

Scientific and Technical Advisory Panel (STAP) Report 'Imaging and Engineering'

April 22, 2020

Panel Members:

Sven Vogel (Chair), LANSCE
Javier Santisteban, Centro Atómico Bariloche
Francesco Grazzi, CNR
Luise Theil Kuhn, DTU
Stephen Hall, Lund University
Nikolay Kardjilov, HZB

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Participants

The meeting was held via video conference with all STAP members (Grazzi, Hall, Kardjilov, Kuhn, Santisteban, Vogel) and representatives of ESS, HZG & NPI (BEER), and TUM & PSI (ODIN) present.

Executive Summary

We wish to thank Premysl Beran and Robin Woracek for organizing the meeting. The STAP received an excellent overview on progress from ESS, BEER, and ODIN teams in the approximately 3.5 hours of the meeting. Technical progress such as design of components like caves, shielding etc., detector development and testing, demonstration of data reduction, sample environment design is in view of the STAP on track for successful early science per schedule as well as per scientific goals defined in the proposals on both instruments. Some bottlenecks, such as urgent engineering support to derive documentation needed for procurement on BEER or an installation package leader for ODIN, were voiced and solutions were offered by ESS. The STAP was impressed by the demonstration of the entire ESS data acquisition and data reduction chains using the test beamline at HZB. This is a milestone of paramount importance for the early success of the entire ESS project. From the perspective of the STAP, reviewing the projects every six months for the past few years, it appears that communication within the instrument teams from different institutions is excellent and the glitches in communication of the teams with ESS are resolved. Given the multi-institutional and multi-national nature of the ESS project, the STAP is impressed that all involved parties seem to have reached a state of a well-oiled machine working together towards making these instruments a reality within two years (for ODIN).

Charge

- *Do the chosen technical solutions match with the scientific requirements of the instrument?*

This was discussed in more detail in previous reviews. At the current stage, selection of technical solutions for beam line components, including detectors, has mostly advanced to the procurement and construction stage. The STAP agrees with the instrument teams on their chosen solutions.

- *To what extent are the instrument projects on track for delivering early science?*

Despite some unavoidable difficulties, such as legal or funding issues, the STAP views both projects as on schedule at this time.

- *To what extent is the progress of the instrument projects consistent with the planned ESS timeline? Look at whether the instrument teams are making scientific and technical decisions in a timely manner. Consider whether there is “scope creep” that might have a negative impact. Consider whether the instrument teams have the necessary support from partner institutions and ESS. Are there any pending technical decisions that may delay instrument progress?*

From the information presented on design, procurement, testing, and installation of all relevant beam line components (shielding, choppers, caves, sample environments, detectors etc.), the STAP believes the progress is in line with the ESS schedule. In particular, ODIN appears on track to receive beam in 2022. Any possible delays are from the perspective of the STAP outside the

control of the instrument teams, such as the delay of funding for NPI (see below), and are not directly related to technical decisions. No scope creep that could have negative impact on the success of either project was identified. Potential bottlenecks were voiced and in all cases solutions were either identified or discussed which involved instrument teams and ESS. Contrary to previous reviews, the teams did not voice any concerns regarding support from ESS. From the information presented, all major technical decisions were made and the solutions were presented in this as well as previous meeting. The design of additional sample environments is still on-going, which is not seen as crucial for commissioning of both instruments by the STAP.

ESS

Andrew Jackson introduced himself as the new group leader for the instrument scientists, replacing Ken Andersen, and provided an update on the ESS overall project and the timeline. The in-person SAC meeting will be held during the week of October 19, 2020, in Lund with the STAP chairs requested to be present and therefore an in-person STAP meeting requested previously.

Relevant to the STAP were

- 20% of the time of the instrument scientists is reserved to be devoted to user community building, outreach, and engaging in the relevant scientific community. While it was mentioned that this often poses a challenge in the current construction phase, the STAP absolutely agrees that this is an important part of the duties of the instrument scientists.
- Construction progress is on schedule, even with the Covid-19 pandemic work is at the 80% level and for now no negative impact on the ESS project is foreseen. However, some production in partner countries has stopped which may lead to delays.
- ESS is leading the development of vanadium strip beam monitors. This was an item of concern in the past and the STAP is pleased to hear that progress is under way.

Robin Woracek updated the STAP on several items identified as action items in the previous STAP meeting in October 2019 in Lund:

- The contract issue between HZG and ESS is essentially resolved.
- An electrical engineer was hired to support electrical power distribution.
- Information flow on technical solutions that could be shared by instrument teams was improved by starting a monthly newsletter.
- Concerns about emergency responders not being able to access the radiological areas are in the process of being resolved.
- Solutions for gamma monitors and temporary hotspots are addressed by ESS. Communication between ESS and the HZG detector team with respect to data formats has been improved.
- Substantial progress was achieved with actual data from the V20 test beam line, by collaboration between instrument scientists and DMSC, for both data acquisition (using the full ESS chain) as well as data processing of the special data formats resulting from the long pulse operation. Results were presented in detail by Robin for diffraction, Bragg-edges, and reflectometry data. In particular a publication on WFM reflectometry is ready to be submitted. The diffraction data also included a comparison with McStas predictions and the agreement

decreases the likelihood that the data from the actual instrument bears major surprises. The STAP encourages ESS to continue the data reduction and analysis of these important data sets and to publish these where possible as they will likely guide early users on the peculiarities of the ESS data reduction and format.

- The STAP is pleased that a post has been opened at DMSC to continue work on ODIN and BEER data analysis (“Instrument data scientist for neutron imaging and engineering diffraction”)

The STAP is very pleased and points out especially the importance of a paper on the data reduction that allows potential users to already understand at this point the unusual data format which some of the ESS instruments will produce (e.g. imaging and diffraction). The STAP commends the team working on this effort.

The STAP wishes to express their gratitude to Robin for compiling the previous action items and document progress. This format makes the STAP meetings very efficient and gives the STAP feedback that issues which are pointed out are actually addressed.

Action Items:

- From the perspective of the STAP, the 20% instrument scientist time devoted to user community building is absolutely essential and the amount of time is commensurate with the task. However, substantial effort is still required for instrument design and more and more construction. The STAP recommends to ESS to remain engaged with the instrument scientists to ensure sufficient resources are provided to the instrument scientists to be able to devote time to this important task.
- ESS needs to continue to ensure that data reduction and data analysis receives required resources (DMSC) to process data on day 1. The ongoing work should continue and be expanded to BEER specific software development (which has not been addressed so far).
- It might be useful for the team involved in the data acquisition and data reduction project to start thinking about tutorials that potential users can take, especially for ODIN’s Bragg-edge analysis, such that users can think more specifically about data analysis and experiment planning. Such tutorials may also reduce a “psychological barrier” for users more familiar with conventional neutron sources.

ODIN & BEER

Both beamlines are interfacing with the ESS project management and lead engineer. Allocation of resources for installations etc. appears to be on a good path from the information presented to the STAP.

The progress in data reduction is crucial for both instruments and having this information available to the user community early contributes to the likelihood of successful early science. More data is collected that awaits processing, including by data scientists assigned to the projects.

- The option of polarized beams was presented by Wai Tung (Hal) Lee. This option would be available at no cost to the instruments. ODIN is scheduled to receive this and has the appropriate priority to have it available early on. No request for this option was received from BEER. The STAP agrees with this approach and points out an opportunity for discussion in the next meeting. Malcolm Guthrie from the ESS sample environments team gave an update on load

frame development for devices potentially used by both instruments. A follow up discussion potentially reaching out beyond the STAP to obtain input was suggested. An issue was raised on possible difficulties for users to bring laboratory-made sample environments to the instruments, due to present regulations.

Action Item:

- For the October STAP meeting, prepare plans on how to use polarized neutron options at ODIN and how BEER arrived at the decision not to use such options, so that the STAP can offer feedback and brainstorm together with the teams about potential early science enabled by the polarized neutron option.
- We encourage both teams to provide effects of the Covid-19 pandemic on the schedule in the next STAP meeting, especially if critical components are delayed.
- To discuss load frame design options, which need to be determined now, a mini-workshop using videoconferencing should be scheduled, for which the STAP of course offers support, but suggest to also reach beyond the STAP to include experts such as Bjoern Clausen (LANSCE), Winfried Kockelmann (ISIS), Vladimir Luzin (ANSTO) or Stefanus Harjo (J-PARC).
- To support engagement of BEER and ODIN teams in the scientific community, the STAP will try to nominate team members for scientific proposal review panels at other user facilities. The STAP recommends to discuss the strategies and current efforts in user community building and engagement in the user community during the longer in-person meeting in Lund in October.
- ESS to ensure possibility for users to bring laboratory-made sample environments to the instruments, both in terms of 'reasonable' safety review procedure as well as hardware and software integration.

BEER

Jochen Fenske and Premek Beran provided updates on the BEER project. Again, resolving the contract issue between ESS and HZG, with signatures in the near future, was essential to keep the project on track. The resulting adjustments of the timeline were approved by the ESS. A solution for beam monitors is in progress. Detectors were demonstrated with lab neutron sources and discussions with DMSC about data formats etc. are on-going. The lack of access to lab spaces may delay the detector development and installation.

Premek reported that NPI's budget for 2020 to 2022 was not yet approved by the Czech government, potentially being delayed by one year. A new schedule reflecting changes in CZ funding mechanism has been proposed. While it still permits to match the final installation milestones set to 2022, there is a high risk of delay caused by potentially lengthy CTV and procurement processes for large part of the NPI work package (cave, user cabin, shutter). As a lead engineer is still to be hired by ESS and cannot thus effectively work on the CTV preparation for next several months, a help with completion and fast processing of CTVs by ESS staff will be needed to keep BEER on schedule.

Action Item: The NPI funding delay and the resulting impact on the schedule should be monitored by ESS.

A potential bottleneck was pointed out by the BEER team as at present Premek is the only person interfacing with construction teams and subcontractors for components as no engineer is available to support this effort (NPI WP's). This also precludes Premek from devoting 20% of his time to user community building and early science. Andrew Jackson offered during the STAP meeting to identify potential support by an ESS engineer to produce documents for tender and procurement.

Action Item: Work with the engineering support offered by ESS and avoid delays in procurement of essential components.

Otherwise the BEER team reports that BEER joined the common shielding project, mirrors are coated by Mirrotron (subject to possible Covid-19 delays). Load frames and deformation rigs are under development in collaboration between the BEER team and the ESS sample environments team.

The STAP therefore concludes that while issues occurred that are probably unavoidable for a complex, multinational project, the BEER team and ESS are working together to resolve all of these issues and at this point no delays or reductions in the initial scope of BEER are anticipated.

ODIN

Aureliano Tartaglione (TUM) and Manuel Morgano (PSI) reported on progress of ODIN. Overall, the instrument is on track to be ready for first beam in 2022. Legal issues, such as the VAT issue, were resolved. In the previous STAP meeting, the reliability of 98% for the heavy shutter was deemed as a weakness by the STAP and this was addressed by a more fail safe design. Integral components, such as shutter, choppers, cave shielding, cave interior, sample table are all on schedule. For the cave interior a common ESS effort for power and utility distribution will be utilized. A risk mitigation plan for possible installation problems is developed together with ESS. A possible bottleneck is the absence of a dedicated installation package leader for ODIN present at ESS, which is an engineering rather than a scientific position. It is the understanding of the STAP that a solution achieved between ODIN team and ESS will be available soon, likely a shared position.

Action Item: Ensure that an installation package leader for the imminent installation of ODIN is identified.

Work with DMSC on detectors is on-going, three different TOF imaging detectors were tested and Manuel reported on results. A potential collaboration between PSI and UC Berkeley (Anton Tremsin) to develop the next generation MCP/TimePix detector was pointed out. Installation of the X-ray radiography source was discussed and per Manuel space, utilities (cooling water, power), and shielding are in place such that if funding for such a source becomes available, it can be installed. The availability of infra-structure to handle hydrogen gas, provided by gas bottles, e.g. for fuel cell experiments was also reported to be on track.

Manuel reported a success story for the early science resulting from a collaboration with the cathedral in Lund: A historic object of the cathedral will be radiographed by ODIN during the early science phase, coinciding with 700th anniversary celebrations of the cathedral. The STAP commends Manuel for this as this offers ESS some early local PR opportunity, which in turn will help ODIN.

The STAP concludes that from the information presented, the ODIN instrument appears to be on track to be ready for construction in 2021 and beam in 2022.