European Spallation Source

ACTIVITY REPORT 2009-2010

European Spallation Source AB is constructing a world-leading European materials research centre in Lund, Sweden. ESS is partnered by a large number of European countries.

Affecting **every step** in **everyday** life

The European Spallation Source ESS will be a powerful research tool that uses neutrons to give scientists greater insight than ever before into the nature of materials.

Unlocking the secrets of materials gives us knowledge that can be applied in a wide number of innovative products and processes to enhance our everyday lives, health, and the environment.

Table of **contents**

Materials research based on neutron science helps diverse technologies move forward to improve the fabric of our lives.

Affecting **every step** in **everyday** life

FROM NEUTRONS TO NEW IDEAS

THE ESSENTIAL GUIDE

The European Spallation Source, ESS, will be built in Lund, Sweden. This brief guide outlines the scope, site and schedule of the ESS and the new insights it can offer. Neutron-based research is already making a difference to our lives – the ESS will open up even greater opportunities to generate new life-enhancing ideas.

WHAT IS THE ESS?

The European Spallation Source will be a world-leading multidisciplinary materials research centre. A neutron source for Europe's science community, the ESS facility can be likened to a super microscope, harnessing neutron beams to provide a superior research tool that can give us a greater in-depth understanding of materials at an atomic level.

The ESS facility will comprise of five main elements. An ion source generates pulses of protons, which speed up in a linear accelerator as they head towards the target station. The impact of accelerated protons causes neutrons to be emitted from the target material in a process known as spallation. The neutrons travel through beam guides to an array of measuring instruments, which are geared to collect specific data on the material being studied. The fifth element is the data management centre in Copenhagen, where the research data is analysed.

WHAT WILL BE ON THE LUND SITE?

At the Lund site, **the ESS facility** will be complemented by another research centre, **MAX IV**, which will use synchrotron light to study materials. This combination of technologies is set to create a world-leading centre for materials research. In between ESS and MAX IV, **Science City** will include laboratories, guest hotels, business incubators, and a visitors' centre to create a productive and welcoming environment for scientists to meet and generate new ideas.

WHEN WILL ESS BE READY FOR USE?

Hundreds of leading European scientists have developed and refined the design of ESS. The site decision in favour of Lund opens the way to realising the world-leading neutron source. With a three-year pre-construction phase and a construction period running between 2013-2018, the first research results are expected around 2020. A completion phase between 2019-2025 will culminate in full specification around 2026 and signal the start of 40 years of advanced science for the 5,000 European scientists currently using neutrons for research. ■

WHAT CAN ESS OFFER?

ESS will offer a more in-depth way to study materials. In neutron science, generating more neutrons creates better conditions for obtaining more detailed and realistic research results. ESS will be the world's most powerful neutron source, 30 times more powerful than current facilities of this type. That means ESS can offer more revealing ways to study materials than are possible today.

This research can lead to new discoveries that can be applied in a wide range of areas to benefit people's everyday life, health and the environment. With greater insight into materials it will be possible to optimise and tailor materials and gain benefits in areas such as:

- **Energy:** neutron-based research can be instrumental in generating the materials knowledge to produce more efficient batteries, new biofuels and drive the development of energy-saving hydrogen technology.
- **Health:** researchers will have a new powerful tool to study proteins and cell membranes and how they interact with, for example, pharmaceutical products, which can lead to better medicines with fewer side effects.
- **New materials:** working at atomic levels, neutron science has a natural affinity with nanotechnology. Future research at ESS can make it possible to tailor nano-composite materials for tomorrow's communications technology.
- **Everyday chemistry:** neutrons have already contributed to the development of a large range of everyday products, and there is great potential to advance in areas such as detergents, paint and cosmetics.
- **Climate:** materials research at ESS can help to develop transport solutions that reduce climatic impact, by identifying materials that can contribute to lighter, safer vehicles, cleaner motors and better catalytic converters.
- **Environmental technology:** with neutrons, the potential for developing more innovative materials and more efficient processes is enormous. Future possibilities include bio-degradable plastics and materials to capture carbon dioxide. ■

CLEAR FOR TAKEOFF

EUROPE GETS BEHIND **THE ESS**

To say that the past twelve months have been a pivotal year for the European Spallation Source would be an understatement. The political agreement at the end of May 2009 to choose Lund in southern Sweden as the site for ESS has been widely endorsed by the scientific community in Europe and has resulted in a growing number of countries – currently 14 – joining together to take the project through a three-year Design Update phase and on to construction, so that the European community of researchers will have at their disposal the world's most powerful neutron source.

This has only been achieved through the dedicated work of many people. Of course the energy and determination of the three competing sites – Bilbao, Debrecen and Lund – ultimately ensured that a decision would be taken. This in turn was made possible by the engagement of ESFRI, the European Strategy Forum on Research Infrastructures, which resolved to reach a conclusion about the siting of the facility, but none of this would have been possible without the pioneering work over 20 years of an impressive assembly of talent.

Now the first hesitant steps are being taken to realise in practice the European Spallation Source. The future decade will be no less challenging than the previous two decades. However, all barriers have been removed and Europe is working together. It will once again require an array of expertise, at least as talented and determined as those who have brought us to this point. But there is no shortage of talent in Europe, and no shortage of determination.

Colin Carlile

Colin Carlile
Director of ESS

CLEAR FOR TAKEOFF

A **MILESTONE** YEAR FOR THE ESS

The past year has truly been a milestone year for the European Spallation Source project. Three major events have dominated the year – three events that have paved the way for the actual construction of the ESS.

MILESTONE 1: THE SITE DECISION

YES TO A LOCATION FOR ESS

The decision reached in Brussels on 28 May 2009 had been eagerly awaited by European scientists for more than a decade. The siting of the ESS has been crucial. It has been a go-ahead for the team in Lund and for scientists all over Europe, and a prerequisite for the start of the design work and creating the organisation to build the facility.

> *"Sweden will host Europe's next-generation neutron facility that, once built, will be the most powerful source of neutrons in the world."*
>
> Physics World, 29 May, 2009.

MILESTONE 2: START OF THE DESIGN UPDATE

LAUNCHING THE NEXT PHASE

The three-year Pre-Construction Phase and the ESS Design Update was launched on 23 October 2009 at the first ESS Steering Committee meeting. The ESS technical design will be optimised in the Design Update. Building an international ESS organisation and finalising site preparation activities are key parts of the Pre-Construction Phase.

MILESTONE 3: ESS AB IS FORMED

SETTING UP THE COMPANY

On 20 April 2010 the ESS Secretariat was transformed into a public limited company, European Spallation Source AB. The company will provide a clear framework for the new international organisation. ESS activities are to be transferred gradually to ESS AB over the following months.

OTHER KEY EVENTS FROM 2009-2010:

MAJOR EVENTS OF 2009-2010

AGREEMENT ON MAX IV — APRIL

SITE DECISION: YES TO ESS IN LUND — MAY

SPAIN BECOMES ESS PARTNER — JUNE

LAUNCH OF THE PRE-CONSTRUCTION PHASE — OCT

2009

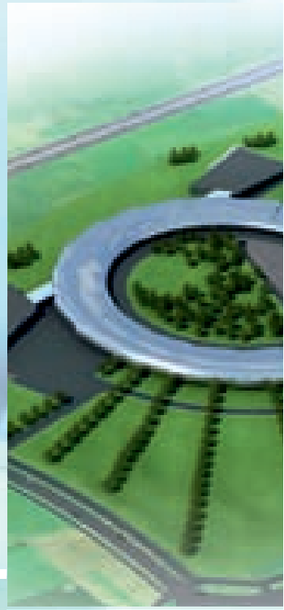
ESS PARTICLE PHYSICS WORKSHOP — DEC

HUNGARY COMES ON BOARD — DEC

ESS INDUSTRY DAY — FEB

ESS AB IS FORMED — APRIL

2010



Future MAX IV synchrotron laboratory. Former Minister Lars Leijonborg announcing the site decision at a press conference at ESS, 29 May 2009. Philippe Chomaz, CEA, at Particle Physics at ESS Workshop.

OTHER KEY EVENTS FROM 2009-2010:

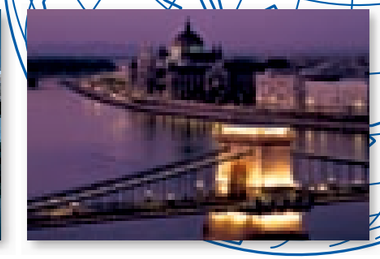
ALL THREE SITE CONTENDERS COLLABORATE

ALL THREE SITE CONTENDERS COLLABORATE

Construction of the ESS will be dependent on European expertise. Today, 14 European countries have committed to ESS as partners. The decision in 2009 of the Spanish and Hungarian teams to collaborate on ESS in Lund means the expertise of former site contenders ESS Bilbao and ESS Hungary will continue to benefit ESS.

SPAIN BECOMES ESS PARTNER

On 10 June 2009, the Swedish Minister of Higher Education and Research, Lars Leijonborg, and the Spanish Minister of Science and Innovation, Cristina Garmendia, signed a Memorandum of Understanding on collaboration. The document outlined Spain's project contribution in areas such as component production and testing.



HUNGARY COMES ON BOARD

The Hungarian Government declared its recognition for the site in Lund on 18 December 2009. Hungary became the 14th partner country, meaning that the ESS will benefit from the invaluable contributions that Hungarian scientists have made to the ESS technical design.

AGREEMENT ON MAX IV

On 27 April 2009, Lund University, Region Skåne, the Swedish Research Council and VINNOVA signed a Memorandum of Understanding on MAX IV, which means a construction start in 2010. Together with MAX IV, a synchrotron light facility, ESS will create a world-leading centre for research on materials, energy and biotechnology.

ESS INDUSTRY DAY

The Industry Day in Copenhagen on 19 February 2010, part of the ESS Preparatory Phase within the EU Research Programme FP7, attracted great interest, with more than 400 industrialists and scientists attending to find out more about the vast R&D potential offered by neutron-based materials research at the ESS.

PARTICLE PHYSICS AT ESS WORKSHOP

The ESS Workshop on Particle and Medical physics held on 2-4 December 2009 in Lund was a great success, attracting more than 100 international scientists. The aim of the workshop was to show the global physics communities the unique research opportunities that the ESS will provide in fundamental and medical physics.

Media coverage of the site decision. Press conference 29 May 2009 with Minister Lars Leijonborg, ESS Secretariat, Lund.

GETTING A SITE DECISION

PAN-EUROPEAN **SUPPORT** FOR ESS

After several years of negotiations, an agreement was made in 2009 between 14 European countries to become ESS partners and build the most powerful source of neutrons in the world.

The Swedish government's declaration of intent in February 2007 was the starting signal for ESS Scandinavia's strategic negotiations with European governments and research institutes. In parallel, negotiations have been led by ESS Bilbao and ESS Hungary, proposing Bilbao and Debrecen, respectively, as sites for the ESS. At all three sites, crucial expertise has been built up to drive forward the ESS project.

The three phases of negotiations for the Lund bid have been led by Allan Larsson, the Swedish government's Chief Negotiator and former Minister of Finance, in cooperation with the ESS Scandinavia Secretariat at Lund University, the Swedish Research Council and Swedish Embassies.

Allan Larsson's final report to the Swedish government in December 2009 describes the negotiation process and confirms how far the ESS project has come in a short time. (See box on page 15.)

ALL THREE SITES JOIN FORCES

Following a lengthy, in-depth and detailed process involving most European countries and the future user community, a decision was taken in Brussels on the evening of 28 May 2009 by a group of European research ministers to locate the ESS in Lund.

On 10 June 2009, the Swedish Minister of Higher Education and Research, Lars Leijonborg, and the Spanish Minister of Science and Innovation, Cristina

Fifth ESS Round-Table, Krakow, September 2009. Mats Johnsson (S), Lars Kolte (DK), Allan Larsson, Marek Jezabek (PL), Christian Vettier, Patrik Carlsson.

Garmendia, signed a Memorandum of Understanding on collaboration. The agreement means that Spain will contribute to the ESS with a site for testing ESS components, a facility in Bilbao for manufacturing certain accelerator components, and a remote access centre for Spanish scientists.

On 18 December 2009, the Hungarian Government declared its recognition for the site in Lund, making Hungary the 14th Partner Country and giving it a place on the Steering Committee. Other countries are either preparing Memoranda of Understanding or considering other forms of support for the ESS.

The decision on a site for ESS was a great success for Europe and for European research, bringing an end to 15 years of uncertainty about the ESS siting. With the ESS, European science will gain a new, powerful neutron source that will safeguard its world-leading position in neutron-based research and also provide new scientific opportunities that we can not imagine today.

COLLABORATION GIVES STRENGTH

The ESS is a joint European multinational project. Sweden and Denmark will be the co-hosts of ESS, with the ESS Data Management Centre located in Copenhagen. The negotiation process over three years has secured a strong commitment from a total of 14 European countries, creating a coalition to participate in the joint building, owning and operating of ESS in Lund.

Construction of the ESS will be dependent on European expertise, especially the expertise that has been built up and the R&D that has been done by the three former site contenders ESS Scandinavia, ESS Bilbao and ESS Hungary.

The Hungarian science community has got a leading role in European neutron science, and has been pivotal for the development of related science. In Bilbao, the Spanish ESS team has contributed with innovative R&D that will benefit the ESS Design Update. Therefore, the decisions in 2009 by the Spanish and Hungarian teams to collaborate on ESS in Lund were greeted as all-important steps.

FORMATION OF THE ESS STEERING COMMITTEE

The ESS Steering Committee was formed in October 2009 and launched the three-year Pre-Construction Phase and the ESS Design Update at its first meeting.

In the Design Update, a large number of scientists and engineers from leading laboratories will collaborate in order to optimise and update the ESS technical design. The Pre-Construction Phase will entail the building-up of the international organisation that will construct and operate the ESS, the concluding of the licensing and planning processes, and the finalising of financial and in-kind contributions.

The ESS Steering Committee comprises delegates from all committed countries. It will drive the ESS project forward and be involved in decisions about future research programmes and the technical design of ESS, what will finally be built, and how the facility will be financed.

The members of the ESS Steering Committee are Germany, France, Spain, Italy, Switzerland, Poland, Hungary, Norway, Iceland, Estonia, Latvia, Lithuania and co-hosts Sweden and Denmark. Discussions and negotiations are continuing with several other European countries on participation in the ESS. ■

"The decision on a site for ESS was a great success for Europe and for European research, bringing an end to 15 years of uncertainty about the ESS siting."

STRATEGIC NEGOTIATIONS SUMMARY

Phase 1 Informing governments

- Information on the Swedish offer to host ESS and the consultation process for the negotiations was given to governments in around 20 countries.
- Phase 1 concluded in 2007 with Sweden receiving broad support for its approach in conducting the negotiations.

Phase 2 Focusing on technology

- Consultation with research institutes in Europe, USA and Japan regarding the technology required for ESS.
- Phase 2 concluded in 2008 with a positive reception for the technical approach proposed for ESS in Lund.

Phase 3 Gaining political support

- Negotiations aimed to gain political support for ESS siting in Lund and prepare for further steps, such as the technology update and financing.
- Phase 3 concluded in 2009 with a positive decision in favour of Lund and 14 countries committed to take part in the construction of ESS.

ESS contributes to the FZ Jülich Neutron Spin Echo spectrometer at SNS, Oak Ridge. Courtesy FZ Jülich.

Small photos, from top:
Therése Welander and Andrew Taylor, ISIS, at ICNS.
Christian Vettier and Axel Steuwer at ICNS.
Dimitri Argyriou, Chair ESS SAC.
Analysing a protein.
Lise Arleth, ESS SAC.

ENHANCING RESEARCH POTENTIAL

SCIENCE **IN FOCUS**

The scientific output of the ESS will be dependent on designing optimum neutron instruments for long pulse neutron source parameters.

The ESS will take advantage of the three-year Design Update phase to define the instruments and scientific facilities that will enable neutron scientists to utilise the ESS facility for innovative research.

SETTING UP SCIENTIFIC GOALS

During the pre-site decision period, the ESS Scandinavia team prepared the ground for an iterative optimisation of the ESS in order to maximise the scientific output in a cost-effective manner. Indeed, ESS success will be gauged by the value of the scientific use that scientists obtain from it more than a decade from now.

The prime specification of the ESS project is to guarantee scientific output of ESS and the best technical performance. Therefore, the scientific potential of the ESS neutron instruments must be the driver for the design of the neutron source – the accelerator, target and moderators.

The ESS Scandinavia Science Advisory Group (SAG) under the guidance of Robert McGreevy (ISIS STFC) defined criteria for success in terms of organisation, funding mechanisms and critical machine parameters, in particular the proton pulse length and the pulse repetition rate produced by the linear accelerator, as well as its reliability.

The newly created ESS Science Advisory Committee (SAC) was approved by the ESS Steering Committee. The SAC will provide international advice and external moderation to the ESS Director General on scientific specifications and the goals to be achieved by ESS. In particular, the SAC will discuss all the relevant scientific and technical issues related to the production of neutron beams, the choice of neutron instruments, the scientific infrastructure to be developed at ESS and the operation of ESS. The committee is composed of potential users from different disciplines who will use ESS neutron beams, and scientists with expertise in neutron scattering methods. Membership of the SAC will rotate on a three-yearly basis. The SAC will be chaired by Dimitri Argyriou (Helmholtz Zentrum Berlin) and will hold its first meeting in June 2010.

ESS will progressively define a list of potential instruments in full collaboration with the scientific community in Europe. A series of meetings have been and will be held to define the priorities for the neutron instrument suite and the scientific facilities that will allow researchers to carry out their best science at ESS. Preliminary reviews of instruments for ESS were carried out under the auspices of the SAG. In parallel, instrumentation workshops have been organised in collaboration with scientists from several neutron centres in Europe and with the University of Copenhagen and Risø in Denmark.

The new SAC will engage in discussions with the whole neutron user community in Europe. An ESS User meeting is scheduled for 21st & 22nd March 2011 and will be prepared by a series of ESS Experts Meetings and topical workshops organised with the neutron community.

Neutrons, and low energy particle physics.
D. Dubbers, Heidelberg University, 12 February, 2009

Structure and mechanical function of biological materials.
P. Fratzl, Max Plank Institute Postda, 6 March, 2009

Spectroscopic methods in biogeochemistry.
P. Persson, Umeå University, 2 June, 2009

Neutron scattering: Understanding biological structure and function.
D. Myles, SNS Tennessee, 9 June, 2009

Magnetism and superconductivity: Enemies or allies?
T. Forgan, Birmingham University, 24 September, 2009

Structure and dynamics at liquid interfaces.
M. Tolan, Dortmund University, 12 October, 2009

ESS DATA MANAGEMENT CENTRE

It is essential that vigorous programmes for development of beam line instrumentation are launched even at this early stage of the project. Instrument control and data acquisition, detectors and sample environment require special attention. ESS is setting up an active instrumentation team, which will optimise neutron methods for ESS.

The modelling of neutron beam lines and potential neutron instruments is currently done at the ESS Data Management Centre based at the Niels Bohr Institute in Copenhagen. Scientists at the DMC have launched a long-term project to model ESS neutron instruments in order to determine the optimum parameters for the ESS as an indisputable long-pulse neutron source. Furthermore, the neutronics studies for the ESS target and moderators have been made feasible due to the DMC granting access to several hundred of its computer cores. The DMC will also ensure that comprehensive software packages for data treatment and analysis are available long before ESS produces its first neutron beams. ESS will coordinate efforts at different centres in Europe that are interested in making more efficient instrument control accessible during experiments. The DMC group will be expanded to ensure efficient running of all modelling tasks.

On the technical front, the ESS is a leading player in a concerted European initiative to develop new neutron detectors in joint collaboration with other neutron centres. Neutron detection involves neutron capture by absorbing nuclei. Until recently, ^{3}He gas was used to build large area neutron detectors because of its special properties. Today, ^{3}He has become a scarce resource and the needs of worldwide neutron scattering are expected to far exceed supply. The ESS has initiated a collaboration to explore the potential of boron in solid form (thin films) together with the ILL Detector Group and Linköping University in Sweden. This project will involve neutron tests at the JEEP II reactor in Kjeller, Norway.

NEW SCIENCE AT ESS & MAX IV SEMINARS

ESS Scandinavia has initiated a series of symposia – the "New Science at ESS & MAX IV" Seminar Series – at the University of Lund in collaboration with the Science faculty. The purpose of this initiative was to raise awareness among scientists of the potential benefits that the planned large-scale facilities, the synchrotron MAX IV and the neutron source ESS, would bring to the scientific community. Renowned experts (see above) have been invited to present their research findings and views on the future of research at neutron and synchrotron x-ray facilities. Internal ESS seminars have also been organised in order to exchange views on technical and scientific issues.

Small angle scattering experiments applied to soft matter.
P. Schurtenberger, Fribourg University, 15 December, 2009

Bone nanostructure: Insights from scanning small angle x-ray scattering.
H. Birkedal, Aarhus University, 17 Mars, 2010

Femtosecond magnetic x-ray scattering.
G. Grübel, DESY, Hamburg, 10 June, 2010

Application of photons and neutrons in biological and soft matter.
S. Larsen, Copenhagen University, 26 February, 2010

Neutrons, nanomaterials and molecular adsoption.
J. Larese, University of Tennessee, 15 April, 2010

These seminars have demonstrated the breadth of science that can be covered by neutron and synchrotron methods. They have also illustrated the impact that such facilities can have on local research institutions.

PARTICLE PHYSICS AT ESS WORKSHOP

ESS is organising workshops and meetings that focus on scientific and technical issues related to the Design Update phase. An important conference was held in Lund between 2-4 December 2009, covering research opportunities within Neutron, Neutrino, Nuclear, Muon and Medical Physics at ESS. The workshop, run by Mats Lindroos, brought together more than 100 international scientists who have proposed new experimental projects at the ESS.

Instrumentation workshops are being run to propose imaginative instruments that will fully benefit from the time structure of the neutron beams at ESS. The first, held on Ven Island, Sweden in October 2008 was followed by workshops at Frascati in August 2009 and again on Ven in May 2010.

Seminars and presentations are given at many scientific conferences and workshops by ESS staff to develop and nurture the interest that ESS has raised in the scientific community.

TRAINING AND OUTREACH

ESS is building up a scientific activity focused on the training of scientists and outreach to the scientific communities that will exploit ESS in the future. ESS scientists are developing new neutron methods and experimenting with modern spallation sources. Maths Karlsson is testing new polarisation methods for the structure determination of biomaterials. Melissa Sharp is contributing to the commissioning of a neutron spin-echo instrument at the Spallation Neutron Source in Oak Ridge, USA. Axel Steuwer, while performing neutron and synchrotron experiments, is lecturing at many universities in Europe to develop a broad user base. A school on neutron instrument modelling is being organised by scientists at the DMC in collaboration with the Technical University of Copenhagen and NMI3. The PhD programme at ESS, which was launched with our first PhD student, Sofie Botegard, will expand in the years to come.

INDUSTRIAL OUTREACH

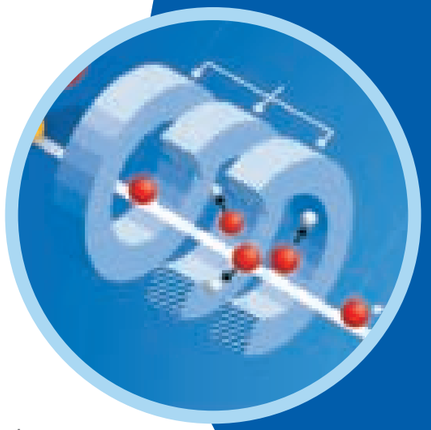
ESS is also actively promoting the use of neutrons in industrial R&D. The number of companies visited rose sharply during the year, reflecting growing interest within industry for the potential benefits of neutron-based materials research. Visited companies included AB Volvo, Scania, Swedish Space Corporation, Tetra Pak, SCA, Autoliv and Sandvik.

ESS staff has also arranged several meetings with business & industry around Europe. As part of the FP7 ESS Preparatory Phase Project, ESS visited the Chambers of Commerce in Padua and Genua in February 2010. French industrial representatives have been informed about possibilities to participate in the construction of ESS at a workshop in Paris in February 2010. In April 2010, a road-show was organised in Germany, in order to link to industry in Hamburg, Munich, Darmstadt and Stuttgart.

The workshops have generated much interest, and the turn-out has been impressive. It has been especially rewarding to note the positive feedback from a large number of SME's, due to ESS ambition to invite business at an early stage of the project. ■

LAUNCHING THE DESIGN UPDATE

EUROPEAN BY DESIGN



The ESS Design Update phase will focus the technical development efforts of the ESS Target Station and Accelerator teams for the next three years and involve collaboration with research institutes and companies from all over Europe.

Building a neutron source capable of considerably expanding our scientific horizons is an idea that originates from Europe. The original ESS conceptual design, published in 2003, was made by several hundred scientists and engineers from 11 European countries.

The technical design of the ESS will now be updated and optimised in the Design Update, which was launched by 13 Partner Countries in October 2009. Sweden's Government is to contribute 30 M€ to the Design Update, in order to secure a successful build-up of expertise and a strong central team in Lund to manage the design work. Substantial contributions to the Design Update will also be made by other Partner Countries, whose technological competence will be crucial for optimising the ESS Design.

Like the original design, the Design Update will be a truly European undertaking, utilising the expertise of many of Europe's leading research institutes and companies. Recent advances in other similar projects, such as SNS in the USA and J-PARC in Japan, will also be taken into account to further optimise and update the ESS Scandinavia reference design. The Design Update phase is planned to be concluded by the end of 2012.

SPEEDING UP THE ACCELERATOR DESIGN

For the ESS Linear Accelerator, the Design Update will be prepared within a Pan-European collaboration. The aim is to produce, by the end of 2012, a Technical Design Report for the accelerator, including full cost to completion.

The Design Update will be based on preliminary work already performed within the ESS Bilbao and the ESS Hungary initiatives. The Technical Project Plan (TPP) contains eight major Work Packages led by different partner institutions, working with other collaborating institutes.

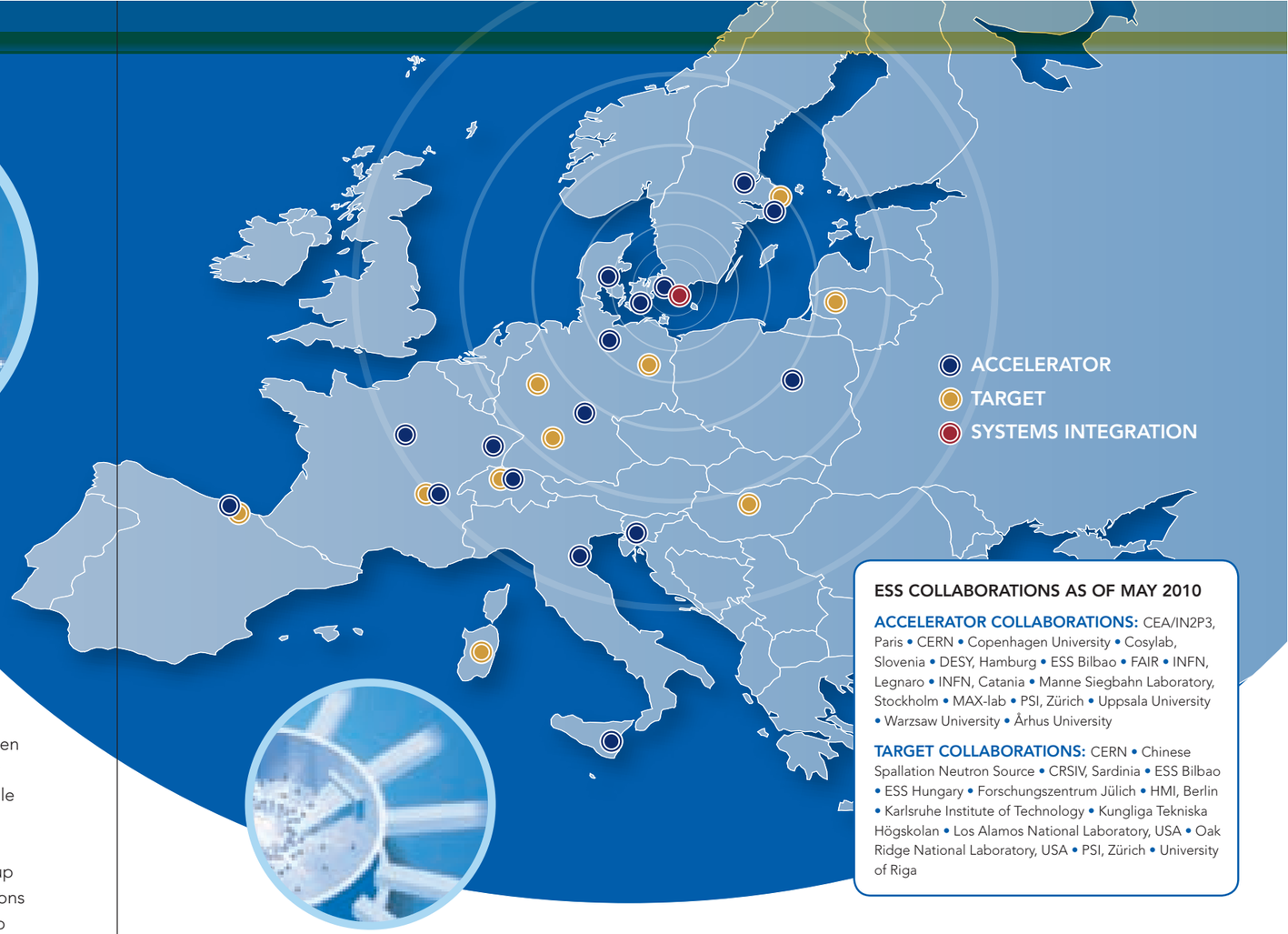
Each Work Package will contain several Work Units, with leadership distributed among all participants. A few work unit leaders will be part of the Lund staff in order to initiate team building as soon as possible, which is necessary for the operation of the future facility.

Planning responsibilities for the Design Update Project Plan have been distributed among the ESS member state institutes that took an active role during 2009 in the preparatory work at the ESS Bilbao workshop, and in the ESS Scandinavia Reference Group meetings. Geographical considerations have also been taken into account to ensure all ESS countries can participate through strong regional nodes.

The Technical Project Plan will be reviewed by the ESS Technical Advisory Committee, and presented to, and approved by, the Steering Committee. It will be financially audited before work starts on 1 January 2011.

MACHINE DESIGN

The Accelerator Division recognises the need for configuration management of the accelerator design. Since the geometry and structure of the design affects so many of the engineering subsystems connected to the accelerator, proper control of the design in the early stages of the project is essential and is on the critical path for the Technical Design Report due in 2012.



ESS COLLABORATIONS AS OF MAY 2010

ACCELERATOR COLLABORATIONS: CEA/IN2P3, Paris • CERN • Copenhagen University • Cosylab, Slovenia • DESY, Hamburg • ESS Bilbao • FAIR • INFN, Legnaro • INFN, Catania • Manne Siegbahn Laboratory, Stockholm • MAX-lab • PSI, Zürich • Uppsala University • Warzsaw University • Århus University

TARGET COLLABORATIONS: CERN • Chinese Spallation Neutron Source • CRSIV, Sardinia • ESS Bilbao • ESS Hungary • Forschungszentrum Jülich • HMI, Berlin • Karlsruhe Institute of Technology • Kungliga Tekniska Högskolan • Los Alamos National Laboratory, USA • Oak Ridge National Laboratory, USA • PSI, Zürich • University of Riga

During the past year a system has been created that begins to address machine design management. We have imported a database schema used at RHIC and SSCL into one of the MySQL servers, a Relational Database Management System (RDBMS) operated by Lund University computing services for ESS.

This database has been built with the design of the accelerator provided by the Accelerator Division via a TraceWin description. We have also built software tools that connect to the MySQL server database and output the design in other formats for use by programs that calculate the geometry of the accelerator as well as other beam dynamics programs such as Trace3d.

The development of this system is ongoing in order to realise ideal configuration management: one source for the design with many different users.

CONTROL SYSTEM

With regard to the design and scope of the Accelerator Control System, the Accelerator Division contracted with Brookhaven National Laboratory (BNL, USA) and personnel from Control System Laboratory (CosyLab, SIovenia) to develop a strategic plan for the ESS Control System. The study was constructed by utilising knowledge from other operating linear accelerators via collaborative links to SNS and ITER, and from ESS personnel and CosyLab. The study's recommendations will serve to provide guidance to ESS in the drafting of the Control System design over the next few years.

MINIMISING POWER CONSUMPTION

The accelerator will be powered by at least three different RF source systems, one for each of the accelerator's normal conducting, spoke and elliptical sections. The average power consumption over a year for the elliptical RF source is estimated to range between 15 and 20 MW and hence accounts for half the power budget for ESS as a whole. Therefore, a high priority is a dedicated test facility for the RF source and distribution system for the elliptical section of the accelerator. Of particular interest is research on, and development of, the integration between klystron,

“Great efforts are being made to build collaborations for the ESS Design Update Phase.”

Patrik Carlsson, Director for Projects. Etam Noah, ESS/CERN. Ferenc Mezei, Head of Target Division. Mats Lindroos, Head of Accelerator Division. Mats Lindroos, Christina Oyon, Francois Plewinski, all ESS.

modulator and low level RF systems, with the objective of minimising power consumption and optimising linear accelerator performance and reliability.

A critical component of the RF power system is the klystron modulator, which generates high voltage pulses to a klystron. To increase the number of potential sources of klystron modulators we are encouraging companies with similar and well-proven solutions to develop products to generate the pulses required for ESS.

STRENGTHENING THE ACCELERATOR TEAM

Efforts to greatly enhance the strength of the Accelerator Division’s technical core in Lund began soon after the ESS site decision. One challenge is to expand as rapidly as possible, while recruiting only individuals with world-leading abilities. We are finding that this challenge can be met, as the best candidates recognise the ESS to be a unique and exciting opportunity.

Another challenge is to achieve the correct mix of senior and junior professional staff – from physicists and engineers with decades of experience designing, building and commissioning large-scale scientific projects and accelerators, through to technical staff fresh out of university. The recruitment process is well on the way to establishing an initial critical mass of technical staff in Lund by the late summer of 2010, but will continue vigorously into 2011.

NEW STUDENT PROGRAMME

To encourage students to seek a future in accelerator physics, the ESS Accelerator Division has initiated a student programme in accelerator physics. The objective is to allow Master and PhD students from external institutes to do research at ESS. Initially, during the second half of 2010, three master students from Warsaw University and two from the Lund Institute of Technology (LTH) will carry out projects for the ESS Linear Accelerator.

FOCUS ON THE TARGET

Work has commenced on identifying, defining and communicating technical solutions for the Design Update phase of the Target Station. ESS is focusing its target-related efforts on exploring new and wide-ranging options to produce an optimised design for a high power long pulse target station.

Different solutions – lead bismuth alloy and pure lead – are being studied as an alternative to mercury for the target material in order to identify the most suitable material. A variety of rotating solid tungsten target solutions and windowless target concepts have been considered.

The first simulations concerning radioactive inventories and shielding for candidate concepts have been carried out. The Target Station team has also been involved in the latest modifications of the Monte Carlo neutronic code, Fluka, a code that CERN developed to be adapted to the ESS Target conditions.

Discussions have been initiated with Copenhagen University and the Risø Laboratory, world-leaders in instrument simulations, concerning their neutron guide and instrument simulations and how they could be applied to coordinate the Target Station’s simulations.

BUILDING COLLABORATIONS

Efforts are being made to build collaborations for the ESS Design Update phase by establishing technical contacts with European institutes that could participate in studying different technical solutions for the Target Station.

This initiative has resulted in strengthened collaboration with the main experts in the relevant field from PSI, Zürich, the University of Madrid and ESS Bilbao, the ForschungsZentrum Jülich and Karlsruhe Institute of Technology, the University of Riga and CERN.

Extended discussions and technical investigations were initiated with similar projects, to identify existing knowledge and experts on material issues and liquid metal technologies, simulations and tests facilities.

The ESS Target Station group was involved in a wide range of workshops and conferences during the year including: the ESS Bilbao workshop, the High Power Linac workshop at FermiLab (USA) and the High Power Targetry meeting at J-PARC in Japan.

The Design Update phase will require a considerable strengthening of the Target Station team. A global recruitment plan has been drawn up identifying the need to find personnel for key positions over the next two years.

ESS INDUSTRY DAY

Being a large, technically advanced project and a scientific flagship project, the ESS attracts much interest from European industry wanting to participate in the construction. Some of the project’s R&D will be made in collaboration between ESS scientists and industry. The aim of the ESS Industry Day, held in February in Copenhagen, was to forge links to such companies, presenting general project information, the time plan, and informing about procurement procedures.

“As we set the ESS design, we are pushing the frontiers of science.”

Ferenc Mezei
One of the originators of the ESS design concept

The programme also included presentations on the R&D possibilities of using neutrons for materials research and life science.

A common theme in the keynote speeches was the importance of European collaboration in the ESS project, and the key role of ESS in increasing European innovation and growth. The keynote speakers were: Peter Honeth, State Secretary at the Swedish Ministry of Education and Science, Inge Maerkedahl, Director for the Danish Authority for Research and Innovation, and Juan Carlos Cortes, Director of Industry for the Spanish Ministry of Science.

The success of the event and its potential to generate interest that can lead to long-term commitment means plans are now in hand to make ESS Industry Day a regular event held at 18 month intervals. ■

BUILDING THE ORGANISATION

A GROWING EUROPEAN TEAM

With a rapidly expanding team and the recruitment of key experts, the ESS organisation is evolving to reflect a truly European project.

During 2009 the staff of the ESS Secretariat continued to grow from 30 to more than 40 people. Through collaborations with other leading European and American laboratories the Secretariat has gained from successful recruitment of both technical and scientific expertise via secondment and direct employment.

With the site decision behind us, the Europeanisation of the ESS organisation is well underway. Today, 50% of the staff is non-Scandinavian and the team represent nine nationalities. Though the head offices are located in the city of Lund in Southern Sweden, a number of our staff are stationed abroad at collaborating research facilities, such as CERN, SNS in Tennessee, CEA in Paris and at Uppsala University in Sweden. The integration of partner countries and collaborations with international expertise will continue at an even higher rate in the years ahead.

RECRUITMENT CAMPAIGN

The transition to the three-year Design Update phase has required a large recruitment campaign for more scientific and technical personnel, a drive that started in early 2010. One successful result of this campaign was the recruitment of Ferenc Mezei, an internationally renowned scientist, and former Scientific Director of ESS Hungary, who joined the ESS team in April as Head of the Target Division.

Another 30 positions have been created within the Accelerator, Target and Science divisions. It is satisfying to see that candidates from all over the world are interested in working for the ESS project. The new staff are expected to be in place spring/autumn 2010, giving a projected number of 70 staff members by the end of the year.

Increasing the number of technical and scientific staff also means expansion of the team serving the rest of the organisation, mainly within HR, IT, Finance and Procurement. The build up of core competence in the organisation will continue during 2011.

Other important recruitments to be made in the coming year are for three key positions; Project Leader, Head of Administration and Head of Finance. A search committee with delegates from the ESS partner countries has been nominated to guide and advise on the process of finding the best candidates. With a growing organisation comes an increasing demand for office space.

The expansion of the Secretariat has begun and the goal is to remain in the offices at Stora Algatan, in central Lund, until we move onto the site in 2015.

ESS Scandinavia was created as a Secretariat within Lund University in 2007 and the transition to a new legal body means a significant change from a public authority to a private company, not only from an administrative point of view, but also for the staff. Much of the present work of the Secretariat is dedicated to preparing the legal, formal and practical parts of the transition.

> *“The transition to the three-year Design Update phase has required an intensive recruitment campaign.”*

FINANCE 2009

PREPARING THE WAY WITH FP7

An EU-funded programme, the ESS Preparatory Phase, has provided valuable assistance in laying the groundwork for carrying through the ESS project.

The ESS Preparatory Phase, a project within the EU Research Programme FP7, concluded on 31 March 2010 after a series of successful collaborations within several work packages. The 5 M€ programme served a valuable purpose in regularly bringing together the leading European laboratories with an interest in ESS, including the three site candidates, ESS Scandinavia, ESS Bilbao and ESS Hungary.

In the original draft Call for Proposals from Brussels almost three years ago, one of the key goals set for the Preparatory Phase was to arrive at "a signature-ready agreement" on the location and construction of, in this case, ESS. With the help of the ESS Preparatory Phase, this goal has been achieved. Furthermore, extensive work was carried out on management models, governance models, access for users, publicity, industrial involvement, planning and licensing, safety issues, costing and specific R&D activities.

One of the most useful aspects of the ESS Preparatory Phase project was a benchmarking cost study carried out on the SNS, independently of the costings conducted by the three site candidates. This study aimed at defining a cost for building SNS, suitably modified, in Europe at today's prices. From an ESS perspective, the big advantage of this comparative costing exercise is that the construction of SNS is based on real experience and therefore on actual costs. ■

FINANCE 2009

During 2009, new income amounted to 3.58 M€. Carry in for 2008 was 1.34 M€. Total expenditure amounted to 5.01 M€.

The main income source during 2009 for the ESS Scandinavia Secretariat, has been funding via the Swedish Research Council, following decisions by the Swedish Government. This funding has allowed ESS to recruit some of the core competence that is needed for the building up of the future international organisation and managing the Design Update, and thus lay the foundation for the current ESS AB.

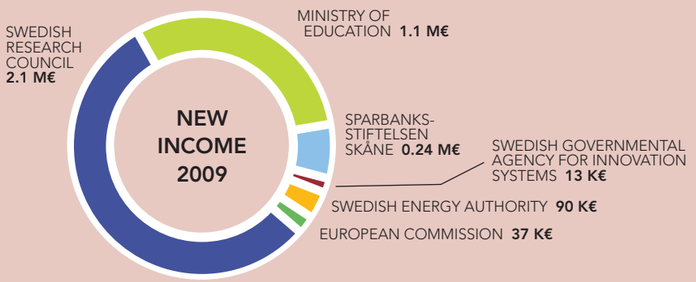
ESS Scandinavia also received funding from other sources, mainly governmental authorities. Funding from the Swedish Energy Authority and the Swedish Agency for Innovation Systems has been important for developing the ESS energy management programme, which is unique in the scientific community.

The generous three-year funding from Sparbanksstiftelsen Skåne has allowed ESS to build up its business liaisons department, as well as develop a detailed, updated costings database for the construction of ESS, benchmarked against the SNS.

ESS has also received funding from the European Commission, in order to participate in the EU FP7 programme, ESS Preparatory Phase. In the Preparatory Phase eleven European universities and laboratories have collaborated to study different aspects of the future ESS organisation, such as governance, legal issues, and organisational model.

In the Government's budget proposition, as presented in September 2009, 300 MSEK (approx 32 M€) is granted for the ESS Design Update Phase.

During the Design Update, ESS AB will also receive substantial contributions from other Partner Countries. Among them, Spain will contribute with a site for testing ESS components, a facility in Bilbao for manufacturing certain accelerator components, and a remote access centre for Spanish scientists. Hungary will actively work for the realisation of the ESS through in kind contributions and funding to the technological design update.



Exchange rate as of 1 January 2008

Small photos, clockwise from left: Inge Maerkedahl, Director, Danish Authority for Research and Innovation. Sebastian Schmidt, ESS Steering Committee. Sven Landelius, President of ESS AB Board. Kurt Clausen, Chair ESS TAC.

State Secretary Peter Honeth, Chair ESS Steering Committee.

BUILDING THE ORGANISATION

INTRODUCING **ESS AB**

With the setting up of the company, ESS AB, and the creation of the Steering Committee, there is now a basic and clear framework for building the new international organisation, which is a prerequisite for the successful construction of the ESS.

The past year has brought major changes to ESS governance and has in many ways been a transition period as the organisation develops to meet the long-term challenges of implementing the ESS project.

ESS STEERING COMMITTEE

The ESS Partner Countries are represented in the Steering Committee. The fifth and final ESS Round Table, held in Krakow in September 2009, planned the next steps for ESS and discussed the conditions for partnership in the project. At that meeting a Letter of Intent from the Swedish and Danish governments was tabled inviting interested countries to join with the two declared co-hosts in building ESS. The Steering Committee will deal with issues concerning research areas, costings, in kind contributions, scientific and technological management and HR policy.

Thirteen countries were represented at the first meeting of the ESS Steering Committee in Copenhagen on 22-23 October 2009, chaired by Peter Honeth, Swedish State Secretary for Research. The thirteen countries were: Sweden (co-host), Denmark (co-host), Norway, Estonia, Latvia,

ESS AB GOVERNANCE AT A GLANCE

ESS Steering Committee
Representatives from ESS Partner Countries. Deals with matters such as research areas, in kind contributions, and scientific and technological management.

ESS AB Board
Legally and financially responsible for ESS AB under Swedish company law.

Technical Advisory Committee
Advises the Steering Committee and the ESS Organisation on matters relating to design and construction.

Scientific Advisory Committee
Advises the Steering Committee and the ESS organisation on scientific matters and instrumentation.

Administration and Finance Committee
Provides the Steering Committee and the ESS organisation with advice and monitoring relating to financial and administrative matters.

Stakeholders Group
Represents local, regional, political, industrial and academic interests.

MEMBERS LISTED ON PAGE 42

Lithuania, Iceland, Poland, Germany, Switzerland, Italy, France and Spain. At the second Steering Committee meeting the Hungarian government took its place at the table, thereby bringing together the three site contenders.

SETTING UP OF ESS AB

On 20 April 2010 the Swedish Government announced the transformation of the ESS Scandinavia Secretariat into a public limited company, the European Spallation Source ESS AB, a process that is expected to be finalised in the second half of 2010.

ESS AB has been established to plan, design, finance, construct, own, manage, operate and maintain the European Spallation Source research facility. The company will be a public limited company under Swedish company law, owned initially by the two co-hosts, the Swedish and the Danish Governments. Once the company is established, part of the shareholding can be sold to other partners.

ESS AB BOARD

The company will have a board consisting of both Swedish and Danish members governing, and being legally and financially responsible for, the activities of the project. Presently the ESS Steering Committee cannot assume such responsibilities and therefore an operational understanding between the ESS AB Board and the ESS Steering Committee has been reached to ensure smooth and authoritative decision-making.

The Board is chaired by Sven Landelius, the former CEO of the Öresund Bridge Consortium. All members of the ESS Board will serve in their individual capacity and not as representatives of their employer. The Chairman of the Board will attend ESS Steering Committee meetings to ensure good communications.

A YEAR OF TRANSITION

The constellation of groups that made up the governance and advisory structure supporting the ESS Secretariat since 2007 has undergone many changes during this transition year. Prior to the site decision each of the three candidate sites had their own legal status. In the case of ESS Scandinavia this was provided through Lund University where a Supervisory Group under the chairmanship of the University Rector Per Eriksson oversaw the activities.

In the spring of 2009 when the mandate of the Secretariat was prolonged, it was decided to replace the Supervisory Group with an ESS Scandinavia Board within the University. This interim board was set up to bridge the transition period before full operation of ESS AB, when the ESS AB Board will take over the legal responsibility and governance. The ESS Scandinavia Board has met three times, advising and monitoring the work of the Secretariat.

TECHNICAL AND SCIENTIFIC ADVISORY COMMITTEES

As part of the setting up process for the governance of ESS, the Steering Committee has set up an Administration and Finance Committee (AFC), led by Morten Scharff, and Technical and Scientific Advisory Committees under the chairmanship respectively of Kurt Clausen from PSI near Zürich and Dimitri Argyriou from HZB in Berlin. The inaugural meeting of the AFC took place in Lund on 16 March.

STAKEHOLDERS GROUP

In the early years of the ESS Scandinavia campaign a number of representative groups representing stakeholders in Scandinavian academia and local government were set up. With the changing status of ESS, these groups have now evolved into one single Stakeholders Group chaired by Henning Christophersen, former EU Commissioner and Danish government minister. This group continues to function as an effective and necessary interface to local interests. ■

LAYING THE FOUNDATIONS

ESS SITE LAND IS **SECURED**

The green light for ESS in Lund will transform a green field site in southern Sweden into the world's leading research site for materials and life sciences with neutrons. A vital stage in this process – the land negotiations to secure the three areas of the site – is now complete.

Workshop on ESS facility layout and site development, autumn 2009.

Planting a tree at the ESS site during European Green Week 2009.

Land negotiations have been concluded with a number of different parties to obtain land for the ESS site, MAX IV and Science City.

The land earmarked for the ESS site is now in the hands of Region Skåne. When the final ESS organisation is in place, Region Skåne will then provide the land via a land lease agreement or sale. The ESS site will be used as the location of the ESS facility and occupy the largest piece of land situated in the north of the area. This land, previously owned by a single landowner, the Björnstorp and Svenstorp Estate, is an Estate in Tail.

The MAX IV high brightness synchrotron will be sited furthest south in the overall area. The City of Lund now fully owns the land designated for MAX IV.

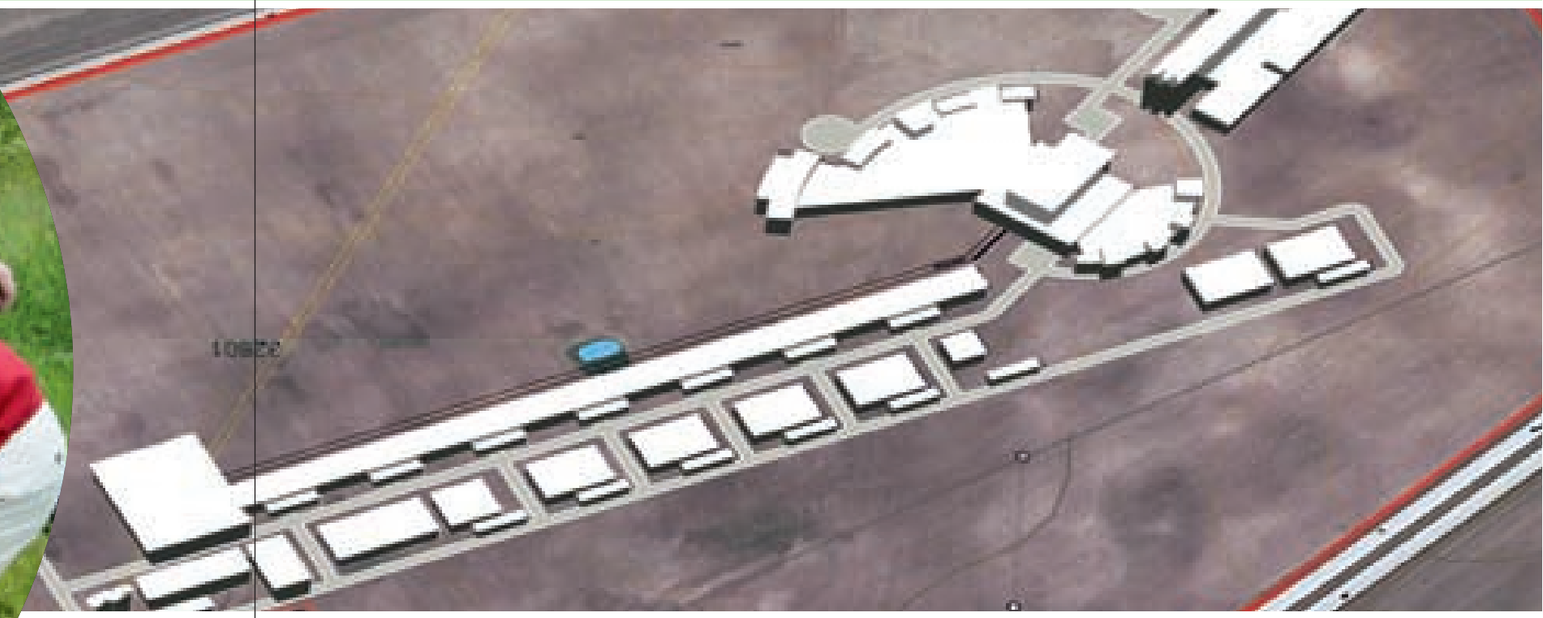
The land for Science City, previously owned by the Lund Diocese, has now been purchased by the City of Lund. A development company, Lundamark AB, a joint venture between Lund University, Region Skåne and the City of Lund will be formed to own and develop the area. Science City will be located between MAX IV and the ESS facility and provide joint infrastructure for the two research centres.

THE PLANNING PROCESS

The ESS facility is subject to a separate planning process, and, subsequently, a building permit process according to the Swedish Planning and Building Act.

The general purpose of the planning process is to determine how land and water areas will be used for development of infrastructure, the erection of buildings and establishment of workplaces. The process is designed mainly to assess and address environmental impact, risks etc in connection with the project and to ensure public participation and influence.

The approved detailed plan will specify the general and specific conditions for the development of the ESS, such as purpose and location of the buildings. When the site and the buildings are designed and fully specified, the ESS will apply for a building permit. The City of Lund will then perform a building permit assessment to ensure that the project fulfils the conditions of the plan as regards visual appearance and landscaping.



Proposal for ESS facility layout, with shortened accelerator, and with current proposal for localisation. View from the north.

ONGOING WORK

The planning process is ongoing. Since Lund University applied on behalf of the ESS Scandinavia consortium for the planning permit, The City of Lund has decided to start the planning process and commissioned the City Planning and Building Office to begin work on the plan. A preliminary programme plan has been made public for display and consultation with all relevant stakeholders.

In connection with these public consultations, ESS personnel have conducted and participated in a series of meetings with authorities, organisations, land owners and the public to present the project and to answer any questions.

LOCALISATION CHOSEN

After thorough analysis, the ESS Secretariat has been able to present a proposal for localisation of the ESS facility and its supporting buildings. The evaluation leading up to the decision was made from a number of criteria such as environmental impact, technical requirements, safety and security requirements, land and licensing prerequisites, as well as functional and esthaetical requirements. Geological conditions and ground water flows have been two fundamental aspects when deciding upon the location. The current proposal has also been chosen in order to minimise the use of agricultural land.

The layout and location can be adjusted to smaller details as the technical design and building plans progresses, but the proposed location, as shown on the illustration above, now constitute the basis for our application for a building permit.

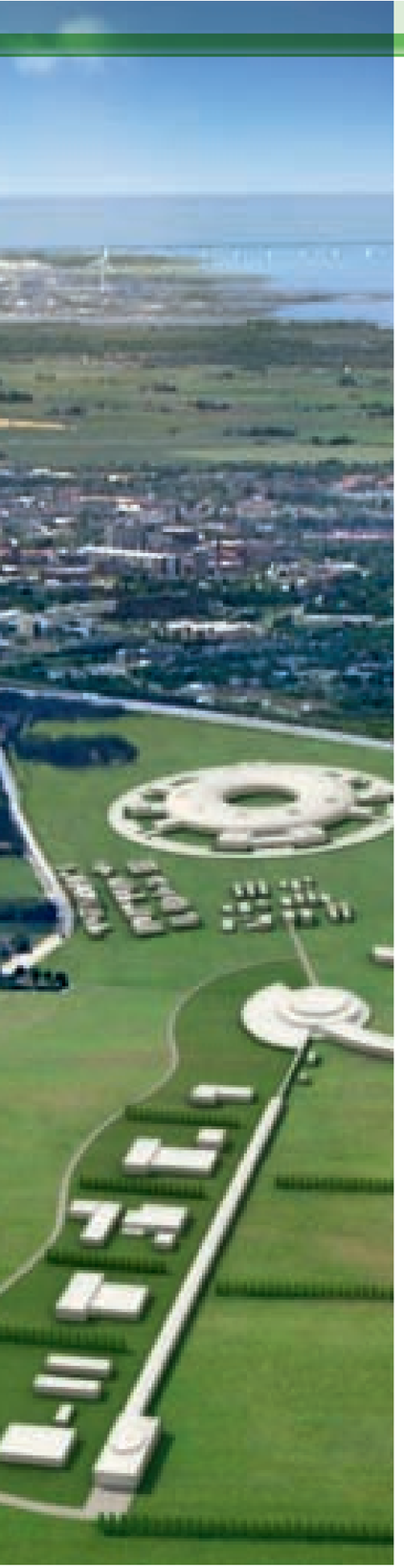
EXISTING CONDITIONS

The entire land area foreseen for the ESS site consists of excellent farmland. Small roads cross the area in two places. Planning for the relocation and design of these roads has started. The centre of the area is crossed by an existing high-voltage power line. To prevent any magnetic field disturbance of the instruments and to guarantee a safe and secure power delivery to the facilities, the power line is planned to be relocated below ground level.

MAINTENANCE OF THE LAND AREA

The required land area for the ESS is defined primarily by the length of the accelerator. The ESS and MAX IV facilities will not occupy the full width of the land between the roads E22 and Odarslövsvägen. As the ESS accelerator will be constructed partly below ground level, a large part of the land will not be occupied by buildings. These areas of surrounding land reserve, mostly located towards the E22, will to a large extent, continue to be used in the near future for agriculture.

A land lease agreement was discussed in the now completed negotiations regarding the details of purchase and exchange of land. Previous owners or local farmers will be able to continue cultivating some of the land reserve. Although some income may accrue from the land lease agreement, the primary intention is to facilitate the continued use of the land for agriculture. ■



LAYING THE FOUNDATIONS

LICENSING PROCESS **ON TRACK**

The licensing and planning process required to make the ESS a reality is now working in parallel with the Design Update.

To design, construct and operate a large-scale research facility such as the European Spallation Source requires thorough planning, and the Design Update and licensing process has continued to take important coordinated steps forward in 2009 and early 2010.

COORDINATING WITH THE DESIGN UPDATE

Preparatory work for the establishment of ESS in Lund is moving ahead in many areas, not least on the technical design of the facility. The work on planning and licensing continues in parallel with the Technical Design Update. Information from the update, including developments on the Accelerator and the Target, will be fed into the licensing process.

The licensing process is dependent on details specified in the Design Update process. This information will allow a more accurate timeline to be set for the Pre-Construction Phase. More advanced plans for the licensing process are expected to be presented by the end of 2010.

One aspect of the Design Update is exploring ways to make the facility more compact compared to the original design, through shortening of the accelerator, without altering the scientific capabilities. Success in these efforts would make it possible to minimise the ESS land use, reduce construction costs and make the facility more energy efficient.

MOVING FORWARD ON ALL FRONTS

ESS must be built to a high safety standard. ESS takes the licensing process very seriously and is convinced that ESS can be built to a high safety standard and with minimal environmental impact.

Before construction can start on the ESS, the project will be assessed according to the Radiation Protection Act, the Environmental Code and the local Planning and Building Act. In-house experts on the Target, Accelerator, licensing and architecture are cooperating with external experts Sweco, Studsvik Nuclear, the law firm Mannheimer & Swartling and others, regarding these assessments. This team is driving the licensing process forward and will provide valuable expertise in the work on obtaining permits required to design, construct and operate ESS.

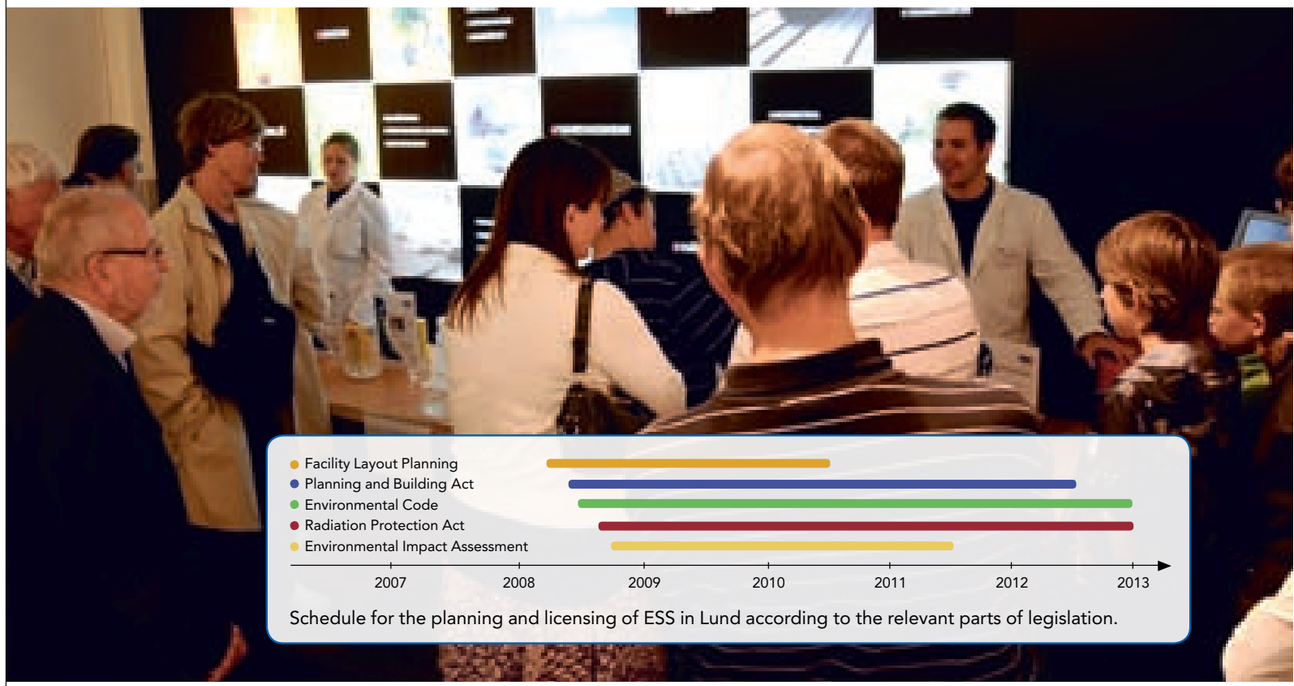
Work is being done on the formulation of the permit applications that will be sent to the Swedish Radiation Safety Authority, the Environmental Court and Local Building Committee in Lund. During the summer of 2010, a formal notification will be sent to the Radiation Safety Authority that enables the authority to start preparing for an assessment of the ESS according to the Radiation Protection Act. An application for a permit according to the Radiation Protection Act will then be submitted to the Radiation Safety Authority in 2011.

Work is also proceeding on formalising the Environmental Impact Assessment (EIA). One purpose of the EIA is to define objectives and methods for establishing a high safety standard, which includes establishing a Safety Doctrine, identifying General Safety Objectives (GSO) and creating a Preliminary Safety Report Analysis. An application for a permit according to the Environmental Code is expected to be sent to the Environmental Court in 2011.

CONTINUING PUBLIC DIALOGUE

During the spring and summer of 2009, a number of consultation meetings were held with people living close to the site, the general public, interest organisations and public authorities. The interest in the ESS project was considerable and the consultation meetings provided a number of useful questions and viewpoints. This input is very important and will be taken into consideration in future work on the ESS project.

This fruitful dialogue with society has continued in an enhanced form in the spring of 2010 when the first dialogue group meeting was held to bring together close neighbours to the ESS site and interest organisations involved in the planning of the ESS. The dialogue groups will offer a forum for people to ask questions and voice opinions, and a channel for ESS to provide information and updates as the project moves forward. Frequent meetings will be held during the Preconstruction, Construction and Operation Phases in premises on the ESS site. ■



Schedule for the planning and licensing of ESS in Lund according to the relevant parts of legislation.

ENERGY & ENVIRONMENT

AN INNOVATIVE **CLIMATE-NEUTRAL** OBJECTIVE

With the site decision in favour of Lund, the ESS and its partners can move ahead to develop the world's first climate-neutral research centre.

A strong commitment on sustainability issues was an integral part of the bid to host the ESS in Lund. Ultimately, the sustainability of the ESS will be decided by the value of the research produced, but the commitment of ESS goes beyond that, and includes sustainability in operations. In this respect, the commitment is unique among big science projects and its fulfilment will make the ESS a beacon for all such future projects around the world.

ENERGY STRATEGY & GOALS

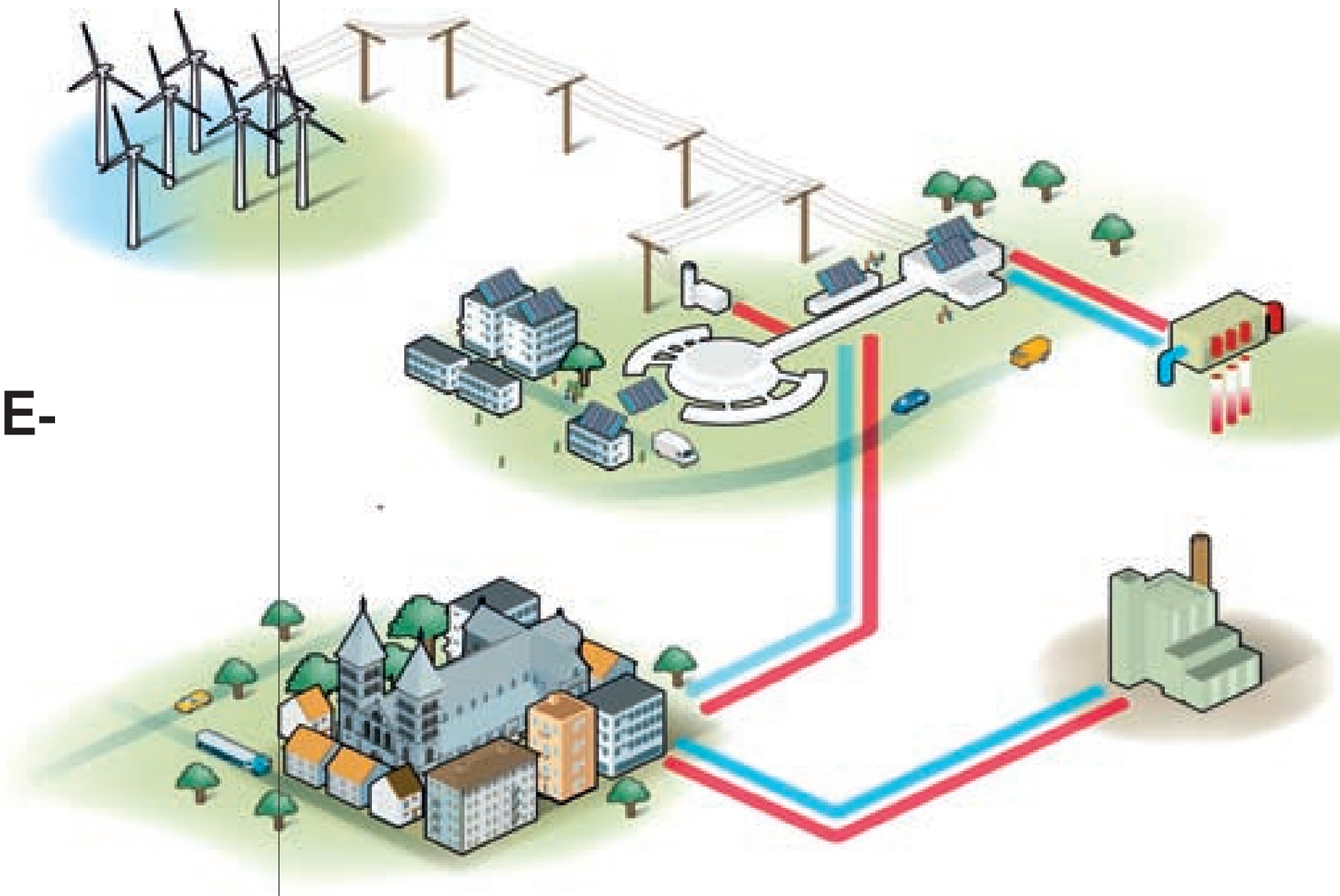
A Sustainable Energy Strategy has been developed for ESS in Lund that includes:

- An energy culture supported by careful monitoring,
- An environmental and energy management system,
- Three demanding energy goals, namely:
  - 20% reduction of energy need
  - 100% renewable energy use, and
  - 60% of used energy to be recycled.

The energy goals present a number of challenges, and processes need to be in place to meet each of these. Significant gains in energy efficiency can be made by the careful design of heating and cooling systems, as well as the buildings themselves. As the accelerator systems will be the biggest consumers of energy, major efforts are being focused on achieving energy efficiency gains in this area.

Efficiency in connection with recycling of excess heat requires careful attention to temperature, as well as energy flows. This is being addressed by constructing an energy and temperature flow chart for the planned facility, which will be presented in its initial form in June 2010.

The energy-recycling goal will require a system for seasonal storage, unless an alternative is developed to use the heat during the summer. Renewable energy production alternatives are being explored with the energy partners of ESS. A recent study indicates profitability for investments in wind power onshore in Sweden or offshore in Germany.



ENERGY PARTNERS

Two full-time ESS employees work specifically on energy matters as part of the Energy Team, which consists of around 20 external people who are involved on a regular basis in the development of an energy concept to realise a climate-neutral research facility. Lunds Energikoncernen AB has cooperated closely with the ESS project in Lund for over two years and currently contributes a team of expert engineers. E.On Sverige AB contributes in a similar way, and the two energy companies have recently signed a cooperation agreement to pool their resources. The present cooperation with Vattenfall Vindkraft AB and Skånska Energi AB is narrower in scope, addressing specific issues. ■

REACHING OUT TO SOCIETY

PROACTIVE COMMUNICATION AND NETWORKING

Science is increasingly taking a more active role towards the surrounding society. ESS is an active and engaged actor in society, towards European as well as local communities.

Melissa Sharp (ESS/SNS) interviewed in regional daily Sydsvenskan. ESS Experimental days. Johan Långberg at the Youth Council of Lund.

PROACTIVE AND UNDERSTANDABLE

ESS is conducting an active public relations work in order to meet the needs of actors within science, the general public, politics and media. Understanding, accessibility, correctness and engagement are the key words.

Good relations with the local community are fundamental. The future ESS facility will have a large impact on Lund City, and ESS strives to ensure that local citizens feel well-informed and have confidence in ESS.

The ESS being a complex project, from a scientific, technological and political view, ESS Secretariat seeks to adapt its communication to different needs. Environmental concerns must be met with respect, and young, curious minds must be met with enthusiasm and encouragement.

As the ESS expands, more focus will naturally be placed on the European dimension and on the science community.

EXTENSIVE PRESS COVERAGE

The media interest in ESS has been considerable, peaking at the time of the site decision in May 2009. The national newspaper Dagens Nyheter, in an article on the day of the decision, said: "Giant microscope will renew science". In an editorial on 30 May the paper stated: "The possibilities [of ESS] are so good that Lund, Leijonborg and all researchers in material science and biology are to be congratulated." The Swedish Broadcasting Company devoted a part of the programme Studio 1 to ESS on 28 May.

Before and after the site decision, local, regional and national media have followed the international negotiations as well as the everyday ESS work. The Swedish national daily newspaper Svenska Dagbladet was the first to report that Italy's President Giorgio Napolitano supported Lund as the site for ESS.

The international science press has also covered the ESS negotiations. Research Europe, the only magazine focused on European science policy, did a thorough evaluation of the three competing sites Lund, Debrecen and Bilbao. Physics Today published the first long story on ESS ambitions to save and reuse energy and to become climate-neutral, something that is exceptional at large science facilities.

ESS TAKES PART IN SWEDEN'S MAJOR POLITICAL EVENT OF 2009

ESS was represented at Almedalen Week, Sweden's main political event in a non-election year.

A few hundred people attended a large informal gathering to learn more about ESS and future scientific possibilities. The event was organised jointly by Lund University, ESS and the South Swedish Chamber of Commerce. ESS highlighted its environmental licensing activities in a seminar arranged in cooperation with the Swedish environmental publication, Miljöaktuellt.

ESS WINS MARKETEER OF THE YEAR AWARD

In October 2009, ESS Scandinavia received the "Marketeer of the Year" award for successfully meeting the "dual marketing" challenge of gaining support from Europe for building one of the largest ever research facilities in Sweden, and getting support in Sweden, as well as extensive visibility, for a unique and expensive, but not easily understandable, project. The prize was awarded by the Marketing Association in Malmö. Previous winners include Linköping University, Saab, Malmö's football club MFF, the Öresund Bridge Consortium and Malmö Aviation.

At the award ceremony at Grand Hotel in Lund, Colin Carlile expressed his thanks to all the different people, who had worked in different ways over a period of several years to reach a variety of target groups, while always aiming for the same goal.

REACHING THE PUBLIC

The ESS exhibition will soon be two years old. During this period it has been a well-appreciated forum enabling the residents of Lund to find out more about the project. After the site decision, there was a subsequent rise in the number of student groups, organisations, companies, public authorities and others that visited the exhibition to find information about the project. More than 5000 visitors came to the ESS Exhibition over the past 12 months.

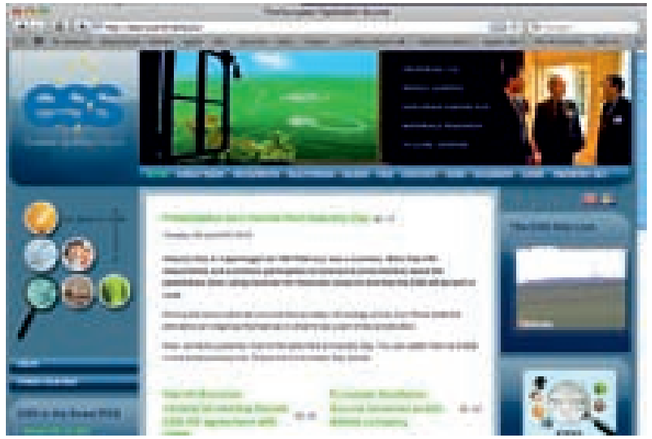
The exhibition was substantially and repeatedly updated in the autumn to reflect the rapidly moving process. There are currently plans to include more hands-on examples showing the benefits and discoveries that stem from using neutrons.

The ESS film has been developed further in the past year. The film is popular among both scientists and the local community as an accessible way to explain and visualise the science and technology of ESS and its positive effects for the region.

ESS experimental days are a regular event that has become something of a tradition. Small-scale experiments for younger people are arranged 4-5 times a year in cooperation with Master students in chemistry and physics. At the experimental days, visitors have an opportunity to perform experiments on their own. The experimental days have been highly appreciated and attract 200 to 300 persons for each session. The events will continue to be an important way to communicate with the public and especially younger people.

Senior members of the ESS have given more than 200 presentations on the project during the past 12 months. These have ranged from major European conferences such as ECRI in Brdo, Slovenia to international scientific conferences like ICNS in Tennessee. There have also been individual scientific seminars in academic institutes such as Kiel University, specialised presentations to politicians and interested public groups. ■

INCREASING INTERACTION WITH ESS WEB 2.0



ESS IT is supporting the creation of a large community around the project by using web tools based on open source code to encourage innovation, social interaction and user-generated content. This is helping not only to develop the science and technology of ESS, but also to integrate the project in society and industry.

To increase transparency and promote dialogue with the ESS community, we have established ourselves in different social media channels in the past year. The preferred channels so far are Twitter and YouTube in combination with blogs from various ESS departments. These blogs enable staff to share everything from expert advice on their specific areas, to live reports on ESS activities and thoughts on everyday life at ESS. Our blog articles are among the most popular content on the ESS website. Live blogging from ESS events and seminars will increase.

Neutron science has a large impact on our lives. In the two new ESS brochures **"Neutrons for Science. Neutrons for Society"** and **"Inside Materials. Seeing with Neutrons Eyes"**, researchers showcase how neutrons have been used to understand issues as diverse as mobile phones, packaging materials, biofuels and Alzheimers' disease.

REACHING OUT TO SOCIETY

STRENGTHENING KEY NETWORKS

A BROAD NETWORK AND WIDE SUPPORT

A large number of individuals, organisations and authorities have been vital in supporting the ESS cause and driving the project forward. Others are making plans for taking advantage of the scientific possibilities at ESS, or planning how the surrounding community can prepare for ESS.

A PROJECT DRIVEN BY SCIENTISTS

A European project like ESS is an exercise in true teamwork. Hundreds of scientists and engineers developed the original ESS technical design, and many more have contributed to its improvement in recent years.

During the past year ESS has strengthened ties with universities and laboratories to build teams capable of managing the high-technology challenge that the ESS project entails. The Memorandums of Understanding between ESS and Forschungsneutronenquelle Hans Meier-Leibnitz (FRMII) in Munich and the Institute for Energy Technology (IFE) in Oslo are just two examples. The agreements will ensure that ESS is developed in cooperation with leading scientific environments.

SUPPORT FROM FOUR CO-HOSTING MINISTERS

During the year the ESS project has also enjoyed firm and clearly expressed commitment from four science ministers of the co-hosting nations, Sweden and Denmark.

The former Swedish Minister for Research and Higher Education, Lars Leijonborg, brought the ESS negotiations to a successful conclusion in May 2009. Before that, he and his ministerial staff gave constant and invaluable support. His successor, the current Minister for Research and Higher Education, Tobias Krantz, and his Ministry have provided crucial support in setting up the company, ESS AB, and also in ensuring that ESS AB will have the financial resources to set up a strong central ESS team in Lund.

The former Danish Minister for Science, Technology and Innovation, Helge Sander, has shown strong commitment to the ESS project. In April 2009, Helge Sander and Lars Leijonborg signed the Swedish-Danish co-hosting agreement.

The current Minister for Science, Technology and Innovation, Charlotte Sahl-Madsen, showed the importance of ESS to Denmark by taking part in the signing of the agreement between ESS AB and FRMII in April 2010. She also paid a highly appreciated visit to the ESS Secretariat in Lund, together with Members of the Danish Parliament.

THE SCIENCE CORRIDOR: BUILDING A LEADING MATERIALS SCIENCE CLUSTER

Four large research facilities and unique competence within materials and life sciences – those are two of the major scientific assets that the southern Baltic Sea Region has to offer, assets that will support the setting up of the Science Corridor, stretching from southern Norway, via Sweden and Denmark to northern Germany.

On 25 November in Hamburg a letter of intent on the Science Corridor was signed between Lund University and the DESY Research Centre. ESS and MAX IV in Lund, the XFEL free electron laser and the PETRA III synchrotron will be the central elements of the Corridor. However, cooperation will also include a large number of existing strong scientific environments.

ESS-FRMII agreement. Colin Carlile, Minister Charlotte Sahl-Madsen, Minister Wolfgang Heubisch, Winfried Petry, FRMII.

Alnarp Masters students presenting innovative ideas for a sustainable site.

The goal is to increase scientific exchanges through the sharing of equipment, the creation of common projects and the setting up of joint grants and scholarships. The Science Corridor has been chosen as one of the flagship projects in the new EU Baltic Sea Strategy.

NETWORKING AROUND THE ÖRESUND

Scientists and students in the neighbouring Öresund region are particularly interested in ESS and future research possibilities. Several sectoral conferences have focused on ESS, and many student groups devote a semester to studying ESS.

The Medicon Valley Alliance's Annual Conference in October was entirely devoted to ESS and the opportunities for life science research. In the spring of 2009, the Danish Engineering Association (IDA) held a similar conference to identify opportunities for Danish scientists and engineering companies.

In January, the international students of the Urban Landscape Dynamics master programme at Alnarp Agricultural University graduated through presenting inspiring proposals to create green infrastructures on the ESS and MAX IV site. During the spring of 2010, nanotechnology students from the Lund Institute of Technology have been working on an ESS-related role-play.

LOCAL COMMUNITIES PREPARE FOR ESS AND MAX IV

Support from local communities for the ESS project is truly impressive. Almost ten years before the ESS will be inaugurated, local and regional authorities in the Öresund region have already started preparing for how to receive both ESS and MAX IV.

A large number of politicians and planners within business liaisons, infrastructure, housing, environment and education have started several projects that will improve the region's capacity to receive ESS and MAX IV.

The planning will be beneficial for ESS, since the regional setting is important to a large research centre. The project will help to create the best conditions for hosting a world-leading research facility and attracting the best scientists, within areas such as receiving international staff, innovation systems, infrastructure planning and international schooling. Participating in the project, besides ESS, are: all 33 municipalities in Skåne, Region Skåne, Region Blekinge and all the universities in the two regions. ■

THANK YOU!

The ESS project has received tremendous support over the years. We are thankful for the support of scientists, academics, politicians, community leaders, ministry staff, civil servants, companies, and many others.

We are also grateful to the people of Lund, most of whom see the ESS as an exciting project and a boost for the City of Lund.

We would like to express our gratitude to the environmentalists and other critics who have made us improve in many ways. They will contribute to making the ESS project better for all concerned.

We also hope that we can soon start giving something back to the surrounding community, for example through collaborations with schools and university students, encouraging scientific curiosity and interest in science. ■

SELECTED PRESENTATIONS

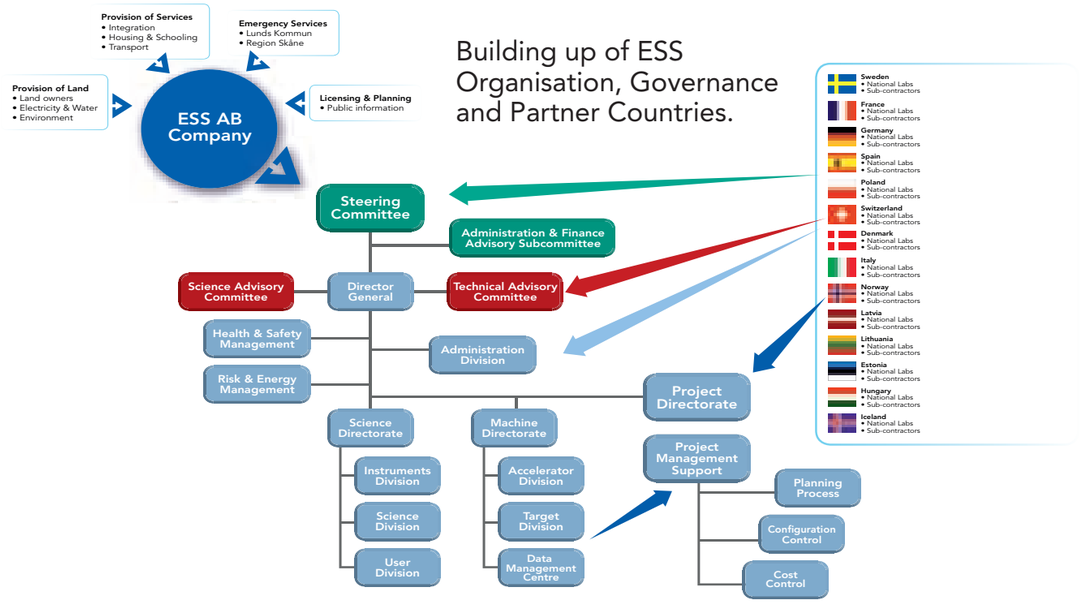
LOCATION	AUDIENCE / DATE
Pisa	Eurisol 2009 – March 30, 2009
San Fransisco	The Minerals, Metals & Materials Society meeting – February, 2009
Uppsala	SNSS Annual Meeting – May 20, 2009
Montpellier, France	French Neutron Scattering Association meeting – May 28, 2009
Lyngby	Nordic Physical Society – June 17, 2009
Tokai, Japan	Japan Atomic Energy Agency (JAEA) – June 17, 2009
Lund	Neutron in Biology conference – June 24, 2009
Tennessee, USA	International Conference on Neutron Scattering – May 2009
Vancouver, Canada	International Accelerator Conference – May 2009
Stockholm, Sweden	Skåne-Stockholm day – November 11, 2009
Lund, Sweden	Atomic Culture first international symposium – December 3, 2009
Lund, Sweden	Finance Committee of the Swedish Parliament – February 23, 2010
Lund, Sweden	Föreningen Samhällsbyggarna, annual meeting – October 8, 2009
Pozna, Poland	Poznan Neutron Symposium – May, 2009
Höör, Sweden	Public meeting, Färs och Frosta Sparbank – November 5, 2009
Garching	32nd European neutron Scattering Association Meeting – October, 2009
Malmö, Sweden	Malmö Marketing Association – January, 2010
Stockholm, Sweden	Meeting with Ambassadors – November, 2010
Copenhagen	Medicon Valley Alliance Annual Meeting – October 2009
Hamburg	Science Corridor Symposium – November, 2009
	Committee of European Municipalities and Regions – April, 2009
Lund, Sweden	Association of Municipalities and Cities in Skåne – May, 2010
Helsinki, Finland	7th Nordic Workshop on Scattering from Soft Matter – January 27, 2010

SELECTED PUBLICATIONS

"Beta Beams – Neutrino Beams", Imperial College Press 2010, by Mats Lindroos (ESS/CERN) & Mauro Mezzetto (INFN, describes technical and experimental aspects of beta beams, and is a valuable source of information for students, scientists, facility designers and policy makers."

1. **Solubilisation of model adjuvants by Pluronic block copolymers**, Melissa A. Sharp, Clive Washington, Terence Cosgrove, Journal of Colloid and Interface Science, 2010, 344, 438
2. **Residual stresses in friction stir welding.** Williams, S. W. & Steuwer, A. in Lohwasser, D. & Chen, Z. (Eds.) Friction stir welding: from basics to applications. Cambridge, UK, Woodhead Publishing (2009).
3. **Progress for the European Spallation Source in Scandinavia.** C. Vettier, C.J. Carlile, P. Carlsson. Nuclear Instruemnts and Methods in Physics Research A 600, 8 (2009).
4. **Using Neutron Spin-Echo to Investigate Proton Dynamics in Proton-Conducting Perovskites** M. Karlsson, D. Engberg, M.E. Björketun, A. Matic, G. Wahnström, P. G. Sundell, P. Berastegui, I. Ahmed, P. Falus, B. Farago, L. Börjesson and S. G. Eriksson Chemistry of Materials (Communication) 22, 740–742 (2010).
5. **Welding process impact on residual stress and distortion.** Colegrove, P., Ikeagu, C., Thistlethwaite, A., Williams, S., Nagy, T., Suder, W., Steuwer, A. & Pirling, T. Science and Technology of Welding and Joining, 14, 717-725. (2009)
6. **Direct observation of double-k lattice modulation in double-k magnetic structures. The case of CeAl2.** A. Stunault, J. Schweizer, F. Givord, C. Vettier, C. Detlefs, J-X Boucherle, P. Lejay. Journal of Physics: Cond. Matter 21, 376004 (2009).

MEMBERS OF GOVERNANCE BODIES



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ACTIVITY REPORT

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