Minutes of the meeting ACR-RF-SC on cryo and safety issues for the ACS system

12/03/2004

Present:

- ACR: L. Tavian, L. Serio, R. Van Weelderen
- SC: R. Trant, G. Lindell
- RF: T. Linnecar, V. Rodel, E. Ciapala, J. Tuckmantel, R. Losito

Agenda:

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1) Issues concerned with safety of personnel and material.

a) Helium release directly into the tunnel or UX45 or via a special recovery line to QUI, in the event of a serious cavity problem.
b) Risk of emptying of complete sector through the ACS.
c) Protection of the cavities against pressure rise in the QRL line D, use of a special automatic safety valve?

As a general rule, R. Trant would prefer not to discharge huge quantities of Helium in the tunnel. If possible, it would be better to discharge in UX45 since there is a much bigger volume. Taking the discharged helium to the surface is not a reasonable option. At the moment an oxygen detector in the zone has not been foreseen to trigger an evacuation alarm, and it will be added.

(Action: G. Lindell)

The risk of emptying a complete sector through a cavity exists, and ACR will calculate the flow that could be generated by a return from QRL line "D" in the worst case (Line D at 20 bars, output valve blocked OPEN), and whether this flow can be limited by a diaphragm, being compatible with the required flow necessary for operation and conditioning. Protection against overpressure in Line D is provided by a valve, pneumatically operated by the process control. The same principal is used for other low pressure systems e.g. DFB. A valve driven by a direct hydraulic connection to line "D" that automatically shuts in case of overpressure, might be studied in the future by ACR. In this case the design would also take into consideration requirements for the cavities.

(Action: A. Perin, R. van Weelderen)

The following scheme to protect both the cavities and the personnel accessing the tunnel:

1) In case of break of insulation vacuum with QRL line "D" under normal conditions the whole flow (~7 kg/s) should be evacuated through the output valve to Line "D". A fast opening mode of the valve, triggered at 1.6 bar in the He tank, is provided. ACR should check if the lines to line D and the output valve are dimensioned to do that safely.

(Action: R. Losito, L. Serio)

2) If line D goes up in pressure, a safety valve connected to the vent line will open at 2 bar. A study to dimension a new line and to integrate it in UX45 has to be launched.

(Action: R. Losito, L. Serio, V. Rodel)

3) Another safety valve or rupture disk discharging in UX45 must open at 2.5 bars and be dimensioned to the **worst case, namely 20 bars in line D and cold**. A study to dimension precisely this component has to be launched.

(Action: R. Losito, L. Serio, A. Perin)

4) The cost of the connection to the Warm Recovery Line, already studied and integrated, should be determined. This line will certainly ease the operation of the cavities, by reducing the risk that the safety valve has to open , particularly during initial operation and magnet commissioning. It may have to be added to the cost-to-completion.

(Action: R. Losito, L. Serio)

5) The design of He circuits of the SC modules will be checked again by ACR to identify possible risks to safety valve connections in the event of icing.

(Action: R. Losito, L. Serio)

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2. Operational and commissioning issues.

a) Replacement of on/off valves for controllable valves

b) Regulation of cavity pressure

- specification?

a) ACS dependence on magnet system cooling down and heating up.

b) Possibility of a separate cryogenic system

c) Other means to separate the magnet & RF systems

It has already been decided to change the output valve from ON/OFF to regulation valve. This can be done by ACR during the LSS installation, after cold test of the QRL

(Action: L. Serio)

It is confirmed that the cavities have been tuned to work nominally at **1350 mbar**. Some deviation from this value can be tolerated with the following constraints:

- The RF system will have an interlock that stops the cavities and consequently *dumps the beam* if the pressure in the cavity goes over **1400 mbar**.

- Slow variations (time scale of seconds) can be recovered by the cavity tuner. However the tuner performs an elastic deformation of the cavity walls so it is not advisable to do it extensively over the lifetime of the LHC. Therefore a limit of **±15 mbar** has been given, to limit the stress induced to the mechanical structure.

- The present He pressure fluctuations in SM18 are in line with these specifications. However, it is proposed to crosscheck whether the valve in SM18 is similar to the one in the tunnel, and whether there are peaks of pressure during magnet quench. Historical data will be analyzed and eventually a test will be done in the future.

(Action: L. Serio)

A separate cryogenic plant is at present envisaged in case of a consolidation for the ultimate beam. A clarification is needed for the losses from RF for the ultimate beam.

(Action: L. Serio, L. Tavian, J. Tuckmantel)

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3. Controls and instrumentation:

a) Importance of the SM18 tests in qualifying all instrumentation.

- AB/RF is building a complete control system for the cavities in SM18. AT/ACR is informed through Antonio Suraci who is looking into the RF needs. AB/RF has already developed a solution for all the equipment (level gauges, pressure gauges etc…) and will install it in SM18 however AT/ACR is invited to make tests of the instrumentation they will use for regulation in the tunnel. If necessary they can be allocated some time to test the process regulation. **Luigi Serio** should be always informed of what is going on from both sides.

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4. The latest planning:

a) When can we connect?

b) How do we fit in the RF tests?

- The answers to these questions will be given by the hardware commissioning working group. The cavities have to be connected to the QRL before the cooldown of the magnets, and can be cooled in the shadow of the magnet cooldown. Commissioning can start immediately after, the regulating valve should be able to recover the pressure fluctuations on line D. Experience in preceding sectors will tell if the pressure is stable enough to allow RF operation during magnet testing. However pressure stability may only really be guaranteed during the dedicated test time allocated to RF by the hardware commissioning WG. After the end of the official tests, the sectors will not be cooled anymore and AB/RF will not be able to keep the cavities cold, unless a specific request is made by RF and resources can be found by AT/ACR