F. Subcommittee 4 – Neutron Scattering Systems

(Chair : Dan Neumann)

F.1 Response to the charge

4.1) Is the project appropriately addressing recommendations from the re-baseline Review in May 2018?

Yes. Most of the recommendations for NSS given by the Rebaseline Review Committee have been appropriately addressed. The committee congratulates NSS on the successful and economically favorable completion of the bunker CDR. There is also noteworthy progress in handling the important in-kind agreements for instrument construction (though much remains to be done) and the support from DMSC for instrument installation and commissioning. Though a schedule has been set-up for the management of tollgate 3 for the first 8 instruments, the development of a detailed plan for their installation has only just begun.

4.2) Is the project team sufficiently and effectively addressing issues and technical risks, executing the work, and on track towards early science success, especially considering the complexity associated with integrating and installing technical systems while completing civil construction and planning for commissioning the first instruments?

Yes. Much of the NSS construction scope, including all 15 instruments, is provided by in-kind partners. NSS has worked effectively with these projects to ensure that state-of-the-art neutron instruments are delivered to ESS with sufficient information which will allow ESS to commission and operate them in the future.

The manufacture, delivery and installation of neutron guides is an area of concern. The ESS will require 100s of meters of neutron guides, while the world-wide capacity for manufacturing them is limited. Currently the lead time to receive guides is well over one year and is likely to lengthen as orders from the in-kind partners are placed. NSS realizes the problem and is working with the wider neutron community as well as the guide manufacturers to ensure that the guides required for “early science” get priority over those for later instruments regardless of when the orders are placed. Similar comments apply to choppers and detectors.

DMSC is responsible for instrument controls, data acquisition, and data reduction and visualization. While these essential attributes of a functioning neutron scattering instrument are often neglected, ESS has developed what appears to be a robust approach to computing which includes a commissioning strategy making efficient use of cold and hot commissioning periods. This is essential for achieving early science.

The Integrated Controls System (ICS) plays an important role in controlling major components of the instruments including choppers and sample environment equipment. It is essential that DMSC, NSS, and ICS work closely to

create the necessary infrastructure and to support the commissioning of the instruments. The creation of a "beam controls team" led by NSS a total of about 10 staff members with approximately five matrixed in from ICS seems to be an effective means to ensure that this happens. The staffing plan for both the commissioning and operation phases seemed reasonable. The apparently close coordination of this team with DMSC is an excellent feature of this effort.

Recommendations
DMSC should prioritize instrument controls, data acquisition, data reduction and visualization over data analysis to ensure early science.

NSS should work with ICS in the creation of the beam controls team led by NSS and with personnel from both NSS and ICS to ensure that the necessary instrument controls are functional on schedule.

4.3) Is the project positioned to manage the risks to complete the project scope within the established cost and major construction project external delivery dates (Beam on Target (BOT) in 2022 and Start of User Programme (SOUP) in 2023)? The committee is asked to comment on risk exposure relative to the amount of remaining cost contingency.

Partially. NSS is well-positioned to manage risks associated with the successful completion of 15 instruments during the construction phase of ESS. The leadership of NSS has managed their ring-fenced budget well and centrally holds 23.6 M€ in contingency. In addition, each instrument project was allocated 10% contingency. A recent exercise to determine risk exposure suggested that at this stage of the project, the contingency should be about 30 M€. NSS is working to identify savings from value engineering, for example, they believe they can save 2.4 M€ by using a common shielding design. Thus, while we believe that the contingency is a bit low, it is not a significant cause for concern.

On the other hand, it is very improbable that NSS can meet the current schedule for instrument commissioning which requires heroic efforts to coordinate multiple installation activities as well as assorted minor miracles. However, it is not possible to evaluate the extent of the problem as NSS lacks an appropriate resource-loaded installation schedule. We believe that NSS, in collaboration with the new installation manager as well as target systems, should continue their efforts to develop a more complete resource-loaded installation schedule (or perhaps schedules). While it is unlikely that any such schedule can be followed, developing it to a reasonable level of detail will help ESS quickly make rational adjustments as the inevitable problems arise. Finally, the lack of signed agreement for 14 of the 15 instruments has the potential to adversely affect schedules as the instruments pass TG3 and move into the manufacturing and procurement phase.

Recommendation
NSS should accelerate its efforts to develop an appropriate resource loaded installation plan. This must include effectively integrating the instrument installation schedule with the overall project schedule.

4.4) Are in-kind deliverables properly planned and managed?

Yes. The neutron instruments are largely being supplied by in-kind partners. This approach provides the ESS with the expertise of some of the best neutron instrument builders in the world. This approach is essential for the ESS to realize a set of 15 world-leading instruments during the construction phase.

Coordinating the design, construction, installation, and commissioning of 15 instruments being contributed by organizations across Europe is clearly a challenge. NSS has responded with a robust process including regular interactions and six "tollgates" which occur at key points of the project. We believe that this process ensures that in-kind deliverables are reasonably well-coordinated. It is essential that frequent and close communications with in-kind partner continue particularly in regard to installation and commissioning.

The primary area of concern is getting signed agreements with in-kind partners. At present only one of the fifteen instruments in the construction phase has a signed "technical annex" (TA), the legal document governing most aspects of instrument construction and delivery. While design work has continued without signed TAs, it is necessary that a conclusion to the protracted legal discussion be reached so that the instruments can proceed to the procurement and manufacturing phase with fully executed agreements in place.

Recommendations
NSS should increase its efforts to conclude TAs with the remaining fourteen instrument teams.

NSS should maintain its diligence in working with its in-kind partners to ensure that the in=kind contributions meet the needs of the scientific community and are delivered in a timely fashion with appropriate documentation.

4.5) Are the transition to and integration with Initial Operations activities and responsibilities well defined and effectively managed?

Yes. The successful delivery of "early science" will require working instruments, functional software, and most importantly effective staffing to support external scientists. NSS does not currently have the staff necessary to ensure "early scientific success". This is because the instruments are largely being built by in-kind contributions and thus NSS has sensibly hired only the staff required to manage the in-kind process. Thus NSS will need to grow substantially to support commissioning and "early science". NSS realizes this and has developed a plan to add the necessary scientific and technical staff to support scientific operations eventually reaching the planned full complement of about 225.

An innovative feature of the Initial Operations activities is DMSCs plan to embed a "data instrument scientist" in each instrument team. They eventual plan is to have ½ FTE per instrument, but to reduce the likelihood of the data issues interfering with "early science," they plan to front load the staffing. This means

that during commissioning and the start of operations, each of the first eight instruments, will have its own data instrument scientist. This is prudent as other similar facilities have struggled with data issues early in their life.

The committee feels that this idea should be extended to other aspects of commissioning by advancing the hiring of instrument scientists and other instrument specific personnel to better spread the heavy workload associated with bringing a new instrument on-line. In addition NSS should ensure that the support personnel for instrument specific technologies, such as choppers and detectors, are also on-board to quickly address the inevitable problems that will arise. This adjustment could likely be accomplished with no change to the overall staffing plan, but rather by fine-tuning when various skills are hired. The staff hired earlier than currently foreseen would move to new instruments as commissioning activities ramp down. This would then allow the deferred hires to be made. We believe that such a plan would enhance the opportunities for early scientific success.

Recommendation
NSS should front-load the hiring of instrument specific staff and instrument technologies support personnel for the commissioning of the first eight instruments, much as DMSC is doing with the instrument data scientists. This should increase the likelihood of the successful delivery of early science. NSS should also explore creative options for securing additional effort including, for example, shared positions with universities.

4.6) Are the Environment, Safety, and Health and Quality aspects being properly addressed and is the regulatory permitting process adequately understood and managed?

Yes, so far. The appropriate licenses are important prerequisites to operating each of the neutron instruments. The review committee was therefore pleased to learn that NSS has established a core group with the responsibility to handle all NSS license issues.

4.7) Does the organization match the needs of the construction project regarding responsibility assignments, management structure, and management processes and tools, especially those associated with installation, engineering, and in-kind contributions?

Partially. The leadership team of NSS is quite knowledgeable and experienced in delivering quality neutron instruments and know what is required to operate a successful neutron facility. Moreover the NSS staff seem to know their roles. Dealing with in-kind contributions is challenging and entails significant costs, but NSS seems to be managing these interfaces effectively. On the other hand, the interfaces within the ESS itself, particularly with regards to installation and with ICS are of concern. Perhaps the hiring of the Installation Manager will help with this issue and enable more effective installation planning across the ESS.

F.2 General Remarks and Recommendations

Neutron Scattering Systems (NSS) is making good progress towards delivering exceptional neutron scattering capabilities to the European scientific community. Currently, thirteen of the fifteen planned instruments have proceeded to the detailed design and procurement phase with the other two nearing this phase. More than 60% of the budget is being used for in-kind projects. This approach is essential to the scientific success of ESS as the in-kind partners have a great deal of expertise in the development of advanced neutron instrumentation. In fact, this project could not have been executed on a reasonable schedule by ESS alone. The issues with the bunker have finally been resolved after a complete redesign. The bunker has now been approved and the contract for construction is about to be signed. It is important to note that the installation of the bunker is on the critical path as it must be done just before the Beam-on-Target milestone.

NSS is looking to the future beyond the initial fifteen instruments. Tentative planning for the full complement of 22 instruments has been initiated. In particular, NSS has performed a capabilities gap analysis and has identified high-priority, other significant and lower-priority instruments, which will be reviewed by user community, STAPs, and SAC. In addition they have identified high priority upgrades costing 30 M€ which would roughly double the performance of the 1st 15 instruments.