

**Neutron Advisory Committee Meeting for J-PARC MLF Facility
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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 of beam lines and sample environment to maintain the uniqueness of the facility attracting not only domestic users, but also international users.**

- 2. Evaluate the appropriateness of the science promotion efforts**
 - a. A new organization; science group and science promotion board**
 - b. Any suggestions to help the smooth penetration of science driven atmosphere**
(*) "science" includes industrial application

- 3. Any suggestions for improvements are appreciated. Our particular concerns include but not limited to the followings:**
 - 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 (per proposals, per MW-hours)**

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

Findings

Excellent work by J-PARC staff has been completed to:

- Establish reliable operation to conserve the remaining target while spares are fabricated.
- Ensure a high probability of success in solving the water shroud problem with the new fabrication of targets 8 & 9.
- Complete structural analysis and mock-up testing for machining, welding, and inspection that demonstrate the water shroud vulnerability that led to two leaks has been solved.

The cost of each target is significantly increased by the required shipping casks and limited conventional facility space for storage. Money saved by minimizing target failures could be used to bolster other programmatic weaknesses at J-PARC. Other issues with target reliability will likely occur, especially as the power level is elevated.

Recommendations

Because target failures have led to reduced neutron production, aggressively aiming for 1 MW operation represents a high risk to the facility. A systematic approach should be taken to learning about target performance while elevating operating power, but inconveniencing the user program as little as possible.

Based on J-PARC power history and comparable performance achieved at SNS at 60 Hz, a near-500 kW power level seems to have a high probability of success. It is recommended that J-PARC run a target at a mid-range constant power for at least a year to:

- Allow user programs, support systems, and science production to mature;
- Establish a proven base reliability target power level (fixed data point);
- Help to establish understanding about power-dependent cavitation damage.

Findings

The NAC recognizes the great efforts made by MLF's neutron source section in cleaning the cryogenic hydrogen system during the 2016 summer outage which succeeded in recovering normal operating conditions without any cleaning intervals. The regular oil concentration measurements on the basis of a cold trap appear to be an appropriate measure to monitor the oil contamination level in the helium.

The accumulation of oil in the heat exchangers of the cold box after some years of operation appears to be quite uncommon. Therefore, the plan to extract the heat exchangers and the ADS from the cold box in the future on a regular basis seems to require extensive work yet does not actually solve the principal problem. Instead, future efforts should be focused on developing a more effective oil segregation system. Possibly the improvement or replacement of some oil separators should be considered in collaboration with industry.

Recommendations

Some effort should be made to locate similar type He refrigerators and it should be checked whether they use synthetic or mineral oil and have experienced similar oil accumulation problems in their heat exchangers. If not, try to understand the differences with respect to the MLF refrigerator.

- b. timely construction of beam lines and sample environment to maintain the uniqueness of the facility attracting not only domestic users, but also international users.**

Findings

The build-up of a high quality instrument suite since the start of MLF has been impressive. However, existing beamlines are not yet fully performing scientifically. The NAC has a concern about yet more beamlines spreading the available effort more thinly. There is also concern about the budget needed to maintain beamlines and equipment compared to that for upgrades, new sample environment etc.

The cross-organizational sample environment group is a good development and the level of support for cryogenics etc. seems appropriate.

Recommendations

The priority for the next few years should be establishing the scientific productivity of the existing instruments, rather than building new instruments. None of the existing instruments has had 10 years of real operation – probably at most 5 when the various shutdowns are taken into account – so it is very early to be considering replacing any instrument.

A strategy is needed to define the balance between maintenance/redundancy and new capability.

2. Evaluate the appropriateness of the science promotion efforts

a. A new organization; science group and science promotion board

- b. Any suggestions to help the smooth penetration of science driven atmosphere**
(*) “science” includes industrial application

Findings

The cross-organizational science groups are a good step towards increasing the emphasis on science, and so raising the scientific profile of MLF.

The NAC were informed that the Science Promotion Board (SPB) will have 5-6 members and its role will be to provide advice on the direction of science and innovation in MLF. However, further information was not available. What are backgrounds of the science board members? How often do they meet? Who decides the agenda? Is the main mission of SPB to introduce new science areas to J-PARC/MLF or to strengthen the existing ‘traditional’ areas?

Recommendations

The breadth of the scientific activity of MLF should be presented so that the SPB can monitor, evaluate, and advise. To be helpful the SPB should meet at least twice a year. SPB members should not necessarily be neutron users – advice from synchrotron users or theoreticians/modellers would also be valuable.

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

- 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 (per proposals, per MW-hours)**

Findings

The separation into different organisations is still a problem although there has been progress towards improved cross-organisational working, for example the science and sample environment groups. However, the support levels across instruments are still very inconsistent.

Unique user numbers per year (~1000) seem very high relative to the number of experiments (~400) performed (for comparison, at ISIS the ratio is about 1:1). If correct then this would indicate a heavy load on instrument scientists (local contacts) in supporting a high turnover of inexpert users. Local contacts need to be involved all the way from preparation of the proposal through performance of the experiment to supporting data analysis and even helping write the paper. Any one of these steps can be a bottleneck that reduces the overall throughput.

The number of journal papers published relative to the number of experiments performed since the start of the facility is low, particularly given that the number of shutdowns would have allowed users additional time to analyze data and publish. The number of publications in proceedings is similar to that in journals. However, it isn't clear whether these are effectively the same data being published twice or whether there are proceedings articles that should be turned into journal articles.

Proprietary industry use on the iMATERIA instrument operated by Ibaraki Prefecture is surprisingly high (50%), particularly when considering the cost per day. This usage, including repeat users, seems to be increasing. However, it is not clear what particular factors distinguish this beamline and lead to this success.

Overall there is a significant proportion of non-proprietary industry use (industry PI). However, this does not appear to produce any visible output, so this must be a major factor in the low overall output.

The NAC is pleased to see progress on scientific software, but is concerned that the current available staffing is well below that needed to deliver the scope of work required for an international user facility.

Recommendations

Non-proprietary industry experiments should be expected to produce some form of visible output. If this is not a publication (with industry being less motivated than universities in this regard) then it should be a case study or a patent, or at the very least an experimental report.

A more detailed analysis is needed of the reasons for experiments not leading to publications, on an individual instrument basis. What proportion of experiments fail for some reason? Is software/expertise a limiting factor? Such analysis is sometimes avoided because it may appear to be critical of those instruments/scientists which have lower output. However, this is not the

purpose. If used properly the results can instead be used to direct more resources towards the bottlenecks or to spread good practice.

Users should be encouraged to publish in standard journals instead of/as well as proceedings.

Increasing the source power will probably not by itself lead to more publications. Experimental throughput is mainly limited by staff numbers, so more power will not lead to more experiments. However, higher power will permit more difficult experiments and/or produce more data. Papers produced from these experiments may have higher impact (though this is not predictable) but they may also be harder/take longer to get to publication.

The NAC encourages MLF to develop a computing and scientific software strategy. The priority is to ensure that users leave J-PARC with reduced, analysable data. Other considerations include standardisation and collaboration. Software is absolutely critical to enable MLF and its users to realise the benefits as the facility progresses to 1MW operations. The level of budget needed is probably equivalent to building 1-2 instruments. Obtaining the necessary resources through a gradual increase in staffing would seem to be impossibly slow, so the NAC suggests to look for opportunities to fund some part of the work as a defined multi-year project (designing and building a software infrastructure instead of designing and building an instrument).

Conclusions

MLF is still in the transition from construction to operation. This transition is always difficult for facilities.

MLF needs to always remember that the priority is to produce science, not to deliver accelerator or target power or develop instruments.

MLF needs to build a strong, well supported and productive scientific user programme. A critical analysis of the causes of low productivity should be carried out.

Industrial use is clearly a high priority for the government. But non-proprietary use must have some visible output.