Dear Readers,

We have the habit of celebrating achievements and mark these milestone events, not only for the accomplishment itself, but also to demonstrate and strengthen our inclusion and involvement in a community. OK, I will not put the Higgs discovery and the 10th issue of the BE Newsletter at the same level of importance, but even the latter is worth highlighting.

Born as an idea coming out of the first BE-staff-meets-management-workshop in 2010, this newsletter is now firmly part of the communication landscape and has created an enthusiastic community of authors, correspondents and readers in our department. The proof is visible by the quality of the contributions and the feedback that I receive, even from retired staff!

A major milestone these days is the “start-of-the-end” of LS1 with the successful commissioning and switch-on of the proton source. The injector chain will come gradually on-line over the coming months. It is worthwhile passing by the CCC and admiring the brand new visit point at its entrance.

Our sportive cyclists will be happy to use the two additional dedicated gates to the Prévessin site, which have been recently re-opened. Please be careful on the road, each accident is one too many!

Happy Easter...
but go easy on the chocolate!

Ronny Billen
Editor, BE Newsletter
Laser-based Transverse Emittance Measurement for LINAC4

The commissioning of LINAC4 is advancing, and as the beam energy increases, so the measurement of the transverse emittance (a quantity defining the size and divergence of the beam) becomes trickier. At the current beam energy of 3 MeV the conventional slit & grid system does a very good job but at the top energy of 160 MeV the slit would need to be as thick as 20 cm to stop the particles. A novel type of instrument is needed!

For over one year we have been developing what we call the “Laser Emittance Meter”. The principle is based on the photo-detachment of the extra electron from the H⁻ ions as shown in Figure 1.

The main advantages of the instrument are:

- Works over a wide energy range (up to 2 GeV)
- No space charge perturbations
- Non-destructive.

In collaboration with the Royal Holloway University of London (RHUL) and the Front End Test Stand group (FETS) a prototype of such a laser emittance meter has been developed. Since October 2013 it has been tested at the 3 MeV section of the LINAC4. Figure 2 shows the installation inside the LINAC4 tunnel.

To detect the small amount of neutralized particles we use a diamond detector since it offers good time resolution, in the order of 10 ns, and high sensitivity at the same time.

Regarding the laser we opted for a fiber laser with relatively low peak power. Because of this we can use a flexible optical fiber to transport the light from the laser to the accelerator, avoiding the need of a complex optical line.

The results obtained with the prototype laser emittance meter have been compared with those of the slit & grid system. A comparison of the vertical beam profile as well as the emittance acquired with the two different systems can be seen in Figures 4 & 5.
In summary, the results of this first prototype of the laser emittance meter are very encouraging and the development can now focus on the design of the final laser emittance station at 160 MeV.

![Figure 4: Comparison of vertical profile measurements. The graph shows very good agreement of the beam-core measurements. The beam halo values are slightly bigger when measured with the laser system.](image)

![Figure 5: Emittance results comparison. The lower graph shows a measurement of the vertical beam emittance of the LINAC4 3 MeV beam measured with the slit & grid system. The upper graph shows a measurement of the same beam with the laser emittance meter. In spite of the lower spatial resolution of the laser-data the ellipse size and orientation is in good agreement.](image)

New SPS energy saving scheme

The SPS accelerator complex has received major upgrades during LS1. Among them are new powering controls, which offer the possibility to significantly improve SPS energy efficiency. Along with a cleaner conscience comes also the monetary advantage in the range of several 100 k€ per year. This only became possible by implementing a new power converter control interface based on the software framework FGCD (Function Generator/ Controller Daemon).

After years of preparation the TE-EPC group launched a big endeavor during LS1, to replace in SPS the obsolete software framework ROCS by FGCD. On the hardware side the old PowerPC architecture with LynxOS was replaced by new x86 systems with Linux. All this was done in order to renovate and synchronize technologies in CERNs accelerator complexes.

FGCD uses the Mugef power converter controls very differently compared to ROCS and increases their operational flexibility. Thanks to that it was possible to design and implement more dynamic powering schemes in the SPS along with many other improvements. The main idea behind the energy saving scheme is simple: **Do not power the magnets if there is no beam!** As simple as it may sound, it is still a complex task.

So far the programmed SPS beam cycles were usually powered in full as soon as the SPS was ready to accept beam. Saving energy could involve manual interactions, namely switching power converters into standby mode when possible. This was, of course, only possible for long periods without beam. There also existed a dynamic economy mode. But it worked only on fixed target cycles, since the intensity detection was too slow to use it on fast cycling beams. Furthermore it only managed to shorten the time on the high beam energy plateau.

The newly installed FGCD software framework allows a more dynamically adapted powering of SPS magnets in the accelerator ring as well as the transfer lines. There are now three basic modes of energy saving available, **full economy, dynamic economy** and **transfer line economy**. All ECO modes can be overruled for testing purposes and the setting up of the machine as well as the transfer lines.
The full ECONOMY (see Fig.1) is triggered by external conditions, which is either the inhibition of SPS or a signal from the French energy supplier EDF. The timing system announces full ECO mode in the telegram. When triggered, the power converter controls wait until the end of the currently played cycle. With the beginning of the next cycle they stay at a power output for a beam energy equivalent of 13.5 GeV, while the transfer lines stay at their minimal current. As soon as the external conditions causing full ECO mode are revoked, the system goes back to normal cycling in the following beam cycle.

During normal cycling, energy can be saved as well by pulsing transfer lines depending on the beam destination. This means only transfer lines which are needed for the current beam extraction, according to their programmed destination, are pulsed during the cycle.

The energy savings result also in substantial monetary savings. One fixed target beam costs about 8€ and LHC beams between 2€ and 4€ per acceleration cycle execution in SPS alone. With the new dynamic ECO mode applied on the run statistics of the 2012, one could save more than 300k€ per year. The destination dependent transfer line economy could save in this case approximately another 33k€. The full ECO mode will likely save a good amount as well - experience shows that shorter injector inhibitions due to technical reasons do happen once in a while. Furthermore avoiding pulsing of equipment throughout the machine reduces its wear and thus prolongs its lifetime.

It is clear by now, that operational costs in form of power consumption cannot be ignored anymore. Today no new accelerator can be built without taking this into account. Existing infrastructure needs to be checked as well for possible improvements in energy efficiency. The operations group started early 2013 with dedicated efforts in this direction. The SPS energy savings is only the first fruit of this ongoing process which has come to light. Other improvements are possible and the goal is to generalize the concepts described above for all cycles and in all zones. The upgrade of the North Area power converter control system is intended for LS2.

A similar renovation project is also foreseen for the TT2 transfer line in PS during LS2. For the East area the idea emerged of replacing DC powered un-laminated magnets by ones that can be pulsed. But so far this renovation project seems only realizable for LS3.

Detailed information on the "SPS LS1 Controls Upgrade" can be found in the functional specification, EDMS no. 1335590.
Beams of protons (up to 250 MeV) and heavier ions, such as carbon ions (up to 430 MeV/u), are used to treat deep-seated solid tumors. This technique is called hadron therapy. Compared to conventional radiotherapy with photon beams, hadrons allow better sparing of healthy tissues surrounding the tumor (see Fig.1) and increased cell killing in the tumor volume.

**Figure 1: Comparison of dose conformality between proton and X-ray beams**

Europe is at the forefront of clinical research in hadron therapy with its proton therapy facilities and synchrotron-based clinical research centers for treatments with both protons and carbon ions in Heidelberg (www.klinikum.uni-heidelberg.de), Pavia (www.cnao.it) and soon, Wiener Neustadt (www.medaustron.at). In parallel, many research groups investigate remaining open questions: How to relate physical dose to biological effect? How to verify that the dose was delivered correctly? And, which is the optimal ion species for a given therapeutic indication?

In support of these and other biomedical research interests, a new ion-beam research facility at CERN based on the Low Energy Ion Ring (LEIR) was proposed (Dosanjh M, Jones B, Myers S. Br J Radiol 2013;86:20120660).

**Why LEIR?**
LEIR is an 80 m circumference ring used as heavy ion accumulator to provide high brightness Pb-ion beams to the PS for LHC experiments. The reasons why LEIR was chosen to provide beams of light ions (from proton to Neon) for biomedical research are threefold. Firstly, its energy range matches that of clinical synchrotrons (maximum beam rigidity of 6.7 Tm). Secondly, LEIR has to be maintained for its LHC use, but beam-time remains available for other applications. Lastly, the adjacent PS South Hall (in building 150), mainly used as storage space at present, could easily accommodate a new large (up to 1500 m²) experimental area for biomedical research.

**What needs to be done?**
First of all, a new slow extraction scheme for LEIR was designed to provide long spills of 1-10 s towards the South Hall, as shown in Fig.2. This requires the installation of an electrostatic septum and two magnetic septa, in straight section 30.

**Figure 2: Sketch of LEIR and the adjacent South Hall area (building 150)**

In addition, a first design for two experimental beamlines has been proposed: a low energy vertical beamline (max 2.6 Tm) and a high energy horizontal beamline. Both can provide pencil beams of 5-10 mm FWHM and broad beams (5x5 cm²) for biomedical research.

Finally, LEIR’s front-end needs to be adapted to be able to provide light ions from Hydrogen to Neon. For this, installation of a new dedicated ECR ion source and RFQ are being studied, so that light ions can be injected into the present LINAC3 through a switchyard.

**ICTR-PHE2014 Conference**
A status update on these studies was recently presented to an international audience of physicists, biologists and medical doctors at the ICTR-PHE conference held in Geneva (www.ictr-phe2014.com). Strong interest from the research community is pushing forward the project, and all prerequisites are gathered to soon enable CERN to strengthen its ties to the biomedical research community.
Utilisation de protection d’élingues
Alerte en février 2014.

Suite à un accident récent dont les conséquences auraient pu être très graves, l’unité HSE rappelle les dispositions suivantes en matière de levage :


- les protections d’élingues ayant la forme de 3/4 de rond (photo 2) ne doivent en aucun cas être utilisées en partie haute (risque d’éjection).

- pour la protection supérieure de l’élingue, des bandes de caoutchouc d’une épaisseur suffisante (pour la résistance à la pression de l’élingue) devront être utilisées (photo 3).

BE-Safety Unit

Latest Safety Alerts

Use of lifting sling protectors
Alert sent in February 2014.

Following a recent accident which could have had serious consequences, HSE unit recalls the following safety recommendations while using lifting slings:

- three-quarter-closed round lifting-sling protectors must be used only at the bottom of loads (sling angle of 90). See picture 1.

- Three-quarter-closed round lifting-sling protectors (see picture 2) must never be used at the top of loads (risk of ejection).

- For the protection of the upper part of the sling, rubber belts of a sufficient thickness (to resist the pressure of the sling) must be used (see picture 3).

BE-Safety Unit

Send a message
**Du nouveau au complexe PS**

**Quoi de neuf ?**


**Pourquoi ?**

Cette nouvelle installation est conforme aux normes de sûreté nucléaire car elle assure la protection du personnel contre les radiations. Elle apporte un niveau de sécurité plus élevé, notamment grâce à l’authentification biométrique et l’unicité de passage.

**Qu’est ce qui va changer en pratique?**

Il faudra présenter votre dosimètre pour accéder au complexe PS.

De nouveaux cours de sécurité obligatoires vont être mis en ligne prochainement sur sir.cern.ch. Ces formations sécurité seront toujours contrôlées.

Les nouveautés sont le contrôle biométrique qui sera effectué avec l’identification de votre iris et l’utilisation de l’outil IMPACT.

**Quelques conseils.**

- Faites-vous d’ores et déjà enregistrer au service biométrie du bâtiment 55.
- N’oubliez pas de vérifier que l’accès demandé dans EDH correspond bien à la zone où vous devez travailler. Vous pouvez voir toutes les zones sur ADAMS.
- Consultez le document « Obligatory personnel protection at CERN » (EDMS 1223620) pour vérifier si vous avez tous les Equipements de Protection Individuels (EPI).

**Plus d’informations :**

**PS - Protection surélevée**

**Something new in the PS complex**

**What's new?**

19 access points in the PS complex are now fully equipped with the new access system. Physical barriers set up for the access system are commonly called EIS-Access (Element Important for Safety / EIS-a).

**Why such a system?**

This new system is in compliance with nuclear safety standards because it ensures the protection of personnel against radiation. It provides a higher level of security, including biometric authentication and the monitoring of who goes in each zone (single passage).

**What are the main changes?**

You will need your dosimeter to enter the PS complex.

New obligatory safety courses will soon be online on sir.cern.ch. These courses will still be checked by the access system.

The new features are biometric verification to be conducted with the identification of your iris and use the IMPACT tool.

**Some advice.**

- Already register yourself at the dosimetry service building 55.
- Check if the access requested in EDH corresponds to the zone where you have to work. Zones can be seen in ADAMS.
- See the document « Obligatory personnel protection at CERN » (EDMS 1223620) in order to check if you have all the Personal Protective Equipment (PPE).

**More info:**

- Enhanced personal protection system for the PS
- LS1 Report: As one door closes, another opens.

**BE-Safety Unit,**

**Envoi un message**
Restructuration of CO Group
@ 1.5.2014

The CO-DA Section will be split into two new Sections:
the Application (AP) Section, under the leadership of Katarina Sigerud
and
the Data services (DS) Section, under the leadership of Chris Roderick

See new BE organigramme!

Responsibility Changes
OP New Deputy Group Leader:
R. Steerenberg – OP-PS

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