Minutes of the 13th PAF working group meeting

5th December 2005

******* FINAL VERSION *******

Participants:

M. Benedikt, L. Camilleri, R. Garoby, W. Kalbreier, M. Mangano, K.H. Mess, R. Ostojic, G. Rolandi, F. Ruggiero, E. Shaposhnikova, T. Zickler.

1) Approval of the last minutes:

The minutes of the last meeting were approved.

2a) Update on status of normal conducting magnets in the injectors (K.H. Mess)

- K.H. Mess gave an update to the presentation on normal conducting magnets that he had shown during PAF meeting #4. The new information concerns mainly the PS main magnet renovation.

- The PS main magnet renovation project is advancing well and in total 25 magnets will have been renovated before the restart of the complex in 2006. After the initial delay due to problems with main-coil (10 months) and pole-face-windings (4 months) fabrication, the expected renovation rate was around 1,5 per week, but could be increased to 2 units per week. With the 25 most critical units being renovated, the risk of severe magnet failures on the PS in 2006 is estimated quite low.

- A long-term solution to the problem of the displacement of laminations due to deteriorated glue between the central blocks 5 and 6 has been found. Replacing the cross-over piece of the "figure-of-eight" loop by a differently shaped piece will allow the insertion of a wedge to hold the laminations in place mechanically. This is considered a long-term solution (>20 years), but still needs a detailed engineering design study and prototype testing before it can be applied.

- Phase 1 of the renovation project is approved and financed and will include renewal of in total 50 units and is expected to last until 2010. Phase 2 (~6MCHF) will include the remaining 50 units, is not yet approved and is expected to take until 2015.

- The lifetime of fully renovated PS magnets (new main coils, new PFW, wedge between blocks 5-6 to keep laminations in place) will be determined by the lifetime of the new coils. Assuming similar radiation levels as in the past, a typical lifetime of ~20 years seems realistic.

- For the SPS main bending magnets the situation has not changed since August 2005.

- During the 2004 run, corrosion leaks (from inside) on the water distribution manifold on seven units had appeared. The main problem is that there is no method to detect this fault in advance. Consequently no selective preventive maintenance is possible and the magnitude of the problem can also not be estimated. Since the statistics is very poor to date only future experience from the 2006 run may give indications on the size of the problem.

- There are ~ 10 spare SPS magnets available. To replace a faulty magnet with a spare takes around 1 full day (no beam in SPS).

- Removal, repair and re-installation of a unit takes around 2 ½ days (when planned). Preventive repair of all 774 units would therefore take around 8 years (if done sequentially, one unit at a time).

- The degradation of the SPS main bending magnets is clearly a major concern, especially as the risk cannot be estimated at present.

- The present situation concerning manpower redeployment and contract renewal is also a major concern to the group since the manpower available for (warm) magnet maintenance will drastically reduce from 15 staff in 2005 to only 5 in 2008 and 3 in 2010, if the current 7 LD staff is not promoted to FT and the 4 retiring persons are not replaced.

2b) Discussion

- In the following discussion it was underlined that, with the long-term solution for fixing the PS magnet laminations, the situation regarding the PS has changed fundamentally since summer 2005. As far as the main magnets are concerned the PS lifetime is expected to be some 20 years (assuming similar radiation levels as in the past). The only (small) concern is the long duration of the renovation project (2015).

- Concerning the SPS main magnets the situation is more worrying, especially since there is no risk estimate at all. More frequent stops of the SPS would very quickly lead to a serious degradation of LHC integrated luminosity (cf. e.g. beam availability for North Area in 2003 after corrosion problems!)

- The committee expressed its concern since up to now no detailed analysis has been made on how to cope with different problem scenarios. It was strongly recommended to look into possible strategies for various failure scenarios. In his reply, K. Mess pointed out that presently all manpower (not only magnet expert but also e.g. transport) is focused on LHC activities. Only from 2007/2008 people will be available again for larger activities (beyond replacement of single magnets) concerning SPS main bending magnets.

- Commenting on possible strategies, KH. Mess indicated that around five bending magnets could be renovated in parallel during shut-downs, after a planning and preparation phase (always assuming sufficient magnet and transport personnel available). This still results in an integrated time of 1,5 years to repair all magnets.

- Analysing the present SPS operation conditions, KH. Mess pointed out that the higher water temperature due to the closed cooling circuit is speeding up corrosion. Therefore operating at lower temperature (i.e. lower rms power) could help. Specifically for fixed target physics, longer flat-tops should be avoided and operating at lower extraction energy would be beneficial.

- KH. Mess also strongly commented on the PS+ option (superconducting PS replacement from ~2 to ~60 GeV) which is one of the potential future upgrades considered by PAF. On the technological side he considers the feasibility of fast-cycling, superconducting magnets for the required large operation range (field quality over range, cooling requirements, quench protection) not at all obvious, even after a long R&D phase. On the operation side, the fast cycling combined with the non-linear field components (which are also temperature dependend) and random behaviour, especially at injection, could make operation extremely difficult. In addition, the use of a superconducting machine in a high-loss environment (comparing to the present PS) seems contraindicated.

3a) Accelerator requirements for the beta-beam (M. Benedikt)

- M. Benedikt summarised the accelerator requirements of the Beta-Beam that is presently studied within the EURISOL Design Study. The Beta-beam neutrino facility is based on the acceleration of beta-decaying ions to high energies (typically SPS top energy). The neutrino source is a high energy storage ring with long straight sections. The neutrinos stemming from ions that decay along the straight section, aiming towards the far detector, form the useful beam. ^{6}He ions are needed for the anti-neutrino beam, ^{18}Ne ions for the neutrino beam. The ion production part has very strong synergies with an ISOL type nuclear physics facility which was the reason for joining the EURISOL design study.

- The proton driver for production of the ions has to provide a beam in the 1 to few GeV energy range with a power of a few 100 kW. A dc beam is preferred for target construction and lifetime issues. Following production, the ion beam will be ionized, prebunched (ECR source) and cleaned before further acceleration.

- The first acceleration stage foreseen is a linac that should accelerate the ions to ~100 MeV/u. This machine will operate at 10 Hz which is the extraction frequency of the ECR source. Following the linac, the ions will be accelerated to the desired end energy (γ=100 for both types) via a chain of circular machines comprising the PS and SPS.

- A 10 Hz RCS will accelerate (on h=1) from 100 MeV/u to 11Tm equivalent (2.5 GeV protons). This (new) machine will provide 20 bunches on consecutive cycles for accumulation in the PS.

- The PS accumulates 20 bunches from the RCS (over 1.9s) and accelerates the beam to top energy. Due to the long accumulation time at low energy and the relatively short lifetime of the ions, the PS will suffer from important beam losses. The power deposition due to decay losses during a year of operation is comparable to a year of

nominal CNGS operation. However the loss mechanisms and also the loss distributions are totally different for the two cases. As a consequence of the ion decay losses, the vacuum quality degrades seriously during accumulation in the PS.
New alternative machine designs (PS replacements) optimized for efficient collimation (cf. SIS 100 lattice) are being studied in collaboration with GSI within EURISOL.

- The SPS receives 20 bunches from the PS, accelerates to the desired energy and transfers the beam towards the decay ring. The power deposition due to decay in the SPS over a year of operation is also comparable to the CNGS case, however in absolute terms it is much lower (per unit machine length) than for the PS.

- The decay ring (with SPS circumference) is a pure storage ring without acceleration. Accumulation over typically 20 injector cycles is achieved by longitudinal merging of already circulating and freshly injected bunches. The lattice features specifically designed insertions for off-momentum injection and also for momentum collimation. In total there will be 20 bunches (total bunch length ≤ 10 ns) with an overall intensity of $\leq 10^{14}$ ions circulating in the decay ring.

3b) Discussion

- Answering a question of Elena on the merging process in the decay ring, Michael clarifies that a phase stability of a few degrees between the 40 and 80 MHz systems is assumed for the actual simulations.

- Asked about the "ideal" new PS for the Beta-beam, Michael replies that for the present baseline scenario, this would be a 10 Hz RCS. With such a machine accumulation would take place at flat bottom in the SPS where the ions have a significantly longer lifetime than in the PS. This way the overall intensity would increase.

- There is clearly a need to review the complete consolidation programme for the accelerators, to have a better understanding of the full picture. This was indeed planned, but made impossible in 2005 because of the tighter deadlines imposed by the Direction. It has to be dealt with immediately after the meeting of the preparatory group, in February 2006.

4) Miscellaneous

- The meeting with R. Aymar has been fixed for 19th December, 08:00 to 10:00.

- The next PAF meetings are scheduled for:

- Monday 12 Dec.16h00: Discussion & Preparation of report.
- Thursday 15 Dec. 16h00: Finalization of report and message to R. Aymar

Minutes by M. Benedikt, 09.12.2005