Vacuum systems for the MICE channel

Mark Tucker

CM43, RAL: 29/10/2015

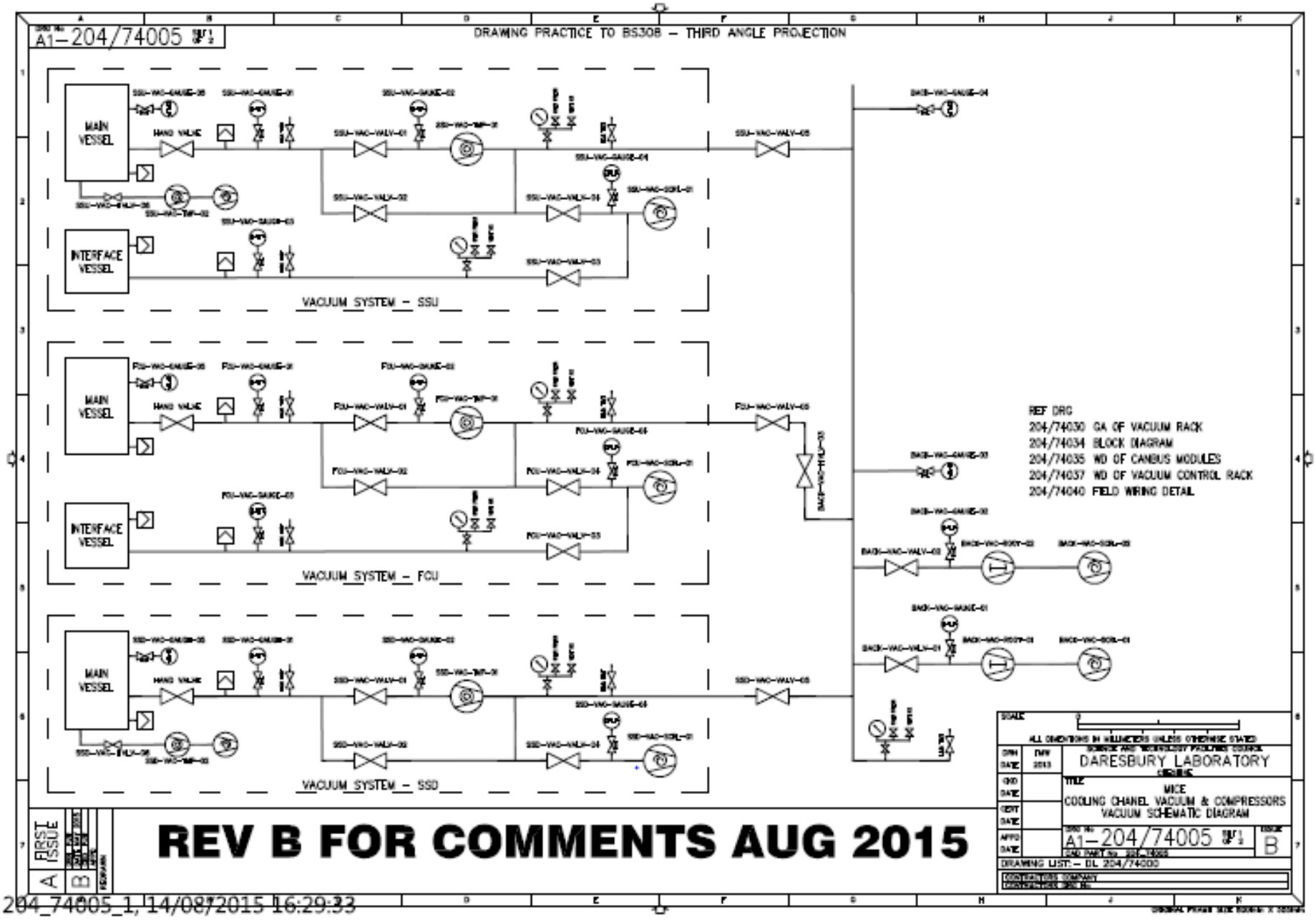
Contributors:

Tom Weston (DL), Mike Courthold (RAL), Mark Tucker (RAL), Ian Mullacrane (DL), Pete Owens (DL), Phil Warburton (DL), Jason Tarrant (RAL), Andy Gallagher (DL), John Webb (DL), Pierrick Hanlet (FNAL), Roy Preece (RAL), Andy Nichols (RAL), John Govans (RAL)

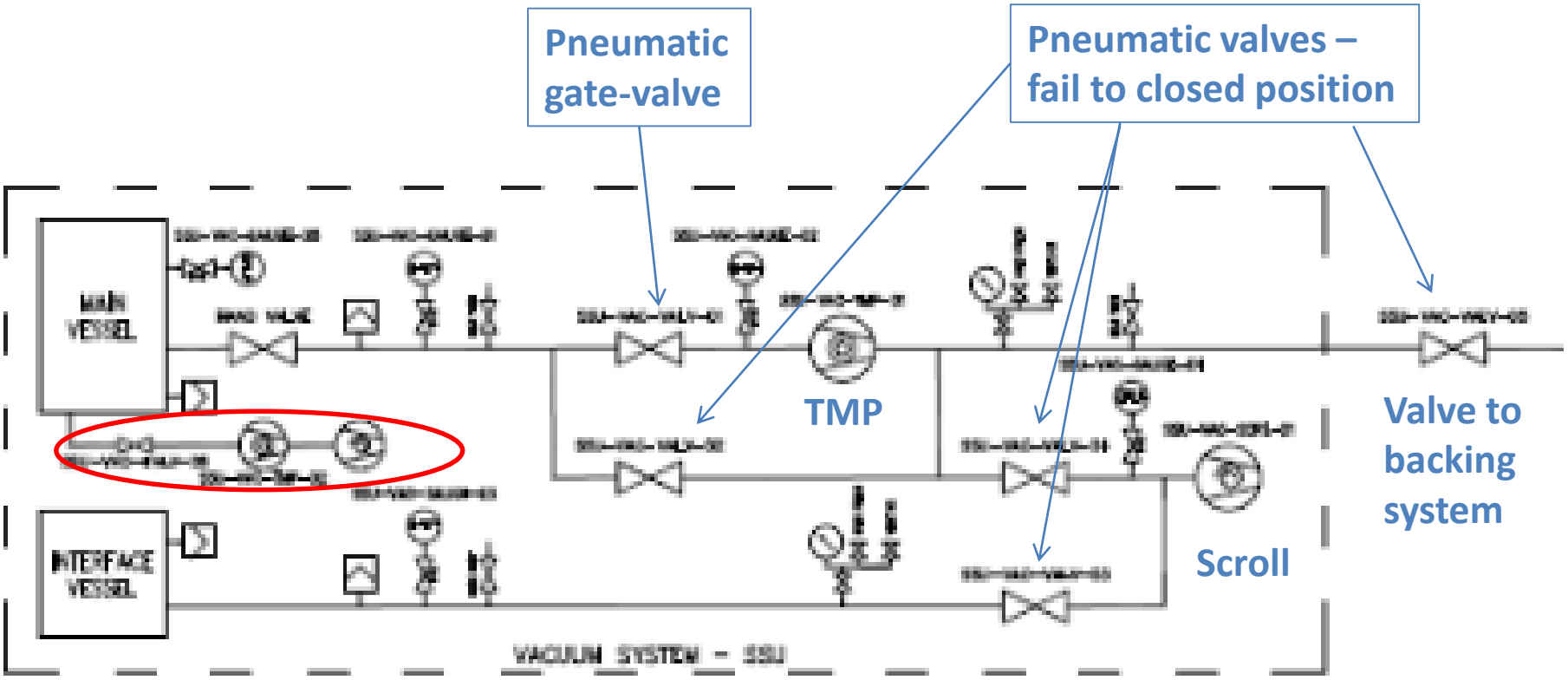
Overview

- One pumping rig for each cryostat (SSU, FCU, and SSD)
- Each rig contains a turbomolecular pump (TMP), a local scroll backing pump, and pneumatic valves controlled by 24V solenoids
- Rigs can also be backed by main backing system
- Fully interlocked for safe operation
- Small valves close under loss of compressed air, or if 24V power fails.
- Gate-valve position unchanged under loss of compressed air, but should close if the 24V power fails.

Drawing of layout

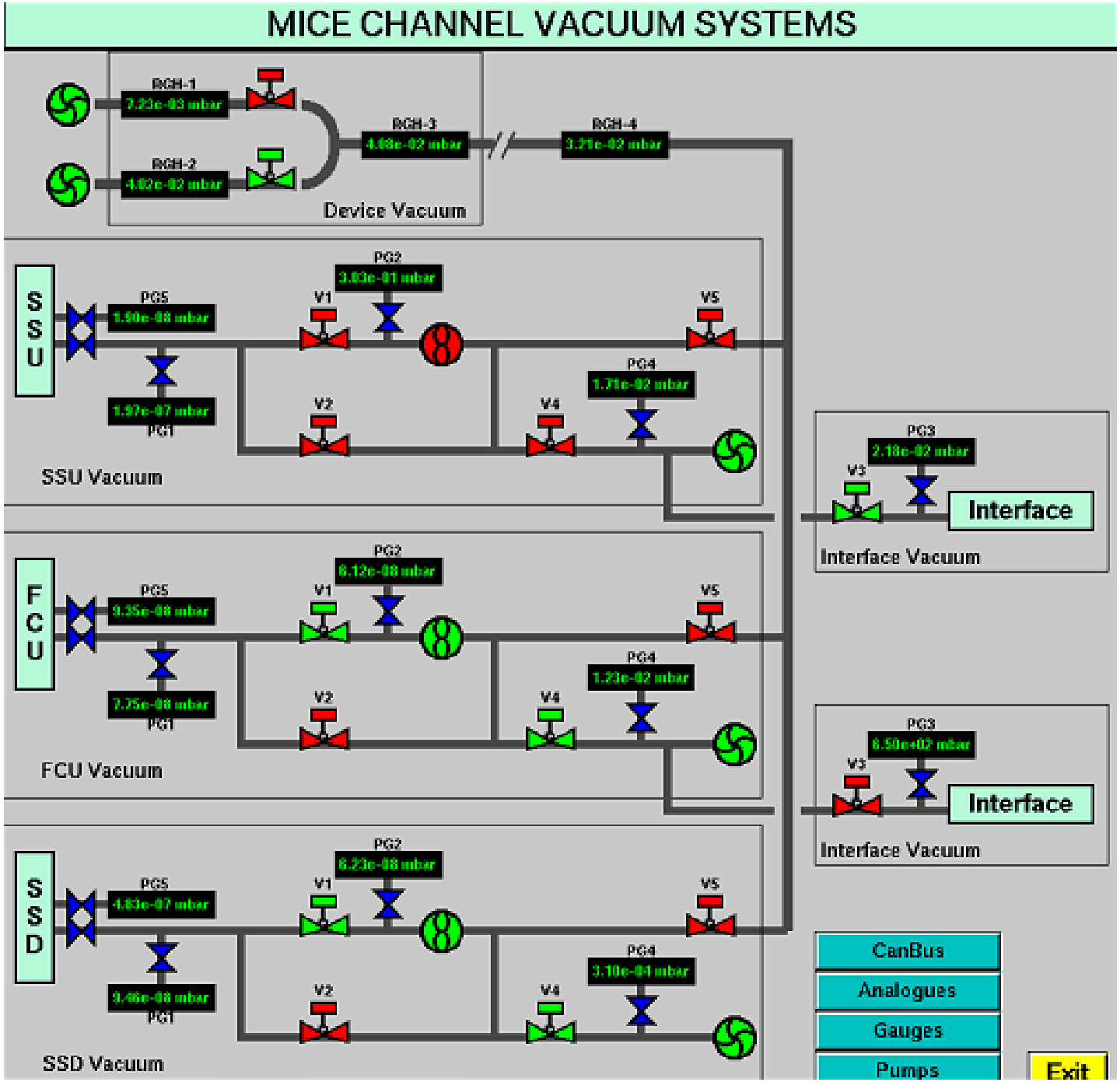


SSU pumping systems



Additional gate-valve (manual), turbopump (TMP), and scroll – highlighted by red ellipse

The GUI


MICE CHANNEL VACUUM SYSTEMS
RGH-1
7.23e-03 mbar
RGH-2
4.02e-02 mbar
RGH-3
4.08e-02 mbar
RGH-4
3.21e-02 mbar
Device Vacuum
SSU
PG5
1.90e-08 mbar
1.97e-07 mbar
PG1
PG2
3.83e-01 mbar
V1
V2
V4
V5
PG4
1.71e-02 mbar
SSU Vacuum
PG3
2.18e-02 mbar
V3
Interface
Interface Vacuum
FCU
PG5
9.35e-08 mbar
7.75e-08 mbar
PG1
PG2
6.12e-08 mbar
V1
V2
V4
V5
PG4
1.23e-02 mbar
FCU Vacuum
PG3
8.50e+02 mbar
V3
Interface
Interface Vacuum
SSD
PG5
4.83e-07 mbar
9.46e-08 mbar
PG1
PG2
6.23e-08 mbar
V1
V2
V4
V5
PG4
3.10e-04 mbar
SSD Vacuum
CanBus
Analogues
Gauges
Pumps
Exit

Later additions

- 360 litres/sec TMPs added to ports on the north side of SSU and SSD
- Manual gate-valve between the TMP and the port
- TMP backed by 15 m^3/hr scroll, with an isolation valve in case of power cut.
- No interlocks.
- Problems arose:

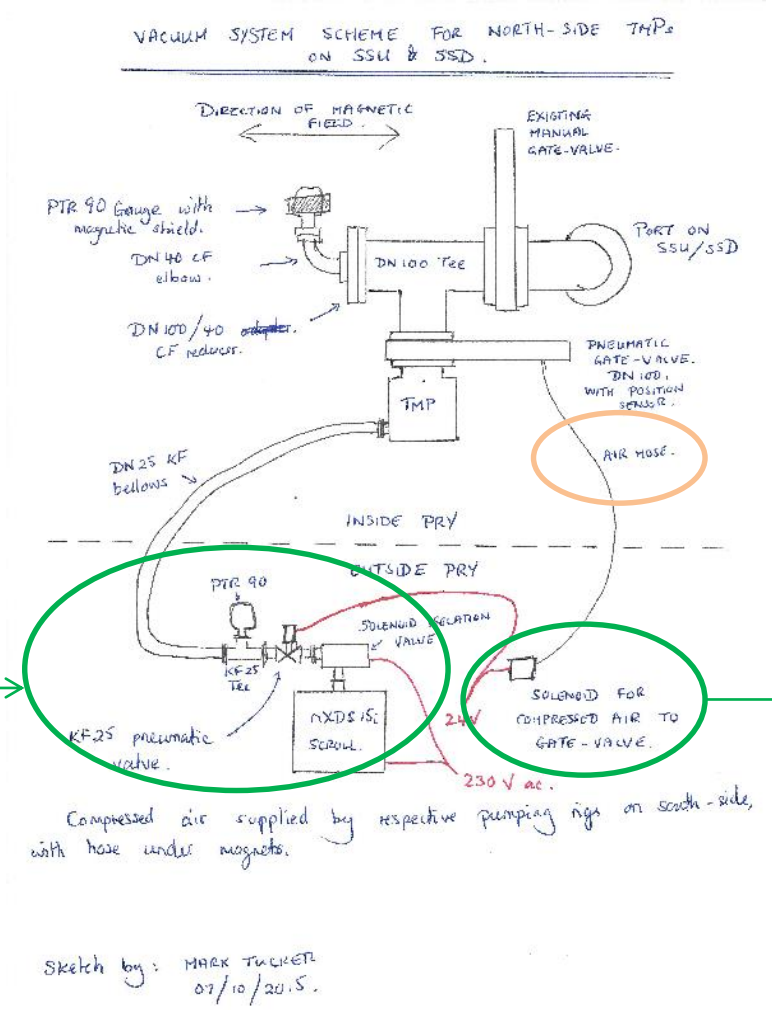
1) SSD TMP failed by being operated in magnetic field during training (not switched off before ramp)

2) SSD TMP was inadvertently off (trip?) for a prolonged period whilst the gate-valve was open, allowing cryo-pumping of atmosphere through the running scroll pump.

Need interlocks

Improving the north-side pump systems

This is situated on the north-side.



This will be sited on the SSU/SSD pumping rig on the south-side.

North-side interlocks

These are being done by Phil Warburton (DL) who has suggested the following…

- TMP can be switched on if:
    1) backing pressure < 0.05 mbar
    2) scroll pump is on
    3) valve to scroll pump is open
    4) magnet is off (software interlock)
- Gate- valve can be opened if:
    1) compressed air pressure is good
    2) TMP is on
    3) cryostat vacuum < 0.05 mbar

The “valve is open” reply signal will be wired in series with the position indicator of the manual gate-valve so that this signal is received only if both gate-valves are open.

Schedule

- The gate-valves (VAT) should arrive mid-November.
- The extra pipework (DN100 Tee, etc.) has arrived
- The gauges and their controllers (Oerlikon-Leybold) should arrive end-November.
- The cables for the controls are being laid in readiness.
- There are existing supplies for compressed air in the pumping rigs.

Future work

- In early planning stage for fitting new vacuum system to the Cooling Demonstration vessel (With Jason Tarrant, Alan Bross, etc.).
- Designed by Terry Anderson's team (FNAL), this vacuum system will be independent of the existing system to eliminate cross-contamination.
- Expect/hope to install all vacuum systems on the South side to avoid restricting access to the systems on the North side
- Set up pump systems to test the RF cavities after they arrive at RAL (April 2016).