LHC RF Meeting

28th January 2009

Participants: Oliver Brunner, Pierre Maesen, Vittorio Rossi, Joachim Tuckmantel, Trevor Linnecar, Edmond Ciapala, Andy Butterworth, Philippe Baudrenghien, Thomas Bohl, Wolfgang Weingarten, Daniel Valuch, Frode Weierud, John Molendijk, Elena Shaposhnikova, Eric Montesinos

1. LHC status and planning

- **Sector 4-5:** Flushing and electrical quality assurance (ELQA) in week 16, cooldown weeks 17 and 18, powering tests weeks 25 and 26. We could do RF tests before the powering test, unless there is activity in UX45.
- **Sector 3-4:** Flushing and ELQA 25, cooldown mid-August.
- **RUX45:** The roof will go back on in the second week of April. The cavities must be empty for this installation.
- **Vacuum investigation in straight section:** 2 vacuum sub-sectors in the straight section next to sector 3-4 have been opened and found no contamination, so there is no need to open the vacuum system any closer to the IP.
    - There is a question over the correct functioning of the synchrotron light wiggler on the 3-4 side. This could mean a vacuum intervention close to cavities.
- **Access:** No access to UX45 during powering tests in either sector. A working group is reviewing this, to be discussed at Chamonix.
- **Planning:** Short circuits to be installed in February, power tests in March, to be ready in April for RF tests of cavities. UX45 water was already switched on in December.
- **Tuner repairs:** Work will be finished end of next week.

2. ADT

- Some problems with tube sockets overheating. However, this could be a Pt100 acquisition problem, and checks are being done with a thermal camera. We will wait until the zone is closed before powering the kickers.

3. Commissioning note

- All contributions have now been received. Trevor will now start to collate and edit them.

4. ACN study

- How much will it cost and how long will it take from launch to installation? We should make people aware that there is something like a 3-year lead time.
- The parameter list should be based on the latest measurements in the PS.
- The ACN cavities are not only for capture, but also for damping. In 2 years we will know how much damping we can get from the ACS cavities.
- CAN represents significant work for developing the LLRF: The system will also need to be redesigned for 200MHz, and also in 5 to 10 years it will be difficult to re-use what was developed for ACS, due to component obsolescence. It will probably be possible to re-use more of the LINAC4 work.
- Do the ACN cavities fit with the QRL now slightly bigger? Yes, apparently with a few mm to spare.
- Capture cavities: The emittance coming from SPS is defined by the blowup of 0.4 to 0.6eVs performed in SPS to avoid instability on flat top, although it is possible to stabilise the beam at 0.4eVs with the 800MHz system up to an intensity of 1.0×10^{11}. It is worth putting effort in to investigate the source of this instability before making decisions about ACN.
- If the beam is unstable in LHC we don't have feedback to cover all frequencies. The solution in the SPS is Landau cavities; should we consider this for LHC (800MHz)?
- Can ACN coexist with crab cavities? Issues are the connection to the cryo line and the positioning of the ACN power stations.

5. **ADT LL**
   - The last batch of cards has been received, with a final version of everything. There are no components left, apart from 10% spares, so decisions are needed for new developments, even for new uses of existing modules. The FPGA dates from 2005 so there are no obsolescence issues yet.

6. **LLRF**
   - The mixers which are extensively used in the LHC low-level RF will go into obsolescence in April this year. New developments (ACN etc.) will therefore not be able to use these mixers, and will require a new PCB design. However for the 400MHz LHC system we have spare modules, and we will order enough components.

7. **ACS couplers**
   - Received 2 more ceramics for couplers (2 years of delay due to problems with metallization etc.).
   - Tests will be made on rough magnetisation of the antenna (with F. Caspers).

8. **SM18**
   - The 18kW cryoplant will be connected in week 7. They can start start cooling half to one week later.
   - Spare module: No progress, waiting for helium. The module will have to be opened at some point for tuner modification.

9. **AOB**
   - Phase 1 upgrade optics: We have been asked by Stephane Fartoukh for the RF requirements on these optics for IP4 LSS (Wolfgang/Thomas).

10. **Discussion on spare cavities:**
    - We have 1 spare module, should we have 2 spare modules in case of a major accident?
    - Cavity 21 can be used as spare, so the proposition would be to build 3 more, and to hold 4 spare cavities with helium tanks.
    - The cost is estimated at 300kCHF for 3 spare cavities if made in industry. Time to manufacture is about 2 years.
    - The time required to rinse and re-commission a polluted module is estimated in Table 1 below.
    - The time required for coating 4 cavities is 13 weeks including equipment setup, or 6 if the equipment is already available.
    - The experience in LEP was that no cavity from the machine was ever thrown away. One vacuum sector was vented in Pt 8 and one cavity was polluted. It was rinsed, with a total down total time of 3 months. One cavity was destroyed in the test stand when a HOM coupler melted.
    - A full opening to atmosphere of the beam pipe next to a module will result in He vessel rupture and cavity collapse. An opening of half the beam pipe aperture will be survivable with the existing rupture discs. A He release incident could result in higher pressure than 1 bar, but the gas will normally be substantially colder than room temperature.
    - Accel may no longer be able to manufacture the cavities in 5 years time. All manufacture could be done at CERN except the welding.
    - Fast valves: Miguel is looking at the possibility of installing fast valves. However dust behind the shutters of these can cause pollution if they are too close to the cavities.
    - Running cavities at half gradient would be possible, but we could be limited in voltage for capture.

Table 1. Repair steps to be taken in case of irrecoverable pollution of a module:

Action	**Time (weeks)**	
Take out	0.5	
Radiation cooldown	?	
Disassemble	2	
Rinse one individual cavity, drying and pumping	0.5	
Assemble in vertical cryostat	0.5	
Test in vertical cryostat	1	
Repeat last 3 steps for 3 other cavities (with some overlap)	3	
Assemble into cryomodule (clean room)	6	Assuming HOM and power coupler spares available
Pumping and leak test	1	
Installation in bunker, vacuum, cooldown, RF low power measurements	2	
High power tests in SM18	5	
Warmup	2	
Transport + installation in Pt 4	2	

Total time required: 24.5 weeks

A. Butterworth, 2nd February 2009