

European Spallation Source ERIC

Project Progress Report

Q4 Report 2016



DG transition - Group photo of the ESS staff attending the Staff Meeting

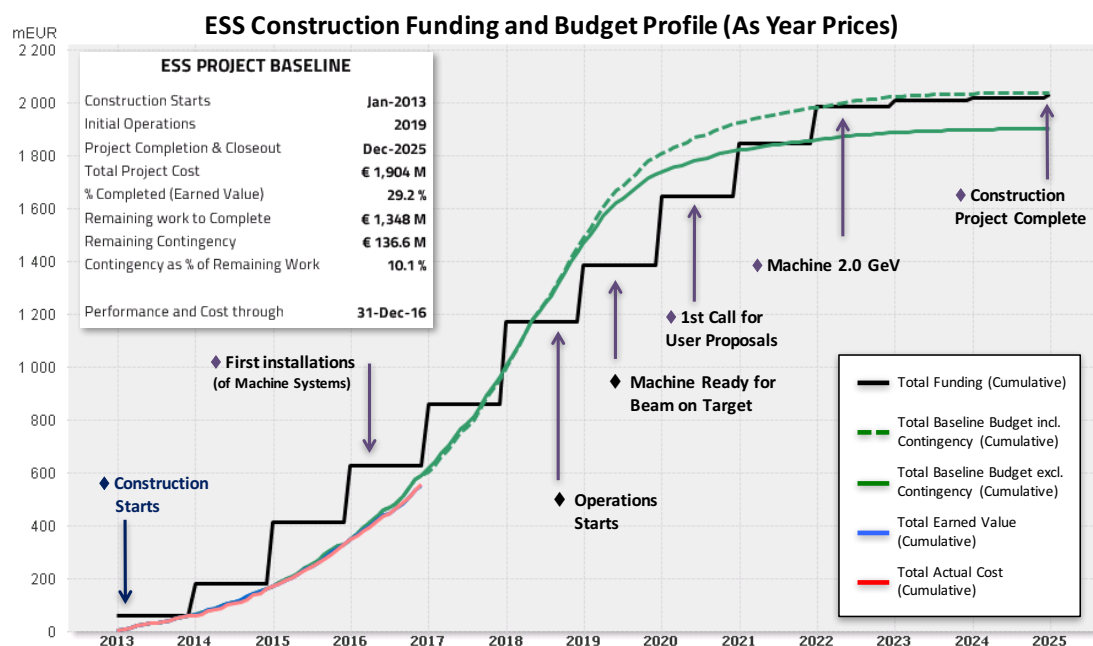
Report due date:
February 2017

John Womersley
Director General European Spallation Source ERIC

Director General Overview

ESS continued to make excellent progress in the fourth quarter of 2016. Highlights of this period include:

- The transition between Jim Yeck and myself as Director-General was completed smoothly on November 1.
- Conventional Facilities construction continues at a rapid pace, working in close collaboration with Skanska. The Target price contract for almost all of the remaining civil construction (98%) has now been signed, including descoping options that can be invoked if necessary to remain within the agreed overall cost envelope.
- The first in-kind deliveries have started to arrive on site and installation work of the first cryogenic and electrical systems has begun.
- Cost and Schedule performance continues to be monitored closely. We have embarked upon a value engineering exercise to identify possible cost savings and items that may be deferred in order to generate additional contingency. We are also working on an integrated schedule for the commissioning phase of accelerator, target and instruments with the goal of delivering science with neutrons as rapidly as possible.
- The ESS cash facility, providing up to 300M€ to manage cash flow and enable the schedule to be maintained, was signed with representatives of the European Investment Bank, the Nordic Investment Bank and the Swedish Export Credit corporation.
- In kind agreements of various kinds are now in place for packages covering 303M€ of value. We are still working to address VAT issues with some of our partners but this is not delaying work.
- A committee of seventeen experts, chaired by Thom Mason, the Director of Oak Ridge National Laboratory, reviewed ESS's bottom-up estimates of operations requirements and costs in the "steady state" operations phase, i.e., 5 MW machine power, 22 instruments, and full user program. The committee endorsed ESS's planning in this area and the review results are an important input to the Council's Operations Working Group. Our next priority is to better develop planning for the transition from construction into initial operations beginning in 2019 and this will be reviewed in May.
- ESS continues to work closely with our host states, our member states and with potential new communities. We have hosted a number of VIP visitors including the Danish minister and Danish parliamentary science committee, a delegation from the Canadian Embassy in Stockholm, and the director of J-PARC in Japan.



The chart above provides December 2016 status against the construction baseline.

Technical Director Overview

Achievements

- Prototyping and construction work have again advanced significantly both at Lund and at in-kind partners. The additional delays encountered on a number of subjects are being revisited and will be integrated in a new version of the integrated schedule to be issued in Q2-2017.
- New roles and functions have been created to address the needs of installation on site. Accelerator and Target subprojects have set-up teams led by dedicated installation coordinators. The leader of the EIS division has been designated to lead Installation Support Coordination with the mission to ensure proper communication of experience between subprojects, identify missing central resources/procedures and propose solutions. He will submit detailed plans to the EMT in January 2017.
- Installation has started on site (Tuning Dump shielding blocks from ESS-Bilbao and ECHIR beam line). Lessons are being drawn from the observed issues.
- A change in the Target sub-project baseline was approved by the ESS Change Control Board which minimizes the impact of the delayed construction of the Target building resulting from the decision to use large bored piles. It is achieved by finely coordinating Target's and CF's schedules related to early access to different parts of the Target Building.
- Plans and resources for steady-state Operations submitted to the Operations Review at the end of October have been positively judged by the reviewers.
- The Machine Directorate has actively contributed to the Value Engineering exercise aimed at making sure that total construction cost will remain within the allocated budget. The first series of conclusions will be drawn during January 2017.
- A new composition of the TAC has been approved by the Council during its December meeting.

Main issues

- The installation phase urgently requires multiple additional services and procedures to be communicated also to the in-kind partners. It is important that they are operational on-time to avoid delays.
- It remains possible to pass the 2019 milestone for the accelerator and the revised milestone in Q1-2020 for the Target, but the reports of the sub-projects illustrate the difficulty and the need for all in-kind partners to be pro-active, speeding-up administrative processes and when negotiating procurements dates from industry.

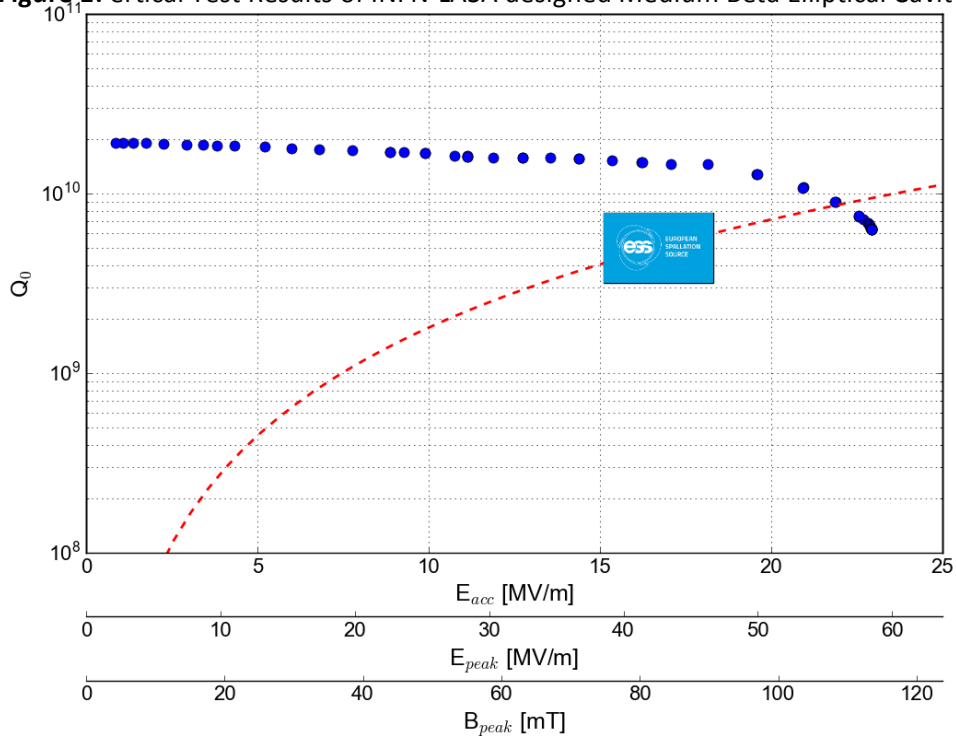
Accelerator Systems

Achievements

- Design reviews held this quarter included: Preliminary Design Reviews for the Electrical Rack System, Tunnel Water Cooling System, 704 MHz Klystrons, Wire Scanner and Cryomodule Test Stand as well as Critical Design Reviews for the Test and Instruments Cryoplant, the INFN Medium Beta Cavity RF Design and the Lattice & Beam Dynamics. In addition, a HAZOP (combined safety & reliability review) was held for the Target Moderator Cryoplant.
- The ESS designed modulator prototype at 120 KVA has been successfully tested in Lund in a longer test and the technical design for the ESS designed 660 KVA modulators has been completed.
- The tender for 3 ESS designed 660 KVA modulators has been published in Spain (IKC to the NC linac RF sources).
- The first vertical tests of the INFN-LASA design of the Medium Beta Elliptical Cavity were completed. The results (see figure 1) show that the cavity meets all the RF requirements. All superconducting RF cavity designs developed for ESS: Spoke, Medium Beta Elliptical

(two versions) and High Beta Elliptical have all met their RF performance requirements. Series production of these cavities will start in early 2017.

Figure 1: Operational Test Results of INFN-LASA designed Medium Beta Elliptical Cavity.



- Installation work has begun for the warm helium gas piping and technical water systems on site. This work, representing the first installation of large scale technical equipment associated with the accelerator, will continue through Q2 2017. Figure 2 showing the layout of these lines in the Cold Box Hall gives a sense of the complexity of this work.

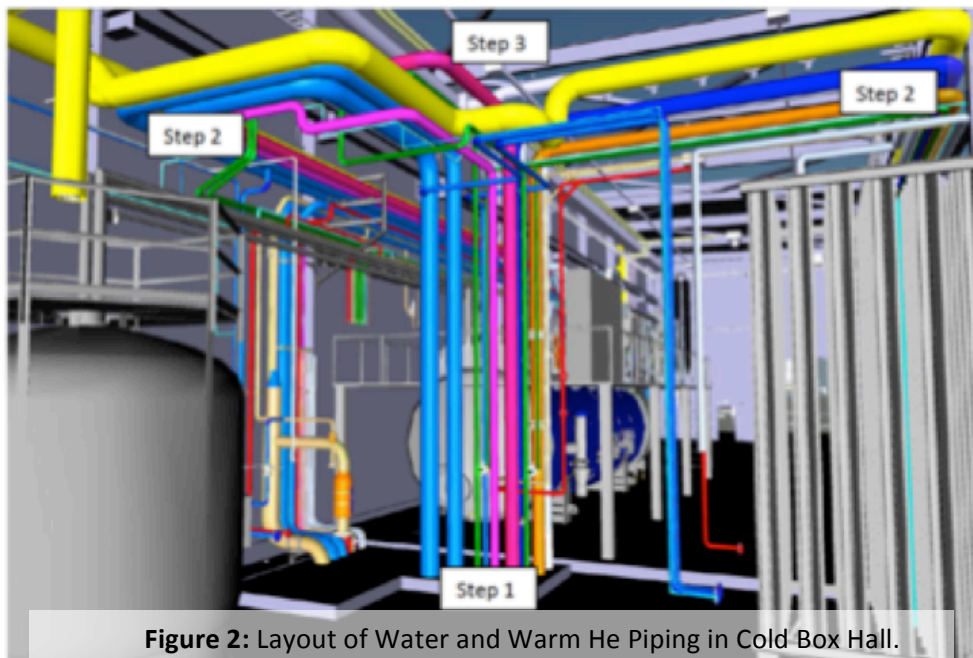


Figure 2: Layout of Water and Warm He Piping in Cold Box Hall.

- Detailed mechanical layouts for the Medium Energy Beam Transport (MEBT) system have been developed and the first buncher cavity is in production. A Critical Design Review for the integrated MEBT is planned for February 2017
- Series production of Beam Loss Monitor ionization chambers is well underway in Protvino, Russia.

- As part of a ESS-wide Value Engineering exercise, approximately 39 MEuros of possible savings and deferrals has been identified in the accelerator project.
- The IK work progress and Negotiations continue with the In-Kind partner and institutions in 12 different countries. The total value of these items represents 52% of the total accelerator budget, 3.1% of the budget is contracted with institutions in Sweden and Denmark.
- The projects with the IK partners has in many cases transitioned from engineering into prototyping, manufacturing of the components and assembly of the deliveries.
- 6 Additional Technical Annexes have been finalized for submission to the IKRC 11 on December 13. All have been endorsed. Work continues with the remaining 12 TAs not finalized which are planned to be submitted to the IKRC 12.
- 2 out of the 8 unallocated in-kind work packages (for a total value of 65 M€) have been placed as procurement/Collaboration agreements. For open work packages, the work continues in parallel to either find partner or start the ESS procurement process.
- Plans and resources for steady-state Operations have been finalized and submitted during the Operations Review in October.

Recent and upcoming milestones

[Delays are expressed with respect to the previous quarterly report which is in-line with the ESS highest level milestones (e.g. 570 MeV beam available mid-2019) where more activities are now on the critical path.]

Name	Current Forecast	Delay (W.Days)	Comment
Start RFQ machining	1-Jan-17	-90	It was 1-Oct-16 in the Q3 report. New delay due to approved fabrication schedule by supplier.
Thales Klystron Prototype Delivered	9-Jan-17	-95	It was 18-Nov-16 in the Q3 report. No impact. The klystron is complete and at the manufacturer. Work package under replanning.
DTL production starts	2-Feb-17	-5	It was 9-Nov-16 in the Q3 report. In-Kind wp under re-planning.
Spoke cryomodule prototype available for Uppsala test stand (FREIA)	17-Jan-17	-85	No change since the Q3 report.
Spoke & MB CM production launched.	1-Mar-17	-45	Obsolete milestone, separate milestones will be established for the spoke and MB cryomodule production start. The current plan maintains the delivery dates for the spoke and MB CM deliveries on site.
CPI/Thales and L3 IOT prototypes delivery	19-Apr-17	-80	It was 30-Jan-17 in the Q3 report. Forecast is for CPI/Thales device. L3 IOT is at an advanced testing stage.
Ready For Installation (RFI) SPK High Power Amplifier - 1st unit	15-Jun-17	-92	No change since the Q3 report.
LEBT assembly complete	14-Aug-17	-170	It was 30-Jun-17 in the Q3 report. The installation schedule is being modified and the testing time at IK partner reduced to maintain agreed schedule.
Ready For Installation (RFI) HV Power Converter for SPK - 1st unit	15-Jan-18	-168	No change since the Q3 report.

Main issues

- VAT issues occurring on a country by country basis create schedule risks.

- Issues such as providing I06 cards to In kind partners and the provision of laydown areas on site may add risk to the installation schedule.
- Delay of prototype Spoke cavity cryomodule test and possible delay of prototype Medium Beta cavity cryomodule test are worrying. The affected work packages do still plan to provide cryomodules on site for installation consistent with our current schedule. This issue is being watched closely.

Target Station

Achievements

- The Preliminary Design of the systems comprising the Target Station is now 90% complete and the Final Design 5% complete. At the end of December 2017, earned value for the Target sub-project stood at 20%.
- A change in the Target sub-project baseline was approved by the ESS Change Control Board, associated with coordinating Target's and CF's schedules related to early access to different parts of the Target Building. Approved changes moved Target's L1 milestone date for "Target Ready for Beam-on-Target" from 30 June 2019 to 31 March 2020, and budget increase of 8.9 M€ to 172.2 M€.
- ESS-Bilbao delivered the first IK contribution to be installed at the ESS site: the tuning beam dump shield blocks, which were installed in December (see figure 3). As the first IK delivery, there were many lessons learned related to design coordination, installation planning, logistics, and receipt inspection. We are planning to use this and future deliveries to continuously improve our processes and procedures related to receiving and installing hardware delivered by our IK partners.



Figure 3: Concrete shield blocks designed, procured and delivered by ESS-Bilbao, installed in the tuning beam dump pit.

- A Call-for-Tender was issued by IK partner UJF's subcontractor CVR for the helium circulators that are part of the target cooling system. Four vendors responded and the selection process is nearly complete.

- A contract has been placed for the final design and manufacture of drain tanks for all of Target's water systems.
- The ECHIR (Ess CHip IRradiation) beam pipe was delivered and installed, in preparation for the monolith puck concrete pour (see figure 4). This fixture accommodates the future installation of a chip irradiation station at ESS, should funding for such a capability materialize.



Figure 4: ECHIR beam pipe, to be embedded in the monolith puck.

- Collaborator DTU irradiated tungsten brick at CERN's ISOLDE facility, and then measured the release rate of iodine and tritium as a function of temperature. Preliminary results support the safety case that iodine releases are not significant for tungsten temperatures below 700°C.
- Conduits to be embedded in the floor and walls of the Active Cells have arrived on site (see figure 5) and are now being installed.



Figure 5: Conduits to be embedded in the Active Cells floor and walls.

- Preliminary Design Reviews were conducted for the Mock-Up Test Stand, the Transfer Casks, and the Radiolysis Gas Handling System.
- Critical Design Reviews were conducted for the Moderator, Reflector and Irradiation Module, and for the Active Cells Confinement and Shielding systems.

- The Target sub-project participated in the ESS-wide effort to identify cost reduction opportunities throughout the project, noting several opportunities for direct cost savings and other opportunities to defer costs to the Initial Operations phase.
- Plans and resources for steady-state Operations have been finalized and submitted during the Operations Review in October.

Recent and upcoming milestones

[Delays are expressed with respect to the updated current schedule which is in-line with the ESS highest level milestones where more activities are now on the critical path.]

Relative to last quarter, the milestone list is updated with the L1 milestones approved this quarter by the Change Control Board. Two milestones appearing last quarter, “PDR – Cask and Handling” and “Delivery on Site – ECHIR pipes” are completed. The former milestone “Award contract for tungsten spallation material” is renamed in the list below as “Contract Signed – Target Spallation Material” and is further delayed by ESS-Bilbao as the manufacturing time is well less than planned. Finally, three milestones that were shown last quarter, “Delivery on Site – Embedments in Active Cells Floor”, CDR – Ventilation and Confinement” and “Delivery on Site – Stainless Steel Liner Plates” are no longer L1 milestones and will not be reported here.

The 51-day delay on the milestone “Installation Complete – Target Cryoplant” is due to extended negotiations that occurred after awarding the contract to the supplier and before signing the contract. This delay will not negatively impact other L1 milestones.

Name	Current Forecast	Delay (W.Days)	Comment (+ text below)
Contract Signed – Target Spallation Material	18-Apr-17	-82	Previously 02-Jan-17. Now no float for assembly.
CDR Target Helium Cooling System	30-Jun-17	0	
Delivery on Site – Monolith Vessel	26-Feb-18	-13	Delayed procurement but shortened production time.
Delivery On Site – Cold Moderator Assembly incl. Vacuum Jacket	29-Mar-18	0	
Installation Complete – Target Cryoplant (Helium)	21-May-18	-51	Contract signing delayed. No impact on main schedule.
Delivery – Complete Target Wheel to ESS Site	06-Jul-18	-16	Schedule is more compressed each month.
Tuning Beam Dump Ready for Proton Beam	06-Mar-19	18	
Installation - 1st Survey of TCS	20-Mar-19	-1	
D02 Bunker Area D03 side released for NSS work	01-Oct-19	0	
D02 Bunker Area D01 side released for NSS work	08-Oct-19	0	
WP3 System Test complete - Cryogenic Cooling Systems (Helium + LH2)	03-Feb-20	0	
Target ready for BOT / ESS Readiness review	31-03-20	0	

Main issues

- Tracking earned value of some IK partners in our project plan is still not functioning properly, which generates artificially low Schedule Performance Index for the Target sub-project. We are working with these partners to resolve this issue.
- Target’s major installation activities start in fall of 2017. The Target sub-project is putting in place a plan and organizational structure to support this next phase of the project. Target’s Installation Coordinator is currently recruiting a deputy to support installations on site.

Integrated Control System

Achievements

- The new project plan completed in the summer 2016 has been implemented in Primavera P6 and several project tracking processes were introduced. In the coming quarters, these processes will need to be tuned and optimized to ensure a path towards operational excellence. Meanwhile the convergence with the ESS integrated planning has continued which has enabled the refinement of ICS milestones.
- One new in-kind agreement has been signed with ESS Bilbao and endorsed by the ESS in-kind review committee in December. New initiatives are being pursued in Estonia and Norway. The work on in-kind will now benefit from the presence of the newly recruited ICS in-kind manager who will drive existing in-kind activities as well as look to expand the ICS in-kind portfolio.
- The strength of the ICS team has increased through recruitment and consultants' procurement using new commercial framework agreements to meet the needs of the project plan. Four new consultants and one new employee joined the ICS team. Four employee contracts have been signed with starting dates in 2017 and another seven positions are in the recruitment phase.
- The tender for a large commercial framework agreement for procuring integration services was finally published in December. This framework agreement is crucial for securing adequate manpower capacity in multiple technical areas. The tender is divided into seven "Lots", or different competence areas and a handful of suppliers are expected to be accepted as framework suppliers for each lot. The first contracts under this framework are expected to be created in Q2 2017.
- The important in-kind development project of the ICS digital controller platform has progressed satisfyingly. However, the administrative situation for in-kind projects in Switzerland might delay further work. A solution is actively searched in Switzerland and. In parallel, ICS and ESS are actively working on potential mitigation measures.
- Plans and resources for steady-state Operations have been finalized and submitted during the Operations Review in October.
- A thorough project risk evaluation has been conducted which significantly improved the description of risks, their consequences and their potential cost. The consolidated risk status has been introduced in the risk tool Exonaut.

Recent and upcoming milestones

All milestones planned during Q4-2016 have been passed except the completion of the controls of proton source and LEBT in Catania where an additional IK partner is involved. Lessons are being learnt.

Milestone	Forecast	Delta	Comment
Controls for proton source and LEBT ready offsite	2017-03-03	180	Strong dependencies with Accelerator and CEA IK partner.
Accelerator PSS-1 complete	2017-10-02	0	
Accelerator PSS-2 complete	2018-12-21	0	
ICS controls for Accelerator Cryoplant ready for commissioning	2017-03-01	0	
ICS controls for TICp ready for commissioning	2017-03-15	0	
ICS controls HW for Linac CDS installed before Cryogenic Distribution for Lund Test Stand 2	2017-06-15	0	
ICS controls HW for Linac CDS installed before Cryogenic Distribution for Spoke Linac	2017-10-02	0	
ICS controls HW for Linac CDS installed before Cryogenic Distribution for Elliptical Linac	2017-11-03	0	

Main issues

- Understaffing is impeding progress according to plan. This is being addressed but the progress needs to be accelerated even further.
- Some work packages, especially those that have early installation activities, are suffering from problems with an underdeveloped installation infrastructure on site.

Engineering and Integration Support

Achievements

- All technical consultants belonging to the earlier framework agreement are now amended and moved under the new framework agreement.
- The deployment of the new software version of the PLM platform took place in December after a first unsuccessful attempt in November due to indexing issues. The first observations at end of December point towards large performance improvements of the integrated CAD tool Catia V6.
- A workshop on “Best Engineering Practice” took place on 14-15 November 2016 in Bilbao (<https://indico.ess.lu.se/event/643>) with the support of “BrightnESS”. Representatives of other large-scale facilities/projects at different stages of evolution were present and dialogued/shared experience with engineering staff from ESS, the ESS partners and BrightnESS In-Kind field coordinators.
- The leader of the EIS division has been designated to lead Installation Support Coordination with the mission to ensure proper communication of experience between subprojects, identify missing central resources/procedures and propose solutions. Detailed plans will be presented to the EMT in January 2017.
- The need of resources from the central teams supporting the ESS program continues to grow, where installation coordinators/supervisors and electrical engineers now dominate.
- The Survey, Alignment and Metrology team supported the successful first high-precision installation related to ECHIR beam line.

Main issues

- Communication of baselined 3D models by the In-Kind partners is now urgent for design integration as well as survey, alignment and metrology purposes.
- Lessons from the first installations must be learnt and used to improve procedures and practice.
- Time is short for defining, negotiating and implementing the new central procedures and framework agreements for installation.

System Engineering

Achievements

- The System Engineering team is coordinating the preparation of the additional information requested by SSM. The deadline has been shifted to the 1st of March 2017, which is still compatible with getting SSM permission on time for respecting the ESS schedule.

Main issues

- On-time delivery of the requested information from all teams inside ESS is critical. Delayed/incomplete information might delay the delivery of the permit and hence the overall project schedule.

Science Director Overview

A major milestone was achieved this quarter, with the completion of the scope-setting process for instruments, the results of which were approved by the ERIC Council in December. In addition, we successfully carried out the Preliminary Design Review of the common shielding bunker. Together this provides a solid, well-defined and value-engineered initial scope from which to move NSS forward towards instrument installation. For the Operations Cost Review, the operations planning was developed to a more mature level, covering all aspects from the user program to the need for continuous capital investment. This provided a valuable view of the future as a world-leading research facility, and insights into what that will require.

Scope-Setting of the Instrument Suite

October was intense, with eight instrument scope-setting meetings, each one involving all divisions at the Science Directorate as well as the partners. This concluded the series of scope-setting meetings held this year, and a full picture of the initial instrument suite could be assembled and brought to the Instruments Collaboration Board for discussion, to the Scientific Advisory Committee for recommendation and to Council for endorsement. In total NSS has assigned a cost-book value of 200 M€ for 15 instruments within the construction budget.

The Scientific Advisory Committee supported the proposed scope of the initial suite when they met in November, expressing concern at the large deferrals of instrument scope, but agreeing that the initial form of each instrument will still be world-leading. Council approved the package at their December meeting. Tollgate 2 meetings for the instrument projects commenced in November, and will continue until the summer of 2017.

Bunker Preliminary Design Review

Acting on the advice of the 2016 Annual Review, a major effort has been conducted to finalize the design of the common shielding bunker. A conference room at headquarters was refurbished into a bunker task force zone, allowing staff from NSS, CF and Target to sit and work together. This paid off: the Bunker Preliminary Design Review was successfully held in December, meeting a 2016 level 2 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 formal report will be received in Q1 of 2017.

Operations Cost Review

The operations cost review in October was a useful exercise for all of ESS, as it allowed us to raise our sights to our future existence as an excellent research facility, servicing users from around the partner sphere. The user program was at the heart of the Science Directorate review, and we coordinated our preparations with the Target Division, the Division for Environment, Safety, Health & Quality and the Administration Directorate. The Target and Instruments subcommittee, chaired by Robert Robinson of ANSTO, found that the resource and staffing levels presented were well thought out but slightly on the low side for maximizing scientific returns on the capital investment.

DMSC Highlights

The 5th meeting of the DMSC Scientific and Technical Advisory Committee was held in October. They found that good progress is being made, and highlighted the need for recognition of the critical role DMSC plays in enabling early experiments.

DMSC hosted the NOBUGS 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.

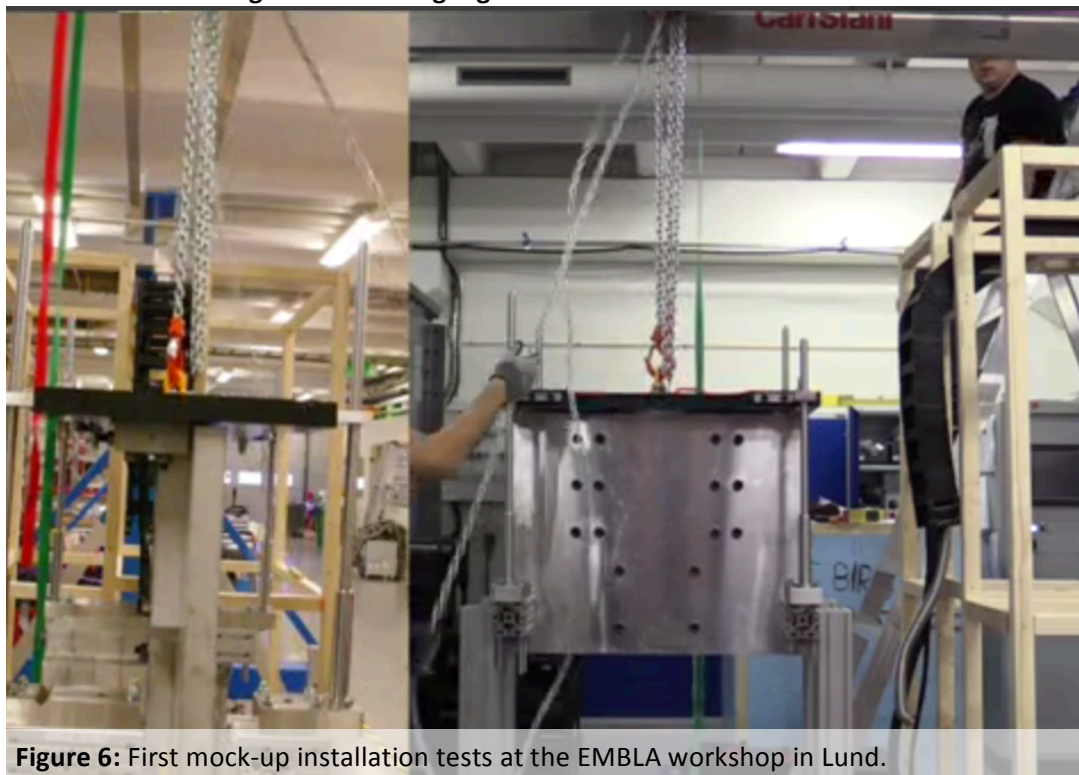
A modular library developed by ESS for treatment of and interaction with histogram-type data has been rolled out to 60% of the Mantid framework. These developments taken together provide significant performance improvements of the entire Mantid project.

Scientific Activities Division Highlights

The Scientific and Technical Advisory Panel on Users and Samples met for the first time in December. Chaired by Michelle Everett of SNS, they provided very timely advice on user access and support, e.g. user office, scientific coordination, sample management, sample preparation support and user laboratories. The report is expected during Q1 of 2017.

A sample environment reference suite has been established, enabling us to cater for the sample environment needs of the first 8 instruments in the user programme. Interactions within ESS and towards the instrument teams continue, currently focussing on TollGate 2 preparations.

Instrument Technologies Division Highlights



In December the Neutron Chopper Group performed the first mock-up installation tests at the EMBLA workshop in Lund (see figure). These tests facilitated the evaluation of the ESS standard chopper mechanical integration solutions in more realistic conditions (such as within the challenging bunker environment) and the verification of the ease of installation and extraction of a chopper using our standard cable bundle and alignment pin designs. The tests lead to a number of improvements for incorporation into standard designs.

Integration activities with the ESS Integrated Control Systems are ongoing as part of the ESSiIP projects, which involves ICS, DMSC and all technology groups within the Science Directorate. A basic infrastructure has been set up at ESS and the next step will be to establish a system under real conditions using the test beamline at the Helmholtz Centre

Berlin, containing the complete chain of instrument components starting with e.g. choppers or sample environment integrated into EPICS and acquiring data at the DMSC.

In-Kind Status

The In-Kind Review Committee endorsed 11 NSS work packages during their 11th meeting in December. For the instrument projects, 97% of the in-kind target has been reached.

The Interface to Conventional Facilities

The baseline for the experimental halls, the guide hall and the auxiliary buildings which house labs and scientific infrastructure has been agreed on between NSS and CF. These buildings are now in detailed design. However, as a part of the CF value engineering efforts, cuts to the NSS building baseline have been suggested. In this context NSS has delivered a proposal specifying which experimental support infrastructure is absolutely necessary to operate the user program with the first eight instruments, deferring much scope to initial or steady-state operations but protecting the possibility of delivering early science success.

Conventional Facilities Overview

There was significant progress accomplished during the quarter as well as a major challenge encountered. The final Target Cost for the Construction contract ("TC2ABC", was signed 22 December with Skanska for almost all remaining construction work. ESS must operate within an agreed overall cost, and therefore it is important that the new CF contract with Skanska is affordable within that ESS ceiling. An additional value engineering and re-scoping exercise is therefore being undertaken to make sure that ESS stays within the total budget even though that CFs Estimate at Completion now exceeds the CF budget.

The main design achievements during the last quarter was establishing and freezing of the Baseline requirements for Target and Experimental halls and the handover of those to the detailed design team. We have succeeded in closing most Taskforce activities and introducing normal working procedures for design management between baseline team and detailed design team.

Progress on site was excellent during 2016. We have started the in-situ concrete works to the Monolith base slab in Target building. All in-situ concrete works in the outer Experimental hall has been completed as all the base slabs are completed. The last steel core piles have been installed and now only some concrete piles are left to be installed. On the Accelerator tunnel the top filling works are progressing to all Sections of the tunnel and the structural steel frame erection to Klystron building have been completed. The first substation has been completed and is now energized and the second will soon follow.



Figure 7: Aerial view of the Construction Site November 2016.

The first access milestone for the ESS sub project teams was achieved providing access to the Cryogenic transfer tunnel into the Cryo building. The remaining access milestones for the Accelerator are also on track.

There has been excellent cooperation in the work with an integrated schedule together with the Target Division in order to mitigate delays and to maintain the goal of "Machine ready

for beam on Target” in December 2019. This result of this work was presented by CF and also by all other divisions in the ESS Change Control Board, CCB, in November. This resulted in new partial as well as full access dates for the D & Ebuildings.

The Campus Labs and Offices are almost ready for tendering. The original office space plans provided work stations for about 450 people. The decision was taken to increase the space to provide more flexibility in the future and to better align with the staffing requirements in the operations phase. A joint feasibility study by CF and the architect is preparing plans for around 2000m² for the office buildings.



Preparations are now made to adjust the design and technical systems and have the updated tender design completed and ready for procurement in early 2017. Pending the financial sourcing the start of the procurement of the design/build contract for Campus will be delayed until March 2017 at the earliest. The aim to complete the Campus by December 2019 will now be more challenging to meet.

Project Support and Administration Director Overview

The cash facility with three credit institutions was successfully established in November after Council approval.

The Governance Office function was established after summer when the Governance Officer was formally employed by ESS. He organised a written procedure by Council on the cash facility in September, the 2nd meeting of the Committee on Employment Conditions in October, the 4th meeting of the Administrative and Finance Committee in November, and the 7th meeting of Council in December.

The work of the procurement division is proceeding according to plan, managing a very high number of new procurement requests per month, including both a high number of low value orders as well as a number of procurement >50.000 EUR. Work is on-going to optimize procurement processes and integrate such into the organization.

The work of the logistics function is ramping up, as larger deliveries are starting and with increased support to in-kind partners. Temporary warehousing is now available and negotiations to finalize a rental agreement for RATS (Reception, Acceptance, Testing, Storage) space were concluded, with access to the RATS space in Q1 2017.

For Human Resources the high recruitment pace continued throughout 2016. By the end of the year, 74 recruitments had been closed.

In September an employee survey was performed. Participation rate was 73% and the results were presented to EMT in November. It shows that we are an organisation with a lot of engagement and positive energy, but also that our employees think that the work tempo is really demanding and the predictability of work tasks is sometimes low. Following the presentation of the result to EMT, a work-shop was held where EMT selected three areas for them to focus on; Decision making process, Internal communication and Mutual respect in behaviours.

The rest of the organisation is currently working on the result and action plans.

An IT System architect function will be established to improve the coordination across the organisation as well as ensuring that the needs of the organisation are met.

Setup is ongoing for new web log in service to enable Single Sign On (SSO) for all In-Kind to our web systems.

A password change policy was implemented and rolled out to all ESS accounts to meet standards regarding ITsecurity.

For the legal function a lot of efforts are currently going in to supporting the in-kind contracting process and the development of the technical annexes to the in-kind agreements. The Intellectual Property Rights & Inventions Policy has been approved by the Council in its 7th meeting in Bilbao and is now available on the ESS website.

Two formal procurement appeals were brought against ESS by suppliers. The first one concerned an appeal brought by a supplier before the Administrative Court in Malmo on the basis of the Swedish Public Procurement Act. However the Court dismissed the appeal confirming that ESS is operating on the basis of its own procurement rules (approved by the Council in its 1st meeting). This decision is significant in enforcing the validity and independency of the ESS ERIC Procurement Rules and preventing legal protests on the basis of the EU Directives/Swedish law on public procurement. The second appeal was heard by ESS Tenders Appeal Board, in relation to the procurement process for manufacturing and delivering of waste water vessels.

The work to establish temporary workstations and workers cabins for incoming installation workers and in-kind staff has begun. These facilities will be operational from the beginning of Q2.

Procurement

A table providing an overview of contract awards >200.000 EUR that were completed during Q4 2016 is provided in Annex 5. These contract awards correspond to procurement processes published on the ESS website, following procedures defined in the ESS ERIC Procurement Rules. In order to support the principle of transparency, ESS has been publishing these contract award notices on the ESS website since 1 October 2015. They are published on a quarterly basis, based on the month of final contract signature.

A list of open and forthcoming procurements is available on the website: <https://europeanspallationsource.se/procurement>.

External Grants summary

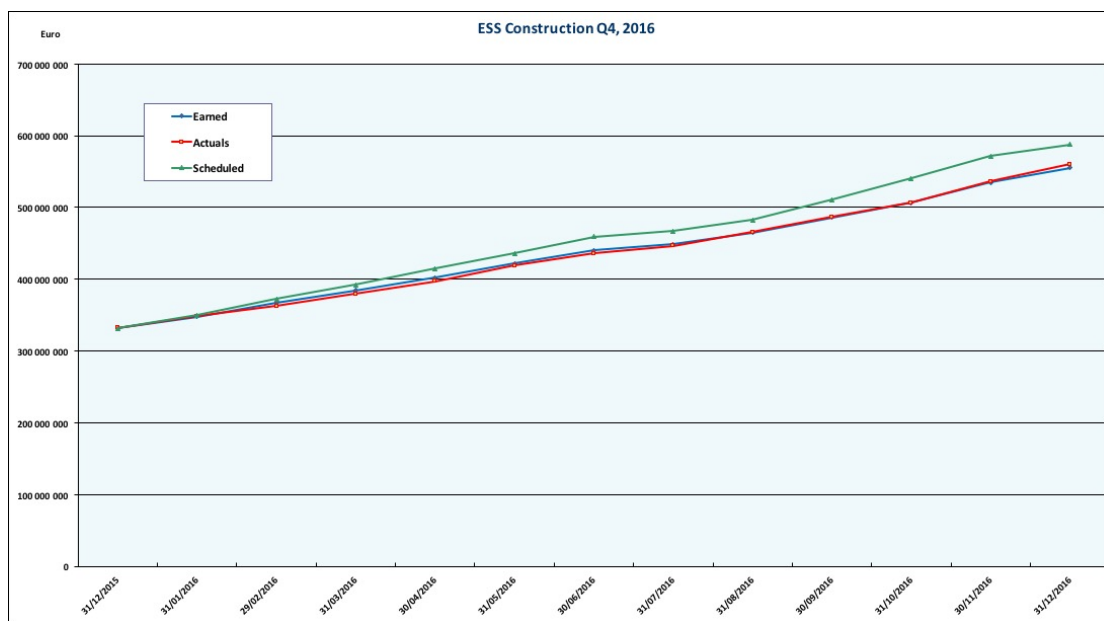
The number of grant applications submitted by ESS has increased significantly in the past years. With only 3 submissions recorded in 2012 and 2013 respectively, ESS grants participation increased to 14 submissions in 2014, 22 in 2015 and 42 in 2016.

ESS is currently involved in 18 international or national grants (12 European grants, 2 regional grant and 4 national grants) with a total volume of approx. 14,5 MEUR, including ESS co-funding of 513 kEUR. Please see below a detailed overview of all international and national grants ESS is currently involved in.

The funding schemes include the EU Framework Programmes for Research and Innovation 7th Framework Programme (FP7) and Horizon 2020, Interreg activities as well as support from the Swedish funding agency VR. Most FP7 grants with ESS involvement started in 2011 and have been finalised and closed in the course of 2016. Four new projects with ESS involvement have been awarded funding through Horizon 2020 in 2016: the CERN led ARIES (Accelerator Research and Innovation for European Science and Society) project, the CERIC ACCELERATE (ACCEleration of Leading ReseArch infrasTructurEs) project, the STFC led EOSCpilot (European Open Science Cloud for Research) project, and the Université Grenoble led Marie Curie ITN RAMP (Rationalising Membrane Protein crystallisation). In addition, two projects with ESS involvement have been recently awarded by VR through the Neutron Scattering Project Grants scheme: the Lund University led project "Computational methods for analyzing self-assembly with time resolved SANS/SAXS" and the Chalmers University led project "A New Method to Model the Dynamic Structure Factor by Molecular Dynamics Simulations".

Cost/Performance Overview

Current trends in earned value measurement (EVM) indicate that ESS is slightly behind schedule and that costs are somewhat higher than planned. There is no question that some work is behind schedule, and the priority is to avoid delays in critical path activities that might jeopardise the overall ESS delivery schedule. The negative cost performance might result in un-recoverable costs but it is too early to make a determination. The EVM performance is reviewed in the sub-projects, and for all the sub-projects combined every month after the close of the previous month's accounting. Activities to mitigate potential delays and seek cost savings are being pursued. The external delivery milestones and the total construction budget remain valid.



Annex 1 provides more detailed information on Cost Performance Status, Risk and Contingency Status, Cost Baseline Change Log, Level 2 Baseline Budget Status and Contingency as % of Remaining Work.

Upcoming Events January 2017 – July 2017

Latvian Delegation @ ILL	30 January
ACCSYS Collaboration Board @ STFC, Darsebury	1 February
Kick-off meeting preparation Big Science Business Forum, CPH 2018	6 February
Committee on Employment Conditions	8 February
Council Meeting	9 February
IKON @PSI	14-15 February
Canadian State Visit	22 February
8 th ILO Meeting, Lund	23 February
Technical Advisory Committee	5-7 April
Administration and Finance Committee	26 April
ESS 4 th Annual Review	2-5 May
In-Kind Review Committee (IKRC) 12	10 May
IPAC, CPH	14-19 May
GSO meeting, Naples	15-17 May
Council meeting	1-2 June
ACCSYS Technical Board, Lund	29 June
ICNS, South Korea	9-13 July

Annex 1: Cost/Performance Status

The construction budget is 1 843 M€ in 2013 prices. The indexed budget is 2 036 M€ and all cost and schedule performance data using earned value management (EVM) is based on indexed values (n.b. In-kind not indexed).

The project is 25.8% complete versus the plan of 29.2% complete, measured using earned value techniques. The contingency budget is 136 M€, 10.1% of the remaining work planned for the overall construction project. There were no changes to the original construction contingency budget during the initial construction years; 2013, 2014, and 2015. Changes were proposed as part of the 2016 and 2017 budget process, (reduction of 15.4 M€ in 2016 and 25.0 M€ in 2017). A project management objective is to keep the contingency budget above 10% of the remaining work budget, in support of the overall goal of completing the ESS construction project within the approved cost baseline.

The Cost-Schedule Status Report (CSSR) for the ESS Construction Project through September 2016 is shown below. The report includes updated Estimate-at-Completion (EAC) forecasts prepared by the subprojects. These estimates capture the project leaders' best understanding of the likely final cost for their subproject. The method used for the EAC figures varies, e.g., the estimate for Accelerator Systems is mainly based on a high-level risk assessment and the Conventional Facilities estimate is based on the final target price negotiations with Skanska. ESS will continue to improve the overall quality of EAC forecasts.

ESS PROJECT PERFORMANCE REPORT														
WORK BREAKDOWN STRUCTURE														
PROJECT	FROM					TO								
	2016-10-01					2016-12-31								
PERFORMANCE DATA														
Total Project.EPS	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION			
ITEM	BUDGETED COST		ACTUAL COST WORK PERFORMED (Actual Cost)	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED (Actual Cost)	VARIANCE		APPROVED BUDGET	ESTIMATED	FORECAST	EAC
	WORK SCHEDULED (Planned Value)	WORK PERFORMED (Earn Value)		SCHEDULE (=EV-PV)	COST (=EV-AC)	WORK SCHEDULED (Planned Value)	WORK PERFORMED (Earned Value)		SCHEDULE (=EV-PV)	COST (=EV-AC)	Actual + Remaining	Estimated At Completion		
Project Support and Administration	7 246 867	7 056 369	7 927 570	-190 498	-871 200	78 232 825	77 840 196	79 648 739	-392 630	-1 808 543	128 366 542	130 192 621	7 034 274	137 226 895
Conventional Facilities	36 154 674	30 932 023	35 400 740	-5 222 651	-4 468 717	246 512 382	240 468 826	244 312 786	-6 043 556	-3 843 961	599 258 271	604 311 066	66 849 044	671 160 110
Accelerator Systems	12 793 994	15 168 646	14 203 569	2 374 651	965 077	125 750 645	112 254 752	113 456 166	-13 495 893	-1 201 415	521 018 325	521 753 944	41 350 000	563 103 944
Target Station	6 940 700	5 820 632	5 734 360	-1 120 067	86 273	38 579 747	33 427 713	34 253 503	-5 152 034	-825 790	172 681 082	173 761 223	9 093 427	182 854 650
Integrated Control System	4 511 672	1 579 405	1 819 738	-2 932 267	-240 332	21 981 779	17 843 736	17 656 513	-4 138 043	187 223	78 156 991	77 823 011	5 166 440	82 989 451
Technical Management & Services	1 904 354	1 726 880	1 904 829	-177 474	-177 949	22 292 320	22 109 342	21 611 197	-182 977	498 146	39 395 834	38 898 733	0	38 898 733
Neutron Scattering Systems	7 405 196	6 921 100	6 385 139	-484 096	535 961	54 466 201	51 142 347	48 986 235	-3 323 854	2 156 112	361 007 241	358 663 117	0	358 663 117
TOTAL	76 957 457	69 205 056	73 375 943	-7 752 401	-4 170 887	587 815 898	555 086 912	559 925 140	-32 728 987	-4 838 229	1 899 884 286	1 905 403 716	129 493 185	2 034 896 901

Schedule Variance (BCWS-BCWP): The cumulative schedule variance is increasing and the total schedule variance at the end of December 2016 is -32 729 k€ compared to -26 583 k€ at the end of September 2016. The majority of the schedule variance is within the Accelerator, Conventional Facilities, Target, ICS and NSS and mainly due to delays in Spoke cavities & Cryomodules, piping, delay in CDS-elliptical engineering and production, delays in redesign of Target & Exp Halls and delays in construction of Target & Exp halls. The overall trend suggests less work is being performed than planned and could lead to a schedule delay unless corrective actions are taken.

The variances at the sub-project level include Accelerator Systems (-13 496 k€), Conventional Facilities (-6 044 k€), Target Station (-5 152 k€), Integrated Control System (-4 138 k€), Neutron Scattering Systems (-3 324 k€), Project Support & Administration (-393 k€) and Technical Management & Services (-183 k€).

There is a schedule variance for Accelerator, Conventional Facilities and Target Station that could correspond to a potential delay of several months. There is a joint effort by all areas to recover and hold the external milestone for machine ready for beam on target in December 2019.

Cost Variance (BCWP-ACWP): The accumulated cost variance at the end of December 2016 is -4 838 k€ which is lower than the accumulated cost variance in September 2016 of -611 k€, i.e. the current trend for the accumulated cost variance showing cost increase. The majority of the cost variance is within the Conventional Facilities and mainly due to delays in redesign of Detailed Design Target & Exp Halls. Also Project Support & Administration has large cost variances mainly due to increased cost for software development and integration (ERP system and collaboration platform) and in Accelerator the cost variance is due to Beam Diagnostics and Power Converters. The overall trend suggests that the work performed costs slightly more than planned.

The negative cost variance is related to mainly related to Conventional Facilities (-3 844 k€), Project Support & Administration (-1 808 k€), Accelerator (-1 201) and Target (-826 k€). There is also a positive cost variance for Neutron Scattering Systems (+2 157 k€), Technical Management & Services (+498 k€) and Integrated Control System (+187 k€).

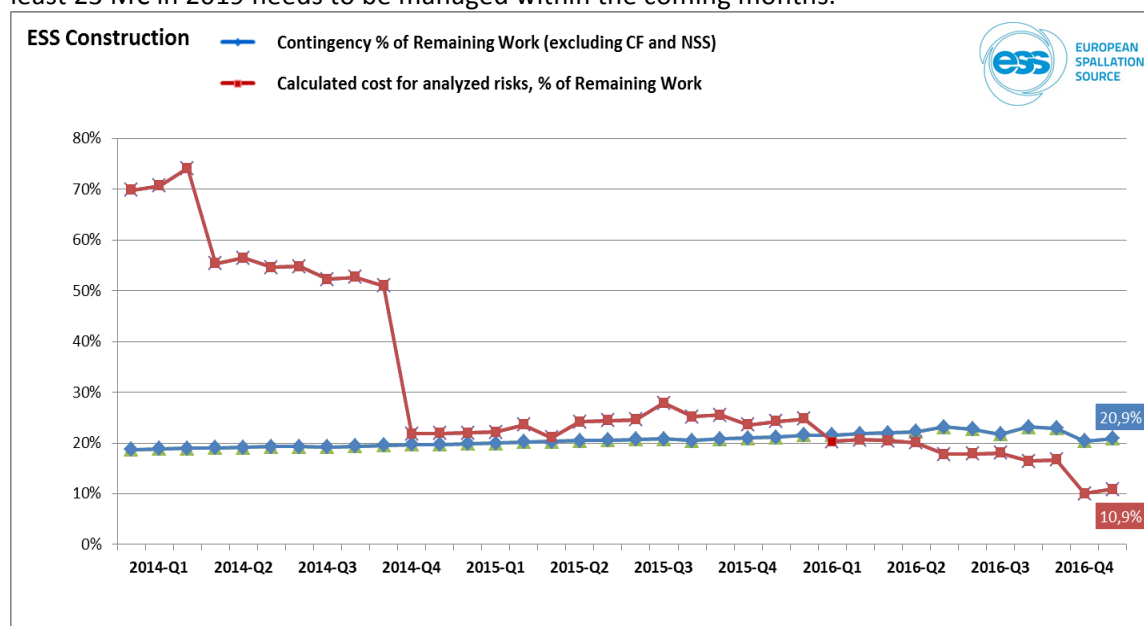
If the negative trend in the cumulative cost variance continues corrective action is needed to avoid a higher total project cost. Cost savings will be sought in all areas, either through value engineering efforts or through cost scrubbing to hold the baseline budget.

Risk and Contingency Status

The graph below shows the calculated risk exposure for identified and analysed risks, together with the contingency as a percentage of remaining work budgeted. Remaining work is excluding the Conventional Facilities (CF) and Neutron Scattering Systems (NSS) projects (CF cost risk within limits is assumed to be a contribution of the Host Countries and the NSS budget is ring-fenced with risk and contingency managed within the fixed budget). The current contingency budget, excluding CF & NSS, is 20.9% of the remaining work budgeted. The current risk exposure is calculated at 10.9%.

The drop in calculated risk exposure the past months is a consequence of successful mitigation to limit the cost impact in the event of delay in receiving permit from SSM. The commissioning of the ion source is therefore no longer in danger following the anticipated time schedule for SSM Reviews. Calculated cost exposure does not include risk of delays in external delivery milestones and/or funding for initial operations.

The funding for transition into operation is becoming an urgent issue. The risk for a gap of at least 23 M€ in 2019 needs to be managed within the coming months.



Change Log – ESS Total Project Budget Baseline (k€) – 31st December 2016

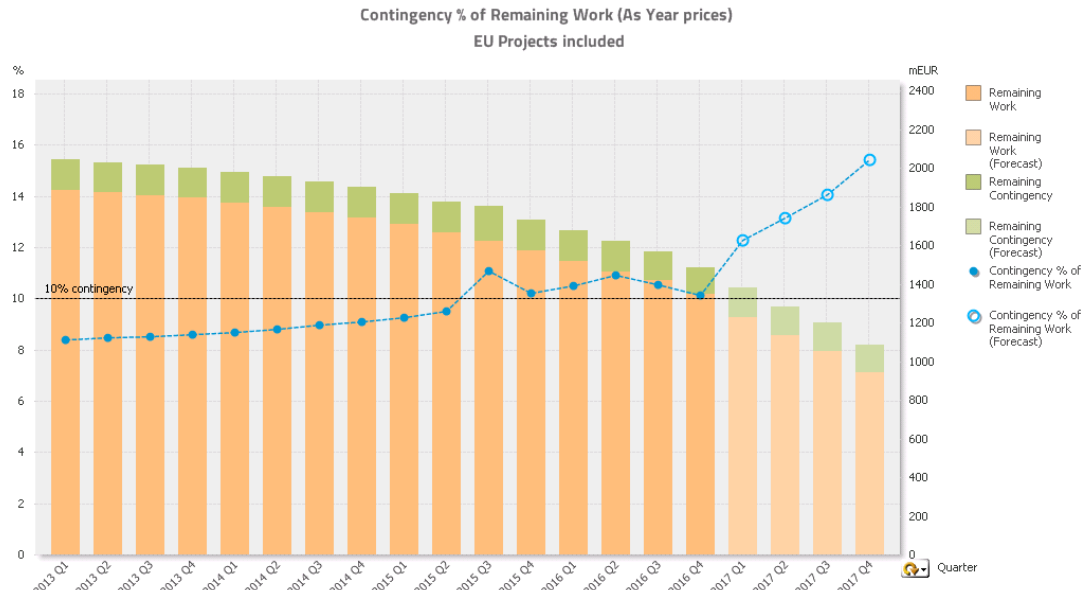
The table below lists the already approved allocations of contingency in *Grey* (part of the 2016 and 2017 budget approval) and the new proposed allocations of contingency in *Blue*.

CR No.	Project	Description	Total Amount (kEuro)
CR0001	ESS Project (ES&H)	Increased fees to be paid to Swedish radiation regulatory authorities.	-840
CR0018	Target	Change to improved design of the moderator/reflectors in the Target.	-4 040
CR0019	ICS	Oxygen depletion and radiation monitoring for personnel safety system.	-2 000
CR0026	Target	Addition of an ESS chip irradiation (ECHIR) beam line.	-125
CR0029	Accelerator	Cryomodule to Cryogenic Distribution System Connections.	-750
CR0030	Accelerator	Lund Cryomodule Test Stand Activities (WP10).	-1 310
CR0031	ICS	Budget transfer from Accelerator to ICS for IPNO work.	-2 500
CR0032	Accelerator	Accelerator Cryoplant cost savings based on actual contract award.	+8 350
CR0033	Accelerator	Radio Frequency (RF) integration laboratory work.	-500
CR0041	Design & Engineering	Increased scope for development, integration and implementation of Product Lifecycle Management (PLM) system.	-4 000
CR0044	ESS Project (Insurance)	Insurance costs covering risks associated with installation of equipment.	-1 600
CR0040	ESS Project (ES&H)	Additional cost for rad waste licensing (200 k€). Scope originally planned for Initial Operations in 2017-2018 (1000 k€).	-1 200

CR No.	Project	Description	Total Amount (kEuro)
CR0042	ESS Project Support (Communication)	Increased scope and level-of-effort for supporting partners and coordinating in-kind.	-594
CR0045	ESS Project (Administration)	Orphan scope - Rent for DMSC office in Copenhagen during construction phase.	-1 332
CR0043	ESS Project (Technical/Admi)	Increased scope and level-of-effort to cover establishment of and Internal Auditor, Operations Coordinator, and Technical Coordinators. Functions recommended by the annual reviews.	-2 304
CR0046	ESS Project (Administration)	Increased scope for Project Support & Administration due to ERIC VAT-administration and Legal support for in-kind agreements and IPR-issues.	-692
CR0057	Accelerator	Cryogenics savings on TICP procurement	1 244
CR0026	CF	CF part of Target ECHIR beam line	-125
CR0058	Accelerator	Power converters	-686
CR0059	Accelerator	Power converters elettra in-kind contribution contract	-150
CR0060	Accelerator	Halogen free cables	-555
CR0052	Accelerator	Elliptical cavities and cryomodules	-1 097
CR0064	Target	Target Cryoplant cost savings	2 700
CR0067	Accelerator	Vacuum	-6 000
CR0004	CF	Dogleg & Beam dump	-1 000
CR0006	CF	Grounding System Accelerator buildings	-210
CR0007	CF	15.6 600V Transformers	-100
CR0008	CF	Stubs (6) between Tunnel and Test Facility	-300
CR0009	CF	Relocation of Technical Labs	5 000
CR0010	CF	Ventilation of CRYO Compressor Building	-120
CR0012	CF	Changed layout of HEBT Loading Bay	-1 044
CR0013	CF	Enlargement of the CUB	-1 000
CR0014	CF	Temporary Shaft Front End Building	-330
CR0015	CF	Active cells layout and waste package logistics	170
CR0016	CF	Chamfers in Stubs	-50
CR0017	CF	Status monitoring for low voltage switchgear	-140
CR0020	CF	Doors in cold box hall	-38
CR0021	CF	CUB, fibers	-923
CR0028	CF	Sprinklers in G01	-305
CR0036 *	CF	Cooling in klystron gallery	-2 460
CR0037	CF	Increased power and cooling to G04, moderator configuration	-1 300
CR0038	CF	EMC grid	-49
CR0048	CF	House vacuum for D&E building	-386
CR0049	CF	Changes in sample environment	-224
CR0051	CF	Nonmagnetic floor in D03	-238
CR0065	Accelerator	AD cryo warm piping	-1 800

CR No.	Project	Description	Total Amount (kEuro)
CR0070	Target	Beam drift room	-2 280
CR0070	CF	Beam drift room	-1 003
CR0071	CF	Rad Waste Handling Equipment (RWHE) and complementary infrastructure	-1 500
CR0072	ESS Project (Administration)	Budget 2016-2019 for the Logistics function	-2 090
CR0073	Accelerator	Commissioning Dump from CERN	-92
CR0074	CF	A2T shielding concrete	-2 330
CR0075	CF	Update of heat loads for racks in the G02 RF gallery	-180
CR0076	ESS Project (Administration)	Staffing of Quality Division(QD)	-500
CR0077	Target	Coverage for wrongly coded staff/contracted staff in P6 Target Project Plan	-2 000
CR0026	Target	NNbar	-250
CR0079	ESS Project (Administration)	Contract with SKB for final disposal of Radioactive Waste/Material	-1 270
CR0082	CF	Structural Shielding	-4 310
CR0083	CF	Increased Campus design cost due to single offices	-168
CR0088	Target	Target Div New Milestones and cost due to new access dates	-8 886
CR0093	ICS	ICS Div New Milestones and cost due to new access dates	1 379
CR0095	ESS Project (Administration)	Change PS&A project End Of Construction date to 2018-12-31	16 238
CR0096	ESS Project (Administration)	Change Project 61 project End Of Construction date to 181231	2 265
CR0097	ESS Project (Administration)	Extended Amount of Staff for ES&H Division	-880
CR0098	Accelerator	Change phase reference line design and cost	-260
CR0099	ESS Project (Administration)	Cash Facility - the loan to bridge the liquidity gap 2016-2017	-3 236

After the proposed allocation of 17 740 k€ and a proposed return of 19 882 k€ to the contingency, the total remaining contingency is 136 644 k€ ("As Year" budget) which is approximately 10.1% of remaining work.



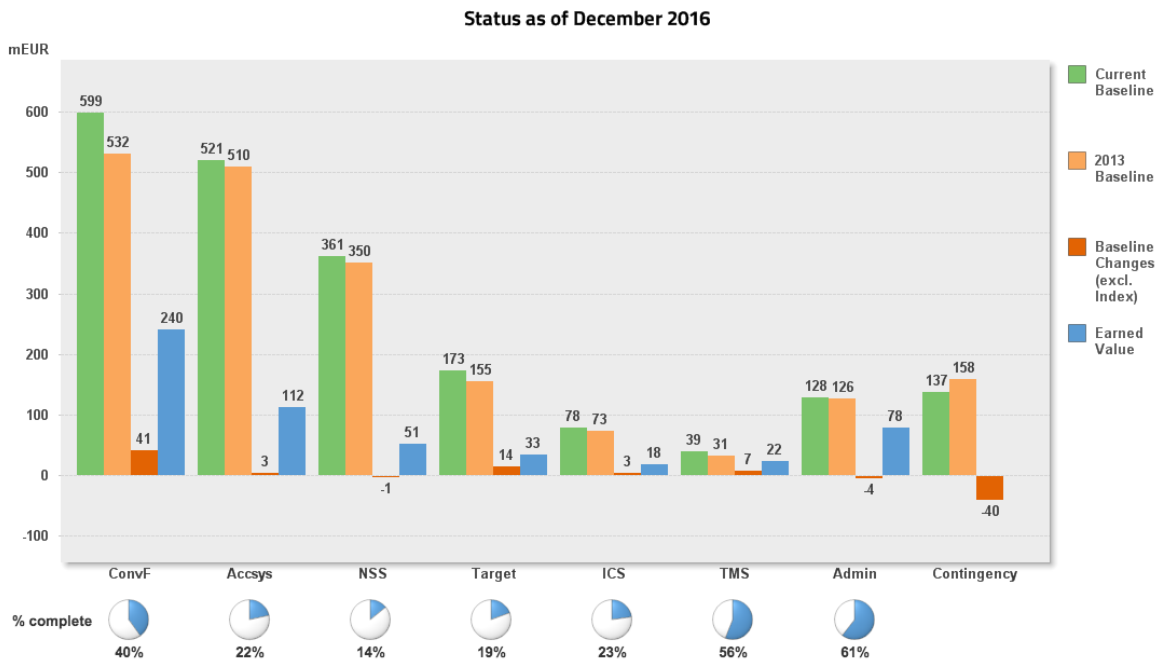
At the end of December 2016, the Contingency % of remaining Work is 10.1% (goal is 10% or more)

The graph above compares contingency with the cost of the remaining work. The goal is to reach a contingency above 10% and currently the level is 10.1%. It should be noted that changes amounting to +3 200 k€ has been approved by CCB and are awaiting final approval from the ESS DG. This will increase the contingency amount 140 but when taking into account the forecasted allocation of the contingency (approximately 145 M€) the remaining contingency level will be approximately 1.2% which is much below the goal of 10%.

A value engineering exercise has been initiated in order to increase the level of contingency.

Level 2 Budget Status

The chart below provides the current Level-2 budgets, including changes and indexation. Also shown is the percentage complete per project based on the Earned Value Measurement data.



Annex 2: In-kind Status

The tenth In-Kind Review Committee (IKRC) on October 4-5, endorsed 38 Technical Annexes (TAs) and their corresponding In-Kind agreements, which were subsequently approved by the ESS Council in December. That raised the number of approved TAs substantially, from 13 to 51, with an associated value rising from 26.2 M€ to 167 M€, a major achievement relative In-Kind contributions at ESS. Additionally, at the eleventh IKRC held at the DMSC premises in Copenhagen in December, a further 16 TAs were endorsed, worth over 20 M€.

The total value of TAs endorsed by the IKRC, but not yet approved by Council, is 103 M€. Together with 3 Heads of Agreement, 15 Collaboration Agreements with host countries, and already approved TAs, over 303 M€ of In-Kind work is now covered by some form of agreement. There are 97 more TAs worth 353 M€ that have been identified and are in various levels of maturity. Currently one IKC has submitted a Final Report for completion of the work package and over 20 are in the pipeline for final approval as the work was completed before the end of 2016.

There are currently on-going discussions regarding the handling of VAT between the BMBF (German Ministry of Science) and the German institutes. Work is also being done in Italy to finalise IKC agreements. There are on-going talks with the UK over the In-Kind conditions. A solution has been found for a funding mechanism in Switzerland meaning that funds should be available at Swiss institutes allowing major procurements to be made.

The BrightnESS project held an In-Kind Best Practice workshop in November 2016, that explored engineering requirements and constraints. This will be followed by an Installation workshop in Qtr2/3 2017. Development of a software tool, also funded by BrightnESS, to manage IKCs is progressing and planned to be launched by the end of February 2017.

Table 1 below shows the current status of IK across the 4 projects. Table 2 shows the difference in the figures from the last quarter (Qtr. 3 2016). The substantial increase in Agreed (141 M€) is clearly evident. The trend in a decreased overall In-Kind total is continued with a reduction of 5.5 M€ from the previous quarter as work is being self-performed rather than executed as In-Kind to protect the schedule.

Table 1 - Current IK totals per Project for Qtr 4 2016

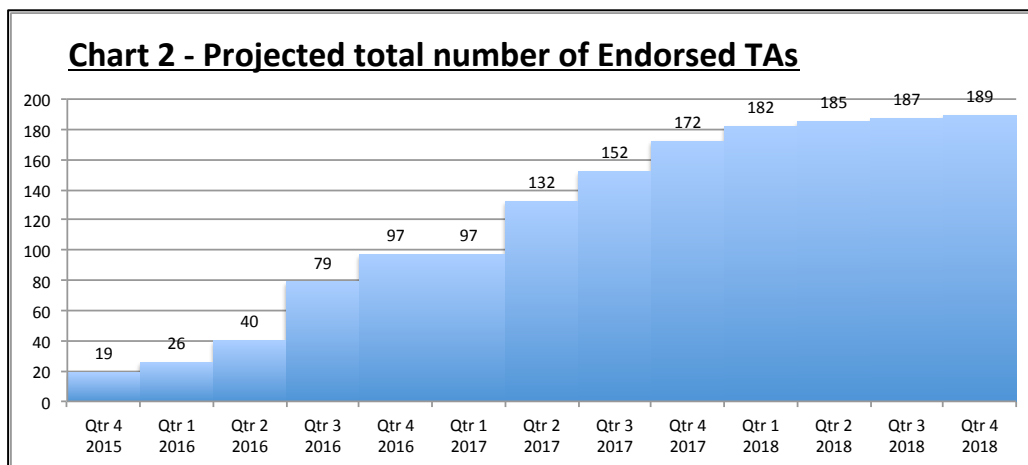
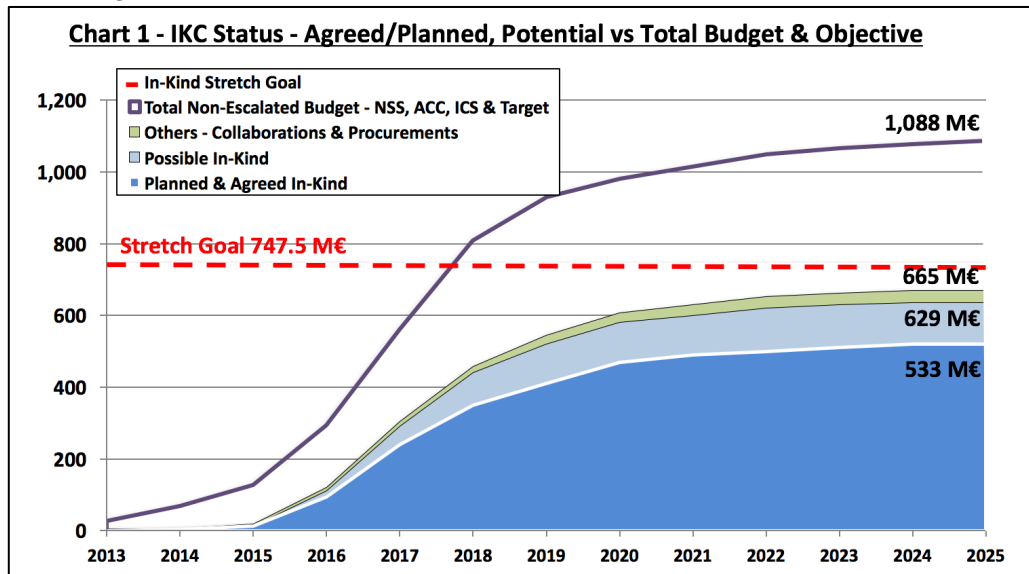
PROJECT	Values kEUR										
	Qtr 4 2016 IN-KIND REPORTING										
	% IKC POTENTIAL			Potential	Others*	Agreed, Planned, Potential & Others	In-Kind Goal	Not In-Kind**	TOTAL***		
% AGREED & PLANNED											
	Agreed	Planned	Planned & Agreed								
11 Accelerator Systems	141,756	129,519	271,275	53.2%	43,355	15,861	330,490	64.8%	75%	179,510	510,000
12 Target Station	18,278	37,951	56,229	36.3%	21,818	16,980	95,027	61.3%	65%	59,973	155,000
13 Neutron Scattering Systems	2,288	187,830	190,118	54.3%	29,891	2,448	222,457	63.6%	65%	127,543	350,000
14 Integrated Control Systems	4,861	10,357	15,218	20.8%	1,256	450	16,924	23.2%	50%	56,076	73,000
Total - All 4 projects	167,183	365,657	532,840	49.0%	96,320	35,738	664,899	61.1%		423,101	1,088,000
Total - All ESS				28.9%				36.1%	747,250		1,843,000

*Collaborations & Procurements/Cash as In-Kind, **Calculated compared to 2013 Budget, ***2013 Budget Totals

Table 2- Difference in IK totals per Project between Qtr 3 2016 & Qtr 4 2016

PROJECT	Values kEUR										
	CHANGE - % IKC POTENTIAL										
	CHANGE - % AGREED & PLANNED			Potential	Others*	Agreed, Planned, Potential & Others	In-Kind Goal	Not In-Kind			
Agreed	Planned	Planned & Agreed									
11 Accelerator Systems	122,529	-120,372	2,157	0.4%	-6,686	0	-4,529	-0.9%	0%	4,529	
12 Target Station	12,688	-13,918	-1,230	-0.8%	-1,344	1,255	-1,319	-0.9%	0%	1,319	
13 Neutron Scattering Systems	1,634	10,312	11,946	3.4%	-12,320	0	-374	-0.1%	0%	374	
14 Integrated Control Systems	4,047	-4,358	-311	-0.4%	1,009	0	698	1.0%	0%	-698	
Total Change - All 4 projects	140,898	-128,336	12,562	1.1%	-19,341	1,255	-5,524	-0.5%		5,524	

Chart 1 shows the planned/agreed and potential IK budget profile during ESS construction years with the In-Kind Stretch Goal as a reference. Chart 2 shows the current predicted dates for TAs being endorsed.



ESS Project Status

Project budgets and In-Kind Goals are based on the original Cost Book values from 2013 and do not include escalation. TAs approved refers to TAs receiving approval at the ESS ERIC Council whereas endorsed refers to endorsement at the IKRC (but without Council approval yet).

Accelerator				
510 M€ Budget	75% (383 M€) In-Kind Goal	22 TAs approved (141.8 M€) 9 TAs endorsed (66.5 M€) 2 HoAs signed (15.1 M€) 7 Collaborations signed (15.8 M€)	8 TAs in Preparation (63.0 M€)* 28.8 M€ of further In-Kind work identified	27.7 M€ EV <i>(includes work on unapproved TAs and HoAs)</i> 36.5 M€ PV <i>(includes work on unapproved TAs and HoAs)</i>

* Excludes TAs with HoAs

Accelerator: For IK partners the main focus is on progress of the technical work and preparation of remaining Technical annexes. The total value of Technical annexes signed, endorsed and planned represents 52% of the total accelerator budget.

The Accelerator IK contract work during Q4 has progressed as expected. During the last period 6 additional TAs have been presented and endorsed at the IKRC. Today the remaining work is focusing on the finalization of all open TAs. The remaining TAs are expected to be presented latest at by the twelfth IKRC in May 2017.

With most IK partners the focus has changed from engineering efforts to prototyping, constructions of components, manufacturing verifications and installation planning. The Accelerator is vulnerable to delays arising from the IK partners. It is important to receive early warnings of potential slippage and delays in order to implement mitigation and take necessary measures to be able to meet the overall project schedule.

Schedule and progress are major considerations and it is clear that ESS will have to execute some work packages as procurements due to the lack of an in-kind partner. The remaining work packages in need of partner mainly consist of large commercial items such as RF sources and power supplies. The potential in-kind without any identified partner have a total value of 65 M€.

Target				
155 M€ Budget	65% (101 M€) In-Kind Goal	4 TAs approved (18.3 M€) 5 TAs endorsed 16.6 M€)	5 TAs in preparation (21.3 M€)*	5.65 M€ EV <i>(includes work on unapproved TAs and HoAs)</i>
	61% (95 M€) forecasted In-Kind	1 HoAs signed (0.5 M€) 1 Collaboration signed (0.2 M€) 3 Procurements (16.8 M€)	21.3 M€ of further In-Kind work identified	7.53 M€ PV <i>(includes work on unapproved TAs and HoAs)</i>

* Excludes TAs with HoAs

Target: No technical annexes from the Target Sub-Project were brought to the IKRC for endorsement this quarter. Target now has ten signed technical annexes (including one collaboration agreement) totaling 35.1 M€ in value. In Target, there have been issues related to tracking earned value of some IK partners in our project plan. We are working with these partners to resolve this issue. This past quarter saw the first delivery to site by an IK partner for all of ESS: ESS-Bilbao delivered the tuning beam dump shield blocks, which were installed in December. As the first IK delivery, there were many lessons learned related to installation planning, logistics, receipt inspection, and ownership transfer. We are planning to use this and future deliveries to continuously improve our procedures related to receiving and installing hardware delivered by our IK partners.

Integrated Control Systems				
73 M€ Budget	50% (36.5 M€) In-Kind Goal	9 TAs approved (4.9 M€) 3 TAs endorsed (7.6 M€) 3 Collaborations signed (0.45 M€)	4 TAs In Preparation (2.8 M€)	0.74 M€ EV <i>(includes work on unapproved TAs and HoAs)</i>
	23% (16.9 M€) forecasted In-Kind		1.15 M€ of further In-Kind work identified	1.57 M€ PV <i>(includes work on unapproved TAs and HoAs)</i>

* Excludes TAs with HoAs

Integrated Control Systems: An In-kind manager, responsible for the overall ICS in-kind portfolio, has started in November 2016. This will greatly enhance the coordination and project management of the ICS in-kind projects. All of the eight projects that were endorsed

by the IKRC 10 have been started and are executing according to plan. One new in-kind agreement, with ESS Bilbao, has been endorsed by the In-Kind Review Committee. Some ongoing negotiations are expected to develop into signed and endorsed agreements during the first half of 2017, examples are with STFC, CNRS/IPNO, Tallinn Technical University and UJF Rez. ICS continues to improve the systematic initiation of new in-kind activities, specifically in the area of software development.

Neutron Scattering Systems				
350 M€ Budget	65% (228 M€) In-Kind Goal	16 TAs approved (2.3 M€) 29 TAs endorsed (12 M€)	28 TAs in preparation (150.2 M€)	4.60 M€ EV <i>(includes work on unapproved TAs and HoAs)</i>
	64% (222 M€) forecasted as In-Kind	5 Collaborations signed (0.67 M€) 8 Procurements (1.8 M€)	55 M€ of further In-Kind work identified	9.24 M€ PV <i>(includes work on unapproved TAs and HoAs)</i>

* Excludes TAs with HoAs

Neutron Scattering Systems: The year 2016 ended according to plan for NSS, with all the remaining 8 instruments completing Scope Setting and receiving a cost book value. In total NSS has assigned a cost book value of 200 M€ for 15 instruments, with in-kind participation at the level of 97%.

Tollgate 2 meetings commenced in November and are scheduled for completion in Q2 2017, which means that most of the effort for the coming months from the IK perspective will be focused on preparing the next set of Technical Annexes, covering the Instrument Projects from Phase 2 onwards.

The Bunker Project, managed in-house, made a lot of progress during the last quarter of 2016, bringing together the mechanical and the neutronics aspects in preparation for the Preliminary Design Review. The PDR, on December 15th and 16th, was successful, receiving a recommendation to proceed into detailed design with constructive feedback from the panel.

The In-Kind Review Committee endorsed eleven NSS work packages during their 11th meeting on December 13th, two for Instrument Concepts, one for the Detector Systems, one for Motion Control and Automation, six for the Phase 1 of the instruments and one for the NMX construction project.

Annex 3: Major Milestones

The following table presents the status of Project Major Milestones as of September 2016.

Milestone	Baseline	Actual/ Forecast
SSM 2nd licence & first Commissioning stage, application submitted (ADMIN)	02-May-2016	4 May 2016
Thales and Toshiba and CPI Klystron Prototypes Delivered (ACCSYS)	01-Jun-2016	18 Nov 2016
Timing System components for Accelerator ready for production (ICS)	30-Sep-2016	30 Sep 2016
All Scope & Cost setting meetings for the construction phase instruments performed (NSS)	31-Oct-2016	31 Oct 2016
Decision proposal for construction phase instruments presented to ERIC council (NSS)	16-Dec-2016	16 Dec 2016
LEVEL1.1G.ACCSYS.WP04.WP05.Spoke & MB CM production launched	23-Dec-2016	20 Jan 2017
SSM 2nd license & first Commissioning stage approved (ADMIN)	01-Mar-2017	
Temporary Control room operational (ICS)	31-Mar-2017	
Full Access to Cryo-Compressor Building G04 (CONVFC)	01-May-2017	
Full access CUB H01 PRELIMINARY (CONVF)	02-May-2017	25 Oct 2019
Full Access to Test Stand, Coldbox G02 (Sectional) (CONVF)	02-May-2017	
Full Access to Linac Tunnel & Front End Bldg G01 level 90 (CONVF)	02-May-2017	
Ready for installation 1st DTL (DTL4) (ACCSYS)	26-Oct-2017	5 Mar 2018
Controls ready for Integrated testing ISrc - LEBT (ICS)	30-Nov-2017	20 Nov 2017
Ready for Installation - Bulk Shielding Below Base Plate (TARGET)	07-Dec-2017	28-Feb-2018
Ready for ESS Readiness Review (1) for Ion Source and LEBT (ADMIN)	01-Jan-2018	
Delivery on Site - Monolith Vessel (TARGET)	08-Feb-2018	26 Feb 2018
SSM 3rd License & Second Commissioning Stage, application submitted (ADMIN)	01-Mar-2018	
Ready to start assembly of Bunker (NSS)	29-Mar-2018	21 Jan 2019
Controls ready for Integrated testing ISrc - LEBT - RFQ - MEBT (ICS)	03-Apr-2018	
Full Access to D04 Lab 2 (CONVF)	31-May-2018	21 Aug 2019
Full Access to E04 Lab 3B (CONVF)	31-May-2018	26 Apr 2019
Ready for ESS Readiness Review (2) for RFQ and LEBT(ADMIN)	02-Jul-2018	
Start RFQ commissioning (ACCSYS)	16-Jul-2018	7 Nov 2018
Ready for ESS Readiness Review (3) for DTL 1 (ADMIN)	01-Oct-2018	
Full Access to Experimental Hall D01 (CONVFC)	24-Oct-2018	30 Sep 2020
Installation Complete - LH2 System (TARGET)	14-Jan-2019	
SSM 3rd License & Second Commissioning Stage, application approved (ADMIN)	01-Feb-2019	
Ready for ESS Readiness Review (4) for DTL 2-4 (ADMIN)	11-Feb-2019	
Ready for ESS Readiness Review (5) for DTL 5 (ADMIN)	18-Mar-2019	
Main Control room operational (ICS)	03-Jun-2019	
Ready for ESS Readiness Review (6) for A2T, Target and Instrument Bunker (ADMIN)	17-Jun-2019	
WP3 System Test complete - Cryogenic Cooling Systems (Helium + LH2)	3 Feb 2020	3 Feb 2020
Bunker ready for beam (and Readiness Review 6) (NSS)	15 Oct 2020	
1-11 High Beta Cryo Modules installed (ACCSYS)	02-Jun-2021	
12-21 High Beta Cryo Modules installed (ACCSYS)	04-Jul-2022	
First call for experiments in full user programme (NSS)	13-Jan-2023	

Annex 4: External Grants Overview

Funding Programme	Project		Total Budget	ESS Budget (in EUR)	Funding rate	Total ESS Cash Income
FP7	NMI3 (about to be closed in ESS accounts)		€ 13 349 994,30	€ 132 160,00	75%	€ 99 120,00
	EuCARD-2		€ 7 979 700,00	€ 198 046,40	46%	€ 90 646,00
Erasmus+	NPAP		€ 397 345,00	€ 25 840,00	100%	€ 25 840,00
Interreg ÖKS	ESS and MAX IV	WP1: Research and Education	€ 18 976 308,00	€ 649 270,00	50%	€ 324 635,00
		WP5: International Attractiveness		€ 11 500,00	0%	€ 0,00
		WP3: Coming to the Öresund		€ 18 975,00	0%	€ 0,00
Vetenskapsrådet	Statistical Methods for Energy Determination in Neutron Detector Systems		SEK 833 333,00	€ 71 500,00 (paid in SEK / conversion rate 1 SEK to 0,10 EUR)	100%	€ 71 500,00
	Computational methods for analyzing self-assembly with time resolved SANS/SAXS		€ 1 000 000,00	€ 315 000,00	100%	€ 315 000,00
	A New Method to Model the Dynamic Structure Factor by Molecular Dynamics Simulations		€ 80 000,00	€ 35 000,00	100%	€ 35 000,00
Vetenskapsrådet / Röntgen Ångström Cluster	TT-SAS		€ 1 200 000,00	€ 117 500,00	100%	€ 117 500,00
COST	EuroNuNet		€ 520 000,00	Not yet announced		
Horizon 2020/ Research Infrastructures	RAMP		€ 3 392 000,00	€ 516 000,00	100%	€ 516 000,00
	ARIES		€ 10 000 000,00	€ 82 800,00	78 %	€ 64 800,00
	ACCELERATE		€ 3 325 755,00	€ 486 900,00	100%	€ 486 900,00
	EOSCpilot		€ 9 953 067,50	€ 77 625,00	100%	€ 77 625,00
	iNext		€ 9 999 534,25	€ 47 000,00	100%	€ 47 000,00
	CREMLIN		€ 1 696 250,00	€ 50 625,00	100%	€ 50 625,00
	SINE 2020		€ 12 080 867,00	€ 1 595 625,00	100%	€ 1 595 625,00
	BrightnESS		€ 19 941 964,00	€ 9 889 485,00	100%	€ 9 889 485,00
SoNDe		€ 3 800 932,00	€ 201 250,00	100%	€ 201 250,00	
TOTAL BUDGET				€ 14 540 101,40		€ 14 026 551,00

Annex 5: Contract awards

The following table provides an overview of contract awards >200.000 EUR completed in Q4. These contract awards correspond to procurement processes published on the ESS website, following procedures defined in the ESS ERIC Procurement Rules. In order to support the principle of transparency, ESS has been publishing these contract award notices on the ESS website since 1 October 2015. They are published on a quarterly basis, based on the month of final contract signature.

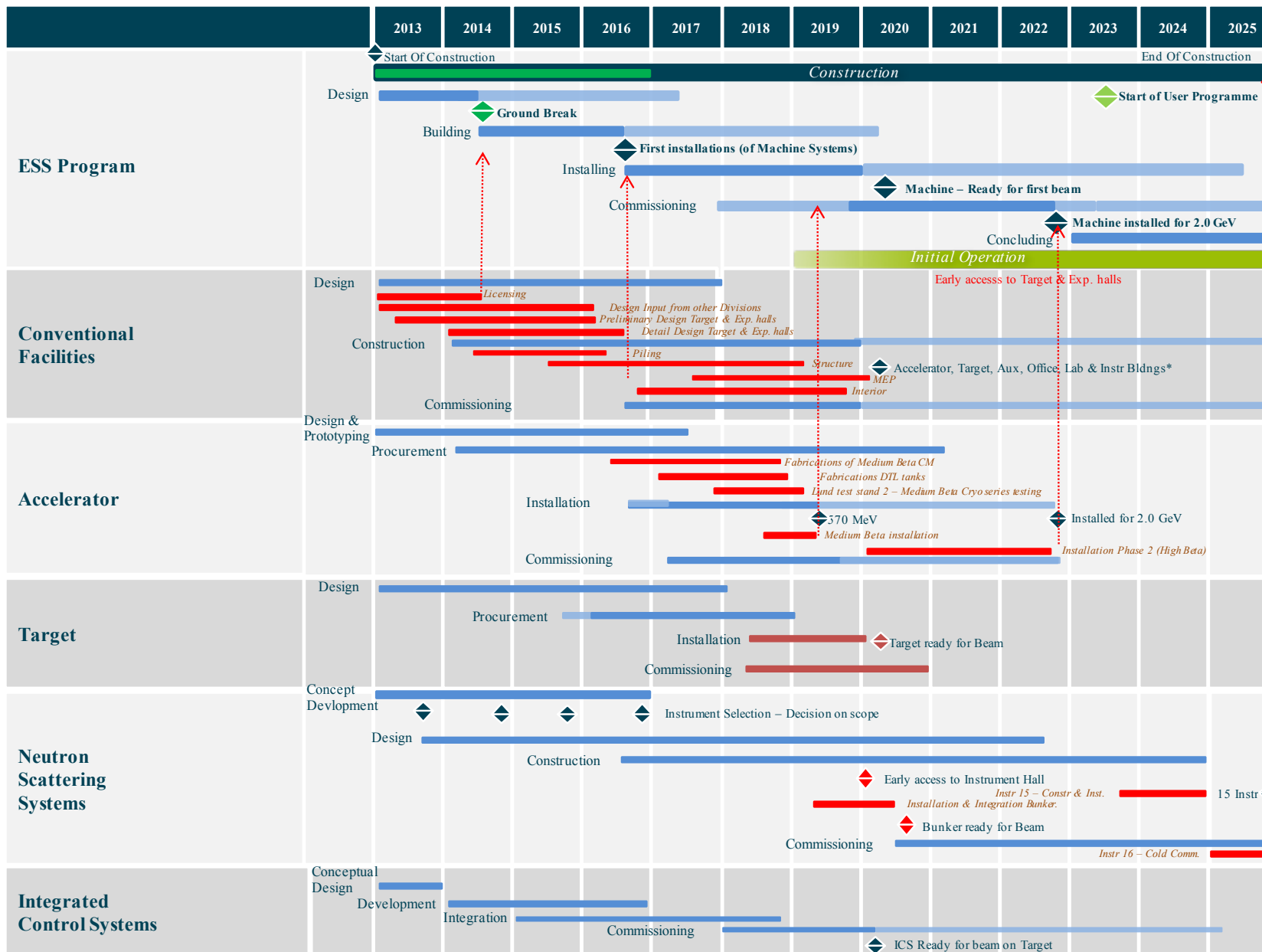
Note: there were no contract awards >200.000 EUR completed in Q4 2016. However, the following <200.000 were completed.

Month	ESS Tender Reference	Description	Name of Company	Award Value	Duration
October	ITT-2016-120402001-001	Manufacturing and Delivery of Extra Embedded Shielding Material	East Metal Trade a/s (Denmark)	178 260,21 EUR	N/A
	OCT-2016-120502001-001	Design, Manufacturing and Delivery of Waste Water Vessels	ÅF-Industry AB (Sweden)	1 799 000,00 SEK	N/A
November	OCT-2016-140402001-002	Embedded systems engineer	OTIF AB	108 000 EUR	6 months

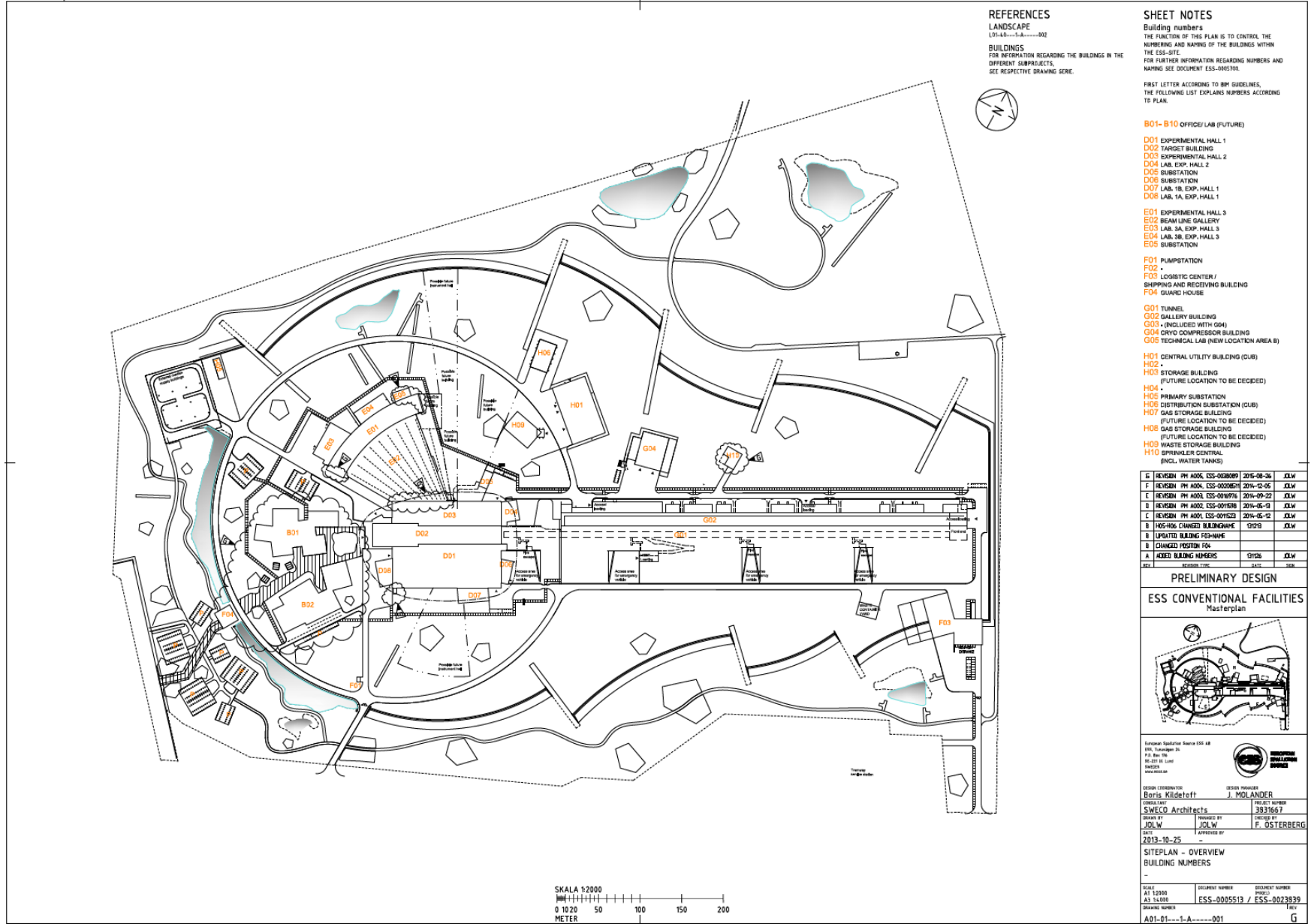
Annex 6: European Spallation Source Construction Project

<p>European Spallation Source ERIC The world's most powerful neutron source for life sciences, energy, environmental technology, cultural heritage and fundamental physics</p> <p>TYPE: Single site</p> <p>MEMBER COUNTRIES</p> <table> <tr> <td>Czech Republic</td> <td>Denmark</td> </tr> <tr> <td>Estonia</td> <td>France</td> </tr> <tr> <td>Germany</td> <td>Hungary</td> </tr> <tr> <td>Italy</td> <td>Norway</td> </tr> <tr> <td>Poland</td> <td>Sweden</td> </tr> <tr> <td>Switzerland</td> <td>United Kingdom</td> </tr> </table> <p>OBSERVER COUNTRIES</p> <table> <tr> <td>Belgium</td> <td>The Netherlands</td> </tr> <tr> <td>Spain</td> <td></td> </tr> </table> <p>TIMELINE</p> <ul style="list-style-type: none"> • ESFRI Roadmap entry: 2006 • Preparation phase: 2008-2010 • Pre-construction phase: 2010-2012 • Construction phase: 2013-2025 • Operation phase: 2019 - • Legal entity establishment: ERIC, 2015 <p>ESTIMATED COSTS</p> <ul style="list-style-type: none"> • Capital value: 1.843 M€ • Operation: 140 M€/year <p>HEADQUARTERS European Spallation Source ESS ERIC P.O Box 176, SE-221 00 Lund</p> <p>WEB SITE http://www.europeanspallationsource.se</p>	Czech Republic	Denmark	Estonia	France	Germany	Hungary	Italy	Norway	Poland	Sweden	Switzerland	United Kingdom	Belgium	The Netherlands	Spain		<p>DESCRIPTION The European Spallation Source is a research infrastructure committed to the goal of building and operating the world's leading facility for research using neutrons. The ESS will deliver a neutron peak brightness at least 30 times greater than the current state-of-the-art source, thus providing the much-desired transformative capabilities for interdisciplinary research in the physical and life sciences.</p> <p>ESS officially became a European Research Infrastructure Consortium (ERIC) in October 2015. The facility is under construction in Lund (Sweden), while the ESS Data Management and Software Centre (DMSC) will be located in Copenhagen (Denmark). The foreseen milestones include the beginning of the first on-site Accelerator installations (Sep 2016), facility ready for Accelerator beam on the Target (Dec 2019), the first call for user proposals (2022), the Machine installed for 2.0 GeV performance (Dec 2022), start user programme (2023), and the completion of the 16 construction phase instruments (Dec 2025).</p> <p>ACTIVITY A total of 16 instruments will be built during the construction phase to serve the neutron user community, with more instruments built during operations. The suite of ESS instruments will gain 10-100 times over current performance, enabling neutron methods to study real-world samples under real-world conditions. The Neutron Scattering Systems (NSS) Project at ESS is responsible for the development and coordination of state-of-the-art instrument concepts for ESS, in collaboration with international partners. Around 40 concepts were developed by ESS scientists and partners. Of those, 16 concepts have now been selected and approved by the ESS Steering Committee for construction within the NSS project. Our partners from the member countries will lead the construction of most of the instruments, and many will benefit from contributions from two or more participating organisations. The NSS project is coordinating the construction and installation of these instruments, and the associated support systems (such as sample environments and data processing and analysis capabilities) to ensure the highest quality outcomes for the European Community. Selection of the additional six instruments will occur once construction of the initial suite of eight instruments, of the total sixteen instruments included in construction, is approaching completion.</p> <p>IMPACT ESS will be an attractive and environmentally sustainable large compound, including industrial and laboratory buildings, office space, and guest accommodation facilities, all housed within a significant architectural design that will make an impact on the world's stage. Even before the expected world-scale scientific impact can be realised with the operation phase, the construction of ESS will have a direct economic impact, by generating growth and jobs, advance development and fuel innovation potential in the Öresund region and across the EU. With ESS being built as a collaborative project, the growth effect will be shared between the Host Countries (Sweden and Denmark) and the ESS-ERIC partners. The realisation of ESS enables access to frontier technology, experienced technical and scientific staff, as well as unique production facilities and technologies, which would otherwise be unattainable. In addition, ESS will be a key instrument for addressing the Grand Challenges, through novel insights on matter at the molecular and atomic level, and applications to energy, carbon sequestration methods, and health issues at a biological level, as well as drug development and delivery strategies, plant water-uptake processes of relevance for agriculture, novel data storage materials, and more.</p>
Czech Republic	Denmark																
Estonia	France																
Germany	Hungary																
Italy	Norway																
Poland	Sweden																
Switzerland	United Kingdom																
Belgium	The Netherlands																
Spain																	

Project Milestone Schedule



Annex 7: Conventional Facilities building numbers



REFERENCES

LANDSCAPE
L01-A0...1-A...-002

BUILDINGS
FOR INFORMATION REGARDING THE BUILDINGS IN THE DIFFERENT SUBPROJECTS, SEE RESPECTIVE DRAWING SERIE.

SHEET NOTES

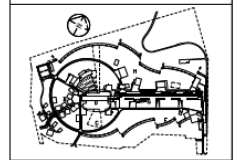
Building numbers
THE FUNCTION OF THIS PLAN IS TO CONTROL THE NUMBERING AND NAMING OF THE BUILDINGS WITHIN THE ESS-SITE.
FOR FURTHER INFORMATION REGARDING NUMBERS AND NAMING SEE DOCUMENT ESS-0005100.

FIRST LETTER ACCORDING TO BIM GUIDELINES, THE FOLLOWING LIST EXPLAINS NUMBERS ACCORDING TO PLAN.

- B01- B10 OFFICE/LAB (FUTURE)**
- D01** EXPERIMENTAL HALL 1
- D02** TARGET BUILDING
- D03** EXPERIMENTAL HALL 2
- D04** LAB. EXP. HALL 2
- D05** SUBSTATION
- D06** SUBSTATION
- D07** LAB. 1B, EXP. HALL 1
- D08** LAB. 1A, EXP. HALL 1
- E01** EXPERIMENTAL HALL 3
- E02** BEAM LINE GALLERY
- E03** LAB. 3A, EXP. HALL 3
- E04** LAB. 3B, EXP. HALL 3
- E05** SUBSTATION
- F01** PUMPSTATION
- F02**
- F03** LOGISTIC CENTER / SHIPPING AND RECEIVING BUILDING
- F04** GUARD HOUSE
- G01** TUNNEL
- G02** GALLERY BUILDING
- G03** (INCLUDED WITH G04)
- G04** CRYO COMPRESSOR BUILDING
- G05** TECHNICAL LAB (NEW LOCATION AREA B)
- H01** CENTRAL UTILITY BUILDING (CUB)
- H02**
- H03** STORAGE BUILDING (FUTURE LOCATION TO BE DECIDED)
- H04**
- H05** PRIMARY SUBSTATION
- H06** DISTRIBUTION SUBSTATION (CUB)
- H07** GAS STORAGE BUILDING (FUTURE LOCATION TO BE DECIDED)
- H08** GAS STORAGE BUILDING (FUTURE LOCATION TO BE DECIDED)
- H09** WASTE STORAGE BUILDING (INCL. WATER TANKS)
- H10** SPRINKLER CENTRAL (INCL. WATER TANKS)

E	REVISION	PH	NOV. ESS-003009	2015-08-26	JLW
F	REVISION	PH	NOV. ESS-003008	2016-02-05	JLW
E	REVISION	PH	NOV. ESS-003010	2016-09-22	JLW
D	REVISION	PH	NOV. ESS-003008	2016-06-03	JLW
E	REVISION	PH	NOV. ESS-003023	2016-05-12	JLW
B	H05-H06 CHANGED BUILDINGNAME		G019		JLW
B	UPDATED BUILDING FORMNAME				
B	CHANGED POSITION FOR				
A	ADDED BUILDING NUMBERS		D108		JLW
A1					

PRELIMINARY DESIGN
ESS CONVENTIONAL FACILITIES
Masterplan



European Spallation Source ESS AB			
ESS, Kungälvsvägen 48 P.O. Box 190 SE-221 87 Lund SWEDEN www.ess.eu			
DESIGN COORDINATOR	DESIGN MANAGER	PROJECT NUMBER	
Boris Kildetoff	J. MOLANDER	3831667	
CONSULTANT			
SWECO Architects			
DRAWN BY	DESIGNED BY	CHECKED BY	
JOLW	JOLW	F. ÖSTERBERG	
DATE	APPROVED BY		
2013-10-25			

SITEPLAN - OVERVIEW
BUILDING NUMBERS

SCALE	SECURITY NUMBER	SECURITY NUMBER
AT 1:5000	ESS-0005519 /	ESS-0023839
DRAWING NUMBER		REV
A01-01...1-A...-001		G

