EUROPEAN SPALLATION SOURCE

Date 9/04/2017

Report of the BIFROST Tollgate 2 Review Committee

Meeting Date
24 March 2017

Location
ESS HQ, Tänkartanken

Attendees:

- **Review Committee:** Shane Kennedy (Chair), Ken Andersen, Stuart Birch, Andrew Boothroyd (U. Oxford), Oliver Kirstein, Gábor László, Mike Murbach (NCNR, NIST), Stéphane Roux (ILL), Astrid Schneidewind (T.U. Munich)
- **For** BIFROST**:** Rasmus Toft-Petersen, Liam Whitelegg, Niels Bech Christensen, Kim Lefmann, Jonas Okkels Birk, Sylvain Rodrigues and Finn Saxild
- **Other active participants (Reviewers):** Jon Taylor (ICC), & selected members of the Neutron Technology groups, DMSC, Science Support Systems, the NSS Project Coordination Team and the MIRACLES project team.

The Tollgate 2 review meeting was convened in order to evaluate the maturity of the BIFROST project in terms of scientific scope, conceptual design, project budget, schedule, risk and resource plan.

The BIFROST project team presented their progress in phase 1: conceptual design of the instrument and their case for approval to proceed through the tollgate to phase 2: detailed design.

The documentation included:

→ Concept of operations,
→ System requirements,
→ Preliminary system design,
→ Work package specification,
→ Initial Operations and staging plan, and
→ supporting documents including detailed budget, Project Breakdown Structure, budget distribution between In-Kind partners and schedule.

Reviews of this documentation had been provided on the following areas:

→ neutron optics and shielding,
→ chopper systems,
→ motion control and automation,
→ detectors and
→ sample environment,

In addition, the NSS Instruments Lead Engineer (Gabor Laszlo) had compiled a short report containing additional comments from ESS support groups (ESS-0101440), and the NSS Instruments Lead Scientist (Ken Andersen) had provided a written review.

European Spallation Source ERIC
P.O. Box 176
SE-221 00 Lund
SWEDEN
Visiting address: ESS, Tunavägen 24
www.esss.se

The BIFROST project team presented their case for passage of the project into phase 2, with an overview of the documentation and discussed all issues of interest or concern to the members of the committee and the reviewers who were present.

The consensus of the review committee is that the BIFROST project team has managed the project well to date, and deserves to be complimented on the quality and breadth of achievements so far in preliminary design and project planning. In particular, the analysis of radiation activation levels in the preliminary safety analysis highlights the need for careful consideration of operational safety in design of the cave and of remote handling methods for samples and sample environment equipment (SEE). It is also pleasing to note that several good examples of possible early science highlights have been identified.

The committee noted that the planned upgrade path for polarization analysis (PA) capability assumes either polarizing supermirror or Heusler crystal analysers. We note, however, that 3He spin filters could have advantages over these two analyser options in the absence of high magnetic field gradients. A review of the strengths and weaknesses of the different options for PA on BIFROST will need to be carried out as part of any future upgrade proposal for PA. Meanwhile we recommend that the sample-analyser area is designed [to guard against magnetic field gradients] so as not to compromise possible future implementation of 3He spin-filter analysers.

Although the plans for project delivery are sound, a few improvements and clarifications are needed before passage through the tollgate to phase 2: detailed design.

The TG2 review committee therefore recommends to the Director for Science that the BIFROST project team implements some changes and revises baseline documents, before moving the instrument project into phase 2. Provided these changes are made to the satisfaction of the review committee, there will be no need for a second TG2 meeting.

Specific changes and actions required are as follows:

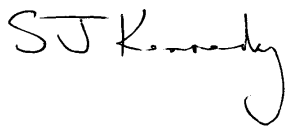
1) The following changes are needed in the High Level Scientific Requirements (HLSR) listed in the Concept of Operations document;
    a) HLSR1; specify primary and secondary spectrometer resolutions separately, and define clearly e.g. 4% of what.
    b) HLSR2; specify kf value and energy transfer value
    c) HLSR3; change wording to "bandwidth", redefine "usefully employ"
    d) HLSR6; define the 5% value in an unambiguous way.
    e) HLSR7; add that design should enable 6 energies to be analysed in the future
    f) HLSR9; add "in horizontal plane" & defined as FWHM
    g) HLSR10; insert "vertical" magnetic fields of 15 Tesla and add that the instrument should be upgradable to allow horizontal and higher vertical fields
    h) HLSR11; the background level (including spurious processes) should be set to ensure signal to background ratio (S/B) as good or better than Thales. Also define how it will be verified (e.g. with beam on, an elastic scatterer with a given geometry and mass, S defined as the elastic peak height, B defined as the background level at a specified energy transfer)
    i) Add a requirement that no detector should receive neutrons from another analyser
    j) Add a requirement to allow polarization & flipping of incident beam as an upgrade
    k) Add a requirement to make provision for 3He spin filters as a possible method of neutron polarization analysis
    l) Add a requirement to design and build BIFROST to be able to accommodate all sample environment equipment needed to meet science case.
    m) Add a requirement to design BIFROST to be upgradable to allow PG(004) reflections from the analyser.
2) Include in the Preliminary System Design;
    a) That a beam attenuator option will be included (to limit activation of samples during initial surveys), and
    b) That the Choppers in the bunker will have magnetic bearings
3) In the work package specification (WPS);

a) The risks differ from those in presentation slides. Those in the WPS need to be updated.
b) Add a cost risk related to over spending (e.g. due to scope creep)
c) Add a risk related to potential conflicts at interfaces with neighbouring instruments (technical and schedule).
d) Re-evaluate the impact of all risks taking account of mitigations
e) Add technical risk related to cross talk protection in the analyser-detector system
f) All high rated risks must be accompanied by a more detailed description of the mitigation strategy.

4) In the Initial operations and staging plan;
   a) detail how calibration and performance demonstration will be done (see process for neutron instrument design and construction for guidance).
   b) discuss how the system calibration can be maintained when adjusting detector sensitivity to accommodate Bragg scattering.

Once the BIFROST project team has made the required changes to the satisfaction of the review committee and passes through the Tollgate 2, we recommend that close attention is given to the following issues as the project moves through phase 2 (detailed design):

1) Activation of samples and SEE should neither impact on radiation safety nor impede operation of BIFROST. Draft procedures for dealing with activation are needed to inform decisions on design of, and access to, the cave.
2) Effective shielding against cross talk between analysers is important, but difficult. Design concepts at existing indirect geometry spectrometers should be reviewed and assessed before choosing the concept for BIFROST.



Shane Kennedy (Chair)
-on behalf of the BIFROST TG2 Review Committee.
12 April 2017.