CRYOGENIC AND VACUUM ISSUES AFFECTING BEAM COMMISSIONING - DISCUSSION

L. Serio, CERN, Geneva, Switzerland

HOW TO DEAL WITH LEAKS IN THE QRL AND MAGNET INSULATION VACUUM

R. Saban questioned that the stated 4 hours for leak tests (just intervention time?) might not be sufficient to detect a leak. String 2 experience has shown that much longer time is required. P. Cruikshank said that the figures given are the best possible time that one can expect with no problems encountered and with a quick and correct identification on the opening of the interconnect.

R. Veness asked to clarify what needs to be done with a leak rate of 3 E-5 mbar.l/s (for 214 m of machine) and 1 E-5 mbar.l/s (for 428 m of QRL) once the cold surfaces are saturated (after 200 days); P. Cruikshank replied that the system needs to be warmed up to at least 25 K and pumped to reset “the timer” for another 200 days.

HOW TO DEAL WITH LEAKS IN THE LHC BEAM VACUUM

B. Goddard doubted that the beam loss monitors resolution would allow detection of beam losses produced by helium leaks in the beam vacuum. This could only happen if the beam losses are in the vicinity of the beam loss monitors.

Ph. Lebrun said that the values of leak rate are measured by the gauge at warm; therefore a correction factor (3 orders of magnitude) needs to be applied. V. Baglin answered that the values given are as detected/measured at warm and therefore the values at cold are 3 times smaller.

R. Schmidt mentioned that at 450 GeV operation the threshold for magnet quench due to electron cloud might be a factor of 10 more; furthermore a helium leak would have continuous beam losses and therefore the magnet quench could be due to the warming-up of the magnets because of limitation in the 1.8 K cooling.

S. Myers said that beam loss monitors can not be used to detect the position of a leak and asked what else can be done. V. Baglin said that another method would be to measure the heat deposited on the cold mass. This would only be an indication as the expected resolution is in the order of 1 W/m. L. Tavian replied that the cryogenic system would be able to identify additional heat inleaks only within one cell and therefore with a resolution of 100 meters.

R. Schmidt suggested having some mobile beam loss monitors to move in the vicinity of the “suspect” location and therefore better investigate a particular area.

R. Assmann said that if the beam losses are such to quench a magnet then it should be possible to see something on the beam loss monitors. One can see an emittance blow-up but still there is the need to locate the leak. S. Myers replied that these are general observations and we will not be able to know what cause it. The vacuum people need to know if it is a leak and where it is.

O. Brunner mentioned that HERA has successfully employed mobile beam loss monitors to detect and analyse problems with dust particles in the beam pipe.

N. Hilleret asked if beam loss monitors (mobile?) would be available in the machine and what would be the resolution. B. Goddard answers yes.

SHORTCUTS DURING INSTALLATION AND COMMISSIONING: RISKS AND BENEFITS

P. Strubin pointed out that the tests of subsectors are hidden except for the last sector. This tests can be skipped but at a high risk to discover problems after magnet installation. G. Riddone replied that a combined pressure and leak test can be done on the last subsector; it can be skipped but with no impact on the installation as there is no magnet circulation on the last sector and therefore no incompatibility with the tests.

S. Weisz questioned some of the points that were mentioned not to have impact on the planning (leak, pressure tests, etc.). He affirmed that everything has an impact because it delays magnet installation. He also mentioned that a combined pressure and leak test for the full sector inclusive of the QRL would reduce significantly the overall installation / pressure and leak test period. G. Riddone replied that this is true but the risk and consequences are high. S. Weisz suggested making only the leak test at a lower pressure and performing only once, at the end and with the magnet, the pressure test which is compulsory form the safety point of view.

Ph. Lebrun said that some of these tests have direct impact on corrective activities and should be maintained while other tests such as heat loads measurements have only contractual implications but not corrective actions. Pressure and leak tests should be performed early enough to have impact on corrective activities and technical work.

S. Weisz said that cold tests and heat inleaks measurements on the full sectors are time consuming, in particular for the preparation work and the installation of instrumentation which is on the critical path. He then suggested to investigate if it was possible to install instrumentation during magnet interconnect to reduce time.
P. Cruikshank mentioned that for the reported 2-3 weeks of leak and pressure tests the pressure test itself lasts only 24 hours. G. Riddone added that the theoretical time to pressurise all lines would be 4 to 5 hours.

**COMMISSIONING THE DFB**

No discussion due to lack of time.

**THE CRYOGENIC SYSTEM IN POINT 4: POSSIBLE OPTIONS**

Ph. Lebrun pointed out that option 1 is feasible but has the significant drawback to be highly inefficient, because it requires a significant amount of refrigeration capacity. S. Claudet clarified that it would only be used when the pressure in line D is not nominal only to avoid discharging helium and pressurizes the cavities; it would only be used for limited amount of time and without beam. Ph. Lebrun then asked if it was then interesting to run the cavities without the beam.

R. van Weelderen pointed out that all these options (except for the ultimate beam) seem to be for “convenience” of operation but there is not a clear and justified request from the RF group.

E. Ciapala said that for the RF the main worry is the pressure in line D and how to decouple from it.

R. Losito added that even if the graphs shown suggest that there are no oscillations above 15 mbar it might be due to the acquisition rate as there might be fast oscillations (less than 1 sec). S. Claudet replied that it is not possible to have faster oscillations and that anyway in the machine line D will act as a buffer.

**ISSUES CONCERNING THE RELIABILITY OF THE LHC CRYOGENIC SYSTEM**

P. Cruikshanck asked if the sector 2-3 would be warmed-up if the refrigerator in point 2 is out of service due to the lack of redundancy. L. Tavian answered that the system would allow redundancy to maintain sector 2-3 below 80 K even without the refrigerator in point 2.

Ph. Lebrun remarked that the switch over time of 12 to 24 hours between refrigerators to allow redundancy seems too long. M. Sanmarti replied that these are theoretical values and would need confirmation.

R. Schmidt asked explanation on the problems encountered with the control system. M. Sanmarti pointed out that the control system was still no yet up to the required performance and stressed the importance of the reliability of the control system as during machine operation any stop of the control system would have the same impact of a utility stop (i.e. 6 hours + 3*stop duration).