Sample Environment STAP Report – April 2019

Executive Summary

There has been a large amount of progress over the last twelve months. We were shown multiple projects that the team have worked on together, including promising prototypes for systems such as the kinematic mounts. We have identified the following key recommendations, which are fleshed out in more detail in the body of the report.

1. **Health and safety.**
    a. The internal health and safety experts should instruct the subject experts on how to do risk assessments within the Swedish context, building up a bank of approved templates.
    b. Where necessary, certification should be done by outside parties if the internal experts are not able to do so.
    c. ATEX/Ex zone classicfications need to be considered carefully.
    d. The ESS as a whole should make clear its policy on hot work areas.

2. **General operation of the Sample Environment team**
    a. The group leader, to be recruited later this year, have experience in personnel management. This position is vitally important for ensuring that the team becomes a cohesive whole.
    b. The team is currently geographically spread out. Where possible, team activities should be co-located to help with the development of a cohesive team.

3. **Collaboration with instrument teams**
    a. Check explicitly, using instrument cave CAD designs, how standard sample environment operations for the given instruments will be done.

4. **Engineering resources.**
    a. The ESS should ensure that some in-house expertise is developend and maintained.
    b. A second non-expert CAD package should be approved for internal use.

5. **Engagement with other facilities**
    a. Work closely with sample environment teams at other facilities to adopt reasonable solutions already developed at other facilities.

6. **Laboratory plans**
    a. Check the storage space requirements against the storage space available.
    b. If possible, re-consider the placing of the FLUCO laboratory to avoid having nitrogen dewars passing through continuously.
    c. Consider ESS-wide controlled zone machining requirements carefully.

Safety

Good contacts between all parties are important. We note that there have been improvements in this over the last year. However, the STAP was not clear on how workable safety procedures will be, and are being, established in collaboration between the scientists and the safety engineer.

We encourage the OSH engineer to prioritise assisting the sample environment team in establishing workable and safe procedures for the activities required. To be specific we recommend that the internal health and safety experts should instruct the subject experts on how to do risk assessments within a specifically Swedish context. The development of approved risk assessment templates for the subject experts to work from would be very helpful. The subject expert should then do the assessment and define the procedures, along with the means to mitigate resulting risks. The health and safety experts should then check these and either accept them, or pass them to an external institution for certification if required. We recommend contacting the MAX-IV safety group for advice on Swedish regulations and safety procedures, and to use consultant companies (e.g. PS Group in Malmö or Pidab AB in Gothenburg) for help with required documentation and certifications.

One specific area of concern is in the handling of explosive gases, such as hydrogen, and the required ATEX/Ex zone classifications. The STAP also notes that the designation of hot work areas (which includes the use of hot air guns and simple soldering) has implications beyond the requirements of the Sample Environment Team, and that the ESS is working on an overall policy.

On the matter of CE marking, we suggest adopting the procedures followed by, for example, MAX-IV, or SINQ at PSI, or other operational facilities.

Sample Environment Equipment Prioritisation

The current purchase/procurement list has been designed with the needs of the first eight instruments in mind, and the panel judges that it is in a good state. If there is an internal decision to assign higher priority to certain instruments within the first eight, the prioritisation list could then be adjusted accordingly. The meetings with the instrument teams have resulted in an internal adjustment regarding pressure cells, as this has not been identified as a priority area for first science by the instrument teams interested in high pressure in the longer term.

More generally, we recommend focussing on off-the-shelf solutions from companies or other facilities where these exist. There will still be integration requirements for these to work at ESS and on particular instruments. This integration work can still take of the order of 7-8 months, and the necessary resources need to be factored into planning (we address this point again in a later section of this report). To help with these issues, we also encourage DMSC to adopt the SECoP protocol as appropriate.

In our previous report, we raised concerns about the high-field magnet. These concerns have been responded to by deciding to dedicate this magnet to diffraction needs. We think that this is correct for this case. However, we note that there is a clear lack of a specialised spectroscopy magnet, and this will impact the science cases for BIFROST and CSPEC. At present, a 15 T magnet will be supplied second-hand by HZB. This will help, but the Berlin

magnet is not designed for use with large solid-angle detector design, and so does not constitute a long-term solution.

Collaboration with other ESS services

Beamline Control Team

The STAP was presented with detailed information on the Beamline Control Team, a cross-service team aiming to assist with integration issues that require multiple groups within the ESS. This addresses concerns that we highlighted in our previous report on the methods for interaction between MESI, DMSC and ICS. The Beamline Control Team has been in existence for six months, and so far, it seems to be functioning well. We hope that the ICS will adopt the Beamline Control Team report. We will evaluate its operation further at our next meeting. These groups should be encouraged to act together to set up common ESS standards for motion control hardware (motors, limit switches, encoders, contacts, cables, *etc*.).

Engineering Resources

The ability to draw on the ESS internal engineering resources is still very problematic. The Sample Environment team have been moving their projects forward by outsourcing to external design and production companies; we approve of the initiative shown, but we also caution that automatically going for the outsourcing option will be damaging in the long-term. The ESS should have an interest in building up and maintaining some in-house expertise. In addition, it is not always easy to guarantee the quality of the workmanship provided by external resources prior to delivery, especially for smaller projects. For example, the new Paris-Edinburgh cell jig showed signs of rust immediately after delivery.

Related to this, we strongly recommend that the ESS approve use of a second, non-expert CAD package for those outside of engineering to use.

Logistics and Procurement

These services were explained clearly; the Samples and Users STAP report goes into more detail on the issues arising from this.

Collaboration with instrument teams

We very much appreciated the presentation by the MAGiC instrument scientist. We see clear evidence for the existence of good channels of communication with the instrument teams, although we recognise that the level of communication may vary from team to team.

The Sample Environment team need to take the initative to make sure that they work with the instrument teams and the instrument cave CAD designs to check explicitly how standard operations for the given instrument will be achieved, with a consideration for how often a given procedure will need to be done. For example, sample handling and transfer to the beam, cryogen transfer or automatic filling, cable and gas connections, etc.

For each instrument, the requirements will be different, but we recommend that the SE team develop a checklist of standard procedures to test against the CAD design.

Engagement with other facilities

We are pleased to see that the team is visiting and working with multiple groups at other facilities. Nonetheless, we strongly encourage direct engagement with the sample environment teams at other facilities to minimise the workload where reasonable solutions have already been developed, in particular in the area of soft matter equipment. Some examples are solid-liquid cells, electromagnets, temperature-controlled sample changers, liquid/air troughs, as well as high pressure cells. We also note that users have expressed a strong preference for similar solutions at different facilities.

Laboratory planning

Laboratory plans for all of the laboratory space to be operated by the Sample Environment team were presented. This included space inside and outside controlled zones. A number of cranes are required in the laboratories. The Sample Environment team should make the final decision on which types of crane are required in each particular location.

The route for filling nitrogen dewars passes through the FLUCO-specialised laboratory. This routing compromises the operation of the FLUCO laboratory. We identify two particular problems: (i) the setting up of fragile and sensitive equipment in a clean environment will be difficult, and (ii) health and safety concerns relating to repeated passage of heavy nitrogen dewars past pressurised gas bottles, gas handling systems, liquid containers or open reservoirs need to be factored in. The number of sinks in this laboratory should also be increased from one where possible, as discussed during the panel.

One common problem was the apparent lack of sufficient secure storage space. In particular, we are concerned about the storage of cryostats and helium dewars, and for the specialised FLUCO laboratory. At present, the magnet testing facility is in the middle of the laboratory. The team should think about how they will work in the space as a whole, in particular with respect to moving equipment and filling cryostats; an alternate location for the magnet testing facility may then prove preferable.

It was also unclear where instrument pool equipment (sample environment paid for by instrument teams but managed by the sample environment team) will be kept.

Current planning places the only machine shop in the controlled area in one of the sample environment laboratory. The current legal requirements on machining items that have been in or near the beam are not yet clear, but this question should be resolved as soon as possible, giving rise to workable procedures that everyone can follow. If there are serious requirements for machining inside the controlled zone beyond the sample environment needs, this will need to be considered carefully.

General operations of the Sample Environment team

At the moment, the activities of the Sample Environment team are spread over several locations, with laboratory space primarily at the Utgard facility, but also in some other locations. This means that the team is geographically spread out, which tends to act against

the development of a cohesive team. This will become more important as operations phase approaches. The FLUCO activities are particularly spread out over multiple locations. In addition, as the procurement phase ramps up, resource allocation will inevitably be FLUCO heavy as there are more individual devices in this area than in the others.

We support the changes proposed to the structure, and we strongly encourage the selection of a group leader, currently scheduled for later this year. We recommend that a group leader is sought who has experience at personnel management, as we see this position as being important for ensuring that the team becomes a cohesive whole. At the present time, it is clear that there are some problems with timely cooperation and integration between the different activities of the sample environment team.

Equipment integration into control and data collection software

One area we wish to emphasize here is that integration of equipment into the instrument control and data collection is mission critical at this stage, and needs to be completed for the items already procured, to avoid backlog problems later. We identify three primary issues here.

- The MESI team need to receive the operating parameters for each piece of equipment from the other team leads.
- The integration tasks depend on support by ESS groups outside the sample environment team and the Scientific Activities Division. The Beamline Control Team is a step towards resolving this, but integration will remain a weak point in the planning of MESI's activities, and is having an effect on the forward momentum of the sample environment team's activities.
- Estimating the workload required is proving challenging. Currently MESI has 3 FTEs. The integration work is mission critical for first science, and the staffing resources need to be evaluated in this light.

Stand-alone vs network dependent systems

There are some health and safety requirements that *must* be stand alone, but otherwise, the team needs to decide on an internal solution that all stakeholders are happy with.

Specific issues for PREMP

For instrument cages with top-loading sample environment, we recommend that the interfaces be kept simple and easy to work with. The bucket design proposed for discussion during the STAP does not look sufficiently ergonomic for repeated long-term use, and so we recommend that the sample environment team limit themselves to defining the largest interface, and then adapt the sample environment equipment to fit.

General remarks

During the operations phase, a proper stores will be very important, keeping in stock consumables like vacuum parts and electronic components.

Closing remarks

We thank all members of the Sample Environment team for their open and honest discussions with us throughout the course of the meeting. We all appreciate seeing the work that you have been doing over the lifetime of the STAP.

We also welcomed two new members to the STAP, Stefan Carlson and Rob Barker, and as panel chair I would like to thank them for their enthusiastic participation. We would also like to thank the former panel members, Stuart Clarke, Michael Meissner, Stephen Hall and Giovanna Fragneto, for their work over the last previous years.

For our next (virtual) meeting we would like to see some information on the interaction between MC&A and Sample Environment. We encourage the team to highlight in their presentations any specific advice they want from us.

Elizabeth Blackburn, May 2019