EUROPEAN SPALLATION SOURCE

Activity Report 2016

1 January – 31 December 2016

European Spallation Source ERIC
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Contents

Foreword by the Director General

In 2017 the European Spallation Source is starting its next phase, adjusting its focus from simply delivering a construction project to that of becoming an integrated part of the Big Science landscape. We are building on the strong foundations that we are putting in place – quite literally, with more than 6,000 pilings installed. Without losing any focus on maintaining cost and schedule of construction, it is now time to start our transition to a scientific and technological flagship facility. The organisation is starting to evolve to support this change.

Construction is proceeding rapidly. The design and manufacturing of ESS technical components is in progress at 40-plus European partner institutes, with contributions from more than 100 labs worldwide. In 2016, the complex ESS in-kind model found its footing, and more than €200 million in in-kind contracts were put on the books.

The ESS Technical team also got its feet wet on the construction site, executing the facility's very first machine installations toward the end of the year. As the buildings are completed one by one, these installations will become the centre of our focus over the next two years.

Some key forward-looking agreements were made in 2016 to ensure the project's rapid momentum. A financing arrangement between ESS and the European Investment Bank, the Nordic Investment Bank and AB Svensk Exportkredit has provided the project with a €300 million line of credit. The next two years will see peak construction activity, and this agreement will offset the gap between those immediate costs and the flat cash contributions distributed by Members over the 10-year construction phase.

The reassurance of the line of credit in turn enabled ESS to sign a target price agreement with Skanska in December to cover the remainder of the civil construction, through 2020. Both agreements provide a solid hedge against project delays during construction.

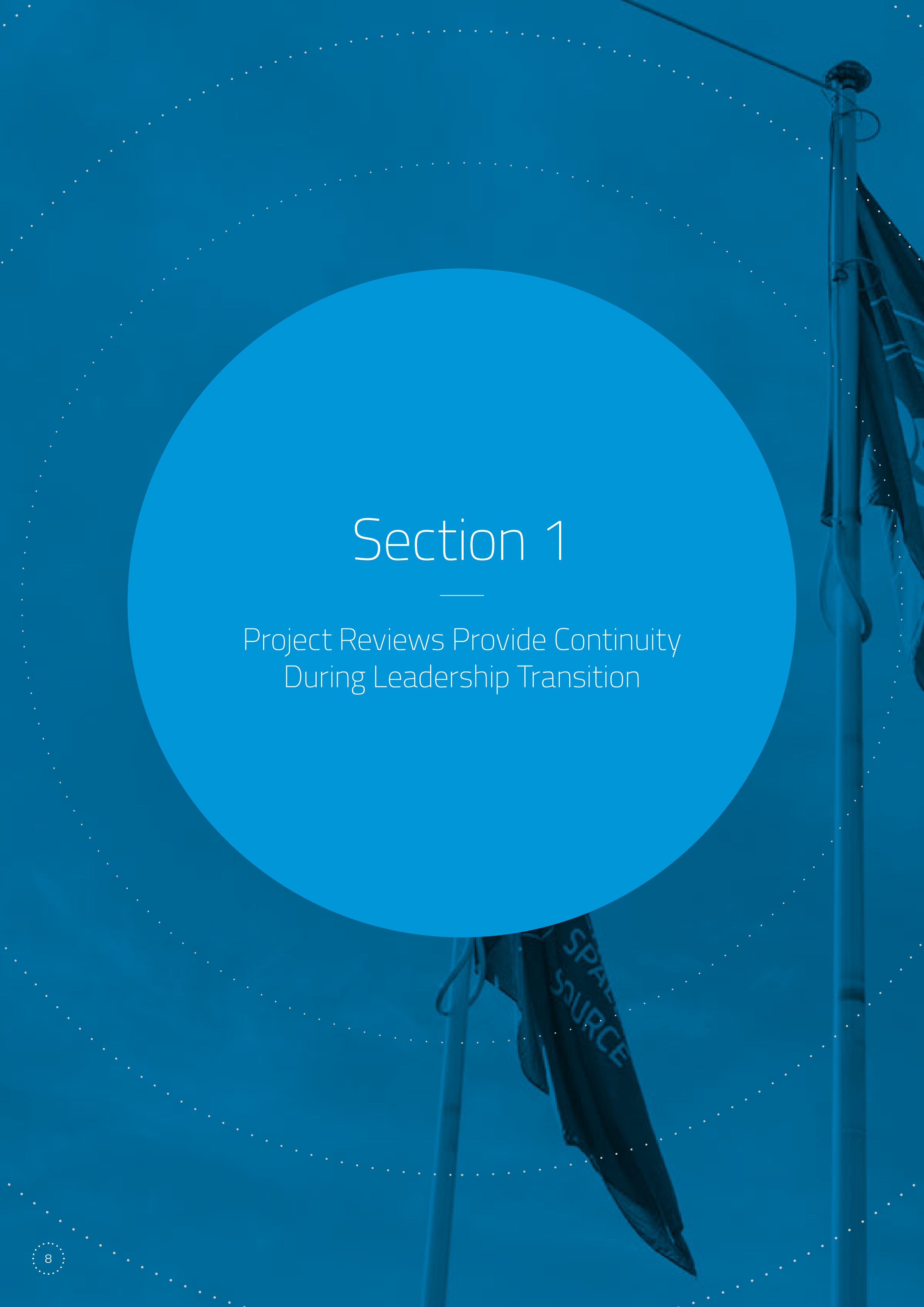
One of 2016's standout achievements was the Council's December approval of the initial programme of 15 neutron scattering instruments, including scope, cost and delivery schedule. This endorsement was the culmination of an intense year of work by the Science team and their in-kind partners responsible for building the instruments.

Council also heard from the international review panel that looked at (and endorsed) ESS's steady-state operations plan. This process will continue through 2017, with a focus on understanding the transition period from construction to initial operations in the years 2019-25.

Materials science research at ESS will address many of the big challenges that lie ahead in the 21st century, including energy sustainability, health care, and climate change. In the process ESS will, together with our neighbours in Skåne and greater Copenhagen, anchor a regional research ecosystem that will drive innovation globally. Plans for the Science Village development between ESS and MAX IV are taking shape, and both facilities are committed to work together to support this goal.

It is a rare privilege to be a part of the development of a new, flagship research facility, and my vision for ESS is that it should be the best such facility in the world. This means not only that we must build it on time and on budget, but we must do so with the promise to deliver the 'gold standard' both in scientific research and its societal impact.

John Womersley
ESS Director General



Section 1

Project Reviews Provide Continuity During Leadership Transition


SOURCE

1.1 Womersley Succeeds Yeck as Director General

In January 2016, Jim Yeck announced he was standing down as the ESS Director General. Yeck came to ESS as CEO and Director General at the beginning of 2013, and led the transition into construction, which officially started at the facility site in September 2014. He also managed the complex organisational transition of ESS into a European Research Infrastructure Consortium (ERIC).

Following a request by the European Spallation Source ERIC Council to consider a contract extension for the duration of the construction phase, Yeck informed the Council that he planned to return to the US and that, for project continuity, a new DG should be identified as soon as possible.

John Womersley, former CEO of the UK's Science and Technologies Facilities Council (STFC), was appointed by the ESS Council in May and took over as Director General in November.

Womersley has long been involved in the ESS project not only through STFC, where he led one of Europe's largest multidisciplinary research organisations, but also in his work as former chair of the European Strategy Forum on Research Infrastructures (ESFRI), the leading forum for prioritising strategic investment in research infrastructure in Europe.

Womersley is a professor and a scientist, and has a PhD in Experimental Physics. He worked at the American particle physics laboratory Fermilab, and later became a scientific advisor to the US Department of Energy. In 2005 he become Director of the Particle Physics Department at STFC's Rutherford Appleton Laboratory.

"I'm excited to join ESS," said John Womersley. "It's one of Europe's largest and most visible new research projects. Scientists, staff, partner institutions and countries across Europe have come together to build what will be the world's leading neutron source for research on materials and life sciences."

1.2 Annual Review

In April, members of the ESS Annual Review Committee, an external international panel of more than 30 experts, reviewed the progress of the past year and fed back on the project's future goals and challenges.

The goal of the four-day assessment was to examine the project from technical, cost, schedule, and management perspectives.

"The committee's impression of ESS was very good," said Review Committee Chair Marzio Nessi of CERN. "There has been a lot of progress, with an established laboratory with all the functions that a laboratory must have."

The ESS Management Team presented the facility's scientific and technical objectives, alongside construction schedules. Special focus was given to major sub-projects including the Accelerator, Target, Integrated Control System (ICS), Neutron Scattering Systems (NSS) and Conventional Facilities (CF). The overarching schedule for the project was also presented and reviewed, helping the committee to manage potential bottlenecks and maintain the project's momentum.

Dan Neumann, from the NIST Center for Neutron Research (NCNR) in the US, chaired the NSS subcommittee: "The people at ESS are doing a great job, and they're very open about what their problems are. A project of this scope always has issues, but they're really proactive and committed in dealing with those problems to deliver the science in 2023".

The review emphasised that planning for the start of the Initial Operations Phase in 2019, alongside the on-going Construction Phase, remains a top priority. Major events up to and including these phases include the formal handover of completed facility buildings from build partner Skanska to ESS, and the commissioning of the Accelerator, Target Station, the NSS suite of instruments and connected labs.

1.3 Steady-State Operations Review

The first Operations Review for ESS was held in October, to look ahead and plan for the time when the facility is fully operational.

A committee of 17 external experts reviewed more than 50 presentations from ESS teams over two and a half days, providing essential input for base-lining cost projections. The main goal was to cost so-called steady-state operations: the machine at full power, 22 instruments in service and the facility operating a full user programme.

The committee oversaw a top-to-bottom review of requirements and key assumptions for every aspect of facility operations. This ranged from maintenance costs, staffing levels and spare parts necessary to keep the Accelerator, Target and instruments operating at very high standards of reliability to such relative minutiae as how many security guards are necessary, who will man the after-hours IT helpline, and more efficient ways to operate a cafeteria. This was all crucial in helping to inform long-term plans and costs.

"In the short term it is clear that the transition from construction into initial operations in 2019 is essential to meeting long-term operations goals," said ESS Director General John Womersley, who participated in the review the week prior to his official start at ESS.

The review committee was chaired by Thom Mason, director of Oak Ridge National Laboratory in the US, home to the Spallation Neutron Source (SNS), and included representatives from a range of ESS partner institutions.

Mason and the committee panels concluded in the review's closeout session that, "the ESS Project has reached a point of maturity where a more comprehensive, bottom-up, analysis of the resources needed to support steady-state operations is possible."

"In the short term it is clear that the transition from construction into initial operations in 2019 is essential to meeting long-term operations goals".

1.4 Vision, Mission and Values

Vision

Our vision is to build and operate the world's most powerful neutron source, enabling scientific breakthroughs in research related to materials, energy, health and the environment, and addressing some of the most important societal challenges of our time.

Mission

To do this, we commit to deliver ESS as a facility that:

- Is built safely, on time and on budget
- Produces research outputs that are best-in-class both in terms of scientific quality and in terms of socioeconomic impact
- Supports and develops its user community, fosters a scientific culture of excellence and acts as an international scientific hub
- Operates safely, efficiently and economically, and responds to the needs of its stakeholders, its host states and member states
- Develops innovative ways of working, new technologies, and upgrades to capabilities needed to remain at the cutting edge

Core Values

- **Excellence** We provide the world's leading neutron science facility and world-class support for the science community. We advance the use of neutrons in science and technology by supporting and developing instrumentation and tools for the highest quality application of neutrons in research. We always aim for scientific, technical and operational excellence in the safest environment.
- **Collaboration** We are an integral member of European society and we engage with the scientific and industrial communities to help build and operate ESS. In our everyday work and all our interactions, we seek to build and maintain relationships that create a shared sense of ownership among our stakeholders. Internally and externally we are committed to act and speak with one voice, as one ESS.
- **Openness** We perform our work in an open and transparent manner. In this way we build trust with our partners, our stakeholders and with each other. We are willing to collectively and directly address challenges and celebrate success. We demonstrate on all levels, internally and externally, that we stand for what we say in the way we act.
- **Sustainability** We act and make decisions with a long-term perspective and strive to safely and responsibly use natural, human and monetary resources. We take the full life cycle of ESS into account, and view sustainability from environmental, social and economic perspectives.

1.5 A European Research Infrastructure Consortium

European Spallation Source ERIC

The world's most powerful neutron source for research in materials and life sciences, energy, environmental technology, cultural heritage and fundamental physics.

Type: Single site

Founding Members

Czech Republic
Denmark
Estonia
France
Germany
Hungary
Italy
Norway
Poland
Sweden
Switzerland
United Kingdom

Founding Observers

Belgium
The Netherlands
Spain

Timeline

- ESFRI Roadmap entry: 2006
- Preparation phase: 2008-2010
- Pre-construction phase: 2010-2012
- Construction phase: 2013-2025
- Legal entity establishment: ERIC, 2015
- Operation phase: 2019 -

Estimated Cost

Capital value: 1.843 B€

Headquarters

European Spallation Source ERIC (ESS)
PO BOX 176
SE-221 00 Lund
Sweden

Website

https://europeanspallationsource.se

1.6 Governance, Management and Advisory Committees

Administrative & Finance Committee (AFC)	
Belgium	Christian Legrain
Czech Republic	Petr Ventluka
Czech Republic	Lukas Levak
Denmark	Fredrik Melander
Denmark	Morten Scharff
Estonia	Priit Tamm
France	Bernard Dormy (Chair)
France	Aurilelie Eray
France	Tobias Afadjigla
Germany	Oda Keppler
Germany	Michael Budke
Germany	Kristin Hess
Germany	Marthe Becker
Hungary	Balázs Kápli
Italy	Ilieana Gimmillaro
Italy	Roberto Pellegrini
Latvia	Armands Plate
Lithuania	Raimondas Paškevicius
Netherlands	Nico Kos
Norway	Björn Jacobsen
Poland	Michal Rybinski
Poland	Zbigniew Golebiewski
Spain	Inmaculada Figueroa Rojas
Spain	Javier Losada
Sweden	Maud Bergkvist
Sweden	Johan Holmberg
Switzerland	Patrice Soom
Switzerland	Xavier Reymond
United Kingdom	Maggie Collick
United Kingdom	Neil Pratt (Vice Chair)

Conventional Facilities Advisory Committee (CFAC)	
Denmark	Carsten Jarlov
Denmark	Peter Lundhus
France	Tim Watson
United States	Martin Fallier (Chair)

Environment, Safety & Health Advisory Committee (ESHAC)	
France	Paul Berkvens (Chair)
Sweden	Göran Larsson
Sweden	Martin Luthander
Switzerland	Enrico Cennini
Switzerland	Doris Forkel-Wirth
United Kingdom	Marek Jura
United States	Frank Kornegay
United States	Kelly Mahoney
United States	Stefan Roessler
United States	Thomas Peterson

In-Kind Review Committee (IKRC)

Belgium	Hamid Aït Abderrahim
Czech Republic	Petr Šittner
Denmark	Søren Schmidt
Estonia	Heisi Kurig
France	Jean-Luc Biarrotte
Germany	Ulrich Breuer
Hungary	Dániel Csanády
Italy	Marco Marazzi (Chair)
Italy	Paolo Michelato
Netherlands	Guy Luijckx
Norway	Bjørn C. Hauback (Vice Chair)
Poland	Adam Maj
Spain	Federico J. Mompean
Sweden	Ulf Karlsson
Switzerland	Peter Allenspach
United Kingdom	Uschi Steigenberger

Scientific Advisory Committee (SAC)

Czech Republic	Vladimir Sechovsky
Denmark	Bo Brummerstedt Iversen
Denmark	Kristine Niss
France	Arnaud Desmedt
France	Bernhard Frick
France	Herve Jobic
Germany	Markus Braden
Germany	Andreas Meyer (Co-Chair)
Germany	Regine von Klitzing
Italy	Fabio Bruni
Netherlands	Catherine Pappas
Poland	Wojciech Zajac
Spain	Carmen Mijangos
Sweden	Björgvin Hjörvarsson
Sweden	Tomas Lundqvist
Switzerland	Klaus Stefan Kirch
Switzerland	Jörg F Löffler
Switzerland	Helena Van Swygenhoven-Moens
United Kingdom	Sylvia McLain (Co-Chair)
United Kingdom	Toby Perring
United States	Kenneth W. Herwig
United States	Roger Pynn

Technical Advisory Committee (TAC)

France	Alban Mosnier
Germany	Michael Butzek
Germany	Anton Möslang
Germany	Robert Stieglitz
Germany	Hans Weise
Hungary	Szabina Török
Italy	Alberto Facco
Japan	Masatoshi Futakawa
Spain	Manuel Perlado
Switzerland	Bertrand Blau
Switzerland	Philip D. Ferguson (Co-Chair Target)
Switzerland	Frank Gerigk
Switzerland	Philippe LeBrun (Chair)
Switzerland	Alessandra Lombardi
Switzerland	Michael Wohlmuther
United Kingdom	Tim Broome
United Kingdom	Mark Heron

Technical Advisory Committee (TAC) (continued)	
United States	Michael Borden
United States	John Galambos (Co-Chair Accelerator)
United States	Ralph Pasquinelli
United States	Karen White

ESS Council	
Belgium	Laurent Ghys
Belgium	Eric van Walle
Chairman	Lars Börjesson (Chair)
Czech Republic	Ivan Wilhelm
Czech Republic	Petr Lukáš
Denmark	Bo Smith
Estonia	Toivo Räim
Estonia	Priit Tamm
France	Amina Taleb-Ibrahimi
France	Patricia Roussel-Chomaz
Germany	Beatrix Vierkorn-Rudolph
Germany	Sebastian Schmidt
Hungary	László Rosta
Italy	Caterina Petrillo (Vice Chair)
Italy	Eugenio Nappi
Italy	Salvatore La Rosa
Norway	Bjørn Jacobsen
Poland	Marek Jezabek
Poland	Mateusz Gaczyński
Spain	Inmaculada R Figueroa
Spain	José Luis Martínez
Sweden	David Edvardsson
Sweden	Sven Stafström
Switzerland	Martin Kern
Switzerland	Joël Mesot
The Netherlands	Louis Vertegaal
The Netherlands	H.T. (Bert) Wolterbeek
United Kingdom	Andrew Taylor
United Kingdom	Brian Bowsher

Caterina Petrillo, ESS Council Vice Chair

Council delegates László Rosta (l) and Salvatore La Rosa

Committee on Employment Conditions (CEC)
Lars Börjesson (Chair)
José Luis Martínez
Patricia Roussel-Chomaz
Katharina Bjelke (Host State representative Sweden)
Bo Smith (Host State representative Denmark)

Executive Management Team (EMT)	
John Womersley	Director General
Andreas Schreyer	Science Director
Roland Garoby	Technical Director
Agneta Nestenborg	Director for Project Support & Administration
John Haines	Project Manager
Kent Hedin	Head of Conventional Facilities Division
Allen Weeks	Head of Communications, External Relations & In-Kind Management
Ralf Trant	Associate Director for Environment, Safety & Health, and Quality
Pia Kinhult	Strategic Project Advisor
Karin Hélène	Senior Executive Assistant

Lars Börjesson, ESS Council Chair

Section 2

Key Milestones

2.1 Submission to Swedish Radiation Safety Authority

The European Spallation Source ERIC (ESS) submitted an application to the Swedish Radiation Safety Authority Strålsäkerhetsmyndigheten (SSM) in May 2016.

The application was for a license to install equipment in the Accelerator tunnel and other parts of the facility that can generate ionising radiation. In addition, ESS also applied for permission to test drive the first part of the Accelerator, which is approximately 50 metres in length.

When the research programme begins at ESS, materials and biological samples will be examined at the atomic and molecular scales using neutrons. When producing the neutrons, ionising radiation and radioactive substances are generated in parts of the research facility. This means that ESS must follow the Radiation Protection Act to protect staff and the surrounding area.

This is the second application in the licensing process, which consists of four stages in total before the materials research facility can go into operation.

Peter Jacobsson, Head of Environment, Safety & Health Division, with ESS SSM submission binders

2.2 Agreement on Radioactive Waste Disposal

The Swedish nuclear fuel and waste management company Svensk Kärnbränslehantering (SKB) has been selected to manage the handling, storage and disposal of the radioactive material that will be produced at ESS from the beginning of operations through decommissioning.

Revised calculations from ESS show that the total volume of active material will be significantly lower than previously indicated, with around 2,500 cubic metres of waste expected over the lifetime of the facility. Most of this, about 75 percent, will be generated during the decommissioning of the facility, after some 40 years of operations. All the active material from ESS will be low and medium level, and it will be deposited in SKB's repository.

The active material that will be produced at ESS during the operations phase will mainly consist of used components from the instruments, the neutron guides and the Target Station, as well as spent equipment from the Accelerator. Most of the waste from the decommissioning phase will consist of demolition material, the Monolith in the Target Station, and parts of the Accelerator.

2.3 ScienceLink Network

ESS became a member of the ScienceLink Network in June 2016.

The network provides a well-established framework in which ESS and its partners will strengthen knowledge transfer from basic science to applied research and accelerate the development of innovative products and services.

The scope of research covers a wide range of industries, from life science, biotechnology and agriculture, to materials science and energy.

Zoë Fisher of the ESS Scientific Activities Division with the Oryx8 liquid handling robot from Douglas Instruments, an in-kind contribution from Norway's University of Bergen

2.4 European Foundation for Quality Management

In May 2016 ESS joined the European Foundation for Quality Management (EFQM), a not-for-profit, membership-based foundation made up of nearly 500 companies and organisations across Europe and around the world.

Two EFQM-led workshops held at ESS later in the year and a follow-up report from EFQM provided ESS with a non-prescriptive external review and analysis of its management practices. This was the first time the EFQM framework was applied within a large research facility, and was an opportunity for improving both the model's implementation and the ESS project's organisational structure.

"Supporting a European research infrastructure which will facilitate scientific cooperation between European countries makes perfect sense for EIB. Furthermore, the ESS' unique, cutting edge research capacity creates significant and exciting new opportunities in the fields of life sciences, energy and environmental technology, which are also priority objectives of the EIB."

Jan Vapaavuori, EIB Vice-President

2.5 Line of Credit Agreed for €300 Million

In November 2016, ESS signed a line of credit agreement with the European Investment Bank (EIB), the Nordic Investment Bank (NIB) and AB Svensk Exportkredit (SEK).

The agreement provides ESS with a €300 million line of credit that extends over seven years. This financing offsets flat cash contributions from Members, and enables ESS to meet costs as they arise. The approach secures the aggressive construction schedule without risking delays.

Financing Facts

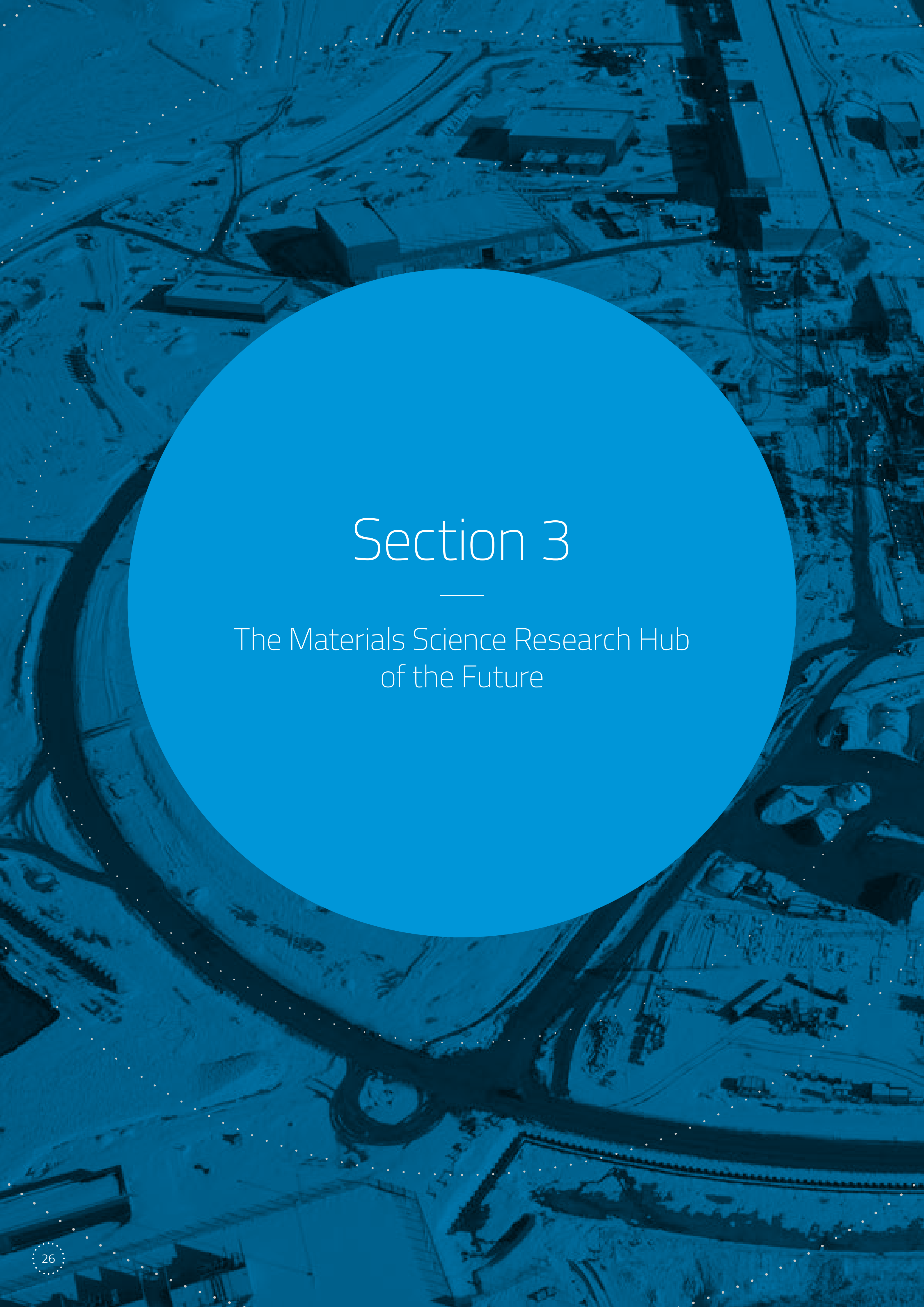
The Member States of the European Spallation Source ERIC directly finance the ESS organisation through cash and in-kind contributions. The total construction budget of the research centre is €1.84 billion in 2013 pricing.

Available credit: 300 MEUR
Duration: 7 years

European Investment Bank (EIB)*	- 100M€
Nordic Investment Bank (NIB)	- 100M€
AB Svensk Exportkredit (SEK)	- 100M€

*The EIB financing is supported by InnovFin Large Projects, within "InnovFin – EU Finance for Innovators", a joint initiative of the EIB Group and the European Commission under Horizon 2020, the EU framework for research and innovation. InnovFin Large Projects aims to improve access to risk finance for research and innovation (R&I) projects.

Executives from EIB, NIB and SEK with Lars Börjesson and John Womersley of ESS



Section 3

The Materials Science Research Hub of the Future

Sure signs of the robust research ecosystem that will grow in the region over the next decade are emerging. Building on the Swedish and Danish university systems, strong national support, and predecessors like the Risø National Laboratory in Denmark, this future already has a strong foundation. Scientists worldwide are excited at the prospect of soon bringing their groundbreaking research to Lund.

3.1 Regional Cooperation and Cross-Border Research

Effective collaboration between researchers is crucial to achieving real scientific breakthroughs. The European Spallation Source (ESS) is fortunate to be situated close to the MAX IV synchrotron as well as a regional network of high-quality Swedish and Danish universities. With ESS making good progress in its construction and MAX IV having already recorded its first scientific data, the region is set to become a global centre of materials science research.

The global ESS collaborations, European and inter-regional EU programmes, and local and regional funding initiatives all combine to give ESS a strong foundation and a broad reach as a key centre of gravity in the Big Science landscape.

Speaking at a joint roundtable at ESS, Christoph Quitmann, Director of the MAX IV Laboratory, said, "These large research infrastructures are wonderful places to collaborate. They bring people from all trades, from all countries, all fields of science together, and we have an incredibly important role in solving the grand challenges. Whether it is climate, whether it is health, whether it is the next generation of industry, we can contribute to that. So I think our role is to reach out, to build bridges between academia and industry, to make sure that what scientists know becomes available for companies to exploit".

"These large research infrastructures are wonderful places to collaborate. They bring people from all trades, from all countries, all fields of science together, and we have an incredibly important role in solving the grand challenges..."

Christoph Quitmann, Director MAX IV Laboratory

The MAX IV synchrotron in Lund

3.2 Danish Science Minister and Parliament Members Visit

A large delegation from the European Spallation Source host country Denmark visited the ESS construction site led by the country's Minister for Higher Education and Science, Søren Pind, and the Danish parliament's Standing Committee for Education and Research. More than 30 politicians, scientists, and business representatives participated in the study visit, which included presentations from ESS, MAX IV Laboratory, Danish academia and industry, as well as guided tours of the ESS site and the adjacent MAX IV synchrotron.

"This is world class, what is being established here," said Minister Pind. "And for the Danish scientific environment, for the whole community, this is important because it shows that you can build world-class facilities here, and you can have world-class people operating in them. That is of course something we want to participate in."

Danish Minister for Science & Education Søren Pind

3.3 Visit by J-PARC Director Opens Doors for Swedish-Japanese Research Collaboration

The winter visits to ESS included Naohito Saito, Director of the Japan Proton Accelerator Research Complex (J-PARC) and Takashi Kobayashi, the head of J-PARC's Particle & Nuclear Physics Division. Discussion centred on the MIRAI initiative, which will see researchers from the Universities of Lund, Stockholm, Linköping, Umeå, Uppsala and Chalmers University of Technology bring their expertise to bear on future collaborations between Sweden and Japan.

The MIRAI initiative is specifically directed at researchers at an early stage of their career to lead future joint activities between universities in the two countries. The project will focus on these collaborations within the broader contexts of large-scale research facilities, life sciences, sustainability, ICT, and innovation.

3.4 Young Researchers Benefit from MAX4ESSFUN Programme

MAX4ESSFUN is a €13.6 million EU Interreg programme focused on building regional user capacity for ESS and MAX IV by directly financing experimental projects as well as training and supervision for PhD and post-doc researchers.

Overall the project enables 1,000 months of training and 500 months of learning with senior researchers.

Researcher: Małgorzata Makowska

Experiment: In-situ energy resolved neutron imaging studies of phase transition and creep behaviour in half-solid oxide cells during thermal and red-ox cycling

Experiment period: 2016-03-01 – 2016-08-31

Neutron source: J-PARC (Tokai, Japan)

Supervisor: Luise Theil Kuhn, DTU

Co-supervisor: Markus Strobl, ESS

Małgorzata Makowska graduated in applied physics from Gdansk University of Technology in 2007. She continued her studies at the Technical University of Denmark (DTU) and concluded her PhD project in the end of 2015. She specialises in neutron imaging.

Małgorzata participated as a 'young researcher' in MAX4ESSFUN in 2016, where she performed a neutron imaging experiment at J-PARC in Japan using funds from the project. She studied how to optimise solid-oxide fuel cells. Scientists from DTU and ESS provided supervision and expertise.

"The experiment was an interdisciplinary project. My group from DTU had the expertise in fuel cells, and their colleagues from ESS in neutron imaging techniques."

"When I conducted the experiment in Japan I was there as a user. Right now I'm 'on the other side', helping other users to perform experiments on the neutron instrument NECTAR."

Researcher: Yana Znamenskaya Falk

Experiment: Structure of pig gastric mucin at wide range of water contents and temperature

Experiment period: 2016-07-01 – 2016-12-31

Supervisor: Vitaly Kocherbitov, Malmö University

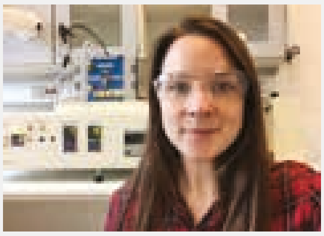
Co-supervisor: Jan Skov Pedersen, Aarhus University

Yana Znamenskaya Falk has an engineering degree from Kazan State Technology University in Russia. In 2013, Yana started her postdoc at Lund University's Physical Chemistry department. She now works as a research scientist at the Biofilms Research Center for Biointerfaces at Malmö University.

Yana was a participant in the MAX4ESSFUN programme in 2016. Her studies centred on the structure and function of biological materials such as pig gastric mucin. The results aim to provide researchers with more tools to prevent and treat common diseases like cystic fibrosis and asthma.

"Thanks to the project I got the opportunity to not only meet but also collaborate with the world famous and brilliant scientist – Professor Jan Skov Pedersen – who can model any system. I also had the opportunity to travel to Aarhus University, to see their laboratory, experimental instruments and got to know Professor Pedersen's group. I met a new contact there for powder diffraction experiments, which also can be useful in the future."

"I definitely think MAX IV and the European Spallation Source will be important and useful facilities that will attract many brilliant scientists. If I stay in academia, there is no doubt that I will apply for beam time there to investigate my samples."



Researcher: Hazel Reardon

Experiment: RuAs2 – A promising thermoelectric material

Experiment period: 2016-07-01 – 2016-12-31

Supervisor: Bo Brummerstedt Iversen, Aarhus University

Co-supervisor: Anders Palmqvist, Chalmers University of Technology

Hazel Reardon received her PhD from the University of Glasgow in 2014 and has been working in Denmark for two and a half years as a postdoctoral fellow at the Center for Materials Crystallography (CMC) at Aarhus University.

Through MAX4ESSFUN Hazel worked on a material called RuAs, which is prepared by melting ruthenium and arsenic together. The project examined the characteristics of RuAs and assessed its potential as a new thermoelectric material for use in clean energy applications.

"I believe that this research will enable us to understand how materials of this kind can be applied and/or modified to generate a useful product. Through the SPS route, we believe that there is a significant opportunity for upscaling thermoelectric materials production, and this will be the next step for this research."

"I think these facilities are important for the next generation of scientists. When we see new facilities like MAX IV and ESS we see a lot of new opportunities! The availability of new and accessible research facilities is pivotal in developing new frontiers and advances in materials science."

3.5 Research on Polymers Points to Future of Region as Global Materials Science Hub

Twice a year, the Technical University of Denmark invites distinguished global experts to give the H.C. Ørsted Lecture. In Autumn 2016 leading polymers investigator Frank Bates from the University of Minnesota discussed the importance of neutron scattering to materials science as well as his long-time connection to researchers and neutron sources in Denmark, France, Germany and Switzerland.

"Neutron beam time is a truly limited resource. You need either a nuclear plant or a dedicated spallation source. Neither solution is within reach of a normal university setting due to both safety and economic concerns," said Bates. "In the USA we have just two facilities. They are both operated as national laboratories, meaning that researchers and industry all across the country compete for time."

Bates' research on polymers points the way to some exciting applications in health science and industry. He looks forward to bringing his ground-breaking research to ESS.

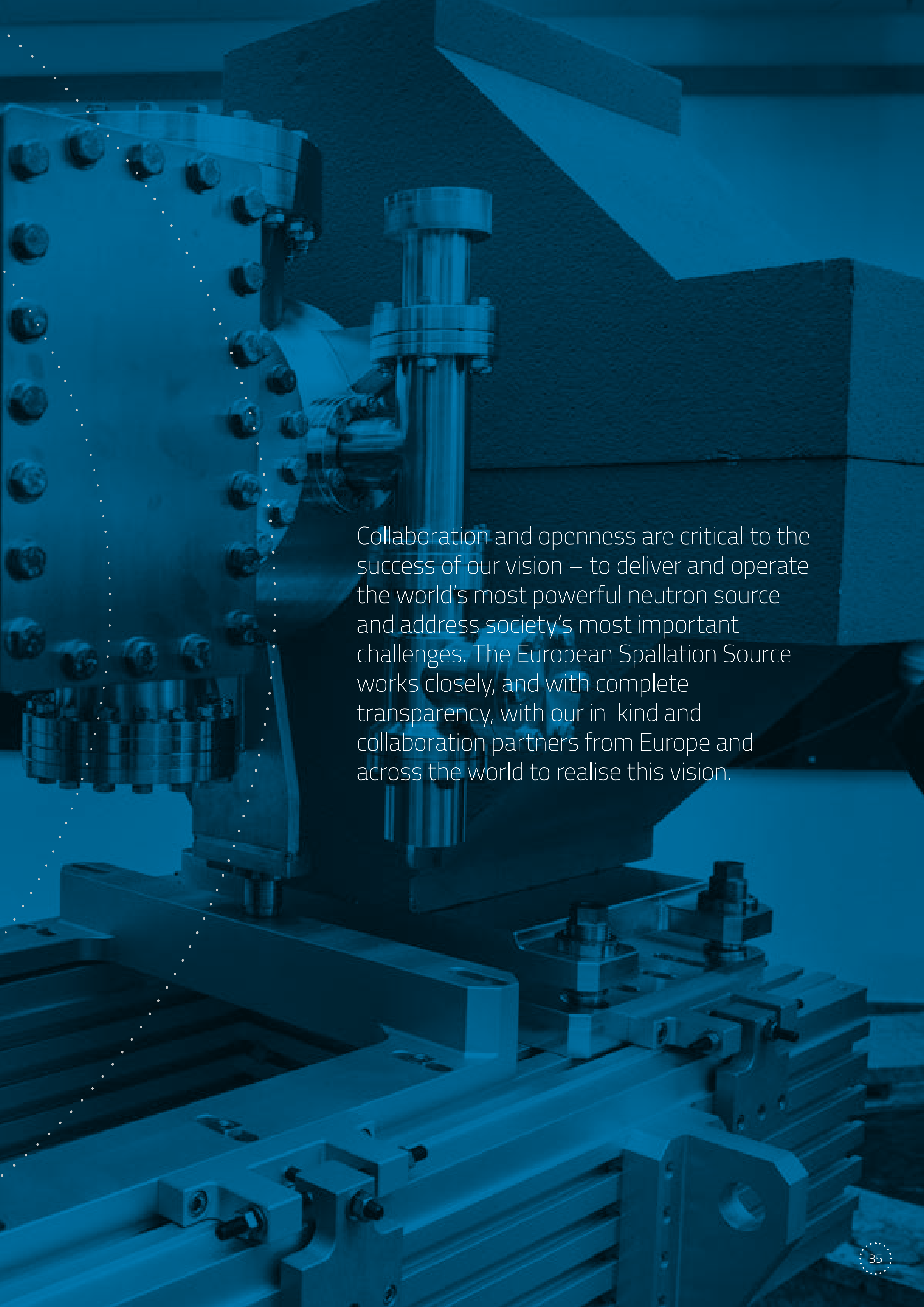
"When it comes to neutron scattering, Europe is more advanced than the US. The facility at Grenoble, France, is in my view the best in the world, while also German and Swiss facilities rank highly. Further, the European Spallation Source (ESS) in Sweden will become the leading source in the world once it opens. I understand that Denmark is a co-host of ESS, and look forward to cash in on my Danish connections once again!"

"When it comes to neutron scattering, Europe is more advanced than the US. The facility at Grenoble, France, is in my view the best in the world, while also German and Swiss facilities rank highly."

Frank Bates, University of Minnesota

Section 4

In-Kind and Collaboration Partners



Collaboration and openness are critical to the success of our vision – to deliver and operate the world's most powerful neutron source and address society's most important challenges. The European Spallation Source works closely, and with complete transparency, with our in-kind and collaboration partners from Europe and across the world to realise this vision.

In-Kind and Collaboration Partners

The European Spallation Source is a collaboration of nearly 130 institutional partners worldwide through in-kind agreements, grant consortiums and other research collaborations. ESS In-Kind Partners are indicated in bold type.

Institution	Acronym	Collaboration	Country
A.V. Shubnikov Institute of Crystallography Russian Academy of Sciences	IUCr	Grants	RU
Aarhus University	**AU**	**IKC**	**DK**
Aragón Institute for Material Science	ICMA	Grants	ES
Association of European Research Libraries	LIBER	Grants	NL
ATHENA Research and Innovation Center	ARC	Grants	GR
Australian Nuclear Science and Technology Organisation	ANSTO	Collaboration	AU
Barcelona Supercomputing Center	BSC	Grants	ES
Bilbao Biscay Savings Bank	BBK	Collaboration	ES
Biobanks and Biomulecular Research Infrastructure Consortium	BBMRI	Grants	AU
Brookhaven National Lab	BNL	Collaboration	USA
Budker Institute of Nuclear Physics of SB RAS	BINP	Grants	RU
Central European Research Infrastructure Consortium	CERIC-ERIC	Grants	IT
Chalmers University of Technology	CTH	Grants	SE
Chemnitz University of Technology	TU Chemnitz		DE
Consorzio Interuniversitario Resonance Magnetite di Metallo Proteine	CIRMMP	Grants	IT
Cockcroft Institute	**CI**	**IKC**	**UK**
Consortium of universities CINECA	CINECA	Grants	IT
Copenhagen University	**UCPH**	**IKC**	**DK**
CSC - IT Center for Science	CSC	Grants	FI
Danish Technological Institute	DTI	Grants	DK
Delft University of Technology	TU Delft	Grants	NL
Diamond Light Source	DLS	Grants	UK
EGI Foundation	EGI	Grants	NL
Elettra Sincrotrone Trieste S.C.p.A.	**ELETTRA**	**IKC**	**IT**
Eötvös Loránd University	ELTE	Grants	HU
ESP Central	ESP	Grants	UK
ESS Bilbao		**IKC**	**ES**
European Molecular Biology Laboratory	EMBL	Grants	DE
European Organisation for Nuclear Research	CERN	Grants	CH
European Synchrotron Radiation Facility	ESRF	Grants	FR
European X-Ray Free-Electron Laser Facility GmbH	XFEL	Grants	DE
Extreme Light Infrastructure Delivery Consortium	ELI DC	Grants	RO/HU/CZ
Facility for Antiproton and Ion Research in Europe GmbH	FAIR	Grants	DE
GÈANT	GEANT	Grants	NL
German Electron Synchrotron	DESY	Grants	DE
Goethe University Frankfurt		Grants	DE
Göttingen University	UGOE	Grants	DE
GSI Helmholtz Centre for Heavy Ion Research	GSI	Collaboration	DE
Helmholtz Centre for Materials and Coastal Research	**HZG**	**IKC**	**DE**
Helmholtz-Zentrum Berlin for Materials and Energy	HZB	Collaboration	DE
Hongik University, Seoul		Collaboration	KR
Huddersfield University	**HU**	**IKC**	**UK**
Hungarian Academy of Sciences - Centre for Energy Research	**MTA EK (CER)**	**IKC**	**HU**
Hungarian Academy of Sciences - Institute for Nuclear Research	**MTA Atomki**	**IKC**	**HU**
Hungarian Academy of Sciences - Wigner Research Centre for Physics	**MTA Wigner**	**IKC**	**HU**
Indiana University		Collaboration	USA
Institute for Energy Technology	**IFE**	**IKC**	**NO**
Institute of Accelerator Technologies of Ankara University	IAT-AU	Collaboration	TR
Institute of Applied Physics of the Russian Academy of Sciences	IAP RAS	Grants	RU
Instruct Integrating Biology	INSTRUCT	Grants	UK
Integrated Carbon Observation System	ICOS	Grants	FI
Integrated Detector Electronics AS	IDEAS	Grants	NO
ISIS Neutron Source Facility	**ISIS**	**IKC**	**UK**
Japan Proton Accelerator Research Complex	J-PARC	Collaboration	JPN
JISC LBG	JISC	Grants	UK
Joint Institute for Nuclear Research	JINR	Grants	RU
Jülich Research Centre	**FZJ**	**IKC**	**DE**
Karlsruhe Institute of Technology	KIT	Grants	DE

Institution	Acronym	Collaboration	Country
Laboratory of Instrumentation and Experimental Particles Physics	LIP	Grants	PT
Laue-Langevin Institute	ILL	Grants	FR
Laval University		Collaboration	CA
Leibniz-Institute for Molecular Pharmacology	FMP	Grants	DE
Léon Brillouin Laboratory	**LLB**	**IKC**	**FR**
Linköping University	LU	Collaboration	SE
Lund University	**LU**	**IKC**	**SE**
Masaryk University	MENI / CEITEC	Grants	CZ
Max Planck Society	MPG	Grants	DE
Mid Sweden University	MiU	Grants	SE
National Institute for Astrophysics	INAF	Grants	IT
National Institute for Nuclear Physcis	**INFN**	**IKC**	**IT**
National Institute of Geophysics and Volcanology	INGV	Grants	IT
National Research Council of Italy	**CNR**	**IKC**	**IT**
Natural Environment Research Council	BGS	Grants	UK
Norwegian University of Science and Technology	NTNU		NO
Nova University of Lisbon	ITQB NOVA	Grants	PT
Nuclear Physics Institute of the CAS	**UJF CAS (ASCR)**	**IKC**	**CZ**
Oak Ridge National Laboratory	ORNL	Collaboration	USA
Paul Sherrer Institute	**PSI**	**IKC**	**CH**
Petersburg Nuclear Physics Institute, National Research Center Kurchatov Institute	PNPI (NRC KI)	Grants	RU
Polish Energy Group	**PGE**	**IKC**	**PL**
PRACE - Partnership for Advanced Computing	PRACE	Grants	BE
Rathenau Institute of the Royal Dutch Academy of Sciences	KNAW-RI	Grants	NL
Rhone-Alpes European Large-Scale Facility for NMR	RALF-NMR	Grants	FR
Roskilde University	**RU**	**IKC**	**DK**
Royal Institute of Technology	KTH	Grants	SE
Science and Technology Facilities Council	**STFC**	**IKC**	**UK**
Spanish National Research Council	CSIC	Grants	ES
Stanford University National Accelerator Laboratory	SLAC	Grants	USA
Stockholm University	SU	Collaboration	SE
SURFsara	SURFsara	Grants	NL
Swiss Center for Electronics and Microtechnology	CSEM		CH
Swiss Federal Institute of Technology in Lausanne	EPFL		CH
Synchrotron SOLEIL	SOLEIL	Grants	FR
Tallinn University of Technology	**TTU**	**IKC**	**EE**
Technical University of Munich	**TUM**	**IKC**	**DE**
The French Alternative Energies and Atomic Energy Commission	**CEA**	**IKC**	**FR**
The Henryk NiewodniInstitute of Nuclear Physics	**IFJ-PAN**	**IKC**	**PL**
The Institute of Experimental and Applied Physics	IEAP CTU	Grants	CZ
The National Center for Nuclear Research	**NCBJ**	**IKC**	**PL**
The National Center for Scientific Research	**CNRS**	**IKC**	**FR**
The Netherlands Cancer Institute	NKI	Grants	NL
The Technical University of Denmark	**DTU**	**IKC**	**DK**
Thomas Jefferson National Accelerator Facility - Jefferson Lab	JLAB	Collaboration	USA
Trust-IT Services Ltd.	TRUST-IT	Grants	UK
United Kingdom Atomic Energy Authority	**UKAEA**	**IKC**	**UK**
University of A Coruña		Collaboration	ES
University of Bath		Collaboration	UK
University of Bergen	**UiB**	**IKC**	**NO**
University of Brescia		Collaboration	IT
University of Edinburgh	UEDIN	Grants	UK
University of Florence	PIN	Grants	IT
University of Latvia	LU	Collaboration	LV
University of Leiden	UL	Grants	NL
University of Manchester	UoM	Grants	UK
University of Oslo	**UiO**	**IKC**	**NO**
University of Oulu	UO	Grants	FI
University of Parma		Grants	IT
University of Patras	UPAT	Grants	GR
University of Tartu	**UT**	**IKC**	**EE**
Uppsala University	**UU**	**IKC**	**SE**
Utrecht University		Grants	DK
Utrecht University	UU	Grants	NL
Uzhorod National University	UNU	Grants	UA
Vilnius University		Collaboration	LT
Warsaw University of Technology	**Warszawa UT**	**IKC**	**PL**
Weizmann Institute of Science		Grants	IS
Wroclaw University of Science and Technology	**PWR**	**IKC**	**PL**
ZHAW Zurich University of Applied Sciences	**ZHAW**	**IKC**	**CH**

4.1 New Members and Founding Observers

UK Confirmed as ESS Member

The United Kingdom has moved from being a Founding Observer to a Founding Member of the European Spallation Source ERIC (ESS), with the decision ratified at the 6th meeting of the ESS Council held in Malmö, Sweden in June 2016.

Netherlands Takes Step Towards Full Membership

In December 2016 the Dutch Permanent Committee for Large-Scale Scientific Infrastructures announced that ESS has been included in its National Roadmap, bringing the Netherlands one step closer to full membership in ESS.

4.2 Pivotal Year for In-Kind Agreements

In-Kind Support

A large portion of ESS's €1.843 billion construction budget will be made of in-kind contributions from European partners.

For ESS to be delivered on time and on budget depends on meeting a strict schedule, which makes the approval of in-kind agreements a critical part of this pathway to success.

In 2016 ESS ratified a number of in-kind agreements to accelerate the construction phase and pave the way for 2017 being the busiest year of the project to date.

Committee Endorsements

By October 2016 40% of the €747.5 million in-kind target had been planned and agreed. This was thanks to the endorsement of 39 new agreements worth €172 million by the ESS In-Kind Review Committee, taking the total planned and agreed contributions close to €300 million.

The endorsed agreements are between the ESS sub-projects and their institutional partners. In many cases they formalise funding for work that has long been in progress, highlighting the good will and collaborative spirit that prevails in the ESS project.

The 39 new agreements represent work with 18 different institutional partners representing 10 different Partner nations.

Council Approvals

Endorsed agreements move from the Committee to the ESS Council for full ratification, and most of these agreements were presented to the European Spallation Source ERIC Council at its December meeting in Bilbao, Spain, home to ESS in-kind partner ESS Bilbao.

The Council approved 38 agreements in this round from the Czech Republic, Estonia, France, Hungary, Italy, Norway and Poland, setting in motion work packages covering technical components for the Accelerator, Target and control systems, as well as instrument construction.

This decision brings the total value of active in-kind work packages to nearly €200 million, and firmly establishes ESS's in-kind model for the construction of key technical components for the project.

In-Kind Management Group Leader Gábor Németh

4.3 First Deliveries

By the end 2016 ESS was more than two years into construction and approaching peak on-site construction activity. Alongside this acceleration of activity came a variety of significant deliveries and project firsts.

Spain Delivers the First Major IK Contribution

Spain's ESS Bilbao delivered 200 concrete shielding blocks to the ESS construction site in November, marking the project's first major in-kind delivery.

The 200 large interlocking blocks were designed by ESS Bilbao, a centre for neutron technologies, as a radiation shielding solution for the Accelerator's Tuning Beam Dump.

This is one of six in-kind contributions ESS Bilbao is expected to make to the Target sub-project.

First Plasma

The ESS partner Laboratori Nazionali del Sud (LNS) of the Italian National Institute of Nuclear Physics (INFN) successfully created plasma in the ion source in June.

The highly-ionised plasma will produce the proton beam for the Accelerator, and thus marks a significant milestone in the ESS project.

The LNS facility has assumed the lead role for the construction of the warm LINAC, the first section of the ESS Accelerator.

LINAC Warm Unit Prototype Arrives

ESS received the delivery of the first prototype of a LINAC Warm Unit (LWU) from STFC's Daresbury Laboratory in August. The LWU is the interconnection between two cryomodules, and will contain part of the beam instrumentation.

The prototype will be used for the ESS Vacuum team to test particle-free procedures, help with alignment, to interface with magnets, and will serve as a test stand for beam instrumentation.

Elliptical Prototype

In December the first prototype assembly of a medium-beta elliptical cryomodule was displayed at CEA-Saclay. The superconducting cavities contained in the cryomodules will comprise the bulk of the LINAC, and will accelerate the proton beam nearly to the speed of light.

LINAC Warm Unit Prototype Arrives

Photo of Paul Aden (STFC), Keith Middleman (STFC), Simone Scolari, Hilko Spoelstra, Thomas Grandsaert, Christophe Jarrige, Fabio Ravelli, Kristell Barthelemy, Richard Smith (STFC), Marcelo Juni Ferreira by the prototype.

4.4 EU and Regional Funds for Science Underpin Collaborations

European Union funding, along with regional and national grants, help the European Spallation Source to foster partnerships with the scientific community and in-kind collaboration partners. This support will help to enhance scientific impact and productivity throughout the Construction Phase and beyond.

BrightnESS

BrightnESS supports ESS in key technical areas such as moderator optimisation and detector development, in-kind coordination, innovation and outreach activities. It is a three-year EU funded project within the European Commission's Horizon 2020 Research and Innovation Programme.

BrightnESS has achieved all of its deliverables and milestones for 2016, and in October General Assembly members endorsed progress thus far and no modifications to the technical programme were proposed. Key results included the following:

- Treating detector readout as a modular system, meaning that a generic readout will support a variety of detector designs.
- Improving the counting rate of the original Multi-Blade design.
- The development of the Low Dimensional Moderator, which is crucial to enhancing neutron source brightness.
- A generic design and demonstration of the Multi-Grid detector.
- A strategic survey of neutron use and users across Europe to inform decisions about the future users at ESS.
- The development of an online In-Kind Contribution management platform called XRM+.
- A VAT workshop on how to handle VAT in relation to in-kind contributions and suppliers.
- Supporting ESS by developing its Innovation Policy and the creation of its Technology Transfer Office.
- A design review of all software (prototypes) that is expected to run at ESS in operations.
- Focus groups across Europe to understand the needs and expectations of future industrial users. The feedback gave ESS a clear picture of the technical, legal and financial constraints that companies have when deciding whether to use large-scale research facilities for their R&D.

In November 2016 ESS Bilbao hosted the first BrightnESS Best Practice Workshop on Engineering Aspects of Large-Scale In-Kind Projects to discuss engineering protocols for collaborative Big Science projects. 80 physicists and engineers from across Europe's leading science facilities met to discuss engineering protocols for collaborative big science projects.

SREss

Spatial Research Excellence by ESS (SREss) is a project at the European Spallation Source ERIC funded by the European Union as part of its regional investment policy through the European Regional Development Fund (ERDF). The aim of the SREss project is to secure physical infrastructure of the research facility and lay the physical basis for future instruments.

Head of External Relations & EU Projects Ute Gunsenheimer (foreground) and Brightness Project Coordinator Roy Pennings (r) at the 2016 BrightnESS General Assembly

DMSC Grants

The ESS Data Management & Software Centre (DMSC) has quickly become an essential partner in broader European efforts to improve both the software and general protocols of scientific computing. This is apparent in recent funding from the European Commission and the Swedish Research Council (VR) that aims to increase the scientific impact of ESS through support of DMSC initiatives.

EOSC Pilot Project

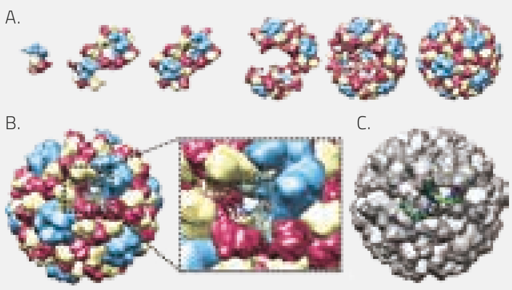
ESS will play an important role in realising the potential of the European Commission's €10 million European Open Science Cloud initiative. The two-year pilot project is led by the UK's Science & Technology Facilities Council (STFC).

Computational Methods for Analysing Self-Assembly with Time-Resolved SANS/SAXS

Led by Lund University, this grant project from VR aims to develop a computational method to analyse time-resolved Small Angle Neutron Scattering (TR-SANS) data from studies of biological self-assembly processes, and to make the methodology available for the neutron scattering user community.

A New Method to Model the Dynamic Structure Factor by Molecular Dynamics

The aim of this VR-funded project is to overcome the challenge of interpreting and understanding inelastic and quasielastic neutron scattering data by developing a new computer modelling method to model the dynamic structure factor. It is led by Chalmers University of Technology in Sweden.



Conceptual figure of a molecular self-assembly closeup from DMSC grant proposal

MAX4ESSFUN

In cooperation with ESS and MAX IV Laboratory in Lund, MAX4ESSFUN aims to build user capacity for the two facilities by directly financing 176 six-month-long experiment projects performed at operational neutron and light-source facilities by PhD students and post-docs. It includes an educational component including courses, workshops and summer schools. The ultimate objective is to stimulate collaborative research across national borders for researchers using neutron and synchrotron light. It is the flagship programme of the EU's larger Interreg Öresund-Kattegat-Skagerrak (ÖKS) project.

RAMP

The European Commission has provided funding for the Grenoble University-led RAtionalising Membrane Protein Crystallization project under the highly competitive Marie Skłodowska-Curie Actions Innovative Training Network (ITN). RAMP is a consortium of organisations from academia and industry who will support the research and training of 12 early-stage researchers over a four-year period.

4.5 Outreach Activities

As work accelerates at ESS it is critical that all current and future partners are aware of the progress being made. To achieve this, ESS undertakes a series of activities to inform, educate and excite all stakeholders, fostering a spirit of openness and collaboration. Such activities include site visits to Lund to see the facility taking shape, but can also include trips to partner organisations for information exchanges and discussions with industry about potential collaborations.

In 2016, more than 4,500 people visited the ESS site, more than double the amount who came in 2015. Visitors experienced the site through a variety of means, including more than 220 site walks and nearly 40 bus tours.

Belgium

The Board of the Belgian Nuclear Research Centre visited ESS in March to discuss collaboration opportunities. The overall goal of the meeting was to identify synergies and work towards Belgian membership in ESS.

The visit was followed, in May, by a project symposium on synergies and potential collaboration between ESS, the Multipurpose Hybrid Reactor for High-Tech Applications (MYRRHA) project in Belgium, and the European hub for Back-End of the Nuclear Fuel Cycle studies under preparation in Oskarshamn.

Denmark

More than 30 politicians, scientists, and business representatives from Denmark visited the ESS construction site last winter, led by the country's Minister for Higher Education and Science, Søren Pind, and the Danish parliament's Standing Committee for Education and Research.

France

The second French Industry and Partner day was held in February and brought together approximately 160 participants from science and industry. It included a tour of the French national laboratories CEA-Saclay and CNRS to showcase the progress of the French accelerator and detector developments for ESS.

Latvia

The ESS Latvian Partner Day in Riga brought together more than 40 participants from the local academic and scientific communities to explore collaboration opportunities between ESS and Latvia.

Following the success of the Latvian Partner Day, ESS hosted a delegation from Latvia on its premises in Lund in November to explore collaboration opportunities between Latvia and ESS.

The Netherlands

In May ESS welcomed the Dutch Ambassador to Sweden, Ines Coppoolse, and the Dutch Ambassador to Denmark, Henk Swarttouw, accompanied by the Dutch Honorary Consul in Southern Sweden, Magnus Dahl.

Sweden

August saw the Swedish Foreign Minister Margot Wallström join forces with the Minister for International Development and Climate/Deputy Prime Minister Isabella Lövin to lead a delegation of 130 Swedish ambassadors and dignitaries from around the world on a visit to ESS and MAX IV.

Swedish Foreign Minister Margot Wallström (r) is welcomed to the construction site by ESS Director for Project Support & Administration Agneta Nestenborg

Section 5

Construction Sets the Pace

The European Spallation Source entered the most intensive phase of the project with peak on-site construction activity fast approaching. The relentless scale of activity will be sustained, with the goal to begin commissioning of the Accelerator in late 2019. To reach this point, a series of milestones had to be met in 2016.

5.1 Technical Installations Take Centre Stage

Building construction moved swiftly and to schedule in 2016, with clear results. Conventional Facilities' work at the end of the year was 40% complete, including structural completion of the Accelerator tunnel and several other buildings.

Head of ESS Conventional Facilities Division Kent Hedin

The complex foundation piling for the Target Station and Beamline Gallery is also in the books. Work in each of the Accelerator, Target and Integrated Control System (ICS) divisions progressed to around 20% complete, with the construction of ESS as a whole nearly one third complete.

The project executed its first technical installations in 2016. Specially designed components and machine systems will be installed one after the other, and sometimes in parallel.

"Construction progress is absolute and continues to meet schedule milestones. We have worked around the inevitable redesigns, setbacks and delays and managed to keep the project as a whole moving forward as planned. We are proud of this, but as in-kind partners begin to join the project on-site, we enter a new phase with new challenges."

Kent Hedin, Head of Conventional Facilities Division

5.2 New Agreement with Skanska

The December Council meeting gave authorisation to Director General John Womersley to sign an agreed target price with Skanska for construction of the remainder of the ESS Conventional Facilities. The agreement includes possible cost-saving options to stay within the agreed budget while ensuring the long-term capabilities of ESS are maintained.

5.3 Accelerator Tunnel Construction Meets Major Milestone

In April the Accelerator and Conventional Facilities teams at ESS, along with construction partners from Skanska, met on site to celebrate the construction of the Accelerator tunnel with a traditional Swedish "Topping-Off" ceremony. This was an important milestone, signalling that early installations in the tunnel could begin.

Solid teamwork across the board allowed construction to move smoothly, even with necessary changes in the design requirements. Good examples of this were enlargement of the HEBT Loading Bay, to optimise the movement of equipment, and the Front End Building, to make a temporary drop hatch into a permanent feature.

5.4 Tunnel Installation Plans Presented

During the ESS Annual Review in April, the Accelerator Division presented plans for installing equipment in the tunnel.

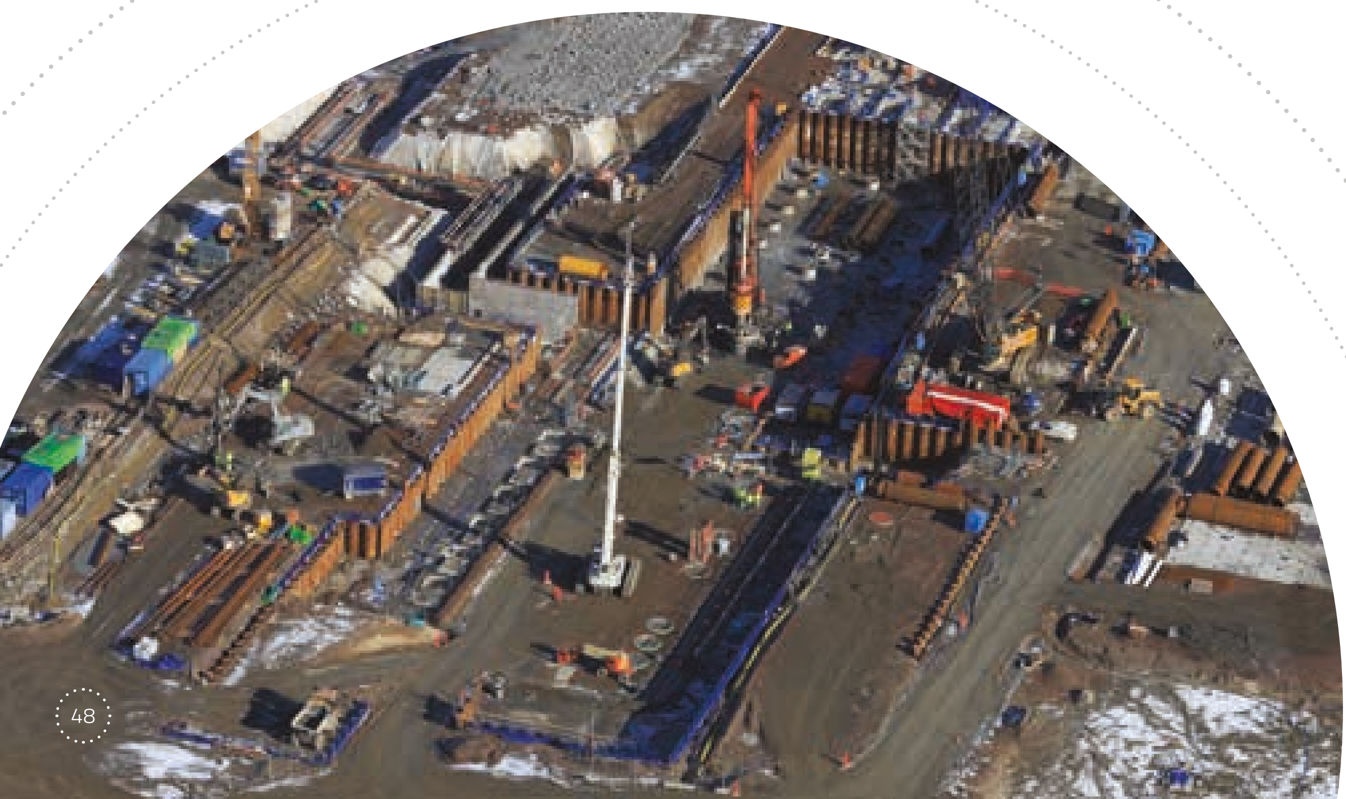
The plans take into account the sequencing of equipment placement, as well as the complicated logistics of moving heavy equipment into limited space and coordinating activities involving hundreds of people.

5.5 Ramping-Up

The first large-scale Accelerator installation began in December. The Swedish company PowerHeat installed warm helium gas piping between the Cryo-Compressor Building and the Gallery Building's Cold Box. That was followed by a full test installation of Stub components carried out by the Accelerator division. The Stubs are chicaned two-storey spaces that are the interface between the RF power source in the Gallery Building and the LINAC components in the tunnel. Lots of equipment needs to be precisely placed into a small space at each of the 30 Stubs.

Full access to the Accelerator tunnel, Cryo-Compressor Building and Front End Building is expected in May 2017, when the tunnel will be ready for full assembly of the LINAC.

Target Station foundation works



5.6 Target Foundation Work Hits Milestones

As construction of the Accelerator tunnel moved toward completion, work ramped up on the Target Station. At the beginning of the year, work on the installation tunnels that snake beneath the Target Station proceeded rapidly. This paved the way for the start of foundation works for the Target Station Monolith and Active Cells Handling Area in March.

By the end of the year, the installation tunnels for the Target Station and Instrument Halls reached 90% structural completion. The final section of the thick Target Station Monolith base slab was cast, bringing a huge five-part concrete pour to an end and putting to rest one of the most critical civil construction elements for ESS.

5.7 Integrated Project Schedule

Technical installations run in parallel with ongoing building construction. Each depends on the other, creating a complex scheduling and planning matrix developed by ESS together with Skanska, industrial suppliers and ESS In-Kind Partners, who in some cases will be moving their work on-site or to workshops and labs in the area.

As a part of the complex logistical planning, ESS developed an integrated project schedule (IPS). Led by ESS Project Manager John Haines, formerly head of the ESS Target Division. The IPS will drive the project forward, enabling the facility to achieve early scientific success and identify cost-saving opportunities along the way.

ESS Project Manager
John Haines

"The Integrated Project Schedule is a necessary step forward and will guide the different ESS projects toward the centralised goal of early scientific success. This will help to focus resource planning across the organisation to support each project as it must make difficult decisions regarding scope, cost and schedule."

John Haines, ESS Project Manager

5.8 Council Approves Instrument Construction Plan and In-Kind Contributions

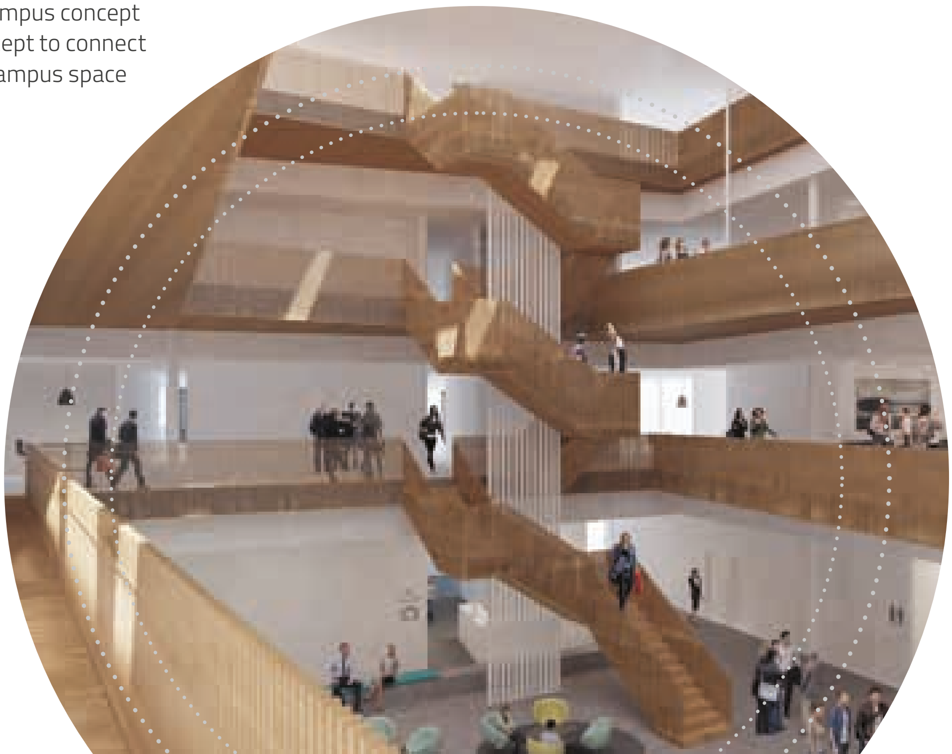
In December the ESS Council approved a construction plan for the facility's first 15 instruments. This plan establishes the main part of the suite of world-leading instruments that will come on line at ESS between 2021 and 2026.

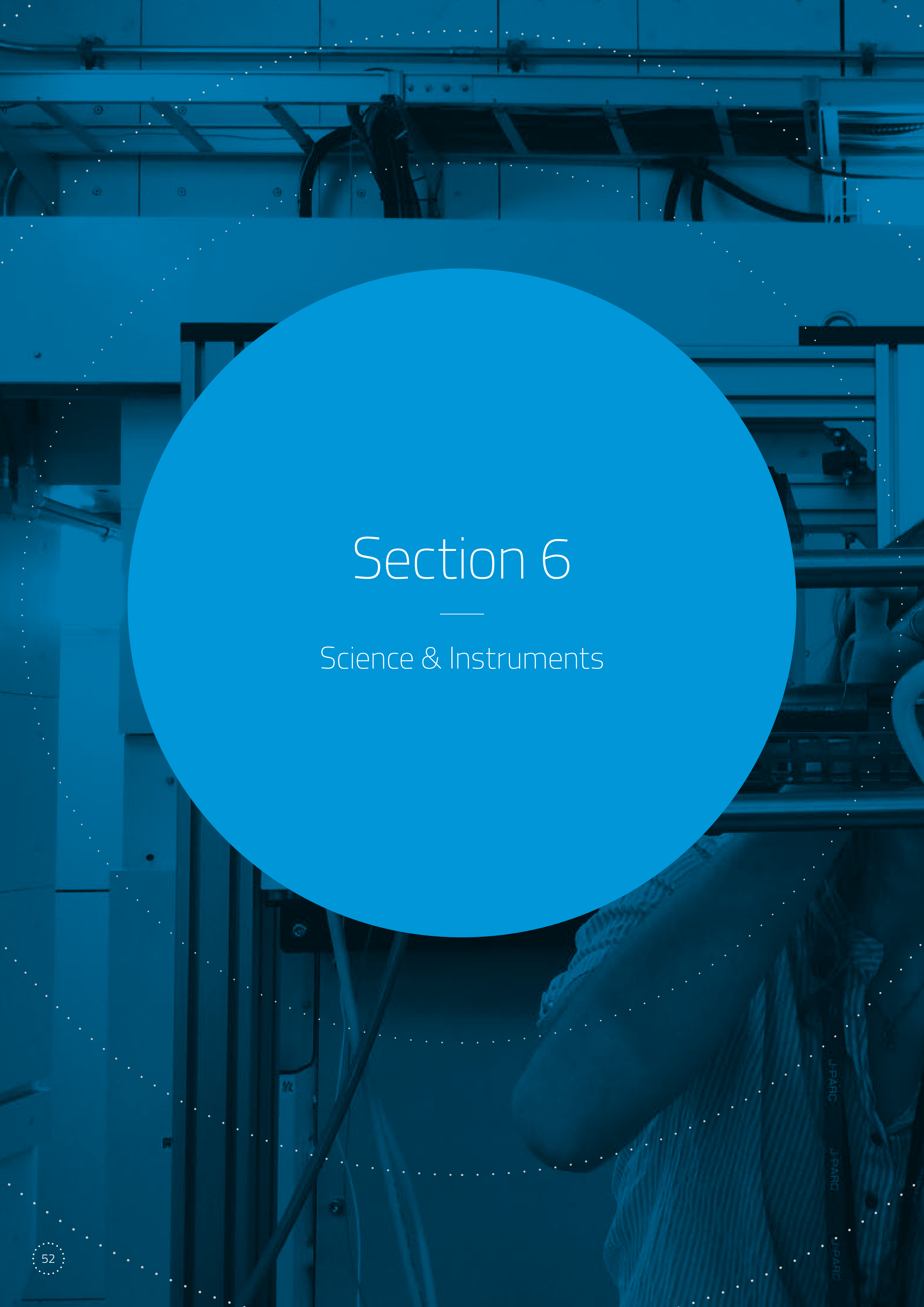
The Council also approved the first eight of the 15 to be brought into service as LoKI, ESTIA, DREAM, MAGiC, BEER, ODIN, C-SPEC and BIFROST. These instruments span a wide range of research capabilities from atomic- to large-scale structure determination, imaging of materials, materials engineering, magnetic and molecular dynamics, and thin films properties.

Another important step to keep the project on track in 2017 was the signing and approval of €172 million worth of in-kind contracts. Council approved 38 agreements in this round from the Czech Republic, Estonia, France, Hungary, Italy, Norway and Poland, setting in motion work packages covering technical components for the Accelerator, Target and control systems, as well as instrument construction.

5.9 Campus Buildings Move Toward Tendering

A comprehensive revision of the ESS campus concept took place during 2016, including a concept to connect the buildings and an expansion of the campus space by 2,000 square metres.





Section 6

Science & Instruments

Instrument design advanced rapidly in 2016, resulting in an established scope, budget and construction schedule for the suite of world-leading instruments that will come on line at ESS between 2021 and 2026. The development of boron-based detectors for ESS met key milestones and the Data Management and Software Centre opened its permanent office in Copenhagen.

6.1 Andreas Schreyer Begins Work as Science Director

In January 2016, Andreas Schreyer took over as the new Science Director at the European Spallation Source (ESS) with responsibility for neutron instruments, scientific research and the Data Management and Software Centre (DMSC).

"I've been involved with the ESS project from the outside so far, and I've seen it grow and seen very good work," said Schreyer. "We're actually now in a status where we know what we want to build and what the instrument suite is supposed to be. It was a long process, but it was important to go through because it helped to involve all the great partners from Europe, which we need here to make the ESS work."

Andreas Schreyer has been deeply engaged with the ESS project since 2011, having served as the head of two steering committees for the German contribution, as a German representative on the ESS Instrument Collaboration Board (ICB), and as the co-proposer of BEER, the engineering diffractometer selected for the ESS instrument suite.

His management experience at large scale neutron and synchrotron facilities and his strong history and interest in supporting collaboration on instruments make him an excellent choice for the ESS executive management team.

6.2 Instrument Construction Schedule Approved by Council

At its meeting in Bilbao in December 2016, the European Spallation Source ERIC Council, the project's governing body, approved the construction plan for the first 16 neutron instruments recommended by the Scientific Advisory Committee (SAC).

Instrument design advanced rapidly through 2016, punctuated by scope-setting meetings held to establish each instrument's scope, budget and schedule. By November, Science Director Andreas Schreyer was able to propose a construction plan for the first 16 instruments that will start operating at ESS between 2021 and 2026.

The plan was presented first to the Scientific Advisory Committee at its November meeting in Copenhagen and then to the ERIC Council in December.

The key compromise of the plan is that in order to build all 16 approved instruments, one instrument would be moved out of the construction budget and into the initial operations budget. This would mean a later start for the 16th instrument but a nonetheless on-time commissioning date.

Though subject to change as the realities of instrument construction emerge, the first eight instruments are expected to be LOKI, ESTIA, DREAM, MAGiC, BEER, ODIN, C-SPEC and BIFROST. These are scheduled to be operational by August 2023.

The instruments span a wide range of research capabilities from atomic- to large-scale structure determination, imaging of materials, materials engineering, magnetic and molecular dynamics, and thin film properties.

The remaining seven instruments to be included in the construction budget are SKADI, FREIA, HEIMDAL, NMX, T-REX, MIRACLES and VESPA, expected to go online in 2024 and 2025.

The 16th instrument is proposed to be constructed with the early operations budget. In 2018 a decision will be made either to go ahead with VOR or an as yet undefined neutron spin-echo instrument. ESS remains committed to the principle of building both of those instruments.

Science Support Systems

The December Council meeting also saw the approval of the scope for Science Support Systems (SSS). The Sample Environment reference suite is now defined to cover the needs of the first eight instruments in the user programme.

Phase 1 Instrument Commissioning Operational by August 2023	**Phase 2 Instrument Commissioning Operational by December 2025**	**To Be Determined**
LOKI – Broadband SANS	SKADI – General-Purpose SANS	VOR
ESTIA – Focusing Reflectometer	FREIA – Liquids Reflectometer	Neutron spin-echo
DREAM – Powder Diffractometer (Bispectral)	HEIMDAL – Hybrid Diffractometer	
MAGIC – Magnetism Single-Crystal Diffractometer	NMX – Macromolecular Crystallography	
BEER – Engineering Diffractometer	T-REX – Bispectral Chopper Spectrometer	
ODIN – Multi-Purpose Imaging	MIRACLES – Backscattering Spectrometer	
C-SPEC – Cold Chopper Spectrometer	VESPA – Vibrational Spectroscopy	
BIFROST – Extreme-Environments Spectrometer		

6.3 IKON Meetings Define ESS Instrument Scope and Budget

In 2016, the semi-annual In-Kind Contributions for Neutron Science at ESS (IKON) meetings played a critical role in locking down the day-one specifications for each instrument within the allocated budgets. The aggressive pace of decision making during the year clarified the final instrument layouts and allowed Science Director Andreas Schreyer to finalise a detailed instrument construction strategy.

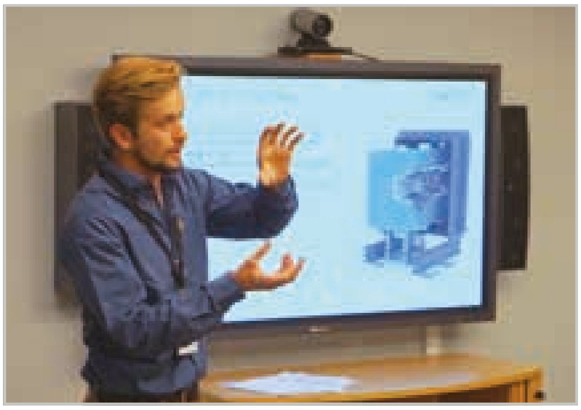
The IKON meetings are a regular forum centred on the design and construction of the ESS neutron instruments, instrument technologies, and associated support facilities. The IKON10 meeting was held in February in Düsseldorf, hosted by ESS partner lab Forschungszentrum Jülich. The IKON11 meeting took place in September at ESS in Lund. Each meeting involved over 160 participants.

During the year each of the 16 approved instruments made substantial progress in defining their day-one specification, design and construction schedule and final instrument budget, as well as securing In-Kind Partners for the engineering design and construction.

6.4 ESS Hosts Instruments Engineering Conference DENIM

The 2016 Design and Engineering of Neutron Instruments Meeting (DENIM) took place in Lund at ESS in September. Over 120 engineers from neutron sources around the globe attended the three-day event.

Over its four-year existence, DENIM has become the most significant engineering workshop in the field of neutron scattering instruments. The meeting allows engineers to showcase projects, exchange information and develop collaborations with industry suppliers.



Sven Oliver Schütz of PSI presents the ESTIA instrument project at DENIM

6.5 Instruments: ESTIA, FREIA, HEIMDAL, ODIN

ESTIA: A Truly Focusing Reflectometer

The ESTIA reflectometer uses an innovative guide concept based on optics already introduced for X-rays, allowing the user to easily control both the beam's footprint and its divergence. ESTIA has successfully passed the Tollgate 2 design review. Detailed engineering is in progress and prototype neutron guide components are being manufactured.

Samples must often be kept small in reflectometry experiments due to the complexity of preparing new materials and the cost of isotopes necessary to study slow diffusion processes in solids or carry out selective molecular labelling.

The focusing optics for ESTIA are an entirely novel concept among present-day neutron instruments. The Selene guide to be installed on the instrument gives ESTIA a unique tool to exploit the high brightness of ESS. Adjustments to the guide allow for unusually precise hand tuning of the neutron beam's intensity and focal area.

"Any reflectometer constructed at ESS would be expected to improve performance over existing instruments by at least an order of magnitude," said Dr. Robert Dalgliesh, chair of the ESS Scientific and Technical Advisory Panel (STAP) for reflectometry. "The unique ESTIA concept was recommended for construction by the STAP because it goes further than this. The design makes use of truly focusing neutron optics, which will provide performance gains of more than two orders of magnitude for samples smaller than one square centimetre. This represents a huge step forward for neutron reflectometry."

ESTIA is anticipated to make an impact on a wide range of science including the design and optimisation of materials used in medical implants, sensor technology, energy storage, data storage and electronics.

ESTIA is being built by the Paul Scherrer Institute in Switzerland.

HEIMDAL: Thermal Neutron Powder Diffractometer

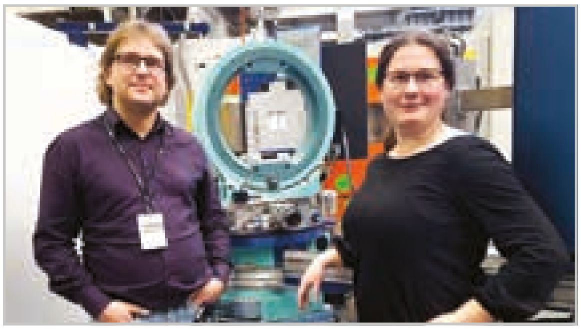
HEIMDAL is an instrument for studying the atomic and magnetic structure of materials. Its novel design will give it world-leading performance. The instrument is currently in the preliminary development phase, preparing for the final instrument design to be ready in summer 2017.

The primary focus of HEIMDAL is on materials to meet future technological challenges in fields such as energy generation and storage, composites, heterogeneous catalysis and nanomaterials, and especially the ability to study these systems over multiple length scales and under conditions which mimic, as closely as possible, those experienced under real operating conditions.

The HEIMDAL diffractometer, proposed by Dr. Mogens Christensen at Aarhus University in Denmark, is well-equipped to serve the needs of the neutron diffraction community and beyond, into the new and fast-growing materials science area of time-resolved measurements.

"HEIMDAL is both a conventional thermal powder diffractometer for crystallographic studies and a completely new instrument aimed at bridging the gap between several traditionally separated user communities. Hence its name for the guardian of Bifrost, the rainbow bridge to Asgård, taken from Nordic mythology," says Paul Henry, coordinator for the powder diffraction group. "Heimdal the god sees and senses everything, which makes it an apt name for an instrument that aims to cover length scales of several traditional neutron techniques – diffraction, SANS and imaging – effectively seeing everything."

HEIMDAL is a collaboration between Aarhus University, the Paul Scherrer Institute (PSI) and the Institute for Energy Technology in Norway.



Aarhus University scientists leading the HEIMDAL instrument project, Mogens Christiansen (l) and Sonja Lindahl Holm

FREIA: Fast Reflectometer for Extended Interfacial Analysis

FREIA will be the first reflectometer in the world capable of performing fast kinetic studies of thin films and other advanced materials. In 2016, the instrument moved into preliminary engineering design, the first step in the process of construction.

The reflectometer will have the world's widest simultaneous range of neutron scattering angles able to measure structural changes over a broad length scale with measurement times of around one second.

FREIA is designed to study free liquid surfaces and solid surfaces. Atoms on a surface have a very different environment to those deep inside a material. This gives surfaces and very thin films of material interesting properties that are exploited in nature and in modern technology.

In an agreement signed between the ESS and the UK's Science & Technology Facilities Council, the UK's ISIS neutron source has been appointed the lead partner for the construction of FREIA.

"I am very happy to have ISIS confirmed as the lead partner for FREIA," said ESS Instrument Scientist and FREIA lead proposer Hanna Wacklin. "I am looking forward to working with their scientists and engineers who have a wealth of experience in constructing and operating no fewer than five neutron reflectometers at a spallation source. The instrument is in very good hands."

ODIN: Optical and Diffraction Imaging with Neutrons

ODIN will be a world-leading instrument in the rapidly developing field of neutron imaging for use in industry, environment, commerce, archaeology and art. One of the first instruments scheduled for construction, in 2016 the ODIN team completed Phase 1 with all engineering design documentation submitted for the Tollgate 2 preliminary design review.

Despite the novelty of a design combining bi-spectral extraction, a long partly-elliptical guide, a complex wavelength-frame-multiplication chopper system, and flexible end station with various detector solutions, there are low associated risks for ODIN as components will employ proven methods for fabrication and testing.

"We are really proud that the ESS management is behind our team in bringing ODIN online among the first instruments," says Eberhard Lehmann, head of the Neutron Imaging and Activation Group at PSI. "This shows how much neutron imaging has progressed in recent years to being an outstanding research tool."

The flexibility necessary to make ODIN a world-leading neutron imaging instrument – with several cutting edge imaging techniques and a test-bench for the imaging modalities that are under development – requires very careful, future-proof and user-oriented planning during this exciting engineering design phase.

The ODIN instrument consortium is a collaboration between the Technical University of Munich (TUM) in Germany, the Paul Scherrer Institute (PSI) in Switzerland and ESS.

Preliminary drawing of the top view of the ODIN experiment cave.

6.6 Data Management and Software Centre Opens in Copenhagen

Permanent offices for the Data Management and Software Centre (DMSC) were opened in August 2016 at the Copenhagen Bio Science COBIS building, on the north campus of the University of Copenhagen.

The Danish Minister for Higher Education and Science, Ulla Tørnæs participated in the opening event. She was joined by Thomas Bjørnholm, the Prorector for Research and Innovation at the University of Copenhagen, and more than 90 representatives from ESS' Danish partners, stakeholders and ESS.

The European Spallation Source is forecast to produce 3-5 petabytes of data per year when user operations start in 2023, rising to 7-11 PB over the following years.

DMSC will provide the analysis and modelling software that will enable researchers to turn neutron data into scientific results and innovation.

The data will be transferred between ESS in Sweden and DMSC in Denmark through a dedicated optical fibre connection over the bridge that spans the Öresund strait.

DMSC has rapidly positioned itself as an essential partner in broader European efforts to improve both the software and general protocols of scientific computing. Such initiatives are in turn critical to the Centre's mission to maximise the scientific impact of research to be performed at ESS.

The Future of Big Data

DMSC and ESS will play an important role in realising the potential of the European Open Science Cloud (EOSC) for the neutron and photon science communities.

The European Commission's grant of €10 million to the EOSC pilot programme will enable the 33 partners in this important long-term initiative to establish a strong formal foundation. The two-year project is being led by the UK's Science & Technology Facilities Council (STFC). It will establish the foundations for broad user access and global standards for interoperability.

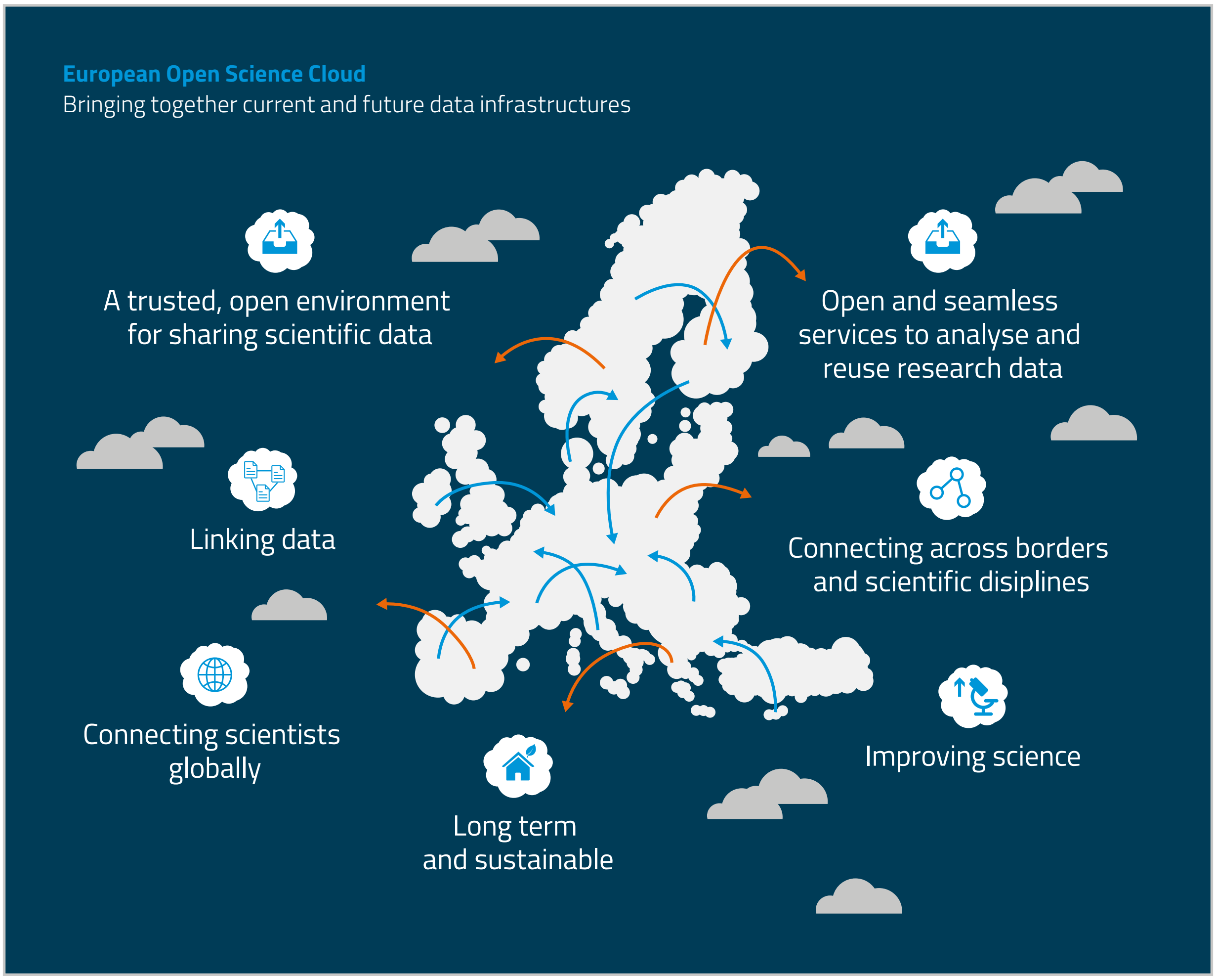
"Big data is transforming science," said ESS Director General John Womersley. "We want ESS to be a part of the leadership in thinking about open data from big facilities, where the facility will be the repository for the data rather than the individual scientist. It's an opportunity to make ESS data openly available from a single source, like the Space community does."

Grants for Data Analysis and Modelling

The Swedish Research Council (VR) has funded two new projects at DMSC.

Lund University will develop a computational method to analyse time-resolved Small Angle Neutron Scattering (TR-SANS) data from studies of biological self-assembly processes, and to make the methodology available for the neutron scattering user community.

Chalmers University of Technology will lead a project to overcome the challenge of interpreting and understanding inelastic and quasielastic neutron scattering data by developing a new computer modelling method to model the dynamic structure factor.



eoscpilot.eu

NOBUGS at DMSC

DMSC hosted the NOBUGS (New Opportunities for Better User Group Software) conference in Copenhagen in October, an event attended by more than 150 scientists and software developers from neutron and X-ray user facilities from around the world.

The event was co-organised with MAX IV and Copenhagen University, demonstrating a good collaboration between neighbours on all levels. There were a number of satellite workshops, most notably on the McStas simulation software, the Mantid reduction framework, and the NeXus data file format.

6.7 R&D for Boron-Based Reflectometry Detectors

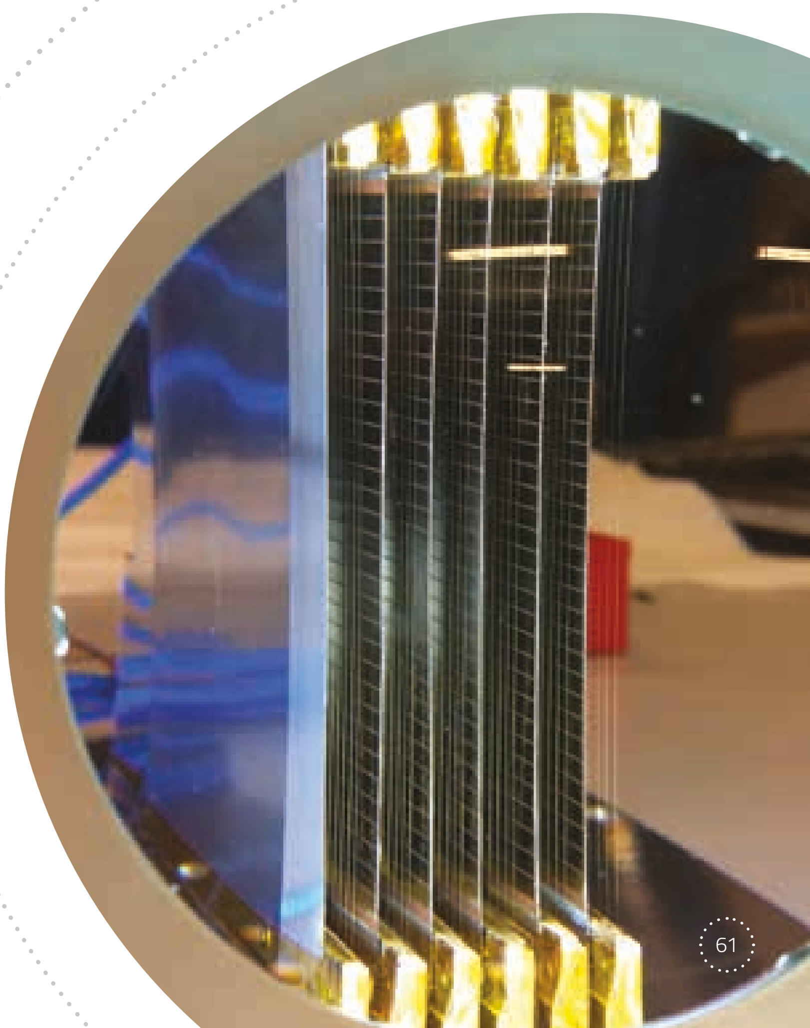
Development of a prototype detector for reflectometer instruments at ESS has rapidly progressed during 2016, with neutron detection parameters coming in line with ESS instrument requirements.

To fully exploit the high flux of neutrons that ESS will be able to deliver to neutron reflectometer instruments, a collaboration between ESS, Sweden's Lund and Linköping Universities, and the Wigner Research Centre of Physics in Hungary has developed the boron-based Multi-Blade detector prototype.

Tests carried out at the Budapest Nuclear Centre in March 2016 and later in the year at Lund University showed improvements of many of the detector's parameters compared with the results obtained in 2013.

"We are happy with how the detector performed in terms of efficiency, gas gain, spatial resolution, stability and gamma-ray sensitivity," says ESS scientist Francesco Piscitelli, who leads the development of this technology.

Further improvement of the detector's uniformity and counting rate capability are in progress and the detector will be tested at pulsed neutron sources in 2017 to study the Multi-Blade detector's performance in real conditions.



A prototype of the Multi-Blade neutron detector for reflectometry instruments

6.8 Boron Large-Area Multi-Grid Detectors Approved for C-SPEC and T-REX

The high-performance boron-10 Multi-Grid detector developed by ESS, the Institut Laue-Langevin and Linköping University was installed on an operational high-intensity neutron instrument at the Spallation Neutron Source (SNS) in the US. The impressive performance over months of routine operations has validated the Multi-Grid concept as a baseline detector for large-area detectors at ESS, and the technology will be optimised for the C-SPEC and T-REX instruments.

The Multi-Grid detector for thermal and cold neutrons has been developed to provide an alternative to standard helium-3 detectors for applications where the cost and availability of this rare isotope would be prohibitive.

The concept was developed extensively between 2010-2014 in a project led by Bruno Guerard, head of the detector group at the Institut Laue-Langevin in France, with contributions from 11 research laboratories across Europe within the EU's Cluster of Research Infrastructures and Synergies in Physics (CRISP) programme.

A collaboration between ESS, the ILL and Linköping University led by ESS detector scientist Anton Khaplanov has taken the project further by developing and extensively characterising several prototypes.

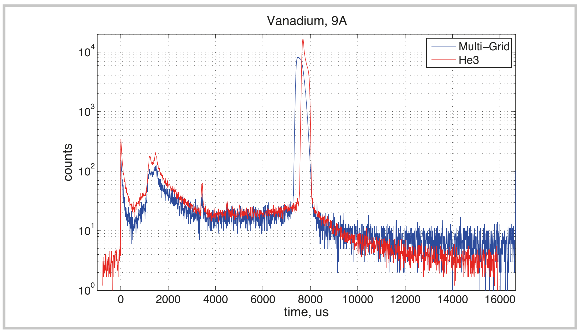
"The Multi-Grid detector development was the first technical collaboration between ESS and ILL," says Guerard. "It has been very fruitful in making this technique mature and there has been a very good complementarity of competence – ILL for the Multi-Grid technology and ESS and Linköping University for production of the thin convertor films."

The Multi-Grid detector exploits the neutron conversion reaction in boron-10 in order to detect neutrons. Thin films of enriched boron carbide arranged in stacks allow the detector to identify the interaction position of each neutron to a voxel of typically 20x20x10mm3 and record time-dependent neutron events.

The SNS in the United States is a working neutron source that has one of the most closely matching neutron scattering environments to ESS.

A Multi-Grid detector prototype was installed on the CNCS instrument at SNS in June 2016 and was operated continuously for many months, collecting neutron scattering data in parallel to helium-3 detectors on the same instrument.

The experiments have demonstrated that the Multi-Grid detector is able to match the data collected by conventional helium-3 detectors, and will be capable of producing high-quality scientific data under the unprecedented neutron flux to be delivered at ESS.



Raw ToF spectra acquired by the Multi-Grid and the adjacent 3He detector module on CNCS instrument; data is from a vanadium sample measurement at 9Å

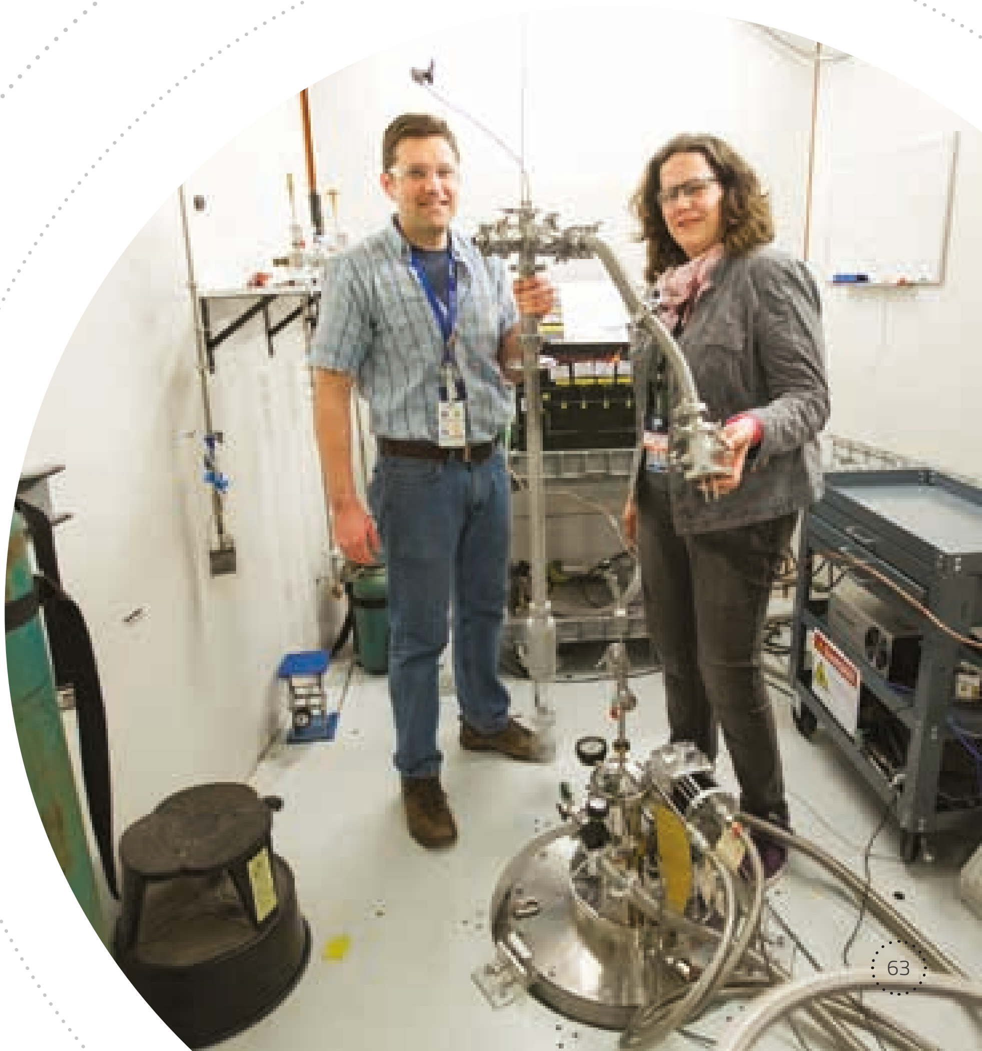
ESS and SNS researchers inside the CNCS detector room at SNS

6.9 Simultaneous Neutron and Light Measurements for Chemistry Research

Monika Hartl, a scientist in the ESS Target Division, has worked with the Spallation Neutron Source in the US to develop a sample stick enabling simultaneous photon and neutron measurements on the same sample.

The sample stick makes it possible for neutron beam users to simultaneously characterise samples using both neutron scattering as well as Raman spectroscopy – the inelastic scattering of light. It will open up new opportunities in chemistry and energy research.

The new equipment is available to use at the VISION vibrational spectrometer at the SNS. The equipment design is also well-matched for use with the ESS instrument VESPA, expected to go online in 2024.

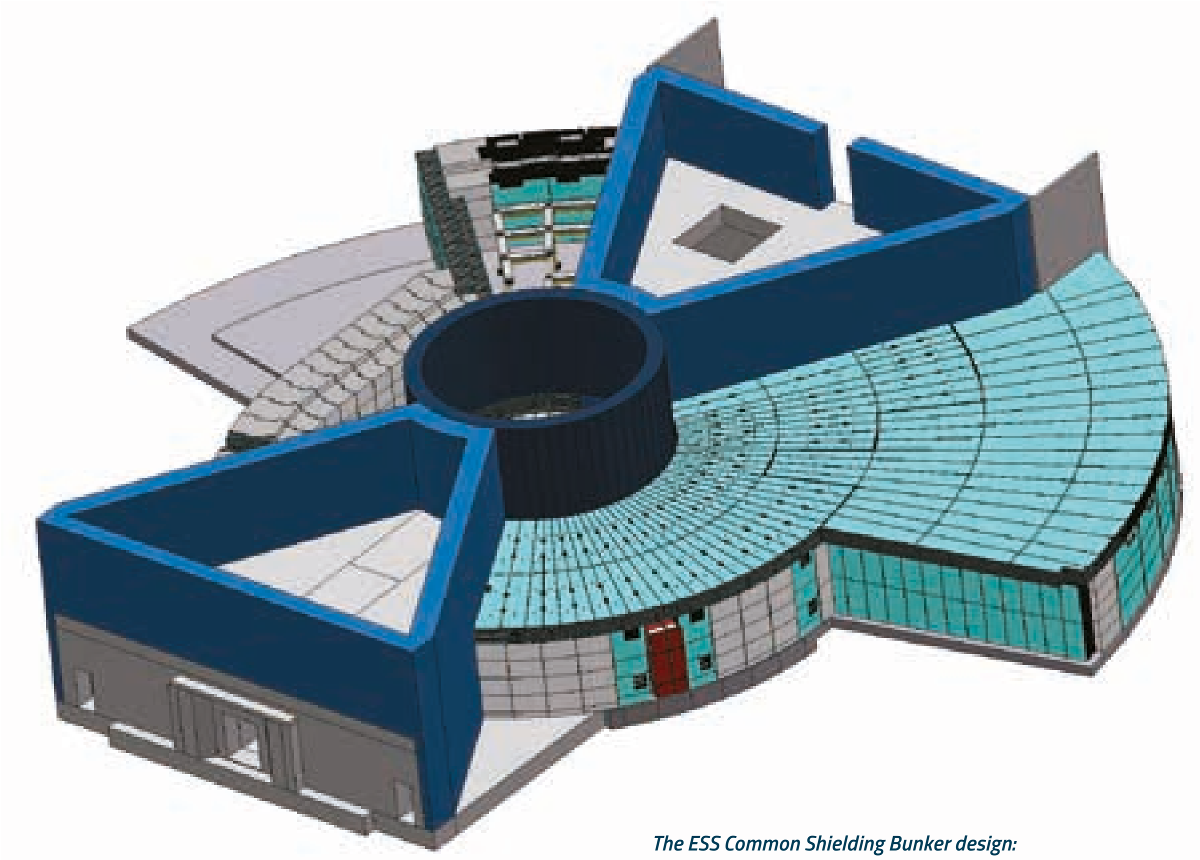


Chad Gillis of ORNL and Monika Hartl of ESS were part of a team developing a sample stick that is available to users of the VISION instrument at the SNS. It allows for simultaneous neutron and photon scattering measurements

6.10 Bunker Task Force Establishes Preliminary Design

A major effort was conducted in 2016 to finalise the design of the Instrument Guide Hall's 10,000 tonne common shielding bunker. A conference room in Lund was established as a bunker task force zone, allowing staff from the Neutron Scattering Systems, Conventional Facilities and Target divisions to sit and work together.

This payed off: the Bunker Preliminary Design Review was successfully held in December, meeting a 2016 milestone. The international review committee, chaired by Erik Iverson of ORNL/SNS, found the bunker concept to be reasonable and appropriate, and ready to proceed to detailed design



The ESS Common Shielding Bunker design:

- *Each bunker side measures approximately 40m long x 26m wide x 5m high*
- *10,000 tonnes of total mass*
- *1400 wall & roof blocks*

6.11 Nobel Prize in Physics Highlights Essential Role of Neutron Scattering Facilities

The 2016 Nobel Prize in Physics recognised the beauty of mathematics that predicted a fundamental shift in viewpoint on how to understand certain quantum states of matter in condensed matter physics.

Awarded to David Thouless, Duncan Haldane and Michael Kosterlitz, the Prize recognised 'theoretical discoveries of topological phase transitions and topological phases of matter'.

The trio's work, puzzled over and published throughout the 1970s and early 1980s, is being recognised now largely due to validation provided by experiments performed at neutron sources over the last 25 years.

That research has led to advances in the understanding of fields as diverse as superconductivity, lasers, superfluids and thin magnetic films.

The unique properties of the European Spallation Source machine design and instrumentation will give a major boost to research in condensed matter physics, allowing researchers to continue to explore the mysteries of these unconventional quantum materials.

"ESS will be a huge leap, because of its unique source performance and state of the art instrumentation. We'll be able to access compounds that we haven't been able to probe and uncover emergent behaviours. Moreover, we'll be able to study time-dependent phenomena. Because neutrons are so uniquely brilliant at proving the dynamic state of magnetic order, we will really make a huge impact in this field."

Arno Hiess, Head of the ESS Scientific Activities Division

Section 7

The Machine

The ESS machine includes what will be the world's most powerful linear proton accelerator, the facility's massive 30-metre-high Target Station, and the controls system that keeps the entire facility synchronized, safe and reliable.

The year 2016 saw the completion of the Accelerator tunnel infrastructure and foundation works across the site. Significant structural and technical work has also been completed for the complex, one-of-a-kind Target Station building and service tunnels. Installation of the first Accelerator and Target technical components were successfully executed by ESS, with preparations in progress for major installations over the next two years.

Significant technical progress was also demonstrated by the Accelerator, Target and Integrated Controls System (ICS) in-kind partners across Europe, with series production of some machine components in progress and the first major in-kind delivery completed in November.

7.1 Accelerator Tunnel Ready for Installations

As an accelerator-driven spallation neutron source, ESS depends on its linear accelerator, or LINAC, as a fundamental system. It creates protons at the ion source, accelerates them to an appropriate energy, and steers them onto the heavy metal Target to create neutrons via the spallation process. The neutrons in turn are distributed for use by a suite of research instruments. There are more than 25 partner institutions working together to build the world-class ESS Accelerator.

Celebrating Completion of the Accelerator Tunnel Infrastructure

In April the ESS Conventional Facilities and Accelerator teams, together with the Skanska construction team, marked the structural completion of the Accelerator tunnel with a traditional Swedish "Topping-Off" ceremony.

Following a morning tour of the 537-metre-long tunnel for local and national media, over 400 construction workers, engineers and guests gathered at the construction site.

"There's a positive psychological impact with completing this project milestone," said Mats Lindroos, Head of the ESS Accelerator Division. "It's an important and motivating factor for the Accelerator Division and our in-kind partners, and a reminder to deliver on time."

Approximately 16,500 cubic metres of concrete and 2,075 tonnes of reinforcement were used for the tunnel and connected areas.

First installation: the Accelerator's cryogenic venting pipe

7.2 First Plasma Generated in Ion Source

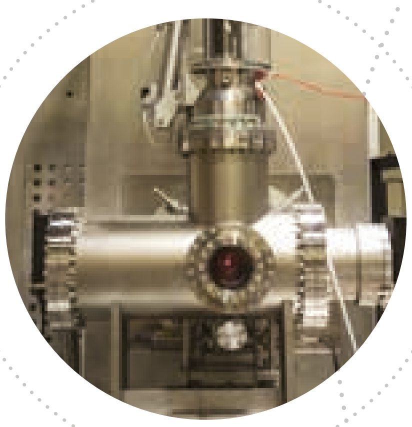
In June, ESS partner Laboratori Nazionali del Sud (LNS) of the Italian National Institute of Nuclear Physics (INFN) successfully created plasma in the ion source. The highly-ionised plasma will produce the Accelerator's proton beam.

"This is a really large milestone for the Accelerator project. The ion source and the warm LINAC are the first major parts that will be installed in the facility, and it is important that we can do that on time. The fact that we have now seen the first plasma makes me confident that we will meet the schedule."

Mats Lindroos, Head of the ESS Accelerator Division

To produce the ESS source beam, strong magnets draw out protons from the plasma and energise them. The proton beam enters the warm LINAC, or low-energy section of the Accelerator, and continues at increasing speed through to the superconducting section, hitting the target at nearly the speed of light.

LNS is leading the construction of the warm LINAC as part of the Italian in-kind contribution to ESS. The Sicily-based team will continue to work on the beam diagnostics and the low-energy section to complete the first part of the ESS Accelerator in 2017.



First Plasma in the ESS Ion Source at Laboratori Nazionali del Sud, INFN, Catania, Italy

7.3 Accelerator Ventilation Pipe Launches On-Site ESS Installations

With the tunnel infrastructure in place, another major milestone was reached in March with the first successful technical installation in the Accelerator: a cryogenic venting pipe.

The new pipe is a safety feature custom-designed for the Accelerator tunnel. At almost 12 metres long and more than half a tonne in weight, the stainless-steel pipe will help ensure proper ventilation of cooled helium gas in the unlikely event of an emergency in the Accelerator tunnel.

"The cryo vent line installation is important because it represents not only the first installation in the Accelerator tunnel, but the first hardware installed at the ESS site," said Wolfgang Hees, ESS Work Package Leader in the Accelerator Project, and senior cryogenics engineer.

The cryogenic venting pipe is designed for the Accelerator's very low operating temperature of 2 Kelvin (-271°C).

7.4 How Do You Power the World's Most Powerful LINAC?

A new high-voltage modulator design is now in production thanks to Carlos Martins and his ESS power converters team, with the help of Lund University researchers.

Carlos Martins was recruited to ESS from CERN seven years ago with the challenge of finding a way to power the world's most powerful linear accelerator. Last year he and his team delivered their answer: a prototype of the Stacked Multi-Level (SML) Modulator for ESS. The cost savings and reduced footprint for these large machines mean a paradigm shift for LINAC power supply worldwide.

The first three modulators went into series production this year as an in-kind contribution from Spain's ESS Bilbao.

A Unique Challenge

The delivery of the unique ESS long pulse relies on the power supply. The proton beam, the RF power, the resonating cavities, the rotating Target wheel, the neutron beams and the pulse-shaping choppers for instruments are all synchronised relative to the 14-shots-per-second repetition rate of the beam pulse – 14 Hz will be the heart rate for the entire facility.

The instruments at ESS are designed to take advantage of this timing, and the reliability of the beam's characteristics is critical to the innovative time-resolved experiments that will be performed at ESS.

"We want a constant power from the grid. It is like we are flipping this light switch on and off 14 times a second. But this is not a light bulb. This is like 115,000 100-watt bulbs for each modulator. We have 33 of them, 380 megawatts," said Martins, Power Converters Section Leader in the Radio Frequency Group.

At the same time, the modulator cannot be siphoning off large amounts of power from the public grid in massive surges.

"There is no electrical network in the world that would allow us to take 380 MW pulsed power with these characteristics: 3.5 ms, 14 shots per second," explained Martins. "All the network in Lund, in Sweden, even across Europe would be flickering up and down and that would not be acceptable. So we needed internal filtering somehow in the modulator."

Setting A New Standard

The SML modulator design overcame many of these issues with the ingenious internal power regulation and buffering scheme of the capacitor bank, where constant incoming power is stored and then released in high-voltage bursts in time with the ESS beam pulse. "This is one of the few modulators in the world with internal power regulation to reduce flicker from the local grid, and certainly the first at this power level," says Martins.

Cost and space were the other major challenges, as traditional modulators are expensive and large. Back in 2010 it was expected that 136 modulators would be required – each roughly the dimensions of a Volvo 240 – and that this would represent 25% of the cost of the Accelerator project as a whole.

Thanks to the SML modulator design, which is four times more powerful than standard modulators, there will now be only 33 powering the Accelerator, with each coming in at only a slightly higher unit cost. That is a 70% savings from the original configuration. And with the size of the new modulator being as compact as a standard one, the space requirement is reduced by 80% from a typical LINAC setup.

The ESS modulator prototype designed and built by Carlos Martins' team, including Göran Göransson (ESS), Getachew Darge (LTH), Max Collins (LTH), Carlos Martins (ESS), Paulo Torri (ESS), and Marko Kalafatic (ESS)

"The technology for the modulator, which has been invented by Carlos, I think will be useful in other places. I know many labs are looking over our shoulders with the expectation that they will use it in the future."

Roland Garoby, ESS Technical Director

7.5 Target Reaches 20% Completion Milestone

The neutrons that scientists will use to study new materials, tissues, thin films, proteins and the like are produced in the Target Station. It is here that the spallation process takes place, when protons from the accelerator hit the target – a 4-tonne helium-cooled tungsten wheel. The design of the target has a direct impact on the number of neutrons that can be generated, and is therefore of utmost importance for the future scientific capabilities of ESS. The Preliminary Design of the systems comprising the Target Station reached 90% complete and the Target sub-project as a whole stood at 20% complete by the end of 2016.

7.6 Installations on Target

The first major in-kind site installation for the Target Station was the placement of radiation shielding blocks and steel shielding for the Tuning Beam Dump, which was completed in December 2016.

The Beam Dump is designed to absorb the full power of the LINAC's proton beam, which is directed there for diagnostics and calibration prior to being redirected to the target wheel to initiate spallation.

The 200 specially engineered blocks were provided by Spain's ESS Bilbao, which designed the shielding solution as one of their six in-kind contributions for the Target sub-project.

A number of mechanical structures were also embedded in the basement concrete structures of the Target Station, in anticipation of implementing the future ESS Chip Irradiation (ECHIR) beamline.

7.7 Small But Mighty Moderator Comes to Life at BNC-Wigner

An unassuming component plays a key role in maximizing brightness and greatly enhancing the scientific impact of ESS. About the size and dimensions of a large canteen, about 3 cm by 10 cm, the significance of the moderator is easily lost in the massive scale of the ESS Target Station. But this small aluminium alloy canister plays a key role in determining the scientific impact of the world-leading instruments designed for ESS.

The high-energy neutrons released by the collision of the proton beam with the target will be slowed down by the moderator-reflector system, then extracted through beamlines and guided to instruments, where scientists will perform their tests and measurements. Moderation of neutrons to usable energies is required for experiments, but it leads to the loss of neutron intensity.

ESS has developed a novel concept of the low-dimensional moderator (LDM), which promises to minimise these losses and improve the performance of the facility.

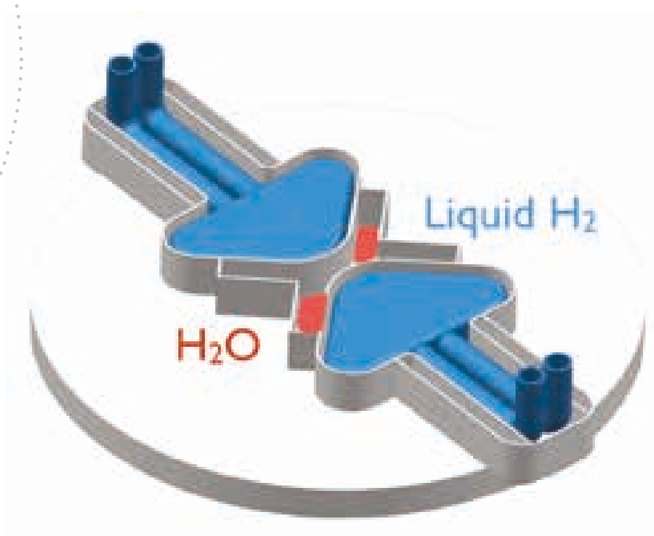
"We obtained very promising experimental results, which will make a great contribution to the modelling of the ESS moderator features."

László Rosta, Scientific and Management Coordinator at BNC-Wigner

The Wigner Research Centre for Physics at the Budapest Neutron Centre (BNC-Wigner) in Hungary has conducted experiments to support the characterisation of the moderator's performance, with promising results that will contribute to the modelling of its features.

ESS will be the first spallation neutron facility that will operate a low-dimensional moderator.

BNC-Wigner is also involved in the design, building and testing of a prototype of the moderator test beamline at their reactor source. The complete set-up will be operational in 2018 and is essential to the commissioning of the ESS Target systems.



7.8 Growth and New Partnerships for Integrated Control System

The full Integrated Control System (ICS) scope and schedule was redefined in 2016 and implemented into the larger ESS Integrated Project Schedule. The ICS Division also made critical progress in bringing in-kind partners on board and successfully launching a large commercial tender for integration services.

New Detailed Project Plan and Growing Staff

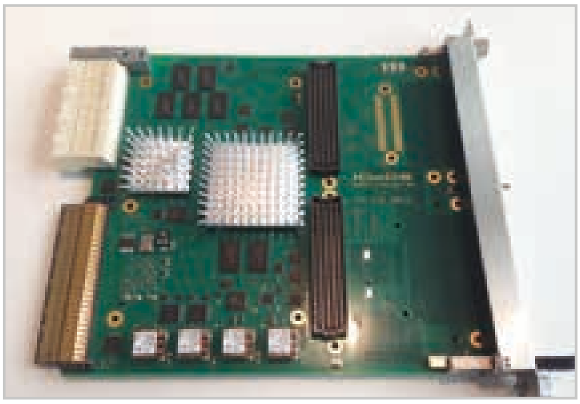
The ICS team has strengthened staff through recruitment and the addition of consultants. Four new consultants and one new employee joined the team in late 2016, with another seven positions in the recruitment phase. This ramp-up is needed to meet the demand in activities in 2017 and beyond. The updated project plan, completed summer of 2016, anticipates approximately 475 man-years, structured into 830 milestones.

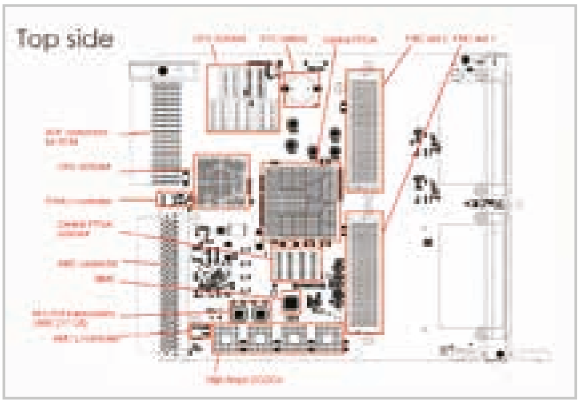
In the meantime, eight in-kind agreements were signed with CEA in France, IFE in Norway, Tallinn Technical University in Estonia, PSI in Switzerland and ESS Bilbao in Spain. This represents a significant increase in in-kind partnerships for ICS. Meanwhile, further in-kind agreements in France and Italy are progressing.

Technical Advances Lay Foundation for Progress

There have been many significant advances on the technical front for ICS as well. There was good progress by in-kind partners on the development of the ICS digital controller platform, which has now been largely accepted as a high-performance platform for control system applications. A CERN beam interlock system has been set up in the ICS lab for evaluation, and the access system for the Personnel Safety Systems has been acquired and installed in the personnel safety lab.

Continued successful usage of the ICS configuration software stack was demonstrated and used in a real-world case. Contributions to the open-source system for EtherCat motion control have been created and made publicly available. The installation, commissioning and test of the proton source vacuum system was also successfully completed in June at INFN-Catania.





The ICS digital controller platform supplied by IOxOS Technologies SA, an in-kind delivery from Switzerland's Paul Scherrer Institute

Personnel Safety Systems at ESS

ESS Senior Engineer Stuart Birch is working with each of the 15 instrument teams to develop Personnel Safety Systems (PSS) meeting the high safety standards of ESS and in accordance with Swedish regulations.

The system will protect ESS users and staff from all manner of harm, including dangers posed by radiation, high voltage, magnetism, moving parts, lasers, and many other risks associated with industrial and scientific workplaces.

It includes standards like colour-coded emergency lighting, key exchange protocols, and mechanisms to completely shut down the Accelerator and eliminate the beam in a fraction of a second.

Instrument-specific adaptations to the system must be included in the detailed engineering design of each instrument.

7.9 ESS Technical Director Reflects on the 'Treasure Chest' Being Built In Lund

Roland Garoby is the Technical Director for ESS. From a previous role at CERN, he joined ESS in 2014 to lead the construction of the Machine. The following are extended quotes from an interview he gave at the end of 2016.

- At ESS we are building an organisation at the same time we are building a facility. I knew it when I arrived, but didn't realise the effort it represents to shape ESS into a well-oiled organisation. Roughly everything has to be established, and once it is established you have people coming and saying, "Yes, but it could be better," or, "Oh no, you forgot this," and it keeps on changing. We continuously revisit the way we are working, thanks especially to the many external reviews. It's very healthy, but it's also very demanding.

- We will measure success by the fact that this infrastructure will advance at the planned rate over the next year. The installation and early commissioning of the ion source will be the cherry on the cake!

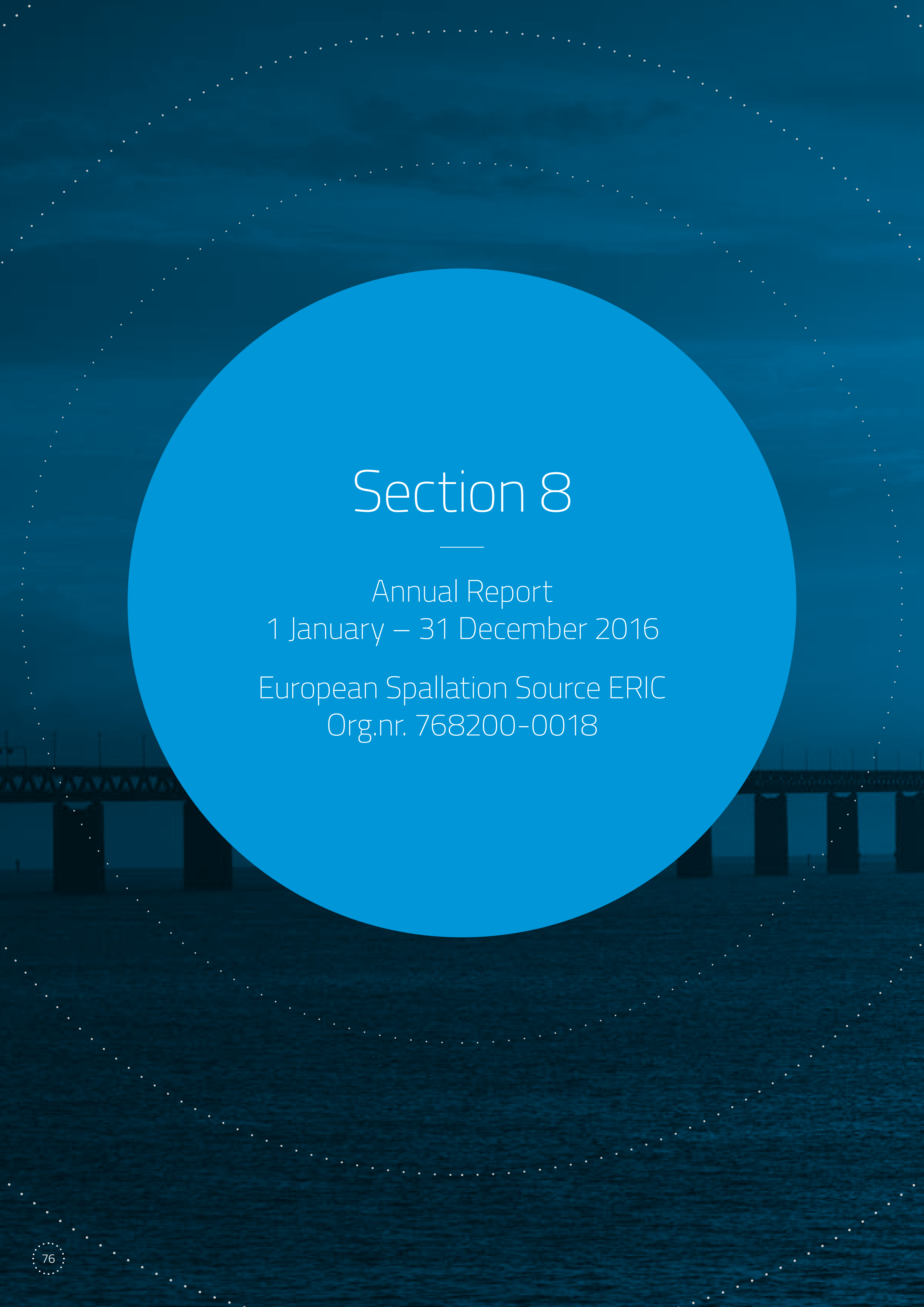
- ESS could not have been built without the experience accumulated by the Accelerator community before. I can say so because it's my community, but I know that for the Target, as well as for neutrons, it's also built on the shoulders of giants. ESS is not something starting from scratch. Technological developments in Europe, the USA, and Japan were crucial for the ESS design to materialise and be credible.

- CERN succeeded building the LHC and bringing it already beyond nominal performance. That's a perfect example of how ESS should evolve. ESS is something for me that obviously must be built, must be successful for science in its first goals, but it can also progress far beyond.

- A big lesson in the history of CERN is that it has become the world-leading laboratory for particle physics because it has benefitted from continuous support of the Member States even at times where there were some troubles.

- In-kind is really at an extreme here. I have some experience with them at CERN, but not at this scale. Here we already have more than 50% of the value of the Accelerator and Target being provided in-kind and we probably will reach 60% – there are negotiations ongoing for doing a bit more. Most of the high-tech equipment is designed and built under in-kind agreements. It is really huge and unheard-of, at least in our field of accelerator builders.

- It is really a treasure chest that is being built here. I'm convinced that the local hosts will be positively surprised by what will pop up out of this during its 40-year lifetime, provided it continues to be supported in the same spirit as it so far has been.



Section 8

Annual Report
1 January – 31 December 2016

European Spallation Source ERIC
Org.nr. 768200-0018

Contents

Statutory administration report

The Director-General of the European Spallation Source ERIC (org. no. 768200-0018), hereby presents the Annual Report for the period 1st January to 31st December 2016.

General information

European Spallation Source ERIC is Scandinavia's first European Research Infrastructure Consortium (ERIC), and the eleventh in Europe. ERIC is a legal framework established by the EU to facilitate the construction and operation of large-scale European research infrastructures. ESS, as an ERIC, has legal status and full legal capacity in all member and observer countries, enabling countries to participate in decision-making and contribute directly to the financing of ESS. See also Notes, Note 2.

European Spallation Source ERIC (hereinafter referred to as ESS) is a European research infrastructure consortium that will be the new generation of neutron sources. The facility will be used to research various materials and will be of great importance in the long-term with regard competitiveness for Swedish research and business. Construction is ongoing outside Lund and is planned to be completed in 2019, the user programme for researchers is scheduled to start in 2023, and the facility will be in full operation in 2025. The project is one of the largest and most prioritised research infrastructure projects in Europe.

ESS comprises the activities at the facility under construction in Lund, Sweden, and Data Management and Software Center (DMSC), which has its head office in Copenhagen, Denmark. The international focus can be seen throughout the organisation. The staff now includes employees from nearly 50 different nations.

ESS has 12 member countries: Sweden, Denmark, Germany, France, Italy, Switzerland, Norway, Poland, Hungary, the Czech Republic, Estonia and United Kingdom. A number of countries are observers until the respective national decision-making process on membership has been completed. Those considered observers are Spain, Belgium, and the Netherlands, while the United Kingdom transitioned from observer to full member in June 2016.

Joint cooperation is taking place with partners from all over Europe and from other parts of the world. ESS has a large network of laboratories to exchange knowledge, staff and experience, and in many cases, contributions also come directly to the project in the form of in-kind contributions. In-kind contributions are expected to finance approximately 35 per cent of the total estimated construction cost 1.843 billion euros (2013 price level).

Once ESS' user programme starts in 2023, it is estimated that two to three thousand guest researchers will conduct experiments at the facility annually. Most users will originate from European universities and institutes, as well as from industry.

Construction project

The construction project, led by the Conventional Facilities Division, operates on the basis of the overall timetable for the entire ESS project. The focus within the organisation is on the schedule in order to complete the project within the defined cost framework.

At the transition to the European Spallation Source ERIC during 2015, 15% of the entire ESS project was completed. During the spring, the very extensive land and pile work under the target station began. 30% of the total 6,000 piles to prevent the heavy target station building from being affected by extreme forces were in place at the end of September.

On 29 May 2015, ESS AB signed an agreement with Skanska, subsequently taken over by European Spallation Source ERIC, to build the second phase of the research facility, which includes installations in a number of buildings, switchgears, and transformers, as well as land work and piling. Work with the accelerator tunnel has continued at a rapid pace. At the beginning of October, the entire bottom plate, as well as 50% of the walls and roofs of the tunnel, were cast. Several adjacent buildings, including the klystron gallery and switchgears with a number of support buildings, were also well advanced.

In-kind contributions

The ESS project is founded on extensive cooperation with research institutions in the partner countries. The majority of the instruments, the target station and the accelerator will be delivered as in-kind. During the year, extensive work continued to ensure in-kind collaboration with partner institutions across Europe. More than 120 partners are now actively involved in the ESS project.

ESH&Q

Environment, Safety, Health & Quality Division (ESH&Q) has a key role at ESS to ensure that safety requirements are implemented throughout the organisation and in the construction of the facility. In July, the Swedish Radiation Safety Authority (SSM) presented a revised specification of the special conditions regarding radiation safety imposed on ESS before the facility can become operational. The ESH&Q division worked during the year to break down SSM's updated specification of requirements and to prepare the application to be submitted to SSM in May 2016 for stage 2 of the licensing process, regarding the installation of equipment in the accelerator that can generate ionising radiation.

Risks and uncertainties

The Organisation's pro-active and structured risk management contributes to the successful implementation of the project and its overall objectives. The knowledge ESS is developing with regard risks is used to continuously develop ESS's project plans.

ESS has a risk management framework, described in two main documents: ESS Risk Management Policy and ESS Risk Management Process. The risk management policy describes the overall 'why and how' the risk management work is to be conducted. The risk management process describes processes and flow charts, as well as criteria for how risks are evaluated at ESS. In addition to these two documents, the Risk Management Plan specifies roles, responsibilities, and timeframes for risk- related activities within the organisation.

Risk Management Objectives

ESS has established the following goals for risk management:

- Frequent and open risk communication, which enables a clear and common understanding of risks and uncertainties within the ESS and among partners, suppliers, etc.

- Continuously updated risk overview, register of risks, uncertainties, and mitigation actions

- Reduced risk exposure through rapid and pro-active enforcement of mitigation measures

- Focus on risks and uncertainties through effective risk reporting, internal and external

- Risk assessments shall be based on both qualitative evaluations and quantitative calculations and decisions are made after careful consideration of the results of these analyses

Risks and uncertainties

Each potential event that may affect ESS's overall objectives implies a risk. Risk identification and risk assessment are part of the daily work at ESS and aim to contribute to effective risk management by providing increased insight into the consequences of a particular risk and the probability that it could occur. Structured risk assessment enables comparisons, simplifies risk communication and is crucial for understanding whether a risk is acceptable or not.

The risks are assessed from several different perspectives:

Risks related to injuries

Health and accident risks are assessed for all activities performed and also covers the management of radiation safety when ESS is operational. This also includes managing risks related to accidents during the construction phase. Processes and rules for the work on the construction site have been established in cooperation with our contractors.

Risks related to the quality and function

Risks that could potentially degrade the quality and function of technical structures, systems, components of the utmost importance to ESS. To manage these risks, ESS has further refined the existing processes for configuration work and developed new technology systems. Process and systems for quality management have also been implemented.

Risks related to the environment and the surroundings

Risks that may affect the environment and the physical environment of the ESS construction site are managed within the line organisation. Work on environmental risks are assessed in close collaboration with affected functions. Identified risks have been mitigated in accordance with the ESS risk management framework.

Risks related to society's view of the ESS

Management of risks related to the society's view of the ESS is important because the ESS depends on collaborations with other European countries and to be able to recruit scientists, engineers and other world-class specialists to Lund in Sweden. Risks related to society's view of the ESS are handled in close cooperation between the ESS management, the human resources division, and the communications division.

Risks concerning time schedule

Risks affecting the time schedule relates to processes and activities that could delay the implementation of the project plan.

Risks regarding the annual operating cost

In order to achieve the overall goal for ESS it is required that the operating costs are met. Risks in the form of, for example, service and maintenance, energy consumption, downtime, insurance premiums, and/or loss of property have been identified. Plans and cost estimates for ESS's operational phase have developed during the year and the continued work will be conducted by a working group with representatives from the member countries, led by the Vice-Chairman of the Council.

Risks related to economics and finance

To understand and manage risks that could have economic consequences in terms of exceeding the project budget is vital to ESS and managed through established processes related to the identification and analysis of uncertainties in the cost estimates. Each part of the project has its definite budget and every risk of exceeding the budget is handled individually. Such measures are handled by the management team through well-defined processes.

The activities undertaken by ESS are financed by all the member countries contributing to the financing. The remaining financing risks with regard to the construction phase relate to reaching a hundred per cent commitment, as well as bridge financing to secure the project's liquidity needs.

Significant events during the year

According to the shareholders' meeting of the ESS AB (556792-4096), 2016-03-18, the company's purchase price claim on the European Spallation Source ERIC has been distributed to the shareholders, the Swedish and Danish Government. The liability ESS AB has since been converted into grants in the European Spallation Source ERIC, Prop. 2015/16: 1st.

On November 29, 2016 a loan agreement was signed with the European Investment Bank (EIB), the Nordic Investment Bank (NIB) and the Swedish Export Credit Corporation (SEK). The loan guarantee is valid for seven years and amounts to EUR 300 million, divided by 100 million for each bank. This will ensure the project's cash requirements to cover expenses as they arise without risking delays. No loans have been utilized during 2016

Development of the company's financial performance and position

Net result amounted to -864 MSEK (-272). The result includes costs for staff and consultants, and administrative and technical infrastructure during the construction phase.

Shareholders' equity amounted to 2 800 MSEK (67).

Investments

Investments in construction in progress amounts to 905 MSEK (278).

Financing and liquidity

ESS has during the fiscal year 2016 received contributions from member countries by 2 752 MSEK (339). More information about received contributions, see Note 16. Cash and cash equivalents amounted to 1 078 MSEK (384).

Significant events after the end of the year

The construction of the campus office at the construction site is expected to take 30 months and the financing will be determined during 2017.

Income statement

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Net turnover	-	-
Gross profit	-	-
Administration expenses (Note 7)	-378 178	-50 944
Research and development expenses (Note 7)	-516 619	-219 212
Other operating income (Note 4)	33 306	7 674
Other operating expenses (Note 6)	-	-9 465
Operating profit	-861 491	-271 947
Financial income (Note 8)	32	4
Financial expenses (Note 9)	-2 989	-39
Profit before tax	-864 448	-271 982
Tax (Note 10)	-	-
NET RESULT	**-864 448**	**-271 982**

Balance sheet

KSEK	2016-12-31	2015-12-31
ASSETS		
Non-current assets		
Tangible fixed assets		
Equipment, tools and installation (Note 11)	17 745	8 217
Construction in progress (Note 12)	1 661 142	756 096
Total non-current assets	**1 678 887**	**764 313**
Current assets		
Short term receivables (Note 13)	312 673	80 965
Prepaid expenses and accrued income (Note 14)	26 431	18 495
Cash and bank	1 078 367	384 062
Total current assets	**1 417 471**	**483 522**
TOTAL ASSETS	**3 096 358**	**1 247 835**
EQUITY AND LIABILITIES		
Equity		
Capital contribution (Note 16)	3 664 647	339 165
Net result	-864 448	-271 982
Total equity	**2 800 199**	**67 183**
Current liabilities		
Account payables	199 496	198 888
Other liabilities (Note 17)	13 103	857 375
Accrued expenses and prepaid income (Note 18)	83 560	124 389
Total liabilities	**296 159**	**1 180 652**
TOTAL EQUITY AND LIABILITIES	**3 096 358**	**1 247 835**

Contingent liabilities and pledged assets

KSEK	2016-12-31	2015-12-31
Contingent liabilities	None	None
Pledged assets	None	None

Equity

KSEK	Cash contribution	Previous year result	Net result	Total equity
Opening balance 2015-08-31	-	-	-	0
Contributions	339 165	-	-	339 165
Net result 2015	-	-271 982	-	-271 982
Balance as of 2015-12-31	339 165	-271 982	-	67 183
Dividend from ESS AB*	845 613	-	-	845 613
Contributions	2 751 851	-	-	2 751 851
Net result 2016	-	-	-864 448	-864 448
Closing balance 2016-12-31	**3 936 629**	**-271 982**	**-864 448**	**2 800 199**

*According to the minutes from the Annual General Meeting of ESS AB (556792-4096), 18th March 2016, the company's purchase price claim on the European Spallation Source ERIC will be distributed to the shareholders, and the Swedish and Danish Government. The debt to ESS AB has since been converted into contributions in the European Spallation Source ERIC, Prop. 2015/16: 1

Cashflow

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Operating activities		
Income after financial items	-864 448	-271 982
Adjustments for non-cash items	3 466	656
Cash flow from operating activities before changes in working capital	**-860 982**	**-271 326**
Cash flow from changes in working capital		
Increases (-)/decreases (+) in operating receivables	-239 644	-99 460
Increases (+)/decreases (-) in operating liabilities	-38 880	1 180 652
Cash flow from operating activities	**-1 139 507**	**809 866**
Investing activities		
Acquisition of tangible assets (Note 11)	-12 994	-8 873
Acquisition of construction in progress (Note 12)	-905 046	-756 096
Cash flow from investing activities	**-918 040**	**-764 969**
Financing activities		
Cash contribution	2 751 851	339 165
Cash flow from financing activities	**2 751 851**	**339 165**
Cash flow for the year	**694 305**	**384 062**
Liquid assets at the beginning of the financial year	384 062	0
Liquid assets at the end of the year	**1 078 367**	**384 062**

Notes

Note 1: Notes with accounting principles and comments on the accounts

The annual report has been prepared in accordance with the Annual Accounts Act (Årsredovisningslagen) and the Swedish Accounting Standards Board BFNAR 2012: 1 Annual report and group consolidation (K3) (Bokföringsnämndens allmänna råd BFNAR 2012:1 Årsredovisning och koncernredovisning (K3)).

The company's registered office etc.

European Spallation Source ERIC (ESS) is a European Research Infrastructure Consortium. The organisation has its statutory seat in Lund, Sweden. The head office is situated in Tunavägen 24, 223 63 Lund, Sweden. The company's corporate identity is 768200-0018.

Classification etc.

Fixed assets, long-term liabilities and provisions consist of amounts expected to be recovered or settled after more than twelve months from the balance date. Current assets and current liabilities consist of amounts expected to be recovered or paid within twelve months from the balance date.

Valuation principles etc.

Assets, provisions and liabilities are valued at cost unless otherwise stated below.

Tangible fixed assets

Tangible assets are recognised as assets if it is probable that future economic benefits will accrue to the business and the cost of the asset can be measured reliably. Property plant and equipment is stated at cost less accumulated amortisation and impairment losses. The cost includes purchase price and costs directly attributable to the asset to bring it on place and condition to be utilised in accordance with the intended purpose. Other additional expenses are expensed in the period they occur. The assessment of whether a subsequent expenditure is added to cost is whether the replacement of identified components or parts is capitalised. Additional components will be added and capitalised. Values of replaced components, or parts of components will be discarded and expensed in connection with the replacement.

Depreciation according to plan

Depreciation is based on cost less estimated residual value. Depreciation is linear over the asset's estimated lifetime.

The following depreciation schedules are applied:
IT equipment 3-5 years
Machinery and equipment 5-7 years

Impairments

The recorded value of the assets at balance date is reconciled for any indication of impairment. If any such indication exists, the asset's recoverable amount is the higher of value in use and net realisable value. Impairment loss is recognised if the recoverable amount is less than the balance value. When calculating the value in use, future cash flows at a pre-tax rate are discounted to reflect the market's assessment of risk-free interest and risk associated with the specific asset. An asset that is dependent on other assets is not considered to generate any independent cash flows. Such assets are instead attributed to the smallest cash-generating unit where the independent cash flows can be determined.

An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount. A reversal is made only to the extent that the assets balanced amount does not exceed the amount that would have been determined, after depreciation, if no impairment loss had been recognised.

Impairments (continued)

ESS operates without profit in accordance with the requirements of the EU regulation relating to ERIC. Financing the future operation of the facility is planned to be achieved through contributions that ensure full cost recovery. This means that the assessment of external and internal indicators related to impairment review according to K3 regulations for ESS, is taking into account ESS ERIC´s specific conditions. This specific application complies in all material respects with the principles and methods as expressed in the " Utkast till redovisningsuttalande från FAR Nedskrivningar i kommunala företag som omfattas av kommunallagens självkostnadsprincip ", which thus is applied similarly for ESS.

Receivables

Accounts receivable are recorded to the expected value to be received after deductions for bad debts, which are assessed individually.

Receivables and liabilities in foreign currencies

Receivables and payables in foreign currencies are converted using the closing balance rate. Exchange rate differences for operating receivables and liabilities are included in operating income, while differences in financial receivables and liabilities are reported among financial items.

Short-term investments

Short-term investments are valued in accordance with Annual Accounts Act (Årsredovisnings- lagen) to the lower value when comparing cost and fair value.

Financial instruments

A financial asset or financial liability is entered into the balance sheet when the organisation becomes a party to the instrument's contractual terms. Accounts receivable are recorded in the balance sheet when the invoice has been sent. Accounts payable are booked when the invoice is received. A financial asset is removed from the balance sheet when the contractual rights are realised, expire or the company loses control over them. A financial liability is removed when the contractual obligation is fulfilled or otherwise concluded.

Leasing

All leases are accounted for as operating leases. Leasing fees are expensed over the term of the usage, as well as with regard to benefits paid or received at the signing of the agreement.

Liquid assets

Cash and cash equivalents, immediately available bank balances and other money market instruments with original maturities of three months or less are converted to the closing balance rate.

Accounts payable

Accounts payable have a short expected duration and are valued at nominal value.

Employee benefits

Defined contribution pensions
Operational payments for defined contribution pension plans are recognised as an expense during the period the employee performed the services covered by the fee. Consequently, no actuarial assumptions for calculating the obligation or the cost are needed and there is no possibility of any actuarial gains or losses. The obligation is calculated without discount, except in cases where they are not entirely due for payment within twelve months after the end of the period during which the employees perform the related services.

Tax

The tax consists of current tax and deferred tax. Taxes are recognised in the income statement except where the underlying transaction is recorded directly against equity, whereby the associated tax effect is recognised in equity. Current tax is tax to be paid or received for the current year. This includes adjustment of current tax with taxes from prior years. Deferred tax is calculated using the liability method for temporary differences between the booked and the tax value of the assets and the liabilities. The amounts are calculated based on how the temporary differences are expected to be settled and by applying the tax rates and tax rules adopted or announced at the balance sheet date. Temporary differences do not take into account the differences relating to investments in subsidiaries and associates, which are not expected to be taxable in the foreseeable future. Untaxed reserves are reported including deferred tax liabilities. Deferred tax assets for deductible temporary differences and loss carry forwards are only recognised to the extent that it is probable that these will entail lower tax payments in the future.

Contributions

ESS is partly financed with cash and partly with in-kind contributions (non-financial contributions) from the member countries.

Cash contributions
Received contributions from members are recognised in equity in the balance sheet. See capital contributions in note 16.

In-kind contributions
The process for approving in-kind contributions are during the construction period performed by the Committee (In-kind Review Committee). The Committee reviews underlying agreements and recommends them to the ESS Council, with delegates from the member countries, for final approval. After approval it is required in order for the in-kind contributions to be recorded, finally documented agreements between the parties regarding the value of completed deliveries and signed contribution documents from the contributors.

Note 2: Associated parties with a controlling influence

The Council (Rådet) is the governing body of the organisation and is composed of up to two delegates from each member of the organisation. The delegates may be assisted by experts. Each member is entitled to the number of votes equal to its contribution relative to the construction costs. Observers are entitled to participate in the Council but have no voting rights.

Note 3: Employees, staff costs and fees to the auditors

AVERAGE NUMBER OF EMPLOYEES		
	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
SWEDEN		
Men	224	220
Women	111	112
Total	335	332
DENMARK		
Men	16	12
Women	3	2
Total	19	14
TOTAL	**354**	**346**

GENDER DISTRIBUTION IN THE MANAGEMENT		
	2016-12-31	2015-12-31
Management Directors and Director General	3	4
Whereof women	33%	25%

SALARIES, OTHER REMUNERATION AND SOCIAL COSTS		
KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Sweden	223 893	60 602
Denmark	16 183	3 859
TOTAL	**240 076**	**64 461**
Social costs	70 217	17 448
Pension costs	33 207	3 023
TOTAL SOCIAL COSTS	**103 424**	**20 471**
Salaries and other remunerations includes		
- to Director General	3 367	606
- to Management Directors	3 772	1 325

ALLOWANCES TO MANAGEMENT DIRECTORS 2016

KSEK	Basic salary	Other benefits	Pension costs	Total
Director General	3 152	215	644	4 011
Management Directors (3 pers.)	3 707	65	913	4 685
TOTAL	**6 859**	**280**	**1 557**	**8 696**

ALLOWANCES TO MANAGEMENT DIRECTORS 2015

KSEK	Basic salary	Other benefits	Pension costs	Total
Director General	504	102	181	787
Management Directors (3 pers.)	1 309	16	338	1 663
TOTAL	**1 813**	**118**	**519**	**2 450**

Incentive scheme

European Spallation Source ERIC has no incentive scheme.

Severance pay to senior executives

In Director General and senior executives employment agreements there are no severance payments.

FEES AND REMUNERATION TO AUDITORS

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
KPMG AB		
Audit assignments	336	301
Other assignments	148	19
PWC		
Audit assignments	476	-
SUMMARY	**960**	**320**

Audit assignments involve examination of the annual report and accounts, other duties that are the responsibility of the Company's auditors to perform, as well as advice or other assistance arising from observations during such examination or implementation of such duties.

Note 4: Other income

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Exchange rate gain on receivables/liabilities of operations	3 872	4 191
Contributions for EU-Grants	27 492	3 404
Other income	1 942	79
TOTAL	**33 306**	**7 674**

Note 5: Leasing fees in respect of operational leases

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Leasing agreements where the company is the lessee:		
Minimum leasing fees	11 352	2 626
Variable fees	128	212
TOTAL LEASING COSTS	11 480	2 838

Contractual future minimum leasing fees relating to non-retractable contracts which become due for payment:

Within one year	2 887	11 352
Between two and five years	3 048	5 811
TOTAL	**5 935**	**17 163**

Note 6: Other expenses

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Exchange rate losses on receivables/liabilities of operations	-	-9 374
Other expenses	-	-91
TOTAL	**-**	**-9 465**

Note 7: Depreciations

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Depreciation according to plan by asset:		
Equipment, tools, and installation	-3 465	-656
TOTAL	**-3 465**	**-656**
Depreciation according to plan by function:		
Administration expenses	-70	-89
Research and development costs	-3 395	-567
TOTAL	**-3 465**	**-656**

Note 8: Interest income

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Interest income	32	4
TOTAL LEASING COSTS	**32**	**4**

Note 9: Interest expense

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Interest expense	-2 989	-39
TOTAL	**-2 989**	**-39**

Note 10: Tax on income for the year

KSEK	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Current tax	0	0
Deferred tax	0	0
TOTAL	**0**	**0**

ESS currently has costs that incur ongoing losses from an income tax perspective. Uncertainty regarding the possibilities and timeframe to make use of these is the reason deferred taxes have not been accounted for.

Note 11: Equipment, tools and installation

KSEK	2016-12-31	2015-12-31
Accumulated cost of acquisitions:		
Beginning of the financial year	8 873	0
Acquisitions	12 993	8 873
TOTAL	**21 866**	**8 873**
Accumulated depreciation according to plan:		
Beginning of the financial year	-656	0
Depreciation according to plan	-3 466	-656
Net value in balance sheet 31 Dec 2016	**17 745**	**8 217**

All fixed assets have been transferred to European Spallation Source ERIC from ESS AB according to agreement dated 1st October 2015.

Note 12: Construction in progress

KSEK	2016-12-31	2015-12-31
Accumulated cost of acquisitions:		
Beginning of the financial year	756 096	0
Acquisitions	905 046	756 096
Net value in balance sheet 31 Dec 2016	**1 661 142**	**756 096**

Note 13: Short term receivables

KSEK	2016-12-31	2015-12-31
VAT receivables	98 966	73 873
Other tax receivables	16 012	4 852
Contribution from members	188 540	0
Other	9 155	2 240
TOTAL	**312 673**	**80 965**

Note 14: Prepaid expenses and accrued income

KSEK	2016-12-31	2015-12-31
Prepaid rental costs	4 396	3 750
Prepaid insurance	15 915	9 665
Accrued income EU-project	4 325	4 407
Other	1 795	673
TOTAL	**26 431**	**18 495**

Note 15: Financial instruments and financial risk management

Finance policy

In view of the phase in which ESS currently operates, no financial instruments are at present being used to hedge flows or the Balance Sheet.

Liquidity risks and interest rate risks

Cash surpluses are placed in bank accounts or other equivalent.

Credit risks

Credit risks are considered limited, as the company's receivables consist of minor amounts.

Exchange rate risks

Exposure to exchange rate changes has been low and the exchange rate earnings that occurred during the year relates to exchange rate differences on account payables and bank balances mainly in EUR.

Note 16: Capital contribution

KSEK	2016-12-31	2015-12-31
Estonia	7 531	5 230
Denmark	445 093	172 971
Switzerland	41 702	20 587
Norway	161 722	106 935
Czech Republic	28 992	28 992
Hungary	9 310	4 450
Poland	12 027	0
Germany	763 633	0
Sweden	1 408 558	0
United Kingdom	212 447	0
TOTAL	**3 091 016**	**339 165**

Note 17: Other liabilities

KSEK	2016-12-31	2015-12-31
Liabilities to ESS AB according to transfer agreement*	0	845 613
Other	13 103	11 762
TOTAL	**13 103**	**857 375**

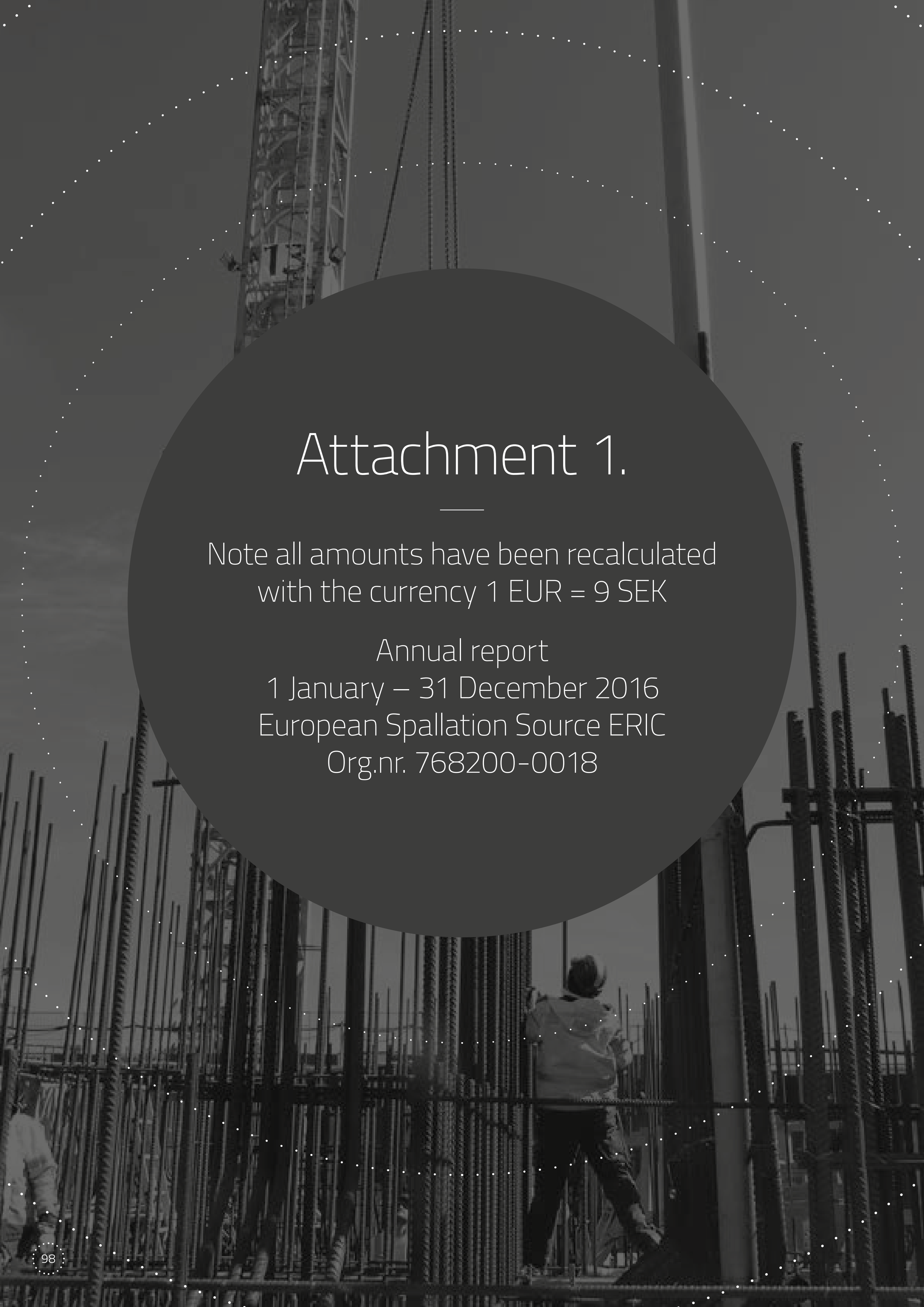
*According to the minutes from the Annual General Meeting of ESS AB (556792-4096), 18th March 2016, the company's purchase price claim on the European Spallation Source ERIC will be distributed to the shareholders, and the Swedish and Danish Government. The debt to ESS AB has since been converted into contributions in the European Spallation Source ERIC , Prop. 2015/16: 1.

Note 18: Accrued expenses and deferred income

KSEK	2016-12-31	2015-12-31
Accrued vacation salary	19 069	17 209
Employee taxes and social costs	4 939	4 726
Accrued salary tax	7 947	1 281
Accrued payments for EU-projects	23 228	48 309
Accrued construction and consultancy fees	3 624	32 192
CEA	0	10 286
Cash in-kind	17 118	0
Other accrued expenses and deferred income	7 635	10 386
SUMMARY	**83 560**	**124 389**

The Council of European Spallation Source ERIC will decide upon the adoption of the financial statement and Annual report.

I, the Director General certify that, based on my best knowledge, belief and understanding, the Annual Report is prepared in accordance with applicable accounting rules, the information provided is in accordance with the facts, and nothing of significance that could affect the image of the organisation as a result of the Annual Report, is omitted.



Attachment 1.

Note all amounts have been recalculated with the currency 1 EUR = 9 SEK

Annual report
1 January – 31 December 2016
European Spallation Source ERIC
Org.nr. 768200-0018

Income statement

1 EUR = 9 SEK

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Net turnover	-	-
Gross profit	**-**	**-**
Administration expenses (Note 7)	-42 019	-5 660
Research and development expenses (Note 7)	-57 403	-24 357
Other operating income (Note 4)	3 701	853
Other operating expenses (Note 6)	-	-1 052
Operating profit	**-95 721**	**-30 216**
Financial income (Note 8)	4	0
Financial expenses (Note 9)	-332	-4
Profit before tax	**-96 049**	**-30 220**
Tax (Note 10)	-	-
NET RESULT	**-96 049**	**-30 220**

Balance sheet

1 EUR = 9 SEK		
KEUR	2016-12-31	2015-12-31
ASSETS		
Non-current assets		
Tangible fixed assets		
Equipment, tools and installation (Note 11)	1 972	913
Construction in progress (Note 12)	184 571	84 011
Total non-current assets	**186 543**	**84 924**
Current assets		
Short term receivables (Note 13)	34 741	8 996
Prepaid expenses and accrued income (Note 14)	2 937	2 055
Cash and bank	119 819	42 674
Total current assets	**157 497**	**53 725**
TOTAL ASSETS	**344 040**	**138 649**
EQUITY AND LIABILITIES		
Equity		
Capital contribution (Note 16)	407 183	37 685
Net result	-96 049	-30 220
Total equity	**311 134**	**7 465**
Current liabilities		
Account payables	22 166	22 099
Other liabilities (Note 17)	1 456	95 264
Accrued expenses and prepaid income (Note 18)	9 284	13 821
Total liabilities	**32 906**	**131 184**
TOTAL EQUITY AND LIABILITIES	**344 040**	**138 649**

Contingent liabilities and pledged assets

1 EUR = 9 SEK		
KEUR	2016-12-31	2015-12-31
Contingent liabilities	None	None
Pledged assets	None	None

Equity

KEUR	Cash contribution	Previous year result	Net result	Total equity
Opening balance 2015-08-31	-	-	-	0
Contributions	37 685	-	-	37 685
Net result 2015	-	-30 220	-	-30 220
Balance as of 2015-12-31	37 685	-30 220	-	7 465
Dividend from ESS AB*	93 957	-	-	93 957
Contributions	305 761	-	-	305 761
Net result 2016	-	-	-96 049	-96 049
Closing balance 2016-12-31	**437 403**	**-30 220**	**-96 049**	**311 134**

*According to the minutes from the Annual General Meeting of ESS AB (556792-4096), 18th March 2016, the company's purchase price claim on the European Spallation Source ERIC will be distributed to the shareholders, and the Swedish and Danish Government. The debt to ESS AB has since been converted into contributions in the European Spallation Source ERIC, Prop. 2015/16: 1.

Cashflow

1 EUR = 9 SEK

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Operating activities		
Income after financial items	-96 049	-30 220
Adjustments for non-cash items	385	73
Cash flow from operating activities before changes in working capital	**-95 664**	**-30 147**
Cash flow from changes in working capital		
Increases (-)/decreases (+) in operating receivables	-26 627	-11 051
Increases (+)/decreases (-) in operating liabilities	-4 320	131 184
Cash flow from operating activities	**-126 611**	**89 986**
Investing activities		
Acquisition of tangible assets (Note 11)	-1 444	-986
Acquisition of construction in progress (Note 12)	-100 561	-84 011
Cash flow from investing activities	**-102 005**	**-84 997**
Financing activities		
Cash contribution	305 761	37 685
Cash flow from financing activities	**305 761**	**37 685**
Cash flow for the year	**77 145**	**42 674**
Liquid assets at the beginning of the financial year	42 674	0
Liquid assets at the end of the year	**119 819**	**42 674**

Note 3: Employees, staff costs and fees to the auditors

AVERAGE NUMBER OF EMPLOYEES		
	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
SWEDEN		
Men	224	220
Women	111	112
Total	335	332
DENMARK		
Men	16	12
Women	3	2
Total	19	14
TOTAL	**354**	**346**

GENDER DISTRIBUTION IN THE MANAGEMENT		
	2016-12-31	2015-12-31
Management Directors and Director General	3	4
Whereof women	33%	25%

SALARIES, OTHER REMUNERATION AND SOCIAL COSTS		
KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Sweden	24 877	6 734
Denmark	1 798	429
TOTAL	**26 675**	**7 163**
Social costs	7 801	1 939
Pension costs	3 690	336
TOTAL SOCIAL COSTS	**11 491**	**2 274**
Salaries and other remunerations includes		
- to Director General	374	67
- to Management Directors	419	147

ALLOWANCES TO MANAGEMENT DIRECTORS 2016				
KEUR	Basic salary	Other benefits	Pension costs	Total
Director General	350	24	72	446
Management Directors (3 pers.)	412	7	101	520
TOTAL	**762**	**31**	**173**	**966**

ALLOWANCES TO MANAGEMENT DIRECTORS 2015				
KEUR	Basic salary	Other benefits	Pension costs	Total
Director General	56	11	20	87
Management Directors (3 pers.)	145	2	38	185
TOTAL	**201**	**13**	**58**	**272**

Incentive scheme

European Spallation Source ERIC has no incentive scheme.

Severance pay to senior executives

In Director General and senior executives employment agreements there are no severance payments.

FEES AND REMUNERATION TO AUDITORS		
KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
KPMG AB		
Audit assignments	37	33
Other assignments	16	2
PWC		
Audit assignments	53	-
SUMMARY	**106**	**35**

Audit assignments involve examination of the annual report and accounts, other duties that are the responsibility of the Company's auditors to perform, as well as advice or other assistance arising from observations during such examination or implementation of such duties.

Note 4: Other income

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Exchange rate gain on receivables/liabilities of operations	431	466
Contributions for EU-Grants	3 055	378
Other income	215	9
TOTAL	**3 701**	**853**

Note 5: Leasing fees in respect of operational leases

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Leasing agreements where the company is the lessee:		
Minimum leasing fees	1 261	291
Variable fees	14	24
TOTAL LEASING COSTS	**1 275**	**315**

Contractual future minimum leasing fees relating to non-retractable contracts which become due for payment:

Within one year	321	1 261
Between two and five years	339	646
TOTAL	**660**	**1 907**

Note 6: Other expenses

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Exchange rate losses on receivables/liabilities of operations	-	-1 042
Other expenses	-	-10
TOTAL	**-**	**-1 052**

Note 7: Depreciations

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Depreciation according to plan by asset:		
Equipment, tools, and installation	-385	-73
TOTAL	**-385**	**-73**

Depreciation according to plan by function:		
Administration expenses	-8	-10
Research and development costs	-377	-63
TOTAL	**-385**	**-73**

Note 8: Interest income

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Interest income	4	0
TOTAL LEASING COSTS	**4**	**0**

Note 9: Interest expense

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Interest expense	-332	-4
TOTAL	**-332**	**-4**

Note 10: Tax on income for the year

KEUR	2016-01-01 - 2016-12-31	2015-08-31 - 2015-12-31
Current tax	0	0
Deferred tax	0	0
TOTAL	**0**	**0**

European Spallation Source ERIC has currently costs generating tax losses. Uncertainty about the possibilities and the timeframe to take advantage of these is the reason for not accounting for deferred taxes.

Note 11: Equipment, tools and installation

KEUR	2016-12-31	2015-12-31
Accumulated cost of acquisitions:		
Beginning of the financial year	986	0
Acquisitions	1 444	986
TOTAL	**2 430**	**986**
Accumulated depreciation according to plan:		
Beginning of the financial year	-73	0
Depreciation according to plan	-385	-73
Net value in balance sheet 31 Dec 2016	**1 972**	**913**

All fixed assets have been transferred to European Spallation Source ERIC from ESS AB according to agreement dated 1st October 2015.

Note 12: Construction in progress

KEUR	2016-12-31	2015-12-31
Accumulated cost of acquisitions:		
Beginning of the financial year	84 011	0
Acquisitions	100 560	84 011
Net value in balance sheet 31 Dec 2016	**184 571**	**84 011**

Note 13: Short term receivables

KEUR	2016-12-31	2015-12-31
VAT receivables	10 996	8 208
Other tax receivables	1 779	539
Contribution from members	20 949	0
Other	1 017	249
TOTAL	**34 741**	**8 996**

Note 14: Prepaid expenses and accrued income

KEUR	2016-12-31	2015-12-31
Prepaid rental costs	488	417
Prepaid insurance	1 768	1 074
Accrued income EU-project	481	490
Other	199	75
TOTAL	**2 936**	**2 056**

Note 15: Financial instruments and financial risk management

Finance policy

In view of the phase in which ESS currently operates, no financial instruments are at present being used to hedge flows or the Balance Sheet.

Liquidity risks and interest rate risks

Cash surpluses are placed in bank accounts or other equivalent.

Credit risks

Credit risks are considered limited, as the company's receivables consist of minor amounts

Exchange rate risks

Exposure to exchange rate changes has been low and the exchange rate earnings that occurred during the year relates to exchange rate differences on account payables and bank balances mainly in EUR.

Note 16: Capital contribution

KEUR	2016-12-31	2015-12-31
Estonia	837	581
Denmark	49 455	19 219
Switzerland	4 634	2 287
Norway	17 969	11 882
Czech Republic	3 221	3 221
Hungary	1 034	494
Poland	1 336	0
Germany	84 848	0
Sweden	156 507	0
United Kingdom	23 605	0
TOTAL	**343 446**	**37 684**

Note 17: Other liabilities

KEUR	2016-12-31	2015-12-31
Liabilities to ESS AB according to transfer agreement*	0	93 957
Other	1 456	1 307
TOTAL	**1 456**	**95 264**

*According to the minutes from the Annual General Meeting of ESS AB (556792-4096), 18th March 2016, the company's purchase price claim on the European Spallation Source ERIC will be distributed to the shareholders, and the Swedish and Danish Government. The debt to ESS AB has since been converted into contributions in the European Spallation Source ERIC , Prop. 2015/16: 1.

Note 18: Accrued expenses and deferred income

KEUR	2016-12-31	2015-12-31
Accrued vacation salary	2 119	1 912
Employee taxes and social costs	549	525
Accrued salary tax	883	142
Accrued payments for EU-projects	2 581	5 368
Accrued construction and consultancy fees	403	3 577
CEA	0	1 143
Cash in-kind	1 902	0
Other accrued expenses and deferred income	847	1 154
SUMMARY	**9 284**	**13 821**

The Council of European Spallation Source ERIC will decide upon the adoption of the financial statement and Annual report.

I, the Director General certify that, based on my best knowledge, belief and understanding, the Annual Report is prepared in accordance with applicable accounting rules, the information provided is in accordance with the facts, and nothing of significance that could affect the image of the company as a result of the Annual Report, is omitted.

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P.O Box 176, SE-221 00 Lund, Sweden

Visiting address:

ESS, Tunavägen 24, Lund
Phone: +46 46 888 3000

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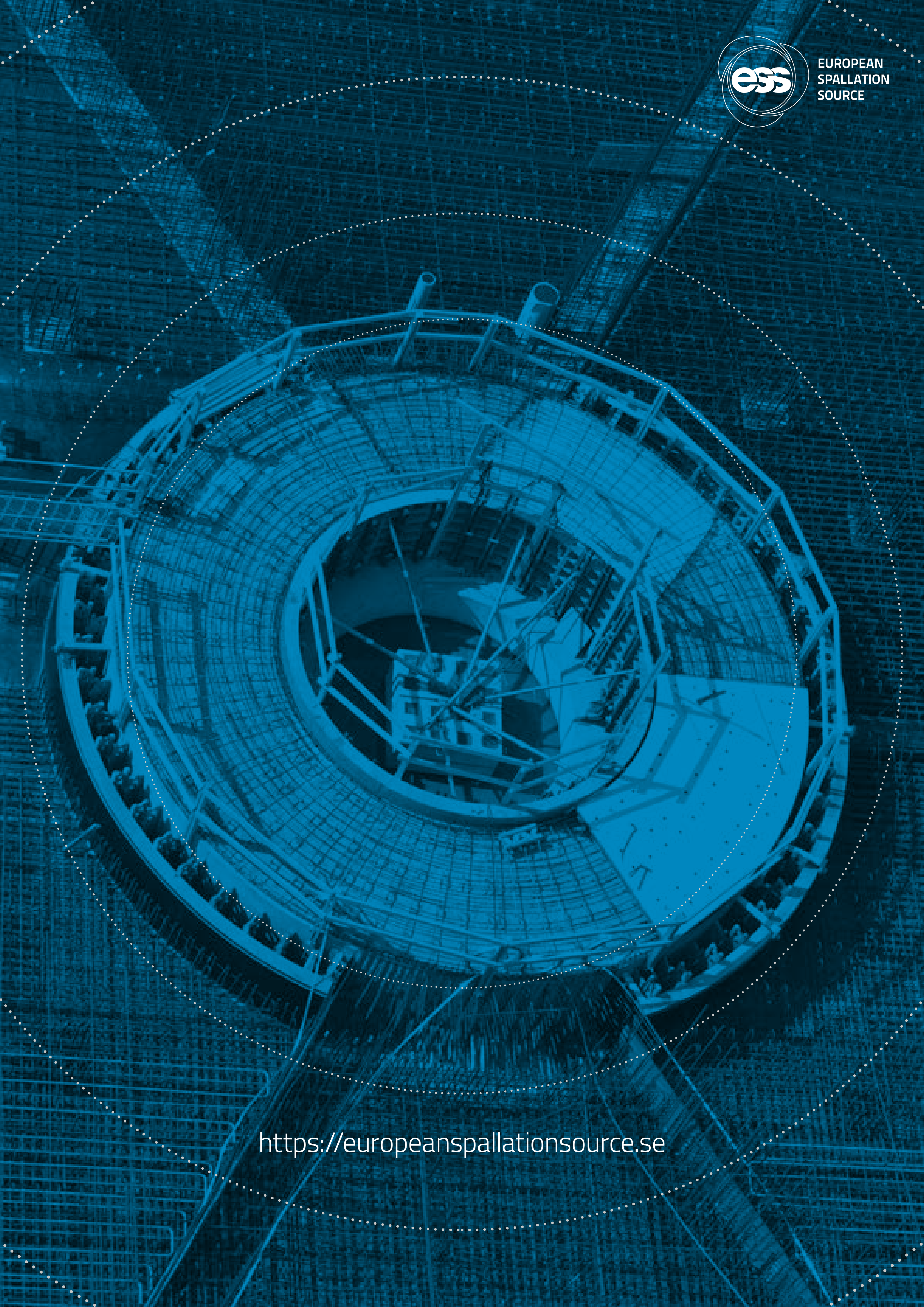

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