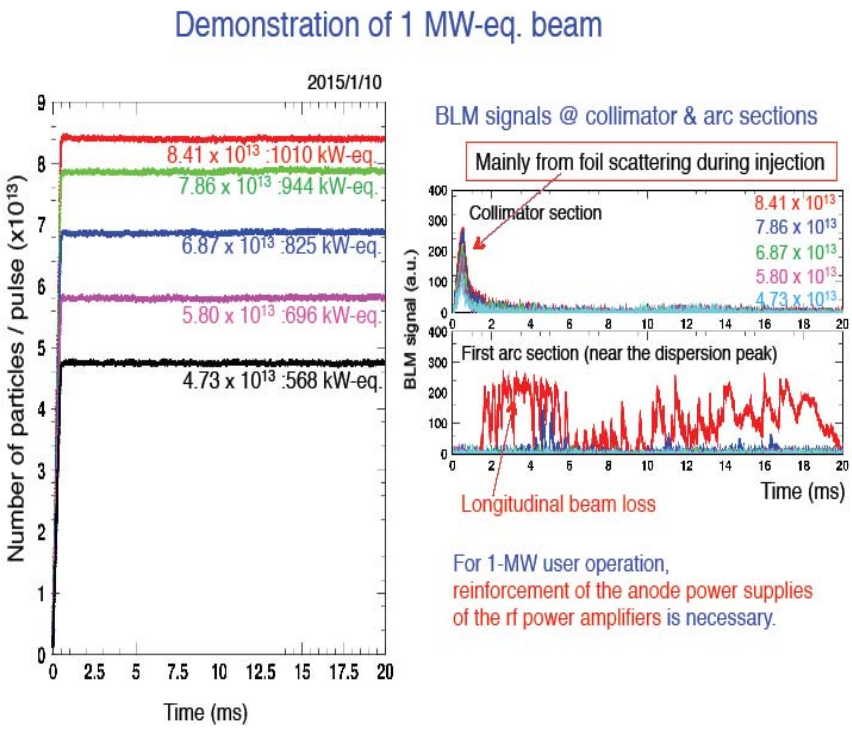
THE INTERNATIONAL ADVISORY COMMITTEE ON THE J-PARC PROJECT

REPORT

Meeting held 16-17 February 2015

Tokai, Japan



March 10th, 2015

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EXECUTIVE SUMMARY

The International Advisory Committee (IAC) for the J-PARC project met on February 16th and 17th, 2015 at the J-PARC centre, Tokai and toured the main J-PARC experimental facilities in the afternoon of the 17th.

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 representatives, Dr. Y. Okada and Dr. H. Namba, for the role of J-PARC in their respective road maps. The views of MEXT on large scale research facilities were presented by Dr. K. Okamura and he outlined four expectations for justifying the continuous support for J-PARC's operations by MEXT.

The lessons learned from the Hadron Hall radiation accident and from a recent fire incident in the MUSE facility have been integrated in the new safety organisation under the leadership of Dr. M. Baba. The promotion of an enhanced safety culture remains the top priority for the J-PARC staff but should also extend to the contractual personnel and the visiting users community. It should also include better project management and quality control in the laboratory.

While dealing with complex safety related issues, J-PARC has nevertheless achieved some very critical milestones during the past year, including the successful high intensity upgrade of the front end of the LINAC, the restoration of the stable running power level of 300kW for MLF users and 240kW in the neutrino facility soon after the intensity upgrade, the demonstration of a 1MW pulse equivalent to the MLF and the first data taking with an anti-neutrino beam. The repairs of the Hadron Hall have progressed to the point of allowing for recertification of the facility by the licensing authorities at an expected restart of the science program in FY2015.

The IAC is still concerned that the operation support for J-PARC doesn't allow for optimal beam delivery to users in the Main Ring in particular to the high profile neutrino program. With the imminent, and welcomed restart of the Hadron Hall program, this is creating a severe shortage of beam time allocations to all MR users.

JAEA has increased its commitment to new TEF ADS facilities using the higher energy LINAC responding in part to the new government strategy for nuclear power and high level waste management policy in Japan. 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. This is due in great part to the leadership provided by Dr. Y. Ikeda who is now giving a much stronger laboratory to his successor, Dr. N Saito, as the Head of J-PARC. Similarly Dr. M. Arai is handing out a superb facility to his successor at the Head of the MLF, having built world-class instruments and world-class scientific programs for the benefit of the neutron and muon users community. The laboratory has been and will be in good hands.

SUMMARY OF THE RECOMMENDATIONS BY SECTIONS IN THE REPORT

Management and safety

Recommendation #1

- Continue to enforce a "Safety First" mentality across the lab. This has to come from the top management. The experience from other major research laboratories is that the "Safety First" mentality works best if **owned by all the lab employees and users.**
- Enforce a strong mentality of Quality Assurance/Quality Control, through the strict adoption of a common Engineering Data Management System across all divisions.
- Establish a **formal** process for **Risk Management** (assessment, ownership, mitigation, and update), creating an organization-wide Risk Register.
- Establish a **formal** process for **Crisis Management**, by adopting standardized procedures to react to different levels of incidents.

Budget

Recommendation #2

In order for Japan to exploit the major investment made at J-PARC, the IAC urges the funding agencies to recognize and meet the need for sustained and predictable operation of the complex in order to ensure scientific productivity. This commitment is critical to the goal of retaining and enhancing international collaborations at J-PARC.

Accelerator

Recommendation #3

It is now urgent to finalize the plans for the MR power supplies upgrades to keep the schedule for power upgrade for fast extraction to maintain the leadership of J-PARC in the neutrino program. The IAC supports the ATAC recommendation to "Explore additional possibilities to increase the MR beam power prior to the completion of the MR power supply upgrade".

Recommendation #4

The IAC agrees that operating the MLF at the highest possible beam power is important for MLF users, but in general beam stability and reliability should not be compromised for beam intensity.

Recommendation #5

The IAC recommends that work on higher duty factor be the highest priority for Slow eXtraction based program.

Particle and Nuclear Physics

Recommendation #6

J-PARC, KEK, JAEA and MEXT should develop a long-term schedule for Main Ring operations and upgrades and commit to it. The science productivity is greatest with maximal utilization of the facility, approaching 9 cycles of physics running per year, which is the best return on the major investment made in the J-PARC facility. Budget realities may prevent realizing 9 cycles per year, and for the purpose of establishing a long-term schedule J-PARC, KEK, JAEA and MEXT should agree on a "base" operations goal and a "stretch" operations goal.

Recommendation #7

The IAC strongly encourages the COMET collaboration to work with J-PARC to find the resources needed to move this high visibility experiment forward.

Recommendation #8

The IAC encourages the DeeMe collaboration to move forward with initial engineering runs and then make a more careful evaluation of the validity of the experimental approach.

Recommendation #9

The IAC encourages continued R&D toward the development of a high- intensity ultra-cold muon source.

Recommendation #10 (see recommendation #5)

The IAC considers that work on higher duty factor should be the highest priority for slow extraction users.

MLF

Recommendation #11

It is now very important to communicate the world leading potential of the MLF facilities to academic, industrial and political audiences and engage the public with the scientific and societal impact through

- ❖ Structured interactions with academia
- ❖ Targeted communications in the media

From a MLF perspective, the Accelerator, Target and Instruments all meet expectation but the Facility needs to run! See recommendation #4

Recommendation #12

The IAC recommends that great care be taken in assessing the cost benefits of changing the classification of the MLF hall from Class2 to Class1 environment and that a staged approach be considered rather than a blanket change.

MUSE facility

Recommendation #13

The IAC 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.

TEF,Transmutation Experimental Facilities:

Recommendation #14

As the ADS development is a long term objective, placing the TEF projects into a roadmap for ADS in Japan and internationally is recommended as part of a comprehensive development strategy.
The IAC recommends to continue the strong R&D effort needed to secure the TEF construction approval.

GENERAL STATUS OF THE PROJECT

The International Advisory Committee (IAC) for the J-PARC project met on Feb 16th and 17th 2015 at the J-PARC User Centre, Tokai and toured the main J-PARC experimental facilities in the afternoon of the 17th. 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. H. Stoeker (GSI) and Dr. H. Yamana, who could not attend. Also T. Roser, Chair of A-TAC which had met the previous week, sent his A-TAC report as well as some recommendations which were considered by the IAC.

Director, Dr. Y. Ikeda, gave an overview of the laboratory. This year has seen key successes like the intensity upgrade of the front end of the accelerator chain, the demonstration that 1MW beams can be delivered to the MLF, the first operation of the neutrino facility in anti-neutrino mode and the rise in publications from all operating facilities. However, this is overshadowed by recent safety issues: he described the considerable efforts deployed during the last 18 months to restart the Hadron Hall program, and the recent problems associated with a fire incident in the MUSE facility. It is anticipated that beam delivery to users will restart soon (within days) while the Hadron hall will be recertified to received beam by the end of the fiscal year 2014. This will then position the laboratory to deliver science for 8 months in the MLF while attempts are being made to increase the KEK budget for the MR operation to allow more than the approved 6 months from the current allocation.

The organisation in place has responded adequately to the recent fire incident. The Head of the Safety Group, Dr. M. Baba, gave an overview of the state of the laboratory and how the new organisation is affecting the safety culture of the staff. Reports on the status of the technical facilities were supplemented by science presentations highlighting the recent scientific achievements. Dr. Y. Okada (KEK) and Dr. H. Namba (JAEA) placed the J-PARC program in the context of their respective institutions priorities. The views of MEXT on large scale research facilities were presented by Dr. K. Okamura as he outlined four expectations for justifying the continuous support by MEXT for J-PARC's operations.

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

This had been a difficult year for the laboratory as it recovered from a radiation accident in the Hadron Hall, which triggered an order to suspension, according to an agreement for the nuclear safety issues between NSRI at Tokai and local governments nearby. After considerable efforts, the causes of the problems were identified, solutions implemented to mitigate such events and the safety organizational 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 accident 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 recent fire incident was dealt with adequately but pointed out some deficiencies in the quality control and project management effectiveness which are to be improved.

Dr. Ikeda indicated that a new user building was about to be available in early spring which will be appreciated by all users and will form the new focal point for J-PARC users community. The expanded dormitory provided by KEK offers now 100 comfortable rooms for J-PARC visiting users.
Dr. Ikeda introduced the changes in leadership which will happen in the new fiscal year and how the upcoming Director, Dr. N. Saito, is organizing his team to run J-PARC and deliver science effectively.

The IAC thanked Dr. Y. Ikeda for his leadership during him term as director of J-PARC, as he assumed a critical role in handling serious incidents, restoring public confidence while moving forward with upgrade plans and science delivery. He hands out to his successor a better laboratory with great expectations.

SAFETY

Dr. M. Baba gave a comprehensive review of the J-PARC safety division and its actions to improve the safety culture and crisis management at the laboratory. It was clear that this was the priority item for management.

The IAC congratulates the management (especially the outgoing Director) for the large and successful effort made for the recovery from the Hadron Hall accident, both in terms of the technical analysis, the adopted measures and for the reorganization of the Safety Group at J-PARC. The reaction of the authorities to the recent fire episode, in itself a minor happening, exposes nevertheless a severe problem of trust, which can seriously threaten the development of the lab, and which needs to be addressed with the highest priority.

The re-establishment of trust with the stakeholders (population, authorities, funding agencies) will entail a long effort, which has to proceed in parallel through several paths:

- Continue to enforce a "Safety First" mentality across the lab. This has to come from the top management. The experience from other major research laboratories is that the "Safety First" mentality works best if **owned by all the lab employees and users.**
  Practical measures like encouraging bottom-up non-conformity reports, requiring a lab specific safety training for all staff, users, and for the contractors BEFORE they are allowed to work on the premises, ensuring a proper supervision of their activities (through auditing by the Safety Division), making a clear line of safety responsibilities etc. All these aspects have been dealt with in many international laboratories and can be adapted to the J-PARC environment. By continuing the effort to foster standing collaboration with outside safety organizations, much expertise can be brought to bear most effectively.

- Enforce a strong mentality of Quality Assurance/Quality Control, through the strict adoption of a common Engineering Data Management System across all divisions.

- Establish a **formal** process for **Risk Management** (assessment, ownership, mitigation, and update), creating an organization-wide Risk Register.

- Establish a **formal** process for **Crisis Management**, by adopting standardized procedures to react to different levels of incidents. The Crisis Group should include all the relevant management and technical actors and **the Communication Group**. It should have a permanent crisis room, and should practice drills based on realistic cases, **run with assistance of external crisis training professionals**.

- Strengthen the effort on **communication and outreach**, to outline all the positive influence the lab has on the national and local communities. Hiring an experienced communicator might be a very good investment.

- Foster transparency and ease of access to the information for the authorities and to the general public.

The laboratory has ambitious scientific plans, which have already seen impressive achievements. Many of the present and future developments are technically challenging and not free of risk. Rising to the challenge of becoming a best-practice laboratory will constitute an extra bonus to a bright future.

BUDGET

JAEA has been able to commit to a full 8 months of user operation in FY15 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 FY15 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 FY15 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 can be attracted and maintained. **A decent sustained yearly beam time allocation is the single most important factor for making J-PARC an attractive international user laboratory.** This was also pointed out by the representative of the MLF user community, Dr. E. Torikai, as the main request from that community.

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.

Recommendation #2

In order for Japan to exploit the major investment made at J-PARC, the IAC urges the funding agencies to recognize and meet the need for sustained and predictable operation of the complex in order to ensure scientific productivity. This commitment is critical to the goal of retaining and enhancing international collaborations at J-PARC.

STATUS OF THE ACCELERATOR SYSTEMS

It is an important milestone to run J-PARC accelerator up to an equivalent proton beam power of 1MW at RCS test operation of one pulse. By achieving this milestone, one can optimistically foresee that the designed full beam power of 1MW for user operations can be realized. The team should be highly congratulated. The new ion source, the new RF chopper and the new RFQ, as well as the LINAC energy recovery to 400MeV contributed greatly to this achievement. Also the completion of the prototype of the new power supply for the MR main magnets is a major step towards the 1Hz operation of the MR

for the neutrino experiment at the design beam power of 750kW.The newly developed MA material FT3L makes it feasible to effectively increase the shunt impedance of the MR RF cavity. The first new cavity has been successfully installed in the MR. The new cavities will be able to provide more than twice the total voltage in the MR.
For stable 1 MW operation of the RCS, some more work needs to be done in 2015. The power acceptance of the chopper scraper should be investigated by both simulation and measurement. The reason of multipacting in SDTL05 and SDTL06 should to be identified and the correspondent measures should be taken to ensure their stable operation. The beam loss measurements at the RCS arc area during the test run of 1MW equivalent power indicate that the high-intensity beam needs better capture and bunching in the RCS. Higher power from the RF amplifiers is required.

Recommendation #3
It is now urgent to finalize the plans for the MR power supplies upgrades to keep the schedule for power upgrade for fast extraction to maintain the leadership of J-PARC in the neutrino program. The IAC supports the ATAC recommendation to "Explore additional possibilities to increase the MR beam power prior to the completion of the MR power supply upgrade".

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SCIENTIFIC PROGRAMS

PARTICLE AND NUCLEAR/HADRON PHYSICS

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 2014 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. After the recent intensity upgrade, Beam power in excess of 300 kW were routinely and stably delivered to the MUSE facility, 220 kW to the long-baseline fast-extraction neutrino experiment. 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

The IAC congratulate Kobayashi-san, Nakaya-san, the T2K collaboration, J-PARC, JAEA, KEK and MEXT on the science accomplishments that led to the Nishina Memorial prize. This well-deserved prize underscores the world-wide interest in neutrino physics. Establishing the appearance of electron

neutrinos in an initial muon neutrino beam is a critical measurement on the long road to understanding neutrinos to level that we understand quarks today. Reasonable projections of beam power and running time for the near and medium term J-PARC program will deliver the required sensitivity to precisely study the disappearance of anti-neutrinos from an initial anti-muon neutrino beam, and establish the appearance of anti-electron neutrinos in this beam which would be an important test of our current understanding of neutrinos. In parallel the NOvA experiment at Fermilab will likely focus on neutrino beam running in the near and medium term to pursue measurement of the mass ordering of neutrinos.

The longer term goal of observing hints of matter-antimatter asymmetry or establishing anomalies in our current understanding of neutrinos will require commitment and patience from the researchers, continued dedication from the J-PARC staff, and continued commitment from the funding agencies for this long term program. This science will unfold gradually, somewhat in contrast to the exciting observation that garnered the Nishina prize, and more in common with the science programs of the Kamiokande and Super-Kamiokande experiments and the Belle experiment that eventually garnered two Nobel Prizes for Japanese science. A long term commitment to T2K operations is also an opportunity to work collaboratively with the NOvA experiment and the international neutrino initiative driven by beams from Fermilab now gaining momentum. A long term commitment to Main Ring operations from the funding agencies will reduce tension between research collaborations, and will improve longer term planning which is presently challenged by the gap between requests from the user community and reasonable projections of beam power and running time at J-PARC for the longer term.

Recommendation #6
J-PARC, KEK, JAEA and MEXT should develop a long-term schedule for Main Ring operations and upgrades and commit to it. The science productivity is greatest with maximal utilization of the facility, approaching 9 cycles of physics running per year, which is the best return on the major investment made in the J-PARC facility. Budget realities may prevent realizing 9 cycles per year, and for the purpose of establishing a long-term schedule J-PARC, KEK,JAEA and MEXT should agree on a "base" operations goal and a "stretch" operations goal.

FUNDAMENTAL PHYSICS WITH MUONS and KAON BEAMS

J-PARC has an ambitious program of measurements aimed at looking for physics beyond the standard model via low-energy precision measurements. This work is being carried out in close collaboration with the IPNS at KEK and with collaborators from around the world. The experiments being carried out and the new ones being developed hold the promise to push Standard Model predictions to unprecedented levels of sensitivity. Below are brief descriptions of the major efforts now underway.

A search for the CP violating decay $K_L \rightarrow \pi^0 \nu\nu$ is currently underway by the KOTO collaboration. The experiment has taken preliminary data and is working on the analysis of it. Understanding the sources of background and reducing them will be key to improving the present upper limit on the branching ratio. The team carrying out this work has had previous experience in this area with a similar measurement at KEK. The data now available should provide new insight into background sources and allow the collaboration to develop analysis tools to reduce them. The IAC encourages the group to vigorously pursue this experiment. In addition to the importance of background reduction for the present experiment, understanding the sources of background will be very important for developing a plan for the future Hadron Hall extension.

A new experiment to test lepton universality in K^+ decay, E36, is being setup with apparatus from KEK. The experiment will measure the decay branching ratio from stopped K+'s into e+ν and μ+ν, which will

provide a different set of systematics to understand if ge=gv than previous measurements done via in-flight decay at CERN. The experiment has a tight schedule since it must be removed in the late fall of 2015 to make way for staging the COMET apparatus. Obtaining some data with this setup prior to the installation of COMET could provide valuable information for a follow up experiment in the Hadron Hall extension.

The COMET collaboration is moving forward with a staged experiment to measure μ-e conversion as a test of lepton number violation. The experiment will require a very high flux of muons to be successful. The estimate is that it will need about 1 year of operation at around 56 KW beam power at 8 GeV proton energy to get sufficient statistics to reach its planned sensitivity goal in the final stage. This experiment is another one that relies on superb background rejection to find the signal of interest.

Recommendation #7
The IAC strongly encourages the COMET collaboration to work with J-PARC to find the resources needed to move this high visibility experiment forward.

A very different approach to search for μ-e conversion has been proposed for the H-line muon beam in the MLF. The DeeMe experiment does not have the ultimate sensitivity to be competitive with COMET but it can proceed on much faster time scale. There are three possible outcomes from DeeMe: (1) an upper limit is obtained for the BR; (2) a signal is observed that ultimately is found to disappear; (3) a real signal is observed. In all cases the COMET experiment remains highly motivated, particularly if a signal is observed that could be verified and studied with different stopping targets in COMET. This experiment is close to carrying out an initial engineering run.

Recommendation #8
The IAC encourages the DeeMe collaboration to move forward with initial engineering runs and then make a more careful evaluation of the validity of the experimental approach.

An experiment using muon beams is in the R&D phase for measurement of g-2 and a search for a muon Electric Dipole Moment. This experiment needs a high intensity ultra-cold muon beam. A novel approach to producing such a beam is now being developed through an R&D effort. This very different approach being developed for these measurements at J-PARC will provide an important check on the next generation g-2 experiment that is presently being setup at Fermilab.

Recommendation #9
The IAC encourages continued R&D toward the development of a high- intensity ultra-cold muon source.

HADRON HALL

The physics program with slow extracted beam in the Hadron Experimental Facility addresses exciting forefronts of particle and nuclear physics, from decisive searches for extensions of the Standard Model of interactions to the origin of the nucleon-nucleon force in quantum chromodynamics, and the properties of the dense matter found in neutron stars. The IAC was pleased to learn that the renovation of the hadron hall was essentially complete and that operations with slow extracted beam are anticipated to start by the end of the present fiscal year. The efforts of the J-PARC staff to complete these renovations are applauded. They have addressed migration of future incidents of the type that led to the melting and radiation dispersal of the production target in a comprehensive, in-depth fashion. These steps include: 1) reduction of the specific heat disposition of the production target by increasing

the transverse beam size; 2) duplicate target assemblies with improved instrumentation that can be easily interchanged if abnormal conditions are detected; 3) more robust target containment assembly; 4) an improved air confinement system on the primary beamline; 5) improved ventilation, filtering, storage and monitoring systems for target releases; 6) improved communication to all personnel on the status of safety systems within the hall; 7) definition and communication of clear roles and responsibilities in standard and incidents of non-standard conditions; 8) training of staff to deal with incidents in well-planned procedures emphasizing transparency and communication.

In past reports, the IAC had noted that an essential element in re-establishing an effective research program with slow extracted beams after the unfortunate delays of the 2011 earthquake and the 2013 radiation accident was: "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." In particular, the delays compared to expectations in achieving considerably higher power slow extracted beams, the construction of the new beamline for COMET and the high momentum line and the unique low-beam energy operating conditions of COMET place definite constraints on the program. As requested the IAC was presented with a plan that, while perhaps optimistic, can represent the basis for operations over the next several years. For the future, this requires the evolution of beam power, first to 50 kW and in the longer term to 100 kW, continuous attention to improving the duty factor of the primary beam above the current 50%, and sustained funding for operations of the slow extracted beam program for at least 3 months per year. In the longer term, the extension of the hadron hall is needed to provide a major increase in capability for this science program.

HADRON PHYSICS PROGRAM

Even with the difficulties, science results are emerging. One of the most significant is that in preparing techniques for dedicated J-PARC searches for Cascade-hypernuclei, previous KEK data revealed the first observation of a bound Cascade-^{14}N state. First results on a d(π^+,K^+) to search for structure in the K^-pp system were also published.

The experiments that are expected to receive beam in the next few years are:

1) Precision studies of hypernuclear spectroscopy by using gamma-ray detection to elucidate features of the Lambda-nucleon interaction.
2) High statistics searches for double-Lambda hypernuclei to get a first glimpse of the Lambda-Lambda interaction.
3) Definitive information on Cascade-atoms and Cascade-hypernuclei to study the Cascade-nucleon interaction.
4) Further study of the K- NN system to understand the K^- nucleon interaction and to confirm the existence of a K^-NN bound state.

Each of these will contribute to our understanding of dense matter in neutron stars, where strangeness degrees of freedom are expected by many theorists to play a decisive role in the equation of state of dense baryonic matter. The results will be directly compared to lattice quantum chromodynamic calculations of the baryon-baryon interactions as well as to other models.

The construction of the new high momentum beamline in the Hadron Experimental Facility has started. This will make possible in 2017 an experiment to measure the in-medium mass spectra of vector mesons, especially the narrow phi meson, in nuclei. Proton-induced reactions have been shown to be

particularly clean for these investigations because there is much less background from rho- and omega-meson production.

Recommendation #10
The IAC considers that work on higher duty factor should be the highest priority for slow extraction users.

MATERIAL AND LIFE SCIENCES FACILITY (MLF)

The IAC noted the impressive progress at the MLF with 18 state-of-the-art neutron Instruments available and 3 in commissioning / construction, complemented by an operational MuSR D line while the U, S & H lines are being developed

Very interesting science is being delivered – covering a range of topics supported by excellent in-house expertise. As requested in the previous IAC report (April 2014), journal publications and conference presentations statistics are being gathered and allow for a comparison with other competing facilities. At this stage of operation, the MLF compares very favorably with its peer institutions worldwide. The remaining challenge is to develop a more diverse user community.
The IAC recognised Dr M Arai's excellent leadership of the Material and Life Science Facility and wished him every success in his future endeavours.

Recommendation #11
It is now very important to communicate the world leading potential of the MLF facilities to academic, industrial and political audiences and engage the public with the scientific and societal impact through

- **Structured interactions with academia**
- **Targeted communications in the media**

From a MLF perspective, the Accelerator, Target and Instruments all meet expectation –but the Facility needs to run! See Recommendation #4

Neutron Scattering Facility

The IAC was asked to comment on the suitability of moving the MLF from a Class 2 to Class 1 environment. This change would allow experimenters to consider the use of powder sample, radioactive species etc. which are not allowed at present under the Class 2 classification. The price to pay would be more stringent access requirements and much higher levels of scrutiny for casual users. The IAC considers that changing the overall classification of the MLF hall to a Class 1 facility would create such a deterrent for the external user community to access neutron and muon beams that it would negate any potential benefits. A case by case assessment and local containment measures to confine certain areas as needed would be preferable and should be investigated first.

Recommendation #12
The IAC recommends that great care be taken in assessing the cost benefits of changing the classification of the MLF hall from Class 2 to Class 1 environment and that a staged approach be considered rather than a blanket change.

MUSE

The IAC agrees with the MAC recommendation that optimizing the experimental stations is considered to be of high priority to generate competitive muon science at this stage while continuing the development of MUSE in particular for the U-line which has been a priority of the MUSE facility., Operation of the S1-line within the next FY will be crucial for enhancing the scientific output of MUSE and to help satisfy some of the user demand for muon beam time. Scientific production by MUSE continues to be adversely affected by limited beam time. However, despite the reduced operation due to safety related issues, a good level of scientific productivity has been maintained, with some notable high-profile publications in 2014 (e.g. Nature Physics, PRL, and Scientific Reports). Also an impressive number of muon-based press releases is acknowledged.

J-PARC has started to attract foreign users from Asian countries. Regarding possible measures to enhance scientific production, we suggest to further develop an environment that is attractive for international users, which are accustomed to other procedures. This includes a more flexible proposal and beam time allocation system, for instance as far as continuation proposals or compensation beam time are concerned.

Recommendation #13
The IAC 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.

NUCLEAR TRANSMUTATION

Dr. Hideki NAMBA (JAEA) reminded us in his presentation of two important recent developments related to ADS:
After the Fukushima Daiichi Nuclear Power Station (NPS1) accident, the importance of nuclear energy in Japan is drastically changed. A new "**Strategic Energy Plan**" has been published by the government in April, 2014, stating that:

- Nuclear energy is one of the important base-load power sources.
- Development of technologies for decreasing the radiation dose remaining in radioactive waste over a long period of time and enhancing the safety of processing and disposal of radioactive waste, including **nuclear transmutation technology using fast reactors and accelerators**, will be promoted by utilizing global networks for cooperation.

Dr. F. Maekawa presented the status of the R&D efforts towards defining the specifications of the two test facilities promoted for construction of Transmutation research at J-PARC. The first meeting of the international TEF Technical Advisory Committee (T-TAC) was held to review the TEF-T and TEF-P designs and safety approaches, and provided valuable input to the J-PARC team.
To get approval from the government for the construction of TEF facility, the TEF team should be put in a position to be ready for the TEF detailed design/construction from FY2016 on. This requires reinforcing the design team and building up a credible construction team as a J-PARC priority.
J-PARC **TEF-T** project in particular is attracting much attention from the world (ADS and Fusion communities for material testing). This is a good chance to show Japan's presence to the world in the

field of nuclear energy after the Fukushima accident and to reach the objective on internationalisation of High Level Waste Management through P&T and ADS
J-PARC TEF-P loaded with MA based Fuel should be carefully evaluated in terms of the safety assurance. The significance of the experiment should be evaluated and maximized within the assurance of the safety and cost.

Recommendation #14
As the ADS development is a long term objective, placing the TEF projects into a roadmap for ADS in Japan and internationally is recommended as part of a comprehensive development strategy.
The IAC recommends to continue the strong R&D effort needed to secure the TEF construction approval.

USER SUPPORT AND INTERNATIONALIZATION

Several major capital investments are being made to improve the user experience at J-PARC. KEK has opened a new wing in the dormitory complex doubling the number of rooms available. In parallel JAEA is constructing a new user building near the MLF facility to be open in about two months, with offices, cafeteria and meeting rooms for the increasing user community. The IAC had a chance to tour this new impressive building and agrees it will provide a much needed user focal point.

The international office continues to program regular lectures and seminars for resident researchers across the disciplines as well as encouraging users to participate in activities sponsored by the local township.

INSTITUTIONAL SUPPORT BY KEK AND JAEA

Based upon the presentations of Dr. Y. Okada (KEK) and H. Namba (JAEA), the IAC fully appreciates that KEK and JAEA see J-PARC as one of their top facilities in future. Moreover, KEK and JAEA's organisations and competences are essential to the success of the J-PARC facilities. The IAC fully supports the goals set by KEK and JAEA for the next 5 years to achieve the initial design objectives and prepare the long term future of J-PARC.

IAC emphasizes the importance of fundamental research to maintain a sustainable innovation driven competitiveness of Japanese industry. It was pointed out that KEK is in the unique position to offer 4 powerful probes to the MLF users: photons, neutrons, muons, and positrons. This extraordinary asset should be exploited, for example by expanding the initiative of Yamada-san to glue the various communities through the establishment of common grand challenges.

IAC recommends KEK and JAEA to more aggressively communicate to the public the societal impacts of J-PARC. Possible examples are: investigation of damaged nuclear plants at Fukushima Daiichi using muon-detectors, successful experiments performed at J-PARC by industrial users, or addressing the societal worry about high level nuclear waste through innovative solutions.
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IAC is of the opinion that regaining trust from local community is of highest importance for J-PARC and its partner institutions. This requires commitment from the entire KEK and JAEA's organisation.

MEXT view of J-PARC

Dr. K.Okamura gave a very crisp view of the expectations of his ministry for the J-PARC project. This gave "marching orders" which the IAC fully agrees with:

- Be the one and only facility with the best research capabilities and performance
- Be a unique international platform for co-creation of new knowledge, value, and innovation
- Contribute to solutions to global issues such as green/life technologies and alternative energy
- Continue to make efforts to increase accountability and rebuild public trust after the incidents/accidents

The IAC would like to point out that the fourth item in the list is in fact a necessary condition for delivering the first three.

CONCLUSIONS

The IAC is pleased to see an excellent accelerator team performance which has now completed a major upgrade of the front end systems to deliver higher intensities and reach the design goal of 1MW on the MLF target. A demonstration pulse at that equivalent beam power was already delivered to the MLF. In parallel major scientific achievements have been published in high calibre journals demonstrating the unique capabilities of the laboratory. This is done in the context of placing safety at the top of the agenda and with considerable efforts expanded to address safety and quality control issues. The new safety organisation is making a difference but there is still more to be done before safety will become entrenched as the top priority at all levels of the organisation, including users and contractual workers.

The IAC would like to congratulate Director Y. Ikeda for his leadership and dedication during his term of office and is wishing him well in his retirement. J-PARC has been well served by its leaders and is becoming recognized around the world for its scientific achievements even in this initial period as it ramps up to design performance. This bodes well for the future and upcoming Director N. Saito will inherit a good platform on which to continue building excellence.

The IAC is confident that J-PARC can meet the expectations as expressed by MEXT and that it will contribute in a significant way to further enhancing the scientific culture of the city of Tokaimura, of the Ibaraki prefecture and to the Japanese society as a whole.

Appendix I

Agenda for the International Advisory Committee Meeting of J-PARC in 2015			
Date:	February 16 (Mon) and 17 (Tue), 2015		
Place:	IQBRC		final
February 16 (Mon)			
Executive Session (closed)			
8:45 – 9:00	(10 + 5)	Charge to the Committee	Yujiro IKEDA
Opening			
9:00 – 9:40	(30 + 10)	Report from the Director	Yujiro IKEDA
9:40 – 10:10	(20 + 10)	Safety at J-PARC	Mamoru BABA
10:10 – 10:25	(15)	Coffee	
Accelerator			
10:25 – 11:05	(30 + 10)	Progress and Prospects (including A-TAC report)	Tadashi KOSEKI
Material and Life Science I			
11:05 – 11:35	(20 + 10)	Overview of MLF Division	Masatoshi ARAI
11:35 – 12:05	(20 + 10)	Overview of MLF Division (users' view)	Eiko TORIKAI
12:05 – 13:05	(60)	Lunch	
Material and Life Science II			
13:05 – 13:45	(30 + 10)	Neutron Science at MLF	Hideki SETO
13:45 – 14:15	(20 + 10)	Muon Science at MLF	Ryosuke KADONO
Particle and Nuclear Physics I			
14:15 – 14:40	(20 + 5)	Neutrino Physics	Tsuyoshi NAKAYA
14:40 – 15:05	(20 + 5)	Hadron Hall Renovation	Takeshi KOMATSUBARA
15:05 – 15:20	(15)	Coffee	
Particle and Nuclear Physics II			
15:20 – 15:45	(20 + 5)	Hadron Physics	Kyoichiro OZAWA
15:45 – 16:10	(20 + 5)	Kaon and Muon Particle Physics	Tadashi NOMURA
16:10 – 16:35	(20 + 5)	IPNS's view	Junji HABA
Executive Session (closed)			
16:35 – 17:50	(75)	Review and Discussion	IAC Members
Views from Funding Agency and Host Institutes			
17:50 – 18:10	(15 + 5)	J-PARC: A View from MEXT	Keisuke OKAMURA
18:10 – 18:30	(15 + 5)	KEK and J-PARC	Yasuhiro OKADA
18:30 – 18:50	(15 + 5)	JAEA and J-PARC	Hideki NAMBA
Banquet			
19:00 – 21:00	(120)	Banquet	
February 17 (Tue)			
Accelerator Driven Transmutation Research			
9:00 – 9:40	(30 + 10)	ADS Project	Fujio MAEKAWA
Executive Session (closed)			
9:40 – 11:30	(110)	Review and Discussion, Drafting	IAC Members
Close out			
11:30 – 12:00	(30)	Recommendations	Jean-Michel POUTISSOU
12:00 – 13:45		Lunch	
14:00 – 16:50		Site Tour	

Appendix II

IAC Committee members for 2015

International Advisory Committee (IAC)

	Name	Affiliation	Position	Area
1	Jean-Michel Poutissou (chair)	TRIUMF	Associate Director & Nuclear Medicine Division Head emeritus	Muon
2	Hiroshi Amitsuka	Graduate School of Science, Hokkaido University	Professor	
3	Thomas Roser	Brookhaven National Laboratory	Chair of the Collider-Accelerator Department	ACC
4	Shinian Fu	Institute of High Energy Physics	Director, Accelerator Technology Division	
5	Sergio Bertolucci	the European Organization for Nuclear Research(CERN)	Director for Research and Scientific Computing	Particle
6	Robert Tschirhart	Fermi National Accelerator Laboratory	Deputy Head of the Particle Physics Division	
7	Robert Tribble	Brookhaven National Laboratory	Deputy Director for Science and Technology	Particle/ Nucl
8	Donald F. Geesaman	Argonne National Laboratory	Distinguished Argonne Fellow and Associate Director, Physics Division	Nucl
9	Horst Stoecker	GSI Helmholtzzentrum für Schwerionenforschung GmbH	Scientific Director	
10	Hajimu Yamana	Research Reactor Institute, Kyoto University	Professor	ADS
		Nuclear Damage Compensation and Decommissioning Facilitation Corporation	Vice President	
11	Hamid Aït Abderrahim	SCK・CEN	Deputy Director-General	
12	Joël Mesot	Paul Scherrer Institute	Director	Neutron
13	Hidetoshi Fukuyama	Research Institute for Science & Technology, Tokyo University of Science	Director	
14	Robert Robinson	Bragg Institute, Australian Nuclear Science and Technology Organisation	Head	
15	Andrew Dawson Taylor	National Laboratories, Science and Technology Facilities Council	Executive Director	

Appendix III

Charges to IAC2015 from J-PARC

Yujiro Ikeda

While the restoration of Hadron facility has been delayed by almost a half of year from expectation a year ago, progresses toward 1MW were successfully made in accelerator and MLF in FY2014.

We are still facing on high constraints of J-PARC recovery of trust in terms of safety from societies, user community, resident, government, authority, etc.

As it is under examination, we strongly feel that we do need to response to the trust, and then, we believe that J-PARC will be a strong and unique user facility in the world.

In those view above, we would appreciate the IAC to provide advises and recommendations on the following points:

- Safety aspect as the multi-purpose user facility
    - Beam sharing and independence
- Management performance for J-PARC from a program keeping point of view; mainly on budget
- Power-up scheme and schedule for RCS and MR, which should be recommended by ATAC
- Science production
- Preparation for ADS project
- Future science direction and priority

We are assuming that there has no particular change in the long-range program plan. However, I would appreciate IAC to give us advise in the situation.

Public relation and outreach activities