

**Neutron Advisory Committee Meeting for J-PARC MLF Facility
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Committee members:

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Charge to the committee:

- Review our efforts to strengthen the facility
 - adequacy of renewed target development strategy in the context of 1MW stable operation in a few years; including moderator cryogenics
 - timely construction and future direction of beam lines, sample environment and devices to maintain the uniqueness of the facility
- Evaluate the appropriateness of the science promotion efforts
 - activities of science group and science promotion board
 - any suggestions to help the smooth penetration of science driven atmosphere
- Review our efforts to develop business model in MLF suitable to 1MW facility, especially the direction in future
- Any suggestions for improvements are appreciated. Our particular concerns include but are not limited to the following:
 - yet to be unified MLF activities between JAEA, KEK, CROSS and Ibaraki prefecture, as pointed out at the last NAC
 - improving paper production rate
 - promotion of industrial use
 - user program handling and user support

Target systems

The stable operation of target #8 at different power levels between 300kW and 500kW, and of target #9 mostly at 500kW, is recognized by the NAC. The overall availabilities of 90% and 93% for targets #8 and #9, respectively, show that the chosen target improvement measures have been highly successful. To continue to improve understanding of the beam power dependency on the pitting damage, the NAC recommends to maintain a simple power history. In this manner, the post-irradiation examination (PIE) measurements can be reliably correlated to beam power. Therefore, it is recommended to consider the move to higher power operation not only from the user requirement point of view but also from the target design point.

The NAC would like to encourage the MLF operations team to establish a target management plan for a long-term power ramp-up strategy taking into consideration the importance of correlated PIE data to the target design. Starting in autumn 2019 the first constraint-free target, i.e. a target with a significant design change, will be installed for operation. MLF should consider that such major changes might suggest a conservative approach to the beam power ramp-up, perhaps either running the first constraint-free target at 500 kW or with a modest power increase.

The planned order of operation of the three constraint-free targets, coming from two different suppliers and all being ready by end of March 2019, is not clear to the committee. This order should be discussed and agreed by stakeholders, including contingencies, and included in the target management plan.

The countermeasures against the performance degradation of the helium refrigeration system taken in 2016 appear very effective, as a new pressure drop increase after 15000 operating hours was not observed. Nevertheless, a replacement of the ADS during the coming summer shutdown as a precaution appears reasonable.

The yet unknown reduction of the helium gas flow rate to the bubbler is a crucial factor for future beam power increase. Also, with the unconstrained version of the target, the vibration measurement will not be so effective to monitor pressure pulse mitigation. It will then be necessary to rely on pressure measurements in the gas supply system to ensure that gas flow is sufficiently high. A strategy to reliably monitor the gas injection rate should be decided and design changes proposed. If pressure measurements are used, the sensors should be capable of measuring the full range of possible pressures.

Some vulnerabilities in the target may exist that are unknown at the current time. Therefore, a plan should be proposed to examine some of these areas through more extensive PIE, e.g. including endoscopic investigation of the target interior surfaces all the way back to and including the bubblers after beam window cutting.

Although the tritium release during target replacement is well below the limits given by the safety authorities it is strongly advised to investigate carefully the reason for its unexpected increase during replacement of target #8. A good solution should be pursued to avoid sudden release of large quantities of tritium when the target loops are disconnected. Different techniques for either confining the residual tritium inside the target or slowly releasing it over an extended period of time could be envisaged. Even if this would lead to the unwanted side effect of a prolonged target exchange time it should be considered as acceptable.

Science promotion

Important efforts have been made over the last year to enhance the scientific activities and to establish a stronger 'science culture' within MLF. MLF should continue to support and motivate the science groups and to monitor how well they are working (e.g. common publications, meetings, students etc.).

The Science Promotion Board is playing an important role in promoting collaboration with external and industrial users, helping MLF staff to get resources through participation in grant funded research and proposing the idea of public beam time on KEK and JAEA instruments. This should be continued.

MLF should formally support the university branches as outstations and ensure semi-permanent contact with the university members outside of experimental beamtime periods. These branches can support the science groups and the development of activities such as deuteration, computing, sample environment development etc. Since this should lead to an increasing number of students/postdocs based long term at J-PARC MLF need to improve the capabilities, e.g. accommodation, to host them.

The neutron scattering schools are well attended but the proportion of Japanese students seems low. Efforts should be made to understand and rectify this.

Instrument development

The NAC congratulates MLF on the successful test of instrument performances at 1MW, the transition of VIN-Rose to operation and the successful commissioning of POLANO. We are pleased to see that all instruments are operating well and are being maintained and upgraded (e.g. with additional detectors) in support of the user program.

The NAC endorses the neutron detector and polarising supermirror development activities. The He3 polarisation capability being installed on POLANO is a world first as an in-situ capability. However, this activity is manpower intensive so installation on other instruments should be carefully considered to ensure maximum return on investment.

Sample environment and laboratories

The SE team maintains common equipment such as cryogenics, magnets, high-temperature furnaces, high pressure etc. The team mainly consists of beam line scientists so the total effort is limited. More dedicated technical support is needed in future if user expectations are to be met, especially as experiment throughput increases with increasing power.

The deuteration laboratory and activity are slowly being built up. However, the manpower and equipment are limited. Often the deuteration effort required to produce the sample(s) considerably exceeds the effort required for the experiment itself. Dedicated staff and collaboration with universities and other international deuteration facilities will therefore be needed. Published results from samples produced and measured at MLF will then be required to provide the justification for this investment.

Industry

The industry program at MLF is significant in comparison to other international facilities. However, the NAC suggests that MLF clarifies what the value of industry usage is to J-PARC (e.g. promotional value to the government, income ...) and determines the corresponding metrics of success other than just % of beamtime used. It is also important to evaluate activities on each beamline, not just overall.

Industry use is also part of the 'business model' (see below). Beamtime is limited, so more use by one group necessarily means less use by another. Any decision on the level of industry use needs to be strategic and informed by considerations of what is lost as well as what is gained. But this balance may differ between countries and facilities.

The NAC understands that the industry programme on the SPICA instrument is highly successful and recommends the inclusion of the high level industry statistics from it such as utilisation (days), number of experiments & number of companies as part of the industry program. Otherwise this success is 'hidden'.

The ambition to increase industry usage further is commendable. However, MLF must consider how the necessary additional support can be provided. For example, the Ibaraki prefecture model with an additional fee for industry usage might be followed, with this income going to MLF to provide additional scientific or technical support for industry access.

User programme and publication rate

The NAC is pleased to see that the user satisfaction is increasing. It would also be good to seek feedback from users on additional capability they would like to have at MLF (e.g. sample environment, software, instruments).

The proposed data policy with a data embargo of 3 years is in line with other international facilities. The proposed storage of raw and meta data for 10 years seems reasonable, but a cost/benefit analysis could be performed to validate the retention period.

User access to data and computing infrastructure to perform data reduction and analysis systems is critical for a world leading user facility. At present at MLF there are significant inefficiencies for both users and facility staff in manually retrieving and transferring data. International best practice to segregate facility operations from user operations could be achieved using an offsite data storage facility or creating a segregated network within J-PARC.

The NAC commends MLF on the number of user workshops being held. We suggest running science as well as instrument based workshops in order to cross-promote the capabilities of multiple beamlines.

The NAC recommends consistent and complete reporting of instrument demand and utilisation to enable key observations to be made and trends to be identified, i.e. this should include all use of beamtime regardless of which programme uses it. The NAC suggests the following metrics that could be reported:

Demand

- Beamline demand - year by year on each beamline (last 5 years)
- Country/Organisation demand
 - average of the past 5 years
 - last round
 - current round

Beamline Utilisation

- Beamline usage (days) per use category as well as maintenance, instrument outages, commissioning & other relevant usages.

User Statistics

- Number of individual users per year.
- Number of user visits per year
- Number of new users per year and demographics (country/organisation/position)

The usage of the mail-in program seems low, so we suggest that MLF promotes this access route more strongly to users.

The NAC is pleased to see that the number of publications from MLF has increased in 2018. With the actions being taken to improve publication rates, and the reliable operation since 2016, a further increase in publications would be expected in 2019 and 2020. MLF should continue to determine and reduce the bottlenecks from proposal to publication that limit scientific output. The database of publications is very detailed and will provide a useful resource for tracking outputs. The use of DOIs for MLF data, as is now being done by several facilities worldwide (see e.g. [https://www.isis.stfc.ac.uk/Pages/Digital-Object-Identifiers-\(DOIs\)-for-ISIS-Data.aspx](https://www.isis.stfc.ac.uk/Pages/Digital-Object-Identifiers-(DOIs)-for-ISIS-Data.aspx)) might be considered as another mechanism for tracking output.

Business model

The engagement of younger staff in discussing the business model is highly commended. The NAC are very impressed by the high level approach; it is certainly not naïve. The choice of topics – management, safety, research results - is interesting. A lot of useful questions have been raised by this exercise; the difficult challenge will now be how to address them. Some of the issues are generic/common to large organisations; JPARC and MLF are not unusual but do have a complex structure which can amplify issues.

‘We have no time to sharpen our axes’. This phrase neatly encapsulated the fact that staff overload is a key issue. MLF staff are clearly dedicated and very hard working, but the current situation is probably not sustainable.

Second target station

The approach is ambitious, as it should be, but to succeed scientifically, not just technically, will require a good business model. All of the currently underfunded aspects of MLF need to be included in any proposal, e.g. sample environment, computing, deuteration etc. The NAC recommend that MLF look at the Oak Ridge ‘3 source strategy’ since the combination of facilities being considered – two target stations and a reactor - is the same. However, this is not an easy optimisation problem.

Conclusion

- MLF has an excellent suite of instruments that provide the capability to produce correspondingly excellent science.
- It is clear that MLF staff are highly dedicated and working hard towards the success of the facility – but possibly they are working too hard.
- Good progress is being made towards high power and reliable operation. This should be continued. MLF should operate as much as possible during the 2020 main ring shutdown to maintain the beamtime for users.

- The introduction of public beam time on KEK and JAEA beamlines, if it leads to more uniformity of support across the beamlines, is strongly supported.
- Industry use is strong but a clear understanding of the purpose and expected outcomes would be helpful.
- If increased synergy of neutrons and muons is a goal, then some merging of the advisory committees might be considered?
- We look forward to the outcome of the business model development and further progress towards the second target station.