ESS Accelerator Collaboration Board 171107

Meeting Date
7 November 2017

Location
National Centre for Nuclear Research, Świerk

Chairman
S. Pape Møller

Secretary
H. Danared

Attendees
A. Abramovicz, F. Ardellier, J.-L. Biarrotte, C. Bocchetta, D. Bocian, H. Danared, T. Ekelöf, W. Fabianowski, A. Fabris, R. Garoby, Z. Gołębiewski, P. González, J. Greenhalgh, P. Gustavsson, T. Jalakas, A.J. Johansson, P. Krawczyk, M. Lindroos, D. Makowski, A. Napieralski, E. Nappi, S. Pape Møller, C. Plostinar, J. Szewiński, M. Skafar, J. Taylor

Open and new actions from last meeting, with changes in red

N°	Actions	Resp.	Due date	Status	Deliverable
2.3	All presentations/discussed documents should be available for the participants at least 24 hours before the meeting.	ESS	Permanent	in progress	See Indico site for each meeting
3.1	Documents from participants to be sent by e-mails prior to the meeting.	All	Permanent	in progress	See Indico site for each meeting
3.2	Creation of an Indico site where ESS will upload the documents. The site should not be password protected.	ESS	Permanent	in progress	See Indico site for each meeting.
3.3	Involvement of the Collaboration Board in decisions affecting work or risk taken by each institute involved.	All	Permanent	in progress	See Indico site, Minutes and Actions of each meeting
8.1	Invite ESS installation team to next meeting	ESS	This meeting	Done	New ITC plan presented by C. Plostinar

1. **Welcome** (K. Kurek, R. Garoby, Z. Gołębiewski)

The NCBJ Director greeted the participants welcome and showed a movie introducing the institute. Also the ESS Technical Director and the host of the meeting welcomed the participants.

2. **Approval of agenda** (S. Pape Møller)

The agenda was adopted.

3. **Approval of minutes from last meeting** (S. Pape Møller)

The minutes from last meeting were approved.

4. **Follow-up of action list** (S. Pape Møller)

Action 8.1 is followed up through the invitation of C. Plostinar to this meeting and his presentation (see below) of the Installation, Test and Commissioning (ITC) Plan.

5. **ESS report** (R. Garoby)

Target wheel progressing in Bilbao.

Design and prototyping of cryogenic moderator system in Jülich.

Active cells being built at the site with 500 kg iron per m3 of concrete.

Ion source being disassembled in Catania, for installation in Lund in January.

Prototypes of cryomodules cooled down in Orsay and Saclay.

Installation of phase reference line from Poland in the tunnel.

Major parts of cryo plants installed.

Schedule delays due to procurement and administrative issues reflected in new ITC (Installation, Test and Commissioning) schedule.

Temporary control room being completed on site.

Partners for neutron instruments decided.

Major engineering work with "bunker", enclosing first part of neutron guides within massive shielding.

Tunnel floor has settled by up to 10 mm during one year between Aug 2016 and Sept 2017, which is considered normal.

428 employees, 50 nationalities, >45 collaborating institutions

Mark Anthony new head of Target Division.

New organizational structures for the installation phase established.

EVM reporting shows the project is 40% complete (i.e., 40% of the construction money is spent).

Start of accelerator installation delayed from end 2017 to early 2018.

First neutrons to instruments delayed from end 2019 to early 2021.

Start of user programme still in 2023.

15 instruments, 1.3 GeV, 3 MW installed power at end of construction in 2025 is the new baseline for ESS.

T. Ekelöf: Is the new time schedule official? R. Garoby: Yes, and it will be presented to Council in December. M. Lindroos: The new ITC Plan will be presented to the CCB (Change Control Board) also in December.

S. Pape Møller: Are we following the plan on the civil construction? R. Garoby: Much of the delays of the schedule are due to the civil construction, because of new requirements from licensing authorities.

6. ACCSYS report (M. Lindroos)

23 partners contribute to build the ESS accelerator.

The question often arises about the challenges with so many partners, but the answer is that it is with the partners that all the expertise to build the accelerator lies.

Highlights of accelerator developments include

- Scope of the utilities installations in the front-end building transferred to Skanska.
- Ion source and LEBT being disassembled for transport to Lund.
- Successful cooldown of M-ECCTD elliptical cryomodule prototype.
- Successful transfer of helium between spoke valvebox and spoke cryomodule prototype.

Two IOT prototypes are being tested at CERN.

A 120 kVA modulator prototype is being tested in Lund.

Important delays in RFI (Ready For Installation) dates will delay beam from normal-conducting linac to 2019 and beam to target at 572 MeV to Oct 2020.

Difficult to find technical solution for radiation shielding in stubs connecting tunnel with klystron gallery.

Estimated costs at completion (EAC) exceed the current budget with 29.85 M€, increasing the accelerator cost from 489.9 to 519.75, which will need to be taken from the overall ESS budget contingency.

E. Nappi: Is ESS or the IK providers are responsible for spares? M. Lindroos: It was clear from the beginning of the project that spares are not included in the construction budget, but would be taken from operations funding. In some cases spare parts are nevertheless included in IK deliveries, but many big items are not included and thus still missing.

T. Ekelöf: Is it technically understood how recovery of the reduced scope will take place? M. Lindroos: Yes, this is mainly purchase of RF components.

7. Status of scenarios for end of construction and initial operations (R. Garoby)

ESS management was asked to explore scenarios for budget and schedule regarding completion of construction and the initial operations phase.

Advice was sought from Annual Review, Scientific Advisory Committee (SAC) and Technical Advisory Committee (TAC).

The goal is to get green light from the Council for completion of construction and for funding of initial operations starting in 2019.

Three scenarios have been elaborated by ESS for completion of construction

- Construction Scenario 1: minimises additional costs, remains within 1843 M€$_{2013}$
- Construction Scenario 2: rapidly completes full scope with 22 instruments and 5 MW beam power
- Construction Scenario 3: is a balance between 1 and 2, adding capability at roughly half the rate of scenario 2.

In scenarios 1 and 3, the accelerator is installed for 1.3 GeV beam energy, i.e. 3 MW of power on the target, although a ramp-up of several years is expected in order to reach installed power.

In addition, two funding levels have been studied for initial operations 2019–2025.

Funding level A: minimises additional costs and stays within the original 2013 estimate of 810 M€$_{2013}$.

Funding level B: adds an additional 10% to reach 891 M€, for spares and improved reliability.

Annual Review and SAC clearly supported Scenario 3B.

TAC supported the decision of temporarily limiting the beam energy to 1.3 GeV by deferring procurement of RF sources for 10 high-beta cryomodules.

Annual Review supported installation of 3 MW power to reach stable operation at 2 MW, since reliability is key to the neutron users.

The main cost increase in the construction project, motivating the additional funds in scenarios 2 and 3, is the 144.5 M€ that have been added to address highly unlikely seismic events and antagonistic threats.

ESS management recommendations are to first ensure the 1843 M€, where 111 M€ are still missing since member states have not yet signed up for 100% of that budget. Then to reach funding scenario 3B to ensure reliable operation for initial science and on-going scientific excellency by adding and upgrading instruments in a rolling programme.

E. Nappi: When will we reach 5 MW? R. Garoby: In any case not until after 2025.

E. Nappi: Are the saved 30 M€ in scenario 1 and 3 in-kind? R. Garoby: No, the RF sources are paid with cash since IK partners could not be found for these.

T. Ekelöf: Isn't the saved 30 M€ a very small fraction of what a full instrument suite would cost, so it would be motivated to complete the accelerator as soon as possible? R. Garoby: It is true that it is a small fraction, but our NSS colleagues as well as SAC emphasize that science benefits more if these 30 M€ are put on instruments rather than on the accelerator.

8. Status of ACCSYS in-kind agreements (P. Gustavsson)

11 Collaboration agreements signed at a value of 16.8 M€.

31 IK contributions signed at a value of 257 M€.

3 IK contributions still to be signed (with STFC and Elettra) at a value of 36.9 M€.

3 open IK contributions are still available at a value of 26 M€. These concern high-beta modulators and amplifiers and a medium-beta beam-stop system which formerly was in the scope of ESS-Bilbao.

9. Installation, test and commissioning plan - re-baseline of installation (C. Plostinar)

Overall update of Ready For Installation (RFI) dates to reflect the most recent status.

Existing installation, testing and commissioning sequence updated.

A new plan proposed.

Ion source and LEBT is current installation priority. Installation Readiness Review (IRR) held in Sept. Assembly in tunnel postponed from Nov 2017 to Jan 2018.

Safety Readiness Review (SRR) is foreseen for end of March and start of beam commissioning scheduled for 3 April 2018.

RFQ delivery expected July 2018.

RFQ RF system not available until early 2019, delaying start of RFQ conditioning until summer 2019.

Mitigation scenario with borrowed RF components may allow RFQ conditioning to start in Nov 2018.

J.-L. Biarrotte: What is the consequence for the overall ESS schedule, and when do we need to decide between scenarios? C. Plostinar: It doesn't change the time for beam on target, but early RFQ tests reduce project risk. We should decide now.

MEBT scheduled for arrival Dec 2018.

Amplifiers for the buncher cavities not available until March or April 2019, but it may be possible to test the MEBT with beam without these.

The five tanks of the DTL arrive between Sept 2018 and Oct 2019, but are also affected by the RF delays.

Three klystrons for the warm linac will arrive Feb-Mar 2018. Modulators will arrive between Sept 2018 and May 2019.

Again, availability of RF sets conditioning of entire warm linac to June 2019.

Beam commissioning of the entire warm linac, except DTL tank 5, can start in Aug 2019 and lasts for nine months.

At the position of DTL5 a neutron shield wall will allow simultaneous installation of the cold linac.

Four major installations for the SC linac are on the critical path: cryo distribution system (CDS), cryomodules, linac warm units (LWUs) and spoke RF stations.

Cryomodule installation can only start once the complete CDS has been commissioned, and LWU installation must wait for cryomodule installation.

The 13 spoke cryomodules will arrive in Lund between Nov 2018 and Nov 2019. Installation of these can start Dec 2019.

The 9 medium-beta cryomodules will be delivered Aug 2019 to Apr 2020. Installation can start end 2019 or beginning 2020.

Two high-beta cryomodules will be delivered May-Jul 2020 and can be installed as they arrive.

Then beam can be sent to beam dump by Oct 2020. This is the earliest date for beam on dump.

Remaining high-beta cryomodules will be delivered at a rate of approx. one per month, but cannot be immediately installed.

Installation of HEBT and A2T can partly take place as equipment arrives, but requires access to the buildings. It is not on the critical path.

Installation in stubs can take place during 2018, once the shielding problem has been solved.

Big picture (to summarize):

- Beam from ion source and LEBT Apr 2018
- Beam through RFQ and MEBT Jan or Feb 2019
- Beam through warm linac Jul 2019
- Beam on beam dump Oct 2020.

J.-L. Biarrotte: Are there any additional constraints on the control system? C. Plostinar: We are checking that the control system readiness matches the accelerator ITC schedule.

E. Nappi: I don't see any contingency in this plan. What happens if there are delays? C. Plostinar: There is contingency for the warm linac, where the commissioning time can be shortened, but indeed there is no contingency for the cold linac.

10. Certificates of conformity (M. Skafar, P. Gustavsson)

In order to support the construction of ESS facilities, ESS Management have decided on a strategy to organize the plant information to comply with EU standards and directives for all deliveries

- A Change Request (CR) will be issued to formalize the request "at the right time".
- Before a CR is issued we jointly need to understand the impact and implications "for evaluation purposes".

For the ACC project, most of the cases will lead to a "declaration of conformity" or a "declaration of incorporation", not CE marking. This is due to bespoke equipment, where we heavily lean against our design and review process.

All deliverables to ESS must comply with applicable European Safety, Quality and other directives including CE marking.

- The provider (in-kind or contractors) has the responsibility to ensure that the applicable directives are identified and fulfilled.

The current version of Technical Annexes are in alignment with ESS needs:

- The Partner shall ensure that all work and deliverables comply with applicable European and national regulations, directives and other acts, also any additionally specified standard, regulation or restriction identified in the documents of the baseline reference design specified
- The Partner shall identify and list the standards the Partner will comply with in executing this SoW, in the Project Quality Plan (PQP).

- The Partner is responsible, in accordance with applicable European and national regulations for safety and health at work, for the safe conduct of the activities to perform this SoW.
- Planning and compliance documentation required might be principally generated from the Partner's own quality management system when applying a system manual with defined procedures.
- ESS remains directly responsible to SSM for licensing.

The intention of the introduction of the "CE" marking is to ease the integration process and secure that the Manufacturer of a deliverable has taken responsibility for the delivery in terms of:

- Safety requirements
- Quality requirements
- Technical requirements
- Compliance to European Directives and standards

The delivery to ESS is expected to include the listed documentation

Risk assessment (ISO 12100), several steps to be performed during the design phase of the project on how to mitigate and minimize the risks.

- Technical File, drawings, wiring diagram, P&ID, etc.
- Operational Manual, in English
- Declaration of Conformity/Declaration of incorporation

By working through, defining and agreeing;

- the process / work flow
- needed documentation
- ESS needs

We can evaluate the amount of work required to perform the "declaration of conformity".
We can see and agree on how to do the work.
We can align and agree on expectations.
We can minimize the risk.

J. Greenhalgh: Testing of equipment is a point where ESS should need to provide guidance. Otherwise large amounts of money can be spent on tests that turn out not to be needed.

P. Krawczyk: Why is this requirement coming so late, being a large additional commitment for the in-kind partners? P. Gustavsson: This was controversial also with ESS and it was simply a long process, for which ESS apologizes.

11. Tour de table with comments and discussions (All)

J. Greenhalgh:

Five topics/issues mentioned:

- Is ESS ready for the high level of deliveries for the RF distribution system, and is it clear who will open and inspect the delivery? H. Danared: We are aware that this will be a big delivery, although details about the reception may not be fully worked out yet.
- What are our plans for information storage? Will JIRA be used? H. Danared: There is now a rather well developed plan for information storage that should have been communicated to our partners.
- A Conceptual Design Review (CDR) for the high-beta cavities will be needed before ordering. H. Danared: We don't plan a CDR, but drawings will be stored in CHESS with an approval procedure and then handed over to STFC.
- CE marking, which has been discussed above.
- The vacuum framework agreement is appreciated, but it turned out to be cheaper going directly to the vendors. H. Danared: Perhaps this was because the STFC order value was so high. The framework agreement is still expected to be useful for smaller purchases.

E. Nappi:

Had to leave the meeting before this agenda item. See instead slides attached to the Indico page of the meeting at https://indico.esss.lu.se/event/929/.

Anders Johansson:

A new collaboration contract has been signed with ESS for LLRF, extending deliveries to beam-instrumentation components.

A. Fabris:

Elettra has four IK deliveries plus manpower for installation TBD.

Three Italian institutions contribute to ESS, with INFN as representing entity.

Trilateral agreement signed where INFN takes care of financial aspects, Elettra of technical aspects.

- More than 200 magnets to be delivered. Can be divided into two groups: LWU magnets (quadrupoles, correctors) and other magnets. Expecting contract signature for first group Dec 2017, for second group June 2018. New measurement laboratory to be completed by end 2017.
- Almost 300 power converters. Several types of magnets, but only two types of DC power converters for simplicity. Four-quadrant units designed in-house.
- 26 spoke power stations based on combination of two tetrodes. Expected contract in place July 2018.
- Wire scanner acquisition system has CDR planned for Feb 2018.

P. Krawczyk:

Representing Polish Electronics Group (PEG).

- PEG provides low-level RF systems to the ESS linac.
- Work is progressing as scheduled.
- Slight extension of scope according to last in-kind agreement.

W. Fabianowski:

Installation of physical networks in accelerator tunnel and klystron gallery has started.

Integrated Control Systems (ICS) Division has three more in-kind agreements to sign, with STFC, IPNO and INFN Legnaro.

T. Jalakas:

Tallinn University of Technology is providing an alternative design for a klystron/IOT modulator.

A Abramowicz:

Warsaw University of Technology is involved in two in-kind contributions.

- Design and development activities for the LLRF is in progress and partly finished
- The phase reference line is under installation at ESS since July 2017. Six persons from WUT are working with the installation, which is expected to finish before the end of 2017.

J.-L. Biarrotte:

An internal project review recommended reinforcement of project management and of the procurement team and also to reinforce follow-up activities.

The fabrication of series spoke cavities is ongoing. First delivery from Zanon expected in Jan 2018.

Coupler conditioning is in progress. 110 kW has been reached in reflection, while the full 400 kW in transmission is expected for next week.

Coupler procurement is also in progress. There is some risk that tendering will not be approved for legal reasons.

Tender for valve box is to be published within one month.

F. Ardellier:

RFQ manufacturing is ongoing.

Test stand for conditioning of RFQ couplers is available.

A substantial number of elliptical cavities has been tested.

Eight power couplers have been conditioned to full power.

A new facility, including a new klystron, for conditioning of series couplers is being installed.

80% of the contracts for cryomodule manufacturing have been signed.

Assembly of the M-ECCTD started in Jan 2017. Cavity string was inserted into spaceframe in May. Spaceframe inserted into vacuum vessel in July. Ceramic coupler window broke in Aug. Cryogenic tests could continue and were completed in Sept. Test results complied with requirements.

New assembly of the M-ECCTD foreseen for beginning of 2018.

Assembly of first medium beta series cryomodule ready for start when cavities arrive in Sept 2018.

Emittance measurement unit EMU-2 has suffered three issues, but repairs have been carried out or are planned by ESS.

CDR for neutron beam-loss monitor (nBLM) is planned for Dec 2017.

A good collaboration spirit is in place between CEA and ESS and will help to meet the ambitious time schedule.

T. Ekelöf: When does the high-beta prototype test need to be done in Uppsala? F. Ardellier: A test before Feb 2018 would be ideal.

P. González:

The Spanish contribution to ESS has been reduced from 5% to 3%.

ESS-Bilbao executive director resigned recently. A search committee appointed by Madrid and Basque authorities have identified several candidates for a new director, giving hope for a quick solution.

ESS-Bilbao is not allowed to publish calls for tenders before Jan 2018, although there are tenders ready for publication. Small orders have been placed, though.

Three klystrons will be ready for delivery to ESS, the first one before the end of 2017 and the remaining two during Q1 2018.

Contract for three modulators, to be built according to the ESS design, has been awarded, and the company is working hard with them.

ESS-Bilbao are trying to borrow RF components to be sent to ESS, in order to bridge the gap until the final ones are available.

D. Bocian:

The three IK agreements with IFJ PAN concern RF installations, cryomodule testing and installation of power converters.

There are now 8 engineers at ESS, preparing for installation works, and there will be approximately 25 persons at peak.

Although planning can still be somewhat flexible, some fixed points are needed since persons are moving to Sweden for extended periods of time.

Because of the value engineering, there are still room for additional in-kind contributions within the Polish ESS budget.

T. Ekelöf:

The first spoke cavity prototype has been tested at FREIA, yielding data for a number of RF and cryogenics parameters.

Software and automated operation of the test stand are being developed.

All sub-systems for cryo, RF, LLRF, radiation monitoring and others are connected to EPICS.

An ESS Ampegon modulator has been tested.

Preparations are being made for tests of a high-beta cavity. Everything is ready except that a klystron is missing.

Installation at FREIA of the prototype spoke cryomodule with its valve box is expected in spring 2018.

Series tests of spoke cryomodules to be started in autumn of 2018.

M. Lindroos: Two klystrons, from CPI and Thales, are installed at Test Stand 2 in Lund. A third one, from Toshiba, is at the Lund Test Stand 1. Its factory acceptance test went without problems, but it shows arcing now at TS1. We are working hard to get it running, so it can be moved to FREIA.

S. Pape Møller

The first pulse train from the first power supply of the rastering system has been achieved, and ferrites are available for complete tests with a load.

12. Status of new members (S. Pape Møller)

Only one additional partner has joined since last meeting, namely University of Bergen in Norway. Dieter Röhrich was invited, but was excused.

13. AoB and summary and close of the meeting (S. Pape Møller)

Updated action list with open but no new actions from this meeting:

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It was decided that the next meeting will be hosted by Elettra in about 10 months time. The meeting after that will be hosted by Uppsala University.

The one-year mandate of the current CB chair, S. Pape Møller, expires by this meeting, and nominations for a new chair should be sent to him.

The meeting was closed.