

Vacuum Pressure Profile of the IR

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Outline

- Program VACCALC
- Model of beam pipe to QD0
- Outgassing rate
- Pressure profiles
- Possible improvements
- Summary
- Conclusion

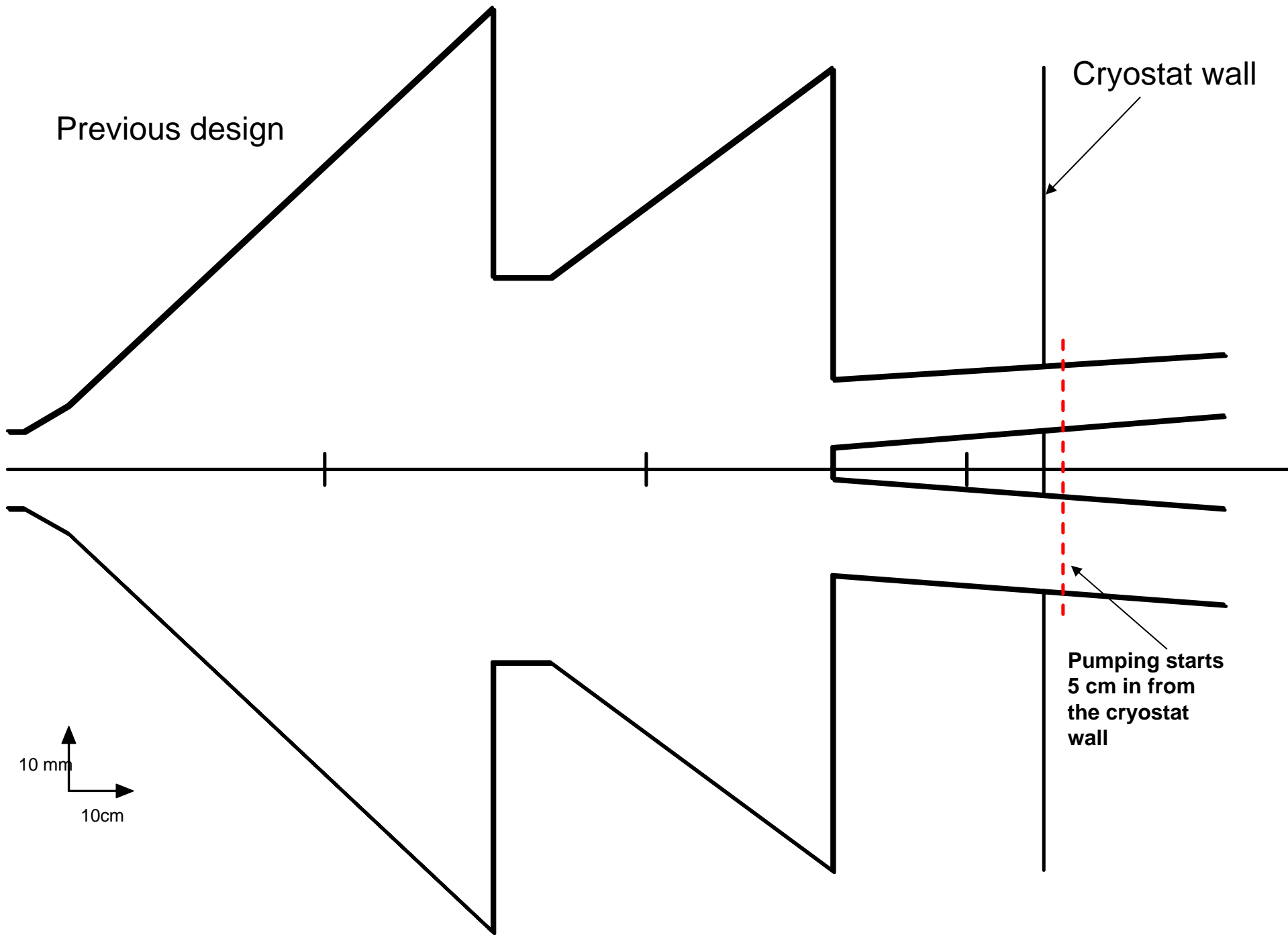
VACCALC

- Program to calculate vacuum pressures using a finite difference algorithm
- It has the capability of computing the pressure in various pipes that are connected together
- Was built for the B-factory and is useful here because of the two pipes that go through the cryostat
- Writeup: “ A Method for Calculating Pressure Profiles in Vacuum Pipes”, SLAC-PEP-II-AP-NOTE-6-94

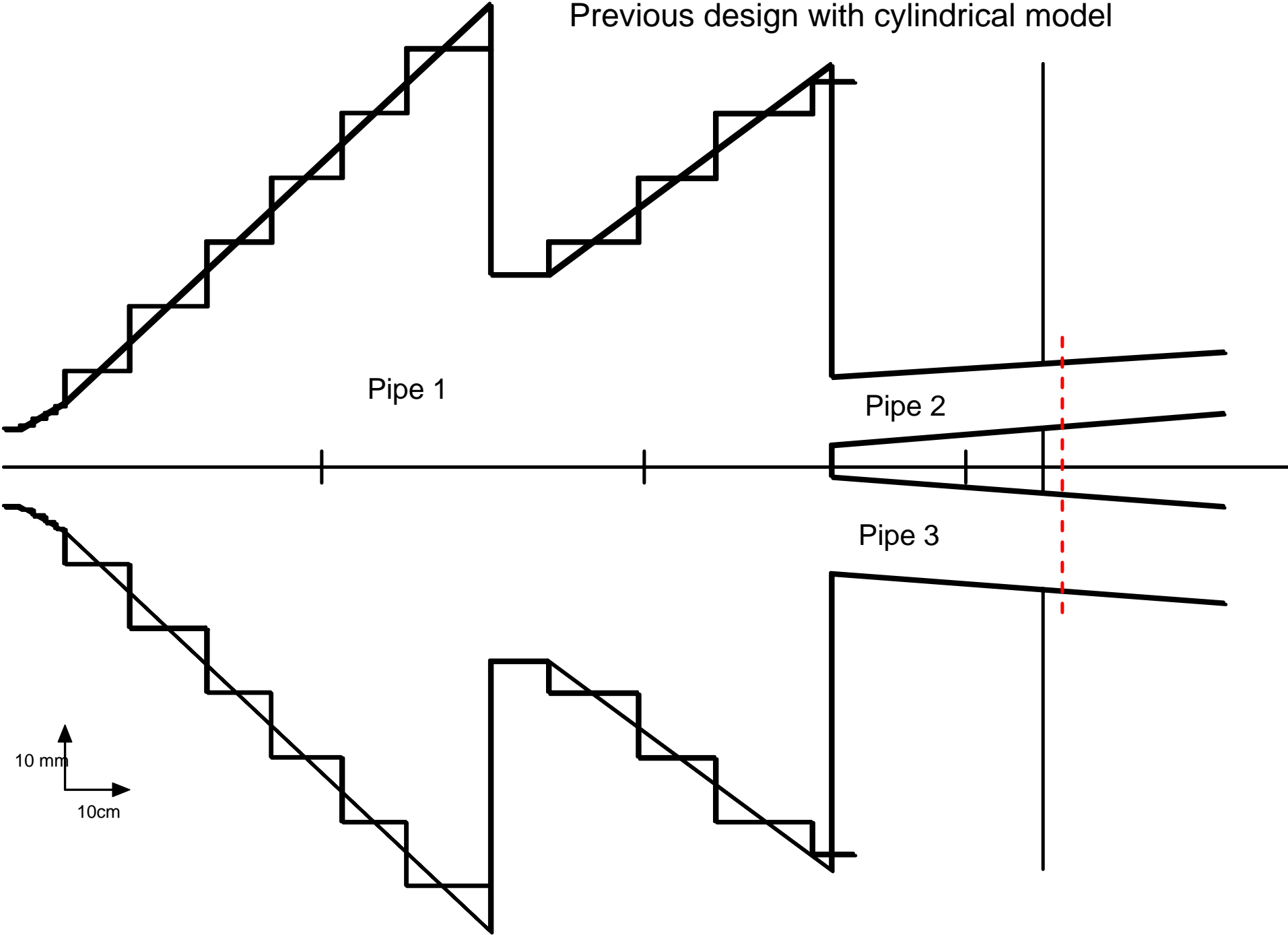
Beam Pipe Model

- The program can only do constant cross-section pipe elements so I had to change the conic sections into steps of increasing radius cylinders
- The outgassing rate is taken to be $0.1 \text{ nTorr}\cdot\text{l/s/cm}^2$. This is a fairly good estimate for a beam pipe that was vented to dry N_2^*

*Chen, Liu, "Thermal Outgassing from Stainless Steel Vacuum Chambers", Chinese Journal of Physics, vol. 24, No. 1, pg. 29, (1986)

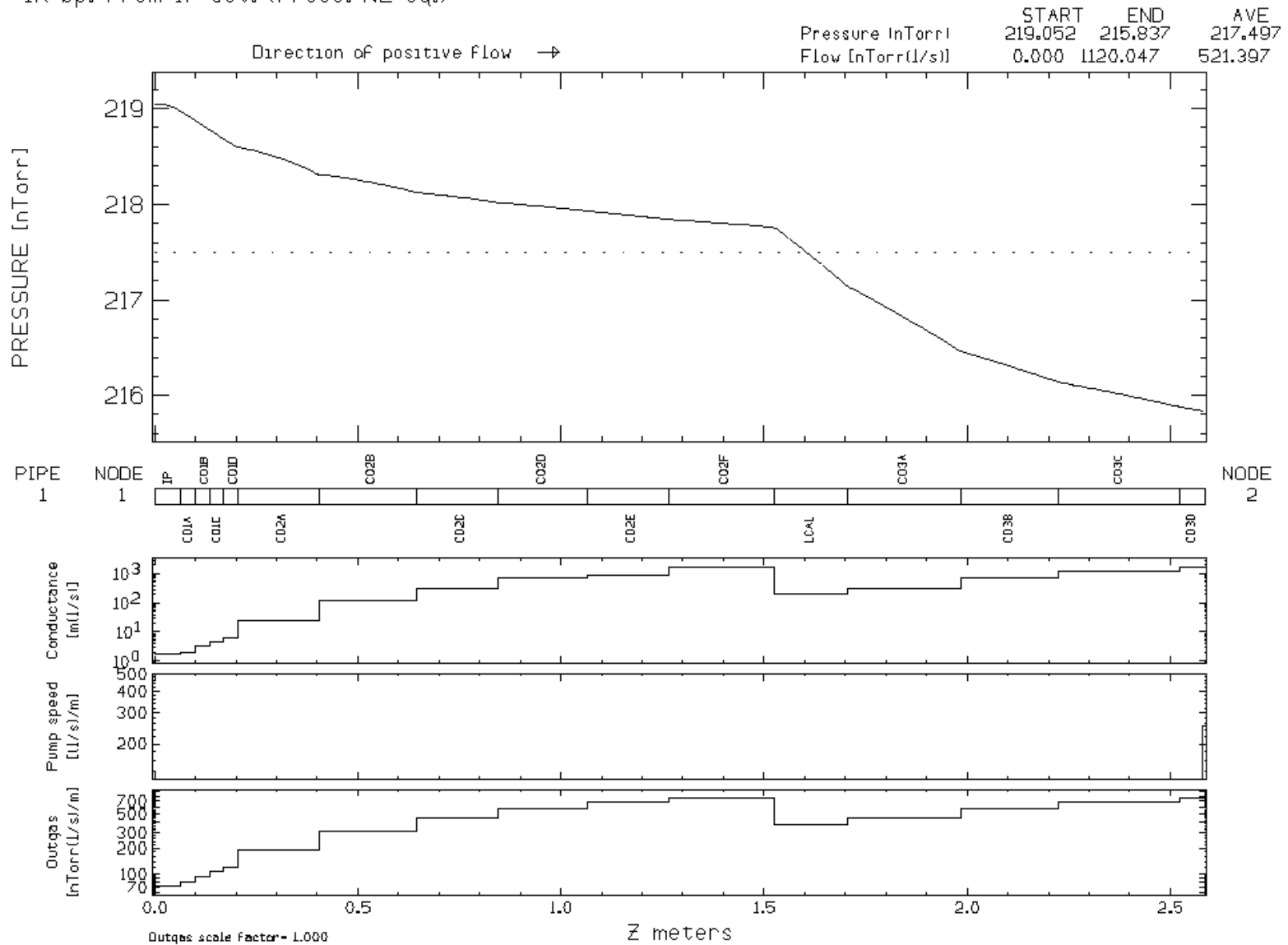


Previous design with cylindrical model



Previous Design

ILC Beampipe Baseline (10/18/11)
 IR bp. From IP out. (Press. N2 eq.)

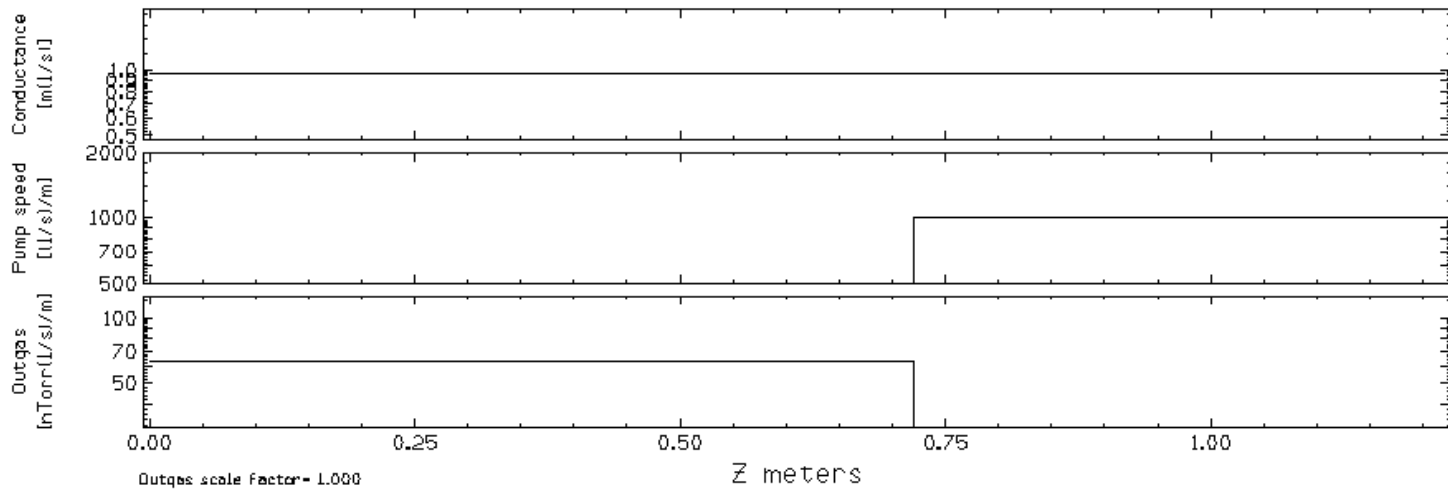
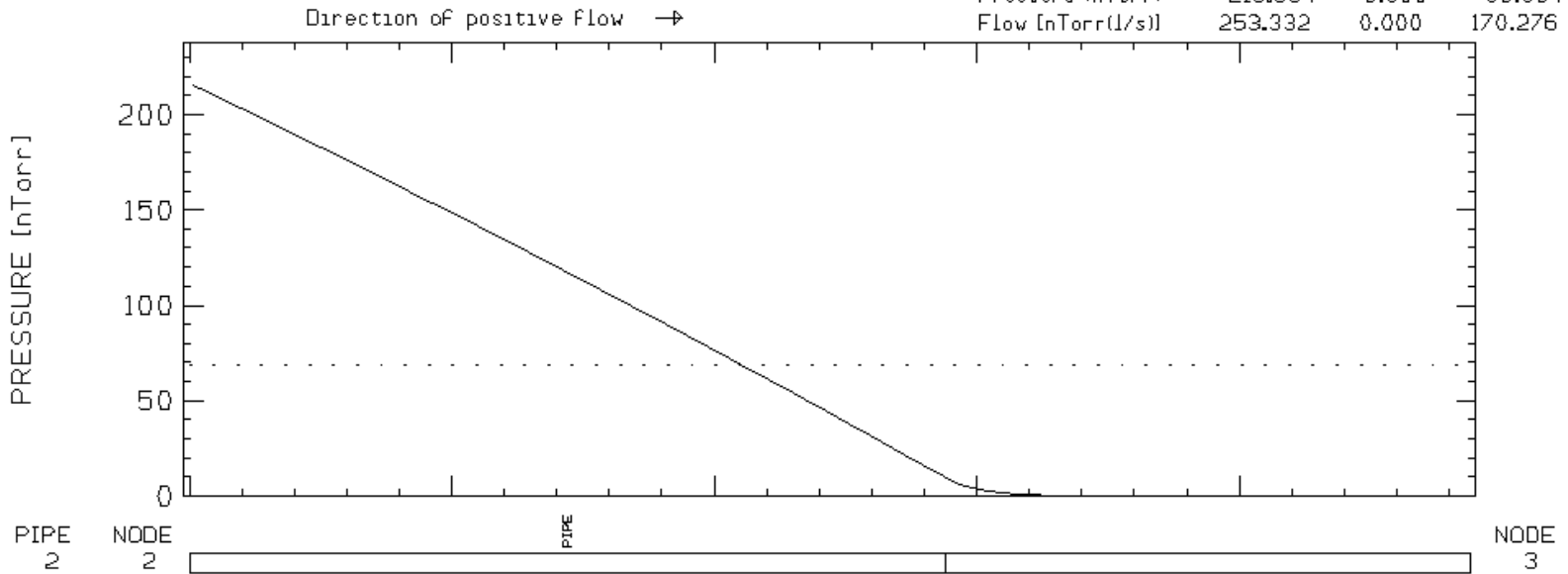


Incoming Pipe

ILC Beampipe Baseline (10/18/11)

Incoming beam pipe. (Press. N2 eq.)

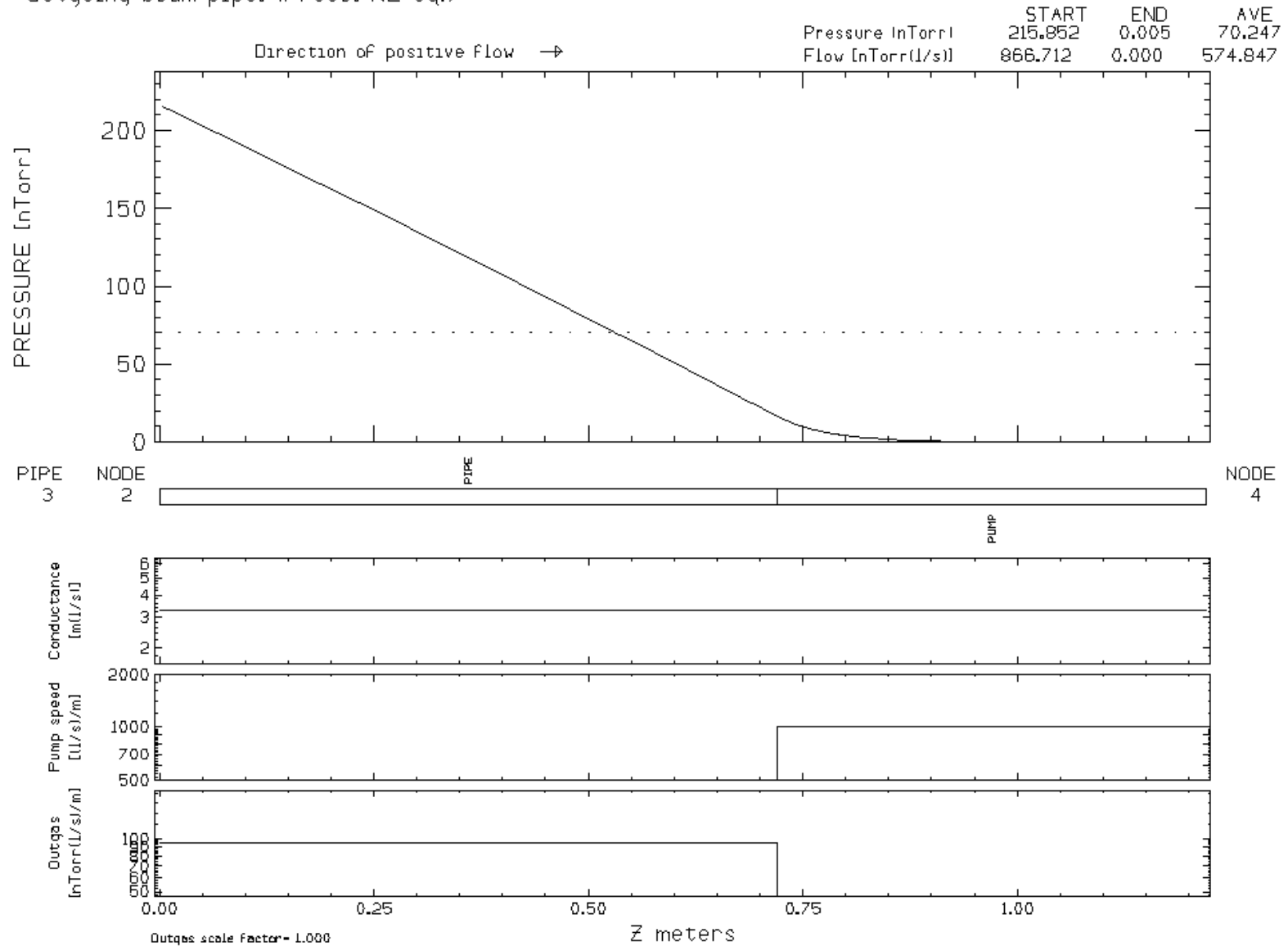
| | START | END | AVE |
|-------------------|---------|-------|---------|
| Pressure [nTorr] | 215.854 | 0.000 | 68.654 |
| Flow [nTorr(L/s)] | 253.332 | 0.000 | 170.276 |



Outgoing Pipe

ILC Beampipe Baseline (10/18/11)

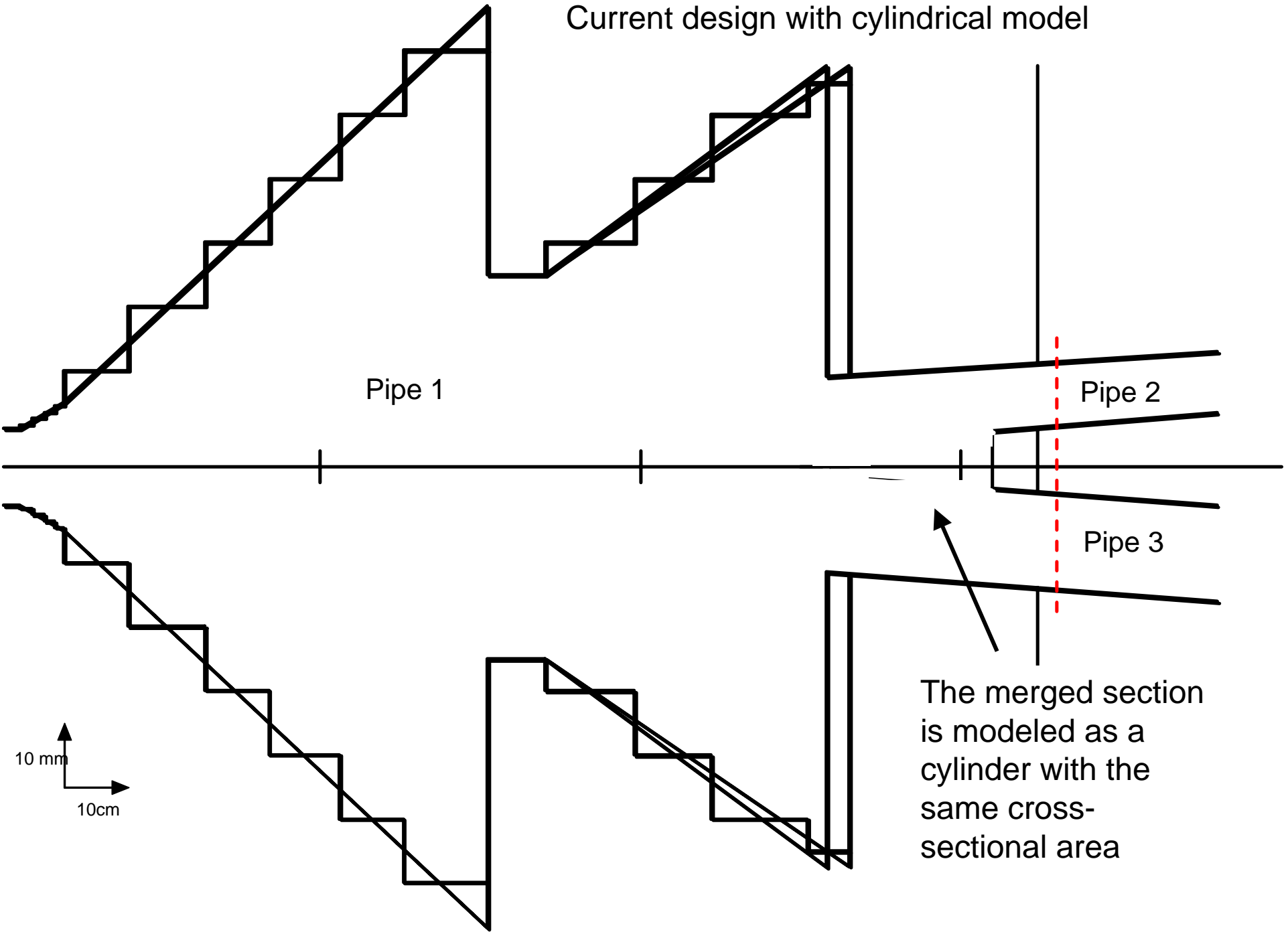
Outgoing beam pipe. (Press. N2 eq.)



Cases studied

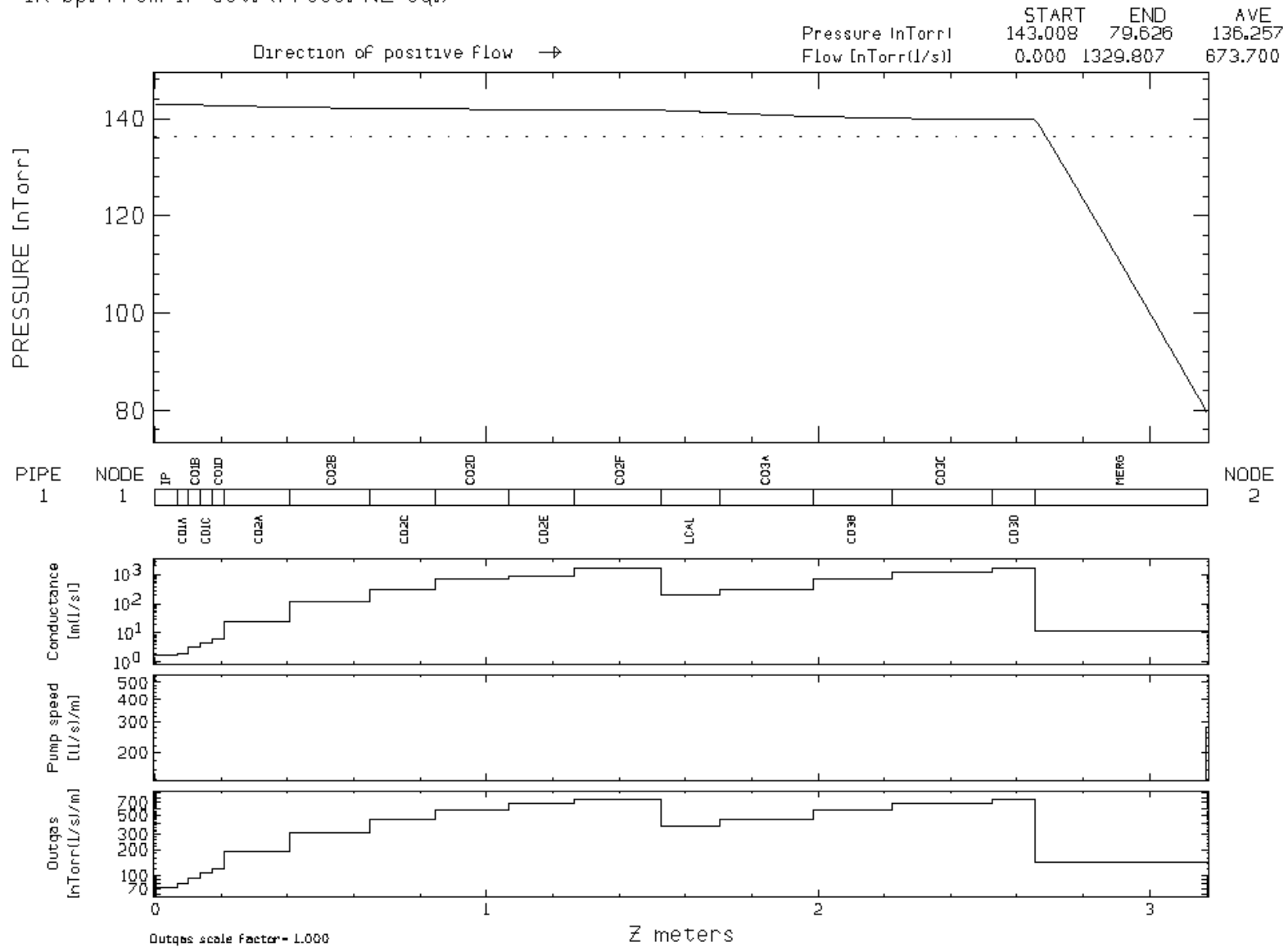
- Previous beam pipe design (baseline)
- Improved design (current design)
- Suggested further improvements
 - Small (NEG?) pump added just in front of Beam CAL (total pumping of 10 l/s)
 - Small (NEG?) pump added just behind Lumi CAL (total pumping of 20 l/s)

Current design with cylindrical model



Improved (current design)

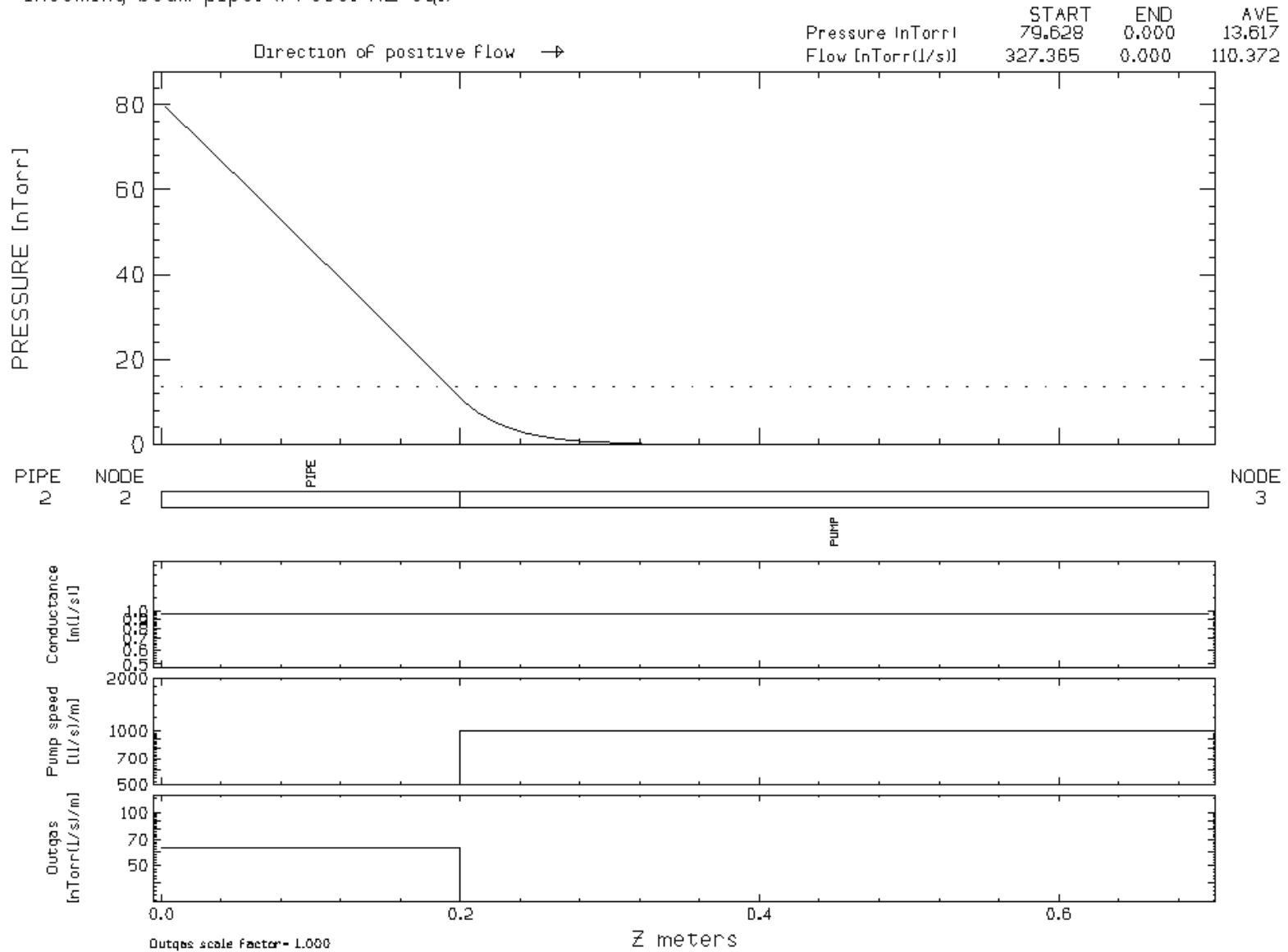
ILC Beampipe Improved (10/21/11)
 IR bp. From IP out. (Press. N2 eq.)



Current design (Incoming pipe)

ILC Beampipe Improved (10/21/11)

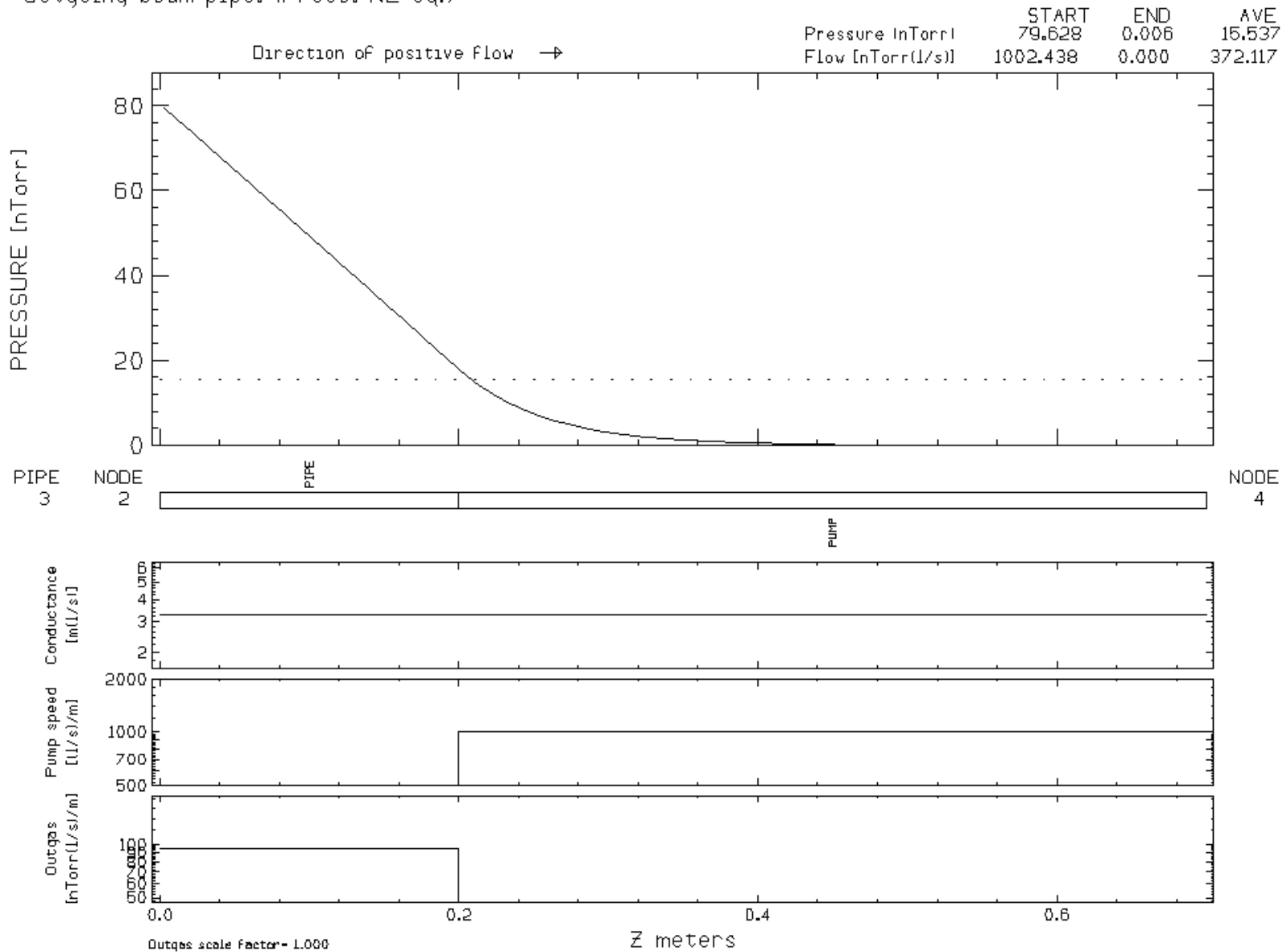
Incoming beam pipe. (Press. N2 eq.)

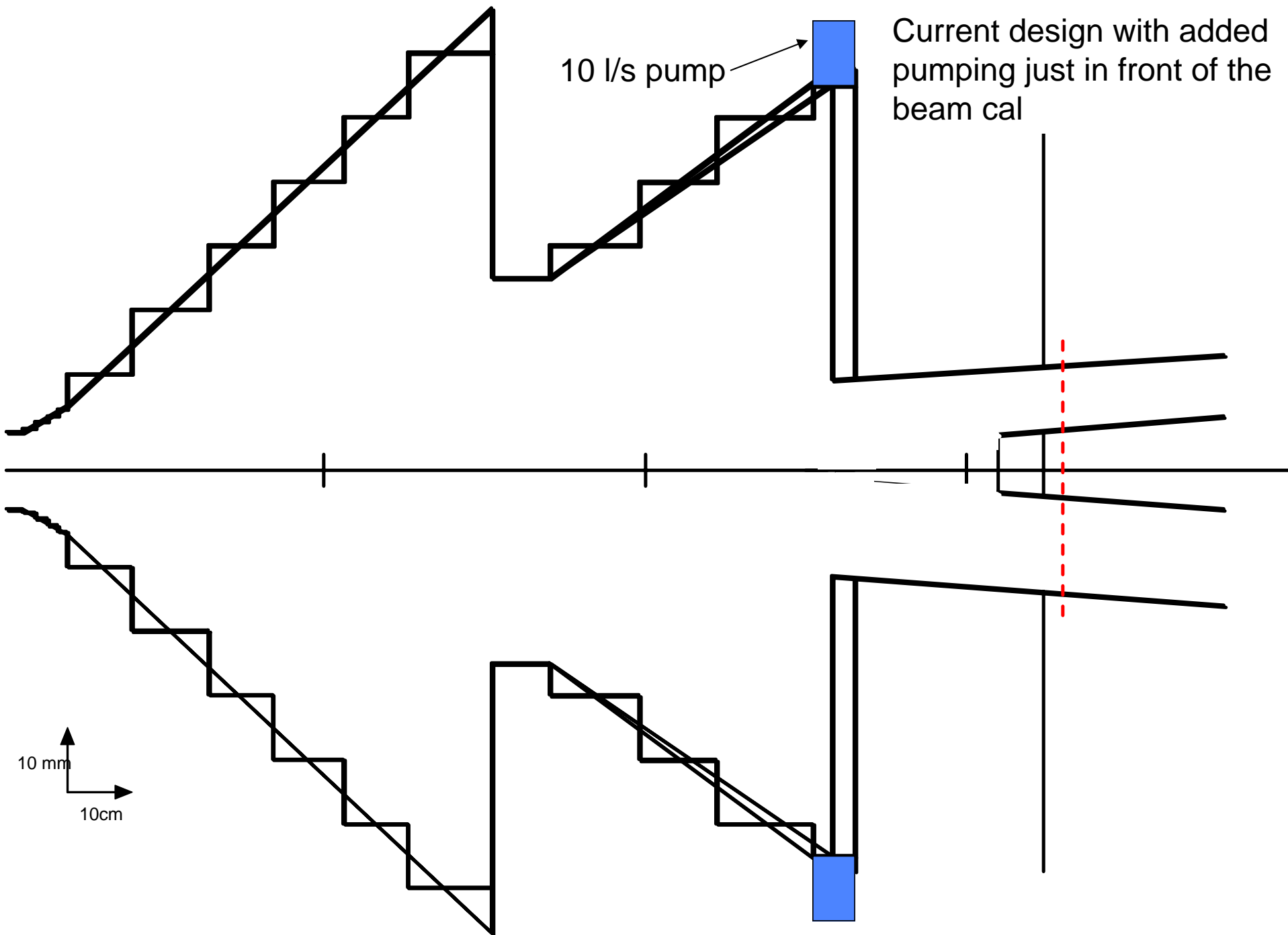


Current design (Outgoing pipe)

ILC Beampipe Improved (10/21/11)

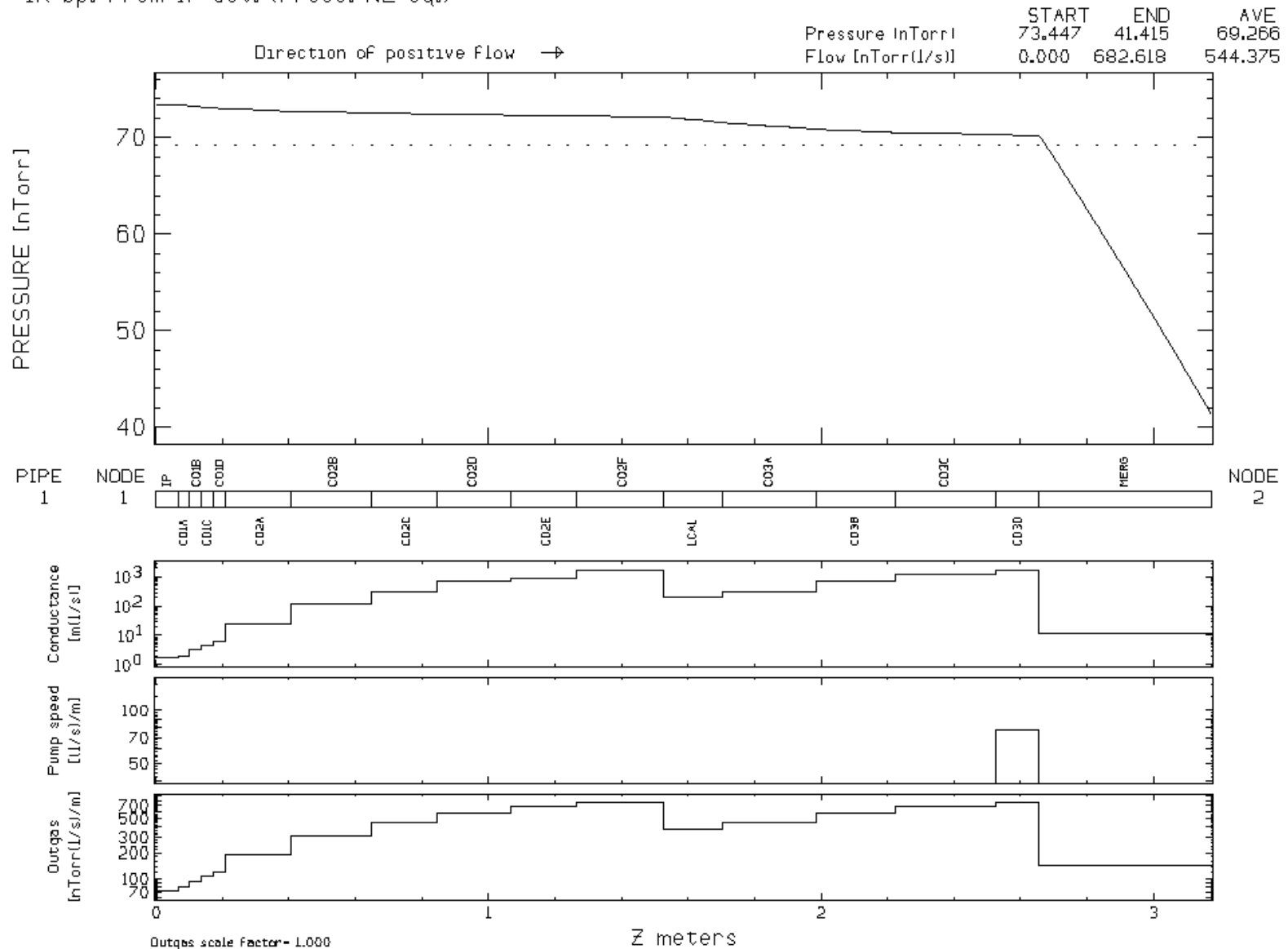
Outgoing beam pipe. (Press. N2 eq.)

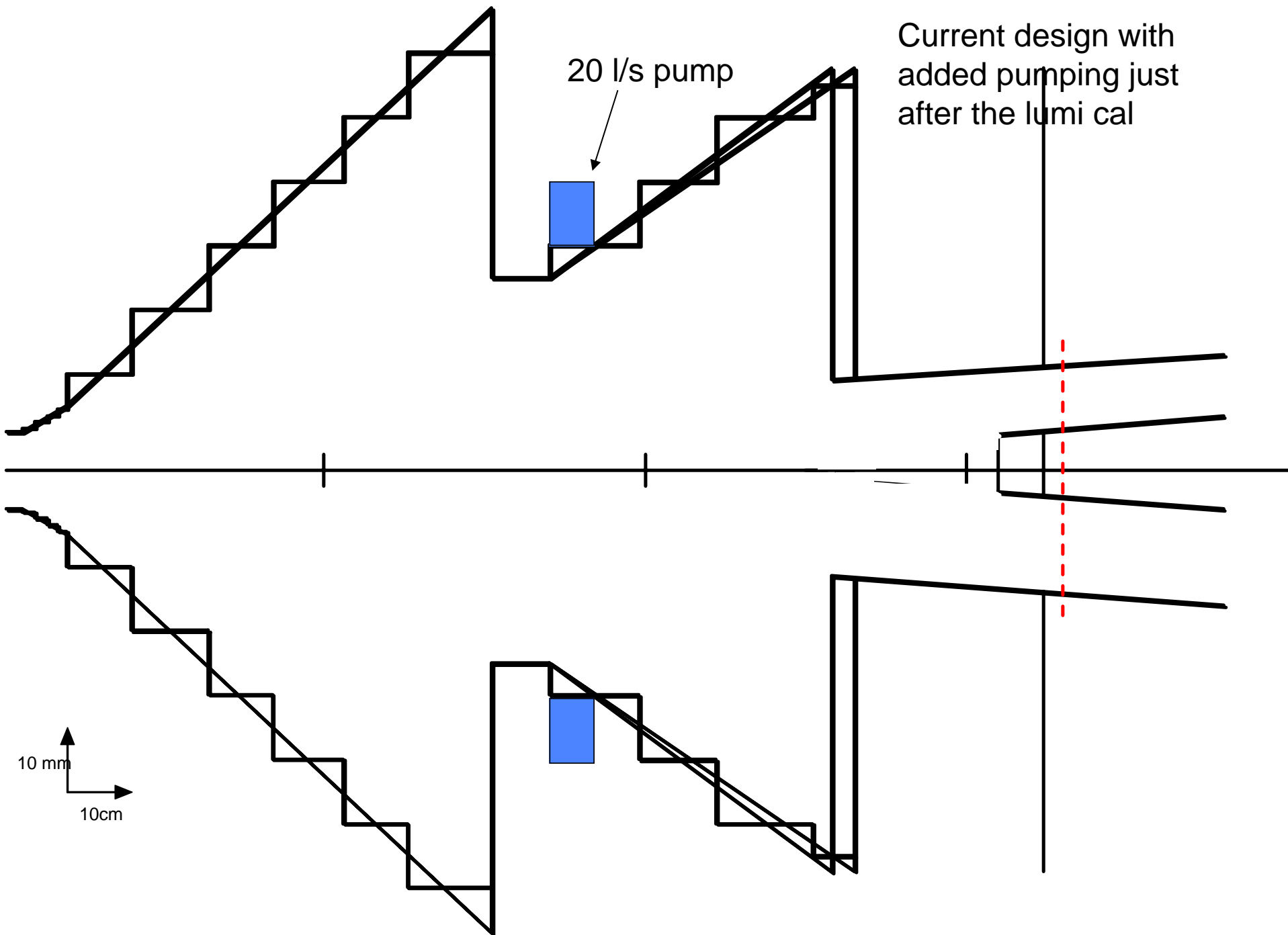




Improved (pump in front of BCAL)

ILC Beampipe Improved - Pump in front of BCAL (10/24/11)
 IR bp. From IP out. (Press. N2 eq.)

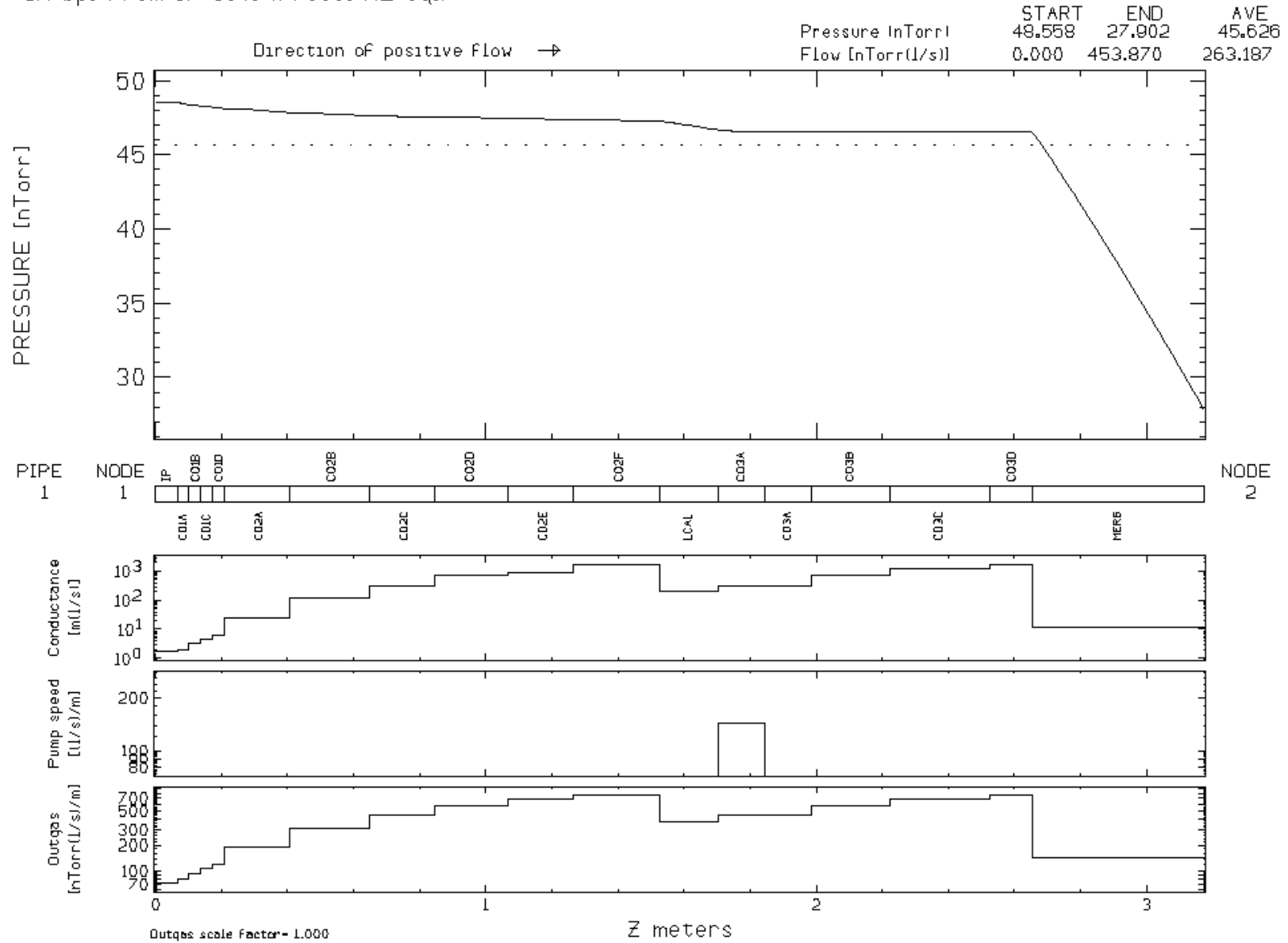




Improved (pump behind LCAL)

ILC Beampipe Improved - Pump behind LCAL (10/24/11)

IR bp. From IP out. (Press. N2 eq.)



Summary

| – | Ave Pressure (nTorr) |
|------------------------------|----------------------|
| • Previous design | 217 |
| • Current design | 136 |
| • More pumping (#1 – 10 l/s) | 69 |
| • More pumping (#2 – 20 l/s) | 46 |

Conclusion

- The present design has an estimated average IR pressure of about 140 nTorr from +/- 2.5m
- In order to lower this pressure we would need to add more pumping
- Two cases are presented which indicate that a small amount of pumping can make a significant improvement