Neutron Advisory Committee Meeting for J-PARC MLF Facility
NAC2018
Tokai 26-27 February 2018

Committee members:
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The committee thanks the participants for the detailed presentations and their helpful and open responses to the discussions. The committee highly values the hospitality and excellent support provided during the committee meeting.

Charge to the committee:

1. **Review our efforts to strengthen the facility**

a. **Adequacy of renewed target development strategy in the context of 1 MW stable operation in a few years; including moderator cryogenics**
b. **Timely construction and future direction of beam lines, sample environment and devices to maintain the uniqueness of the facility**

2. **Evaluate the appropriateness of the science promotion efforts**

a. **Activities of science group and science promotion board**
b. **Any suggestions to help the smooth penetration of science driven atmosphere**

3. **Any suggestions for improvements are appreciated. Our particular concerns include but not limited to the following:**

a. **Yet to be unified MLF activities between JAEA, KEK, CROSS, and Ibaraki prefecture, as pointed out at the last NAC**
b. **Improving paper production rate**
c. **Promotion of industrial use**
d. **Direction of life science in MLF**
e. **User program handling and user support**

1. **Review our efforts to strengthen the facility**

a. **Adequacy of renewed target development strategy in the context of 1 MW stable operation in a few years; including moderator cryogenics**

Target

MLF has successfully stabilized target operations at mid-range power levels (300-400 kW) leading to high reliability of the facility during operation in 2017 and enabling a productive science programme. This has established a solid basis from which further power increases can proceed.

For the first time, with target #8, it should be possible to measure the mitigating effect of gas injection on the cavitation damage. However, target #8 cavitation damage results will be harder to interpret because the target was operated at three different power levels for prolonged periods, though results could still provide a point of reference for future targets operated at higher powers. SNS cavitation data and gas injection experience is also beginning to become available. MLF should collaborate with SNS on predictive models for cavitation damage.

Design and analysis efforts have successfully led to target designs with partially and totally decoupled water shrouds which should enable future power increases up to 1 MW. However, a steady and systematic approach to power increases on the target should continue.

A careful incremental increase in beam power is more important than reaching 1 MW quickly. Large increases in power, beyond the limits of confidence based on prior operational experience, create a disproportionately high risk for target failure. MLF should also consider running targets at a single power level (apart from very short accelerator tests) to maximize performance data that are useful for estimating target lifetimes at higher powers.

Target #10, which is a new design as the first partial-constraint-free target, might not be delivered on schedule in Fall 2018. A strategy for neutron production should therefore be developed that accounts for this contingency, e.g. whether or not target #9 would be used.

Storage of spent targets will be limited to about 10 years for the new RAM building, so longer term planning for additional capacity will be required soon.

Cryogenics

All counter-measures against the former performance degradation of the helium refrigeration system appear effective. In particular, the intensive cleaning of the affected heat exchangers, in combination with the improvement of the ADS, was obviously successful. Additional differential pressure gauges and the introduction of a cold trap as a monitoring system for the oil concentration in the helium appear to provide an effective early warning system.

Because HX1 and HX2 efficiencies will decline again due to accumulation of the normal oil concentration, it is recommended that a spare clean set of heat exchangers be kept in stock. They could be installed while the other set is being cleaned.

b. Timely construction and future direction of beam lines, sample environment and devices to maintain the uniqueness of the facility

Instrument development

Overall the NAC is impressed with the construction and technical development activities with respect to both instruments and development and construction of targets. These highly appreciated skills lay a solid foundation for the continual renewal of the facility.

The NAC is pleased to see a number of upgrades delivered on the beamlines over the past year. The proposed future beamline upgrades and developments presented appear to be well thought through. However, these activities should be aligned and prioritised according to the needs of the user community and the resources available to deliver and operate them and should be planned to minimise interruption to the user program.

SE and laboratories

The NAC appreciates the efforts to establish D-Lab and related activities. However, it will not be effective without dedicated full-time staff. If resources are not available the NAC recommends that MLF promote a collaboration based D-lab, for example by outsourcing activities or functions to universities. There are many scientists in Japan who can produce high quality deuterated samples, both chemical and biological. Their participation should be welcomed as it enlarges the community base of MLF.

The NAC identified a number of specialist roles in the sample environment and computing groups that were filled by contract staff, as opposed to employees. This poses a risk to the long term success of MLF. Roles which require significant investment in training and experience should be prioritised to be recruited as employees.

2. Evaluate the appropriateness of the science promotion efforts

a. Activities of science group and science promotion board
b. Any suggestions to help the smooth penetration of science driven atmosphere

11 science groups have been created to encourage the development of a more science based, rather than technique based, culture. For further development, these should have common objectives and become more active in interacting with community and promoting science with neutrons such as, for example, holding meetings/seminars (including with external scientists). However, the NAC is concerned that many members of each group are too busy to fulfil their main mission, e.g. running their own instrument, working for the users, SE services etc. and they do not have enough time to meet and discuss science.

3. Any suggestions for improvements are appreciated. Our particular concerns include but not limited to the following:

a. Yet to be unified MLF activities between JAEA, KEK, CROSS, and Ibaraki prefecture, as pointed out at the last NAC

See section 4.

b. Improving paper production rate

The transition from MLF construction to initial operation was a great success, particularly given the disruption caused by the earthquake and other lengthy outages. 20 world class instruments have been made available to users. Now, in the regular operation phase, it is important to reorganize the tasks and identify dedicated experts for the different support areas. Instrument scientists, sample environment, data acquisition and analysis, polarization analysis etc. all need additional resources and manpower to scale up the scientific outcomes.

Continued efforts must be prioritised to increase the paper production rate per experiment conducted. The current rate is well below the rates at other facilities such as SNS, ISIS and ANSTO. In-line with standard practice at other facilities the NAC recommends not to differentiate between "refereed proceedings papers" and "refereed papers".

The production rate per instrument might, to some extent, reflect inexpert and new users. Having new users is extremely valuable and demonstrates the attraction of JPARC, but it also induces a heavy overload on the scientists at the beamlines. In order to prioritize resources a more detailed analysis is needed of which experiments do not produce outputs (both academic and industrial). Is analysis software a limitation, sample preparation, scientific or technical support? An example of what can be achieved is the case of iMATERIA, which is highly productive through the support of five instrument scientists (which is actually high compared to international benchmarks). However, the level of resourcing is not consistent across the instrument suite and the NAC sees this as a major obstacle in increasing the paper production rate.

c. Promotion of industrial use

The NAC continues to be impressed by the efforts to increase industrial use and output, and to better define and track non-publication outputs. The NAC commends the new industry/university initiative “Research Group on Polymer Science under Humidity Conditions” and looks forward to further development of the MLF-industry relationship and to more visible outputs.

d. Direction of life science in MLF

MLF is producing some excellent scientific results in the life sciences using a variety of techniques, e.g. diffraction, small angle scattering and quasi-elastic scattering. Deuteration is indispensable for these studies, and for many biological experiments the time/effort needed to produce the samples is now considerably greater than the time/effort to perform the experiments. The importance of the D-lab has already been commented on.

The proposal for a new single crystal diffractometer for life sciences was presented to the NAC. While this should in principle open up a higher proportion of the proteins in the PDB to study with neutrons, this still requires in practice the growth of suitably large crystals and the number of studies per year will still be limited. In addition, neutron studies do not add value to all structures. The NAC would therefore recommend that the science case is much more focussed on (examples of) specific scientific questions that can be addressed with available crystals. Consideration should also be given to the effect that the rapid developments in electron microscopy will have in this scientific area. In addition, now that MLF has a limited number of vacant beamlines (before a second target station is built) the case for a specific instrument needs to be compared to other alternatives.

e. User program handling and user support

The organisation of the user programme is steadily improving and this is reflected in the user satisfaction questionnaires. However, the Single Sign-On application/registration system has not been completed. MLF should bring this into use as soon as possible so as to increase the activity and output, while lowering miscellaneous procedures/tasks.

f. Second Target Station

The NAC is pleased to see effort in developing concepts and ideas for a second target station at MLF. However, it is too early to provide detailed comments as ideas and concepts are at a very preliminary stage.

The NAC would suggest that the second target station concept should provide for sufficiently different and new capabilities compared to the first, which is a challenge since the current 25Hz frequency was already a compromise between higher and lower frequencies, e.g. ISIS (50/10Hz) and SNS (60/15Hz). The plan should also consider the optimization of instruments across both target stations in order to demonstrate the added value and capability to the scientific community. 'More of the same' is not likely to attract funding.

The NAC encourages the development team to devise realistic, buildable and easy-to-operate models for a muon source.

4. Additional remarks

Business model for MLF operation

Modern MW class neutron sources with suites of advanced instruments, such as MLF, have the capability to continuously produce many significant scientific results. However, to achieve this requires an appropriate 'business model' for operation, i.e. organizational structure, staffing levels and budget. The scale and complexity of the MLF operation are enormously different from KENS, for example, the expectations of users are much higher and their requirements are more varied and more demanding to execute, so the business model also needs to be different.

A significant scale up of the results achieved so far by MLF could be expected if the level of resources is increased appropriately in areas such as sample environment, software/computing, detectors, neutron devices etc. as well as instrument scientists. This support should be structured in specialized groups providing a consistent level of support across the facility.

Instrument scientists should be enabled to concentrate on scientific support for users and producing scientific outcomes, rather than on a broad range of technical and scientific tasks. This is especially important as the demands on instrument scientists increases as a result of the increased beamline throughput gained from increased source power. Despite the constraints of the separate organizations (JAEA, KEK, CROSS, Ibaraki prefecture) all efforts should be made to provide a consistent service to users within the general user or public beamtime. The external perception of a facility, and its attractiveness for users and funding, is often set by the lowest performance level rather than the highest, so it is in the interests of all the organizations comprising MLF to use their resources in the most effective way to achieve consistency.

Cooperation with universities and industries, as has already been started, can further enhance the productivity.

Conclusion

It is clear that MLF staff are highly dedicated and working extremely hard towards the success of the facility.

Steady well-considered progress is being made towards high power operation. This should be continued.

MLF has an excellent suite of instruments that provide the capability to produce correspondingly excellent science. However, the business model for operation of MLF needs to be appropriate to the technical capabilities of the facility if the potential scientific output is to be achieved.