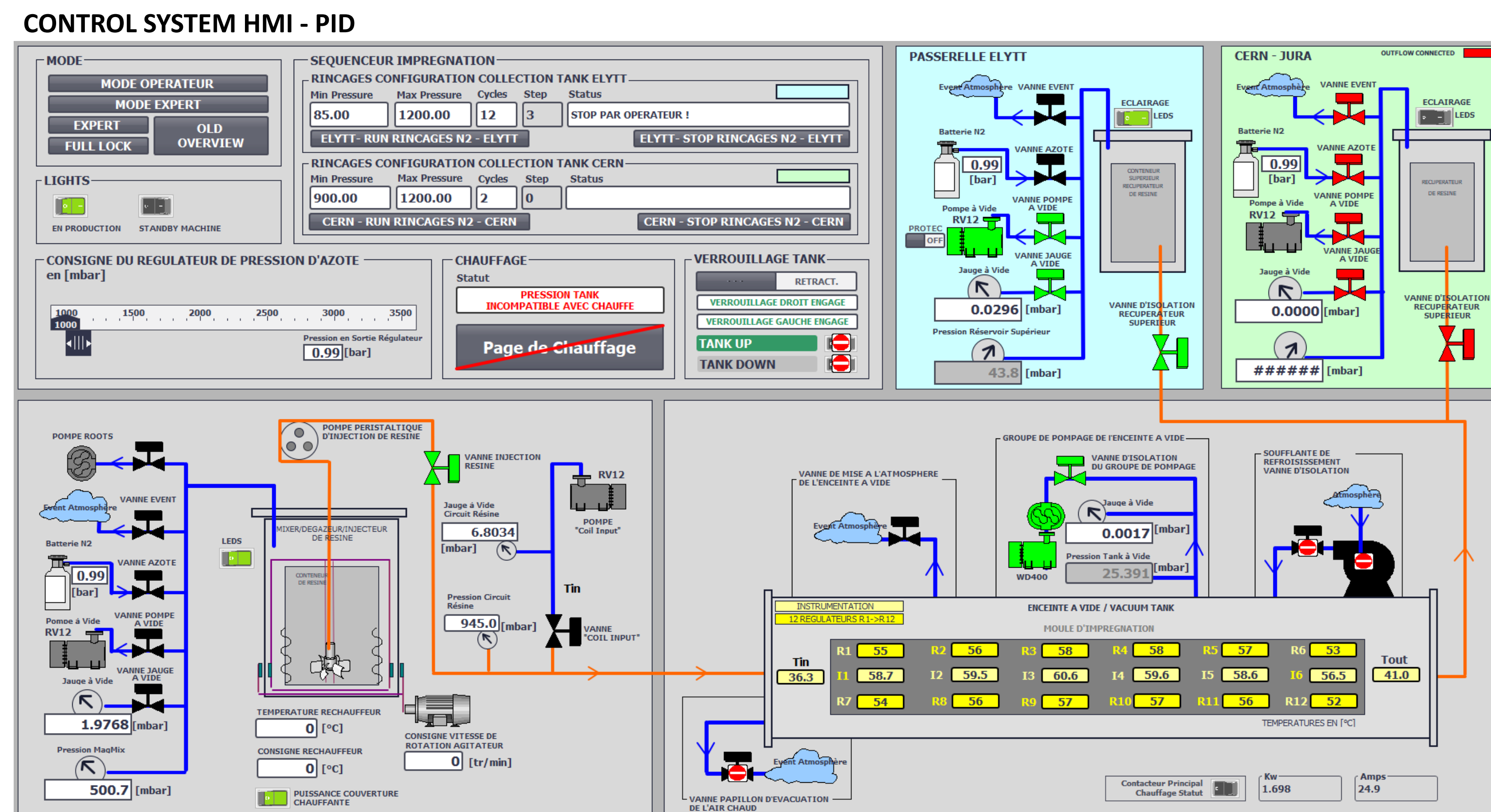
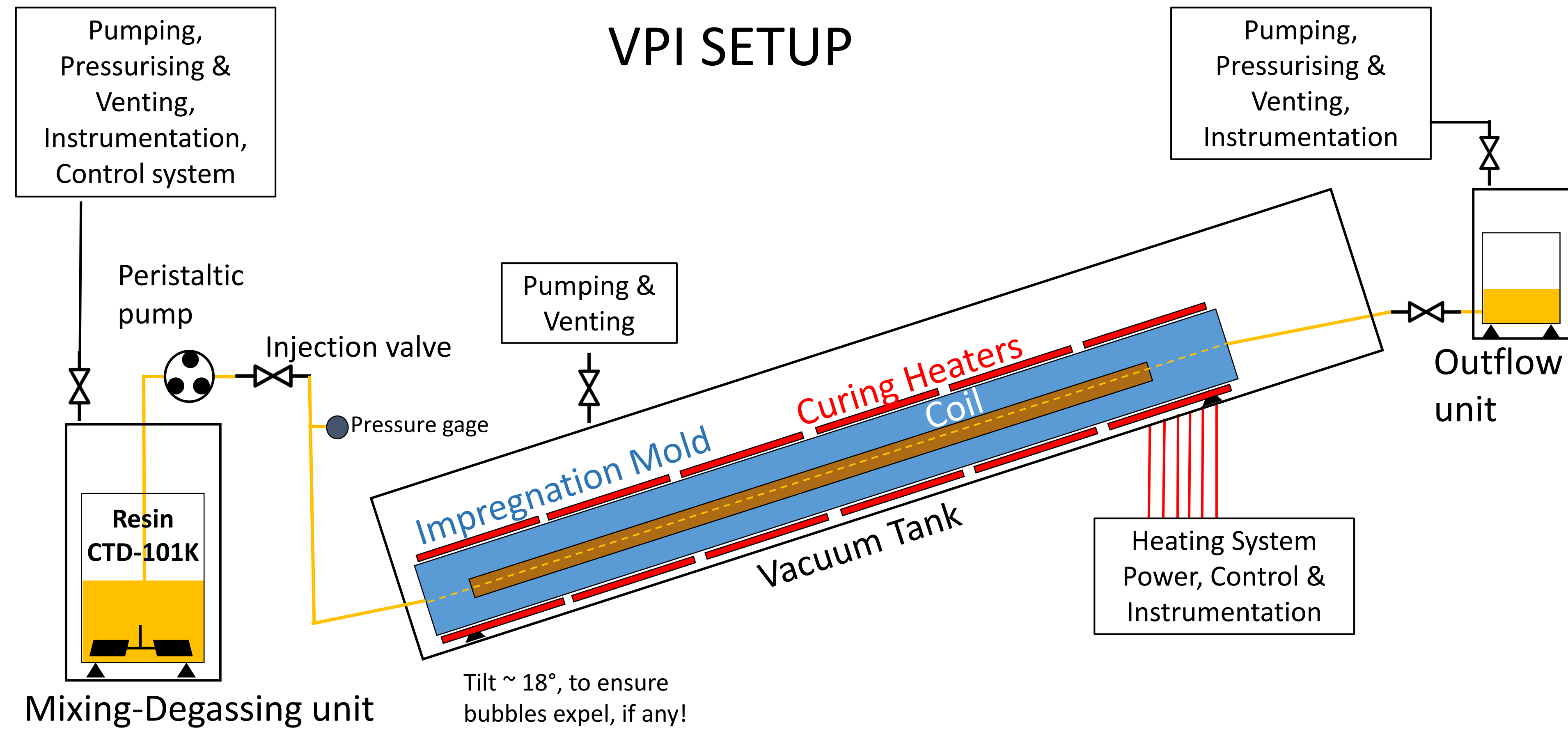


CONTEXT

The CERN Large Magnet Facility (LMF) is currently producing 5.5 m long 11 Tesla dipole and 7.2 m long MQXFB quadrupole coils for the HL-LHC project. Both coil types are fabricated with Nb₃Sn conductor with the so-called wind and react technique. These coils require a vacuum pressure impregnation (VPI) process to form the final insulation and to give the final dimensions. The CERN LMF impregnation infrastructure and process are shown here.

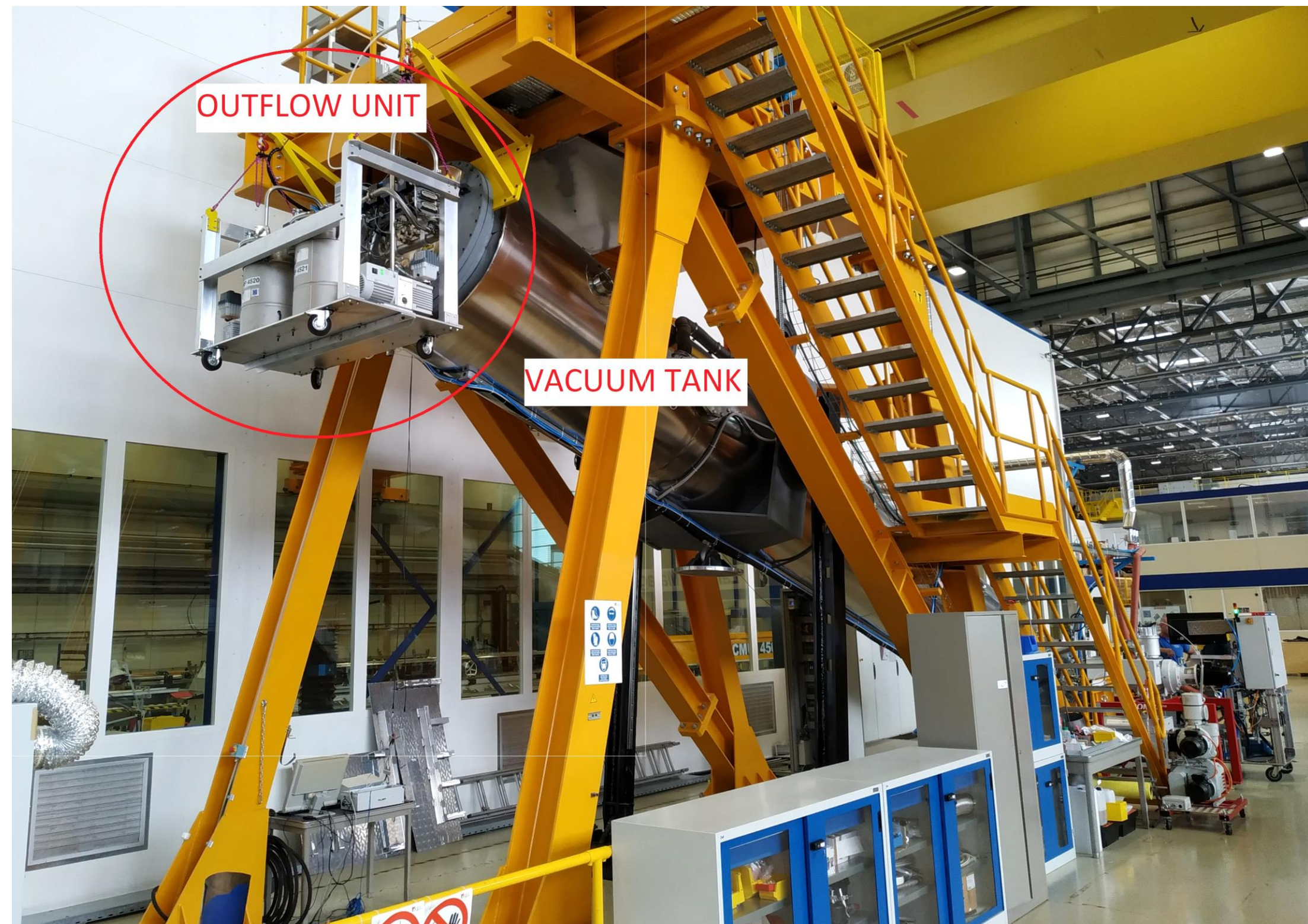
VPI SETUP



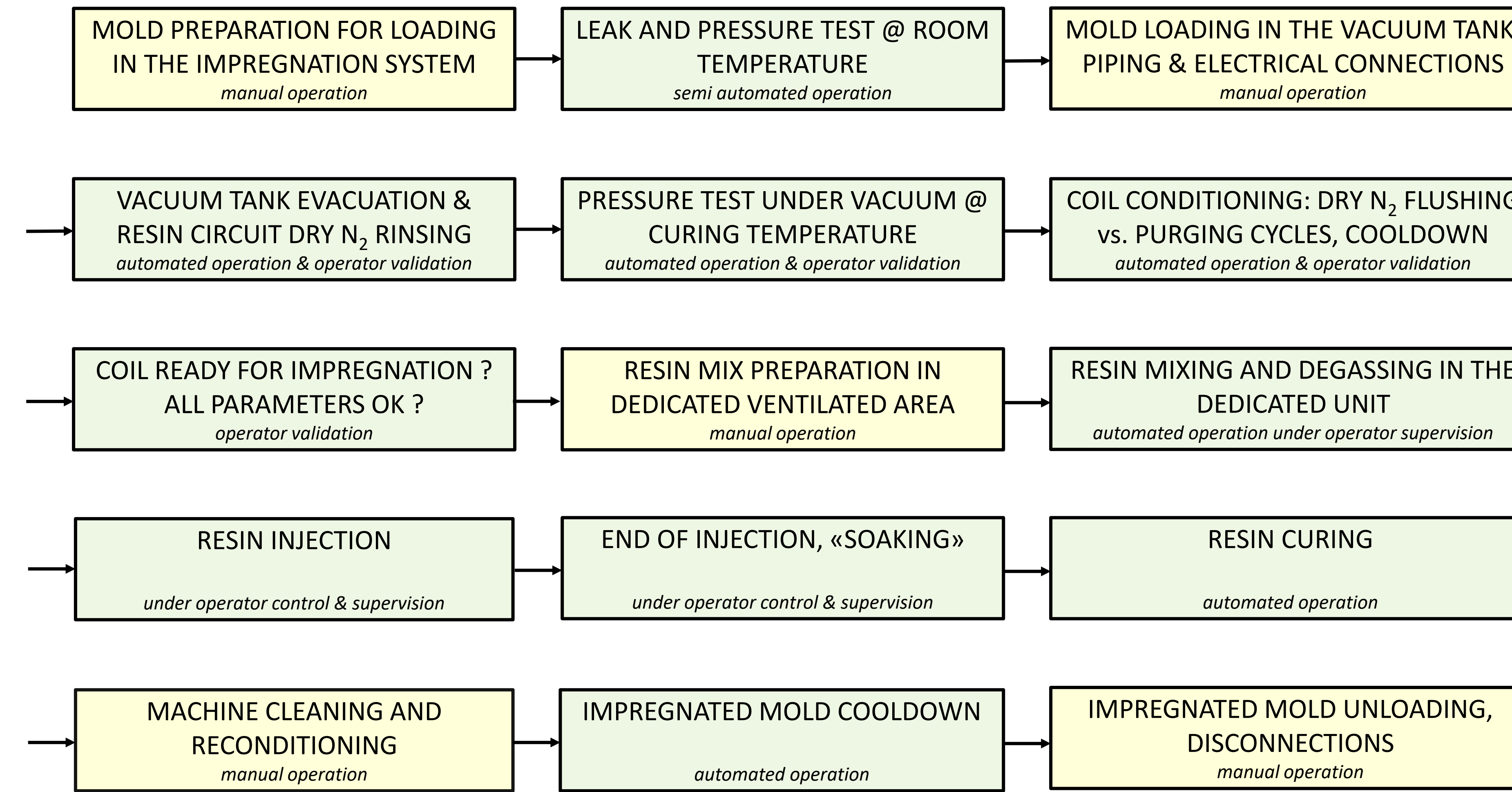
GENERAL OVERVIEW: MIXING-DEGASSING UNIT, VACUUM TANK & GANTRY



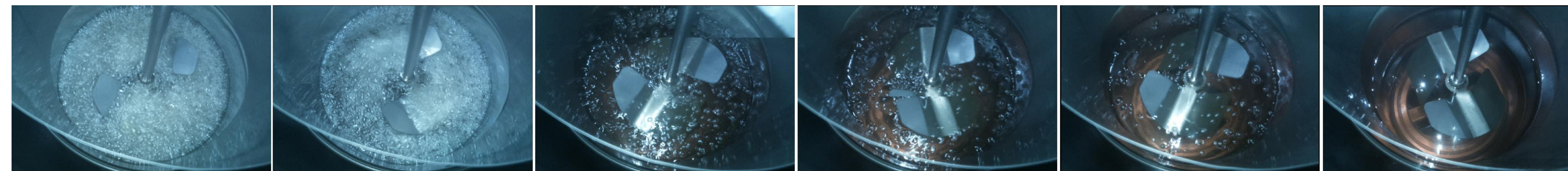
REAR VIEW: OUTFLOW UNIT, VACUUM TANK



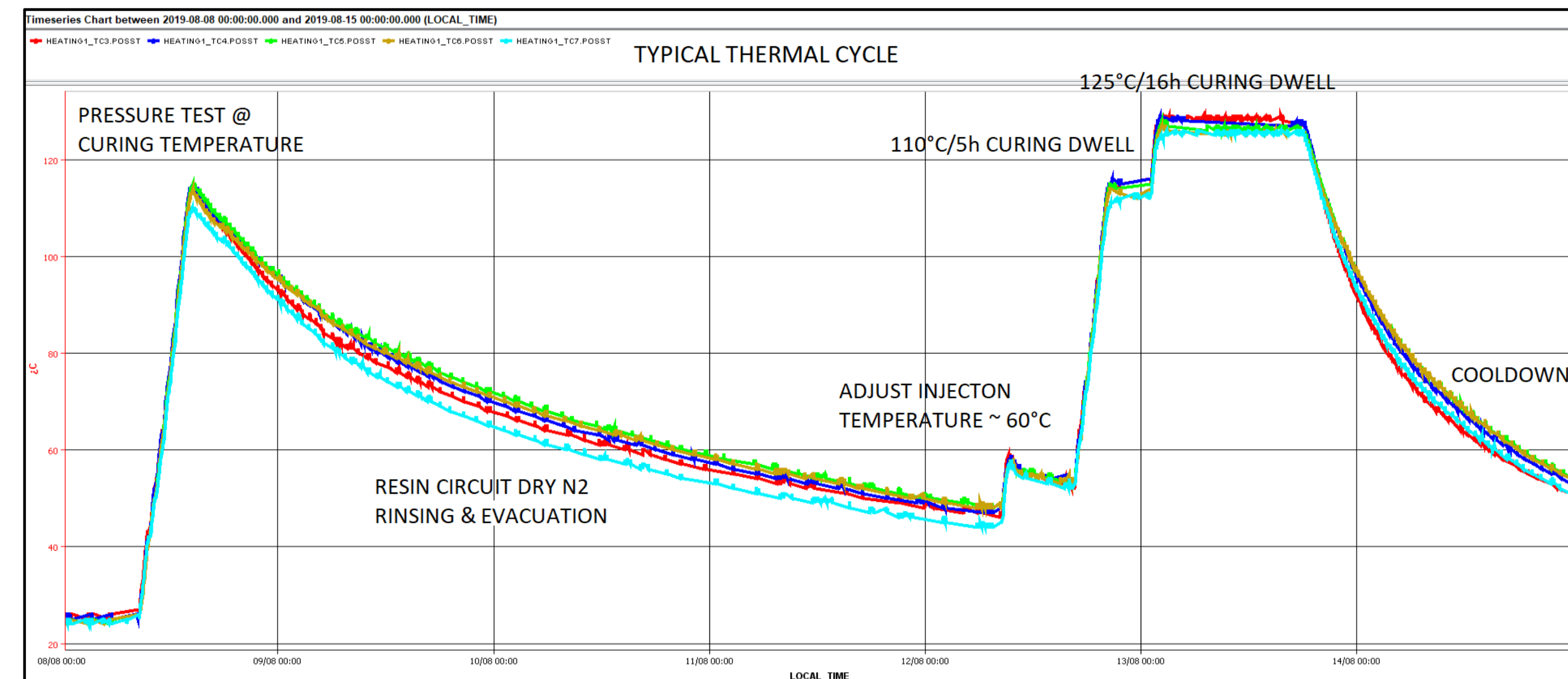
VPI PROCESS (cycle time ~ 7 days)



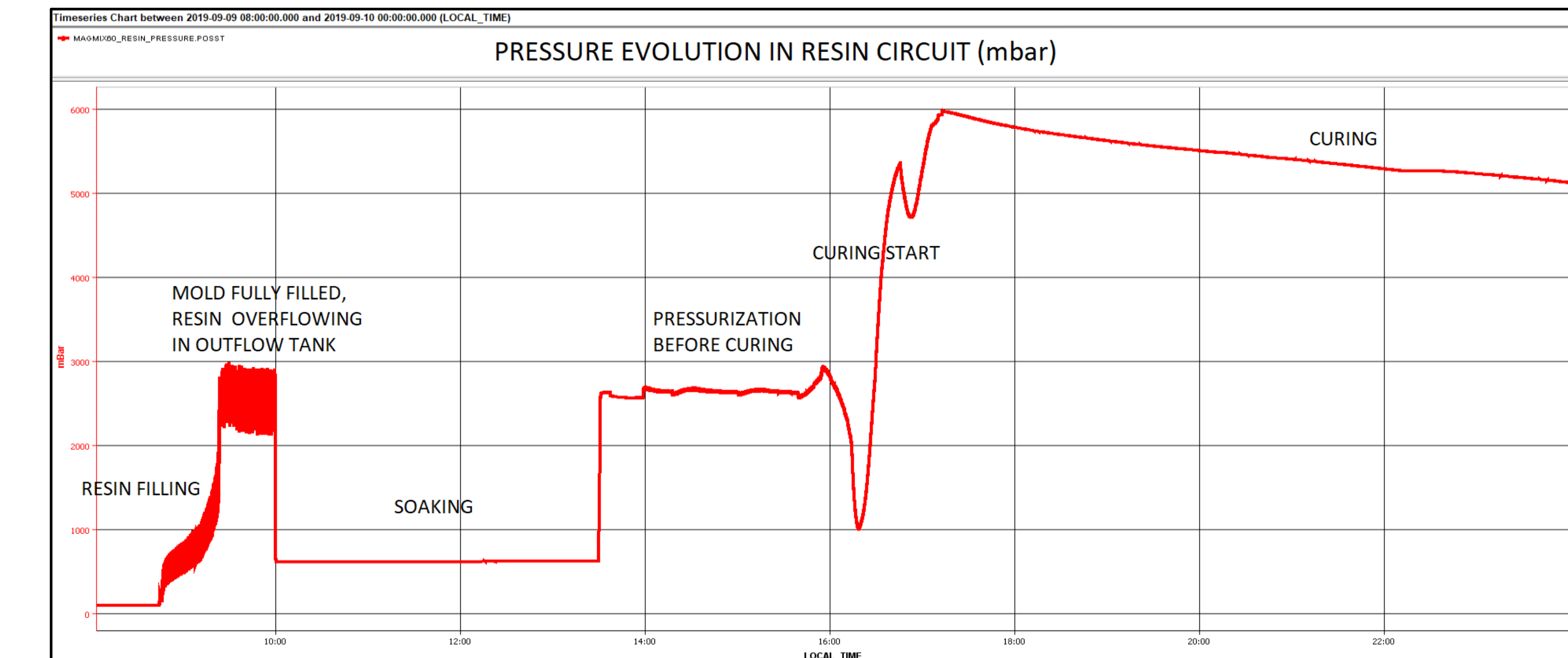
CTD-101K RESIN DEGASSING : FROM ~ 1000 mbar to ~ 0.1 mbar, ~45 to 60 min



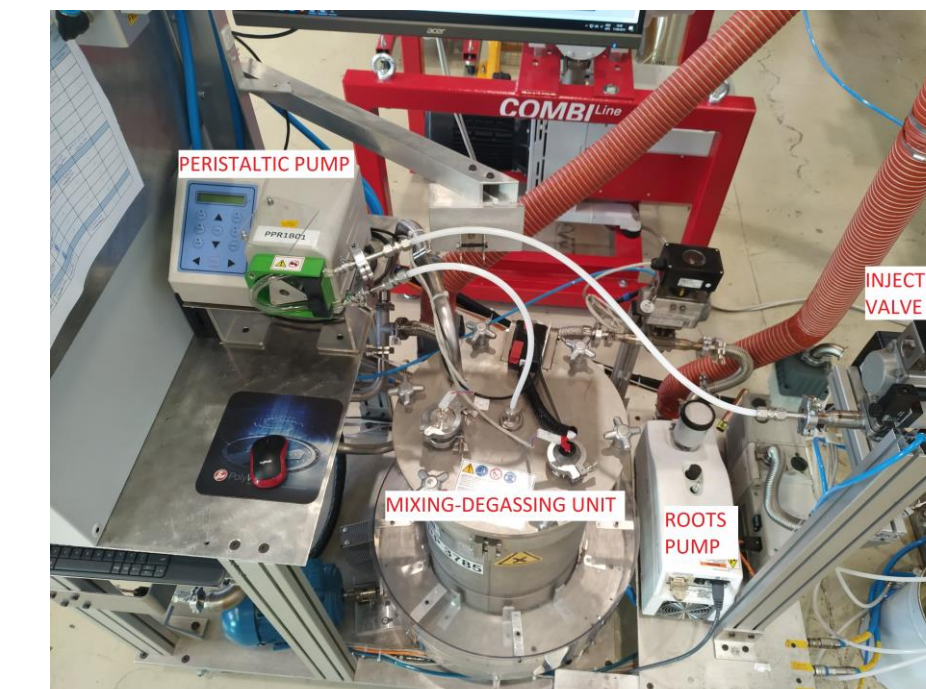
STANDARD THERMAL CYCLE



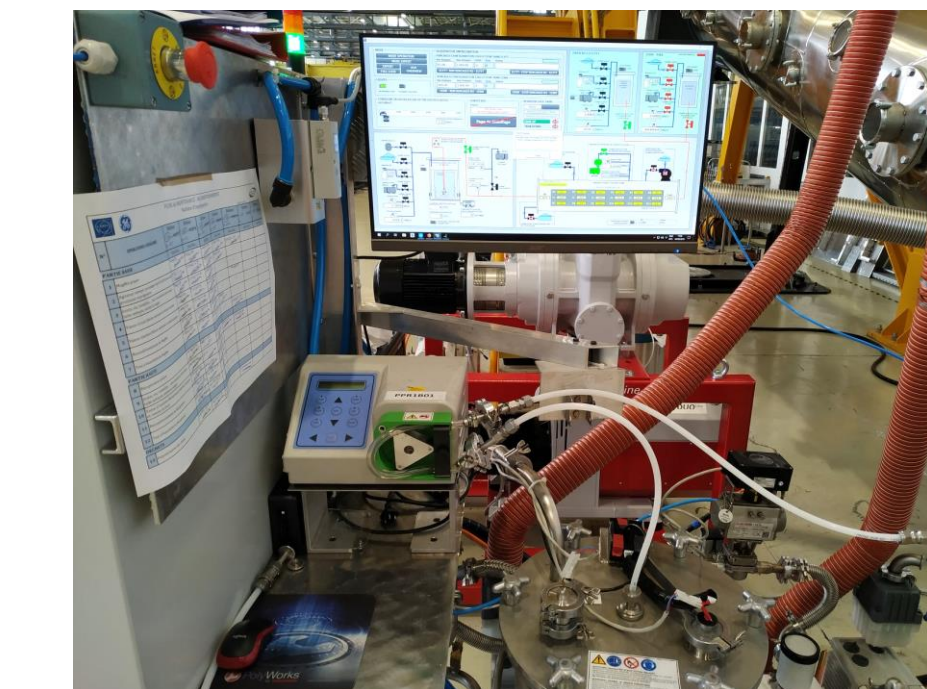
RESIN PRESSURE DURING INJECTION AND CURING



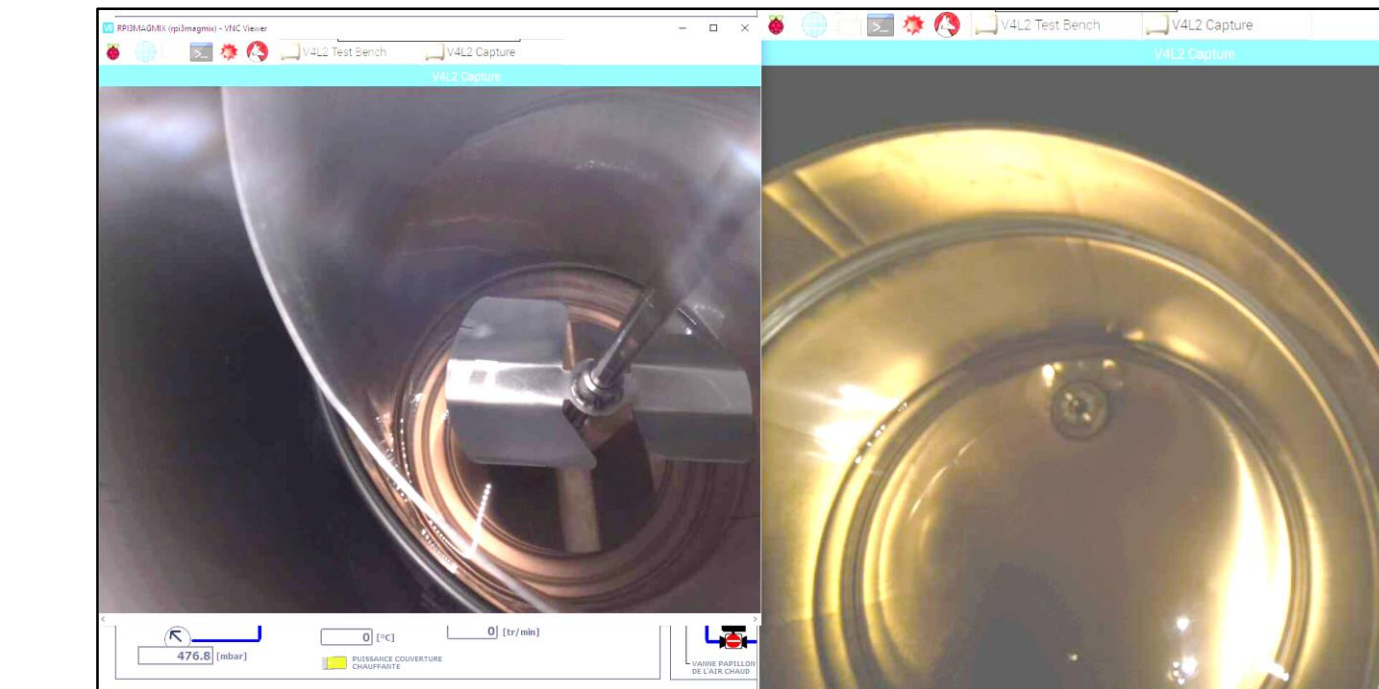
INJECTION SETUP: PERISTALTIC PUMP, INJECTION VALVE



IMPREGNATION SYSTEM HMI



RESIN LEVELS MONITORING: INSIDE CAMERA



EASY CLEANING!



CONCLUSIONS

More than 15 series 11 T coils have been impregnated up to now, the present CERN impregnation machine is efficient and reliable. Many impregnation data collected (post analysis) and a strong experience gain («production mode»). The CERN impregnation system is a robust base for adding new features and test new impregnation compounds (cyanate ester). Continuous improvement is ongoing on the system: e.g. refined temperature pick-up on the impregnation molds to better understand the temperature distribution. The second impregnation unit that will be soon available will give more time opportunities for development sessions: resin degassing studies, optimized curing cycles, make capacitance measurements consistent, etc.