

February 15, 2010

## TO MEMBERS OF THE J-PARC NEUTRON SOURCE TECHNICAL ADVISORY COMMITTEE

This is a report of our (J-PARC/MLF project team's) reply and understanding to the recommendation and comments described in the report of N-TAC-7 given by the Committee. Recognizing the critical importance of recommendations, we have tried to respond to all of them. Most of advices have been seriously taken into the consideration and factored into the redesign.

The followings are our reply to each comment:

### 1. Overview

### 2. Operations

#### Operation

##### Recommendation

NTAC recommends that, as instruments come on-line, staffing be increased to the level of about six per instrument consistent with international best practice. Furthermore, the MLF should endeavor to secure a credible commitment (or at least a plan) to staff and operate additional instruments at the proper level, at the time funding is sought to construct each additional instrument.

##### *Our reply and understanding*

*We are aware of the importance reasonable level of staffing for the user operation in this type of MW class pulse neutron source, e.g. J-PARC. We set a target of six per instrument to be realized in near future although right now still it has not been satisfied with. In every event, we are requesting number of persons to be added to the personnel affairs divisions of JAEA and KEK. As for as for instruments prepared under "the new law regarding promotion of common use of the specific advanced large research facilities" which will be effective in 2011, enough manpower is expected to be prepared by the budget associated with this law.*

#### Sample Environment

##### Recommendation

NTAC recommends that the MLF develop a comprehensive, prioritized list of existing and planned sample environment equipment for J-PARC (including equipment at JRR-3M that can be used at J-PARC) by the next NTAC meeting. In addition, a plan should be developed for the management of sample-environment equipment, including planned staffing levels and support space.

### *Our reply and understanding*

*Although we do not have dedicated SE group yet, we have organized interim SE group. It includes technical staff members to work on maintenance/development of the equipment and a so-called advisory team by scientists. The SE group has just started developing SE equipment based on our concrete future plans and the standardization protocol. Then the SE team will be able to manage the SE equipment with clearer strategy. We also note that the SE group is now planning to equip support space in MLF. We will present detailed plans at the next NTAC meeting.*

### **User Support**

#### Recommendation

NTAC recommends that the MLF develop a prioritized plan for support laboratories at the MLF and/or accessible to users of the MLF by the next NTAC meeting. In addition, a plan should be developed for the equipping and staffing of these support laboratories.

### *Our reply and understanding*

*There are already the following rooms with some equipment in the MLF building and IQBRC for the user and the staff.*

- 1) Irradiated sample handling room (chemical Lab); MLF*
- 2) Sample preparation room (chemical Lab), MLF*
- 3) Electric circuit room and physics laboratory, (under construction) MLF*
- 4) Workshop (in experimental hall), (under construction) MLF*
- 5) Rooms for off-line experiments, IQBRC*

*The above-mentioned environments are necessary at least for the user and the staff for making neutron experiments. We have been discussing the support equipments and rooms (buildings) for these 6 years and then, we have some plans depending on the budget. We have made effort for obtaining the budget every year.*

*The support staff members for the rooms and equipments are mainly interim staff and MLF scientists who have other duties now. The rooms and equipments must be operated and maintained effectively by dedicated team with proper staff members.*

#### Recommendation

Many neutron facilities (SNS, ILL, ANSTO) have developed deuteration laboratories nearby that assist neutron users in preparing appropriately deuterated samples. This capability should also be considered for the MLF, but could be developed in collaboration with nearby universities or research institutes. In addition, the plan needs to include a well-organized system to check samples after irradiation and standard procedures to cope with activated samples. Presumably these activities will occur in the Class-I radiation laboratory.

### *Our reply and understanding*

*Although we have discussed the deuteration laboratories, we need more discussion with user group members of polymer science and biology for making a concrete strategy and plan (for specifications and budget) of the deuteron laboratories. We immediately set up user-committee for such a discussion with the proper users.*

*There are already rules and room (Class-I radiation Lab.) for handling irradiated samples and it works well now. However, we have discussed effective rules and procedures for handling, taking away and disposal of irradiated and activated samples. It will be safe and effective rules and arrangements for MLF users.*

### Recommendation

Attracting industrial scientists is an admirable goal of the MLF. However, these users impose an additional set of requirements. For example, they require rapid access as industrial problems need to be addressed with a very short time line. They need secure office space and computer systems for proprietary research. And as industrial researchers are rarely neutron experts, they need a high-level of support from the staff.

### *Our reply and understanding*

*We will introduce the rapid access system to promote industrial uses which require quick reviews and immediate experiments after proposals. We are fully aware that security is one serious issues in MLF. Although security policy of office space and computer systems was discussed in MLF, it has not been fully realized yet. We will do serious discussion on security issues in handling data. About secure office space, we are planning to have such rooms in the support building, which we are applying the budget for. As for as for Ibaraki prefectural instruments, since industrial uses have increased rapidly for them, secure office spaces are already prepared in IQBRC. As we have replied in previous recommendation, we are continuing effort to increase numbers of supporting staffs in MLF and as for as for instruments prepared under the new law regarding promotion of common use of J-PARC/MLF, we expect that enough number of supporting staff will be prepared under this law. It is also emphasized various lecture courses for beginners to raise their skill levels have been carried out and planed by the user group of J-PARC, Ibaraki Prefecture, etc.*

### **Outreach**

#### Recommendation

One important approach for educating this community is to produce attractive, interesting, and important results as soon as possible to show the power of J-PARC for solving industrial problems.

### *Our reply and understanding*

*Variety of experiments as well as industrial applications is on-going. It will be soon that new results come up. For example, internal strains in superconducting cables were investigated on BL19 (Takumi). Also, many of industrial applications are on going on a powder diffractometer at BL20 (iMATERIA). According to the statistics of last one year, usages of industrial application are about 39% of total number of applications. It is the same level of usages of academic users from universities. On the other words, industrial usages have been already moving ahead.*

### Recommendation

NTAC recommends that the MLF develop strategies for increasing the use of the neutron facilities by industrial and international scientists. This should include the types of facilities that will be required to attract these scientists as well as formal and informal outreach methods.

### *Our reply and understanding*

*It is essential to collaborate scientific communities outside MLF to realize efficient outreach activities as well as strengthening outreach group of MLF. J-PARC/MLF Users Society was founded in September 2007 by volunteers to exchange information between users from various fields and to promote better user programs in J-PARC/MLF. For industrial users, outreach activities with user groups outside MLF such as "Ibaraki Prefectural society of promotion of Neutron utilization" and "Industrial Users Society for Neutron Application" are in progress. The former is promoting by Ibaraki prefecture. The latter society is formed by major Japanese industries (53 industries as of July 2009). Inside MLF, "coordinator system" is forming for user consultation in experiments at MLF. To attract international users, internationalization of proposal selection was decided and internationalization of MLF infrastructures and Tokai village are on going. International neutron/muon school and international symposium will be held regularly. For example, young scientists through AONSA (The Asia-Oceania Neutron Scattering Association) neutron scattering school for young scientist at J-PARC will be held in 2011. International Symposium on Pulsed Neutron and Muon Sciences will be held every 3 years since 2008.*

### Recommendation

J-PARC will be a focus for some of the world's best scientists. Informal meetings and discussions are an important contributor to the scientific atmosphere in any research organization. These meetings often lead to new collaborations and result in significant advances in our understanding of materials and the development of new technologies for neutron science. These interactions are so important and exciting that certain areas at existing facilities are legendary as a highlight of the user's scientific experience. The committee did not see any location where these important interactions would

naturally occur at the MLF. It seems to us that the Ibaraki Quantum Beam Research Center is too far from the MLF for informal scientific discussions to occur naturally. Moreover the Ibaraki Quantum Beam Research Center is on the other side of a very busy road which is difficult to cross safely. On a related note, J-PARC is located in the country-side. Thus the development of appropriate accommodations and restaurants are very important to attract users to the MLF.

*Our reply and understanding*

We have requested the construction budget of a building which has 4 stories including a cafeteria, meeting rooms, computer rooms, sample preparation rooms, device preparation rooms and nap rooms for user and us near MLF every year, but requests are not allowed until now. Therefore, firstly, we will construct a prefabricated rest house which is located southeast near the MLF. The rest house will be opened from September 2009. There will be 48 seats in it. Box lunches and sandwiches, etc will be sold during 11:00~14:00. User can use the rest house for 24 hours.

Accommodations are insufficient, though JAEA existing facilities are used for user. We mediate the neighboring accommodations about lack accommodations. We are continuously considering accommodations.

## Recommendation

NTAC encourages the MLF (perhaps, in conjunction with the Japanese Society of Neutron Science) to develop a user-feedback system on the user experience at the MLF, so that improvements can be made in a timely and responsive way.

*Our reply and understanding*

*We have two user committees and a user association. J-PARC user consultation committee acts as a committee to give advises for J-PARC in a global point of view including all facilities in J-PARC. Quite recently they published "Grand Design of J-PARC for Future", in which strategic and sustainable developments of J-PARC are described in 5years, 10years and 20years term. Another committee is MLF user advisory committee. This committee is dedicated for the MLF facility and gives advises on the user programme including scientific proposal reviewing and usage of the facility. Since the MLF user programme has been started only last year, we have still needed improvements in it and, hence, most of the time of the committee meeting has been spent on it. Now the MLF user programme is entering steady operation phase and we are shifting to discussions how the facility can be really user friendly.*

*The MLF user association was formed 2 years ago. This association facilitates communications between users, orchestrates seminars etc. and gather user's demand to facility. The activity of the association is still limited and we need to encourage it to be a real gate way of user's feed-back.*

*We have another association outside J-PARC. It is the Japan Society for Neutron Science (JSNS), which is a formal society registered in the Japan Academy of Science. JSNS comprises any communities related to neutron*

*sciences in Japan including activities in reactor sources. JSNS has been having indispensable importance for the MLF facility. The Ministry also admits influence and importance of JSNS to give advises to the MLF user programme. JSNS has compiled the ground design of neutron instrumentation of MLF, which was submitted to the J-PARC user consultation committee. Quite recently it has formed a committee to discuss what kind of instruments should be built under the new law regarding promotion of common use of J-PARC/MLF.*

### **3. Instruments**

#### Recommendation

NTAC recommends that at this early stage the MLF focus on commissioning instruments rather than hosting users.

#### *Our reply and understanding*

*We understand that commissioning instruments is very important before accepting users. However, we have a political pressure from the government to open the instruments for users as soon as possible we can. Otherwise operation budget can be very limited. Therefore, we decided to take following strategies for the commissioning and user programme.*

- 1) Instrument groups can have priority to take beam-time for commissioning. Instrument groups can get beam-time as they wish during their commissioning phase.*
- 2) Project proposals were accepted, but they should have a strong linkage with instrument groups, and should be flexible in their beam-time in some sense in order to cooperate with instrument groups.*
- 3) We accept limited general user programmes so as to perform instrument commissioning.*

#### **Reflectometer**

#### Recommendation

NTAC recommends seeking funding for the construction of a reflectometer that is optimized for the MLF with capabilities that complement those of the reflectometer transferred from KEK.

#### *Our reply and understanding*

*High-performance Neutron Reflectometer with a Horizontal Sample Geometry (BL16) will be upgraded with a fund from ERATO project lead by Prof. Takahara at Kyushu University. KEK will provide additional fund for this beamline from the fiscal year of 2009. Another reflectometer with a vertical sample geometry has been funded and the construction will be started from 2010.*

## **Priority**

### Recommendation

NTAC recommends that the MLF develop a prioritized plan to acquire and install the full detector complement on all of the new neutron scattering instruments.

### *Our reply and understanding*

*We have once increased the priority of the detectors complement. However, because of problem of He-3 shortage in the world, we recently discuss if we should postpone to purchase the rest of detectors of existing instruments as for as for He-3 gas detectors. Shortage of He-3 in the world is another issue which we should consider seriously. To solve this problem, we have started to discuss with major detector vendors, as well as to collaborate with other neutron facilities in the world.*

## **4. Devices**

### Recommendation

NTAC recommends developing a long-term strategy for instrumentation and utilization and using this to identify the devices necessary to realize their vision. Then they should pursue, in collaboration with partners, developing the devices that cannot be procured elsewhere.

### *Our reply and understanding*

*We have a short-term (5 years') project to make the basis of quantum beam technology promoted by the Ministry of Education, Culture, Sports, Science and Technology, Japan. In the project, neutron polarizing filters, focusing devices, and detection systems have been developed since JFY2008 and those devices are expected to be widely applied to not only TOF spectrometers or TOF imaging in J-PARC but also spectrometers in JRR-3. Discussion on a long-term strategy for instrumentation and utilization is to be held. We will make a base (laboratories, staffs, simulation software) for developing devices to realize the visions with collaborators based on the strategy.*

## **Polarization Device**

### Recommendation

The development of polarized  $^3\text{He}$  filters for white beam polarization using the SEOP method has shown good progress.  $^3\text{He}$  polarization of 60% in simple cells with lifetimes approaching 400 hours has been achieved. This development is very important for the long term polarization program at the MLF. However, substantial efforts are still required to develop cells which cover a wide angular range.

### *Our reply and understanding*

*We have a project to make a  $^3\text{He}$  polarizing filter one of standard polarizing system. In the project we have a plan to develop cells with various shapes*

*including a cell which can cover a wide angular range of an instrument such as a chopper spectrometer.*

## **DAQ and software**

### Recommendation

With event recording, 100Mbit/sec TCP/IP data transfer rate J-PARC has developed a high speed, efficient, low power consumption data acquisition system, that will cope with the amount of data produced at the MLF. The chosen data format (NEXUS) also allows users access to the data using their own software. User friendly software is on the way and available for some applications on some of the experiments. However it is clear that it will take considerable time and effort until all instruments are adequately supported. This will need attention and adequate resources.

### *Our reply and understanding*

*We have been continuous trying to establish computer support team at MLF. Although it is not fully realized so far, manpower is gradually increasing and developments are getting organized. We will keep efforts to increase number of staff of support team cultivating human resources who can interpret scientific needs as computing implementations.*

## **5. Neutron source**

### **Target**

#### Recommendation

Since PIE is going to take some time and the information will be the more useful the earlier it becomes available, the first target should definitively be examined (contrary to current planning). It should also be remembered that, once the pressure wave effect mitigation is successful, the criterion for exchanging targets will be radiation damage. Therefore it is important to obtain realistic information on this issue from examination of the water shroud of Target 1, even if it does not fail from cavitation erosion until 2012.

### *Our reply and understanding*

*Planning PIE for the first target greatly influences the cutting device design, its arrangement plan in the facility, and the scenario of the used components storage. We will certainly carry out PIE for the separate-type target. And also we are investigating the feasibility of PIE for the first target, and if it is revealed to be feasible, we will do it.*

*If the natural end means the breakage of the mercury vessel, we have not decided the policy to continue using the first target until its end of the service life. But taking the operational data of SINQ and SNS into consideration, we think we will be able to reach a consensus to continue using the first target up to 10 dpa.*



## Recommendation

For these reasons and also in the interest of waste and cost minimization, NTAC recommends using the first target to the natural end of its service life, or at least to a radiation damage level well beyond 10 dpa and carry out a PIE as quickly as possible.

### *Our reply and understanding*

*If the natural end means the breakage of the mercury vessel, we have not decided the policy to continue using the first target until its end of the service life. But taking the operational data of SINQ and SNS into consideration, we think we will be able to reach a consensus to continue using the first target up to 10 dpa.*

## **Beam profile**

### Recommendation

NTAC recommends that every effort should be made to provide a less peaked intensity distribution at the target than the present Gaussian one.

### *Our reply and understanding*

*We will make every effort to reduce the peak current density by utilizing multi-pole magnet, and so on.*

### Recommendation

A method should be developed which allows regular checks of the functionality of the leak detection system of the space between the hulls, e.g. a gas analyzing system into which relevant species (Xe) can be introduced for validation purposes. A source of such gas may be available in the ballast tank of the mercury loop.

### *Our reply and understanding*

*Operation of the leak detection system has been carried out since last October, and the plenty of data has been obtained. Analyzing the gamma-ray spectrum data accumulated with the system, we observed the followings:*

- Radioactive products, such as  $^{52}\text{Mn}$ ,  $^{44}\text{Sc}$ ,  $^{41}\text{Ar}$  etc., induced from the target vessel by proton bombardment, were included in sampled helium gas*
- The radiation intensities of such products were synchronized with proton beam intensities.*

*Therefore the system performance can be regularly checked by monitoring the relation between the radiation intensities and the proton beam intensity without doing something special.*

## **Laser Doppler diagnostic system**

### Recommendation

Efforts to develop a reliable system are therefore endorsed by the NTAC.

### *Our reply and understanding*

*One of possible reasons for degrading quality of measurements by the laser Doppler system would be lack of return light intensity due to low reflectivity of the recursive mirror resulting in a low S/N ratio. Recently, significant corrosion of the recursive mirror was found. Therefore, we are investigating suitable material and fabrication method to improve the reflection rate of the mirror.*

### **Spare target**

#### Recommendation

In the interest of minimizing waste and cost, the NTAC agrees with the plan not to use the spare target now being manufactured unless of course there is an unexpected failure of the first target.

### *Our reply and understanding*

*We think the spare target that is now manufactured is for the replacement in the emergency case and it will not be used in the normal operation scenario.*

### **Development of future targets**

#### Recommendation

NTAC believes that adequate funding for testing the swirl bubbler concept at ORNL is of paramount importance and will clearly pay off quickly.

### *Our reply and understanding*

*We appreciate the committee's recommendation. We think the swirl bubbler experiment using TTF is very important and we will invest energy into it.*

#### Recommendation

The design of the reduced size target as presented is still in a conceptual state and should be reviewed carefully before giving it out to a manufacturer for detailing. Apart from the question of how to arrange a bubbler system, there are other issues the Committee considers worth revisiting, such as leakage monitoring and capture, the attachment of the target nose to the spool piece (there are now tie-bolts on the spool piece, which may present a long-term risk). In this context it might be worthwhile to carefully analyze the concept developed for the ESS target (ESS- Technical Report Update, 2004). In addition, the nose piece itself may - apart from the general flow guide system - still need some improvements, e.g. to avoiding gas trapping (no flat horizontal surfaces) etc.

### *Our reply and understanding*

*We will continue the conceptual design of the reduced-size target in this fiscal year. We will check the fixing adjustment of each component using 3D model and the operational test using the mock-up model simulating a part of the target vessel. The mercury leak detection, the confinement of the mercury*

*leak and the remote handling of the components will be further investigated and, if necessary, be improved. The gas trapping on the flat horizontal surface will be checked in the TTF experiment. We will refer to the ESS reports, as well.*

#### Recommendation

The present schedule for developing the reduced size target calls for fabrication to start in early JFY 2011 and installation in the first quarter of JFY 2012. Given the present difficulties with the accelerator system this might look overly ambitious but the Committee recommends not to relax this schedule in view of the fact that the spare target currently under manufacturing is not intended to be used.

#### *Our reply and understanding*

*We agree to the committee's recommendation. We think that we should prepare the reduced size target as soon as possible because the target vessel lifetime is indefinite. We plan to procure the target by 2010.*

### **Neutronic performance**

#### Recommendation

Comparisons with the ISIS and SNS high-resolution diffractometers should also be pursued. The data is useful for evaluating the effectiveness of the para-hydrogen moderator and for giving a measure of the para to ortho ratio of the hydrogen moderators at existing facilities as well as for future moderator development.

#### *Our reply and understanding*

*We will try to collect pulse shape data for comparison for two instruments similar to the J-PARC/SuperHRPD, that is, the HRPD instrument at ISIS and the POWGEN instrument at SNS under commissioning.*

#### Recommendation

The spectra obtained by C-TOF are not completely reliable, so the data obtained with the  $^3\text{He}$  detector should be compared with simulations. Precise data obtained at low power are very important for understanding the neutronic performance at high power. Therefore, accumulation of spectral and pulse shape data is required at this stage.

#### *Our reply and understanding*

*We thoroughly agree with the committee's opinion. Although reliability of the C-TOF method is inferior to that of a  $^3\text{He}$  detector, we are trying to measure spectral intensity data for all the instruments by the C-TOF method. The data can be measured easily with the C-TOF method in a short time, and the measured data are useful to systematically compare the spectral intensity among almost all the instruments. We also recognize that the  $^3\text{He}$  detector is needed for precise measurements. We are also trying to measure the spectral*

*intensity data systematically with the He-3 detector for as many instruments as possible.*

#### Recommendation

NTAC recommends that the ortho-para ratio be experimentally determined, for example, by measuring the pulse shape of the decoupled moderator, by Raman scattering, and/or thermal conductivity.

#### *Our reply and understanding*

*We have installed a Raman spectroscopy to measure the Ortho/Para hydrogen ratio in-situ. We will measure neutron pulses with changing the Ortho/Para hydrogen ratio to confirm the validity of our moderator design.*

#### Recommendation

NTAC recommends that the first spare moderator should be a decoupled moderator with a decoupler material other than AIC. A new decoupler material is required as soon as possible.

#### *Our reply and understanding*

*We agree with the committee's opinion. We are developing the Au-In-Cd alloy as a substitute of Ag-In-Cd alloy with the first priority. However, the development might not complete in time for the spare decoupled moderator fabrication because it will take about 5 to 6 years at least to realize the Au-In-Cd decoupler.*

#### Recommendation

The MLF staff has been exploring replacing the light water in the moderator systems with D2O. However, from the data shown it appears that the intensity gain from this change will only increase the intensity of the tail of the neutron pulse from the coupled moderator. Thus there is no apparent performance advantage in going to heavy water.

#### *Our reply and understanding*

*The committee probably misunderstands the effects of the replacement of light-water with heavy-water on neutronic performance. The replacement brings in 25 % increase in intensity without changing pulse shapes for PM, DM (in whole energy range) and for CM (> 0.1 eV). It also brings in 25 % increase in peak intensity without increasing pulse tails for CM (< 0.1 eV). Hence the replacement is rather effective for improving the neutronic performance.*

*When light-water coolant is used for a long time, tritium concentration in the light-water increases gradually, and exceeds a disposal limit (1,200 Bq/cc). We want to replace the light-water with heavy water soon to dispose the light-water from MLF. However, it is difficult to secure a budget to purchase heavy-water even in JFY2010. Under this situation, we have to give up to dispose the light-water (4 m<sup>3</sup>) after the replacement, and store the used light-water in the MLF for a long time.*

## Cryogenic systems

### Recommendation

NTAC recommends that consideration be given to switching to one of these proven designs in order to avoid further down times related to pump development.

### *Our reply and understanding*

*In order to solve the problem of the hydrogen pump, we are considering to improve the gas bearing and to make change to a thrust magnet bearing. At the same time, we also commence studies to substitute the hydrogen pump that has been used in SNS for the existing ball bearing pump.*

## Hot cell entry

### Recommendation

Thus the MLF needs to develop a different way to enter the target area. The proposed iron shield is feasible for now but in the long term, it would be better to try to develop a filter system to remove the “sticky” elements. The NTAC recognizes, though, that such a filter may be difficult to install on the activated Hg loop.

### *Our reply and understanding*

*Since reconstruction of the mercury circulation system, such as filter instillation, is impossible at this moment, we can not change our plan to install an additional shield in the hot cell. We are convinced that research on a method for removing spallation products stuck on the piping wall is very important.*

## Used component disposal

### Recommendation

However, the power up scenario has already been changed, and if the life of the target is further increased by adopting a larger dpa value than 5, the schedule should be adjusted. In the future, the effect of the pitting should also be taken into account in the schedule.

### *Our reply and understanding*

*We are reconsidering the current schedule of the used component storage and disposal with referring the latest proton beam power up scenario. Furthermore, we will confirm the effects of the pressure wave mitigation technique during a low power operation, and then we will rearrange the schedule with taking account of the influence of the pitting on the life time of the mercury target.*

### Recommendation

Furthermore, solutions to the problems discovered in the early tests need to be developed. Additional experiments with the cutting device are key.

*Our reply and understanding*

*We are reconsidering whole scenario about the used component disposal. Handling equipments will be designed, and tested. Test and modification of the cutting device will be conducted to make sure the handling procedure.*

Recommendation

The items of PIE should be discussed for future target improvement and diagnostics.

*Our reply and understanding*

*We are discussing possible PIE items for improvement of the future target structure and the diagnostics for integrity of the target. Candidate PIE items are SEM observation, tensile test, indentation test and measurement of He production. In order to carry out each test, we will discuss the cutting machine for PIE test pieces as well as the scenario for rough cutting from the large components.*

End