EUROPEAN
SPALLATION
SOURCE

ESS ACTIVITY REPORT 2010-2011

Preparing to build a major new European research facility for materials and life sciences, the **EUROPEAN SPALLATION SOURCE**. The ESS project is partnered by 17 European countries.

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DIRECTOR'S **INVITATION**

We look back at a year full of change and progress for ESS, full of excitements and the occasional frustrations, full of uncertainties and promise. Let us look back and see what has been achieved since 1st July last year when we became an independent entity, but let us concentrate on the future - the road ahead.

ESS will be a 5MW long pulse source of slow neutrons, with 22 instruments, and driven by a superconducting proton linac. We have 17 partner countries. ESS will be a very powerful neutron source. But it will be a very different kind of neutron source. Nothing like it has been built before. As such the scientific exploitation of ESS is an important topic deserving of much reflection and innovation. We are taking initiatives now to involve the present and future user community in defining this through our Science and Scientists meetings at Prague and Berlin where we shall stress our emphasis to Get Involved. The ESS Science Symposia, run by specialist groups of researchers, and which are proving to be remarkably popular, will also help to fulfill this goal.

ESS will be different in many other significant respects. It will be built on a truly green field site, and certainly the land is wholesomely rural even though it sits only 5km from the centre of the city of Lund. Perhaps more pertinently, ESS is neither an offshoot of nor a bolt-on to a bigger laboratory, which means that the opportunity to define a new mode of functioning is there for us to grasp. This can only be achieved with the cooperation and energy of the whole broad community. It also means that ESS has to develop an inner strength and resilience. Paradoxically this can only be done through the very extensive network of partners which have assembled around the project: nations and laboratories and universities; funding bodies and political personalities; and the very important man and woman in the street who pay our way.

ESS will be different in many ways - its instrumentation and its green field certainly - but much more fundamentally: the way it relates to the environment; the way it interacts with and embraces its user community; the way it capitalises upon its intellectual property; the way in which it nurtures its staff; the way it operates its instrument suite. Perhaps these are lofty ideals, but they are worth aiming for. We must keep in mind that we are talking about a neutron source which will operate at full specification only in 2025. Life will be different then, and ESS should mirror that.

Help us to define this future!

Colin Carlile

Colin Carlile
Director of ESS

A MAJOR NEW EUROPEAN RESEARCH FACILITY IS **GEARING UP**

In 2003, the European Strategy Forum for Research Infrastructures (ESFRI), set up by 31 European countries, agreed that a new European facility generating intense, low-energy neutron beams – the European Spallation Source (ESS) – was needed to advance a wide range of scientific research areas of strategic economic importance. A design for ESS was put forward that would generate neutron beams 30 times more intense than achieved with similar sources operational today.

In 2009, EU Research Ministers decided that the preferred site for ESS would be Lund in southern Scandinavia. Since then, rapid progress has been achieved towards realising ESS, in terms of setting up a management structure, carrying out science and engineering R&D, and seeking international participation. ESS is co-hosted jointly by Sweden and Denmark, and so far, 17 European countries have joined the project.

Why neutrons?

Neutrons are subatomic particles found in atomic nuclei. Like X-rays, they interact with materials to produce diffraction or reflection patterns that provide information about their internal structure at the scales of atoms, molecules and biomolecular assemblies. They can also exchange energy with these structures to reveal details about their motions. Neutrons also have a number of useful properties such as a magnetic spin, which makes them ideal for studying novel electronic and magnetic materials with technological potential. They are sensitive to very light atoms such as hydrogen, making them unique probes of biological materials and 'soft' matter. Like X-rays, neutrons can even be used for imaging. A wide variety of sophisticated instruments (diffractometers, spectrometers and reflectometers), and associated analytical methods, have been developed to exploit neutrons. The resulting experiments complement to analogous studies with X-rays. Indeed, experimental programmes often require both kinds of analysis.

Neutron studies are now essential in research investigating new materials, elucidating biomolecular mechanisms in cells, developing electronic and magnetic devices, and exploring processes relevant to climate change and greener energy generation. The properties of neutrons themselves are also of interest as they throw light on the fundamental physics of the Universe. The result is that in Europe alone, up to 10,000 researchers, mainly from academia, but also from industry, are likely to require access to a high-power neutron source, during the 21st century.

How are neutrons produced?

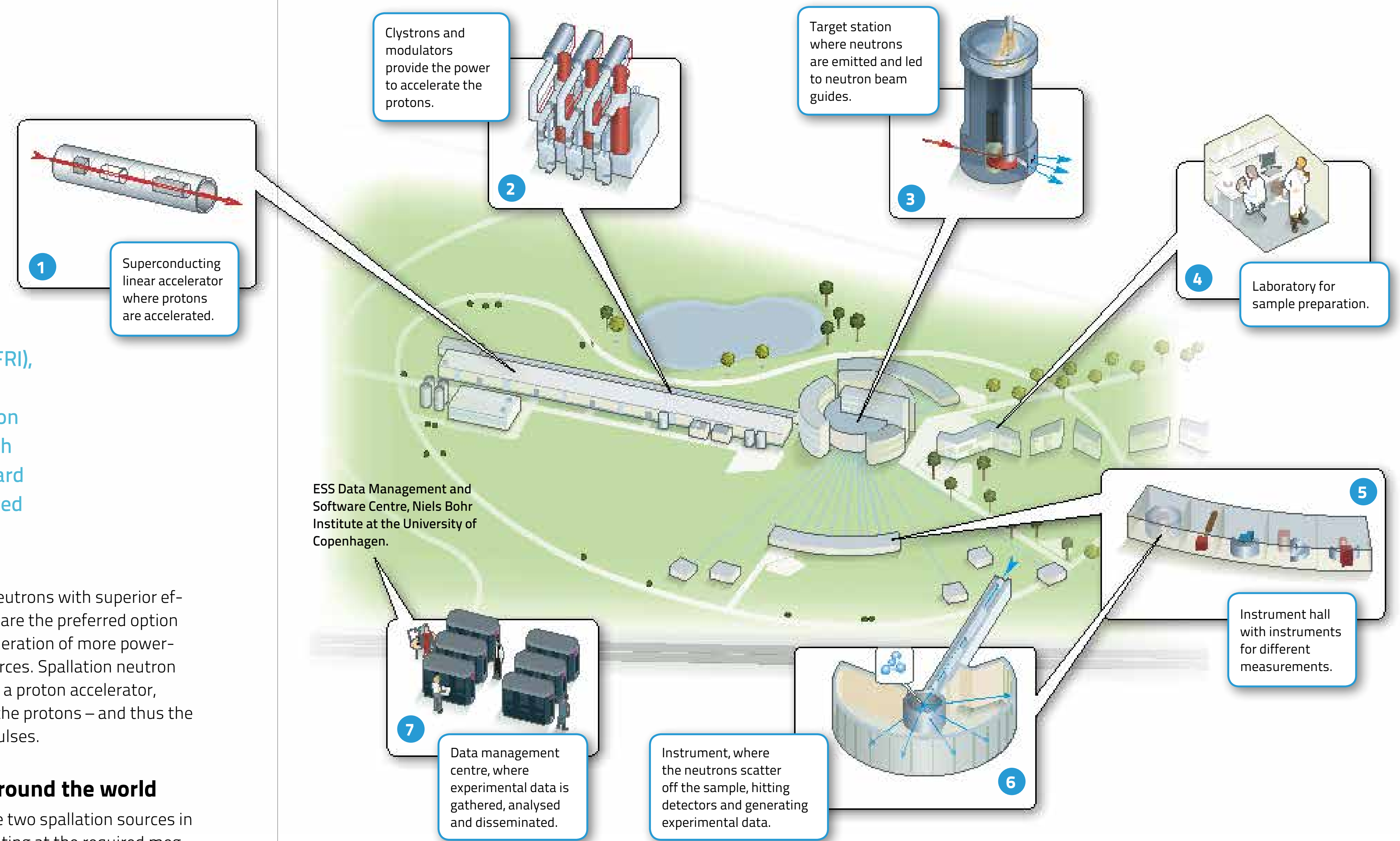
Neutrons are emitted either through nuclear fission or in the process of spallation, whereby neutrons are knocked out when a beam of protons hits a target. The neutrons are then guided down beamlines to the experimental areas housing the instruments. Both methods are used to produce neutron beams for research; however, spallation sources have the potential for generating greater intensities of neutrons with superior efficiency, and so are the preferred option for the new generation of more powerful neutron sources. Spallation neutron sources require a proton accelerator, which delivers the protons – and thus the neutrons – in pulses.

Neutrons around the world

Today, there are two spallation sources in the world operating at the required megawatt power levels: the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory, Tennessee in the USA, and the Materials and Life Science Experimental Facility (MLF) at JPARC, Tokai in Japan. ESS will be five times more powerful and will use long-pulse technology (as opposed to short-pulse technology employed at SNS and MLF) to generate much more intense beams. ESS users will also benefit from the siting of ESS close to a new X-ray synchrotron source, MAX IV. It is planned that essential experimental support infrastructures will be shared between the two facilities.

The ESS programme

Since 2009, following the development of a reference design for ESS with a 5-MW, long-pulse, single target-station layout, serving 22 instruments, a life-cycle timeline has been set in place consisting of:



- Pre-Construction Phase;
- Construction Phase;
- Operations Phase;
- Dismantling and Decommissioning Phase.

The Pre-Construction Phase started in 2010 and will continue until 2013. It consists of three major projects:

- The Design Update, which involves developing and refining the engineering baseline of the whole facility, and also carrying out a cost assessment of the construction, operation and decommissioning.
- The Preparation-to-Build activity, which aims to minimise technical and financial risks in constructing the facility by prototyping essential components, and also undertaking the various licensing processes needed to obtain permits to transfer to the Construction and Operations Phases.
- The Integration, Acceptance and Support programme, which aims to integrate ESS locally and support negotiations with international partners.

An international facility

ESS will be a jointly owned European research facility. Seventeen partner countries have so far agreed to participate in the Pre-Construction Phase and move towards the Construction Phase, aiming at a formal agreement in 2013. Negotiations are underway with further potential partner countries. The financial structure, i.e the levels of support and in-kind contributions, and the legal framework are currently under discussion.

ESS is managed as a Swedish public limited company, ESS AB, and operates according to Swedish law. The international partners are represented by the Steering Committee. The Technical Advisory Committee (TAC) and the Scientific Advisory Committee (SAC) regularly review technical and scientific progress, and the Administration and Finance Committee (AFC) oversees all administrative and financial functions. Ongoing engineering and science projects within the Design Update and Preparation-to-Build programmes carried out by partner institutes are organised in Collaborations currently broken down into Work Packages. As the ESS infrastructure develops and grows, these are being integrated into the overall programme and coordinated by ESS management.

Colin Carlile, CEO and Director-General, Sven Landelius, Chair of ESS AB Board (top left), Lars Börjesson, Chair of ESS Steering Committee and Sebastian Schmidt, ESS Steering Committee (bottom right), by the Turning Torso, Malmö, at the 4th Steering Committee meeting, 15-16 June 2010.

A NEW BEGINNING

The period 2010-2011 marked a significant milestone in the realisation of ESS as a major European research facility. The ESS organisation became an independent legal entity, and so was in a position to begin putting in place the underpinning administrative infrastructure, recruiting staff, and planning the legal and managerial framework for further progress. In parallel, the first formal steps could be taken to achieve the essential goal of establishing a truly international community of partner organisations through binding national agreements. Up to now, seventeen countries have agreed to become partners in ESS.

An independent company

Until 2010, ESS had operated as a Secretariat within Lund University; on 1 July 2010, a Swedish public limited company – European Spallation Source ESS AB – was set up with the aim of formally supporting and coordinating the management and decision-making processes involved in building and operating ESS. Since then, all Secretariat activities and staff have been transferred to the new body. ESS AB was originally owned entirely by the Swedish state, but on 21 December 2010, Denmark became a second shareholder, acquiring 26 per cent of the shares. Denmark's in-kind contribution is to host the ESS Data Management and Software Centre, which will be built at the Niels Bohr Institute in Copenhagen (p 18). It will specifically benefit from both the Copenhagen-based Nordic Data Grid and Danish expertise in high-performance computing and software for neutron research. Other partner countries are expected to become shareholders as international participation and funding proposals become firm commitments. The Board currently has eight members, of which three are Danish, with Sven Landelius, former CEO of the Öresund Bridge Consortium, as Chair.

Inge Mærkedahl and Katarina Bjelke of the ESS AB Board

ESS AB has overall responsibility for the ownership, management, construction, operation and maintenance of the facility, while the international partners are represented by the Steering Committee that provides the primary advice on all aspects of scientific, technical and financial planning.

Organisation under construction

Once ESS became an independent body in the form of a company, the organisation was able to start creating the administrative framework needed to operate a major international facility. The result has been that staff numbers have grown substantially, and policies on employment and human resources (HR) have been put in place. Because ESS is a Swedish company, it is obliged to follow Swedish company law regarding employees and taxation. This has presented particular challenges when placed in the international context of recruiting staff, or obtaining services from other countries with widely differing cultural expectations and legal infrastructures. Nevertheless, discussions are underway on the most appropriate pan-European legal and organisational model for the future management and operation of the facility.

Administrative infrastructure in place

One of the first tasks for ESS AB was to transfer the 30 existing ESS staff from public sector employment (the previous University Secretariat) to the private sector (the new company), where the rules are different. This involved negotiating a new collective labour agreement, taking out new insurance policies for employees covering workplace accidents, life assurance, redundancy and health insurance for foreigners, and procuring outside financial services such as payroll management, travel insurance, credit cards, and tax and pension advice. A consultant on compensation and benefits has been hired. An interim salary grid was set up, and policies on recruitment, gender equality, work environment, and healthcare benefits were also implemented.

Towards an international facility

ESS has worked hard to set up collaborations with institutes across Europe and the world, particularly where there is extensive technical expertise in neutron science. Collaborations with more than 40 laboratories in 20 countries now form the foundation of an enthusiastic and growing ESS community.

During the period up to 2010, 14 countries had agreed to become ESS partners: Sweden, Denmark, Spain, Hungary, Estonia, France, Germany, Iceland, Italy, Latvia, Lithuania, Norway, Poland and Switzerland. Most support has been in the form of in-kind contributions to the Pre-Construction Phase and Design Update. Sweden's contribution is 30M€. In 2009, the Spanish Government proposed an in-kind contribution of 180M€ in the form of a test facility to be built by ESS Bilbao.

During 2010 and 2011, ESS and the Steering Committee were very active in carrying out further negotiations with current partners, and securing new partners, with the aim of achieving fully binding agreements to commence construction in 2013:

- April 2010 – A Memorandum of Understanding (MOU) was signed with the German research facility FRM II (Forschungs-Neutronenquelle Heinz Maier-Leibnitz) to collaborate on ESS science and technology.

- June 2010 – The Netherlands and the Czech Republic became ESS partners. Both countries have an extensive expert base in neutron-based science, through the Reactor Institute at Delft Technical University and at the Rez Neutron Physics Laboratory, near Prague, respectively.

- November 2010 – Germany announced that its Ministry of Education and Research would make available funds of 15M€ to support the Pre-Construction Phase. The funding was supplemented by a further €6M from the German Helmholtz Association, and the bid is coordinated by the Forschungszentrum Jülich.

- December 2010 – France confirmed its support for ESS with the signing of MoUs between ESS and the French research agencies CEA and CNRS. These major research organisations are carrying out collaborative work on the Design Update. The agreements cover R&D on key ESS accelerator components (p.10-13) and beamline instrumentation.

- December 2010 – Collaboration agreements were signed with CERN to share key personnel, to make available specialised project management technology, and to assemble a cryomodule test-facility at CERN (p.12).

- February 2011 – The partner countries signed the first multinational Memorandum of Understanding on ESS, "An International Collaboration concerning the European Spallation Source". The MoU provides the essential framework for the participation of the partner countries in the Pre-Construction Phase. The signing took place at a ceremony at the Swedish Embassy in Paris at the sixth meeting of the ESS Steering Committee.

The MoU specified the following deliverables, to be ready in February 2013:

– the time-lines for construction and operation;
– a funding scenario for construction and operation;
– a detailed budget and cost-book;
– a proposal on the organisational structure;
– a signature-ready agreement on international partnership for construction and operation.

- April 2011 – The UK became the 17th country to join ESS. The project will benefit considerably from the established UK technical and scientific expertise developed at the ISIS spallation neutron source at the STFC Rutherford Appleton Laboratory near Oxford.

- April 2011 – Poland signed the international MoU to commit to the ESS project.

Other countries are expected to sign up to ESS later in the year.

Signing the first multinational agreement on ESS

Ceremony for the signing of an "International Collaboration concerning the European Spallation Source", Swedish Embassy, Paris, 3 February 2011. Swedish Ambassador Gunnar Lund holding a ceremonial speech, Patrik Carlsson, ESS Director for Accelerator & Target. Matti Tiirakari, ESS Head of Administration, Gunnar Lund, Graziano Fortuna, INFN Legnaro, Italy. Beatrix Vierkorn-Rudolph, Ministry of Education and Research, Germany. Gabriele Fioni, Ministry of Higher Education and Research, France. Peter Honeth, Ministry of Education, Sweden. Luis Ruis Lopez, Ministry of Research and Education, Spain. Louis Vertegaal, Netherlands Organisation for Scientific Research. Lars Kolte, Ministry of Science, Technology and Innovation, Denmark.

Senior staff in place

The number of ESS staff has grown from 30 to about 75, with two or three new people being recruited each month; it is projected to reach about 120 staff in 2012. In particular, the year has seen the recruitments of senior staff, such as several directors and division heads. Dimitri Argyriou took over from Christian Vettier as Science Director from 1 January 2011. He was a senior scientist at the Helmholtz-Zentrum Berlin and the Chair of the ESS Science Advisory Council. Also starting in January, Kjell Möller was appointed interim ESS Programme Director, and Matti Tiirakari was seconded from CERN, where he was Head of Site Engineering and Management, to be ESS Head of Administration. Other key recruitments have been Ken Andersen, Head of Instrumentation; Oliver Kirstein, Head of Instrument Support; Stig Skelboe, Head of ESS Data Management and Software Centre; Arno Hiess, Head of Neutron Science; Luca Zanini, Head of Neutronics; Johan Brisfors, Programme Office Manager; Peter Jacobsson, Head of Safety, Health and Environment; Kent Hedin, Head of Conventional Facilities; Lena Petersson, HR Manager; Hélène Björkman, IT Manager and Mikael Palade, Interim Head of Finance.

Recruiting the best

Increasing focus is now being put on recruiting scientific and technical personnel, which largely means hiring people with the appropriate level of expertise from other countries. In the first group of staff employed in 2010, 18 came from outside Sweden, while in 2011, 12 scientists and engineers have joined ESS from Australia, France, Italy, Spain, the UK and the US, and a further 10 scientific and technical specialists are expected to join in the next few months. ESS puts a great deal of effort into facilitating relocation.

The HR Department has two full-time staff dedicated to dealing with recruitment and relocation issues, and providing useful information on living in Sweden. External relocation services have been procured to help employees and their families with moving house, finding accommodation and schools, dealing with residential utilities and services, and Government agencies. Lessons in Swedish and courses to aid cultural acclimatisation are also arranged. New managers employed are trained in Swedish law on health and safety at work. An important adjustment for some employees is to adapt to the Sweden taxation system and the comprehensive social support system that it enables, which includes free education, healthcare and other substantial benefits.

A legal framework for ESS

A legal framework for ESS as an international body should be in place by the end of 2012. The Administration and Finance Committee (AFC), in charge of overseeing all administrative and financial functions of ESS and preparing the future legal framework and organisational scheme, has set up a working group to explore which legal form is best suited to building and running ESS. One possibility is that ESS might be awarded diplomatic status like CERN, but this is unlikely. More likely it could adopt the new EU legal framework European Research Infrastructure Consortium (ERIC), which has been specifically designed to facilitate the joint establishment and operation of European research facilities. In early 2012, preparations for the ratification of ESS partner membership will commence, with the aim of establishing the framework for financing by the Member States at the end of 2012, prior to the start of the Construction Phase in 2013. Sweden has also agreed to provide interim financial support if the legal framework is not ready by 2013, so that the Construction Phase is not delayed.

TECHNICAL **EXPERTISE** IN NETWORKS

The aim of the ESS programme is to produce intense, high-quality neutron beams operating in a configuration that offers the highest performance. The production of neutrons requires a machine infrastructure consisting of an ion source to generate protons, an accelerator to accelerate the protons to the required energy, and a target station from which neutron beam-lines then radiate to experimental areas.

ESS Collaborations 2011

ACCELERATOR COLLABORATIONS:
Aarhus University ● Brookhaven, USA ● CEA/IN2P3, Paris ● CERN, Geneva ● DESY, Hamburg ● ESS Bilbao ● INFN, Legnaro ● INFN, Catania ● Jefferson-Lab, USA ● MAX IV Laboratory, Lund ● Paul Sherrer Institute, Zürich ● Royal Holloway University, London ● University of Manchester ● University of Rostock ● Uppsala University ● Warsaw University

TARGET COLLABORATIONS:
CERN, Geneva ● China Spallation Neutron Source, Beijing ● CRS4, Sardinia ● ESS Bilbao ● Budapest Neutron Centre ● Forschungszentrum Jülich ● Helmholtz-Zentrum, Berlin ● Helmholtz-Zentrum, Dresden-Rossendorf ● Huddersfield University ● Institute for Energy Technology, Halden ● ISIS, Rutherford-Appleton Laboratory ● Karlsruhe Institute of Technology ● Los Alamos National Laboratory, USA ● Lunds Tekniska Högskola ● Oak Ridge National Laboratory, USA ● Paul Sherrer Institute, Zürich ● Rez Nuclear Research Institute, Prague ● Risö DTU National Laboratory for Sustainable Energy, Roskilde ● University of Riga

The ESS technical design is currently being revised and optimised in the Design Update programme (p.5). The work is implemented by two Divisions, the Accelerator Division and the Target Division, and overseen by the Technical Advisory Committee (TAC). The programme makes full use of the expertise of ESS European partners through a series of Work Packages (WPs) to develop specific components, each work package being an international collaboration led by a particular partner institution. During 2010-2011, these collaborations made considerable progress in developing key components of the machine design.

Planning the Accelerator Design Update

The ESS Accelerator Design Update (ADU) project is being carried out by a collaboration consisting of ESS, CEA-Saclay (France), CNRS-IN2P3-IPNO (France), INFN (Italy), Aarhus University (Denmark), Uppsala University (Sweden), ESS Bilbao (Spain) and the University of Lund (Sweden).

The first meeting of the ESS ADU project took place in Lund in March 2010. To date, four contracts have been signed, two agreed and one is under negotiation. All work package leaders reported progress according to plan with impressive results from the SCRF (superconducting radio-frequency) work packages at IPNO-IN2P3-CNRS and CEA. The result of the first complete risk analysis and risk model, the system engineering and the internal review processes were also presented. The Technical Board of the ADU project consisting of the management teams and the work package leaders meet monthly to keep track of progress and assure coordination.

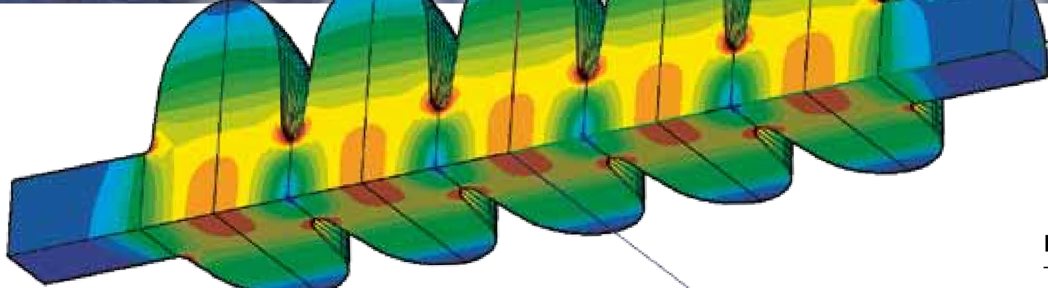
A first milestone will be an intermediate design report with a new baseline of the facility for the end of 2011. The broader collaboration within the European and International accelerator community is assured through the open collaboration meetings, with a first two day meeting organised together with the CERN Superconducting Proton Linac (SPL) study group, in Paris, in June 2011. The planning for the next stage – the Preparing-to-Build programme (p.22) – has started, with a first list of prototypes having been established and reviewed by the ADU Technical Board. Discussions with future partners for this project have started.

The Accelerator Division provides and develops tools for the Technical Communications and Configuration Control for the ESS design, integrated with the other ESS Divisions. An alpha release of a Parameter Management System has been put in place This system is evolving towards a beta release based on a relational Database Management System that will streamline the activities of all ESS divisions to communicate and maintain consistent "technical" parameters, at the same time as enabling the validation and notification chain mechanisms of the Change Control Board in the formal control of "high level" parameters.

The Division has also been closely involved in the joint preparation, with other stakeholders, of a Technical Content Management System (TCMS) consolidation plan. These stakeholders include ADU collaborators across Europe and beyond, the Programme Management Office, the other ESS Divisions in Lund, the Design Office, and the IT department. The TCMS plan, soon to be released, strives to minimise the number of inter-related technical communications tools that are centrally supported, while still delivering complete and efficient functionality to all parties. No single product or development environment is able to satisfy all users. The implementation of the strategic TCMS plan will immediately follow its delivery and acceptance, in mid-2011.

ACCELERATING COLLABORATION

Accelerator Design Update Kick-off meeting on 24 March 2011, with all the Accelerator Collaboration partner laboratories.



First simulation results, ESS High beta Superconducting Elliptical cavity. Courtesy of Guillaume Devanz, CEA-Saclay, France.

Progress on accelerator development

To meet the ESS specifications for high power, much of the development work has initially focused on the design of the accelerating cells and controlling the proton-beam physics.

The ion source

The ion source relies on well-established technology in which electrons are stripped from hydrogen gas to generate protons. This approach is simpler and more cost-efficient than that employed at other spallation neutron facilities, where negative hydrogen ions are first produced and later stripped of their electrons to generate the proton beam.

● Collaborating partners: The ion source is being developed by INFN Catania.

The Accelerating infrastructure

The central accelerating device, the linac, is 350 metres long, with a beam power of 5 MW, and operating at a beam current of 50 mA to deliver a pulsed proton beam of 2.5 GeV energy. The pulses will have a peak power of 125 MW and a length of 2.86 ms. These basic parameters determine the layout of the linac and the technologies used. One of the key challenges is that the acceleration efficiency must be extremely high. Once the protons leave the ion source, they are accelerated by alternating electromagnetic fields at microwave frequencies, at 352 and 704 MHz. The final energy of 2.5 GeV is reached after about 1500 energy steps in an equal number of acceleration cells along the length of the linac.

> *"The ESS Accelerator Collaboration is an international effort, involving many of the leading laboratories in the world, to construct the world's most powerful particle accelerator."*

● Collaborating partners: Involved in the design of the accelerator are laboratories in Italy (INFN, Catania), Spain (ESS Bilbao), France (CEA-Saclay and CNRS-IN2P3-IPNO) and Sweden (Uppsala University). The final part of the beam line, from the end of the accelerator to the target, is being designed in Denmark (Aarhus University). The Aarhus team is also designing the magnets and collimators, while subsystem integration is being carried out by the Bilbao collaboration.

Superconducting accelerating devices

The first 30 metres of the linac will contain accelerating cells working at room temperature. However, the remaining 320 metres of devices will employ novel niobium superconducting radio-frequency (RF) cavities cooled by liquid helium to 2 degrees above absolute zero. Superconducting cavities offer much lower power dissipation, and thus both improve accelerator performance and reduce energy consumption. Between three and eight of these cavities are grouped together in a cryomodule.

● Collaborating partners: The superconducting cavities are being developed by our French partners. ESS is collaborating with CERN, which has considerable expertise in superconducting technology, to produce a four-cavity cryomodule prototype by 2012. The aim is to optimise the performance of the module and its energy efficiency and test it in CERN's SM18 test-stand in late 2013.

The RF power source

A large number of radio frequency power sources, i.e. klystrons and modulators, are needed to achieve the high power levels required, and much of the design and development efforts have so far been focused on this aspect. Studies on the lifetimes and maintenance of the power sources are being carried out. The klystron gallery is being designed to enable efficient maintenance, and to optimise the use of available floorspace in accommodating the large modulators.

● Collaborating partners: Prototype tests of high efficiency klystrons and R&D of the low level RF power source are planned for as part of a collaboration between the ESS and Uppsala University. The rf power source is an expensive part of the accelerator. Because only a few companies exist that are capable of producing klystrons or modulators, and a large number are needed, the orders will have to be placed during 2014 at the latest. The procurement process of prototype klystrons and modulators has therefore already been initiated to ensure fair competition between companies and a sufficient source of supplies.

Controlling the beam

To achieve an intense proton beam with maximum efficiency, the beam dynamics need to be well-understood. This requires large-scale numerical calculations that take into account practicalities such as manufacturing tolerances, the finite stability of power supplies, and a realistic alignment precision of the accelerator components.

● Collaborating partners: The team, together with the tools to perform the calculations, have now been assembled in Lund, and work has started together with Cosylab, Slovenia.

Beam diagnostics

The beam intensity and position need to be measured along the length of the linac. A system capable of monitoring small particle losses at any point in the machine is required, and to ensure maximum performance, the transverse and longitudinal beam distribution must be measured at several locations. Preliminary specifications have been developed, which will be refined.

● Collaborating partners: The beam diagnostics equipment will be developed by the ESS Beam Instrumentation Group in Lund, in collaboration with other groups in Europe and the USA. Efforts are ongoing to identify the appropriate collaboration partners and define the scope of the collaboration project for each instrument. However, the ESS machine presents some unique challenges in that it will accelerate protons rather than negative hydrogen ions. Collaboration and exchange visits with existing facilities will also be important to train new members of the beam-diagnostics team.

FOCUS ON THE **TARGET**

Small photos, from top:
Francois Plewinski, Group Leader Target Station Engineering, ESS.
Werner Wagner, PSI, and Etam Noah, ESS, 4th High Power Targetry Workshop, Malmö, 2-6 May 2011.
Ferenz Mezei, Head of Target Station Division, ESS.
Kurt Clausen (PSI, Zürich), Chair of ESS Technical Advisory Committee.
Cyril Kharoua, ESS.

The ESS Technical Advisory Committee

During 2010 and 2011, the Technical Advisory Committee (TAC) reviewed the progress of the Design Update, in particular, the prototyping and preparations for constructing the accelerator and the target station. It confirmed the suitability of the accelerator design and technology, and the viability of the project plan and collaboration set-up. The accelerator collaboration is now formalised in a multilateral collaboration agreement and bilateral contracts between ESS and the collaboration partners. A decision on the target will be taken in the end of 2011. The TAC advised on the WP structure for the target station collaboration, which is subject to contract during mid-2011. The Committee also reviewed a set of high-level facility parameters and the overall direction for enhancing and optimising facility scientific performance. This will allow a baseline facility specification to be set in the near future.

Planning the Target Station Design Update

The central task of the Target Division in 2010 was to create the conditions for an efficient start of the actual target station design update work, which will be completed by the end of 2012 in the framework of the ESS Pre-Construction Phase. The main aspects of this task are:

- Elaboration of the technical work-plan for the Target Station Design Update Project for the years 2011-2012
- Team building
- Organisational planning

The Target Division has been collaborating with international experts since early 2010 in reviewing the target options. A detailed work breakdown structure was drafted, which was reviewed by collaboration partners as the basis for establishing the common work-plan. We have started to provide information and data specifically required by the licensing authority for the alternative targets, with particular focus on optimal environmentally-friendly solutions. After further analysis and selection of the variants, a final proposal was prepared for the baseline option, and for the fallback option.

During the middle of 2011, the proposal will be presented to the TAC, the ESS Board and to the Steering Committee for formal acceptance by the end of 2011. The Target Station Technical Design Report on the detailed study and optimisation of the fundamental engineering design and bottom-up costing estimate will be completed as part of the ESS Design Update Programme by the end of 2012.

Organisation

The Target Division team in Lund has been intensively strengthened and is preparing to assume its leadership and coordination role in the ESS Design Update programme, involving outstanding centres of excellence in spallation-related research worldwide.

The organisational structure will be composed of two layers:

- Contractual collaboration of institutions from countries represented in the ESS Steering Committee engaged in performing a common work plan.
- Mutually advantageous coordination, task sharing and exchange of information with leading spallation facilities worldwide based on common interest in globally advancing spallation neutron research.

The rapidly developing team of the ESS Target Division is becoming one of the recognised pillars in this field, as witnessed by its vivid contributions to the success of the recent conference Accelerator Applications 2011 in Knoxville, Tennessee, in the USA.

Progress on target development

The generation of a neutron beam requires a neutron-rich target, usually a heavy metal, which releases copious quantities of neutrons when a proton beam strikes it. The current standard material is mercury as, being a liquid, it can more readily redistribute the large amount of heat emitted during operation. However, target hulls have to be replaced regularly, and since the irradiated mercury is extremely toxic, it presents a serious disposal problem, which has not yet been solved.

One of the goals of ESS is to employ technology that meets the highest standards of environmental safety. A target composed of a lead-bismuth eutectic mixture, which is solid at room temperature but liquid under operating conditions, would be less toxic and easier to handle. The other candidate is a solid target which rotates, thus distributing the heat generation over a much larger volume than the immediate area of irradiation. Such a rotating target, composed of tungsten rods, has the advantage of longevity with a life-span of three years or more, compared with six months for the lead-bismuth target.

- Collaborating partners: Around 20 partner laboratories will be involved in the development of the target station, with Switzerland and Germany being the main partners. ESS Bilbao is also a collaborator and ISIS in the UK, which became a partner in April 2011, is expected to provide important expertise.

PEOPLE AND EVENTS


4th High Power Targetry Workshop, Malmö 2-6 May 2011.


Poster session, 4th High Power Targetry Workshop.

ESS Energy Event, 18 March 2011 on the ESS site. The project leaders with MP Ewa Thalén-Finné.


ESS Science Advisory Committee.


Axel Steuwer explaining neutron experiments to industry.

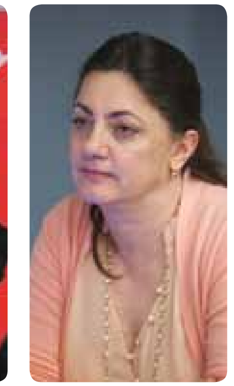

Science Director Dimitri Argyriou receiving the Friedrich-Wilhelm Prize for his habilitation thesis.


Discussing instrumentation at the Vaals Expert Meeting, September 2010.


Performing the ESS song.


Lecture by Dean Myles in the "New Science at ESS and MAXIV" seminar series.

ESS Energy Event




Lars Leijonborg, former Minister of Research and Higher Education, at the ESS Energy Event.


Steering Committee, Malmö, 15-16 June 2010.


Bilayers at ILL 2011, 12-14 January 2011, Grenoble


4th High Power Targetry Workshop.

DEVELOPING A **UNIQUE** SCIENCE RESOURCE

The newly formed Science Directorate is responsible for bringing online the first seven neutron instruments, for key classes of experiments, by 2019, with a full suite of 22 instruments operational by 2025. The Directorate is also managing and developing the support technology and beamline infrastructure.

ESS Data Centre in place

The ESS Data Management, Computing and Software Centre, which is hosted by the Niels Bohr Institute at the University of Copenhagen and led by Stig Skelboe, comes under the Science Directorate. The first task of the Centre is writing software to simulate the operation of the accelerator, target and instruments. These simulations will help ESS optimize key parameters in both the target and instrument suite. In addition the DMSC will work together with other neutron facilities to develop software tools for processing experimental results. Remote, online modes of instrument access and control, and data retrieval and processing are also evaluated. Photo: Peter Willendrup, ESS DMSC.

Small photos, from top, left:

Former Science Director Christian Vettier recieves the Royal Swedish Order of the Polar Star (Sw. Nordstjärneorden), here with his wife at the Swedish Embassy in Paris.

Aleksandar Matic, Chair Science Advosory Committee, Peter Böni, Deputy Chair.

Dimitri Argyriou, Science Director.

Hanna Wacklin, instrument scientist.

Ken Andersen, Head of Instruments, Pascale Deen, instrument scientist.

Tommy Nylander, SAC, preparing a sample at ILL.

This includes parts of the moderators, which slow down the neutrons to the required energy range, choppers, which are rotating devices that block unwanted neutrons (usually high-energy), and the devices that steer and focus the neutron beams down the beamlines running from the target station into the experimental areas. Other essential support includes data management, and the planning and development of sample-preparation areas and specialised sample environments.

These challenges require a coherent, well-managed programme, coordinated and implemented by an expert international team of scientists and engineers, in collaboration with ESS partner countries, and in full consultation with the future user community. To achieve this goal, the Science Directorate has grown rapidly, gaining considerable momentum during the past year, with increased staffing, focused programme development within the international context, technical R&D in key areas, and extensive community consultation.

Choice of instruments

The brilliance of the generated neutron beam nature of ESS enables many neutron instruments to achieve a factor of 10 to 100 gain in performance over similar instruments at other facilities. The high intensity allows polarised neutron beams (polarisation involves filtering neutrons with a selected spin orientation) to be prepared for a wide range of experiments, for example, analysing complex magnetic or electronic behaviour, or subtle changes in large-scale structure. The long pulse enables the beam to be structured in a variety of ways, benefitting many types of instruments, such as those designed for time-resolved experiments and those investigating dynamics and function at the microscopic and mesoscopic scale. ESS instruments exploiting these characteristics will provide substantial opportunities for achieving major scientific breakthroughs.

During the year, the Science Advisory Committee (SAC) organised a series of workshops to gauge the kind of science that should be carried out at ESS. An expert group of 35 scientists from the world's leading neutron facilities then met to prioritise which instruments to develop and commission. The first seven generic instrument types were identified, relevant to key research areas that will particularly benefit from the unique characteristics of ESS. The final selection of instruments for construction will begin in 2013 when the SAC will refine the list based on the following criteria:

- Potential gain in performance;
- Potential to provide significant insights into current and future research problems, as moderated by demand from the user community;
- Innovative nature of the instrument making unique scientific opportunities possible.

Proposed seven flagship instruments:

- Small sample small-angle neutron scattering (SANS) instrument for studying large-scale structures (soft matter and biological macromolecules).
- Horizontal sample reflectometer for analysing thin films, particularly at the liquid-air interface.
- Narrow band width powder diffractometer for rapid structural characterization of crystalline materials.
- High resolution imaging instrument for probing macroscopic structures in three dimensions.
- Crystal analyser spectrometer for measuring atomic and magnetic motions in single-crystal materials.
- Cold chopper spectrometer for study very rapid measurements of dynamics in soft and hard condensed matter.
- Macromolecular diffractometer for studying the crystal structure of large molecules such as proteins or zeolites.

Building up the group

Based on this initial selection, ESS has appointed instrument scientists working in these areas to take forward the development and construction of these instruments. In the first three months of 2011, three instrument scientists joined the Directorate to cover diffraction, polarised neutron spectroscopy and reflectometry. We are now in the process of recruiting specialists in small-angle neutron scattering, macromolecular crystallography, single-crystal excitations, and imaging. Further people are being taken on to take forward the programmes on chopper specifications, neutron optics, moderator concepts and beam extraction. Staffing is frequently reviewed in order to make sure that we can complete the design update phase of ESS and be in the best position to move forward to construction of instruments and support facilities.

Programme and work packages

In-kind contributions from partner countries are critical to the successful completion of the Design Update. To ensure success, the Science Directorate is setting up the necessary tools for managing in-kind contributions as a European distributed programme.

All components of the Instrument Programme are therefore being brought together under the umbrella management structure of the Science Directorate. This will allow us to plan and organise the effort, allocate resources, furnish specifications for components, and put in place mechanisms for evaluating risk. We will be able to provide clear timetables for development and construction, as well as assist in identifying opportunities for collaboration.

The current instrument work packages involve several countries, including Germany (teams from several universities), Switzerland (PSI and EPFL), France (ILL) as well as Denmark and Sweden. Other countries including the Czech Republic, the Netherlands and Italy, are also preparing to participate in instrument development. We are aiming to bring all the work packages into the Instrument Programme framework and harmonise their implementation based on three guiding principles:

- The decision-making processes should follow that laid down by the ESS governance, and fall within accepted requirements of the Instrument Programme, as stipulated by the SAC or TAC and agreed by the Steering Committee.
- A scientific and technical coordinating body for each work package will be set up, consisting of people nominated by ESS and the participating partner, and reporting to the ESS and the partner institute managements. It will supervise progress, and ensure compliance with and integration into the ESS Instrument Programme.
- All work packages will be subject to the ESS In-Kind Review Process, which is completely independent.

Selection of future instruments

Current activities in Lund and within the work packages will remain focused on instrument concepts already identified within the Design Update programme. However, ESS is open to proposals for new instruments from the wider community. A proposal must conform to the selection criteria given above, and explain the science that the instrument will address and its importance. A technical case must be made, outlining the instrument concept, how it can be realised, and the specific advantage of siting it at ESS. A cost estimate is also required.

All proposals for instruments will be evaluated in three steps:

- An ESS Technical Review will assess the feasibility, provide an estimate of ESS resources required for construction and make a safety assessment.
- The SAC will then evaluate the proposal and Technical Review according to the science criteria outlined above and in terms of cost. If approved, it will then make recommendations to ESS management.
- ESS management will submit the SAC recommendations to STC for final approval, along with information on costings, a programme plan and a date for delivery.

It is envisaged that the first seven instruments to be operating at ESS will be approved for construction during 2013 and 2014. Further instruments will then be selected and approved every year until the Instrument Programme is completed.

Lund Institute for Neutron and X-ray Science

Providing state-of-the-art facilities for users will be of paramount importance. A significant proposal under consideration is to build a science centre – LINXS, the Lund Institute for Neutron and X-ray Science – in the area bridging ESS and the nearby MAX IV light source to provide joint services for the two facilities (p.24). These would include specialised sample-preparation facilities, for example for biology experiments, housing of sample-environment equipment such as pressure cells, and theory support. LINXS would also provide complementary laboratory instruments, such as various spectrometers, so that users can carry out their research projects in an integrated way.

Consulting the community

ESS recognises that close interaction with the user community at all stages is essential in order to set scientific and technical priorities as well as to maintain development progress. To meet these aims, we have organised two meetings. The first will be held at the European Conference on Neutron Scattering in Prague in July 2011 and will inform the community of current progress. The second meeting will be a plenary gathering in Berlin in April 2012, which will present the ESS project to the community prior to completion of the Design Update and formal agreement to start construction.

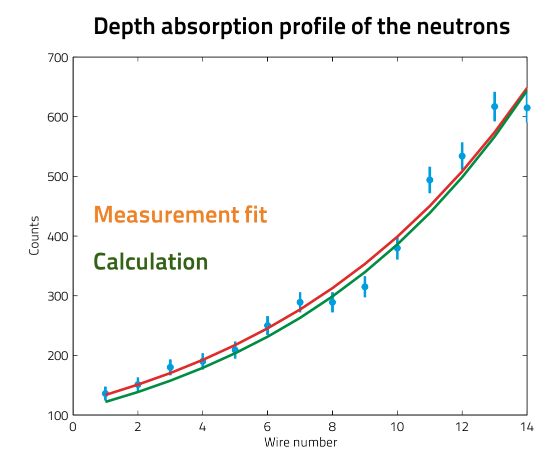
In the meantime, a series of focused workshops – the ESS Science Symposia - are being organised that will allow the community to address scientific opportunities at ESS, and make recommendations on neutron instruments and infrastructure. ESS will provide funding of up to 12 k€ and organisational support for each workshop. The first call for proposals was made in March 2011 and has been very encouraging. The first meeting in June will be on "Neutrons, NMR and molecular simulations" and will be held in collaboration with the Niels Bohr Academy in Copenhagen. The outcomes of workshops such as this one will be presented to the SAC, which will then use them to make recommendations to ESS management.

Outreach to Industry

As in previous years, ESS has continued to raise awareness of the potential of neutron scattering techniques for industrial R&D by visiting companies such as ABB, Volvo, SCA and Sandvik in Sweden, and participating in dedicated workshops and interest groups and public institutions, e.g. as Hjärntrusten, the TITA-project, the Danish Big Science secretariat as well as at the VINNOVA funding agency and Danish Ministry of Science, Innovation and Research.

A detector success story

Helium-3 has been the material of choice for large-area detectors used in neutron experiments. However, this isotope is now in short supply, so alternative detector gases are needed. In June 2010, the ESS detector group, in collaboration with the ILL and Linköping University in Sweden, started the development of detectors exploiting thin films of boron-10. Preparing chemically stable thin films that will have areas of many square metres is extremely challenging. Nevertheless, the first prototype has been assembled and tested at the ILL where it performed to specification. Work is ongoing on a second prototype (2m x 10cm active area) to be tested in the summer of 2011. To this end, thin films of boron-10 have been deposited on 6 square metres of sheet aluminium. The aim is to use the results to design a full-scale demonstrator detector in 2012.



Ideal absorption. The absorption profile of the neutrons with depth inside the detector from the initial prototype tested at the ILL. The measured profile agrees very well with the ideal calculated profile.

ESS Detector team in action
Carina Höglund preparing the aluminium pieces for the second prototype prior to the coating procedure. In the foreground are pieces coated with enriched Boron-10 Carbide waiting to be shipped to the ILL for further assembly.

Small photos, from left:
The deposition chamber is being loaded by Head of Detectors Richard Hall-Wilton prior to a coating run.
The blades being inspected and prepared by Anton Khaplanov during detector assembly at the ILL.

PREPARING TO BUILD

Now that partner countries have agreed to participate in the Design Update at an appropriate level, best efforts are being made to proceed in a timely manner to the Construction Phase, which is due to start in February 2013. This involves building up programme management, solid costing calculations, site planning and licensing, as well as an active outreach work to inform about and anchor a large and complex project like the ESS.

Thomas Hansson overseeing sample drilling at the ESS site.

Minister of Education Jan Björklund at the ground-breaking ceremony for the MAX IV Laboratory, 22 November 2010 (top). Director-General Colin Carlile and Programme Director Kjell Möller inaugurating the second ESS office, housing the new Programme Directorate (bottom). At the ground-breaking for MAX IV, the Mayor of Lund Mats Helmfrid casts the first concrete in a model of the MAX IV building, together with Mats Paulsson and Anders Jarl, CEO:s of building companies Peab and Wihlborgs (right).

Programme management in place

An important step was the establishment of a Programme Directorate in January 2011, which will be responsible for delivering ESS within budget, on time and according to specifications, and within the required scientific context. Staff are currently being recruited and the programme management team should be in place by the end of the year. The goal, during 2011, is to develop the programme management structure and processes so that they will be fully operational by 2013. Cost control, specification-change control, scheduling, procurement, risk control, energy use and licensing are all important aspects for which management systems must be implemented.

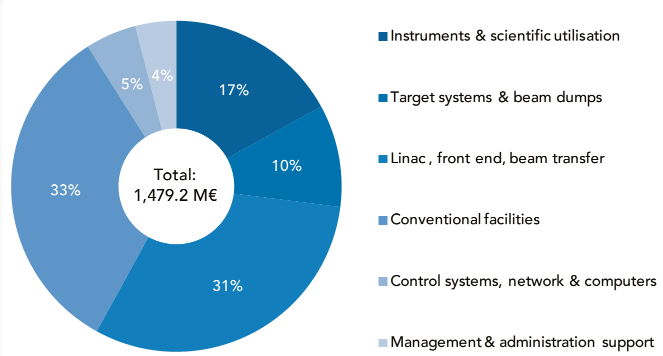
An ESS Programme Group (EPG) has now been set up to take forward and deliver all aspects of the programme. The Configuration Control Board will apply these decisions in managing the configuration of the whole facility in terms of the various sub-projects. A Programme Plan has now been developed and released as a basis for the future programme management, and the deliverables for the Pre-Construction Phase have been defined. The Programme will be continually updated as it moves towards the Construction Phase.

Various tools for programme management are being evaluated. Life-cycle management principles, according to the international standards, are being implemented to describe and evaluate the ESS project during its whole life. This is the first time that this approach has been applied to a neutron facility.

Control over costings

The latest Costing Report for ESS is now complete and provides the base for the future costing of the programme. Detailed evaluation has furnished a top-down capital cost of 1479M€ for the updated design of one target and 22 instruments. This estimate is supported by bench-marking data from SNS in the US – a comparable facility, and is in line with calculations made by partner countries that had bid to host ESS.

This costing provides the data needed by ESS Partner Countries to decide on their individual levels of funding commitment for the Construction Phase. ESS signatories have agreed to an in-kind contribution of 55 per cent and a cash proportion at 45 per cent. Several Partner Countries have already made commitments, which need to be clarified. The ESS management has proposed the setting-up of an In-Kind Review Committee in the autumn to lay down a framework for evaluating and managing such contributions. Maintaining a tight envelope around this cost value is therefore now essential, and will be given particular priority by the ESS Programme Office. A new costing exercise is now starting that will examine closely all the assumptions in the Costing Report, taking into account any design modifications made over the next two years. A costing engineer has been employed to analyse the detailed costing of components from the bottom-up. The aim is to provide, in 2013, a consistent costing based on the updated technical design.



A new facility layout

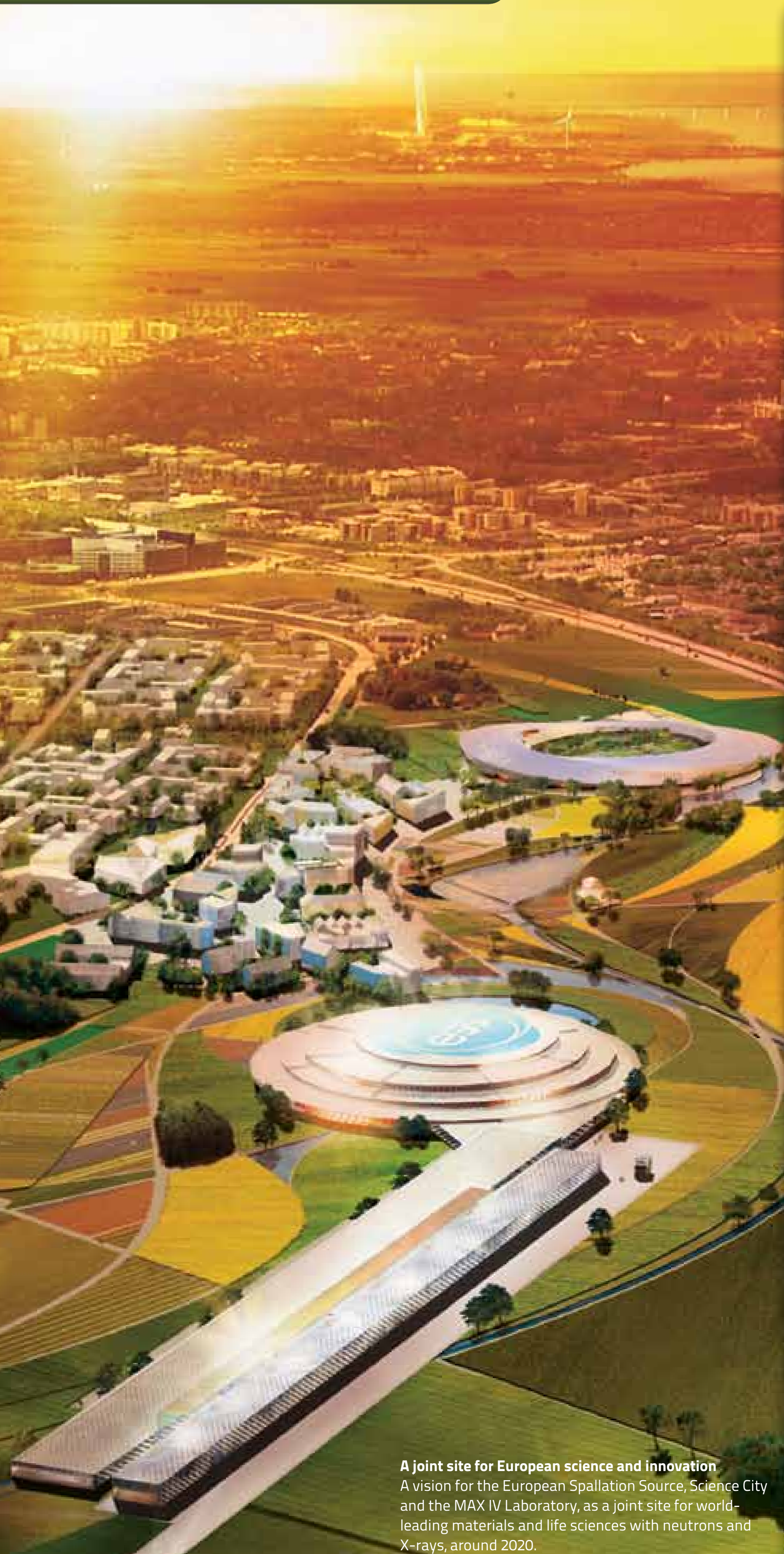
During 2010-11, a series of workshops were held to refine the design of the site plans. A new facility layout has been agreed that takes advantage of a shorter accelerator design, made possible by the introduction of superconducting accelerating devices (p.12), to accommodate a new beamline configuration. The location of the target station is being shifted slightly to allow six very long beamlines (300 metres) to be incorporated as required. Long beamlines are essential for many neutron measurements used in materials analysis. The support laboratories and offices will also be sited centrally around the target station to provide an amenable working environment. In April 2011, the layout was presented to the local municipal authority to be incorporated into the planning permission procedure, and also to the local community. It is expected that planning permission should be finalised before the end of 2012, when the plans will be available for public display.

An infrastructure for science and innovation

ESS forms the largest component (covering 75 hectares) of an integrated site-development project that will establish a major science research centre in the Lund area, along with a support infrastructure. To the south of ESS, a new synchrotron radiation facility, the MAX IV Laboratory, is to be built (20 hectares) under the aegis of Lund University. A joint company, Lundamark AB, owned by the University and the City of Lund will develop the land connecting these two complementary facilities (18 hectares) as a centre for science and innovation. The area will also be developed to provide the necessary infrastructure for the science centre, including new housing, hotels and restaurants, a new tramline to the centre of Lund, and a road connection to the nearby motorway.

Licensing and planning

ESS is a major analytical laboratory that relies on generating and exploiting particle beams (protons and neutrons). As such, it must conform to stringent environmental regulations regarding construction and operation, as covered by both the Swedish Environmental Code and local Planning and Building Act, and the Radiation Protection Act. During 2010-2011, ESS continued the process of assessment under these regulations, recruiting personnel in order to establish a formal licensing group. The group started its work in the autumn of 2010 and consists today of five people. One of the first important tasks for the group has been to prepare and launch the General Safety Objectives (GSO) for ESS. The GSO report was finalized during the spring of 2011.



A joint site for European science and innovation
A vision for the European Spallation Source, Science City and the MAX IV Laboratory, as a joint site for world-leading materials and life sciences with neutrons and X-rays, around 2020.

Minimising local environmental impact

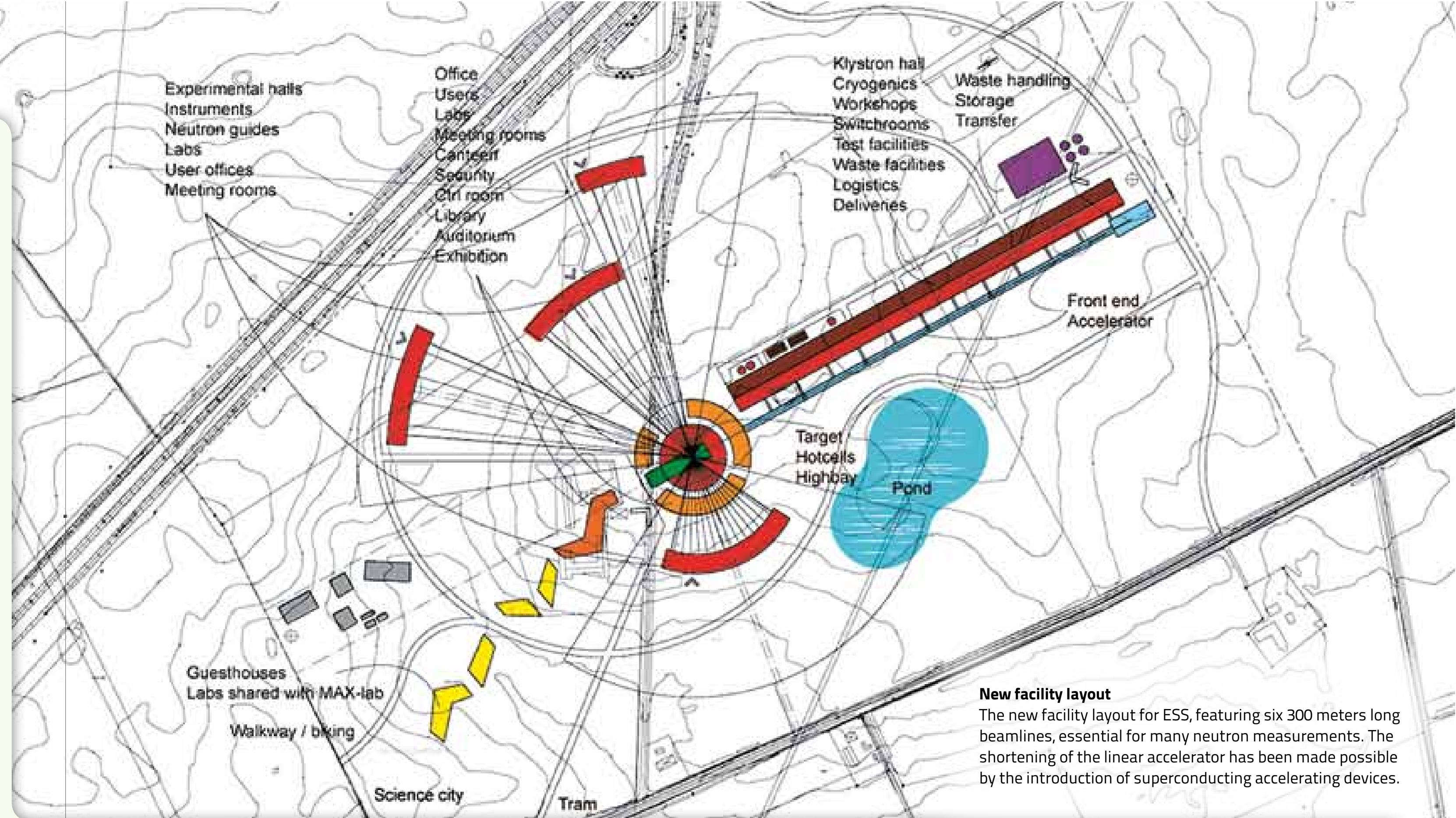
An Environmental Impact Assessment (EIA) has to be drawn up and tested according to the Swedish Environmental Code. The rigorous process of acquiring a permit guarantees that ESS will have minimum impact on the local environment. Our work on the EIA is proceeding, and submission to the Environmental Court is planned for early 2012.

Work has continued internally on the facility layout planning. The external evaluation in relation to the municipality of Lund and the County Administrative Board is being carried out in accordance with the Planning and Building Act. ESS has established a good working relationship with both the MAXIV Laboratory and the Lund municipality regarding the planning of the whole area north-east of Lund. The licensing work also includes the first soil and ground-testing done in 2010. Further analyses and investigations will be needed to obtain a full evaluation.

Radiological protection

ESS continued the process of assessment under the Radiation Protection Act. A Safety Review Committee (SRC) is being set up as a support to the Director-General, with the purpose of reviewing all aspects of facility safety. The SRC will consist of international experts in various fields of nuclear safety, and is planning to have the first meeting in late 2011.

In August 2010, ESS formally notified the Swedish Radiation Safety Authority (SSM) that it intended to apply in late 2011 to start construction. SSM replied, stating that although it regarded ESS as a non-nuclear facility, the same requirements applicable to nuclear facilities might also be applied to ESS because of its uniqueness as a neutron spallation source. Meetings between SSM and ESS have since then been held on a regular basis. Our primary goal is to produce a Preliminary Safety Analysis Report (PSAR), which describes the technical concept, potential risks and the mitigation of those risks, waste-management and decommissioning of the facility. The PSAR will form the basis for the construction application. So far, the required information for the PSAR has been provided by the accelerator, target and instrumentation teams for performing preliminary assessments and analyses of radiation protection (shielding).



New facility layout
The new facility layout for ESS, featuring six 300 meters long beamlines, essential for many neutron measurements. The shortening of the linear accelerator has been made possible by the introduction of superconducting accelerating devices.

Technical solutions for ambitious energy goals

ESS aims to be carbon-neutral and as energy-efficient as possible by implementing an energy strategy under the three key banner words:

- "Responsible" - reducing annual energy usage by 20 per cent;
- "Renewable" - 100-per-cent renewable energy;
- "Recyclable" - at least 60 per cent of the energy will be re-used.

The first step was to perform an energy inventory of the facility so as to identify opportunities for savings. Because ESS design is still being finalised, compiling the inventory was greatly helped by the generous access that was given by the SNS, where much of the initial work was conducted.

ESS has made good progress in achieving quantitative targets for the above goals:

- "Responsible" – an energy-saving strategy, employing good building techniques, will reduce electricity use from a baseline level of 350 GWh per year to under 270 GWh per year;
- "Renewable" – electricity from wind power and/or bio-energy will be used. It was estimated that a wind farm of 25 wind turbines would be sufficient to operate ESS. Investing in such electricity generation not only reduces the operational costs but also provides a hedge against fluctuating external electricity prices.
- "Recyclable" – the waste heat produced will be put to good use. The preferable solution is heat recovery to the municipal heating system. However, direct cooling against the district heating system would require cooling temperatures above 75°C, a level hitherto unheard of in similar facilities. Cooling at more conventional temperatures of 30-40°C would require the use of heat pumps, conflicting with the goal "Responsible". An assessment of temperatures showed that as much as 120 GWh of heat might be recoverable at a temperature of 90°C, saving around 40 GWh of electricity per year. The excess heat would not escape to the atmosphere via cooling towers, as with conventional facilities.
- A further goal was added – "Reliable". This is in recognition of the fact that the power supply needs to be very stable, not only to maintain critical, superconducting components at just above absolute zero, but also to ensure accurate readings from sensitive experimental instrumentation.

All the energy work at ESS has been conducted in cooperation with energy companies E.ON and Lunds Energi. The three collaborating companies have together produced an Energy Report. It was presented on 18 March 2011 to local and regional decision-makers.

Work with energy issues at ESS is inspired by a desire to connect research for a sustainable future with efforts to conduct research sustainably today. It is the stated intent of the management of ESS to establish an "energy culture" at the facility.

Encouraging scientific curiosity
PhD Marie-Louise Ainalem lecturing on neutron science for high-school pupils (left).
Photo: Bodil Malmström, Lund University.

ESS with the Royal Delegation
The ESS Director-General Colin Carlile with His Majesty King Carl XVI Gustaf. ESS was invited to take part in the Royal Delegation to China and Expo Shanghai in October 2010 (right).

Public relations

As a large and complex facility for advanced science, placed in a complex organizational and scientific setting, and also in an early stage of construction, public relations is an essential part of ESS activities, and has been a continuing effort. Work is being focused mainly on three fronts: communication towards the ESS scientific and other stakeholders around the world, towards the press and towards the local community.

Understanding is the key
Maintaining good relations with external actors is a priority for ESS. The ESS approach is to be open, pro-active and accessible. Because of the complexity of the project, facilitating broad understanding is the single most important strategy.

The communication towards the key ESS stakeholders is conducted via many different channels, both through the web, newsletter, conferences, et cetera, and through direct contacts with the ESS committees, partner laboratories and partner countries. In the current building-up of the international partnerships, this communication will be strengthened.

Press relations is another crucial aspect of ESS external relations activities. Interest from the press is high, and ESS seeks to provide the mainstream press and the specialized science press with frequent news about ESS progress. It is a special challenge to explain the complex science and technology of ESS to journalists, and much work is being done to make the ESS project accessible.

Extensive local support
The support for the ESS project in the local and regional community has increased dramatically over the past few years, and the project now enjoys impressive support. Acknowledgement of issues that might cause worries, for example environmental impact, and seeking to give adequate answers, has been prioritized. This has contributed to building up good relations with the local and regional community, which will be very valuable for the project during the construction period.

The ESS exhibition has also been an important tool in our communication with the general public. In cooperation with students, we have arranged well-visited experimental days, during which children can do their own experiments. ESS has also initiated dialogue groups with local residents and NGO's, besides the public consultation that is a formal part of the licensing process. In October 2010, ESS arranged its second dialogue group. The dialogue meetings provide many useful viewpoints and questions that will be take into consideration in future planning.

An example of the wide support enjoyed, is the project "ESS MAX IV in the Region", aiming at preparation for the establishment of ESS and MAX IV. The project is partnered by 33 municipalities, all universities in the region, and the regional authority, and has a budget of almost 5 M€. The project will provide valuable support for ESS as regards planning of infrastructure, support facilities, innovation management and receivement of international staff, and will thus benefit the building-up of a leading science centre for European researchers.

Public relations will remain a high priority for ESS. Future plans will include a focus on international out-reach, web development, development of information content for the complex activities now being built up and for ESS scientific and technical activities.

"Research in the centre". News story on ESS and MAX IV in *Svenska Dagbladet*.

ARTICLES

L. Josic, A. Steuwer and E. Lehmann, **"Energy selective neutron radiography in material research"**, Applied Physics A: Materials Science & Processing, 2010, 99, 515

A. Chahardehi, F. P. Brennan and A. Steuwer, **"The effect of residual stresses arising from laser shock peening on fatigue crack growth"**, Engineering Fracture Mechanics, 2010, 77, 2033

M.-L. Ainalem and T. Nylander, **"DNA condensation using cationic dendrimers - morphology and supramolecular structure of formed aggregates"**, Soft Matter, 2011, in press (DOI: 10.1039/C0SM01171A Review)

P.O.Å. Persson et al., **"Ti2Al(O,N) formation by solid state reaction between substoichiometric TiN thin films and Al2O3 (0001) substrates"**, Thin Solid Films, 2011, 519, 2421

A. Khatibi et al., **"Face-centered cubic (Al1- xCrx)2O3"**, Thin Solid Films, 2011, 519, 2426

H. Wacklin, **"Composition and asymmetry in supported membranes formed by vesicle fusion"**, Langmuir, 2011

M. Lindroos and M. Mezzetto, **"Beta Beams"**, Annual Review of Nuclear and Particle Science, Vol. 60, p.299, 2010

ESS CONFERENCES & WORKSHOPS

ESS-CERN Super-Conducting Proton Linac (SPL) Conference, Lund, 29-30 June 2010
ESS Energy Event, ESS site, 18 March 2011
4th High Power Targetry Workshop, Malmö, 2-7 May 2011
ESS Neutron Instrument Design School, Lund & Lilla Vik, 7-17 June 2011
ESS-CERN SPL Conference, Paris, 30 June-1 July 2011
Science & Scientists at ESS, European Conference on Neutron Scattering, Prague, 22-23 July 2011

TARGET & SAFETY SEMINAR SERIES

Safety and Licensing of Large nuclear facilities in a international environment, Jean-Philippe Girard, ITER, 9 June 2011

CONFERENCES & WORKSHOPS SPONSORED BY ESS

Swedish Neutron Scattering Society, 14th annual meeting, Lund, 24-26 August 2010
Biointerfaces – from Molecular Understanding to Application, Lund, 26-27 August 2010
Bilayers at ILL 2011 (BILL2011), Grenoble, 12-14 January 2011
First Niels Bohr International Academy Meeting on ESS Science, Copenhagen, 27 June - 1 July 2011

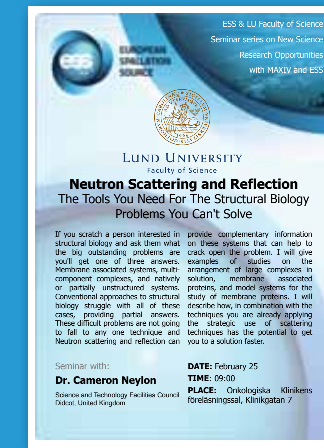
ESS ACCELERATOR DIVISION SEMINAR SERIES 2010 – 2011

Crystal Collimation in Modern Accelerators, Emanuele Laface, 05 July 2010
Accelerator Driven Subcritical Reactors, Rebecca Seviour, 22 October 2010
Early Performance of LHC: Optics and Lumi-Monitor, Ryoichi Miyamoto, 29 November 2010
Project-X: A High Intensity Proton Source at FermiLab, Steve Holmes, 2 December 2010
Single-Proton Irradiation of Living Cells, Natalia Artego Marrero, 10 December 2010
Numerical Modeling of Electromagnetic Fields, Wolfgang Ackermann, 17 December 2010
Selected RF and Instrumentation Applications at CERN and Thin Film Technology for Solar Energy Systems at Fraunhofer ISE, Thomas Kroyer, 17 January 2011
SNS Target Imaging and Related Developments, Thomas Shea, 28 January 2011
Higher Order Modes in Accelerator Cavities, Stephen Molloy, 15 February 2011
Coupled Bunch Instability Fighting in the MAX IV Accelerators, Mikael Eriksson, 15 February 2011
Higher Order Mode Damping in the MAX IV Storage Ring Cavities, Åke Andersson, 15 February 2011
Project Management at CERN, Lessons Learned from the LHC Project, Pierre Bonnal, 15 March 2011
Helium and Large Scale Cryogenics in Accelerator Sciences, Christine Darve, 14 April 2011
Timing Systems, Jose Dedic, 19 April 2011
Dealing with MegaWatt Beams, Nikolai Mokhov, 27 April 2011
Accelerators, Giant and Compact – for Science, Industry and Society, Andrei Seryi, 12 May 2011
Timing and Open Hardware, Javier Serrano, 12 May 2011
RF Cavity studies at RHUL: Simulation and Measurement, Rob Ainsworth, 19 May 2011
Beam Diagnostics for Project-X, Manfred Wendt, 20 May 2011
Review of Heavy-Ion Induced Desorption Studies for Particle Accelerators, Edgar Mahner, 27 May 2011
Design of Project-X LINAC, Nikolay Solyak, 9 June 2011

PHD THESES

K. Rathsman, **"Modeling of Electron Cooling: Theory, Data and Applications"**, Department of Physics and Astronomy, Nuclear Physics Uppsala University, 2010

M.-L. Ainalem, **"Controlling DNA Compaction and the Interaction with Model Biomembranes"**, Division of Physical Chemistry, Lund University, 2010


ESS & LU Faculty of Science
Seminar series on New Science
Research Opportunities
with MAXIV and ESS

LUND UNIVERSITY
Faculty of Science

Neutron Scattering and Reflection
The Tools You Need For The Structural Biology Problems You Can't Solve

If you scratch a person interested in structural biology and ask them what the big outstanding problems are you'll get one of three answers. Membrane associated systems, multi-component complexes, and natively or partially unstructured systems. Conventional approaches to structural biology struggle with all of these cases, providing partial answers. These difficult problems are not going to fall to any one technique and Neutron scattering and reflection can provide complementary information on these systems that can help to crack open the problem. I will give examples of studies on the arrangement of large complexes in solution, membrane associated proteins, and model systems for the study of membrane proteins. I will describe how, in combination with the techniques you are already applying the strategic use of scattering techniques has the potential to get you to a solution faster.

Seminar with:
Dr. Cameron Neylon
Science and Technology Facilities Council
Didcot, United Kingdom

DATE: February 25
TIME: 09:00
PLACE: Onkologiska Klinikens föreläsningssal, Klinikgatan 7

"NEW SCIENCE AT ESS AND MAX IV" SEMINAR SERIES

Application of photons and neutrons in biological and soft matter research
Sine Larsen, Department of Chemistry, University of Copenhagen, Denmark, 26 February 2010.

Bone nanostructure: insights from scanning small angle X-ray scattering
Henrik Birkedal, Department of Chemistry and iNANO, Aarhus University, Denmark, 17 March 2010.

Neutrons, nanomaterials and molecular adsorption
John Larese, Joint ORNL Faculty, University of Tennessee, US, 15 April 2010.

Femtosecond magnetic X-ray scattering
Gerhard Grübel, DESY, Germany, 6 June 2010.

Protein structure analysis using hybrid data; NMR, crystallography and small-angle scattering
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A LOOK TO THE **FUTURE**

The ESS thus has a long and demanding – but very exciting – journey ahead, before it reaches its destination of fully specified operation in 2025.

The construction of the European Spallation Source is a high-profile, high-prestige, high-technology international scientific endeavour. It is the largest scientific project in northern Europe, and will be one of the main large-scale scientific facilities serving European research in basic science and technological innovation.

Mapping out the road ahead

Although the development of ESS is still at an early stage, the road ahead is being mapped out with care to meet the significant challenges of constructing and operating a technically demanding facility within the European context. Work so far has focused on updating the original ESS design and preparing for construction. The aim now is to move ahead in a seamless way through the Pre-construction phase to the Construction and Operation phases. The Memorandum of Understanding signed in Paris in February 2011 outlined the documents to be delivered in two years time, in February 2013:

The ***Programme Plan***, which is updated regularly during the Pre-Construction Phase.

A ***Design Proposal***, consisting of:

- Technical Design Report (TDR)
- Project Specification for Construction Phase
- Preliminary Project Specification for Operation Phase
- Preliminary Project Specification for De-Commissioning
- Collaboration plan
- Transition Plan - Construction to Operation
- Life Cycle management framework

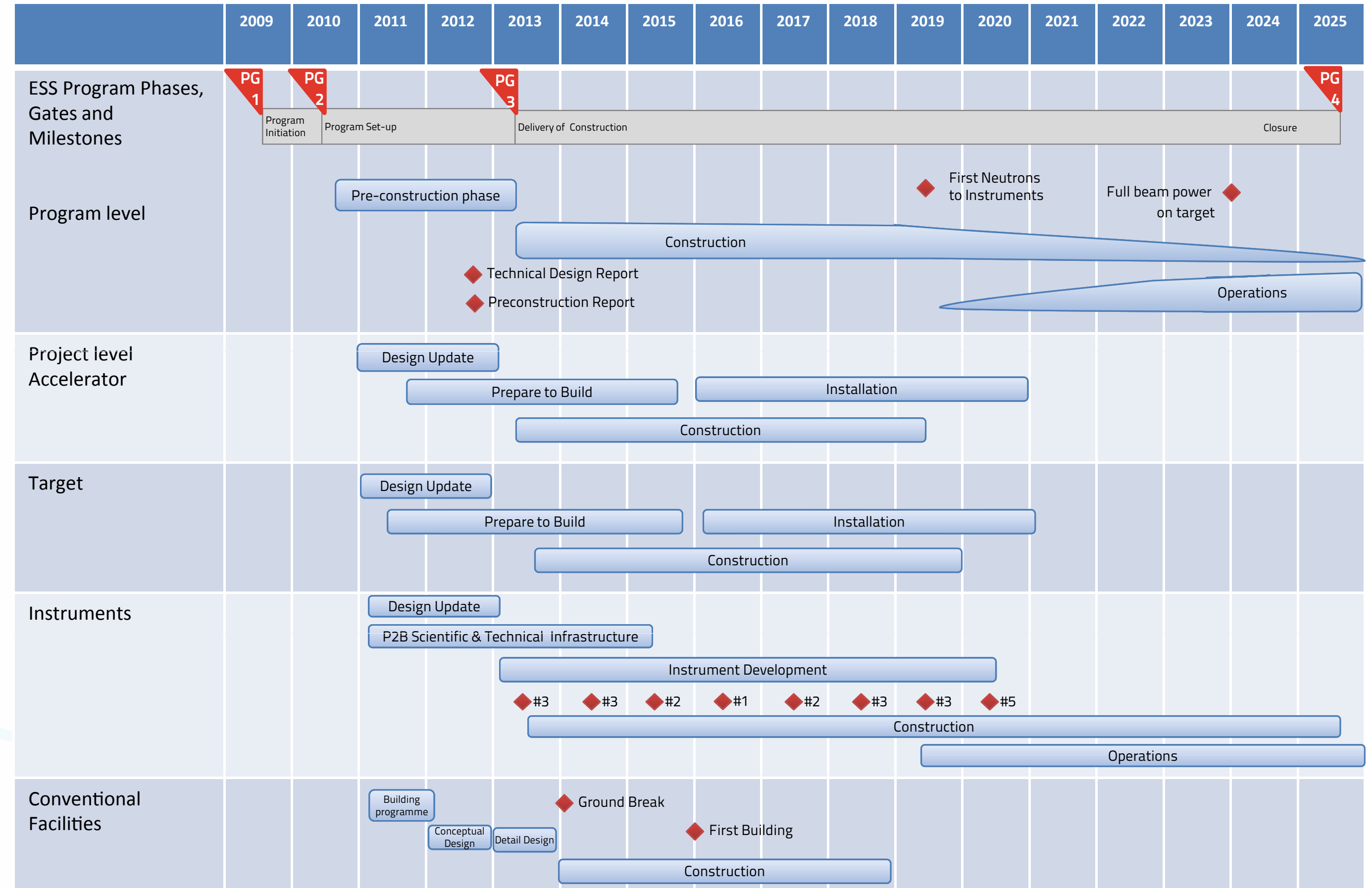
The TDR will specify the final design for the accelerator, target and instruments, as well as integration plans for all the sub-systems. A baseline facility specification should be in place by the end of 2011, and the design of the first seven instruments approved by 2014. The design work is being performed partly by ESS staff, but above all by the institutions and universities participating in the three Collaborations. The collaboration partners provide key competence for the ESS project. The Collaboration for the Accelerator Design Update is already formed, and it is governed by a Board. ESS is currently setting up collaborations for the Target Design Update and the Instrument Programme.

ESS is currently collaborating with more than 40 laboratories in 20 countries and is rapidly creating an ESS community that will together assess scientific requirements, technical developments and the impact of the future of European research, through workshops, conferences and collaborative R&D. Managing the integration and acceptance of component activities is a major element in the Construction and Operation Phases.

The Design Update includes comprehensive analysis of construction and operation of all phases of the ESS project, including the technical specifications for optimal performance and reliability within given cost parameters. Work within the Design Update is progressing according go plan, but the complexity of the work means that challenges remain ahead.

A ***Budget*** for both the Construction and the Operation Phase. Accurate expenditure calculations with relevant bench-marking are crucial to an advanced technical project such as the ESS. An updated cost estimate based on the updated technical design will be produced in late 2012.

A ***Financing Plan*** for the Construction Phase, covering in-kind and cash contributions. Currently, ESS AB depends on capital coming from the Swedish and Danish national budgets, which provide interim support until financing by Partner Countries is legally set out. The Partner Countries will make contributions partly in the form of equipment, goods and services whose management will be crucial to cost control. Legally binding international agreements will be signed with the current 17 partner countries at the end of the Design Update Phase to provide financial and in-kind contributions.



ESS Programme Schedule for Pre-Construction, Construction and Operation.

Meeting the challenges

There are also other important challenges ahead. To meet these challenges requires building on an ongoing dialogue with current and future ESS stakeholders, including local, regional, national and European governments, the research community, industry and the local population.

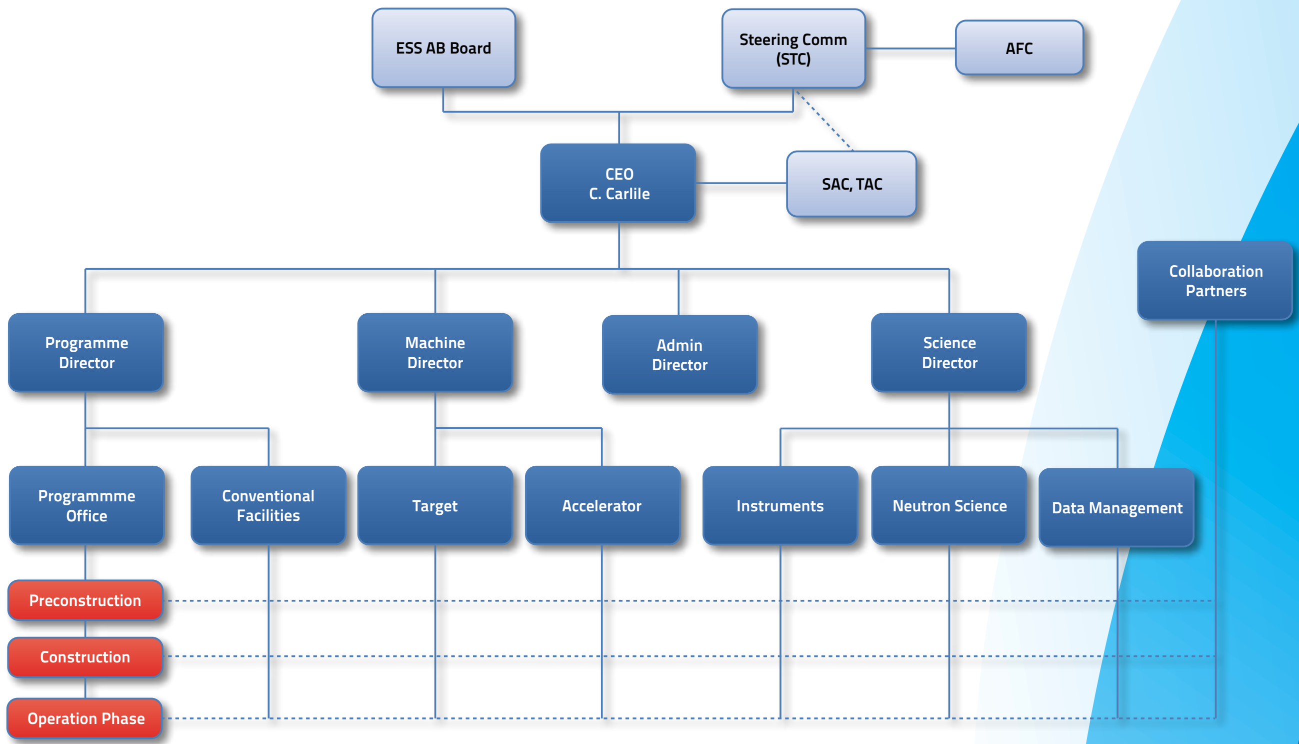
The last Pre-Construction deliverable is therefore a ***Risk Management Plan***, needed to identify and manage the uncertainties involved at different stages of the project. These include risks associated with innovative design of facility components and instruments to meet the future needs of the user community in the light of likely directions of research worldwide. Reducing uncertainties regarding time-tables and budgetary control, including financing and in-kind provision, requires having a comprehensive legal infrastructure to be in place soon. Finally, the challenges associated with effects on the local environment and community, also have to be managed. Professional risk management based on established principles will thus be a decisive element in all ESS AB's operations.

Before the Construction Phase starts, ESS AB must obtain planning permission, which is subject to safety, evaluation of energy use, and community considerations. The aim is to obtain full planning permission for construction before the end of 2012.

The smooth transformation into the construction and operational phases depends on setting up an efficiently functioning organisation, combined with the necessary scale and quality of staff recruitment. The international nature of ESS AB means that it inevitably has a complex organisational structure and governance, which requires a specific legal framework for administration and financing. The aim is to have this framework in place by 2013.

The ESS thus has a long and demanding – but very exciting – journey ahead, before it reaches its destination of producing the first neutrons in 2019 and reaching fully specified operation in 2025.

ORGANISATION



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