Meeting Notes EnEfficient, DESY, May 21, 2014

Participants: M.Seidel (PSI), J.Stadlmann (GSI), R.Gehring (KIT), Th.Parker (ESS), P.Spiller (GSI), Ph.Eymard (SOLEIL), J.P.Jensen (DESY), J.Eckoldt (DESY), E.Leister (DESY), S.Claudet (CERN), Ch.Schneider (BTO-Consulting), V.Skarda (STFC, WP2), Ph.Gardlowski (GSI), C.Tenholt (GSI)

Discussion on Energy Management and Virtual Power Plant

J.Stadlmann made some introductory remarks on the theme. Availability and cost of electrical energy on the public grid vary strongly, especially in the presence of renewable energy suppliers. Thus new facilities with varying consumption should evaluate how a dynamic management of their energy consumption could be achieved. [slides on Indico!] When subsystems are switched off to reduce consumption temporarily, the impact on the user operation should be minimized. A large spectrum of accelerator based facilities exists. While for a huge particle physics collider like CLIC it may be acceptable to run only at times with excess energy available, this scheme is less acceptable for a light source with lower consumption but with hundreds of short-time users. The frequent standby operation of subsystems could cause problems for the technical reliability.

J.P.Jensen reported that DESY was approached by the energy supplier, asking whether consumption could be adapted during tight situations on the grid.

In the extreme case the switch for standby operating conditions could be even given to the supplier company. However, many colleagues including Ch.Schneider of BTO expressed their opinion that this leads too far and presents risks for the facility.

The question was raised wether a cryogenic plant could be used as energy storage system. S.Claudet replies that several arguments speak against that (degraded performance factor at reduced capacity, duration of transients). Furthermore the startup process takes hours during which already the full electrical power is needed, but no cooling respectively He liquification is provided. This makes the scheme of switching back and forth between operation and standby rather inefficient.

Ch.Schneider commented on the virtual power plant scheme from his experience with industrial companies. The first step would be to analyse the spectrum of consumers in a facility. Each consumer has a certain power demand and could be switched off (or not) for specific durations. It may also be possible that a facility has different suppliers available, which must be analysed as well. Based on the collected data different schemes for management are then simulated and their benefits and consequences evaluated. This may include for example the expected energy cost savings for such a managed scheme, but also technical consequences in terms of reduced reliability or reduced output of a facility. Based on the assessment different scenarios can be accepted or rejected.

On the question of the econonomics of a small gas power station Ch.Schneider responded that a general assessment without analyzing the specific conditions of a facility is not possible. For example the option to use also the excess heat of such a power station is an important aspect. However, likely a small generator will not lower the energy cost of an accelerator facility.

Another question was raised on the volatility of the energy cost. With smaller availability of base power stations and increasing wind and photovoltaic supply one could expect volatility to go up. However, Ch.Schneider expects no further increase of volatility since the system gradually adapts to the new situation and with more volatile suppliers an averaging effect tales place.

Unused magnets are often running without beam and consume significant power. The same situation occurs with auxiliary systems such as ventilation and air conditioning. This is observed at different labs. Several colleagues commented that power savings in times without beam could be achieved best with better control systems.

A discussion on the operating schemes of different facilities took place. ESS expects to have their shutdown period in the summer, since facility has an interest to supply excess heat for the public heating system. In summer no heating is needed and thus no income will be generated for the supplied heat. S.Claudet comments that studies are ongoing for the energy intensive beam filling of LHC, to be performed during certain daytimes in order to achieve a peak shaving effect. In addition the supplier company could deliver a signal (as it was practiced during LEP operation in the 90's) to request reduction of the consumption. Different reductions are foreseen with varying reaction times. At DESY (and this is investigated at CERN as well) a regular test of a backup diesel generator is used to feed additional power into the system, again for a peak shaving purpos. This idea was appreciated by several participants. Th.Parker commented that possibly regulations exist that prohibit to use a backup generator for long term energy production. The DESY scheme amortizes within 4 years.

In order to approach the theme of energy management more systematically it was concluded that a survey will be performed on the different parameters at the various facilities. The survey will include the facilities at the participating institutes: DESY, PSI, GSI, FAIR (separately), ESS, SOLEIL, CERN and also others that participated in the previous survey on energy data, performed by ESS. M.Seidel will set up a survey sheet including the following aspects:

- Seasonal volatility of consumption
- Daily volatility
- Load curve, if available
- Base load of facility
- Energy consumed per year
- Which part of consumption could reduced in a flexible manner for ¼ hour and for 1 hour
- Assessment of economic benefit for switching subsystems off; which risks exist
- Examples of ongoing or past efforts

The list of aspects is probably not yet comprehensive and could be further extended.

Furthermore it will be useful to define figures of merit for the different types of accelerators (integrated luminosity, generated secondary particles/radiation).

Future Activities in WP3/EnEfficient

The Taskleaders summarize the plans for their themes in the future.

Heat recovery: In April 2014 the planned workshop on heat recovery was held in Lund with good participation and outcomes. There exists a series of workshops „Energy for sustainable Science", with two workshops held in 2011/Lund and 2013/CERN. Thomas Parker has discussed with Frederick Bordry (CERN) to hold the next workshop in this series (DESY, Oct 2015) also under the label of Eucard-2/EnEfficient. A proposal by Thomas is to evaluate at more depth the compromise between high efficiency and reliability that has to be made for technical subsystems. For example the option to operate klystrons at higher cooling temperature represents such a topic. Talks on such themes could be held as a specific session within the mentioned workshop at DESY. Another theme of general interest for EnEfficient is to obtain a better

definition of the figure of merit of efficiency for the most common types of accelerator research facilities, e.g. light sources, neutron sources and particle physics facilities.

Efficient RF generation: A first workshop is held very soon, June 3,4 in Daresbury.

Energy Storage Systems: R.Gehring (KIT) has replaced M.Sander. A workshop on storage systems is planned for 2015. SOLEIL (P.Eymard) is evaluating a storage system to bridge trips on the grid for their facility and has an interest in this workshop. CERN has replaced the flywheel system for the PS against a capacitor bank. The experience from this project could be reported. Heat storage systems could be of interest for many facilities. Another theme is bridging short trips on the grid, either on a large scale for an entire facility or on a smaller scale, for example bridging interruptions for electronic racks. Modulators for klystrons are storage systems as well and could be a theme. A general overview talk on storage systems (not necessarily specific for accelerators) would be welcome at this workshop. Eucard funding could be used to invite a speaker.

Virtual Power Plant: Jens Stadlmann plans to hold a mini workshop with focus on the FAIR project already in 2014. The main workshop for this task will take place in 2015 and it should include the results of the survey of the situation at different labs (mentioned above). SOLEIL (P.Eymard) is interested in the theme with regard to intelligent consumer management within the lab. GSI works together with BTO-Consulting to evaluate the best energy management solution for the FAIR project. The main purpose is to study and characterize the different classes of consumers in a large facility and to evaluate which of those could be operated flexible according to the dynamic situation on the grid. As a general talk at this workshop a presentation on electric mobility was proposed.

Efficient transport lines: P.Spiller introduced two GSI students who are working on the subject. C.Tenholt is studying technical solutions for the pulsed quadrupoles. Ph.Gardlowski will prepare a comparison of the different schemes that are available for efficient transport lines, e.g. pulsed magnets, s.c. magnets, permanent magnets. A workshop on this subject will be organized jointly by EnEfficient and CERN in October 2014. Another workshop can be anticipated for 2016.

General information for EnEfficient:

The second part of the common pot funding will remain at CERN. This will ensure that the funds can be transferred more easily to other particpants than PSI. A workshop can be supported for example in the range of 4-6k€. Fifty percent of the cost can be pre-financed and the other half will be reimbursed only after the workshop was held.

Information on the themes discussed at this meeting will be posted on the website of EnEfficient. M.Seidel prepares the notes. All particpants will be include in the mailing list.

Minutes by M.Seidel, completed May 28 incl. feedback from particpants.