



## NeutronSource ESS Activity Report 1<sup>st</sup> Reporting Period

### Project description

The ESS Preparatory Phase project (NeutronSourceESS) has the overall goal to pave the way to and to facilitate a site decision and a final decision to construct and to operate the European Spallation Neutron Source (ESS). ESS will be the brightest source of neutrons that will be used for experiments to look inside the materials. It will be the best neutron source world-wide for practically all classes of instruments. ESS will provide much more intensity than the present neutron sources, brighter neutrons beams that, with a suite of more than 40 neutron scattering instruments, will enable scientist of all disciplines to investigate materials in situ, in vivo, in real time and for real life applications. This will have enormous positive consequences for society, industry and technology. It will also retain and strengthen Europe's lead in neutron science in quality and quantity.

Presently, there are three governments (Spanish, Swedish and Hungarian) firmly committed to host ESS in their own country. While the process for reaching an agreement is mainly political and lobbied for by the site contenders, the ESS-PP project has focalized on several aspects not fully covered by the early 2003 ESS project (legal, financial, governance, environmental and target issues). Other important objectives are the promotion of neutron research and its applications, and the organization of site-independent actions aimed to enable a better comparison between the three candidates in order to ease the decision process.

### Project partners

Beneficiary Number	Beneficiary name	Short name	Country
1 (Coordinator)	Paul Scherrer Institut	SI	Switzerland
2	Consorcio para la Fase Preparatoria del Proyecto de Fuente Europea de Neutrones por Espalación	ESS-B	Spain
3	Lunds Universitet	ULund	Sweden
4	ESS Hungary	ESS-H	Hungary
5	University of Huddersfield	UHuddersfield	UK
6	Science and Technology Facilities Council	STFC	UK
7	Forschungszentrum Juelich GMBH	FZ- Juelich	Germany
8	Consiglio Nazionale delle Ricerche	CNR-INFN	Italy
9	Consorzio Nazionale Interuniversitario per le Scienze Fisiche de la Materia	CNISM	Italy
10	Commissariat à l'Énergie Atomique	CEA	France
11	Latvijas Universitāte	ULatvia	Latvia



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## **Project web site**

[www.ess-neutrons.eu](http://www.ess-neutrons.eu)

## **Project objectives**

The objectives of the NeutronSourceESS project are:

- 1- To address all site-related strategic issues of ESS which might affect in any way the decision-making process.
- 2- To address all strategic issues aimed to improve the definition and the awareness of the ESS.
- 3- To establish and analyse all site-independent financial and legal issues related to the ESS, its construction, exploitation and decommissioning phases
- 4- To critically assess and compare the current models of governance in functioning European laboratories in order to arrive at a preferred model of governance for the ESS
- 5- To define and evaluate the core issues relevant to environmental impact and compliance for the three possible target types: solid targets (tungsten and alloys), liquid mercury and liquid lead / lead eutectics.
- 6- To compare the technical performance of the three possible targets, as well as to assess the upgradeability of ESS

## **Project status**

### **Site characterization**

Site characterization issues are addressed in WP3. The tasks within this WP are quite diverse, with only few interactions within the WP; however some of the tasks -especially T3.2 (Risk assessment) and T3.3 (Updated safety report) are tightly linked to other work packages such as WP7,8 and 9. Tasks T3.1 (List of site characteristics) and T3.4 (Assessing the issue of geographic balance) are done and the deliverables are available. T3.2 and T3.3 will need more time due to a late start and the interaction and dependencies to other WPs. For T3.5, the existing reports are being assessed and the deliverable is in the stage of being written as a draft.

A particularly important contribution of the project towards a site decision was the work carried out in T3.1. A questionnaire on site strategic issues was elaborated together with EWESS (ESFRI Working group on siting of ESS) and distributed to the three contenders. The answers provided by the sites, together with the visits of Lund Debrecen and Bilbao by the expert review group nominated by ESFRI, organized by the PSI in close collaboration with EWESS, were an important contribution for paving the way towards a site decision. The decision on the site cannot be forced by such investigations, but their existence is imperative for such a decision.

T3.4/D3.4 clearly demonstrate the strength of the network of neutron sources in Europe and their overlap with the distribution of e.g population, geography or economic factors. The geographic distribution of synchrotron sources - essential for a very similar user base - is very much comparable and allows the users to combine both techniques. A 3<sup>rd</sup> generation neutron source such as ESS built at one of the (somewhat geographically peripheral) proposed sites will distort the distribution to a certain extent. However, this can be compensated in the future with improved traffic connection according to the increased demand triggered by such a facility and all the industry attracted by it. Arguing that such facilities have to coincide with the centre of gravity of population or economy would contradict the political will to let all EU countries participate in the scientific and economical growth.

### **Publicity and communication**

Publicity and communication issues are addressed in WP4. The purpose of this work package is to elevate the presence of the ESS project in the media, with the public, with scientists from wider disciplines and with industry. An increased awareness of ESS, what it does and what it can achieve for European science and technology, will facilitate the decision making processes associated with securing construction of ESS.

As part of the publicity programme we have established an ESS Preparatory Phase Project website providing an overview of the ESS, the Preparatory Phase Project, and details of current activities. The web address is [www.ess-neutrons.eu](http://www.ess-neutrons.eu).

Aspects of WP4 public relations activity have been subcontracted to Campuspr (Midlands) Ltd, a company which has previously handled the UK public relations activity for ESS. Specifically, Campuspr is handling (i) press releases (ii) brochure production (iii) exhibition materials (iv) liaison with the public relations officers of the ESS site candidates, all under the direction of the WP4 coordinator.

Site-independent promotional movies on ESS and its potential applications in European science and technology have been planned and storyboarded. A contract is about to be placed with Optic Verve and Puppetman Productions, both of whom have in the past worked on visualization and animation of the ESS. The producers have already produced, for this work package, a short movie describing ESS (available on the website) and narrated by UK broadcaster and scientist Lord Robert Winston. For the additional promotional/educational movies we are anticipating having an internationally recognised personality to present the project.



The presence of ESS in the wider scientific and political arena has been maintained through subcontracting activities to Dr Peter Tindemans, who has promoted and publicised ESS across Europe in numerous high-level meetings and conferences.

Additionally activities have included writing articles for publication in Research Fortnight (December 2008), Research Europe (January 2009) and three articles for publication in Public Service Review (to appear in June 2009), and producing an ESS-PPP poster for ECRI 2008. Plans have been formulated to produce a high quality photographic book on images from neutron tomographic reconstructions, as a way of introducing the power of neutrons to non-cognate scientists and artists.

### Financial approach and Legal issues

The financial approach and Legal issues related to ESS are addressed in WP5 and 6, respectively.

WP5 is considered to be a key area as it consists of achieving an accurate, updated ESS cost (T5.1 and T5.2), a central issue of the negotiations. Likewise, it provides a financial model that guarantees the feasibility and viability of such a large project.

With regards to WP6, its importance lies in the establishment and analysis of a comprehensive legal basis relating to the construction and operating stages of the ESS on which it will be possible to base the site chosen for the implementation and management of the ESS.

To coordinate the work of the different partners, two combined WP5+6 meetings were organized in Bilbao during the first reporting period (11 June 2008 and 12 February 2009). In spite of some delays, mostly motivated by the difficulties of some partners due the late transfer of funds, work has begun in all the tasks; two have even been completed: T6.1 “Legal Background” and T6.5 “Legal from of ESS”. Closely interrelated, both tasks attempt to analyse the possible legal forms for the ESS. In this regard, the main conclusion is that the most appropriate legal form for the ESS would seem to be the ERI and secondly, the private limited-liability company.

The current state of progress of WP 5 and 6 are shown in the following tables.

WP	Tasks	In progress	Preliminary completed	draft	Deliverable completed
5	5.0 Fixing of spec. for costing	[Green bar]			
	5.1 Updated installation costs				
	5.2 Updated operating costs				
	5.3 Decommissioning costs				
	5.4 Computer tool				
	5.5 Funding sources				
	5.6 Scenario for fund creation				



Tasks		In progress	Preliminary completed	draft	Deliverable completed
<b>W P 6</b>	6.1 Legal background				
	6.2 Collation of regul. and restr.				
	6.3 Collation of licensing				
	6.4 Collation of safety regul.				
	6.5 Legal form of ESS				
	6.6 Intellectual property rights				

## Governance

The questions related with the governance of ESS are addressed in WP7. The work, or the framework of the work, is centred around the database containing information about different labs. Regular meetings of the members of WP 7 have taken place in Lund (September 9-10, 2008), Paris (December 8, 2008) and Budapest (March 2, 2009). We have chosen to have meetings at different locations in order to maintain balanced travelling for participants of WP7. This has proven to be an effective way of maintaining contact within WP7. Three quarters of the database have been filled in. Task meetings have taken place for T7.6 (Access framework for external users, Villigen, November 20-21, 2008) and for T7.7 (Opportunities of a new paradigm of how to run a research facility, Rome, December 19, 2008 and Kloten, February 9, 2009). Other subtasks leaders have decided to assign work to individuals.

The outline of the database has been completed and three quarters of the information has been submitted. We are convinced that such a database which enable a critical comparison of models of governance in more than a dozen laboratories in Europe and in the world, allowing an overall suggestion for model of governance for the ESS. The work in WP7 will be one input to the definition of governance for the ESS, written from point of view by those currently active in the project. Other people will doubtless have further input.

The socioeconomic impact of the work carried out in WP7 will show itself through the actual construction of ESS. It will have significant impact on scientific capabilities in Europe and on the harnessing of innovation, which eventually will feed through to commercial products and economic progress.

## Health, safety and environmental issues

Health, safety and environmental issues related to the construction and operation of ESS are addressed in WP8. Both the experience with spallation sources in operation and the ESS conceptual design study have shown that spallation is a safe and environmentally friendly method for producing high intensity neutron beams, which can be realized in compliance with all relevant regulations. The subject of this work package is therefore to elaborate quantitative aspects for the specific basic design parameters of ESS (such as power, choice of target material, lifetime, etc) with the purpose of providing basic input data both for health, safety and environmental licensing and for the forthcoming optimization of the detailed engineering design, in order to realize the

project goal of voluntarily minimizing the hazards and environmental impact well below the requirements set by the regulators.

After having established a detailed work plan, we have accomplished a critical evaluation of the available methods in the literature for the evaluation of the radioactive inventory during operation. On this basis, a set of methods and tools have been chosen for (1) the establishment of the key data, (2) the optimization of the emission control, waste treatment and disposal and (3) the definition of decommissioning measures and procedures for the reference mercury target, as well as for the other possible alternative target materials in view of a final comparative evaluation of their relative performance and environmental impact.

Specifically, work has been started to investigate disposal methods for mercury in the form stable solidified compounds. The methodology for the evaluation of ground water protection needs has been elaborated, although it will need to be partially adapted to the conditions of the selected ESS site. The first phase of the probabilistic safety assessment study was accomplished by the examination of safety documentation of the US Spallation Neutron Source facility (in operation since 2006), which has successfully dealt with previously open issues. The progress of work is on track for the completion of the deliverable project reports in time, i.e. for tasks T8.1, T8.2 and T8.3 by end of October 2009 and for task T8.4 by end of December 2009.

## **Technical issues**

Technical issues needing revision with respect to the original ESS project are addressed in WP9. The ESS reference conceptual design ([http://neutron.neutron-eu.net/n\\_ess/29](http://neutron.neutron-eu.net/n_ess/29)) was completed in 2003. Its basic technical design choices received a powerful proof of principle and vindication by the successful construction and operation since 2006 of the Spallation Neutron Source (SNS) at Oak Ridge, USA. In order to enable starting actual construction work, the ESS conceptual design will need to be reviewed and developed into a detailed engineering design taking into account both, the specific conditions and characteristics of the site to be selected, and the technical developments in the meantime.

Two basic technical issues have been identified as important, site independent conceptual design choices: the selection of the target material between various options (task T9.1) and the identification of potential upgrade paths for future enhancements of the ESS facility (task T9.2). Recent developments at PSI demonstrated the potential feasibility of considering molten lead-bismuth eutectic as a third choice of target material, in addition to the two original options considered for ESS, liquid mercury (preferred) and rotating solid tungsten target (fallback option). The comparative study of the neutronic performance of these three alternatives has been started in this work package in parallel with their environmental evaluation in WP8. These complementary sets of data will enable the choice of the optimal target material for ESS from the combined points of view of minimizing the environmental impact and maximizing scientific output. The goal of the technical analysis of potential future upgrade paths for the ESS facility is to provide guidance for the detailed engineering design work and design review by the identification of long term technical implications of the various possible, essentially cost equivalent short term design choices. These long term implications include the feasibility of cost effective future enhancements of the facility



performance. A corresponding work plan has been elaborated in conjunction with the tasks it significantly builds on in WP8 and the target material study T9.1. The progress of work in WP9 is in line with the delivery date for the report on task T9.1 at end of October 2009, and of the upgradeability report T9.2 at end of February 2010.