EUROPEAN SPALLATION SOURCE

Notes from:
“Green Technolo
developed at Res
Infrastructure

Frithiof Andreas Jen

“Superconducting Links for the LHC machine”

A. Ballarino, CERN, Geneva

- Intelligent application of superconducting links improves plant Efficiency, Operation & Maintenance, and system reliability.
- Super-Conducting (SC) Links reduce losses,
  - High temperature SC links for electrical power transfer into cryostats can significantly reduce heat transfer and I^2R losses
  - Losses into the cryostat scales with the efficiency of the cryoplant. Conv. leads consume 450 W/kA cooling power vs SC’s 150 W/kA
  - The overall saving to CERN is 10% on the cryoplant consumption
- Relocating magnet power supplies to better locations,
  - SC-Cables can be Long, Thin - while carrying kA’s of current!
  - The cables are made from $MgB_{2,}$ a low(ish) cost material, superconducting below 25-30 K, He-gas cooling can be used.
  - Challenging installation, LHC P1 and P5 features a height difference of 80 meter.

"ORC process for reducing power consumption at the energy recovering electron cooler system for FAIR"

Kurt Aulenbacher, Helmholtz-Institut Mainz (HIM)

- Accelerators can be made to work in the reverse mode, collecting energy from the beam and reusing it.
- Recirculating LINAC's are the most effective design for energy recovery. Rings do not tolerate perturbations to the beam well, a straight LINAC use the beam Once by smashing it against targets.
  - MESA 2, will use RF-technology to draw energy away from the "spent" beam, convert it to electrical power and reuse it for acceleration. The gain in efficiency by energy recovery is such that the beam power match the electrical power!
  - COSY Electron Cooler uses electrostatic breaking of the beam by sending it back against the accelerating field. The Electron Cooler accelerates with a 2 MV Cascade Transformer. 2 MV is the design limit.
  - Voltages higher than 2 MV can be achieved by powering 500 KV C-T stages from turbine generators using SF6 as working fluid
  - Organic Rankine Cycle is perhaps possible with SF6

“Development of new power supplies for J-PARC MR upgrade”

Yoshi Kurimoto (KEK) for J-PARC accelerator group

- The upgrade to 1 Hz operation will cause large electrical power variations of 96 MVA @ 1 Hz. One possible solution is to store the required energy in capacitor banks, 100- 200 mF @ 2 kV per power supply is needed, a total of 10 MJ per magnet assembly!
  - Capacitors used for energy storage are designed as “pixels”, layers of capacitor plates interconnected with fusible links. These links limits the energy dumped in a breakdown. Capacitance is lost when links blow, at 5% loss the capacitor is considered worn out.
  - It is important to correctly optimise this structure to the operation frequency and insulating material. Too few “pixels” will dump too much energy while too many will lead to excess losses
  - A suitable compromise between electrode design and insulating material has been found allowing the capacitor banks to be designed.

“ The High Efficiency SRB Solar Thermal Collector: A by product of the CERN Accelerator Technologies“

Cristoforo Benvenuti (SRB Energy)

- The SRB solar collector achieve very high performance by a combination of several technologies,
  - Glass-to-metal vacuum sealing (welding) and mechanical design for high vacuum
  - Selective coating for collector structure, emissivity optimised to absorb light and not radiate in IR
  - Efficient Gettering Pump design maintains the vacuum
  - Sputtering techniques for manufacture of gettering pump material in bulk and coatings for glass and absorber
- The cells are very effective at absorbing diffuse light, this lowers demands on positioning. Up to 60% of the solar energy can be captured, producing temperatures up to 350^{o} C.
- Getter pumping remains an important vacuum technology. The LEP and LHC relies on getter pumps to keep a high quality vacuum.

Conclusions

- Large improvements in efficiency and availability can be made by exploiting local resources (cryogenics, superconductors, vacuum technology)
- We see that these same technologies can also be used to produce very advanced products in a practical way.