THE INTERNATIONAL ADVISORY COMMITTEE ON THE J-PARC PROJECT REPORT

Meeting held 10-11 March 2014

Tokai, Japan

LINAC upgraded successfully!

April 15th, 2014

Contents

EXECUTIVE SUMMARY (JMP)

The International Advisory Committee (IAC) for the J-PARC project met on March 10th and 11th, 2014 at the J-PARC centre, Tokai and toured the main J-PARC experimental facilities on the 11th.

The IAC thanks the J-PARC Director Dr. Y. Ikeda for providing a comprehensive view of the laboratory through detailed presentations from his staff and appreciates the commitments expressed by the two host laboratory directors, Dr. A. Suzuki and Dr. H. Namba, for the role of J-PARC in their respective road maps. The views of MEXT on large scale research facilities as a vector for Japan's recovery and Industry Revitalization Plan through the promotion of Science, Technology, and Innovation augurs well for the continuous support for J-PARC's operations by MEXT.

The lessons learned from the Hadron Hall radiation incident have been incorporated into a new safety organisation and in the promotion of an enhanced safety-culture and better project management in the laboratory. This should not be viewed as an added burden but as a way of delivering science in a more efficient and professional manner.

In parallel and in trying circumstances, an exciting milestone was reached on the way to the design goals for J-PARC's accelerators with the successful completion of the energy upgrade of the LINAC to 400 MeV. With the concomitant realignment of the RCS magnets, this provides a strong basis for the intensity upgrade plan pursued by management. The MLF is operating at 300 kW with much reduced beam losses and it is very likely that the 1MW operation will be possible when the mercury target will be capable of withstanding the associated thermal stresses. World class instruments are attracting a large academic user community (~800) from diverse fields to MLF and interestingly also a sizable fraction of industrial users (20%). Exciting new results were published by the T2K experiment which paved the way to a search for CP violation in the neutrino sector, the holy grail for this field. Higher intensities and sustained operation of the MR are now key to moving forward. Similarly the flagship experiments in the Hadron Hall were ready to take data when the radiation incident occurred and will be eagerly awaiting the return of the beam delivery. Several new long term programs on rare muon decays, precision measurement of muon anomalous moment and modification of hadrons in nuclei are also moving forward with new facilities that are competing for new funding and resources.

JAEA has increased its commitment to new ADS facilities using the higher energy LINAC. In the context of international participation, an attractive program can be mounted which will have a complementary role to existing or planned infrastructure for studying radiation damages in materials and improved fuel cycles for nuclear power generators.

The IAC finds that the future scientific opportunities at J-PARC are world-class and with a carefully managed operation and appropriate resources, it can contribute in a meaningful way to Japan's objectives of industrial revitalization and global outreach.

SUMMARY OF THE RECOMMENDATIONS BY SECTIONS IN THE REPORT

Management and safety

Recommendation #1

The IAC supports the implementation of a bottom-up approach to safety for all personnel and users with uniform standards across the J-PARC site. The IAC recommends the inclusion of a comprehensive risk analysis as part of the evaluation of all projects and experiments.

The IAC supports the continuation of including a national and international component in safety related management committees. As part of its annual review, the IAC should be asked to comment on the statistics and lessons learned from safety related incidents.

Budget

Recommendation #2

In order for Japan to exploit the major investment made at J-PARC for particle and nuclear physics we urge the funding agencies to recognize and meet the need for sustained and predictable operation of the complex in order to ensure scientific productivity in particle and nuclear physics. This commitment is critical to the goal of enhancing international collaboration at J-PARC.

Recommendation #3

The IAC supports an examination of the potential savings in operating efficiencies for example in running some MR programs at a lower proton beam energy (24 GeV).

Accelerators

Recommendation #4

It is now urgent to finalize the plans for the MR power supplies upgrades to keep the schedule for power upgrade in the MR especially to maintain the leadership of J-PARC in the neutrino program.

Particle and Nuclear Physics

Recommendation #5

We recommend that J-PARC and the hadron user community together examine the slow-extraction program, trying to optimize the physics results in light of current and expected future conditions and clearly define with the users what they can realistically expect over the next 5 years.

MLF

Recommendation #6

As a tool to make strategic decisions regarding the optimal scientific exploitation of the MLF instruments, the IAC again recommends that highlights together with statistics of publications of the MLF be benchmarked against those of its peer-Institutions like ILL, SNS, ISIS, etc. In this context the IAC also recommends that MLF and CROSS collaborate to establish a scheme to seek for scientific advice from the wider scientific community to identify truly pioneering research targets.

MUSE facility

Recommendation #7

The committee still considers the U-line to be the highest priority beamline at MUSE, as the pulsed ultra-slow muon beam will be a unique facility worldwide that will attract international users.

Recommendation # 8
The committee supports the current plan to develop the H-line ahead of construction of the S2-S4 lines which should be commensurate with the growing demands of the muSR user community. The development of the S-line in 2014 should concentrate fully on completing the S1 station.

Transmutation

Recommendation #9
The TEF-T and TEF-P designs and their safety approach should be submitted to an International reviewing panel.

Recommendation #10
The Users group for the TEF-T facility should be consulted to assess more specific demands on irradiation conditions in order to define the characteristics of the facility accordingly.

Recommendation #11
The upgrading the Technological complex of the HLM at Tokai laboratories should be conducted in synergy with other laboratories in the world active in this field to avoid duplication leading to saving money.

Recommendation #12
Safety rules and management to be applied for the ADS facilities in J-PARC need to be carefully developed in agreement with nuclear facilities regulations.

Recommendation #13
Personnel and expertise available at J-PARC (for ex-targetry) or at JAEA (Monju) should now be engaged in the ADS programme.

GENERAL STATUS OF THE PROJECT

The International Advisory Committee (IAC) for the J-PARC project met on March 10th and 11th 2014 at the J-PARC User Centre, Tokai and toured the main J-PARC experimental facilities on the 11th. Appendix I gives the agenda for the meeting while Appendix III indicates the charge that the J-PARC director gave to the committee. The full committee (see Appendix II) participated in the two-day meeting, except for Dr. Beierschmitt (ORNL Associate Director for Neutron Sciences) who could not attend.

Presentations on the status of the laboratory by the Director, Dr. Y. Ikeda, and by the newly appointed head of the safety group, Dr. M. Baba, gave an overview of the state of the laboratory nine months after the May 2013 radiation incident in the Hadron Hall which stopped all beam operation for the rest of the calendar year. Reports on the status of the technical facilities were supplemented by science presentations highlighting the recent scientific achievements. The IAC also heard reports from the Accelerator Technical Advisory Committee (A-TAC) which had just met a few days earlier. The directors of KEK, Dr. A. Suzuki and of JAEA, Dr. H. Namba placed the J-PARC program in the context of their respective institutions priorities, while Mr. K. Kudo from MEXT described the views of the main funding agency. Hence, the IAC had a very global view of the laboratory on which to formulate its recommendations.

The safety-related issues and budgetary constraints dominated the discussions and were highlighted in the IAC recommendations.

This had been a difficult year for the laboratory as it recovered from a serious radiation incident in the Hadron Hall which triggered a removal of the operating licence by the overseeing authorities for many months. After considerable effort, the causes of the problems were identified and the organization structure was modified to better deal with such abnormal situations. A breach of trust with the local governments and public resulting from the inadequate initial response to the incident had to be addressed with great care.

The IAC commends the laboratory management for its response to these challenges and in particular for how the J-PARC staff as a whole pulled together to address the issues. The IAC highlights the openness with which the remedial actions taken were reported to the user community and to the public and how the use of expertise nationally and internationally gave credence to the solutions adopted.

SAFETY

This year's proceedings were dominated by the issues related to the Hadron Hall radiation incident of May 2013. A technical fault in the extraction quadrupole power-supply of the main ring (MR) resulted in a fast extraction of the full circulating beam in 5 msec instead of the normal slow extraction over two seconds resulting in the partial melting of the gold production target with a subsequent release of volatile contamination in the hall. Radiation monitors in the hall indicated increased radiation levels. However, at the time, a misunderstanding of the event led to confusion and wrong decisions by the personnel and it took more than a day before the nature of the earlier event was fully appreciated and reported to the licensing authorities. Several users received radiation doses (less than 1mSievert) and tracked contamination outside the hall. This led to a suspension of the operating license for the whole site and a subsequent major effort to understand what went wrong initially and why the response to the initial alarms were misunderstood and mismanaged.

The IAC was impressed by the tremendous effort pulled together to re-establish operation approval by the national and local authorities. It noted the unity of focus of the whole J-PARC staff in these trying circumstances.

The technical issue with the power-supply control system has been identified and mitigation actions have been taken to reduce the probability of such event and to better control the possible contamination releases in the target enclosure. The IAC believes that even if the specific failure mode encountered last May is unlikely to reoccur, the new safeguards introduced for the Hadron target should envisage a possible meltdown of the target by any unforeseen circumstances (worst case scenario). The IAC was concerned that reusing a gold target was not optimal from a melting temperature point of view. A target with a higher melting point might be safer in that regards even at the price of reduced secondary pion and kaon production. This is a case where a careful risk management evaluation must be undertaken, including evaluations of the technical, personnel, users, and public impacts for the whole of J-PARC not just the Hadron Hall.

The second facet revealed by the handling of the incident is a safety organisation deficiency and a safety-culture inadequacy. J-PARC management has now elevated the safety group under Dr. Baba to the level of a division, reporting directly to the director. The safety group should be viewed as an auditing group with expertise in occupational and personnel safety management which would have the authority to stop any unsafe practices onsite. It should be the key interface between divisional leaders responsible for the safety aspect of their respective divisions and management. The IAC views this as a good first step and recommends that bottom-up approaches to safety be included in any scenario for approving facilities, experiments, and operating procedures. Although the Hadron Hall incident focused the attention on radiation safety, the IAC is aware that most accidents in laboratories like J-PARC are not radiation related but industrial in nature; hence the need to have an all-encompassing approach to safety. The IAC considers that the reorganisation implemented in October can deliver better safety management. The realignment of the safety-culture in the laboratory will require a continuous effort and is a long-term objective requiring constant interaction with all levels of personnel. It is particularly challenging when dealing with a large and diverse user community. The IAC supports a bottom-up approach in which everyone - staff members, managers, and users - feel responsible for their safety and that of their colleagues.

The IAC supports the director's efforts in devising mechanisms to ensure that safety is the first and foremost priority and to promote a safety-culture at all levels

The IAC was pleased to see that the response to the incident by management included reviews by external (international) expert panels and communications on a regular basis with the user community, the regulatory authorities and the public. This openness is key for re-establishing the confidence lost with the community of users and with the public.

The IAC applauds the initiative taken by J-PARC in soliciting input on safety-culture and safety practices (at CERN, Brookhaven, Oak Ridge, and ANSTO) as part of the recent ATAC and NAC meetings. We recommend that these exchanges be extended and deepened, in order to get the maximum benefit both ways. In addition, we urge that J-PARC identify other Japanese domestic industries or companies that are recognised as "best in class" for safety-culture, in order to benchmark and share experiences within the specific Japanese political and cultural context. In other countries, these exchanges occur with the chemical, petroleum, aviation, defence and mining sectors, for instance.

Recommendation #1

The IAC supports the implementation of a bottom-up approach to safety for all personnel and users with uniform standards across the J-PARC site. The IAC recommends the inclusion of a comprehensive risk analysis as part of the evaluation of all projects and experiments.

The IAC supports the continuation of including a national and international component in safety related management committees. As part of its annual review, the IAC should be asked to comment on the statistics and lessons learned from safety related incidents.

BUDGET

JAEA has been able to commit to a full 8 months of user operation in FY14 but KEK was only able to fund 3-4 months of beam time for the MR program. This has dramatic consequences for the Hadron Hall restoration of the scientific program which has suffered greatly from the radiation accident and from previous poor slow-extraction beam quality. With both items under control it was hoped that a sustained beam delivery in FY14 would truly launch several key experiments like KOTO and the hypernuclear program based on kaon beams and allow the neutrino group to continue to make major advances. The IAC views this situation as very problematic not only for FY14 but for the long term. It is critical that the user community at large be reassured that beam availability at J-PARC will not be in question on a year-to-year basis so that long-term international programs could be attracted**. A decent sustained yearly beam time allocation is the single most important factor for making J-PARC an attractive international user laboratory.**

Retaining a leadership position in the world particle and nuclear physics stage

The J-PARC neutrino, rare-processes, and hadron-physics programs have a strong presence on the world stage which is now at risk with the lack of resources allocated to operate the accelerator complex for these experiments. In contrast to the large number of very successful Material and Life Sciences experiments which typically are short in duration, the high-sensitivity particle-physics experiments at J-PARC require years of dedicated operations in order to lead the field, at the level of several thousand hours of operation per year. The hadron physics program requires a coordinated series of experiments which again require substantial beam time. This level of operational commitment was the foundation of the recent Nobel prizes awarded for research at the CERN Large Hadron Collider for discovery of the Higgs and for research at the KEK B-factory on matter-antimatter asymmetries.

Principal Recommendation #2

In order for Japan to exploit the major investment made at J-PARC for particle- and nuclear- physics we urge the funding agencies to recognize and meet the need for sustained and predictable operation of the complex in order to ensure scientific productivity in particle- and nuclear- physics. This commitment is critical to the goal of enhancing international collaboration at J-PARC.

Recommendation #3

The IAC supports an examination of the potential savings in operating efficiencies for example in running some MR programs at a lower proton beam energy (24 GeV).

STATUS OF THE ACCELERATOR SYSTEMS

The IAC was very impressed by the success of the energy upgrade of the LINAC from 180 MeV to 400 MeV. The installation of the 25 new accelerating cavities, the upgrade to the injection system in the RCS and the realignment of the RCS were conducted over the 6-month shutdown period on schedule and a fast commissioning period allowed for the return of operation of the MLF with 300kW beam power by

the 17th of February. Not only was the beam power restored to pre-shutdown values in record time but the beam losses at injection in the RCS are now considerably reduced below the requirement for 1MW operation. This is a tremendous accomplishment. In parallel and following the recommendations of ATAC, the new high-intensity ion source and the new improved RFQ III were operated on the test stand and met the requirement for 1MW operation in the future. Long-term operation of these devices on the test stand is now underway to assess the reliability and stability of the systems before committing to installation in the next summer shutdown. This bodes very well for the power-increase projection for both the RCS and MR programs. The planned power-level increases appear to be quite feasible on the approved schedule certainly for the RCS. For the MR intensity upgrade, the required new high-power RF cavities are being produced and the R&D for MR fast cycling power-supplies has made significant progress. The MR power-supply upgrade project is now on the critical path for a future 750kW operation of the MR by FY2017.

The IAC reaffirms the importance of achieving the design goals of 1MW in MLF and 750kW in the MR ring as the next critical milestone.

Recommendation #4
It is now urgent to finalize the plans for the MR power supplies upgrade to keep the schedule for power upgrade in the MR especially to maintain the leadership of J-PARC in the neutrino program.

SCIENTIFIC PROGRAMS

PARTICLE AND NUCLEAR/HADRON PHYSICS

The IAC congratulates the particle and nuclear physics research communities, laboratories, and agencies on their continued scientific productivity and development future programs while simultaneously addressing the Hadron Hall accident that occurred in May 2013. The particle and nuclear physics programs are primarily supported by the Main Ring (MR) fast extracted beam for the neutrino program, and the MR slow extracted beamlines for experiments in the Hadron Hall. Two additional beams support particle- and nuclear-physics programs, these are the MLF (MUSE) H-line that supports muon measurements and the LINAC beam that could support future neutron Electric Dipole Moment (EDM) measurements. Construction of an additional MR target station and a high momentum beamline began in 2013 and will open up an exciting new domain of research in hadron physics and supports the timely staged development of the muon-to-electron conversion experiment (COMET).

The scientific productivity of the J-PARC particle- and nuclear-physics research program depends critically on both the quantity and quality of the high-power beams delivered to experiments. Beam power in excess of 300 kW is now routinely delivered to the MUSE facility, 220 kW to the long-baseline fast-extraction neutrino experiment and in excess of 15kW of high quality slow-extracted beam to the Hadron Hall facility. The laboratory successfully completed the LINAC upgrade, raising the proton beam energy from 180 MeV to 400 MeV, and planned upgrades of many other accelerator systems which will enable eventual Megawatt class operation of the MUSE facility and the long-baseline fast-extraction neutrino experiment and in excess of 100kW of high-quality slow-extracted beam to the Hadron Hall facility. For the rare-processes experiments, there has been important progress on R&D supporting the future muon program and on the commissioning of the kaon experiments. Both programs have world-class sensitivity to physics beyond the standard model of particle physics, and beyond the direct reach of the Large Hadron Collider.

Neutrino Experiments

A leading pursuit in particle physics today is the search for physical phenomena beyond the so-called “Standard Model”. Even in the context of the now established Higgs Boson, a central feature of the Standard Model, neutrino physics is the only laboratory venue today that has revealed phenomena beyond the Standard Model, through the existence of massive neutrino states. An intense worldwide program to measure the mixing properties of neutrinos has continued to surprise us, and the emerging pattern of large mixing between neutrino species is now providing intriguing hints of possibly other new physics beyond the Standard Model.

We congratulate the T2K collaboration, the laboratories, JAEA and MEXT on definitively establishing the appearance effect of electron neutrinos in an initial muon neutrino beam. This effect together with other precision measurements by T2K and other experiments in the field have provided the first hints of the “holy grail” in neutrino physics: matter-antimatter asymmetry among neutrinos which if discovered could be more significant than the matter-antimatter asymmetries among quarks for which Japan won the Nobel prize in 2008.

For the remainder of this decade the international neutrino community will closely follow the combined sensitivity of the T2K experiment and the recently commissioned Fermilab long-baseline neutrino experiment NOvA for measurement of neutrino mass ordering (mass hierarchy) and evidence of matter-antimatter asymmetry within the neutrino sector. Both are approved to run at 750kW beam power on

target but with different mean neutrino energy and baseline length which makes them complementary. Combining the sensitivity of the T2K and NOvA programs will optimize the sensitivity of the joint world-wide program through the decade. The IAC endorses the vision of T2K working in a long-term international collaborative pursuit of the next frontier of neutrino physics: mass ordering and matter-antimatter asymmetries. The IAC appreciates the recent effort of the T2K collaboration to develop quantitative models of joint future sensitivity to neutrino parameters which will valuable in communicating with the broader scientific community.

FUNDAMENTAL PHYSICS WITH MUONS

It is natural that a facility with the potential for high-intensity beams such as J-PARC should support an experimental program which explores, with high precision and high sensitivity, a broad range of fundamental processes. It also seems appropriate that the experimental program bridge different sub-facilities.

COMET experiment

Currently, the experiment which is fully approved and which will be mounted first is COMET Phase I in the Hadron Hall. This experiment is fast tracked with construction to be completed and to run, perhaps as early as 2016. With the intended sensitivity for muon to electron conversion of 10^{-14}, there is a window for this experiment to produce a measurement with the world's best sensitivity. The experiment is not without its challenges, but has reviewed well in the PAC and has had its experimental progress on its highest technological challenges examined by an international review. The Mu2E experiment at Fermilab is expected to have higher sensitivity but currently COMET Phase I is scheduled to run significantly earlier. Targetry concerns following the Hadron Hall accident have motivated a graphite target with higher radiation tolerance but a lower muon yield which substantially increases the run time of Phase I to 83 days of dedicated beam time. This will have a significant impact on the program planning for the whole MR program.

COMET Phase II has a projected sensitivity of 10^{-16},which approximately matches that of the Mu2e experiment at Fermilab. The necessary civil construction will already be completed for COMET Phase I, which is an advantage. Both experiments project running by the end of the decade. For COMET Phase II to maintain its competitive posture, it needs to accomplish important aspects of its R&D program ahead of eventual approval.

There is also an initiative (DeeMe) to search for end-point electrons (typically 105 MeV/c) produced in the target by the RCS beam which would be a signal of the conversion of a muon to an electron. The technique contrasts dramatically to the COMET approach and could have a sensitivity in the range of COMET phase I with very different systematic errors.

The IAC continues to consider that COMET Phase I is potentially a very high return experiment which could establish world leadership in a new area for J-PARC.

g-2 experiment:

The experimental technique proposed in the Material and Life sciences Facility (MLF) is a departure from the approach used by the famous series of muon (g-2) measurements made over the past 50 years at CERN and Brookhaven. The new technique stores the decaying muons in a high-quality MRI like magnetic field in which the very-low emittance of the injected muons relaxes the relatively high "magic

momentum" requirement of the CERN-Brookhaven technique. The potential sensitivity (0.2 ppm) improves on that of the measurement at BNL (0.5 ppm) but falls a little short of the original projection (0.1 ppm),which is similar to the precision of the new measurement at Fermilab. By measurement of the up/down asymmetry in the positrons, a sensitive measurement of the electric dipole moment can be achieved. This is thought to exceed slightly the sensitivity of the Fermilab (g-2) measurement, which would be its main competitor. This innovative approach makes the program very attractive.

The IAC congratulates the (g-2)/EDM team on their recent break-through of dramatically increasing the production yield of muonium, which is critical to the eventual success of these innovative techniques.

Phase II of COMET, and a novel approach to the measurement of the muon g-2, and muon electric dipole moment, are packaged as a physics initiative along with the Hadron Hall extension. To proceed beyond the R&D, which was included in the top 27 projects by the Japan Science Council, needs approval by Working Group for "Large Scale Projects for Scientific Research" under the MEXT Council for Science and Technology.

Rare-processes program with kaon beams

The KOTO collaboration has produced high quality data from the pilot run in 2013 that was cut short by the Hadron Hall accident. These data demonstrate that the experiment is now ready to embark on a physics run aimed at providing world-leading sensitivity, beyond the so called "Grossman-Nir" search frontier established by other experiments.

The E36 experiment has received Stage-2 approval from the PAC and is now facing a major scheduling challenge exacerbated by the Hadron Hall accident. The K 1.1BR beamline, in which it runs, is to be removed for the COMET and High momentum beamline installation. There is a narrow window for operations by the summer of 2015 that is scheduled but currently not funded.

These programs cannot run when COMET is taking beam (COMET relies on a 8 GeV pulsed proton beam), nor when the neutrino program is on.

Hadron/Hypernuclear physics:

The research of the hadron physics program addresses forefront issues in the properties of dense baryonic matter and our ability to understand nuclear forces and properties from the underlying theory of quantum chromodynamics. The focus on hypernuclei, doubly- strange hypernuclei and the impact of kaons in nuclei bear directly on the nature of the interior of neutron stars where potentially dramatic efforts of the strangeness degree of freedom has been long debated. Our limited experimental knowledge of hyperon-nucleon interactions and hyperon-hyperon interactions is at the heart of this issue. At the same time, QCD predicts other high density many-body effects that may be observed in changes of hadron masses and interactions inside nuclei. At the last IAC meeting with the significant improvements in beam power and duty factor, the hadron program was poised to move into the kaon physics era. The Hadron Hall accident brought this to a halt and has delayed the program by perhaps 18 months. Obviously re-establishing safe and reliable operations in the Hadron Hall is the priority for now. This delay and the significantly increased requirement for dedicated COMET running make the pressure on beam time even more intense. This pressure is shared by the particle physics experiments in the Hadron Hall.

The MR program includes a number of exciting opportunities requiring large commitment of dedicated beam operation. A careful programming of the beam time will be required as recognized by the IPNS PAC.

Therefore we want to reemphasize our recommendation of the 2013 meeting:

Recommendation #5
We recommend that J-PARC, IPNS/KEK and the Hadron Hall user community together examine the slow extraction program, trying to optimize the physics results in light of current and expected future conditions and clearly define with the users what they can realistically expect over the next 5 years.

MATERIAL AND LIFE SCIENCES FACILITY(MLF)

Neutron Scattering Facility:

The MLF neutron facility is now transitioning from its construction and commissioning phase to being a productive and impressive user facility. 18 beamlines are now instrumented, and a further three under construction, resulting in an impressive and diverse portfolio with the potential to deliver both capacity and capability for its user community. Operating MLF at 300 kW is more than enough to deliver world-class science; the planned development to 1 MW -anticipated for 2015 - will give capacity to absorb the anticipated growth in user demand from an ever broadening Japanese Materials and Life Science community.

Inevitably, output in refereed scientific journals is a lagging metric, but will develop in time. The committee was impressed to see articles published in *Science* and *Nature*-group journals from MLF, as well as several magazine covers. We found the research in Li-ion battery materials particularly exciting, along with work on the strength of the main superconducting cable for the ITER fusion reactor.

J-PARC is already a powerful neutron source for condensed-matter science. Focus now needs to be turned to evolving it into a leading user facility supporting a diverse and growing Japanese science base. The IAC applauds the funding of a User Research Building as an important step towards realising this goal. It also applauds the funding of the radioactive storage facility for J-PARC waste.

Recommendation # 6
As a tool to make strategic decisions regarding the optimal scientific exploitation of the MLF instruments, the IAC again recommends that highlights together with statistics of publications of the MLF be benchmarked against those of its peer-institutions like ILL, SNS, ISIS, etc. In this context the IAC also recommends MLF and CROSS collaborate to establish a scheme to seek for scientific advice from the wider scientific community to identify truly pioneering research targets.

MUSE

The committee is impressed with the recent developments of the MUSE facility. A major milestone has been reached with the near completion of the USM beamline, and we look forward to hear news of the first slow muon to exit U1A. We are pleased to hear about the progress of the S1 line and the two new spectrometers.

Significant progress has been reported about the U-line, specifically the installation of a state-of-the-art laser system. The U-line is at a critical stage nearing completion, where resources should not be diverted at the risk of slowing down current progress; especially because of the lengthy commissioning stage ahead.

Recommendation #7

The committee still considers the U-line to be the highest priority beamline at MUSE, as the pulsed ultra slow muon beam will be a unique facility worldwide that will attract international users.

The committee considers the progress at the S1-line (including the electrostatic kicker and a new spectrometer) to be a positive development, which is going to help alleviate some of the user demand for muon beam time and immediately increase the scientific output of the MUSE facility.

The scientific urgency of the three proposed long-term projects for the H-line requires that the H-line receive adequate funding to complete construction (all experiments have made significant progress in their preparation and in establishing strong international collaborations).

Recommendation #8
The committee supports the current plan to develop the H-line ahead of construction of the S2-S4 lines which should be commensurate with the growing demands of the muSR user community. The development of the S-line in 2014 should concentrate fully on completing the S1 station.

The scarce amount of beam time available at MUSE has been well used, supplemented by access to other muon facilities outside of Japan. A good level of scientific productivity has been maintained, with some notable high-profile publications. The diversity of scientific activities is impressive, with a good mix of problems in fundamental and applied research being addressed ranging from spin-orbit coupling studies in spinels, through shallow donor levels associated with hydrogen impurities in ferro-electric insulators to the determination of Li- and Na- diffusion in solid electrolytes.

We are encouraged to learn that there is now a mechanism for hiring much needed research associates which will help to alleviate the serious manpower shortage associated with the development of MUSE.

NUCLEAR TRANSMUTATION

The presentations from Dr. H. Oigawa and Dr. T. Sasa gave a survey of the recent development both strategic and technical regarding the Accelerator Driven System (ADS) program at JAEA.

From the strategic point of view, Dr. H. Oigawa reported of the work completed by the Working Party of MEXT to Review Partitioning and Transmutation (P&T) Technology. This Working Party was set under the Nuclear Energy Science and Technology Committee of MEXT and delivered its preliminary report in November 2013 giving a global strategy for P&T development & deployment. The reviewing covered all aspects namely:

1. Nuclear power plants spent fuel reprocessing including minor actinides (MA) partitioning,
2. Dedicated MA fuel fabrication for transmutation,
3. Design of dedicated MA burners from Heavy Liquid Metal (HLM) cooled sub-critical Accelerator Driven System (ADS),
4. Dedicated reprocessing technology for MA transmutation fuels based on pyroreprocessing.

Coming to the P&T and ADS development, the Working Party recommended:

- To further develop the ADS Target Test Facility (**TEF-T**) under J-PARC to verify the feasibility of the beam window which is a big challenge for ADS and to consider it as a material test facility,
- To further develop the Transmutation Physics Experimental Facility (**TEF-P**) under J-PARC to overcome difficulties in reactor physics issues such as for a subcritical core and a MA-loaded one,
- To consider a participation of Japan in the **MYRRHA** Program, as the intermediate step between the TEF-T/TEF-P stages and the ADS industrial transmuter. The Working party indicates that it is

appropriate to proceed with negotiation about JAEA's participation at a reasonable level and **mutual collaboration** with Belgium and other relevant countries.

- Last but not least the evaluation of technical readiness levels of the technical fields (**partitioning, ADS, fuel cycle, and MA fuel fabrication and reprocessing**) showed that the technology is approximately at the stage to move up R&D from "conceptual study and lab-scale" to "principle demonstration", **and it is appropriate to shift the R&D to the next stage of engineering scale**.

From the technical point of view Dr. T. Sasa reported briefly on the progress in the design of TEF-T facility specifically on the aspect of target coupling and decoupling to the accelerator beamline and on the remote handling device for target extraction. He reported more thoroughly of the technological development on HLM technology in particular regarding instrumentation (oxygen-meters, HLM flow-meters, HLM level-meters, and pressure gauges). He also pointed out the implementation of the IAC 2013 recommendations concerning the internationalisation of TEF-T.

The IAC acknowledge the following facts:

- The global strategy on P&T and ADS development recommended by the Working Party of MEXT to Review Partitioning and Transmutation (P&T) Technology is rational and sound, in particular the decision to move from lab-scale demonstration towards "Engineering level prototyping",
- The internationalisation of the project has been started and should be expanded through cross-participation and exchange of experts and teams with other organisation active in the field of P&T and ADS development,
- The designs of TEF-P and TEF-T facilities look promising but the IAC members can't judge on their technical value based on the short presentation they were exposed to.

Based on these findings, the IAC would propose the following recommendations:

Recommendation #9
The TEF-T and TEF-P designs and their safety approach should be submitted to an International reviewing panel.

Recommendation #10
The Users group for the TEF-T facility should be consulted to assess more specific demands on irradiation conditions in order to define the characteristics of the facility accordingly.

Recommendation #11
The upgrading the Technological complex of the HLM at Tokai laboratories should be conducted in synergy with other laboratories in the world active in this field to avoid duplication leading to saving money.

Recommendation #12
Safety rules and management to be applied for the ADS facilities in J-PARC need to be carefully developed in agreement with nuclear facilities regulation.

Recommendation #13
Personnel and expertise available at J-PARC (for ex-targetry) or at JAEA (Monju) should now be engaged in the ADS programme.

User support and internationalization

Several major capital investments are being made to improve the user experience at J-PARC. KEK is doubling the number of rooms available in the dormitory complex. These should be available by the fall 2014 and will alleviate a chronic shortage of convenient and affordable housing close to the laboratory .

In parallel JAEA has funded a new user office building to be built onsite near the MLF facility, with offices, cafeteria and meetings room for the increasing user community. On a slightly longer timescale a new access will be provided separating J-PARC access from that for JAEA employees. This should allow for secure but not-so-stringent controls at the gate to J-PARC.

The international office continues to program regular lectures and seminars for resident researchers across the disciplines and is planning for the 2nd International Symposium on Science at J-PARC (J-PARC 2014) to be held in Tsukuba on July 12-15, 2014. This major event will provide an opportunity to review the accomplishments and prospects of J-PARC's science portfolio.

The IAC commends the laboratory for maintaining this effort as a priority even in the tense recovery period following last year's accident in the Hadron Hall. In the end the success of the internationalization of J-PARC is intimately related to the performance of the accelerators, the quality and reliability of the beam delivery, the excellence of the instruments and ease of access.

CONCLUSIONS

J-PARC management faced a critical situation after the Hadron Hall radiation incident of May 2013. The IAC noted that a strong leadership and a rallying of the troops behind management allowed for a resolution of the technical and safety related issues to the satisfaction of the regulatory authorities within the calendar year. A new emphasis on safety issues will be an overall priority of management to guarantee a safe delivery of high power beams to the user community. This should not be seen as an added burden but as a more efficient and more professional way of delivering top science.

In a difficult year, J-PARC management and staff should also be congratulated for restoring 300kW beam operation in the MLF after the major success with the LINAC energy upgrade project and the realignment of the RCS. This was one of the milestones for operating the MLF at the MW power level in the future and the initial operation confirmed the significant improvement in beam losses which will allow higher currents once the new ion source and new RFQ are installed next summer.

The Hadron Hall (and neutrino program) suffered a long shutdown to resolve the technical problems in the Hadron Hall target area which crippled several key programs. Several key experiments in the Hadron Hall, which were ready for data taking last spring, have been delayed by one year or more. A significant crunch is looming in the hall due to upcoming new facilities like COMET and the new high momentum beamline installations. A careful planning of the experimental program must be done to optimize physics outputs.

Programs like T2K are producing world-class results and depend for their long-term future on the planned intensity upgrade of the MR which is now on the critical path to meet the advertized intensity ramp up schedule.

On the ADS front, JAEA has increased its commitment to developing two test facilities TEF-T and TEF-P. TEF-T is seen as being a complementary materials testing facility to other international facilities and a MOU of collaboration with MYHRRA has been signed to formalize the sharing of such opportunities.

The IAC is convinced that the J-PARC laboratory is responding to its challenges in a professional manner and that given the proper resources, it can continue to attract large national and international user communities so that it will deliver top science and societal benefits on competitive basis with its peers.

Appendix I

Agenda for the International Advisory Committee Meeting of J-PARC in 2014

Date: March 10 (Mon) and 11 (Tue), 2014
Place: IQBRC

March 10 (Mon)

Executive Session (closed)		
8:45 - 9:00	Charge to the Committee	Yujiro IKEDA
Opening		
9:00 - 9:35	Report from the Director	Yujiro IKEDA
9:35 - 10:05	Safety at J-PARC	Mamoru BABA
Accelerator		
10:05 - 10:35	Progress and Prospects	Tadashi KOSEKI
10:35 - 11:05	A-TAC View of Accelerator Activities	Thomas ROSER
11:05 - 11:15	Coffee	
Particle and Nuclear Physics I		
11:15 - 11:40	Overview of Particle and Nuclear Physics Division	Takashi KOBAYASHI
11:40 - 12:10	Neutrino Physics at J-PARC	Chang Kee JUNG
12:10 - 13:10	Lunch	
Particle and Nuclear Physics II		
13:10 - 13:40	Hadron Physics at J-PARC	Takeshi KOMATSUBARA
13:40 - 14:10	Muon Particle Physics at J-PARC	Satoshi MIHARA
14:10 - 14:25	PAC report & View from IPNS	Katsuo TOKUSHUKU
Material and Life Science		
14:25 - 14:55	Overview of MLF Division	Masa ARAI
14:55 - 15:35	Neutron Science at MLF	Takashi KAMIYAMA
15:35 - 16:05	Muon Science at MLF	Ryosuke KADONO
Views from Funding Agency and Host Institutes I		
16:05 - 16:30	J-PARC: A View from MEXT	Katsuyuki KUDO
16:30 - 16:55	KEK and J-PARC	Atsuto SUZUKI
16:55 - 17:05	Coffee	
Executive Session (closed)		
17:05 - 18:00	Review and Discussion IAC Members	
Banquet		
18:00 - 20:00	Banquet	

March 11 (Tue)

Views from Funding Agency and Host Institutes II		
9:00 - 9:25	JAEA and J-PARC	Hideki NAMBA
Accelerator Driven Transmutation Research		
9:25 -10:05	ADS Project	Hiroyuki OIGAWA, Toshinobu SASA
Executive Session (closed)		
10:05 -11:55	Review and Discussion, Drafting of Recommendations	IAC Members
Close out		
11:55 - 12:25	Recommendations	Jean-Michel POUTISSOU
12:25 - 13:45	Lunch	

14:00 - 17:00 **Site Tour**

Appendix II

IAC Committee members for 2014

	Name	Affiliation	Position	Field
1	Jean-Michel Poutissou(chair)	TRIUMF	Associate Director & NuclearMedicine Division Heademeritus	Muon
2	Hiroshi Amitsuka	Hokkaido University	Professor	
3	Thomas Roser	Brookhaven National Laboratory	Chair of the Collider-Accelerator Department	ACC
4	Fu Shinian	Institute of High Energy Physics	Deputy director, AcceleratorCenter	
5	Sergio Bertolucci	the European Organization for Nuclear Research(CERN)	Director of Research andScientific Computing	Particl e
6	Robert Tschirhart	Fermi National Accelerator Laboratory	Associate Head, ScientificComputing Division	
7	Hugh Montgomery	Thomas Jefferson National Accelerator Facility	Director	Particl e/Nucl
8	Donald F. Geesaman	Argonne National Laboratory	Distinguished ArgonneFellow/former Director of thePhysics Division	Nucl
9	Horst Stoecker	GSI Helmholtzzentrum für Schwerionenforschung GmbH	Scientific Director	
10	Hajimu Yamana	Kyoto University	Professor	ADS
11	Hamid Aït Abderrahim	SCK•CEN	Deputy Director-General	
12	Kelly J. Beierschmitt	Oak Ridge National Laboratory	Associate Laboratory Directorfor Neutron Sciences	Neutro n
13	Hidetoshi Fukuyama	Tokyo University of Science	Vice President	
14	Robert Robinson	Australian Nuclear Science and Technology Organisation	Head, Bragg Institute	
15	Andrew Dawson Taylor	Science and TechnologyFacilities Council	Executive Director, NationalLaboratories	

N.B. Dr Beierschmitt could not attend

Appendix III

Charges to IAC2014 from J-PARC

Yujiro Ikeda

In light of the mission of J-PARC to maximize science output, we like to receive your advice on:

- Science production aspects
- Neutron, Muon, Hadron, Neutrino, ADS
- Management performance for J-PARC operation
- Budget
- Organization
- Adequacy of the power up scheme and schedule for MW
- Adequacy of user support, user environments in terms of accommodation, access, etc.
  Public relation and outreach activities, Internationalization.