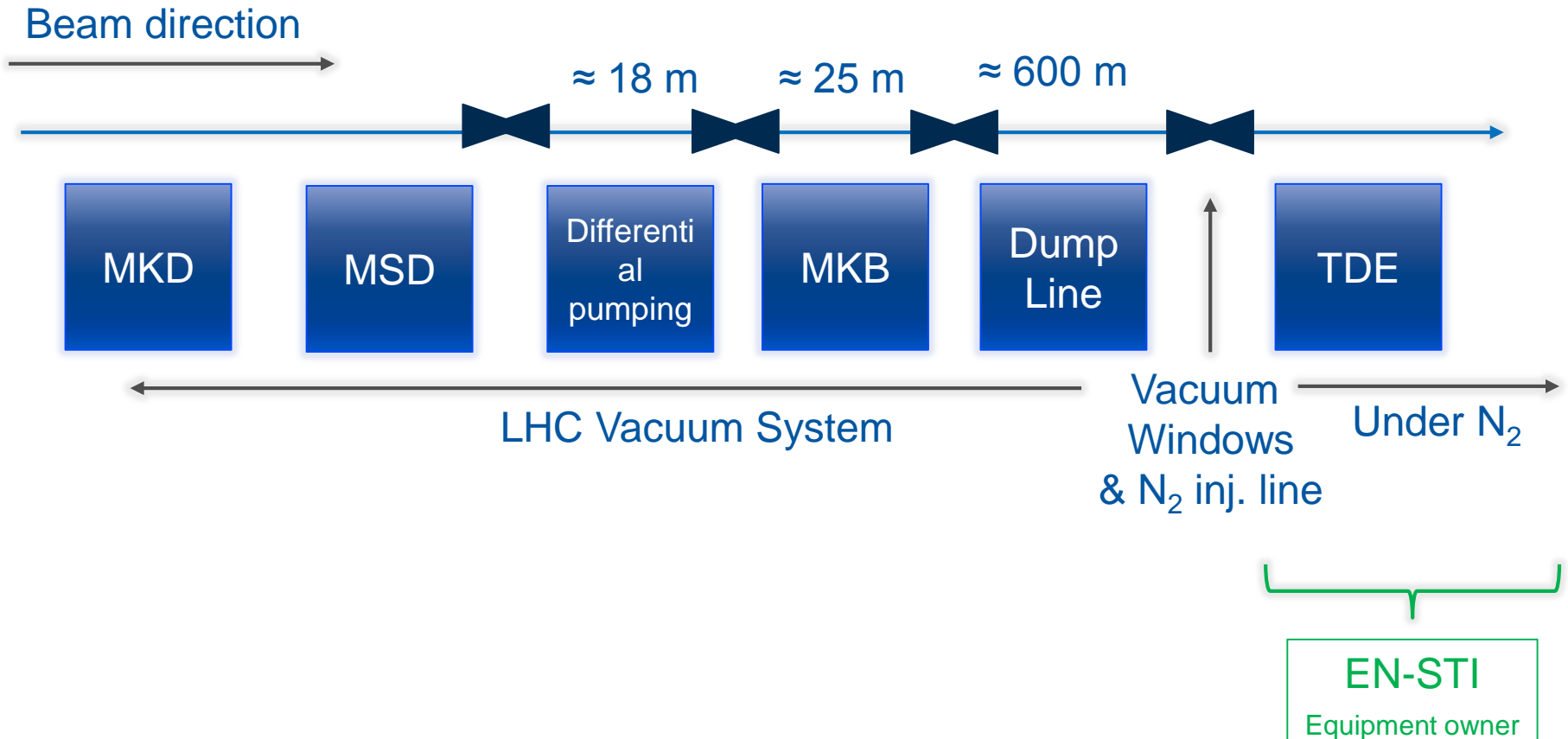


TDE in the LHC: Vacuum consideration

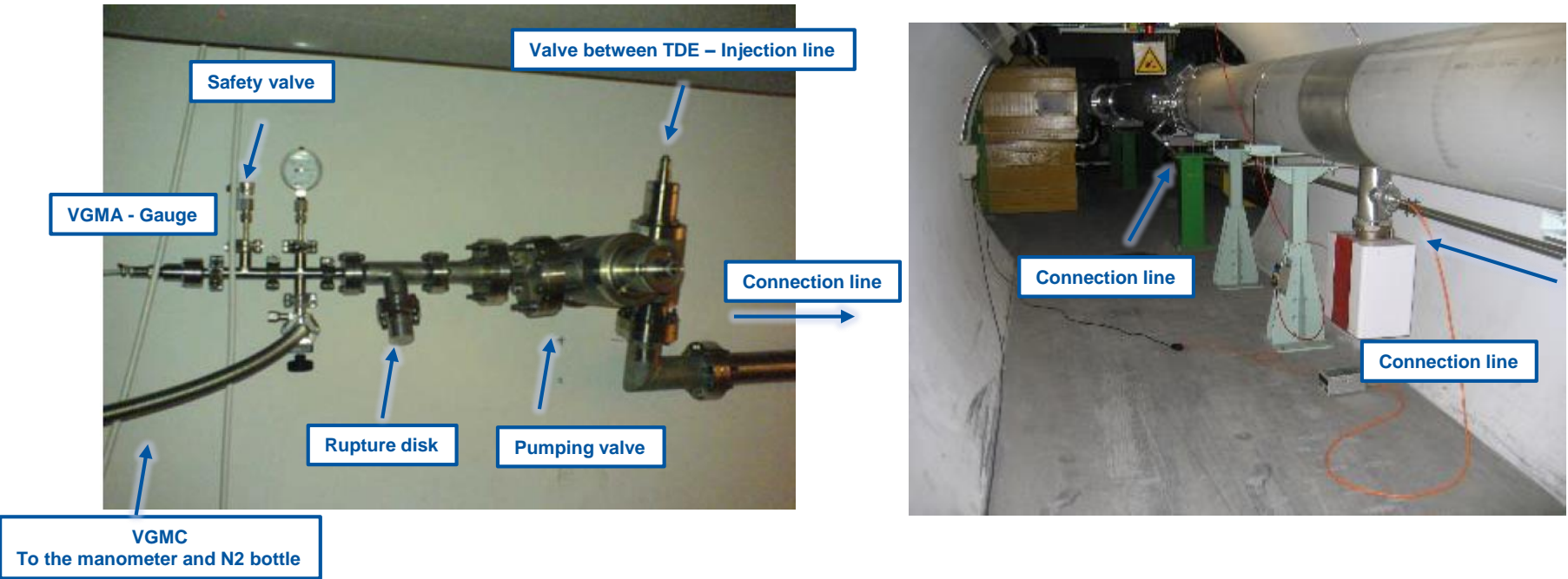
G.Bregliozzi
TE-VSC-BVO

Vacuum dump line schematic



N₂ Injection line schematic

Historical: TE-VSC built the injection line and gave the pressure monitoring



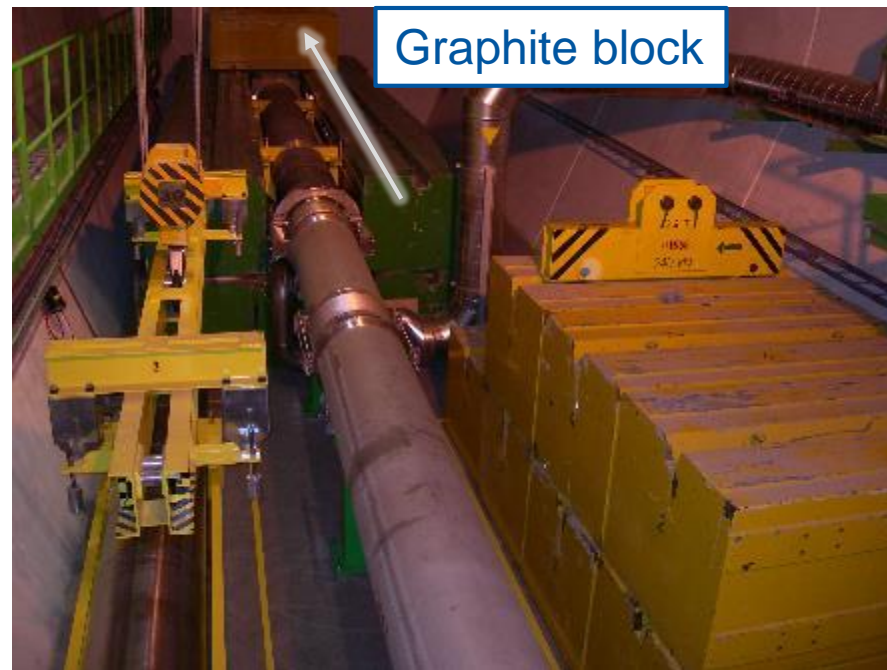
Two distinctive pressure reading:

VGMA: Membrane gauge – Range of pressure 0 – 2 bar – Precision of ± 5 mbar

VGMC: Manometer – Range of pressure 1 – 250 bar – Precision of 0.5%

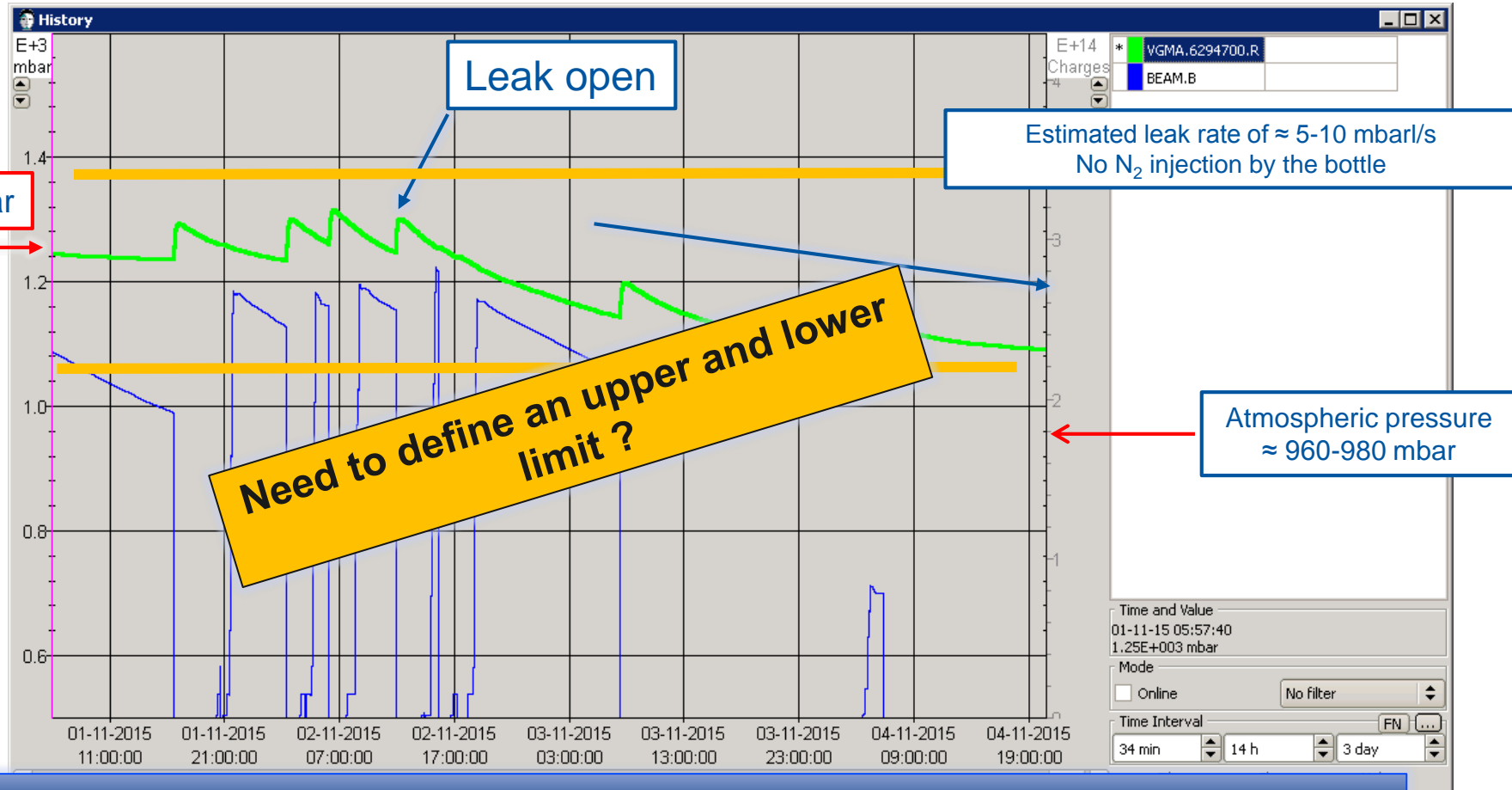
Safety valve: Open-Closed state – Calibrated ≈ 1.3 bar

TDE Dump Line



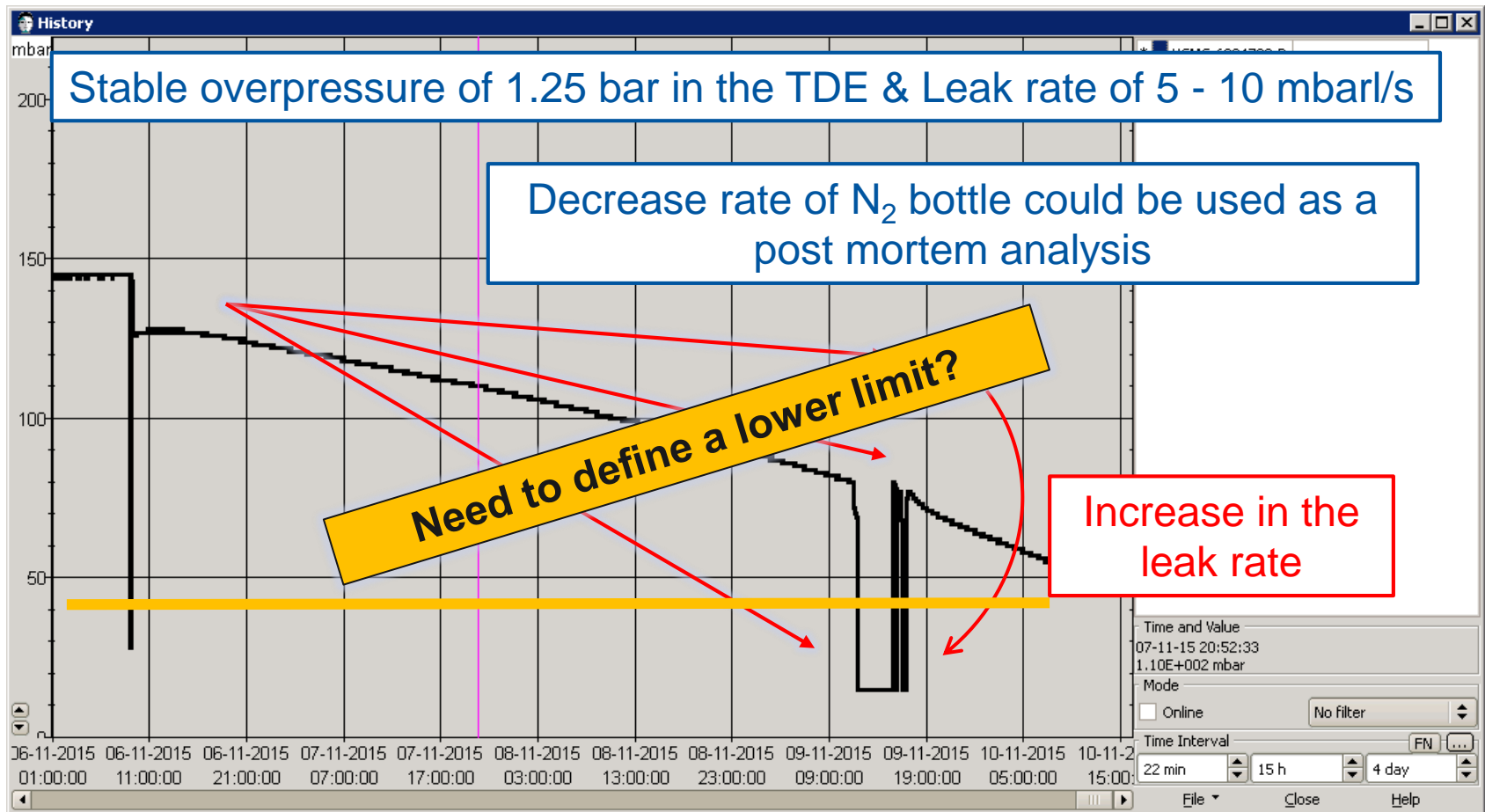
Normal operation: N₂ overpressure of 1250 mbar
About +280 mbar over atmospheric pressure

Leak of November 2015: What we have learned



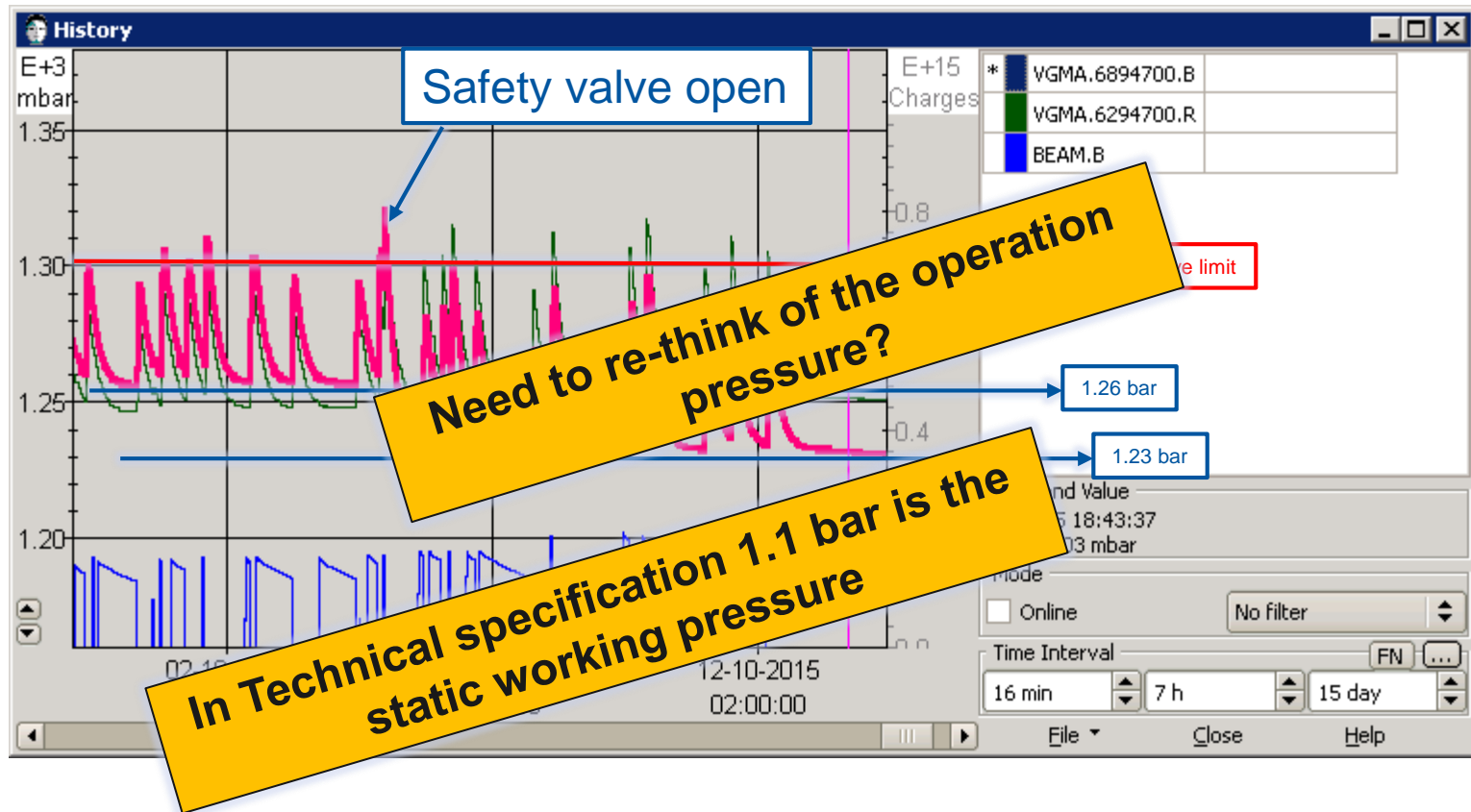
Safe operation - Still under N_2 Atmosphere
Impossible to have any air inrush

N₂ Bottle consumption: Consumption rate



TED Still under N₂ atmosphere: safe condition.

Pressure increase in the TDE during each dump: fatigue cycles?

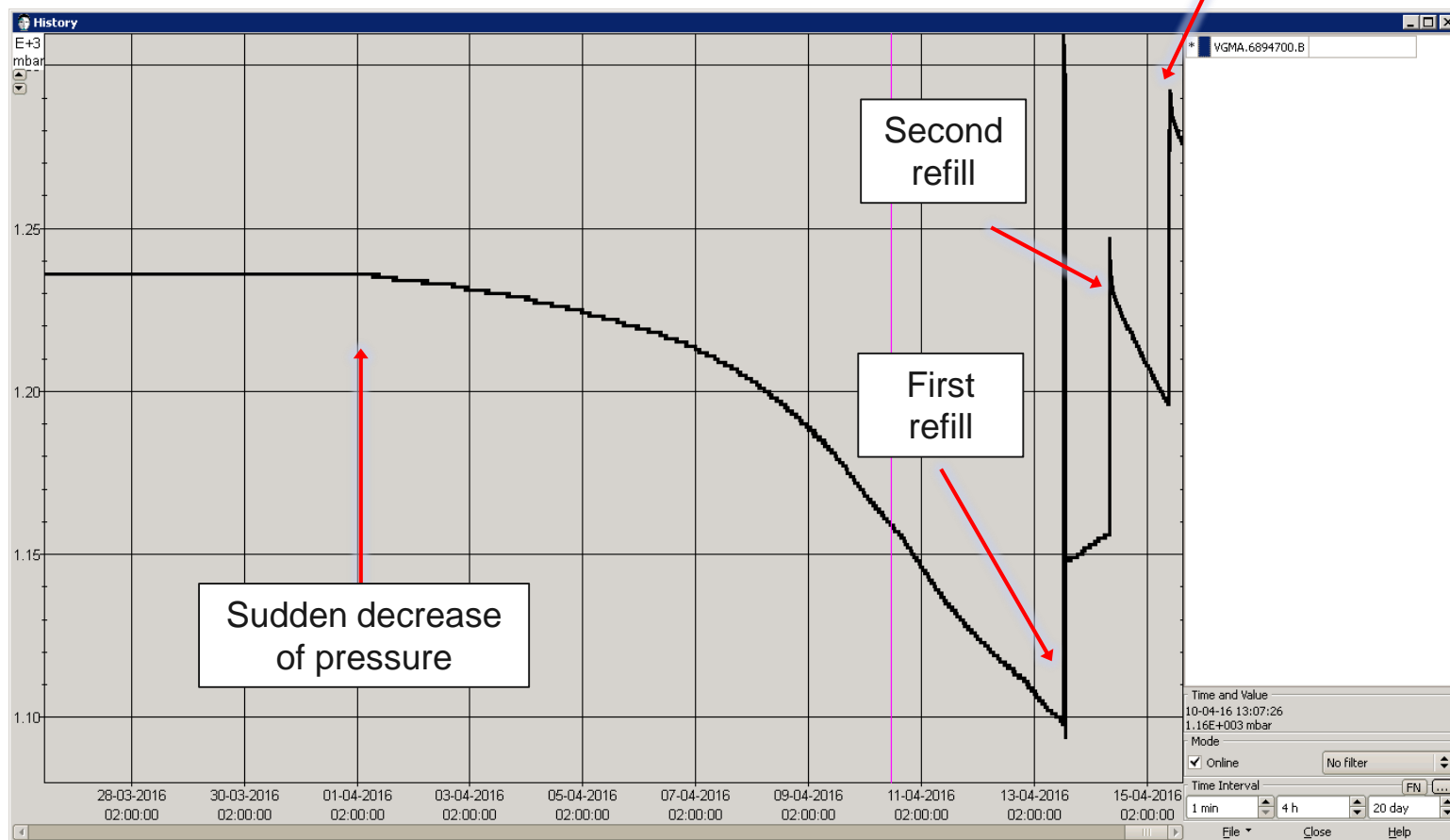


Summary Proposition

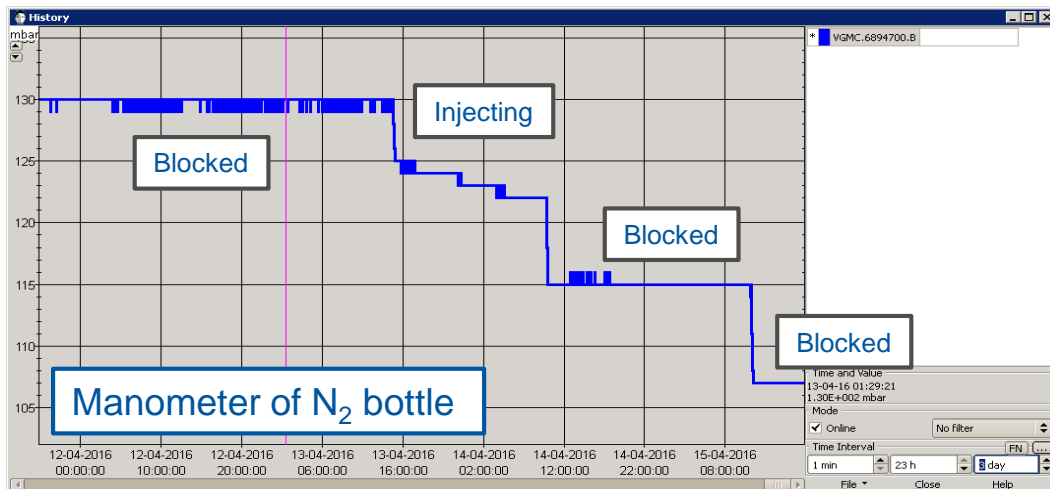
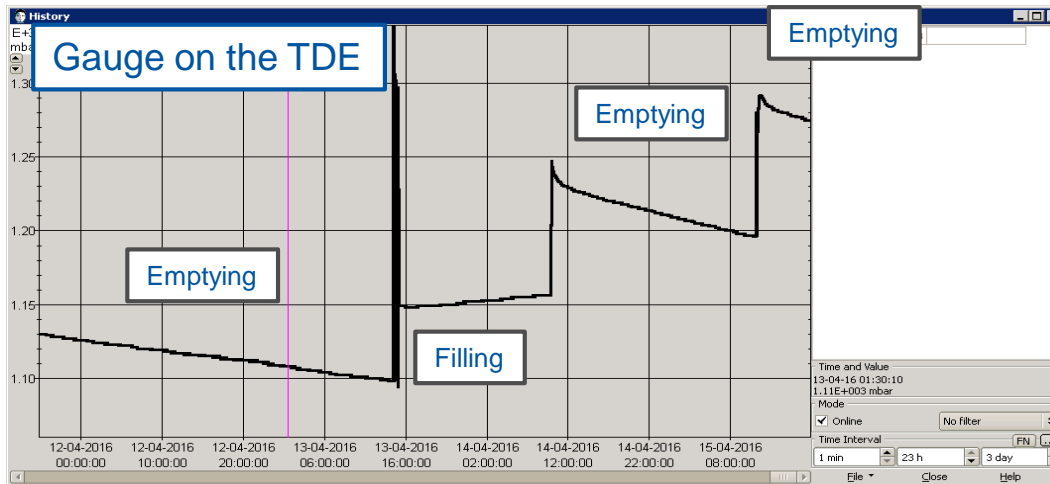
- **Definition of a TDE & N₂ bottle pressure level to trigger alarms for the injection:**
 - For the TDE – **Alarms limit**: If pressure in the TDE is $\Delta P < 10$ mbar compared to the operation value - **Alarms**
 - For the TDE - **Lower limit**: Close to the atmospheric pressure value but still over pressure: ≈ 1.05 -1.1 bar - **Injection interlock for next**
 - For the TDE – **Upper limit**: Anticipate or analyse possible dump problems: 1.30 bar? - **Alarms**
 - For the N₂ bottle – **Lower limit**: Allow a safe over pressure operation in the TDE until the bottle exchange during next TS – **Alarms**
- **Pressure value in the dump: could it be revisited?**
 - Less pressure imply less absolute pressure increase during each dump and less induced stress on the flanges.
- **Decrease rate of N₂ bottle could be used as:**
 - Estimation of leak rate & post mortem analysis
- **Possible Consolidation upgrade on the N₂ Injection line & TDE System:**
 - New gauges close as much as possible to the TDE: for high and low pressure.
 - Remotely activated valve to isolate the injection line to the TDE to analyse the system remotely
 - New remote primary pumping station: radiation gas pumped remotely and not need presence of personnel
 - Installation of a rack of 12 N₂ bottles on surface

TD68.DB – 04/2016

Pressure evolution in the TDE Line – Vacuum Gauge



TD68.DB: Interventions



- 01.04.2016:
A leak appear on a flange in front of the TDE graphite block ID660 flange: TDE emptying due to fault on the manometer mechanism: $P > 1.1$ bar
- 13.04.2016:
Access due to SPS. Manometer unblocked and TDE refilled. Leak still present in the ID660. Tried to tight it but no variation and maximum torque already reached.
- 14.04.2016:
Pressure in the line increase up to 1.23bar but apparently the manometer is blocked again
- 15.04.2016:
Pressure in the line increase up to 1.29bar but apparently the manometer is blocked again

Estimated leak rate of 1 mbarl/s