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 the recovery process from the target incident at MLF:**
   1.1 adequacy of the renewed target development strategy in the context of 1 MW stable operation in the foreseeable future
   1.2 appropriateness of program handling including execution of approved proposals as well as the call for new proposals

2. **Evaluate the appropriateness of the facility operation and its upgrades with respect to the following points:**
   2.1 safe, stable, and efficient operation towards the production of science in timely manner, even with limited beam time available in CY2015,
   2.2 timely construction of beam lines and sample environment to maintain the uniqueness of the facility attracting not only domestic users, but also international users.

3. **Any suggestions for improvements are appreciated. Our particular concerns include, but are not limited to, the following:**
   3.1 yet to be unified MLF activities between JAEA, KEK, CROSS, and Ibaraki-prefecture, as pointed out at the last NAC
   3.2 improving paper production rate (per proposals, per MW-hours)
   3.3 promotion of industrial use
   3.4 beamtime balance

1. Review the recovery process from the target incident at MLF

1.1 adequacy of the renewed target development strategy in the context of 1 MW stable operation in the foreseeable future

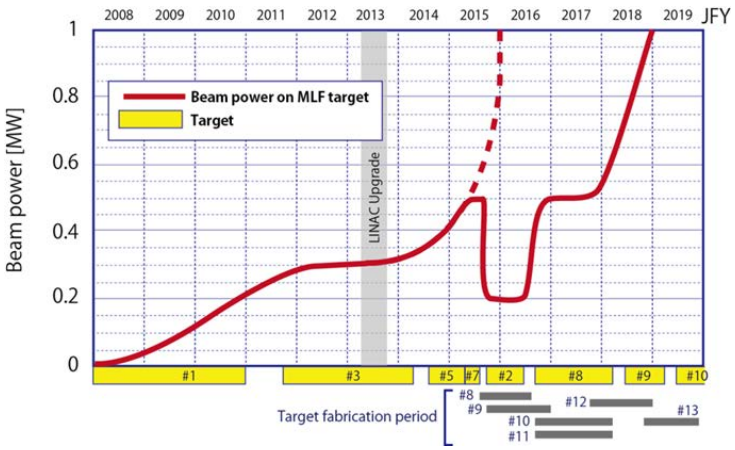
Findings

The independent review of the target is welcomed and the review committee is thanked for their oral report to and discussion with the NAC. The review report will provide more detailed feedback than given below.

The overall target redesign response is sound. The vulnerabilities from stress concentrations are being addressed and weld lengths / bolt numbers are all being reduced. The move toward a constraint free design (decoupled water and Hg vessel shrouds) is also good.

The proposed enhanced fabrication inspection with the vendor is appropriate. Maintaining good communication between the fabrication and design efforts is important for evolution towards a robust target. Independent fabrication qualification is also encouraged.

The proposed schedule for design completion and fabrication of target 8 is aggressive (see figure). Care should be taken not to rush design or fabrication steps. Ensure the delivery of a high quality target, even at the expense of a delay in the change from target 2 to target 8 (with extended operation at reduced power).



The schedule for target 9 (constraint free) design/fabrication and the plan to reach 1 MW operation is even more aggressive. The possibility of additional target failures should not be ignored in operational planning. Contingency analysis on additional failure impacts should be done (target storage, replacement times, impact on the user program, etc.) as part of the risk assessment. Establishing a reliable operation base is critical.

Higher power operational periods shortly before planned target changes are an appropriate (reduced risk) mechanism for high power operation testing in the near term.

Recommendations

The highest priority for MLF is to provide reliable neutron beam instruments and operation to their scientific community. The production and support to science needs to be prioritized ahead of reaching

the technical goal of 1 MW. *Extended (reliable) operation at 200kW would benefit both the scientific programme and the target programme.*

1.2 appropriateness of program handling including execution of approved proposals as well as the call for new proposals

Findings

The approach taken with regard to carry over of experiments and priority being given to external users is consistent with that used by other facilities for unplanned outages.

Recommendations

When beamtime is reduced, increased priority should be given to external users. (This is not obvious from the statistics provided.)

The approach to reducing the target replacement time should be supported and could possibly be taken even further.

1.3 approach to moderator cryogenics (not included in the formal charge)

Findings

An additional issue, not directly related to the target incident but linked in terms of future operational availability, is apparent contamination of the hydrogen moderator cryogenics system. The approach of J-PARC's cryogenic team to tackling this issue appears to be very professional. They have clearly identified the problem and excluded many possible causes. The proposed further measures appear to be reasonable and achievable. The present situation with reduced helium flow and intermittent operation can only be an intermediate solution and every possible effort must be taken during the coming summer maintenance period to identify the cause of the contamination and the method for its elimination.

Recommendations

There are several devices on the market measuring in-situ the oil mist and the C_xH_y content in He flow. Some of them require an extra pyrolyser unit. *Contact specialists from other institutes or from suppliers of He refrigerators in order to get advice as it appears that J-PARC is not the only facility facing this kind of problem.*

It is difficult for the committee to judge the acceptable level of oil contamination. In principle the level should be as low as possible, i.e. in the ppb range. However, it is important to monitor the oil mist concentration over an extended period of time (several months) to get an indication of the tendency. If the concentration significantly increases over time the refrigerator should be stopped and cleaned.

2. Evaluate the appropriateness of the facility operation and its upgrades with respect to the following points:
2.1 safe, stable, and efficient operation towards the production of science in timely manner, even with limited beam time available in CY2015,
2.2 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

MLF is almost fully instrumented with only two available beam ports for new beam lines. The instruments that have been constructed are among the best in the world in their respective class. The variety and support from the community in developing instruments shows strong community interest and engagement. This is a fantastic achievement that the NAC applauds. The NAC notes that the NIPRC has made recommendations for jBIX, a next generation instrument for macromolecular crystallography, and for a polarized epithermal neutron spectrometer. If both were eventually funded and built this would result in all of the neutron beamlines at the MLF having been instrumented.

Due to budget constraints, many instruments have unfortunately not reached their potential. The NAC notes and appreciates the efforts to find resources to get the MLF instruments to full scope. However this process appears to be uneven among the partners at the MLF.

Progress in neutron optics, detectors, and polarization devices is similarly outstanding, with the ^{3}He polarization in spin filters finally reaching more than 80%. Regrettably, the NAC was not similarly informed about the MLF's efforts in sample environments.

Recommendations

The 'grand plan' developed at the start of MLF construction was an excellent tool for developing a coherent instrument suite to service the needs of the scientific community. *It is now time to update this plan by developing a coherent scientific strategy that sets a vision for the future development of the MLF on the basis of the needs of the community and the impact of the science that can be achieved.* Then align all the instrumentation and development activities to achieve this vision. This would require developing prioritized lists for completing the full scope on the existing instruments, for the development of sample environment, and for the development of neutron technologies. While many avenues may be attractive and exciting, with the limited resources available it is likely impossible to be truly excellent in all of the development activities being undertaken and in all types of sample environments.

This scientific strategy should also inform an independent assessment of where the best scientific opportunities lie for instrumenting the last two remaining beam-ports. The current choice of instruments may not be the best ones if viewed in the light of other options.

Finally this strategy should discuss the future challenges that can be addressed using neutrons and how a 2nd target station (STS) may address them. Use these scientific priorities to develop a technical concept for a STS (in terms of pulse lengths, rep-rate, power and moderators) that will be utilized by an instrument suite that will meet these future scientific challenges. To secure a 2nd target station it is important that MLF develops a user community that will be able to fully exploit the new capabilities. This will likely require that the 1st target station be fully exploited. Thus it may take several years to reach a productivity level that clearly demonstrates the need for the capacity and capabilities that can be provided by a 2nd target station. In spite of this, it is time to incorporate a second target station into the long term plans of the MLF.

The plan for harmonising the allocation of beamtime on the different funded beamlines is commended. The merits of the introduction of the new General (Long Term) proposal access type should be carefully considered as experience from other facilities is that this has not delivered an increase in scientific output from the facility.

It was clearly evident that the general user program is not adequately supported on some beamlines which are hampering the delivery of the scientific outcomes. The committee urges J-PARC to determine strategies to increase the conversion-rate of raw data to publication.

The committee is pleased to see progress being made with the local community regarding the new site access entry for J-PARC. This will streamline access to the J-PARC site for users and benefit the local community by reducing traffic congestion.

It was unclear whether the views or the satisfaction of the user community were considered in a number of presentations. The committee encourages the introduction of a process to survey users shortly after the completion of experiments to gauge their satisfaction and allow determination of their concerns. Items that may be considered in the survey include data acquisition and reduction software, security, performance of the beamline/sample environments.

The committee had difficulty in understanding the metrics and data reported throughout the presentations. Specifically some data reported was not self-consistent and incomplete. The committee encourages J-PARC to consider using the metrics and data that is reported for other facilities to permit comparison and clearly identify trends, e.g. number of experiments and publications per beamline per year.

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

3.1 yet to be unified MLF activities between JAEA, KEK, CROSS, and Ibaraki-prefecture, as pointed out at the last NAC

Findings

The most concerning point is that each organization (JAEA, KEK, CROSS, Ibaraki) has its own program and strategy, and very different levels of resource to support the different instruments. The most successful user programmes, for example ILL, have been built on consistency of approach to access and support.

The current situation about beam time allocation is very complicated and difficult to understand. Hence, it should be improved (or simplified). The future plan for the beam time structure for Facility Use (as presented by Kawakita) is one way to go. That is simplification to two categories - Instrument Group Proposals and Facility Projects. Instrument Group Proposals (public; JAEA) and CROSS development proposals (CROSS) become Instrument Group Proposals. Project Research Proposals (public) will be renamed as Facility Projects. S-type Proposals (KEK) will be divided between Instrument Group and Facility Proposals (S1) and to general user proposals (S2). This kind of change is certainly better than doing nothing. However, even further simplification would be desirable.

Recommendations

The NAC understand that to move all MLF staff and funding into one organization is probably impossible. Accepting this fact, *the next best approach would be to structure and control activities so that they externally (for users) appear to be one organization.* The leader of this organization should (literally) be the MLF Director. The different organisations contributing to MLF need to develop a common strategy that accommodates their individual strategies – this may require some compromise but given that all have a strong interest in the future productivity and success of MLF there should be a lot of common ground. Structuring activities across instruments by common interest (e.g. diffraction) rather than organization (e.g. KEK) may help to foster a sense of common purpose and enable more uniform sharing of resources.

3.2 improving paper production rate (per proposals, per MW-hours)

Findings

Even when the unplanned shutdowns are taken into account, the paper production rate of J-PARC/MLF is worryingly low relative to the number of experiments that have actually been performed. In 2012 and 2013 a total of 564 experiments were carried out, leading to 101 papers in 2014 and 2015 – the target should be about 1 paper for every 2 experiments. A possible cause is the lack of man-power on some instruments, so instrument scientists do not have enough time to follow-up their (user) experiments until publication. However, even the better staffed instruments have low publication rates.

Experience at other facilities is that publication rates are only marginally related to source power. As power increases it enables more complex experiments, not just more experiments, and the number of experiments that can in practice be supported is limited by staff and budget levels. The best metric is therefore publications per experiment performed (not proposals submitted or accepted).

Recommendations

Better data is required before the NAC can make any clear recommendation (aside from the obvious issue of the staffing level – see below). *MLF should ask instrument scientists to carry out an in-depth analysis of all the experiments (internal and external users) that have so far been carried out.* Where experiments have not led to a publication, contact the users and ask why. Typical reasons might be insufficient data quality, more beamtime needed to complete data collection, additional data needed (from other techniques), data analysis/software problems, insufficient time/people to analyse/publish, require assistance from facility etc.

The average level of staffing on instruments is certainly below that of other internationally leading facilities. If this is leading to low productivity when MLF is operating at 200-500kW, then the situation at higher power (more data, more complex experiments) will simply be worse.

For some of the younger instrument scientists, closer collaboration with academia may help. Facilities, with their smaller number of scientists and quite strong emphasis on technical aspects, are a more limited environment for scientific development than universities. A "mentor" system, pairing instrument scientists and university professors, might be helpful for the development of broader scientific perspectives and productivity improvement. Note that this recommendation only relates to the professional development of the instrument scientists. We do not recommend building special relationships with regard to access to beamtime.

3.3 promotion of industrial use

Findings

The MLF places a high value on industrial engagement with approximately 20% of the successful proposals being led by industry. This is the highest fraction of any major neutron facility in the world. They recognize that the needs of industry are different than those of academic users and have some mechanisms in place to accommodate the differences. There is also a very healthy fraction of proprietary work for which the companies pay the full cost of providing the beam time, though unfortunately the MLF does not actually receive the money generated by these experiments. Instead the funds are paid directly to the government. Overall, the NAC congratulates the MLF on their very effective program for industrial engagement.

Recommendations

NAC strongly recommends industry collaboration (and/or consultation) with academia (experts on neutron scattering, theories, synthesis, etc) to further broaden industry participation and make output more productive.

As the MLF clearly recognizes, industry needs rapid access to the facility. In light of this, the NAC encourages them to expand the rapid (two week) access to powder diffraction to other instruments. In addition we believe that the commissioning of the imaging station presents the MLF with an excellent opportunity for future growth of industrial use of the MLF. The NAC also believes that the MLF should explore additional ways to attract industrial use of the facility. This could for example, include other mechanisms of access to the MLF instrument suite through joint projects with MLF scientists requiring some sort of contract to spell out IP issues, web meetings to help industrial scientists learn how neutrons can be used to help them solve their companies problems, and greater use of beamtime to demonstrate the utility of neutron techniques to problems of interest to specific companies.

At present the impact of most of the industrial use is effectively invisible. The NAC recognizes that it is often difficult to judge the effectiveness of such programs as counting papers is clearly inadequate. Thus *we recommend that the MLF develop a different set of metrics for their industrial engagement programs*.

Besides the number of successful applications for beamtime, which is already being tracked, these metrics could include the number of patents informed by neutron results, case studies of products whose development was assisted by neutron experiments (such as the tyre rubber example), and even the number of companies that return to the MLF. This last one is actually a very good way to gauge whether or not companies found enough value in their neutron results to expend their staff's time to continue using the facility.

MLF management should make it clear to the staff that industrial engagement is highly valued. For example staff (including scientists) who are effective in attracting and assisting industrial scientists to their instrument should be credited with these activities in their performance review. It is unfortunate that the money generated through proprietary work is not returned to the MLF. If it was, it could partially be made available to the instrument scientists to improve the capabilities of their machine.

3.4 beamtime balance

Findings

The statistics are not easy to interpret, but the general impression is that the beam time balance looks too much biased towards internal use. Japanese use of international facilities does not appear to have increased either due to the JRR-3 reactor out of operation or to the unplanned stoppages of J-PARC/MLF. Thus suggests that potential users are not using neutrons, which increases the risk that they are lost to the field. If the pipeline of trained students dries up due to lack of access then this will lead in the future to a lack of postdocs and then of professors, which is not good for the long term future of MLF.

Recommendations

As in recommendation 1.2, the NAC strongly recommends giving increased priority to external users, of course working in collaboration with instrument scientists.