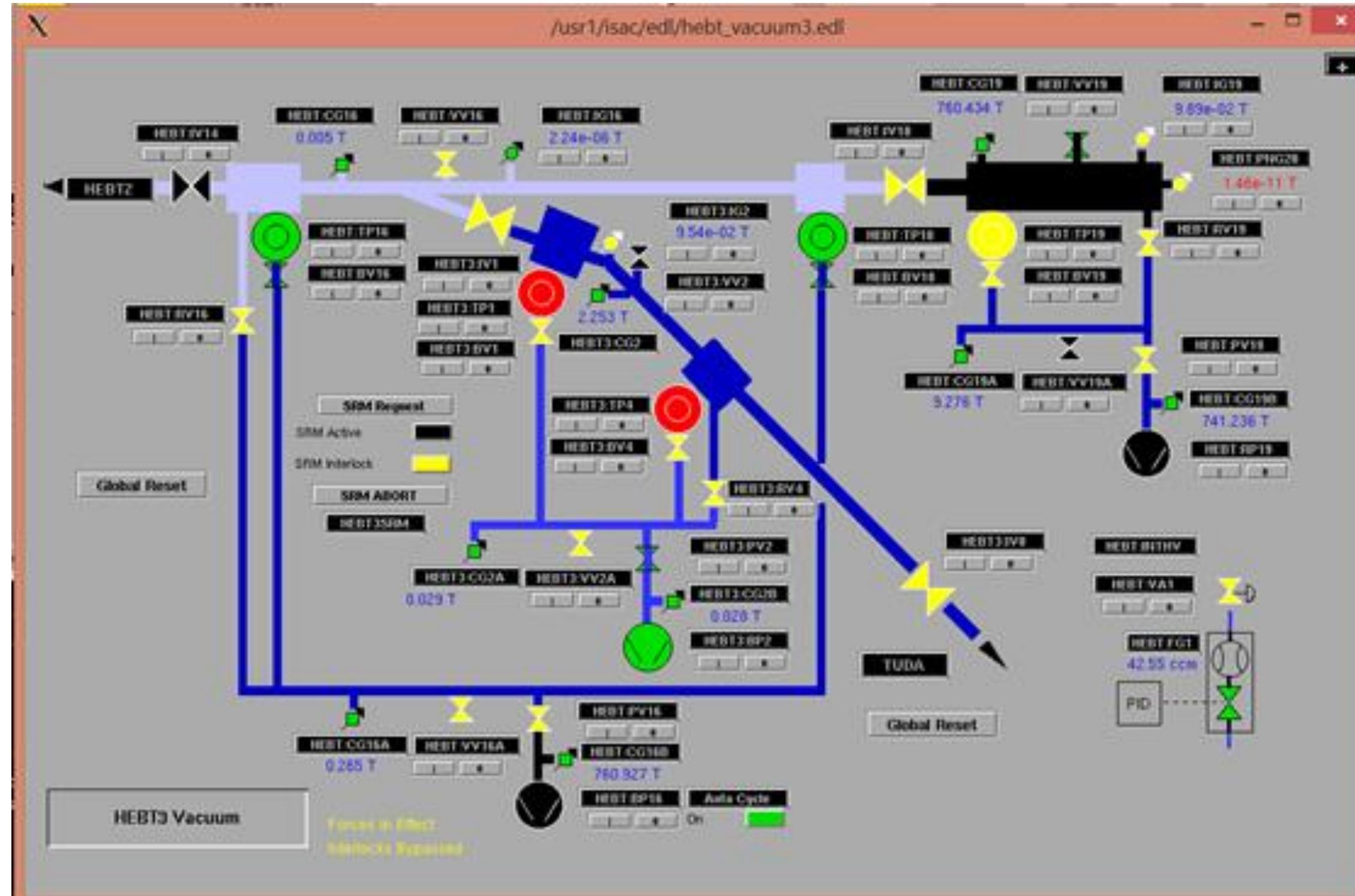
Maintenance cost

Activity	Time per activity	Instances	Time
Replace tip seals	0.3 days	25	7.5 days
Rebuild a backing pump	2 days	14	28 days
Replace a backing pump	2.5 hours	39	13 days
Total			48.5 days

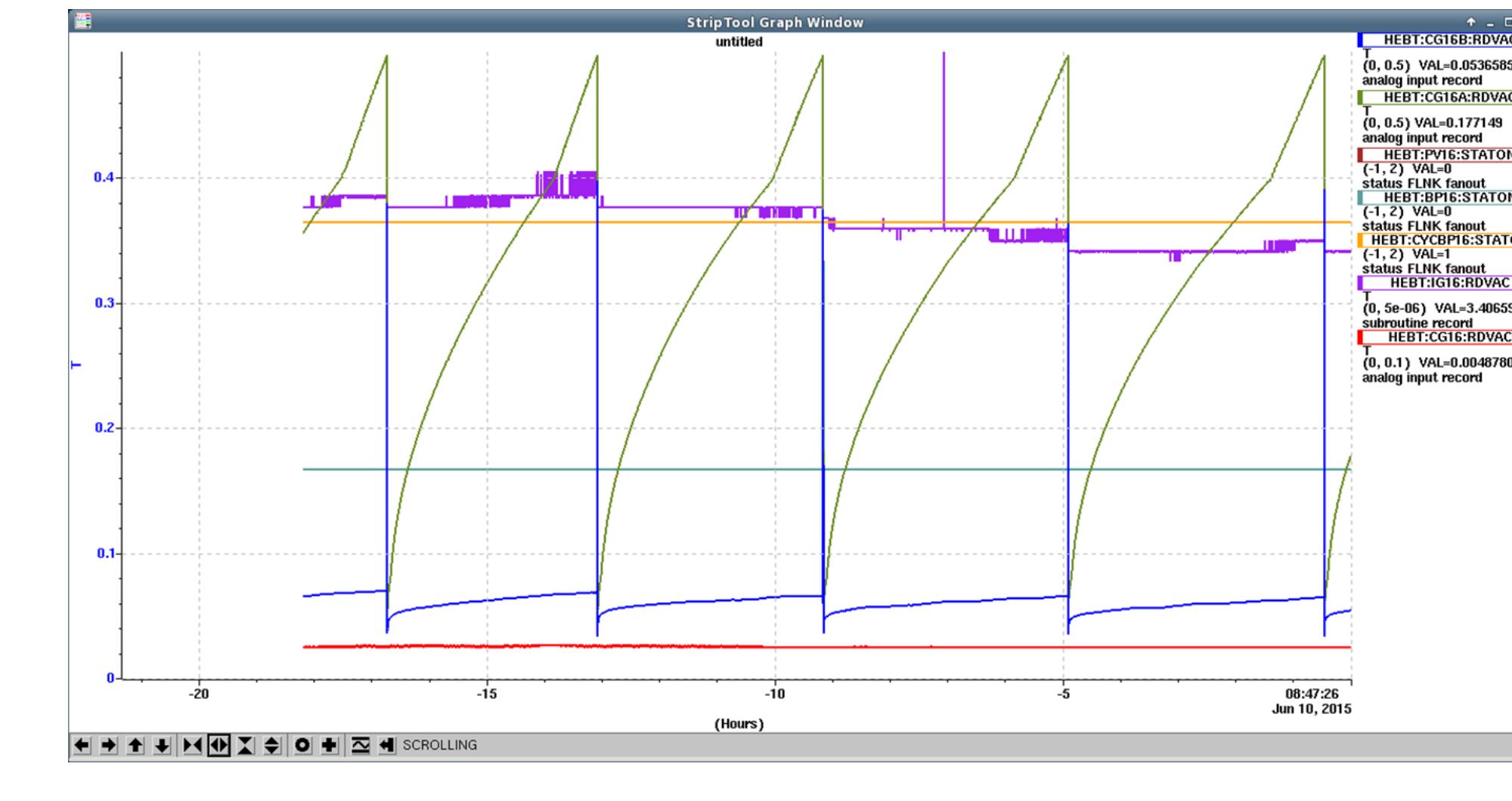
Time spent maintaining backing pumps in a typical year assuming a workday equals 7.5 hours

Running the pumps 50% of the time should decrease the time spent maintaining backing pumps by 24 days per year.

On-line test set up



“On-demand” mode operation Result



Pressure readings from gauges in “HEBT” beam line during “cycle-mode” operation. Green and blue are roughing-line- and roughing-pump pressures. **Every 5 hours the scroll pump runs for 5 minutes only!**

Summary

- Significant reduction in scroll pumps operating time achieved.
- The reduction will lead to reduced maintenance costs and less electrical power consumption
- The changes to the ISAC vacuum system are mostly in changing the PLC code and interlocks.

