QRL installation in Sector 7-8: from repairs to cool-down

In 2004, problems were discovered and diagnosed on the sliding tables of the Helium distribution line (QRL) (see previous LHC News) and on November 11th 2004, CERN Director General mandated the AT and TS departments to repair the QRL in sector 7-8 of the LHC, following a feasibility study completed between September and November 2004. Many people in AT and TS were redeployed and set to work on this additional task despite the already heavy workload.

QRL repairs in sector 7-8

After analysis, a simple solution using prefabricated rings and sleeves was proposed by AT-CRI in order to simplify the interconnection work in the tunnel. TS-IC and TS-SU studied the external supporting and alignment system. The proposed technical solutions and the planning were reviewed on December 8th 2004.

A contractor (IEG) was then mandated to cut open the existing line, repair the pipe elements and weld again the interconnection components. In order to meet the tight schedule for these repairs, a second contractor (ICS) was mandated later on to close the outer envelop.

The repair activity started immediately after the review, with the service modules and fixed points being repaired by TS-MME in building 110 and the simple pipe elements by the contractor in UX65.

Elements to be repaired were moved in and out of the tunnel by another contractor (DBS) under the responsibility of TS-IC; all repaired elements have been re-aligned by TS-SU.

Leak test of the repaired elements and new interconnection welds were performed at the same rate as the repairs by AT-VAC and a Polish collaboration from Krakow.

A major effort by many groups at CERN and with the help of different contractors, but above all a brilliant demonstration that with motivation and determination it is possible to move mountains!

Junction Region between UX85 and the tunnel

Nevertheless one of the major difficulties in this sector 7-8, which was identified from the beginning, is the so called "junction region" of the QRL, a set of bends and short straight pipes connecting the cold box in UX85 to the main QRL line in the LHC tunnel.
The thermo-mechanical design of this “junction region” had to be recalculated by AT-ACR and heavy modifications were executed by TS-MME on the original components to make them compliant with the calculations.

**When corrosion sets in…**

In June 2005, a new serious problem became apparent when corrosion was detected on a header inside a service module. Thorough investigations revealed that all service modules would have to be modified to prevent this corrosion to propagate, adding yet another load to the TS-MME group in charge of the repairs.

The service modules were repaired and the installation of the QRL proceeded despite this new set-back. The plan then called for the pressure test and cool-down of the first two sub-sectors, out of nine in total, of sector 7-8.

**Pressure Test**

The sub-sectors A and B of the QRL in sector 7-8 were isolated from the rest of the line and pressure tested by AT-ACR on September 3rd 2005, an operation closely monitored by the Safety Commission and performed during a week-end when access could be restricted with the least disturbance to other tasks.

During this pressure test, as the pressure had reached over 70% of the ultimate test pressure, a non-conformity was detected on the external supporting system: under the longitudinal force induced by the pressure on a fixed point a weld gave way and the associated QRL element shifted, elongating the adjacent bellows.
After opening it was clear that the damage was limited and repairs were carried out in a record time during the following days and nights by TS-MME and other groups involved.

A new pressure test was successfully performed on Thursday September 8th 2005, during the local holiday of the "Jeûne genevois". The pressure went up to 1.25 times the design pressure of the different circuits, and the two sub-sectors A and B were declared mechanically conform and turned over to cooling down.

Before starting the cool-down itself, the circuits were configured and purged by AT-ACR during the following week-end. Each circuit was successively flushed with a high flow of room temperature helium circulating in closed loop in order to trap the solid impurities on a dedicated filter. This proceeded smoothly and impurities were found in the filter as expected, but it was large enough that its exchange could be avoided during the cleaning process.

**Cool down**

The cool-down of the line by AT-ACR finally started on September 13th 2005 during the evening – again for safety reasons - and the first plateau at 80 K was reached about 10 hours later. The completion of the cool-down to the quasi-nominal temperature conditions was performed on September 14th in the evening.

![Temperatures in the 600-m QRL sub-sector](image)

Following these tests, the thermo-mechanical integrity of the line is now validated. During the coming weeks, the next step will be the validation of the thermal performance of these sub-sectors.
The successful cool-down of this first section of the QRL despite the extremely tight schedule and unexpected difficulties, could only be achieved thanks to the excellent collaboration between all involved parties, CERN groups and departments as well as the contributing contractors.

**Congratulations !!!**

Despite all hurdles a very important milestone has been met with the first cool down of a part of the QRL in the LHC tunnel. Lyn Evans would like to extend his congratulations to all those who have made this possible through their hard work and dedication, and in particular to the personnel of the Main Workshop.