Update on the situation of the QRL

Following the new technical difficulties with the cryogenic distribution line (QRL) installation that were unveiled at the end of June a number of actions have been taken over the summer by the LHC Project management.

Support tables

Late in June, cracked support tables were discovered during disassembly of the pipe bundle of a module that had developed a vacuum leak due to bad welds. Endoscopic investigation of other modules then revealed many other broken tables.

Later it was confirmed that many support tables supplied were breaking even under low stress and it was soon discovered that an improper material had been used making the tables very brittle and subject to breaking under shock.

The correct material will now be procured and used for the new tables. All tables produced so far will be scrapped.
Figure 2: Support table broken at the level of the cryogenic pipe support inside the QRL. Below the table is the so-called F-line where many weld defects were found.

Figure 3: Detail of the fracture of a sliding table, as observed by endoscopy.
The action line follows three axes ranked by order of priority:

1. restart the production of QRL modules with new support tables at Air Liquide plants,
2. restart the installation of the QRL, starting with sector 8-1,
3. repair the already produced QRL modules equipped with bad support tables.

Restart of Production

Production of the new tables will restart as soon as possible following a Production Readiness Review that has taken place on 15th September. In the meantime more tests are ongoing on the new design for final assessment. Although the tables will now be stronger, they should not be subjected to undue stress and shocks and QRL elements must be handled with care; transport procedures and tooling will be improved.

Restart of installation

Methods and procedures for improving the installation are under review and an Installation Readiness Review will take place before the actual installation can resume. The target date for installation restart is early in November.

The time delay between production restart and installation restart will not only be used to build up a stock of the new tables and QRL elements but also to train the personnel and improve the methods and Quality Assurance.

CERN will now provide additional help before and during installation, in particular the survey group will mark the position of QRL elements in the tunnel according to the CERN survey reference frame for a faster and more accurate positioning.

Repair of QRL elements

The third line of action is the repair of the QRL elements, simple pipe elements and service modules, equipped with bad support tables. In agreement with Air Liquide these elements will be repaired at CERN and by CERN.

The repair of simple pipe elements requires rather simple tooling but the bottleneck here is the production of the new tables, the assembly with F-line pipes and subsequent delivery by Air Liquide.

Simple pipe elements which are still on the surface will be repaired in building 904 where preparations have started and tooling and techniques are under test.
The more complex **service modules** will be repaired by experts from the main workshop in building 110.

Air Liquide will assume the full responsibility of the repairs and will do the dismounting of installed elements and of course the re-installation of repaired elements.

CERN is also looking at the best possible way to use existing resources, and eventually divert resources from other tasks for a limited time, in order to minimize the overall impact on the project. A crash program for the repairs is envisaged that would cut the projected time to repair simple pipe elements from several months to a few weeks.

**Impact on Logistics : Storage and Transport**

The repair of QRL elements requires the handling and transport of many delicate pieces of equipment on top of the scheduled activities. A major effort which requires careful coordination and optimisation of the use of resources.

Also the delay in QRL installation has a major impact on the storage of magnets at CERN: Point 19 storage area, along the route de l’Europe, will be complete by the end of September. Another storage area will be installed in Prévessin in the North area. The total storage capacity will then be over 800 cryomagnets, about two thirds of the total required for the LHC.

**Impact on Planning**

Clearly this situation will have an impact on the installation and overall planning of the project. Unfortunately we do not have enough information at this time to come up with a new overall schedule.

We need to assess the actual installation rate of the QRL in sector 8-1 before the installation planning can be revised. This will be evaluated in November after the installation has restarted and an overall schedule for LHC could then be updated by December.

**The LHC project is committed to make every effort required to provide colliding beams in the LHC in the summer of 2007.**

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