
ESS Cost Book 2013

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The ESS Cost Book 2013 is an annex to the ESS Cost Report April 2013.

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1. INTRODUCTION

This ESS Cost Book, which is an annex to the ESS Cost Report and should be read as such, provides the cost for the construction of the ESS facility at a more detailed level than in the Cost Report. The Cost Book is still preliminary awaiting final approval.

The Cost Book contains the total cost for the construction of the ESS facility and for each project/area the cost is broken down into detailed packages for which:

- Name
- Start Date and End Date
- Short Description
- Cost Value
- Indication of In-Kind Potential (percentage of the cost value of the item)

is stated.

This version of the ESS Cost Book is for reference only and therefore it does not contain any cost values.

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2. SUMMARY

2.1 Construction cost

The Construction of ESS consists of the following items:

	Million Euros
Accelerator	
Target	
Neutron Scattering Systems	
Integrated Control System	
Conventional Facilities	
Energy	
Programme Support	
Administration and Line management	
<hr/>	
Total	

2.2 Assumptions

- Construction Phase only
- January 2013 cost level (i.e. cost to be escalated)
- VAT not included (deductible as today)
- Labour cost the same as during Pre-construction
- Euro assumed (no cost for hedging included)
- Not tax for energy included
- Leasing of office and lab building(s)
- Commissioning partly included in Construction and partly in Operations costs

2.3 Scope

2.3.1 Included

- Accelerator
 - capable of 5 MW etc.
- Target station
 - capable of 5 MW etc.
- Integrated Control System
 - for the whole facility
- Conventional Facilities
 - includes all buildings for the facility, except office and lab buildings which are constructed under an operational lease agreement
- 22 Instruments
 - includes neutron guides, development of new detector technology etc.
- Data Management Software Centre in Copenhagen
- Sustainable Research Centre - Responsible, Renewable & Recyclable.
- Administration and CEO office
- Programme Support functions

2.3.2 Not included

- Not included is investment in renewable energy sources (e.g. windmills)
- Upgrades and options not included

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3. ACCELERATOR

3.1 Introduction

The ESS accelerator is a linear proton accelerator consisting of a normal conducting front-end, followed by three families of superconducting cavities. The front end consists of an ion source, an RFQ, and four DTL tanks. The superconducting part has one section of double spoke cavities, one section of medium beta elliptical cavities, and a final section of high beta elliptical cavities. The accelerator baseline is presently undergoing a redesign to reduce cost. The details of the new baseline will be available in the third quarter 2013. It will consist of the same building blocks with the described normal conducting parts and superconducting cavity families, optimised for a more efficient use of the RF power generated in the sources and higher gradients and current. The final energy will be in the range of 2.1 GeV, with the current approaching 65 mA.

3.2 Scope

3.2.1 Included

The accelerator system construction project (ACCSYS) includes the management of the project, the redesign effort, detailed design of all sub systems, prototyping and evaluation of prototypes and the construction of the accelerator components. It also includes the testing, installation and commissioning of the accelerator and all its sub-systems. The accelerator project delivers cryogenics and vacuum design, construction and installation for all of ESS.

3.2.2 Excluded

The early design, safety, and reliability analyses and requirements for Machine Protection System are at present excluded from the project. WP planning for safety, reliability, and machine protection system is ongoing, and could at least partly be supported by in-kind contributors.

3.3 Major milestones

Order of first prototypes for RF sources	Q4 2013
Test of NC linac and cryomodule prototypes	2014-2015
Access to buildings	2017
Commissioning of the linac	2019

3.4 Accelerator Cost

Table 1 Accelerator cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS	Accelerator Systems	31 Dec 2012	28 Dec 2022	The ACCSYS project WBS is based on the October 2012 Technical Design Report for the ESS Linac		75%	M. Lindroos
ACCSYS.1	Management	2 Jan 2013	28 Dec 2022	This work package will lead the execution of the accelerator construction project. It assures contract management, system engineering, planning and communication for the project.		0%	
ACCSYS.1.2	Contract Management	1 Mar 2013	28 Dec 2022	This work unit assures the technical support for the contracts. It includes the writing of the contract, the oversight of the deliverables, the procurements, the testing and delivery of the deliverables specified in the contracts		0%	
ACCSYS.1.1	Management Accelerator	2 Jan 2013	23 Dec 2019	This work unit assures the execution of the project.		0%	
ACCSYS.1.3	System Engineering	2 Jan 2013	20 Dec 2019	This work unit assure the writing and tracking of requirements, the writing and tracking interfaces and leads the reviews and validation process.		0%	
ACCSYS.1.5	Communications	2 Jan 2013	12 Dec 2019	This work unit assure the support for the Collaboration meetings, Project meetings and Site visits.		0%	
ACCSYS.1.6	Operations during commissioning	2 May 2017	16 Aug 2019	This work unit holds the resource plan for the operators needed during the installation and commissioning of the accelerator.		0%	
ACCSYS.2	Accelerator Physics	2 Jan 2013	4 Feb 2021	This work package covers the ESS accelerator-physics tasks and operations.		0%	
ACCSYS.2.1	Accelerator Physics Management	2 Jan 2013	23 Dec 2019	This work unit holds the planning of accelerator-physics work, staff management and other administrative duties within the project organisation.		0%	
ACCSYS.2.2	Beam Dynamics	2 Jan 2013	20 Dec 2019	This work unit is a continuation and refinement of the work done during Accelerator Design Update. Tools for modelling of the beam must be developed, and an excellent theoretical understanding of relevant beam-physics issues must be acquired.		75%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.2.3	Configuration and Integration	2 Jan 2014	5 Dec 2018	This work unit holds the maintenance of the BLED database with the one-dimensional configuration of the linac with respect to active components		0%	
ACCSYS.2.4	Commissioning and Operations Management	2 Jan 2013	23 Dec 2019	The accelerator-physics group will lead the commissioning of, first, the normal-conducting and the superconducting linac at low beam power, and finally the entire accelerator to the target at high power.		0%	
ACCSYS.2.5	Control Room Environment	2 Jan 2014	23 Dec 2019	During the Construction Phase, the software environment in the control room will be prepared. This includes constructing an on-line model of the linac that allows the behaviour of the beam to be derived from hardware settings.		0%	
ACCSYS.2.6	Upgrade Studies	1 Jan 2016	31 Dec 2019	Upgrade scenarios are expected to evolve continuously during the ESS project as science at ESS develops and new technologies become available.		100%	
ACCSYS.2.7	Normal Conducting Beam Commissioning	2 May 2017	27 Oct 2017	This work unit holds the beam commissioning of the normal conducting part of the accelerator: source, LEBT, RFQ, MEBT, DTL and all supporting systems		0%	
ACCSYS.2.8	Super Conducting Beam Commissioning	1 Oct 2018	4 Feb 2021	This work unit holds the beam commissioning of the superconducting part of the accelerator: spoke cryomodules and elliptical cryomodules, and all the supporting systems.		0%	
ACCSYS.3	Normal Conducting Front End	1 Jan 2013	23 Dec 2019	This WP covers the construction, testing and the delivery of the normal conducting front-end of the ESS linac. It contains the following accelerating systems: source, LEBT, RFQ, MEBT, and DTL's		75%	
ACCSYS.3.1	Normal Conducting Management	2 Jan 2013	23 Dec 2019	The management of WP3 holds the synchronisation of different activities within the ESS Construction Phase. It contains an ESS/Lund liaison to work with the remote work package/unit managers		0%	
ACCSYS.3.2	Proton Source and LEBT	7 Jan 2013	6 Jan 2017	This work unit deals with two ion sources and one LEBT line to be delivered for SAT at ESS in Lund.		100%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.3.3	RFQ	1 mar 2013	27 Jul 2017	The WU deals with the RFQ to be delivered for SAT at ESS in Lund. The task consists of industrial drawings, procurements, adjustments, construction and assembly and finally dismantling and transport from CEA-IRFU at Saclay to ESS at Lund		75%	
ACCSYS.3.4	MEBT	1 Jan 2013	4 May 2016	The WU deals with the MEBT to be delivered for SAT at ESS in Lund. The task includes the prototyping of critical components, MEBT procurement, adjustments, assembly and light tests and finally dismantling and transport to Lund.		100%	
ACCSYS.3.5	DTL	3 May 2013	17 Jul 2018	The WU deals with the 4 DTL tanks to be ready for SAT after being fully assembled in the ESS workshop in Lund. The task includes the prototyping of critical components, procurement, adjustments, assembly of tanks and DTs separately, transport to Lund.		100%	
ACCSYS.4	Spoke Cavities and Cryomodules	1 Jan 2013	31 Dec 2019	This work package covers the construction, testing and installation phase of the spoke cryomodule prototype and the procurement, assembly, testing, and transport of 14 spoke cryomodules.		75%	
ACCSYS.4.1	Spoke Management	2 Jan 2013	31 Dec 2019	The aim of this work unit is to plan, coordinate, organise, monitor, and report on the work to be performed within this WP. This includes a ESS/Lund liaison to work with the remote work package/unit managers		25%	
ACCSYS.4.2	Spoke Cryomodule Prototype	1 Jan 2013	13 Dec 2016	This work unit holds the procurement, construction, preparation/assembly and cryogenic test at 2K (at low RF power at IPNO and high power at Uppsala) of the first complete spoke cryomodule integrating 2 fully dressed double spoke cavities.		0%	
ACCSYS.4.3	Spoke Series Cryomodule Design Adjustment	3 Nov 2015	29 Apr 2016	The cavities and other cryomodule components are likely to require design modifications as the result of prototype test results and account for final modifications of linac parameters.		0%	
ACCSYS.4.4	Spoke Series Procurement	3 Nov 2015	30 Apr 2018	This WU holds the procurement of Niobium, 28 spoke cavities, 28 power couplers, 28 cold tuning systems, 14 cryomodules and valve boxes, Cryogenic control box, insulation vacuum.		100%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.4.5	Spoke Cavity Packages Preparation and Test	2 Mar 2017	30 Jul 2018	The cavity packages consist of the spoke cavities, power couplers, cold tuning systems, and require preparation and tests prior to their installation in the cryomodules.		100%	
ACCSYS.4.6	Spoke Cryomodules Assembly	1 May 2017	29 Oct 2018	This work unit holds the assembly plan and schedule along with the resources necessary to perform and manage the assembly of the series cryomodules.		100%	
ACCSYS.4.7	Spoke Cryomodules Transport	17 Jul 2017	17 Dec 2018	After the assembly, each cryomodule will be transported to the high power 352 MHz test station for the final acceptance test		100%	
ACCSYS.4.8	Spoke Cryomodule tests at High Power	31 Jul 2017	31 Dec 2018	After the cryomodule has been assembled, each cryomodule will be tested under nominal conditions of RF excitation and temperature for the final acceptance and performances assessment.		0%	
ACCSYS.5	Elliptical SRF inc. Cryomodules	1 Jan 2013	29 Jan 2020	This work package covers the construction and high power testing of the elliptical cryomodules, including high-beta and medium-beta elliptical cavity-packages. It consists of 84% what is specified in the TDR.		75%	
ACCSYS.5.1	Elliptical Management	2 Jan 2013	23 Dec 2019	The management of the WP5 consists in organising and monitoring the progress of the design, fabrication, assembly, and testing of the medium and high beta structures. This includes a ESS/Lund liaison to work with the remote work package/unit managers		0%	
ACCSYS.5.2	Medium Beta Structures	1 Jan 2013	7 Jun 2018	This includes: One medium beta elliptical cavity cryomodule technology demonstrator. 84% of the medium beta elliptical cavities and 85% of the medium beta cryomodules specified in the TDR, shall be procured, assembled and tested.		75%	
ACCSYS.5.3	High Beta Structures	1 Jan 2013	29 Jan 2020	This includes: One high beta elliptical cavity cryomodule technology demonstrator. 84% of the high beta elliptical cavities and 85% of the high beta cryomodules specified in the TDR, shall be procured, assembled and tested.		100%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.6	HEBT and Conventional Magnet Systems	2 Jan 2013	12 Dec 2019	This WP holds all normal-conducting magnets, excluded are magnets for the LEBT and MEBT. All special, radiation hard, magnets prepared for remote disconnection, exchange and reconnection, all associated power supplies, collimators		75%	
ACCSYS.6.1	HEBT - Management	2 Jan 2013	12 Dec 2019	Coordinate the work performed within all WUs in ACCSYS.6.This includes a ESS/Lund liaison to work with the remote work package/unit managers		25%	
ACCSYS.6.2	HEBT beam Optics Design Update	2 Jan 2013	12 Dec 2019	This work unit will keep the HEBT beam optics updated and perform simulations as needed and requested by other WP's.		100%	
ACCSYS.6.3	Procurement Planning and Supply	1 Mar 2013	10 Dec 2019	This work unit will include identification of possible vendors, manufacturing capacities and estimates of delivery times?		100%	
ACCSYS.6.4	LWU - non-special Normal-Conducting Magnets	1 Mar 2013	12 Dec 2019	This WU concerns all non-special magnets (all normal-conducting) needed for the HEBT, in particular quadrupoles, dipoles and steerer magnets, used to transport the beam from the exit of the linac to the beam dump or target		100%	
ACCSYS.6.5	Special HEBT radiation resistant magnets	1 Mar 2013	12 Dec 2019	The last magnets in the HEBT in front of the target will receive a large radiation dose (actual numbers is being evaluated), which demands fabrication of magnets using especially radiation-resistant materials for insulation, water cooling tubes/hoses etc.		100%	
ACCSYS.6.6	DC Power Supplies	2 Jan 2013	12 Dec 2019	This work unit concerns all dc constant-current power converters including those for normal conducting magnets (dipoles, steerers, quadrupoles and octupoles for the HEBT, LEBT, and MEBT) and warm corrector and quadrupole magnets, in the LWU sections.		100%	
ACCSYS.6.7	Collimators in the HEBT	2 Jan 2013	10 Dec 2019	This WU includes 3 collimator systems: 1. low energy at the LEBT 2. transverse collimators are in the S1 section of the HEBT, 3. fixed collimator situated in front of the Proton Beam Window, plus a prototype collimator featuring two jaws.		100%	
ACCSYS.6.8	Interface to Target	1 Mar 2013	12 Dec 2019	This WU holds the interface between the two major groups and systems of the ESS (accelerator and target), it also concerns itself with the radiation doses involved, the interlocks, the building issues and more.		100%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.7	Beam Diagnostics	1 Jan 2013	29 Jan 2020	This work package includes the procurement, assembly, testing and installation of all the beam diagnostics equipment in the ESS accelerator, up to and including the spot size measurement on the target.		50%	
ACCSYS.7.1	Beam Diagnostics Management	1 Jan 2013	12 Dec 2019	This work unit includes the overall coordination effort for beam diagnostics as well as monitoring/reporting of the other work units.		0%	
ACCSYS.7.2	Non Reoccurring Engineering (NRE) BD	1 Jan 2013	1 Jan 2020	This work unit contains the non-recurring engineering (design, development, prototyping and testing of the different beam diagnostics types) for all beam diagnostics.		25%	
ACCSYS.7.3	LEBT Diagnostics	1 Jan 2014	13 Oct 2017	This includes: 2 BCM, 1 Faraday Cup, 1 Slit station, 1 SEM, 1 Optical Imaging System		50%	
ACCSYS.7.4	MEBT Diagnostics	4 Feb 2016	23 Oct 2017	This includes: 3 BCM, 1 Fast BCM, 1 Faraday Cup, 1 Slid Station, 1 SEM grid Station, 6 BPM, 4 Wire Scanners, 2 Halo Monitors, 2 Non invasive Profile Monitors		50%	
ACCSYS.7.5	DTL Diagnostics	15 Apr 2015	16 Aug 2018	This includes: 12 BLM, 5 BCM, 1 Fast BCM, 8 BPM, 4 Faraday Cups, 4 Wire Scanners, 4 Non-invasive Profile Monitors, 1 Bunch Shape Monitor		50%	
ACCSYS.7.6	Spoke LINAC Diagnostics	11 Jul 2016	14 Aug 2018	This includes: 42 BLM, 28 BPM, 5 Wire Scanners, 5 Non-invasive tranverse profile devices, 3 Halo Measurement Systems, 3 Longitudinal Bunch Shape Monitors		50%	
ACCSYS.7.7	Medium Beta Elliptical LINAC Diagnostics	27 May 2016	22 Nov 2017	This includes: 48 BLM, 1 Beam Current Monitor, 32 BPM, 4 Wire Scanners, 4 Non-invasive tranverse profile devices, 4 Halo Measurement Systems, 4 Longitudinal Bunch Shape Monitors		50%	
ACCSYS.7.8	High Beta Elliptical LINAC Diagnostics	28 Dec 2017	29 Jan 2020	This includes: 60 BLM, 1 Beam Current Monitor, 30 BPM, 4 Wire Scanners, 4 Non-invasive tranverse profile devices, 4 Halo Measurement Systems, 4 Longitudinal Bunch Shape Monitors		50%	
ACCSYS.7.9	HEBT High Beta Upgrade Diagnostics	10 Mar 2016	4 Sep 2017	This includes: 22 BLM, 2 Beam Current Monitor, 14 BPM, 4 Wire Scanners, 4 Non-invasive tranverse profile devices, 2 Halo Measurement Systems, 2 Longitudinal Bunch Shape Monitors		50%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.7.10	Beam-on-target Diagnostics	3 Nov 2017	30 Apr 2019	This includes: 10 BLM, 2 Beam Current Monitor, 8 BPM, 1 SEM Grid Station, 3 Wire Scanners, 4 Non-invasive tranverse profile devices, 2 Target/Beam Window Imaging Systems, 4 Halo Measurement Systems		50%	
ACCSYS.7.11	Tune-up dump line Diagnostics	7 Jan 2016	3 Jul 2017	This includes: 10 BLM, 2 Beam Current Transformers, 8 BPM, 1 SEM grid station, j 1 Wire Scanners, 1 Non-invasive profile monitor, 1 Halo Measurement Systems, 1 Dump imaging system		50%	
ACCSYS.7.12	Insertable Beam Dumps	23 Mar 2016	4 Sep 2017	This includes: 10 BLM, 2 Beam Current Transformers, 8 BPM, 1 SEM grid station, j 1 Wire Scanners, 1 Non-invasive profile monitor, 1 Halo Measurement Systems, 1 Dump imaging system		50%	
ACCSYS.8	Radio Frequency Systems	31 Dec 2012	6 Apr 2022	This work package covers 83% of the design, prototyping, specifications, procurement, test, and installation of the Radio Frequency System specified in the TDR.		75%	
ACCSYS.8.1	RF Management	31 Dec 2012	21 Dec 2018	The RF system design WU covers the coordination and the management of the construction of all subparts of the RF system.		0%	
ACCSYS.8.2	Low Level RF Control and control system	2 Jan 2013	1 Oct 2020	The LLRF WU covers construction of the systems that allow controlling/maintaining amplitude and phase stability of the accelerating fields in pulse mode for all the RF cavities along the linac. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.3	Master Oscillator/Phase distribution	2 Jan 2013	29 Jun 2017	In this WU the scope is to deliver the construction of the Master Oscillator and the associated phase reference/master clock for the control system. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.4	High Power Amplifiers (klystrons etc.)	2 Jan 2013	31 Dec 2020	This work unit covers the specification, design, procurement, test, and installation of the amplifiers. Prototypes of amplifiers will be procured and tested. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.5	High Power Voltage Converters (modulators etc.)	1 Jan 2013	29 Mar 2019	This work unit covers the specification, design, procurement, test, and installation of the High Power Converters specified in the TDR. In the prototype part prototypes of HPCs will be procured and tested. It includes 83% of what is specified in the TDR.		75%	

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ACCSYS.8.6	RF distribution	2 Jan 2013	31 Dec 2020	Between the amplifier RF output and the cavity the distribution system is placed. The RF Power Distribution is taken to mean all components from the output of the power source to the cavity couplers. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.7	RF Gallery	1 Jan 2013	31 Dec 2020	This work unit holds work and M&S on the RF-related parts of the gallery, like water cooling, power, and cabling. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.8	RF Installation phase 1	3 July 2017	1 Oct 2018	This work unit holds the schedule for the installation of the RF systems up to and including the Medium Beta Cryomodules. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.8.9	RF Installation phase 2	13 Jan 2020	6 Apr 2022	This work unit holds the schedule for the installation of the RF systems for the High Beta Cryomodules. It includes 83% of what is specified in the TDR.		75%	
ACCSYS.9	Installation	2 Jan 2013	25 May 2022	This WP includes the planning, training, coordinating, and finally executing all the logistics of installing all systems destined for the tunnel. It includes site acceptance testing, and dry commissioning		75%	
ACCSYS.9.1	Tunnel Systems	2 Jan 2013	24 Dec 2014	This work unit provides the layout of the tunnel with all its accelerating and support systems.		0%	
ACCSYS.9.2	Cabling	1 Apr 2013	23 Dec 2013	This work unit provides the planning and layout of the cabling system of the LINAC.		0%	
ACCSYS.9.3	Installation Management	2 Jan 2013	30 Dec 2019	This WU holds the management, administration, and coordinate the work performed within all WUs.		0%	
ACCSYS.9.4	Installation Support Equipment	1 Jan 2014	17 Jun 2014	This WU comprises the design, procurement and fabrication activities needed to support installation operations		0%	
ACCSYS.9.5	Installation phase 1	22 May 2017	30 Oct 2019	This WU holds the installation of all systems residing in the tunnel up to and including Medium beta Cryomodules, and a beam line and HEBT to reach 640 MeV. It includes SAT, supports, alignment, connections, dry commissioning.		75%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.9.6	Installation phase 2	16 Dec 2019	25 May 2022	This WU holds the installation of High beta Cryomodules in three shutdowns. It includes SAT, supports, alignment, connections, dry commissioning.		75%	
ACCSYS.10	Test Stands	1 Jan 2013	4 Mar 2020	This WP covers the test stand in Uppsala and the local test stand in Lund for the main accelerator components.		50%	
ACCSYS.10.1	Test Stands Management	2 Jan 2013	4 Mar 2020	This WU concerns the management and administration required for WP 10. It includes interface and coordinating activities between the test stand WP and other WPs as well as reporting activities.		0%	
ACCSYS.10.2	Test Stand in Lund phase I	2 Jan 2013	30 Jun 2017	Phase I concerns the test stand for the main RF equipment prototype soak tests.		75%	
ACCSYS.10.3	Test Stand in Lund phase II	2 Jan 2013	29 Jan 2020	Phase II concerns the SAT of the series production cryomodules		75%	
ACCSYS.10.4	Uppsala (P2B WP19)	1 Jan 2013 A	30 mar 2016	The Uppsala test stand will be used to test the spoke cavity prototypes and the spoke cavity cryomodule prototype. Series tests might also be done on this test stand. It consists of a bunker, RF equipment and a cryogen supply.		0%	
ACCSYS.11	Cryogenics	2 Jan 2013	12 Dec 2019	This work package covers all the cryogenics systems associated with the ESS project. It includes 3 cryoplants and the cryogenic distribution.		75%	
ACCSYS.11.1	Cryogenics Management	2 Jan 2013	12 Dec 2019	This WU concerns the management and administration required for WP 11. It includes interface and coordinating activities between WPs as well as reporting activities.		0%	
ACCSYS.11.2	Accelerator Cryoplant	2 Jan 2013	5 Mar 2018	This work unit covers all the activities (design, specification, procurement, installation and commissioning) of the accelerator cryoplant that will provide cryogenic cooling to the 59 cryomodules via the distribution system.		75%	
ACCSYS.11.3	Instruments and test stand cryoplant	1 Mar 2013	13 Apr 2017	This cryoplant provides 2 K and 40 K refrigeration to the cryomodule test stands as well as providing up to 50 L/hr of LHe for the beam line instrumentation.		75%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ACCSYS.11.5	Cryogenic Distribution	2 Jan 2013	11 Jul 2018	This work unit covers the cryogenic distribution system that will transport cryogenic fluids and warm gases between the accelerator cryoplant (WU11.1.1) and the cryomodules		75%	
ACCSYS.12	Vacuum	1 Jan 2013	31 Dec 2020	This work package covers the vacuum systems associated with ESS.		25%	
ACCSYS.12.6	Vacuum Management	2 Jan 2013	12 Dec 2019	Provides for the management and administration of the vacuum group.		0%	
ACCSYS.12.1	Vacuum for Accelerator General Tasks	1 Jan 2013	23 Dec 2019	This work unit covers the vacuum equipment standardisation, the Accelerator Vacuum Manual, the Accelerator Operations Manual, and commissioning support		0%	
ACCSYS.12.2	Vacuum for Accelerating Systems	1 Mar 2013	31 Dec 2019	This work unit covers the vacuum systems for all parts of the LINAC up to and including the HEBT.		50%	
ACCSYS.12.3	Vacuum for Accelerator Support Equipment	1 Jan 2014	28 Dec 2017	This work unit includes the design, procurement and the fabrication needed to support vacuum operations		0%	

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4. TARGET

4.1 Introduction

The Target Station is the spallation centre of the ESS Facility, receiving the proton beam from the accelerator and delivering neutrons to the instruments.

4.2 Scope

4.2.1 Included

The Target Station includes proton beam window, moderator and reflector plug, target wheel unit, neutron beam ports, cooling equipment, associated supplies for cooling, handling of contaminated supplies and shielding to keep the facility safe, active cells and remote handling equipment including all development, manufacturing, installation and testing for these areas.

4.2.2 Excluded

The Target Station Project does not include HVAC system, cranes in the target building, utilities into the target building, tuning beam dump, shutters, collimators, A2T area, and other items within the target building whose purpose is not related to the target.

4.3 Major milestones

Design Option Freeze	Q3 2014
Major raw materials secured	Q4 2015
Critical Components Manufactured	Q3 2016
Early Access to Target Building	Q1 2017
Installation Completed	Q2 2018
Testing Completed	Q2 2019

4.4 Target Cost

Table 2 Target cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
TARGET	Target Station	1 Jan 2013	31 Dec 2025	Target Station Construction Project		65%	Ferenc Mezei
TARGET.1	Management	1 Jan 2013	28 Jun 2019	This WP manages steering and control of Target Station Construction Project.		0%	
TARGET.1.2	Cost and Resources Management	1 Jan 2013	28 Jun 2019	Cost and resources tracking, analysis, evaluation and decision-making. Includes Misc. equipment year 2015-18 10MEUR. Resources are supplied by programme division. Cost inc. PM cost, project admin and travel.		0%	
TARGET.2	Target Station Physics	1 Jan 2013	29 Mar 2022	This work package covers physics related support function for WP4 to WP7		15%	
TARGET.2.1	Management	1 Jan 2013	28 Jun 2019	This work unit includes all management, planning and coordination of the resources and activities within WP TARGET.2. Herein is performed schedule tracking and cost estimations with follow-ups.		0%	
TARGET.2.2	Neutronic	1 Jan 2013	29 Mar 2022	Develop an optimised target-moderator-reflector-shield. Calculate heat loads and radiation damage. Maintain relevant codes and libraries.		0%	
TARGET.2.3	Waste Characterisation	1 Jan 2013	28 Jun 2019	Calculate radionuclide inventories. Calculate shield requirements.		0%	
TARGET.2.4	Waste Management	1 Jan 2013	25 Jun 2020	Support the development of a waste management plan and decommissioning plan. Estimate waste stream volumes and waste profiles.		0%	
TARGET.2.5	CFD Global	1 Jan 2013	28 Jun 2019	In collaboration with the safety and control groups, merge all loops model into a single system and analyse their behaviour for normal operations (including start up and shut down) and for accidental scenario		0%	
TARGET.2.6	Global Mechanical	1 Jan 2013	28 Jun 2019	Perform global mechanical analyses for postulated accidents such as earthquake and airplane crash.		75%	

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Table 2 Target cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
TARGET.2.7	Environmental and Impact Consequence Analyses	1 Jan 2013	28 Jun 2019	Assess the radiological consequences resulting from radioactive waste discharges whose source is ESS.		0%	
TARGET.2.8	Material Issues	1 Jan 2013	28 Jun 2019	Address issues related to materials and acts as a support for other WP requiring basic properties for thermo-mechanical studies, release properties for radioisotope		10%	
TARGET.2.9	Shielding Calculations	1 Jan 2013	28 Jun 2019	Perform neutronics calculations to support shield design for the target station and A2T.		0%	
TARGET.3	Target Station Configuration Control	1 Jan 2013	1 Aug 2019	This work package covers engineering support function for WP 4 to WP 7		0%	
TARGET.3.1	Management	1 Jan 2013	1 Aug 2019	This work unit includes all management, planning and coordination of the resources and activities within WP TARGET.3. Herein is performed schedule tracking and cost estimations with follow ups.		0%	
TARGET.3.2	Integration	1 Jan 2013	4 Jul 2019	This work unit coordinates the interfaces between the target and the global ESS facility, so that the target will be well integrated into the global ESS system in a consistent manner.		0%	
TARGET.3.3	System Engineering	1 Jan 2013	28 Jun 2019	This work unit coordinates the systems engineering activities for target subsystems, and set up a link to the global ESS systems engineering policy.		0%	
TARGET.3.4	Operation & Maintenance Definition	1 Jan 2013	28 Jun 2019	This work unit sets up the definitions for the commissioning, operation and maintenance states and modes of the target system, in consistence with the global ESS definitions, and makes detailed procedures for these.		0%	
TARGET.3.5	Safety Analysis	1 Jan 2013	28 Jun 2019	This work unit provides supports the licensing activities managed by ESS safety division.		0%	
TARGET.3.6	Decommissioning Conform Design Requirements	1 Jan 2013	28 Jun 2019	This work unit manages the design conformity of the target station design to the decommissioning requirements.		0%	

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Table 2 Target cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
TARGET.4	Monolith and Plugs	1 Jan 2013	15 Oct 2019	This work package covers all components within the monolith.		75%	
TARGET.4.1	Management	1 Jan 2013	30 Aug 2019	This work unit includes all management, planning and coordination of the resources and activities within WP TARGET.4. Herein is performed schedule tracking and cost estimations with follow ups as well as controlling interfaces with other WPs.		0%	
TARGET.4.2	Target Wheel Unit	1 Jan 2013	28 Jun 2019	Contains all design, analyses, manufacturing, installation & commissioning of Target wheel unit. Includes wheel with spallation material, surrounding mechanical structures, drive unit, monitoring plug & interfaces to connected and adjacent systems.		75%	
TARGET.4.3	Moderators and Reflector Plug	1 Jan 2013	28 Jun 2019	Contains all design, analyses, manufacturing, installation and commissioning of moderators and reflector plug. Includes the plug assembly with cryogenic and thermal moderator vessels, beryllium reflector and interfaces to connected and adjacent systems.		75%	
TARGET.4.4	Proton Beam Window Plug	1 Jan 2013	14 Aug 2019	Contains all design, analyses, manufacturing, installation and commissioning of proton beam window plug with surrounding mechanical structures and all interfaces to connected and adjacent systems. Also includes proton beam window diagnostic plug.		90%	
TARGET.4.5	Monolith	1 Jan 2013	15 Oct 2019	Contains all design, analyses, manufacturing, installation and commissioning of monolith. Includes the outer liner, mechanical structures, metal shielding and interfaces to connected and adjacent systems, with focus on handling, maintenance and operation.		75%	
TARGET.4.6	Neutron Beam Ports	1 Jan 2013	28 Jun 2019	Contains all design, analyses, manufacturing, installation and commissioning of beam extraction system. Includes neutron beam port cartridges for used beam ports, dummy plugs for unused beam ports and interfaces to connected and adjacent systems.		60%	

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Table 2 Target cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
TARGET.5	Fluid Systems	1 Jan 2013	19 Sep 2019	This work package covers all cooling related areas as well as supply and disposal of activated fluids		75%	
TARGET.5.1	Management	1 Jan 2013	25 Jul 2019	Planning, controlling and follow up for all units within package. Included other cooling equipment and Piping cost for the entire WP.		0%	
TARGET.5.2	Gaseous Cooling System	1 Jan 2013	19 Sep 2019	Target primary and secondary cooling, monolith pressure control and circulation and PBW cooling		80%	
TARGET.5.3	Liquid Cooling Systems	1 Jan 2013	19 Sep 2019	Reflector, water moderator, shielding cooling systems and water as well as gas intermediate cooling systems		0%	
TARGET.5.4	Cryogenic Cooling System	1 Jan 2013	19 Sep 2019	H2 moderator cooling systems, including the connection to the refrigeration system supplied by the ESS cryo-team		75%	
TARGET.5.5	Contaminated or Active Vent and Drain Systems	1 Jan 2013	19 Sep 2019	Ventilation (HVAC&RGEC), vacuum pumps, cover gas handling systems, gas purification and storage, water purification and storage, radioactive monitoring system		75%	
TARGET.5.6	Non-Active Gas Supply	1 Jan 2013	28 Jun 2019	Gas purging systems, helium supply and buffer, hydrogen supply and buffer, instrument air supply		0%	
TARGET.5.7	Non-Active Liquid Supply	1 Jan 2013	28 Jun 2019	Water supply		0%	
TARGET.6	Handling and Logistics	1 Jan 2013	24 Sep 2019	This work package covers waste management handling and logistics within the target building		80%	
TARGET.6.1	Management	1 Jan 2013	24 Sep 2019	Cost and recourse planning and tracking, schedule planning and update, risk management, quality plan, procurement management, WP interface control		0%	
TARGET.6.2	Active Cells	1 Jan 2013	14 Aug 2019	A hot cell facility for processing, refurbishment, intermediate storage and shipment of activated waste. Contains 3 main WU's: confinement, handling and equipment. Main purpose: to treat high and intermediate level waste.		90%	
TARGET.6.3	Active Cells Commissioning	1 Jan 2018	28 Jun 2019	The final delivery of the active cells. All inherent systems should fulfil their requirements and all remote handling operations validated. The commissioning should be done prior to beam on target.		90%	

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Table 2 Target cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
TARGET.6.4	Internal Casks and Associated Handling Devices	1 Jan 2013	28 Jun 2019	Casks and transport equipment for safe transport of radioactive and contaminated components from their point of installation to the active cells facility, i.e. only ESS internal transportation.		90%	
TARGET.6.5	Machining, Testing and Tooling	1 Jan 2013	28 Jun 2019	Workshop contaminated parts & Mock-up and test stand for new components. Workshop should handle slightly contaminated components. Test stand to be equipped to have possibility for site acceptance tests & alignment test of new components. Staff training.		0%	
TARGET.6.6	Complementary Shielding	1 Jan 2013	28 Jun 2019	Shielding not covered by other WP's like "Monolith and Plugs". Typically neutron back scattering shielding in the A2T as one example.		0%	
TARGET.7	Target Station Safety System	1 Jan 2013	30 Aug 2019	This work package covers the target specific control system.		0%	
TARGET.7.1	Management	1 Jan 2013	30 Aug 2019	Continuous interface discussion shall be maintained with other ESS construction projects		0%	
TARGET.7.2	Design of Target Station Safety System	1 Jan 2013	28 Jun 2019	Design of TSS behaviour, i.e. safety actions required by TS		0%	
TARGET.7.3	Manufacturing	1 Jan 2013	28 Jun 2019	Interact with the suppliers- procurement and installation of power, network, racks and delivered system components. - define the integration and verification specifications		0%	
TARGET.7.4	Integration and Verification of TSS	1 Jan 2013	28 Jun 2019	This task performs all activities needed to integrate all system components of Target station safety system and to verify the functionality.		0%	

5. NEUTRON SCATTERING SYSTEMS

5.1 Introduction

The Neutron Scattering Systems Project will deliver 22 neutron scattering instruments to the user community by 2025. The instruments will be complemented by suitable technical and IT support infrastructure, such as user interface and operational software, data analysis, and storage capabilities, and the experiment proposal software that is necessary to operate a successful neutron scattering instrument and user program. This will allow ongoing operation, maintenance or development and instrument upgrades beyond the "ESS Construction Programme".

5.2 Scope

5.2.1 Included

The Neutron Scattering Systems Project will deliver:

- Instrument concepts mature enough for decision to be made to build
- Supporting scientific infrastructure (e.g. labs)
- The 22 neutron scattering instruments
- The R&D to support those instruments
- The required technologies to support those instruments
- The required IT infrastructure for the instruments via the Data Management and Software Centre (DMSC)

5.2.2 Excluded

The buildings, utility infrastructure, target and accelerator shielding, ICS control boxes, and the IT infrastructure between the Lund and Copenhagen sites are all specifically excluded, plus any work not described in the relevant project specifications.

5.3 Major milestones

Major (global) milestones of the NSS Project are shown in the "ESS Cost Report" and include:

A total of 22 "Instrument Decision"	2013–2020
A total of 22 "Handover to Operations"	2019–2025
An "Early Access to Instrument Labs/Workshops"	2017
An "Early Access to Neutron Tech Labs"	2017
The "Begin Construction in Experimental Hall"	2017

Some of the major NSS milestones depend on other projects achieving their respective major milestones, such as "First Proton on Target" or "License – Beam Permit".

5.4 Neutron Scattering System Cost

Table 3 Neutron Scattering System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ	Neutron Scattering Systems Project	2 Jan 2013	23 Dec 2025	Identify and develop instrument concepts and supporting technologies in parallel with the actual construction of the instruments, the required neutron technologies, the scientific infrastructure required by the instruments and the supporting computing.		40%	Oliver Kirstein
NSSPRJ.1	NSS Management	2 Jan 2013	23 Dec 2025	The overall management of the NSS project will ensure fulfilment of project goals. Provide the oversight reviews, cost, scheduling of all WPs and co-ordinate activities required to deliver the project goal in terms of scope, time, cost and quality.		0%	
NSSPRJ.1.1	2013 Project Coordination	2 Jan 2013	23 Dec 2013	Provide the oversight reviews, cost, scheduling of all work packages and co-ordinate activities.		0%	
NSSPRJ.1.2	Project Coordination	2 Jan 2014	23 Dec 2025	Provide the oversight reviews, cost, scheduling of all work packages and co-ordinate activities.		0%	
NSSPRJ.2	Instrument Concepts	2 Jan 2013	23 Dec 2025	Delivery of 22 instrument concepts for construction.		10%	
NSSPRJ.2.1	Instrument Concepts Management	2 Jan 2013	23 Dec 2025	Management of the instrument design work, as well as the associated review and selection processes.		0%	
NSSPRJ.2.2	Concepts Development	2 Jan 2013	23 Dec 2019	Development of conceptual design, science case and preliminary costing of possible neutron instruments, resulting in a sufficient number of instrument construction proposals to choose 22 world-leading instruments. Limited prototyping can be performed.		50%	
NSSPRJ.3	Neutron Science Support Facilities	2 Jan 2013	23 Dec 2019	Delivers the adequate neutron science support facilities required for the ESS user programme.		40%	
NSSPRJ.3.1	Management	2 Jan 2013	23 Dec 2019	Defines the interfaces within NSS project, the Science directorate, ESS and the user community.		0%	
NSSPRJ.3.2	User Support & Sample Handling	2 Jan 2014	13 Dec 2019	Provides on-site facilities for the ESS users tailored to needs of different user groups as well as for the sample handling taken the potential radiological, chemical biological risks into account.		20%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.3.3	Deuteration	2 Jan 2013	27 Aug 2018	Covers the need for biological and chemical deuteration as an essential part of all soft condensed matter and biology experiments. Gather user input, collaboration agreements, process development, procure and install equipment.		60%	
NSSPRJ.3.4	Soft/Bio	2 Jan 2013	27 Aug 2018	Covers the need for soft matter research and life science to provide a certain degree of sample fine-tuning on site in dedicated labs. Gather user input, collaboration agreements, process development, procure and install equipment.		40%	
NSSPRJ.3.5	Chem/Phys/Acti	2 Jan 2013	27 Aug 2018	Covers the need for chemistry, physics hard and surface science for hard condensed matter in dedicated labs. Gather user input, collaboration agreements, process development, procure and install equipment.		50%	
NSSPRJ.3.6	Facility for Engineering, Geology, Cultural Heritage and Plants	28 Feb 2013	27 Aug 2018	Covers the need for engineering science, geology, investigations of cultural heritage and plants in dedicated labs. Gather user input, collaboration agreements, process development, procure and install equipment.		40%	
NSSPRJ.4	DMSC	2 Jan 2013	23 Dec 2025	Provide IT infrastructure (software, hardware, and support) required for instruments and associated user programme at ESS in the Operation Phase and for research and development activities at ESS in the Construction Phase.		0%	
NSSPRJ.4.1	DMSC Management & Coordination	2 Jan 2013	23 Dec 2025	Management of the DMSC sub-project including coordination between internal and with external work packages.		0%	
NSSPRJ.4.2	IT Support & Policies	2 Jan 2013	23 Dec 2013	Maintaining existing IT service to ESS and to prepare policies and strategies to be used in subsequent work in the DMSC sub-project. This WP is restricted to 2013.		0%	
NSSPRJ.4.3	Science Software Suite	2 Jan 2014	23 Dec 2025	Providing software required for the DMSC sub-project to reach its goal including software for user office, proposal system, instrument control, data acquisition, data reduction, data analysis, and instrument simulations.		0%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.4.4	Scientific IT Infrastructure & Support	2 Jan 2014	23 Dec 2025	Providing IT infrastructure required for instruments and associated user programme at ESS on the Operation Phase as well as for research and development activities at ESS in the Construction Phase.		0%	
NSSPRJ.5	Instrument Construction & Technology	2 Jan 2013	22 Dec 2025	Contains the work packages for neutron technologies and the neutron scattering instruments.		50%	
NSSPRJ.5.1	Chief Instrument Project Engineer's Office	2 Jan 2013	22 Dec 2025	The people that manage the sub-project, its design and construction.		0%	
NSSPRJ.5.1.1	Sub-project Management	2 Jan 2013	22 Dec 2025	Sub-project management, monitoring progress, tracking risks, etc.		0%	
NSSPRJ.5.1.2	Instrument Common Engineering	2 Jan 2013	18 Dec 2019	Engineering tasks that are common to all or most instruments (guide supports, common shielding)		0%	
NSSPRJ.5.1.3	Instrument Construction Preparation	5 Jan 2015	23 Dec 2015	Development of contracts for construction personnel, preparing processes for instrument construction, purchase and/or rental of tools and equipment needed to begin physical construction of neutron scattering instruments.		0%	
NSSPRJ.5.2	Neutron Chopper Systems	2 Jan 2013	22 Dec 2025	The work package for neutron chopper systems within neutron scattering systems.		0%	
NSSPRJ.5.2.1	Management	2 Jan 2013	22 Dec 2025	Project management		0%	
NSSPRJ.5.2.2	Development Facility	2 Jan 2013	22 Dec 2017	A space with tools and equipment needed to develop new chopper technologies.		0%	
NSSPRJ.5.2.3	Operation Facility	2 Jan 2014	23 Dec 2019	A space with tools and equipment needed to operate and maintain the ESS suite of chopper systems.		10%	
NSSPRJ.5.2.4	Operation Program	2 Jan 2014	22 Dec 2025	The capability and processes needed to operate and maintain the ESS suite of chopper systems.		0%	
NSSPRJ.5.2.5	Development Program	1 Apr 2013	22 Dec 2025	The capability and processes needed to develop new chopper technologies.		0%	

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Table 3 Neutron Scattering System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.5.2.6	Engineering Activities	2 Jan 2013	30 Jun 2025	The engineering work necessary to support the development and operation programs of the Chopper Group.		0%	
NSSPRJ.5.3	Neutron Optics	2 Jan 2013	23 Dec 2022	The work package for neutron optics and shielding within neutron scattering systems.		10%	
NSSPRJ.5.3.1	Neutron Optics Management	2 Jan 2013	23 Dec 2020	Project Management		0%	
NSSPRJ.5.3.3	Helium 3 Polarisation (R&D)	1 Oct 2013	23 Dec 2019	Research and Development into methods and processes for performing 3He polarisation of neutrons for neutron instruments.		50%	
NSSPRJ.5.3.4	Deposition Systems (R&D)	2 Jan 2014	23 Dec 2020	Research and Development into methods and processes for making deposition systems for improving neutron optics.		0%	
NSSPRJ.5.3.5	Alignment Monitoring and Misc.	4 Jan 2016	23 Dec 2022	Equipment and systems for performing alignment and measurement of neutron optics for neutron instruments.		50%	
NSSPRJ.5.3.6	Neutron Guide Systems & Shielding	2 Jan 2013	23 Dec 2019	Performing calculations, simulations and final design of guide work units, shielding work units, common shielding, common guide elements for instruments		0%	
NSSPRJ.5.3.7	Neutron Optics Laboratory	2 Jan 2014	7 Jan 2021	The equipment and space needed to do neutron optics research and development, assembly, and testing.		60%	
NSSPRJ.5.4	Sample Environment	2 Jan 2013	22 Dec 2025	The work package for sample environments within neutron scattering systems.		20%	
NSSPRJ.5.4.1	Sample Environment Management	2 Jan 2013	22 Dec 2025	Project management of the sample environment work package.		0%	
NSSPRJ.5.4.2	Low Temperature (R&D)	2 Jan 2014	22 Dec 2025	The research and development of novel techniques and equipment for bringing samples to low temperature.		20%	
NSSPRJ.5.4.3	Fields (H, E, F, ...)	2 Jan 2014	22 Dec 2025	The research and development of novel techniques and equipment for applying magnetic, electric and other fields to samples.		20%	
NSSPRJ.5.4.4	High Pressure Systems	2 Jan 2014	22 Dec 2025	The research and development of novel techniques and equipment for bringing samples to high pressure.		30%	

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WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.5.4.5	Soft Matter (R&D)	2 Jan 2014	22 Dec 2025	The research and development of novel techniques and equipment for managing the environment of soft matter samples.		20%	
NSSPRJ.5.4.6	Other Sample Environment Systems	2 Jan 2014	22 Dec 2025	The research and development of novel techniques and equipment for other types of sample environments not contained within the other sections		20%	
NSSPRJ.5.4.7	Sample Environment Laboratory	2 Jan 2014	8 Jun 2018	A laboratory with the tools, equipment and supplies needed to perform R&D on novel sample environment equipment.		30%	
NSSPRJ.5.5	Electrical Engineering	2 Jan 2013	22 Dec 2025	The work package for electrical engineering systems within neutron scattering systems.		20%	
NSSPRJ.5.5.1	Electrical Engineering Management	2 Jan 2013	22 Dec 2025	Project Management		0%	
NSSPRJ.5.5.2	Motion Control Development	1 Jul 2013	22 Dec 2025	Electrical engineering tasks to develop the motion control system used for all ESS instruments		40%	
NSSPRJ.5.5.3	PPS System and Robotics	2 Jan 2014	22 Dec 2025	Electrical engineering tasks to develop the PPS for the neutron scattering instruments at ESS. Development of standards and methods for robotics uses on neutron scattering instruments.		0%	
NSSPRJ.5.5.4	Electrical Engineering Laboratory	2 Jan 2014	8 Jun 2018	The equipment and space needed to do electrical engineering research and development, assembly, and testing.		40%	
NSSPRJ.5.6	Detector Systems	2 Jan 2013	22 Dec 2025	The work package for neutron detectors within neutron scattering systems.		10%	
NSSPRJ.5.6.1	Detector Management	2 Jan 2013	22 Dec 2025	Project management of the Detector work package.		0%	
NSSPRJ.5.6.2	10B Systems (R&D)	2 Jan 2013	22 Dec 2025	The research and development of technique and hardware for detecting neutrons with 10B.		0%	
NSSPRJ.5.6.3	Scintillator Systems (R&D)	2 Jan 2013	22 Dec 2025	The research and development of technique and hardware for detecting neutrons with scintillators.		40%	

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Table 3 Neutron Scattering System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.5.6.4	High Resolution High Rates (R&D)	2 Jan 2013	22 Dec 2025	The research and development of technique and hardware for detecting neutrons at high resolution and high rates.		10%	
NSSPRJ.5.6.5	Detector Other Systems	2 Jan 2013	22 Dec 2025	The research and development of technique and hardware for detecting neutrons with other systems.		10%	
NSSPRJ.5.6.6	Detector Laboratory	2 Jan 2013	8 Jun 2018	A laboratory with the tools, equipment and supplies needed to perform R&D on neutron detector systems.		10%	
NSSPRJ.5.7	1 Instrument 6 years	3 Jun 2013	28 Jun 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.7.2	Phase 1 / Concept Design	3 Jun 2013	9 Jun 2014	Define and refine concepts, build 3D CAD model of outline of instrument. Develop schedule for design, procurement and installation of all instrument components, estimate costs for same, and development of all needed baseline documents.		70%	
NSSPRJ.5.7.3	Phase 2 / Final Design	9 Jun 2014	13 Jun 2016	Engineering design of all aspects of the instrument.		50%	
NSSPRJ.5.7.4	Phase 3 / Acquisition, Construction, Integration, Installation	19 Jan 2015	16 Nov 2018	Purchase/Acquisition/Validation/Testing of all instrument components. Physical construction of instrument support structures and its internal infrastructure. Installation of technical components onto the supporting structures and integrating all.		70%	
NSSPRJ.5.7.5	Phase 4 / Verification	19 Nov 2018	28 Jun 2019	Verifying the operation of all instrument components as a unit.		70%	
NSSPRJ.5.8	2 Instrument 6 years	3 Jun 2013	28 Jun 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.9	3 Instrument 6 years	3 Jun 2013	28 Jan 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.10	4 Instrument 5 years	2 Jun 2014	28 Jun 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.11	5 Instrument 5 years	2 Jun 2014	28 Jun 2019	A generic neutron scattering instrument.		70%	

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Table 3 Neutron Scattering System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.5.12	6 Instrument 5 years	2 Jun 2014	28 Jun 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.13	7 Instrument 5 years	2 Jun 2014	28 Jun 2019	A generic neutron scattering instrument.		70%	
NSSPRJ.5.14	8 Instrument 6 years	1 Jun 2015	25 Jun 2021	A generic neutron scattering instrument.		70%	
NSSPRJ.5.15	9 Instrument 7 years	1 Jun 2015	10 Jun 2022	A generic neutron scattering instrument.		70%	
NSSPRJ.5.16	10 Instrument 6 years	1 Jun 2016	28 Jun 2022	A generic neutron scattering instrument.		70%	
NSSPRJ.5.17	11 Instrument 6 years	1 Jun 2016	28 Jun 2022	A generic neutron scattering instrument.		70%	
NSSPRJ.5.18	12 Instrument 7 years	1 Jun 2016	13 Jun 2023	A generic neutron scattering instrument.		70%	
NSSPRJ.5.19	13 Instrument 6 years	1 Jun 2017	28 Jun 2023	A generic neutron scattering instrument.		70%	
NSSPRJ.5.20	14 Instrument 7 years	1 Jun 2017	12 Jun 2024	A generic neutron scattering instrument.		70%	
NSSPRJ.5.21	15 Instrument 6 years	1 Jun 2018	27 Jun 024	A generic neutron scattering instrument.		70%	
NSSPRJ.5.22	16 Instrument 6 years	1 Jun 2018	27 Jun 2024	A generic neutron scattering instrument.		70%	
NSSPRJ.5.23	17 Instrument 6 years	1 Jun 2018	27 Jun 2024	A generic neutron scattering instrument.		70%	
NSSPRJ.5.24	18 Instrument 6 years	3 Jun 2019	27 Jun 2025	A generic neutron scattering instrument.		70%	
NSSPRJ.5.25	19 Instrument 6 years	3 Jun 2019	27 Jun 2025	A generic neutron scattering instrument.		70%	

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Table 3 Neutron Scattering System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
NSSPRJ.5.26	20 Instrument 6 years	3 Jun 2019	27 Jun 2025	A generic neutron scattering instrument.		70%	
NSSPRJ.5.27	21 Instrument 5 years	1 Jun 2020	27 Jun 2025	A generic neutron scattering instrument.		70%	
NSSPRJ.5.28	22 Instrument 5 years	1 Jun 2020	27 Jun 2025	A generic neutron scattering instrument.		70%	

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6. INTEGRATED CONTROL SYSTEMS

6.1 Introduction

The ESS Control System is a complex network of hardware, software, and configuration databases that integrate the operations of the Accelerator, Target, Instrument and Conventional Facility infrastructures. It is essential for the synchronisation and day-to-day running of all the equipment responsible for the production of neutrons for the experimental programmes. The Integrated Control System (ICS) project manages the activities involved in the design, construction, installation, and commissioning of the ESS Control System.

6.2 Scope

6.2.1 Included

The ESS Integrated Controls System includes:

- Requirements and overall system design
- Design and installation of control system core components organised in four work packages for physics applications, software, hardware, and protection
- Integration support with all integration efforts for ICS stakeholders
- Control System Infrastructure enabling the control system to operate

6.2.2 Excluded

ICS is not responsible for the Target Safety System. The TSS is the responsibility of the Target Division, and ICS provides control systems for those parts of Target Systems that are not classified under safety system regulations.

The ICS construction project does not include the following activities, which are defined as operations activities:

- Commissioning and operation of control system core components defined in work packages 2, 3, 4 and 5
- Integration of target and instruments
- Installation and commissioning of control system infrastructure defined in work package 7
- Control box support after June 2018
- Development environment after January 2018

6.3 Major milestones

Final system design specification ready	Q4 2014
BLED device database ready	Q4 2016
Vertical test complete	Q1 2017
ICS operational for installation	Q3 2017
End of construction	Q4 2019

6.4 Integrated Control System Cost

Table 4 Integrated Control System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
INTCSS	Integrated Control Systems	2 Jan 2013	23 Dec 2019			6%	Garry Trahern
INTCSS.1	Requirements, Architecture and Design	2 Jan 2013	19 Dec 2014			0%	
INTCSS.1.1	Final Design	2 Jan 2013	19 Dec 2014	Updating and refining system design after prototypes of the individual sub systems are evaluated. The most critical design decisions will be verified and validated. Results from tests and experiences will be incorporated into an overall final design spec		0%	
INTCSS.2	Physics Core Components	7 Jan 2013	22 Dec 2017			0%	
INTCSS.2.1	Machine Model	7 Jan 2013	22 Dec 2017	Development and implementation of an accelerator simulator that interacts with the user interface as a real machine.		0%	
INTCSS.2.2	High Level Applications	1 Feb 2013	22 Dec 2017	Defining and implementing software frameworks addressing non-functional requirements such as scalability, look & feel of GUI and communication among distributed processes. Aim is to improve efficiency in developing control system application functionality		0%	
INTCSS.3	Software Core Components	7 Jan 2013	23 May 2019			0%	
INTCSS.3.1	Data Management (BLED)	7 Jan 2013	08 Jan 2018	Development and integration of configuration databases where all accelerator parts and the relationships between the parts are modelled		0%	
INTCSS.3.2	CS Services	1 Feb 2013	23 May 2019	Maintenance, diagnostics, supervision and similar services not covered by control box design and integration.		0%	
INTCSS.4	Hardware Core Components	14 Jan 2013	22 Dec 2017			0%	

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Table 4 Integrated Control System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
INTCSS.4.1	Timing System	14 Jan 2013	22 Dec 2017	400 cPCI + 200 uTCA event receivers, 34 fanouts, 500 TTL IOs. Requirement, design and implementation of receiver device synchronisation. Develop functions for device specific actions JIT and distribute events to all timing receivers.		0%	
INTCSS.4.2	Control boxes	31 Jan 2014	22 Dec 2017	Develop and prepare hardware required to integrate all sub-systems of the ESS machine. Implement real-time control loops		0%	
INTCSS.5	Protection Core Components	2 Jan 2013	14 Sep 2018			0%	
INTCSS.5.1	Machine Protection System	2 Jan 2013	22 Dec 2017	1 BIS Master device, 20 BIS switches, 100 BIS nodes, 5000m cable, 222 UPS, 1 post mortem sys. Develop and implement functions necessary to detect signals on input interfaces and fault indications to trigger output interfaces/mitigation to switch off beam.		0%	
INTCSS.5.2	Personnel Protection System	1 mar 2013	14 Sep 2018	1 Master device, 10 switches, 50 nodes, 3000m cable. Development and implementation of all functionality necessary to trigger one or more output interfaces needed to prevent on-site staff injuries. Interfacing with MPS and target security system.		0%	
INTCSS.6	Integration Support	2 Jan 2013	20 Dec 2019			10%	
INTCSS.6.1	Accelerator Integration	2 Jan 2013	20 Dec 2019	400 cPCI control boxes, 200 uTCA control boxes. All activities required to integrate accelerator devices into ICS. 2013-2015 this is managed in monthly iWeeks sessions.		10%	
INTCSS.6.4	Conventional Facilities Integration	7 Jan 2016	8 Sep 2017	All activities required to integrate conventional facilities into ICS. Preparations 2013-2015 are managed in monthly iWeeks sessions included in Accelerator integration.		0%	
INTCSS.6.5	Test stands Integration	7 Jan 2016	18 Dec 2018	All activities required to integrate test stands into ICS. Preparations 2013-2015 are managed in monthly iWeeks sessions included in Accelerator integration.		10%	
INTCSS.7	Control System Infrastructure	21 Jan 2013	20 Dec 2019			10%	

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Table 4 Integrated Control System cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
INTCSS.7.1	Control Room	3 Feb 2014	30 Sep 2019	8 Main stations, 6 Accelerator stations, 8 Target stations, 22 Experiments remote stations, 44 UPS units, 1000m ² carpet, control room furniture. Design based on requirements to be collected from all other projects/stakeholders		70%	
INTCSS.7.2	Data Centre	7 Jan 2014	20 Dec 2019	50 servers, 50 storage units, 100 UPS. Design and implement server and storage infrastructure for normal control system operation during development, commissioning and operations. Includes procurement and finishing of contracted installation services.		0%	
INTCSS.7.3	CS Networks	1 Mar 2013	22 Dec 2017	20 32port routers, 50 wi-fi routers, 100 32port switches, 20 MACs, 40 PCs. Design of infrastructure to transfer all data from the machine, front end and IO-controllers to the control room, CS Services and Data centre.		0%	
INTCSS.7.4	Cabling & Wiring	5 May 2014	15 Jul 2016	10000 m ethernet cable, 5000 m optical cable for timing system + 5000 m for networks. Defining and implementing the routing and connection of cabling and wiring to all systems.		0%	
INTCSS.7.5	Scientific Computing Infrastructure	21 Jan 2013	18 Sep 2019	Requirements of the machine model and other control system data stakeholders. Problem debugging, deploying code.		0%	
INTCSS.7.6	Develop Environment	1 Feb 2013	15 Dec 2017	Defining and implementing the standardised set of tools that all ICS stakeholders use in order to develop standardised components, systems and products.		0%	
INTCSS.8	Management	2 Jan 2013	20 Dec 2019			0%	
INTCSS.8.1	Management	2 Jan 2013	20 Dec 2019	All management activities within the ICS project. Planning, monitoring and control, training, recruitment, correspondence, organising meetings and general administration.		0%	

7. CONVENTIONAL FACILITIES

7.1 Introduction

Conventional Facilities are responsible for the design and civil construction of the buildings, and the landscape surrounding the buildings.

7.2 Scope

7.2.1 Included

The scope consists of the design and construction of all buildings, landscaping, and utilities serving the facility on the site in Lund.

7.2.2 Excluded

The following is not included in CF's scope:

- Shielding in any form, except the earth berm above the accelerator tunnel
- Piling
- Costs due to architectural design
- Temporary facilities and utilities for other projects on site during construction
- Earthquakes above 10E-5
- Ventilation of the accelerator tunnel
- District heating piping to heat exchangers, and heat exchangers and pumps
- Sprinklers
- Procurement of land

7.3 Major milestones

ITT for contract E101	Q3 2013
Contract signed E101	Q4 2013
ITT for contract E201	Q4 2013
Contract signed E201	Q2 2014
Building Permit received	Q4 2013
Construction on site start	Q1 2014

7.4 Conventional Facilities Cost

Table 5 Conventional Facilities cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
CONVFC	Conventional Facilities	20 Mar 2012	23 Dec 2024	The buildings, infrastructure and landscape that compromise the spaces that house ESS research equipment, machines, instruments and human beings.		0%	Kent Hedin
CONVFC.1	Management	28 Sep 2012	23 Dec 2024	The management activities for the CF.		0%	
CONVFC.1.1	Staff	2 Jan 2013	23 Dec 2024	The ESS staff employed to manage the CF.		0%	
CONVFC.1.2	Contracted Staff	2 Jan 2013	23 Dec 2019	Contracted staff, that holds a position in the CF management organisation. Mainly 100% project allocated.		0%	
CONVFC.1.3	Travel	2 Jan 2013	23 Dec 2019	Travel costs for the project.		0%	
CONVFC.1.4	Procurement	28 Sep 2012	6 May 2014	Procurement activities for procuring the construction contractors as well as some design services. Costs for services procured in order to assist in this work.		0%	
CONVFC.1.5	Construction Management	3 Feb 2014	23 Dec 2019	Construction management costs, such as site office, security, workers cabins, temporary utilities and connection fees.		0%	
CONVFC.1.6	Preconstruction	1 Jan 2013	22 Dec 2017	Works performed before the construction start on site, such as inspection of existing buildings, construction of external roads, main power connection, archaeological investigations.		0%	
CONVFC.2	Design	20 Mar 2012	2 Jan 2018	All design performed by CF in order to construct the facilities. Procured through our framework agreements initially. New procurement necessary in 2015.		0%	
CONVFC.2.1	Feasibility Study	20 Mar 2012	2 Jan 2018	The first stage of the design, where the scope baseline is being defined.		0%	
CONVFC.2.2	Preliminary Design	1 Feb 2013	5 Feb 2016	The second stage of the design, where the scope is detailed.		0%	
CONVFC.2.3	Detailed Design	10 Oct 2013	2 Mar 2017	The final stage of design, where the drawings and descriptions that are used for the construction are produced.		0%	
CONVFC.3	Construction	2 Jan 2014	20 Dec 2024	All construction of the facilities. Procured in competition.		0%	

Table 5 Conventional Facilities cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
CONVFC.3.10	Site preparations	2 Jan 2014	12 June 2015	Mobilisation, temporary fencing, temporary utilities, temporary roads and parking, site security.		0%	
CONVFC.3.7	Earth Works	3 Feb 2014	29 Apr 2015	Mass balancing the site, excavation for main utilities, permanent roads and parking, storm-water, water and sewage.		0%	
CONVFC.3.16	Main utilities and Ground Installations	10 Apr 2014	19 Apr 2016	All utilities to the facility from the border of the site. All utilities on the site to and from the Central Utility Building.		0%	
CONVFC.3.5	Auxiliary Bldgs	2 Sep 2014	02 Jul 2018	All support buildings for the facilities		0%	
CONVFC.3.1	Accelerator Bldg	4 Jul 2014	11 Jan 2017	The buildings and tunnel housing the Accelerator and its support infrastructure inc. the Klystron Gallery.		0%	
CONVFC.3.2	Target Bldg and Experimental Hall 1 2	18 Aug 2014	20 Dec 2024	The buildings housing the Target and the two Experimental Halls adjacent to the Target. This also includes labs and other rooms that are incorporated in the buildings.		0%	
CONVFC.3.3	Experimental Hall 3 and Guide halls	13 Nov 2015	20 Dec 2024	The third Experimental hall housing the medium long instruments, inc. the guideways stretching from Experimental Hall 2 towards Experimental Hall 3.		0%	
CONVFC.4	Testing & Commissioning	29 Oct 2015	15 Nov 2019	Testing and commissioning of the Conventional Facilities.		0%	
CONVFC.4.01	Earth Works	12 Feb 2018	26 Apr 2018	Testing and commissioning of the Earth works constructed.		0%	
CONVFC.4.07	Main Utilities & Ground Installations	18 Jan 2016	5 Jul 2016	Testing and commissioning of the Main Utilities & Ground Installation works constructed.		0%	
CONVFC.4.06	Auxiliary Bldgs	29 Oct 2015	20 Sep 2016	Testing and commissioning of the Auxiliary buildings constructed.		0%	
CONVFC.4.02	Accelerator Bldg	15 Dec 2015	06 Mar 2017	Testing and commissioning of the Accelerator building constructed.		0%	
CONVFC.4.03	Target Bldg and Experimental Hall 1,2	21 Nov 2017	26 Jun 2018	Testing and commissioning of the Target building and Experimental Hall 1, 2 constructed.		0%	

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Table 5 Conventional Facilities cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
CONVFC.4.04	Experimental Hall 3 and Guide halls	22 Jan 2018	28 May 2018	Testing and commissioning of the Experimental Hall 3 and the Guideways constructed.		0%	

8. ENERGY

8.1 Introduction

The Energy Project is responsible for the energy goals 'Responsible, Renewable and Recyclable'. This entails implementing and maintaining an Energy Management System and developing technical, economic and legal solutions for renewable energy production and recycling of surplus heat. Additionally, the Energy Project is responsible for the acquiring the appropriate connections to public power grids for electrical power and heat recycling.

8.2 Scope

8.2.1 Included

The Energy project includes the following Work Breakdown Structure:

- Management
- Energy Management System
- Renewable Energy
- Heat Recycling
- Electrical and Heat Grid Connection

8.2.2 Excluded

The costs for acquiring solutions for renewable energy and surplus heat will be financed by other means.

8.3 Major milestones

Business plan for Renewable Energy and Heat Recycling	Q4 2014
Electrical Grid Connection	Q1 2016
Heat Grid Connection	Q1 2016

8.4 Energy Cost

Table 6 Energy cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ENERGY	Energy	7 Jan 2013	23 Dec 2019	Energy Project		0%	Thomas Parker
ENERGY.1	Management	7 Jan 2013	23 Dec 2019	Project Management activities for the Energy project		0%	
ENERGY.1.1	Management 2013	7 Jan 2013	20 Dec 2013	Project Management activities for 2013		0%	
ENERGY.1.2	Management future planned activities	7 Jan 2014	23 Dec 2019	Future planned project management activities		0%	
ENERGY.2	Energy Management System	7 Jan 2013	23 Dec 2019	The purpose of an Energy Management System (EnMS) is to form a basis for the organisation to ensure achievement of the set goals.		0%	
ENERGY.2.1	Energy Management System - First Baseline	7 Jan 2013	15 May 2013	Compile documents and information as in ISO 50001		0%	
ENERGY.2.2	Environmental Investigation	7 Jan 2013	15 Mar 2013	Aid SHE division to value all environmental impacts		0%	
ENERGY.2.3	Energy Management System update	12 Aug 2013	31 Oct 2013	Update the EnMS incl. all associated documents/information		0%	
ENERGY.2.4	Energy Baseline update	2 Sep 2013	01 Nov 2013	Updating of the Energy Baseline		0%	
ENERGY.2.5	Energy General work	2 May 2013	23 Dec 2013	Supporting the project manager within the Energy project		0%	
ENERGY.2.6	Energy Performance Indicators	1 Oct 2013	20 Dec 2013	Present relevant EnPI		0%	

Table 6 Energy cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ENERGY.2.7	EnMS future planned activities	7 Jan 2014	23 Dec 2019	Future planned activities for the Energy Management Systems which includes maintaining the EnMS and updating the Energy Baseline		0%	
ENERGY.3	Renewable Energy Sources	7 Jan 2013	31 Mar 2015	Realise full provision of energy need emanating from renewable energy sources at a stable and predictable price.		0%	
ENERGY.3.1	Business Plan Refinement	7 Jan 2013	23 Dec 2013	Continue work with refining business plan (e.g., develop case for complementary technologies such as solar and CHP). This work will be ongoing during all of 2013.		0%	
ENERGY.3.2	Legal status and taxation clarification	7 Jan 2013	30 May 2013	Get clarification regarding choice of legal status and specific taxation rules. Understand how these have an impact on chosen way to structure renewable and recycling projects from a practical, legal and financial perspective.		0%	
ENERGY.3.3	RFI and RFQ	1 Feb 2013	26 Apr 2013	Prepare for an RFI (Request For Information) and an RFQ (Request For Quotation).		0%	
ENERGY.3.4	Evaluation of RFI	1 Jul 2013	5 Nov 2013	Evaluate RFI/RFQ and in parallel refine business plan		0%	
ENERGY.3.5	Evaluation of RFQ	10 Jan 2014	9 Jun 2014	Final choice of energy partner and signing of agreement.		0%	
ENERGY.3.6	External financing	7 Jan 2013	20 Dec 2013	Writing of information memorandum, run negotiations with external finance partners, liaise with legal support and manage external financial placement in ESS subsidiary.		0%	
ENERGY.3.7	Creation of subsidiary	1 Apr 2013	31 Jan 2014	Incorporation of fully owned subsidiary (Swedish AB) to the ESS with sole task to serve as a platform for providing renewable and recyclable energy services to the ESS		0%	
ENERGY.3.8	General Renewable Energy activities	7 Jan 2013	20 Dec 2013	Meetings with turbine suppliers, wind farm developers, financial players, etc.		0%	
ENERGY.3.9	Future Planned Activities	7 Jan 2014	31 Mar 2015	Future planned activities for Renewables which will lead up to a final Business Plan		0%	
ENERGY.4	Heat recycling	7 Jan 2013	21 Dec 2015	The objective of the work package is to achieve recycling of surplus heat in accordance with the goal "Recyclable".		0%	

Table 6 Energy cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ENERGY.4.1	Development of Business Plan Recycling	7 Jan 2013	23 Aug 2013	Development of an overall business plan describing potential recycling solutions		0%	
ENERGY.4.2	Research and development collaboration ESS - SLU	7 Jan 2013	31 May 2013	A pre study performed in collaboration with SLU to clarify what is needed in terms of R&D on how to recycle medium and low grade surplus heat.		0%	
ENERGY.4.3	The Hybrid Cooling chain	7 Jan 2013	23 Dec 2014	Offering a cooling loop for ESS as well as net revenue.		0%	
ENERGY.4.4	Formation of R&D consortium (SSEC)	7 Jan 2013	21 Dec 2015	ESS are participating in a national collaboration where methods, systems and technology are being developed for usage of medium and low grade surplus heat within bio production		0%	
ENERGY.4.5	Recycling system 2.0	7 Jan 2013	23 Dec 2014	Updated description on the ESS recycling system		0%	
ENERGY.4.6	Future Planned Activities	7 Jan 2014	31 Mar 2015	Future planned activities for Recycling which will lead up to a final Business Plan		0%	
ENERGY.5	Grid Connection	7 Jan 2013	23 Dec 2015	The purpose of the work package is to supply connections to the necessary energy grids, the electrical power grid and the district heating grid.		0%	
ENERGY.5.1	Grid Connection 2013	7 Jan 2013	20 Dec 2013	The objective of the work unit is to secure agreements with the grid companies for grid connections		0%	
ENERGY.5.2	Grid Connection planning	7 Jan 2014	23 Dec 2015	The objective of the work unit is to manage the implementation of the grid connection agreements		0%	
ENERGY.5.3	Cost for Critical investigation	7 Jan 2013	20 Dec 2013	Costs for critical external work made by E-on and RWTH Aachen to lay the legal and technical background and to investigate impact of ESS in the electrical grid.		0%	
ENERGY.5.4	Grid Connection cost	7 Jan 2014	18 Dec 2015	Connection tariff payable to grid operator		0%	
ENERGY.5.5	Heating Grid Connection cost	7 Jan 2014	18 Dec 2015	Costs for connecting ESS to the heat recycling grid		0%	

9. PROGRAMME SUPPORT

9.1 Introduction

The Programme Support provides the infrastructure and cross-programme functions, such as cost estimation/control, scheduling, equipment logistics, contract management and project lifecycle planning, safety and licensing, engineering support, system engineering, and equipment logistics.

9.2 Scope

9.2.1 Included

The Programme Support is organised into the following Work Packages:

- Engineering Support
- Safety & Licensing
- Programme Management
- Systems Engineering
- Equipment Logistics

9.2.2 Excluded

The Programme Support does not include the following:

- Administrative processes on ESS level
- External communication
- Human resource management on ESS level

9.3 Major milestones

Construction Readiness review	Q4 2013
Permissibility SSM	2013
Environmental court decision	Q1 2014

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9.4 Programme Support Cost

Table 7 Programme Support cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
PROADM	Programme Support	7 Jan 2013	23 Dec 2025	The Programme Support includes central functions related to steering, controlling and supporting the programme and the projects during its lifecycle		0%	Johan Brisfors
PROADM.1	Engineering support	7 Jan 2013	5 Dec 2025	Coordination of the Design, support of the design activities, design integration, tools and Survey & Alignment.		0%	
PROADM.1.1	Design Division	7 Jan 2013	6 Jan 2025	Coordination of the Design Management, including design processes, Component Standardisation and Design Technology Development		0%	
PROADM.1.2	Engineering coordination	7 Jan 2013	20 Dec 2019	Coordination and integration of the 3D master model, ESS Plant Layout Model		0%	
PROADM.1.3	Engineering contents	7 Jan 2013	28 Nov 2025	CAD & PDM implementations, user support, methodology & training for the support of design work, product data management and exchange of design data		0%	
PROADM.1.4	Survey & Alignment	2 May 2013	5 Dec 2025	Survey and Alignment will advise appropriate engineering groups on design, fabrication, installation of equipment stands, monument systems and other alignment systems for ESS		0%	
PROADM.1.5	Programme Engineering	7 Jan 2013	20 Dec 2019	Coordination of Cooling and Electrical Design activities		0%	
PROADM.2	Safety & Licensing	7 Jan 2013	20 Dec 2019	The Safety & Licensing work package contains actions and associated cost needed for receiving necessary permits from the legal authorities as well as managing the work with safety, security and environmental requirements		0%	
PROADM.2.1	Radiation Safety Management	7 Jan 2013	20 Dec 2019	The WU includes the cost for the annual fee to the Swedish Radiation Safety Authority (SSM), activities for the Safety Analysis Report (SAR), setting up the Radiation Safety Management Program and the Radiation Safety Review committee.		0%	
PROADM.2.2	Conventional Safety Management	7 Jan 2013	23 Dec 2016	Manages the fire safety requirements and the contacts with local fire brigade. It also manages other conventional safety requirements, e.g. electrical safety and chemical handling.		0%	

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Table 7 Programme Support cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
PROADM.2.3	Security Management	7 Jan 2013	23 Dec 2016	The work unit manages the legal and the internal security requirements for how the security systems will be constructed and how the security organisation will be built-up for the Construction Phase and the Operations Phase.		0%	
PROADM.2.4	Environmental Management	7 Jan 2013	23 Dec 2016	The WU manages the EC application, including complementary analyses, the court negotiations and possible appeals concerning the permit from the EC. It also manages the Environmental Management System.		0%	
PROADM.2.5	Property & Land Management	7 Jan 2013	23 Dec 2014	The work unit include activities associated with general negotiations with authorities and organisation of the ESS site. Examples are the cost for archaeological investigations and necessary agreements with the ditching companies.		0%	
PROADM.2.6	Expenditures	7 Jan 2013	23 Dec 2016	Travel expenses for Safety & Licensing Work Package		0%	
PROADM.3	Programme management	7 Jan 2013	23 Dec 2025	Programme Management is responsible for overall steering of the Programme and supports the projects with cost, budget, planning and risk management		0%	
PROADM.3.1	Project Support Management	7 Jan 2013	23 Dec 2025	Supports the programme and projects with cost, budget, planning and risk management		0%	
PROADM.3.2	Collaboration Management	7 Jan 2013	20 Dec 2019	The scope for Collaboration Management is to manager commercial suppliers, partnerships and In-kind collaborators		0%	
PROADM.3.3	Quality Management	7 Jan 2013	20 Dec 2019	This work unit includes activities for Quality Management and Quality Assurance. It also includes the cost for using Norms & Standards.		0%	
PROADM.3.4	Monitoring & Controlling	7 Jan 2013	20 Dec 2019	The work unit include activities for Programme Control		0%	
PROADM.3.5	Management of Programme	7 Jan 2013	20 Dec 2019	Responsible for Programme, EPG, CCB and Programme Plan. Costs for Programme Director, Deputy, Senior Advisors for Programme and Management Assistants		0%	
PROADM.3.6	Travel, training & software licenses	7 Jan 2014	20 Dec 2019	Costs for travel of Programme Management WP, training in Project Management and License fee for Primavera P6 and Cobra		0%	

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Table 7 Programme Support cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
PROADM.4	Systems Engineering	7 Jan 2013	23 Dec 2020	Establishing and maintaining the technical cohesiveness of all individual ESS elements, and overall framework and procedures for the management of the ESS technical requirements, design process and verification process		0%	
PROADM.4.1	Acquisition & supply	7 Jan 2013	23 Dec 2020	Support process, and acquisition process for product acquisition and supplier performance evaluation.		0%	
PROADM.4.2	Technical management	7 Jan 2013	23 Dec 2020	Planning (imc. strategy, technical effort definition, schedule and org., technical plans, work directives), Assessment (progress against plans and schedules, requirements, technical reviews), and Control (outcomes management, information dissemination)		0%	
PROADM.4.3	Systems Design	7 Jan 2013	23 Dec 2020	Requirement definition process, and solution definition process (logical, physical).		0%	
PROADM.4.4	Product realisation	7 Jan 2013	23 Dec 2020	Implementation process and transition to use process		0%	
PROADM.4.5	Technical evaluation	7 Jan 2013	23 Dec 020	System analysis process (effectiveness, trade-off, risk), requirement validation process, system verification process (design solution, end product, enabling product readiness), and end products validation process.		0%	
PROADM.4.6	Travel, training & workshops	7 Jan 2013	20 Dec 2019	This activity includes all travel, training and expenses for supporting workshops for the Systems Engineering Work Package during the Construction Phase		0%	
PROADM.5	Equipment logistics	12 Aug 2013	20 Dec 2019	This work package handles the goods on site and includes the following activities: management, on site moving, equipment procurement, shipping & receiving, storage management		0%	
PROADM.5.1	Equipment Logistics 2013	12 Aug 2013	23 Dec 2013	Plans, policies and procedures for implementation of a logistics system		0%	
PROADM.5.2	Future planned activities	7 Jan 2014	20 Dec 2019	Includes activities such as material handling, warehousing, information, transportation, packaging and inventory		0%	

10. ADMINISTRATION AND LINE MANAGEMENT

10.1 Introduction

The Support organisation is responsible for providing the necessary administrative infrastructure, including services, tools, and resources. Our customers are mainly the rest of the organisation.

10.2 Scope

10.2.1 Included

The Administration and support budget includes Office, IT, and HR, which are the main cost drivers and where direct costs and support costs are based on the FTE assumptions for ESS organisational growth projection. The budget also includes the service functions within Procurement, Legal, Finance, and general administration, Director's services (including Communications and Innovation) and Line management.

10.2.2 Excluded

The costs cover operations at ESS's current offices in Lund, and do not include any activities within, establishment of, or support for the DMSC in Copenhagen. Furthermore, the estimate does not cover the transformation of ESS AB into an ERIC and the establishment of such an organisation. The Administration budget covers the company insurance but it does not cover the project insurance. Direct costs related to relocation of employees are not covered by the HR budget.

10.3 Major milestones

The nature of the support organisation makes it difficult to divide all work into milestones since much of the work is repeated daily. However, important milestones for 2013 are:

Implementation of Service matrix	Q1 2013
Draft template in-kind contract for Construction Phase	Q1 2013
Implementation of the ERP system	Q2 2013
Establishment of a legal entity in Denmark	Q2 2013
Publication of annual report	Q2 2013
Annual salary review	Q2 2013

10.4 Administration Cost

Table 8 Administration cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ADMLIN	Admin & Line Management	1 Jan 2013	31 Dec 2019	The Support organisation i.e. the Administration, Director's services and Line Management is responsible for providing the necessary administrative infrastructure including services, tools and resources as well as collaboration with governing bodies.		0%	Matti Tiirakari
ADMLIN.0	Admin Directorate	1 Jan 2013	31 Dec 2019	The objective of the Admin Directorate is to secure efficient and cost effective delivery of administrative services to the organisation.		0%	
ADMLIN.0.4010	Admin General inc. Bureau	1 Jan 2013	31 Dec 2019	Responsible for leading the Admin Directorate. The objectives of the Bureau are to support ESS governing bodies and ensure that legal requirements regarding governance and reporting are met.		0%	
ADMLIN.0.4020	HR	1 Jan 2013	31 Dec 2019	The objective of the HR department is to ensure that the organisation has the required human resources by attracting, recruiting, retaining and developing ESS staff.		0%	
ADMLIN.0.4030	Finance	1 Jan 2013	31 Dec 2019	The objective of the Finance department is to deliver a complete and reliable finance function complying with financial laws and ethics as well as other statutory requirements.		0%	
ADMLIN.0.4040	IT	1 Jan 2013	31 Dec 2019	IT is responsible for all administrative IT within the organisation. The overall objective is to deliver an efficient and secure IT-platform with high reliability and adequate support.		0%	
ADMLIN.0.4050	Office	1 Jan 2013	31 Dec 2019	The Office department is responsible for facility management and office services. The objective is to deliver a service minded office management service with high reliability and cost effectiveness.		0%	
ADMLIN.0.4060	Procurement	1 Jan 2013	31 Dec 2019	The procurement division shall supply a cost efficient and reliable procurement process in compliance with the existing legal frameworks.		0%	
ADMLIN.0.4090	Legal	1 Jan 2013	31 Dec 2019	The objective of the legal function is to support, advice and monitor legal aspects of issues concerning ESS governance, procurement, commercial agreements and contracts etc.		0%	

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Table 8 Administration cost

WBS Code	WBS Name	Start	Finish	Description	Budget [Euro]	In Kind Potential	Responsible
ADMLIN.5	CEO Services	1 Jan 2013	31 Dec 2019	CEO services include also the Innovation & Industry team as well as the Communication division. The objective of Director's services is to support the CEO and the governance of the organisation.		0%	
ADMLIN.5.1010	Director's Services	1 Jan 2013	31 Dec 2019	Services rendered by the CEO. The work includes support for external relations and communication with stakeholders and industry.		0%	
ADMLIN.5.1020	Corporate	1 Jan 2013	31 Dec 2019	Services rendered assisting the CEO and general corporate matters,		0%	
ADMLIN.5.1040	Board	1 Jan 2013	31 Dec 2013	Services rendered by the governing body the Board of Directors of ESS AB.		0%	
ADMLIN.5.1060	Innovation	1 Jan 2013	31 Dec 2014	Services rendered by the Innovation & Industry Team.		0%	
ADMLIN.5.5020	Communication	1 Jan 2013	31 Dec 2019	Services rendered by the Communication department in order to handle internal as well as external communication.		0%	
ADMLIN.7	Science Support	1 Jan 2014	31 Dec 2019	Research activities as well as Project sponsor activities for the Science Directorate including interactions with SAC and other governing bodies.		0	
ADMLIN.6	Machines Support	1 Jan 2013	31 Dec 2019	Project Sponsor activities for the Machine (Accelerator and Target Station) and high-level requirements management. Building and management of collaborations for the Machine. Management of Machine interactions with TAC and other governing bodies.		0	