THE INTERNATIONAL ADVISORY COMMITTEE ON THE J-PARC PROJECT REPORT

Meeting held February 24-25, 2025

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EXECUTIVE SUMMARY

The International Advisory Committee (IAC) on J-PARC met at J-PARC to review the progress and prospects since the last meeting in March 2024.

The committee was able to fulfill its mandate as set by the director (see Appendix III). The IAC thanks J-PARC staff for the considerable efforts put into the preparation of the material, the efficient running of the meetings, and their hospitality.

The committee particularly expresses appreciation for the presentations of selected results by young scientists and engineers, and for the detailed and insightful reports of A-TAC, MAC, NAC and PAC

The IAC thanks JPARC for having addressed the recommendations in their 2024 report.

MEXT view of J-PARC

- MEXT recognises the importance of 'bottom up' large scale scientific research projects, such as J-PARC. Since these are long term investments they require funding stability and a strategic approach, but also that public acceptance is maintained. International recognition, which may act to attract talent, is essential. The Hyper-Kamiokande project, including J-PARC as the neutrino source, is one example of such an internationally significant project.

- J-PARC has been highly evaluated by MEXT. However, due to budget challenges it may not be possible to provide funding to cover both the increased electricity costs and the aging infrastructure programme, so difficult priority choices will have to be made.

JAEA view of J-PARC

- The JAEA vision has three priority directions for R&D: pursuing nuclear-renewable energies synergy; making nuclear energy sustainable; making nuclear energy ubiquitous.

- J-PARC has an important and varied role to play in supporting these R&D directions, for example through research on fuel cells or radiation tolerant thermoelectric devices.

KEK view of J-PARC

- J-PARC activities are a significant part of the KEK programme. About 1/3 of KEK users come through MLF (neutron and muon), neutrino and hadron physics.

- Different industrial applications of accelerators are being developed. For example, the iBNCT facility in Ibaraki is based on J-PARC expertise.

- The SOKENDAI graduate university, where KEK is a partner, supports students working on J-PARC projects but has also supported the construction of the SOKENDAI building at J-PARC.

GENERAL STATUS OF THE PROJECT

Findings:

- J-PARC continues to demonstrate its **technical excellence,** underpinning its **scientific excellence**.
- J-PARC has an incredibly diverse scientific portfolio, delivering first-rate scientific achievements and contributing to the scientific visibility of Japan. For this reason, the number of users from abroad is increasing steadily, particularly after COVID-19. Almost 40% of user visit days in 2024 were by foreign nationals.
- Accelerator performance is continually improving, with 1MW to MLF, 800 kW to MR-FX, and 80 kW to MR-SX in 2024. The MLF target has been operated at 1MW, delivering the highest neutron production per pulse in the world, and a 2 year target lifetime is in sight.
- Muon cooling and acceleration have been demonstrated. The use of muons in cultural heritage research is growing. There is a broad science programme with neutrons, and a good publication record.
- T2K data taking has continued in 2024 with a beam power of 800kW. Hyper-K construction is progressing, with operation expected in 2027. COMET continues construction, but the funding to enable phase 1-LI operation in 2027 is not yet secure. The Hadron hall extension remains a high priority but there is as yet still no funding.
- Construction has started on the SOKENDAI Joint research Center/J-PARC Experimental Equipment Development Building. However, the J-PARC access road has not been funded for JFY2025.
- An outline design for a multi-purpose Proton Beam Irradiation Facility has been presented and discussed at a workshop for potential users.
- The J-PARC symposium was held in October 2024, with 415 participants from 18 countries.
- J-PARC has a real potential to achieve more. However, the flat budget, which is being eroded by inflation and a poor exchange rate, has to cover the high cost of electricity cost and aging equipment, and a continually expanding portfolio of activities. This creates a risk to future success. A significant portion of the operating budget relies on supplementary funding from the government. This is inevitable, but it may not be sustainable.
- Electricity cost is a very high proportion of the operating budget (~40%). Reduction of 1 cycle of operation (22 days) would save KEK 2-3 oku-yen (depending whether FX or SX) and would save JAEA 4 oku-yen in electricity costs. Costs for aging counter measures for JFY2025 are estimated at 16 oku-yen for JAEA and 6 oku-yen for KEK.
- J-PARC has an excellent safety culture and record. However, there is a high risk that safety procedures may lead to significant loss of beam time. A fault in June, that was designated as

a fire incident, could have resulted in a 3 month loss of beam time if it had not occurred just before the summer outage.

- Other technical faults led to loss of beam time, mainly for MLF.
- A key strength of J-PARC is the committed and highly competent staff which has clearly led to the technical success of J-PARC. However, staffing remains a challenge. The average age of staff members continues to increase, for JAEA by more than a year in the past year.

Recommendations:

- With constrained public funding, but increased costs, it is critical that J-PARC effectively communicates its excellence. J-PARC is a unique facility worldwide. J-PARC, including its staff, is a valuable asset for Japan. J-PARC is an outstanding example of Japanese technical and scientific capabilities. The current challenges do not negate these facts. So J-PARC key stakeholders (funders) need to hear these messages, reinforced by examples, continually and from different directions.
- Electricity cost is such a high proportion of the overall budget that it dominates the strategy for sustainable operation. The aging infrastructure challenge is cumulative, i.e. the problem doesn't go away if you don't deal with it. Given that MEXT has clearly indicated that J-PARC should not expect supplemental funding for both aging and electricity, J-PARC has little option but to prioritise the aging programme. However, careful prioritisation of the work schedule (and corresponding spend profile) within the programme should be done to maximise the number of operating cycles.
- Investments such as the hadron hall extension or MLF-double would produce more science output for fewer cycles. However, even if funding were available for these they would not produce the return on investment until the later years of the aging programme. MLF should should consider the extra staff required to enable MLF-double to achieve its goal. (This does not apply to hadron hall experiments since these are fully supported by the participating research groups.)
- Expanding the portfolio of activities also puts demands on a flat budget. IAC recognises that (in many countries) it is often easier to get funding for new developments than for continued operation of existing capabilities. However, at some point this becomes unsustainable. The 'Proton Beam Irradiation Facility' would be an addition to the portfolio that would be motivated by economic/societal benefits rather than scientific. The IAC recommends that a business case is developed, which is different from a science case or technical design report, and would need to consider the options for the marginal operating costs be covered by other sources than the J-PARC operating budget.
- Balancing the J-PARC budget is a challenge. Reliance on uncertain annual supplemental budgets does not enable a strategic approach, and is precarious now that interest rates are increasing. J-PARC should therefore explore opportunities for diversifying funding streams, whether national or international. J-PARC has internationally unique capabilities that could attract foreign involvement. Korea and Taiwan are interested in building pulsed neutron

facilities, but they do not have the financial resources, or currently the know-how, to build a facility like J-PARC. They may be interested in participating in the operation by providing a part of the operational budget, and by making specific investments (e.g. in MLF-double), in return for certain guaranteed beamtime, which could be restored for domestic users by increasing manpower or number of operating cycles. Such a negotiation will take a long time, so at least some initial attempt should be commenced right away.

- The age distribution of staff is a known problem. From year to year, necessary work can be completed through increased use of company employees, though this has a higher cost. Currently J-PARC still has a great deal of expertise, but this is not being passed on to sufficient numbers of early career staff. As with ageing of equipment, this loss of experience is cumulative. Succession planning needs to be a key component into the future as staff retire. All options for hiring new 'permanent' staff should be explored, even if these positions are not really permanent.
- Hyper K, COMET and Hadron hall experiments will not run simultaneously. From 2027, when Hyper-K will request 75% of the available beamtime, the total demand will be more than 100%, even with 8-9 cycles/year. Hard discussion/decisions will be needed.

SAFETY

Findings:

- J-PARC has an excellent safety record. For a facility of this size and complexity, incident numbers are low.
- A significant fraction of potential incident reports are traffic related. When these are removed the ratio of potential incidents to incidents is quite low. The process for investigating potential incidents, and implementing any subsequent actions, is good.
- There have been a number of actions aimed at maintaining a good safety culture – J-PARC safety day, International Technical Safety Forum, Safety meeting with Contractors, Emergency Drill and Staff Survey.
- In June 2024 an abnormality occurred in the supply current to a chiller. The chiller was shut down and beam operation continued. Investigation in July, after the end of the cycle, revealed scorch marks in a power supply terminal box. This box had been installed by the chiller manufacturer without J-PARC's knowledge. The public fire department classified this as a fire incident. The local government procedure to permit restart of operation was completed in late September, before the planned restart after the summer outage.

Recommendations:

- In the 2024 report IAC had recommended 'implementing a standard practice of cross-facility reviews'. We apologise that this was not well worded, and was misinterpreted as referring to safety reviews. We had meant engineering design reviews. The incident in question was related to a design fault in new equipment, where the mitigation for this fault was known in a different section of the organisation. A general practice of cross-facility mechanical and electrical design reviews (i.e. before equipment is built or procured) would help to spread knowledge and avoid similar incidents.
- IAC encourages J-PARC to continue with the staff safety survey on an annual basis and track trends in the responses. Actions should be identified and implemented where required.
- IAC recommends that J-PARC should encourage staff to report potential incidents.
- J-PARC were *extremely lucky* that the fire incident occurred just before the planned summer outage, and no operating time was lost due to this incident. If the fault had occurred just after the restart then 3 months could have been lost. In most similar facilities this type of incident would have been classified as a potential incident. Monitoring systems identified a potential fault (even though the terminal box was not known about) and the equipment was safely taken out of service. This was not in an area where there was a risk of release of radioactivity. The subsequent investigation was detailed, lessons were learned and the necessary mitigations put in place. i.e. *J-PARC did all the right things that would be expected.* The potential loss in operating time should be at most days, certainly not months. However, there have now been similar incidents in the last three years, so the future risk to efficient J-PARC operation, and the consequent loss of reputation, must be considered high.

The IAC fully recognises that safety incidents in facilities that generate radioactivity must be taken seriously. However, over-reaction to potential incidents may actually have the effect of weakening the safety culture (e.g. non-reporting of potential incidents). IAC strongly recommends that J-PARC continues dialogue with the local government to try and streamline their processes to be appropriate for potential incidents.

PUBLIC AFFAIRS AND COMMUNICATION

Findings:

- IAC highly values J-PARC's response to the recommendations of IAC2024. The activities during the year were excellent in communicating the importance of basic science to society. The public relations activities are very good, but they are mainly focussed on the local region and not extended to the whole country and abroad.
- MEXT has stressed the importance of raising public interest in science, and maintaining broad-based society support for the investments in large-scale projects, such as J-PARC. This is achieved through communication.
- The J-PARC website needs improvement. It sometimes is difficult for foreigners to navigate, with Japanese appearing without English translation. This is important for potential international users.
- We understand that J-PARC is jointly managed by KEK and JAEA, but from the user's perspective and in terms of communications, this bureaucratic structure should not be visible.
- Communication during the beam shut-down was less than satisfactory, particularly for the overseas users.

Recommendations:

- Given the emphasis placed by MEXT, the IAC strongly recommends to J-PARC to 'Communicate, Communicate, Communicate' as a high priority. The excellence of the J-PARC facility and its science should be communicated to the wider public, both domestic and international. This is also the way to communicate, indirectly, to politicians and policy makers such as Cabinet Office, and the Ministry of Education, Culture, Sports, Science and Technology. Communication should not be solely delegated to the communication staff. All staff, such as the beamline scientists, should make efforts to improve communication, particularly with current and potential users from abroad, or to provide material that can be communicated.
- In order to continue and expand communication activities, IAC recommends that J-PARC formulates a more detailed strategy. Writing down a formal communication strategy is a valuable way of developing which messaging to send to which audience, for particular aims. Start by articulating the target audiences and the objectives, and then develop a plan. Strategic plans should be developed by the executive team together with the PR department. It is not the PR staff's responsibility alone.
- J-PARC should prepare a continual stream of 'stories' that should be easily accessible to the target audiences (for example, 1000 characters in Japanese and one photo'; short videos are also good). The same 'story' can be communicated multiple times, e.g. when an experiment is proposed, when it is performed, and when it is published. Press releases may be a simple metric but are really only an effective communication tool for the very

highest impact stories. Instead J-PARC should develop a social media/web programme. When doing so, it is necessary to use hashtags effectively to get people who have not been involved before to see it. Continuously check metrics such as the number of followers and views. All Japanese articles should be translated into English, since easy to use tools are now available. Various themes can be covered, including introductions to research topics and daily research activities.

- When the facility encounters operational problems, such as a shut-down, the current situation, prognosis and projection should be communicated more widely and quickly, particularly to overseas users.
- IAC requests that J-PARC's overall strategy and role division in the communications team be clarified.
- J-PARC should consider that advisory/review committees can be used as an aid in communication, since sometimes they can express views that J-PARC itself may find difficult to express.

DE&I (Diversity, Equity & Inclusion)

- Japan's scientific research field is seriously behind in terms of DE&I, and J-PARC is no exception. IAC recommends that J-PARC continues to report annual progress on DE&I, especially the activities and support of female researchers and support for female students. IAC recognises that progress may be slow when recruitment to staff positions is low, but this makes it even more important to continue efforts to improve DE&I.

RADIOACTIVE WASTE MANAGEMENT

Findings:

- With current planning for 2-year MLF targets, the RAM building should be able to accommodate another 20 years of operation. This gives the organisation enough time to develop plans for dealing with spent targets from further operation including upgrades.
- A strategy is being developed regarding muon targets.
- Within the existing budget system it is not possible for J-PARC to 'save' for future requirements such as a new RAM building. This can only be enabled by additional specific funding from the government.
- Some large and low activity waste items (RF cavities, magnet coils) are now being managed by the JAEA/NSRI back-end facility.
- Studies are still ongoing regarding management/storage of the waste produced by KEK facilities.

Recommendations:

- It is still difficult for IAC to understand the plans and costs regarding radioactive waste management. For example, for the work carried out by JAEA/NSRI in 2024, referred to above, what was the cost and what is the plan for future years? A flask will be needed for transport of the muon target – how will this be funded? How are these costs split between JAEA and KEK? The IAC would like to see more information at its next meeting.

ACCELERATOR SYSTEMS

Findings:

- Since the IAC meeting in 2024, the J-PARC accelerator team has reached a major milestone by delivering stable 1 MW equivalent beam to the MLF during user operations. Following the successful installation and commissioning of the MR power supply upgrades, the beam power for MR operations has also been increased, exceeding 800 kW in the MR-FX to the neutrino experimental facility and 80 kW in the MR-SX to the hadron experimental facility. The J-PARC team are to be congratulated on their dedication in achieving this level of machine performance.
    - The RCS delivered 730 – 970 kW beam to the MLF during the periods January to March and April to June. However, the scheduled operation in the period November to December was cancelled due to problems with the MLF target. Higher beam powers were achieved after the RF system was returned to its original configuration of 12 units by replacement of one of the transformer-rectifier sets.
    - Availability for the RCS only was once again very good at 95.1%, with most of the downtime caused by a cooling water pump failure and frequent bending magnet power supply trips – both issues have now been satisfactorily resolved.
    - During the period April to June, beam power was decreased from 950 kW to 900 kW to save on electricity costs. However, a figure for the actual cost saving made was not presented.
    - The MR beam power was successfully increased from 760 kW to 800 kW for the neutrino experimental facility by reducing the repetition time from 2.48 s to 1.36 s, and from 65 kW to 80 kW for the hadron experimental facility by reducing the repetition time from 5.20 s to 4.24 s.
    - The MR experienced bending magnet, power supply and cooling tower failures, resulting in accelerator availabilities of 89% for the period January to March, 66% for the period April to June, and 84% for the period November to December.
- During JFY2024, the J-PARC accelerator complex operated without reportable incidents on personnel safety or beam-induced machine protection. However, following the two incidents of equipment fire reported at the IAC meeting in 2024, there was a further issue this year when observation of a scorched component in a terminal block in the linac building was determined to be a fire incident by the public fire department.
- To address the recommendation from the last IAC meeting, the J-PARC team have established three modes of response, dependent on the seriousness of an incident. The typical process to return the affected equipment to operation after a fire incident is currently expected to take 2 – 3 months, whereas resuming operation of those parts of the facility unaffected by the incident is expected to take about 2 weeks. The team will continue efforts to shorten these periods.
- Significant efforts have been made to address issues of aging and obsolescence of accelerator equipment in line with the recommendation from the last IAC meeting, for example upgrading linac and RCS water utilities. Nonetheless, the trend of a decline in the

number of operational user days and the level of overall facility availability is concerning. Contributory factors include the annual J-PARC operations budget having remained largely flat during the past decade and slow response resolving conventional issues during accelerator operations.

- In recent years supplementary funds have been essential to run a full user program, ensure implementation of strategically important programs and to address urgent facility aging and obsolescence issues. To mitigate the downtime risk from growing obsolescence, a program of sustained upgrades would be needed over the lifetime of the J-PARC facility.
- A detailed analysis of facility downtime hours by system (*e.g*. safety/personnel protection, machine protection/interlocking/diagnostics, equipment protection, controls, magnets, RF, PSUs, vacuum, collimation, source, cryogenics, utility, handling, *etc.*) for recent years of user operations, backed up by consistent reporting of the resulting yearly loss of availability for scheduled user programs, would help to inform the request for an appropriate level of funding to address ongoing operational, obsolescence and spares provision issues.
- In response to the recommendation to identify accelerator development initiatives aligned with J-PARC's long-term missions, the J-PARC team have produced a tentative roadmap, including RCS operation at >1.5 MW, linac operation at 50 Hz, MR-FX operation at 1.3 MW and MR-SX operation at 100 kW.
- The J-PARC Proton Beam Irradiation Facility (PBIF) is a newly proposed initiative, using the beam produced by doubling the linac repetition rate to 50 Hz. This could be a significant new capability, which would attract industrial users with societal impact and expanded funding sources. Funding has yet to be secured for this initiative, and there will be some additional cost associated with operating the linac at 50 Hz.

Recommendations:

- Continue to work with regulators to develop appropriate incident response protocols in accordance with the category and severity of incidents to ensure expedited recovery and minimize overall impact to accelerator availability and user programs without compromising safety.
- Develop a program of sustained upgrades over the lifetime of the J-PARC facility and integrate it in multi-year planning and funding requests, including for an adequate workforce. Include detailed information on the root causes of facility downtime and identify mission-critical aging items and essential spares whose replacement or preventive maintenance cannot be funded by the current budget.
- Establish the electricity cost savings associated with operating the facility in different modes or at reduced beam powers so that J-PARC (and IAC) can better understand what compromises can be made between cost and performance.

PARTICLE AND NUCLEAR PHYSICS

Findings:

- An updated timeline for J-PARC activities/experiments in nuclear and particle physics, considering the available financial and human resources, was presented.
- The HyperK experiment is on track to start data collection in 2027.
- Steady 800 MW of power on the neutrino target for the T2K experiment was achieved in 2024. J-PARC is progressing well to provide 1.3 MW of power on the target by the time of HyperK operation.
- Steady delivery in 2024 of 83 kW of beam power to hadron hall experiments was achieved.
- There is still uncertainty with the hadron hall extension project regarding both scope and timing.
- The first engineering run for the muon g-2 experiment is now planned for 2030, assuming that the H-line extension building is realised in time.
- An in-depth review of the COMET experiment was performed. KEK and the collaboration are working on the options to complete construction of the experiment, including identifying the funding needed for completion. The experiment has added an additional phase “Phase I Light” to start data collection and analysis with a minimal set of equipment and shielding in place.
- Exciting presentations of selected recent nuclear and particle physics results were made to the IAC by the junior scientists.
- Scheduling beam time to hadron hall experiments remains challenging due to the short beam operation time related to the high electricity costs.

Recommendations:

- Keeping the HyperK program on schedule, including delivery of 1.3 MW power to the experiment, is critical.
- Continuing uncertainty regarding the hadron hall extension scope and timeline is a concern. Although the plan to collaborate with universities is commendable, an effort should be made to prepare realistic timelines and milestones having in mind the uniqueness of the scientific program.
- Similarly, the uncertainty regarding the timeline for the H-line extension building presents a large risk to the ongoing developments of the muon g-2 experiment and the muon microscope. A path forward should be established as soon as possible.

- Due to the high cost of electricity, a clear understanding of the power consumption vs mode of operation of the accelerator complex, including intensity/beam power delivered to the users, will help in optimizing accelerator operation.
- It will be useful to see the availability of 30 GeV beams for various users vs time (year), especially after HyperK will start running and is expected to use a large fraction of the beam. For example, will COMET, with a beam timing structure that is not compatible with at least some of the other experiments, be able to accumulate many months of beam time?

MATERIALS AND LIFE SCIENCE - NEUTRONS

Findings:

- The technical capability regarding the neutron source and related equipment at MLF is outstanding. The success of achieving the highest single pulse power is highly commended. The beamlines are excellent, generally with low background and high resolution. The scientific output is also good. Unique and prominent contributions are now being made in different fields.
- The work on achieving a 2-year target lifetime is very good. However, a significant amount of time was lost during the year due to problems related to other parts of the target system.
- The obsolescence (aging) budget is a positive development; recent failures underline the need for this. However, exchange rates may have a negative impact on its procurement value. The budget includes no instrument component.
- The tension between operating and obsolescence may reduce MLF productivity. MLF has world-class neutron instruments and instrumentation in many areas and these should be fully utilised. The aspiration for 8 or 9 cycles should be maintained.
- The programme of instrumentation developments remains strong, for example continued improvements in imaging, polarisation, sample environment and detectors.
- In these areas, and in areas such as neutron targets, MLF has considerable technical expertise which other neutron facilities could benefit from, and vice-versa.
- 50% of proposals are now from non-Japanese institutions. The use of some beamlines is dominated by overseas users.

Recommendations:

- The MLF roadmap would benefit from being coupled to a strategy which maximises the scientific impact of the facility by developing complementary capabilities at MLF TS1 (as part of MLF double), TS2, and JRR3. This would be similar to the Oak Ridge 3-source strategy, with the instrument suites at the three sources being tailored to the specific technical strengths of each source so as to enhance complementarity and maximise overall scientific output.
- MLF should seek a sustained, annual budget to enable an instrument upgrade and renewal programme so that MLF instruments remain world-leading. While all of the parts can be gathered under the MLF-double 'brand' (which is an effective communication tool), aging issues should also be addressed to ensure that the instrument suite remains operationally reliable. In addition to a critical spares list, a list of components requiring replacement before observed aging is seen should be created based on failure likelihood and impact.

- A set of key success criteria and high-level milestones should be created for the MLF-double programme, and further measures should be taken to involve the community.
- A workforce / staffing plan should be developed soon to inform staffing needs and succession planning, including the requirements for MLF-double.
- Enhanced communication will be critical to ensure that key messages regarding J-PARC and MLF-double are getting to funders and lead smoothly to the plan for TS-2.
- Due partly to the limited workforce, collaborations with other facilities and institutions appear to be rather modest, but the quality is high. Regarding international collaborations, MLF may consider working with facilities and research groups in near-by Asian countries other than China, such as Korea, Taiwan and Singapore. An example of an interesting opportunity is Okinawa Institute of Science and Technology (OIST). OIST is Japanese, but its staff are mostly non-Japanese. They can provide a useful window to wider collaboration with other Asian researchers.
- Partnerships in technical areas should be explored between MLF and other facilities, for mutual benefit. E.g. there are European/international networks for detectors, polarisation, deuteration, sample environment and software development that MLF could become a member of.
- A Digital Object Identifier (DOI) should be attributed to each experiment, which should be cited in publication and thesis work. This may enable publications and theses to be found more easily.
- Now that J-PARC can retain industrial income, a mechanism should be explored that enables MLF instrument scientists to benefit from this through e.g. beamline developments, students or other means, in order to positively reinforce industrial engagement.
- The number of days allocated per experiment should be considered to ensure that beamtime is being used most effectively.
- MLF should take a variety of approaches to encourage further domestic use, for example through encouraging Japanese PhD student use of MLF.

MATERIALS AND LIFE SCIENCE – MUSE

Findings:

- The MUSE team has done outstanding work in the development of the facility, running the experimental program, and increasing the number of scientific results. Each beamline has a role in generating distinctive output. The human resource development programs are impressive: for the general public, high schools, undergraduates and graduates' programs.
- The g-2/EDM collaboration has made significant progress, with the world's first demonstration of cooling and RFQ re-acceleration of the muon beam.
- Work on the 1S-2S spectroscopy in muonium in S2 has improved statistics 300x over the last best measurement in 1999 at RAL, allowing for a muon mass extraction at 80ppb(10x).
- A new category of research proposals for non-natural-science has been created, enabling an independent access and use of muons, e.g., by cultural heritage specialists. This programme is developing well.
- A spare muon target is now available, and a long-term strategy is being developed and pursued for storing the used targets and planning of the next spare targets.
- The long-standing S-line kicker power supply problems have been solved. Funding is secured and a plan in place to complete replacements.
- The MUSE team has been very successful in acquiring external funding, including new large-scale Grants-in-Aid for Scientific Research and three out of the eight projects under the newly established KProgram, indicating that muon science is gaining significant recognition. This will enable, for example, new high-precision muonic X-ray measurements in H1.
- There is a high work-load on staff in the S1 area with experiment turn-around times of 2-3 days. S1 is a real workhorse with steady output. The team should be congratulated, in particular the new generation of staff who handle their tasks extremely well.
- The U-line team has much improved the performance of the laser system, with excellent USM beam quality and understanding of its properties. The USM rate was significantly improved and extrapolates to >1000/s once the high-power beam to MLF is back. An external laser review committee has been installed. They have described the work of the laser team as 'world-leading' with 'amazing achievements' and made the clear statement that 'more laser experts must be hired urgently'.
- The MuSEUM collaboration has demonstrated measurements of the two hyperfine transitions in muonium at high magnetic field at the low available 100kW beam power. Extrapolation to 1MW operation should produce a world-record measurement.
- The transmission muon microscope TmM project continues to make impressive progress. Its full realization is critically dependent on achieving 40MeV muon energy, which is entirely

contingent on the H-line extension and its new building. However, the budget request to MEXT for this fiscal year for the H-line experimental building was cancelled.

Recommendations:

- The further increase of temporary staff by two due to the excellent success with external funding is welcomed, but the permanent staff situation remains very concerning, in particular the urgent need for senior laser specialists. It is important to hire and promote people with broad skills who can further develop the instrumentation and methodology of research. Only in this way can the future of the facility be guaranteed.
- An immediate search for and hire of at least one additional laser specialist, to enforce the mission-critical muonium ionization systems for the U- and H-lines, is recommended. The present situation is high-risk with no mitigation plan.
- A staff scientist with expertise to initiate a high-pressure program, and support the comprehensive portfolio of the versatile D1 measurement program, should be hired.
- The outstanding efforts on graduate student education, the wide range of outreach and educational programs, internship programs, schools, and symposia for national and international audiences should be continued.
- The important short-term provision of substantial resources for ‘aging counter-measures’ is welcomed, but it is recommended that sufficient resources also be made reliably and sustainably available for mid- and long-term maintenance and consolidation works.
- The activities to exploit the synergies with the neutron sample environment team for magnets and dilution refrigerators are strongly supported. Closer cooperation also for high-pressure sample environments is encouraged.
- Intermediate results of the muonium 1S-2S spectroscopy should be published as soon as possible.
- The option to install the CYCLOPS spectrometer permanently in S4 should be investigated, including work towards attracting respective project funding that would leverage this installation.
- A first science strategy should be prepared for USM operation.
- All options to realize the H-line extension building as quickly as possible should be considered. The building is essential for next-generation uses of re-accelerated muons, first for g-2/EDM and TμM, and later also beyond, and a unique opportunity for the facility.

ADS

Findings:

- Funding for the originally proposed Transmutation Experimental Facility (TEF) has not been found, so the plan has been 'reframed' as a multipurpose facility which could include ADS developments.
- Options considered comprise materials irradiation (for fission and fusion reactors, including ADS), soft error testing of semiconductor devices, medical radioisotope production, and other proton beam applications (e.g. for space technology).
- A workshop has been held to bring together potential users of this "J-PARC Proton Beam Irradiation Facility" (PBIF) and start discussion on the detailed specification.
- Other work related to ADS continues, including Pb-Bi target technology and Linac spoke cavity prototyping.

Recommendations:

- With the current flat financial support from the government it is extremely difficult to secure a large enough budget to make ADS a reality. The situation for ADS may change with the government pivot back towards nuclear energy, but this is unlikely to happen in the short term.
- Until the future for ADS in Japan is clear it is justified to maintain a core of expertise through a small development programme. However, this work needs to be integrated with other related J-PARC activities, e.g. for the accelerator.
- The PBIF as proposed will not provide fundamental or crucial input for ADS. It therefore needs to be considered on its own merits. The core cost of the facility is high, which explains the rationale for sharing this cost between multiple purposes. However, each of these purposes then needs to be separately justifiable. A proper business case needs to be developed, not just a science case or technical design. In particular, even if funding for construction can be obtained, can funding for the additional cost of operation be found outside of the existing J-PARC budget? If not then it would be extremely risky for J-PARC to further increase its portfolio of activities through construction of PBIF.
- Several high intensity proton and neutron irradiation facilities already exist in the world. In considering the technical design the uniqueness and originality of the J-PARC PBIF should be emphasized to make the difference from other similar facilities clear. Proton beam applications require a wide variety of beam properties such as energy, intensity, size, emittance, profile and so on depending on versatile needs. Flexibility and controllability of beam handling are particularly significant for the interdisciplinary and industrial applications.

Appendix I

Agenda for the International Advisory Committee Meeting of J-PARC

Monday February 24

Charge to the Committee / Report from the Director
09:30 Charge to the Committee /Report from the Director. KOBAYASHI, Takashi
10:10 Introduction to JAEA evaluation. KINSHO, Michikazu

Views from Host Institutes
10:20 KEK and J-PARC. MICHIZONO, Shinichiro
10:40 JAEA and J-PARC. MOMMA, Toshiyuki

Accelerator
11:00 Progress and Prospects. OGURI, Hidetomo
11:25 A-TAC View of Accelerator Activities. WEI, Jie

11:45 Lunch

Particle and Nuclear Physics
12:30 Overview of Particle and Nuclear Physics. SAITO, Naohito
12:55 PAC Report. YAMANAKA, Taku

Accelerator Driven Transmutation Research
13:10 ADS Project. MAEKAWA, Fujio

Public affairs and communications
13:35 Public affairs and communications at J-PARC. KOMATSUBARA, Takeshi

Radioactive Waste Management
13:50 Radioactive Waste Management. KINSHO, Michikazu

14:05 Coffee break

Material and Life Science I (muon)

14:15 MUSE Status. SHIMOMURA, Koichiro
14:40 MAC Review. KIRCH, Klaus

Material and Life Science II (neutron)
15:00 Overview of Neutron Facility. OTOMO, Toshiya
15:25 NAC Review. KING, Philip

15:45 Coffee break

Material and Life Science. Accelerator Driven Transmutation Research.

15:55 Irradiation test of optical fibers for abnormality diagnosis of the neutron target system. SARUTA, Koichi

16:10 In situ neutron diffraction study of hydrogen-induced mechanical property enhancement mechanisms in Fe-24Cr-19Ni stainless steel. ITO, Tatsuya

16:25 Deuteration. ODA, Takashi

16:40 Nitrogen gas-filled neutron beam monitor. OHSHITA, Hidetoshi

16:55 First acceleration of cooled muon using an rf cavity. KAMIOKA, Shusei

17:10 Beam Transient Simulations in the Low-Energy Beam Transport Line for the Superconducting ADS Linac. YEE RENDON, Bruce

Particle and Nuclear Physics. Accelerator.

15:55 T2K/HK. NAKAJIMA, Yasuhiro

16:10 COMET. UCHIYAMA, Yusuke

16:25 Kaonic Nuclei. HASHIMOTO, Tadashi

16:40 Summary of Particle & Nuclear Physics Program at J-PARC Symposium. SAKASHITA, Ken

16:55 Permanent magnet system for high-intensity beam transportation in J-PARC LINAC. FUWA, Yasuhiro

17:10 Precise evaluation of time-varying quadrupole field errors through closed-orbit measurements in the J-PARC main ring. ASAMI, Takashi

17:25 Coffee break

17:35 Executive Session (closed)

18:05 Group Photo

19:00 Reception

Tuesday February 25

Safety

09:30 Safety at J-PARC. KASUGAI, Yoshimi

Views from Funding Agency

09:55 View from MEXT. MURAMATSU, Tetsuyuki

10:15 Coffee break

10:25 Executive Session (closed)

11:25 Summary of recommendations. MCGREEVY, Robert

11:55 Lunch

12:45 Site tour

Appendix II

IAC Committee members for 2025

In person:

Hamid Aït ABDERRAHIM
Ken ANDERSEN
Angela BRACCO
Dmitri DENISOV
Takeshi EGAMI
Mitsuhiro FUKUDA
Shinichi KAMEI
Cynthia KEPPEL
Klaus KIRCH
Robert McGREEVY
Joachim MNICH
Jamie SCHULZ
Yoko SUGAWARA
John THOMASON
Jie WEI
Hiromi YOKOYAMA

Remote:

Unable to attend:

Appendix III

Charges to IAC2025 from J-PARC by T. Kobayashi, director

- Evaluate overall performance of J-PARC Center
  - Promotion of science with safety
  - Each facility should have a good balance of user program and facility improvements
  - Future vison of the facility

- Review safety activities at J-PARC
  - Safety culture is well penetrated thru staff and users?

- Any suggestions to improve the total performance are welcome. Our concerns include but not limited to
  - Public relations
  - Open access for users
  - More uniform operation combining KEK, JAEA, and CROSS efforts is critical to further success of MLF