THE INTERNATIONAL ADVISORY COMMITTEE

ON THE J-PARC PROJECT

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EXECUTIVE SUMMARY

The International Advisory Committee (IAC) for the J-PARC joint project of the Japanese Atomic Energy Agency (JAEA) and the High Energy Accelerator Research Organisation (KEK) met between 5 and 6 March 2007 at JAEA, Tokai and toured the construction site of J-PARC.

The IAC had reports from the Accelerator Technical Advisory Committee (A-TAC), which met the previous week at Tokai and the Neutron Technical Advisory Committee (N-TAC), which met at Tokai 20 to 22 November 2006. The present report is also informed by reports from the Muon Science Experimental Facilities Advisory Committee (MUSAC) meeting at KEK 11-13 January 2007. The agenda of the IAC meeting is attached as Appendix I and the membership at Appendix II.

The J-PARC Project has reached an important point in its development. The efforts of KEK and JAEA to provide strong funding in 2006-2007 has boosted morale and brought successful progress in the construction. We note that the LINAC reached full energy on time (24 January 2007). The 2006-2007 budget provisions and reports from construction divisions have restored confidence that the 3GeV accelerator would meet its first operational goal in 2008 and that six neutron and one muon instrument will be ready for first beam. The IAC expressly indicates that the performance reported, both from the point of view of achieving targets and inventiveness in meeting technical challenges is of very high quality.

Establishment of the J-PARC Center was a positive step forward in 2006 for the project. The IAC commends the KEK and JAEA for the devolution of responsibility that has occurred. Operational structures are developing and have the potential to meet the challenges of the fuller operational phase as beam is delivered in 2008 - provided adequate funding is allowed and program management steps are implemented. Using the metaphor of our 2006 report we state that the achievements of this "child" of KEK and JAEA is already something for the "parents" to be proud of - but their continued commitment to it and in the operational phase, is essential. We draw attention to matters related to these points below.

The IAC now strongly recommends that KEK and JAEA settle an operational budget and budget profile for J-PARC into the years 2008-2012. The current high morale and the many pressing technical developments that will arise with operation need this. At our request the Director has prepared an analysis of cost cutting measures in the operational budget - so that systematic improvement of the accelerator system and instruments can be done within the envelope of about 190 OYen per annum (estimated last year) at full operation after 2008. Early operations inevitably reveal the need for adaptation of an accelerator system- and this is particularly so with the reduced injector energy.

The IAC has analysed the cost benefit of an early introduction of energy recovery to 400 MeV in the LINAC. We conclude that design studies for this Phase 1 project (removed to allow acceleration of the neutrino project in 2004-2005) should be done at an early stage in the operational phase with implementation in 2011. We consider that this fits well with the scale up of the user program - as this program ramps up with the increased performance of the accelerators during 2008-2011. The energy recovery will deliver the necessary power to the neutrino experiment and the neutron target for international pre-eminence from 2012.

With these parameters set, the IAC gave detailed consideration to models of how the J-PARC Center might develop to the benefit of Japanese and world science. We are convinced that the original concept of the Japanese Government - to bring together the cultures of KEK and JAEA in this major center was right. The benefit to Japan of this move is already obvious in the splendid cooperative work done for the conception and construction so far. Strong links to both "parents" must be preserved to fulfill the initial vision of a world center.

The correct operational budget and operating characteristics of a great center are now indispensable steps for the project. In the text below we illustrate some " growing pains" which must be remedied. We also note some centrifugal tendencies of the partners - faced with organisational changes and budgetary constraints of their own. Much is at stake and now is the time for active participation of KEK, JAEA and the Japanese Government to make key decisions so that coordination of the programs arriving at J-PARC and the expectations of the users national

and international will be met in a way that respects world's best practice. These matters are illustrated below.

One aspect of the operation is the model under which J-PARC will function. The IAC considered this in the light of the matters raised above. The two extreme models are either a fully user oriented center - basically a facility, run in the best way for the external users or a research center with a distinguished core of in house scientists. Judged by our experience, neither of these is ideal. A model between them where "in house" excellence, as tested by access to the facilities in competition with external users, has been proven elsewhere to be optimal. In this model "in house" staff have the dual responsibility of supporting the user program and developing an individual research program. This individual research program should be peer reviewed in the same manner as the external user program.

The IAC thanks the J-PARC Director, Professor Nagamiya, and the project team for the detailed information and discussion at the IAC meeting. The distribution of papers before the meeting allowed key policy points to be discussed early on. The IAC notes with approval the extent to which its recommendations for IAC 2006 have been taken up by the project team, the individual project leaders and the partner organisations.

In this report the principal recommendations have been numbered and brought to the Executive Summary. There are a number of important process recommendations – left un-numbered in the text.

Recommendations

Recommendation 1: The IAC recommends that KEK, JAEA and the Japanese Government come together to make key decisions on operational budget and organisation so that coordination of the programs arriving at J-PARC and the expectations of the users, national and international, will be met in a way that achieves world's best practice.

Recommendation 2: The IAC urges both KEK and JAEA management to consider mechanisms for transferring most operational responsibilities and associated financial and personnel resources to the J-PARC Center management as soon as possible.

Recommendation 3: The IAC again recommends that the 400 MeV LINAC capability be restored as the immediate priority following successful completion of the Phase I construction project and the transition to initial operations. This should not be achieved at the expense of initiating the fullest possible user program.

Recommendation 4: The IAC recommends that a commissioning team leader be identified with responsibility and authority for coordinating the commissioning of the entire J-PARC complex, including the transition to operations. An integrated commissioning plan should be developed containing the roadmap towards Phase I design goals and defining technical, schedule, cost, and personnel requirements. The integrated commissioning plan should be discussed with, and made available to, the user community. The published plan should include estimates of performance, anticipated reliabilities, and the time allocation between users and accelerator physics.

Recommendation 5: The IAC recommends a model for operation where "in house" scientific staff have the dual responsibility of supporting the user program and developing an individual research program. In addition, some staff - scientists, engineers and technicians will be needed to maintain and develop the facility

Recommendation 6: The IAC urges the J-PARC Center to develop plans for the strategic population of the Neutron and Muon Instrument Suite, creating, as early as possible, a balanced portfolio to satisfy the large and dynamic Materials and Life Science Community in Japan.

Subsidiary Recommendations

Recommendation 7: The IAC agrees with the recommendations of ATAC that a reassessment of operating scenarios be aligned with a performance goal of 450 kW in the main ring based on the Phase I configuration.

Recommendation 8: The IAC agrees with the recommendation of ATAC that an improvement plan for the RCS collimation system be prepared to provide sufficient margin to cope with realistic operations scenarios.

Recommendation 9: The IAC urges that the plan for involvement and engagement of KEK staff in accelerator operations, improvement and upgrades be formulated already at this stage.

Recommendation 10: We recommend, that the construction of the "Dai Omega" channel receive the highest priority of the phase II muon projects. We recommend that the accelerator team continue to work on reducing the 3GeV proton beam pulse width to 100 ns or less.

GENERAL STATUS OF THE PROJECT

From the presentations and the tour of the accelerators the Committee has formed a clear impression that J-PARC will become a world center of excellence in the broad area of science set out in the original goals by the partners JAEA and KEK. The right continuing support from the Japanese government and the combined expertise of JAEA and KEK will produce this and demonstrate the soundness of the Japanese Government's concept for this joint program. The present success has been achieved by good management, the formation of the J-PARC Center and, particularly, by the devotion and hard work of the teams at J-PARC. The very great attention to detail needed to achieve such a broad result is commended. Of course, there are many things still to be done, problems to be solved and preparations to be made as full operation is reached in 2008. The fact that the project approaches this target date with confidence is a major signal of merit.

The present report reinforces some of the policy and action points of our previous reports and is coherent with them. Detailed proposals from the J-PARC Center have been considered and are responded to here. Advice is offered on strategies for the optimum operation of the facilities to meet the strong expectations of J-PARC growing in the user community.

J-PARC CENTER ORGANISATION

The J-PARC Center is now a key feature for ensuring the timeliness and quality of all aspects of the project. Its establishment to manage a world-class accelerator complex, as it enters its exploitation phase, is succeeding. A structure has been agreed by the two funding partners, KEK and JAEA, which should provide a managerial environment to develop J-PARC to its full potential. The IAC congratulates KEK and JAEA management for their vision in establishing the bases for an effective organisation in the difficult context of shrinking budget and future uncertainties in their own overall programs. The vision of a strong international center at J-PARC with a scientific reach which will be enhanced beyond that provided by the sum of the two investments by KEK and JAEA through the new partnership is fully endorsed by the IAC which would like to offer the advice for the next steps.

Recommendation 1: The IAC recommends that KEK, JAEA and the Japanese Government come together to make key decisions on operational budget and organisation so that coordination of the

programs arriving at J-PARC and the expectations of the users, national and international, will be met in a way that achieves world's best practice.

Attainments 2006-2007

The achievement of 181MeV injection energy for the LINAC on the 24th of January 2007 was a milestone for the project. The team is to be commended on reaching this goal in a timely and elegant way. Inspection of the LINAC facility shows a spectacular example of Japanese science and technology. In the same way, the presentations and our visits to the RCS, the Materials and Life Science Neutron Scattering and Target Areas, the presentations on these areas as well as in the neutrino and nuclear physics area, the developments around the 50GeV ring and the Hadron Physics Center all look to be achieving the same spectacular quality. We particularly comment on the developments for the mercury target in the neutron production area. Enormous ingenuity has been applied in the design as well as the execution to its present state. Developments that will lead to improvements during the operation phase and attainment of the final 1MW operation are commended and must continue with careful input from the international N-TAC. Coordination with the only other development of this kind at the Oak Ridge National Laboratory, SNS, is also commended and is an illustration of the best relationship between major scientific centers.

Proposals From the J-PARC Center

In the course of the review, and from the documents presented to the Committee, a number of issues for advice were raised by the J-PARC Center.

One issue concerned the improvement of communication between the J-PARC Director and both JAEA and KEK. In this respect, the IAC welcomes Professor Nagamiya's appointment to the J-PARC Core in JAEA and as a member of the Board of KEK. Another issue was the devolution of authority to the Director to make third party contracts. This is another commendable step taken by the partners, as is the agreement about no beam time fees for academic use of the facility. This will be very important for drawing the best people and the best science to J-PARC both nationally and internationally.

International scientific communities expect that both sides, KEK and JAEA, will make every possible effort to realise J-PARC project to the full extent, which they officially declared to commit themselves. For example, KEK is

expected to make proper decisions in respect of the various projects they decided to commit to in J-PARC at the outset. In this respect, implementation of a solid administrative structure and associated functions, including right to make budgetary proposal and personnel hiring, of J-PARC Center is highly desirable with the help of KEK and JAEA.

At the level of the science program the IAC strongly supports the "single doorway" entry of proposals via J-PARC Center. The arrangements for peer-review of proposals are developing satisfactorily and we have advocated continued and strong connection to the user community who should be aware of developments in the facilitation structure J-PARC. These measures are very important in the management of user expectations.

Structure of J-PARC

In our 2006 report (Recommendation 6) we made a preliminary consideration of the way in which the J-PARC Center might operate with respect to its national and international communities. Further consideration of this point arose at the IAC. We obviously reject the model of a "closed" but excellent Center and the other extreme of a purely user-oriented facility with a minimal sized group of scientists, engineers and technicians ensuring facility development and expert operation of the various components. The favored model of the IAC lies between these two for young scientists joining the organisation. Their terms of employment should have the dual specification of service to external users and development of their individual scientific program. In this mode the scientific quality of J-PARC staff would itself be tested by their having to make proposals for their experiments through the program advisory committees' peer review process. It would of course be open to the "in house" people to make joint proposals externally.

The IAC heard very interesting suggestions about the J-PARC "User Office" to develop and facilitate the external user program. In this respect electronic communication to and from J-PARC (publicity, proposal review and user internet access) need to be highly professional. For users, their accommodation and ease of access to the J-PARC site will be important. The point was strongly made at the IAC meeting that one of the greatest benefits that can come to Japan from the J-PARC Center will be the inflow of new science and the scientific competition for access as proposals are peer reviewed and refined.

Structural Developments

As the capitalisation of Phase I projects is ending and the focus turns towards the operation of the accelerator complex, the time is right for a bold decision in transferring the operational responsibilities and associated financial and personnel resources to the J-PARC Center management. This would strengthen the position of the J-PARC center director allowing for an at-arms length relationship with the two parent institutions KEK and JAEA on operational matters while retaining a strong scientific oversight role. The IAC understands that this is a major decision that will require a qualitative change in the way both KEK and JAEA operate but feels that the long term benefit of such an arrangement will offer the best chance for the success of J-PARC as a joint project of the two institutions.

Matters to be Addressed As Full Operation Approaches

The IAC has been made aware of coordination gaps developing between areas of responsibility such as the different accelerator systems. Although such deficiencies are not unusual in projects of the scope of J-PARC, the resolution of them in the context of continued split operational responsibilities between KEK and JAEA makes for time consuming negotiations which affect the effectiveness of the decision making process.

As an example of such coordination gaps, the situation of the ambitious neutrino project. Establishing areas of responsibility amongst a large multinational partnership, which has grown to cover 65 institutions in 12 countries, has been exacerbated by a lack of focal point in J-PARC management regarding the infrastructure support to be provided by the host institutions.

In addition, not only will the J-PARC accelerator have to handle the most intense proton beams in the world safely but also, an interface with major equipment elsewhere will have to be managed in the operation phase as well as the construction phase, electronically and internationally. This electronic management will have to be very transparent and powerful and the quality equivalent to that at other major international centers such as CERN.

A third area of possible concern is in the management of the commissioning efforts for the accelerators - mentioned in the accelerator report, which relies on the partition of responsibilities in place during the construction phase. That effort would benefit from a unified organisation of the accelerator support groups.

Recommendation 2: The IAC urges both KEK and JAEA management to consider mechanisms for transferring most operational

responsibilities and associated financial and personnel resources to the J-PARC Center management as soon as possible.

The above points indicate a strong need at this time for technical and project coordination across the site. At the moment, the Director has not yet been able to appoint a technical coordinator in response to our Recommendation 3 of 2006 but has created the Director's group to manage this. The IAC accepts this measure provisionally, but from its own experience suggests that a site wide process headed by someone to whom the Director could delegate responsibility for ensuring that site-wide infrastructure developments could be addressed, be appointed.

ACCELERATOR STATUS

The Accelerator Technical Advisory Committee (ATAC) reviewed the status of the accelerator construction project over the period March 1-3, 2007. The ATAC delivered its report at the IAC meeting.

The construction project has made considerable progress over the prior year and is now nearing completion both in terms of civil construction and accelerator component fabrication. Major achievements over the last year include successful acceleration of beam in the LINAC to the full design energy of 181 MeV in January, 2007, and the development of a viable strategy for resolving issues with the RCS and MR rf systems which were the dominant challenge of a year ago. Congratulations are due to the J-PARC accelerator team on both of these significant accomplishments. RCS beam commissioning is scheduled to start in September of this year with MR beam commissioning following in May 2008. This schedule is unchanged from a year ago—an excellent achievement—and will lead to a startup of accelerator operations in support of the research program in the 3rd quarter of JFY2008.

Despite impressive progress in many areas the ATAC identified several areas of concern that the committee feels will require particular attention to bring the J-PARC accelerator project to successful completion:

- Main Ring performance
- RCS performance with the 181 MeV LINAC
- Performance of rf accelerating cavities for the RCS and 50 GeV MR during the operations phase

- Planning for the commissioning and the transition to operations

These items are discussed in detail in the ATAC report, and are simply summarised here.

Main Ring Performance

Good progress has been made on many fronts over the last year. Dipole, quadruple, and sextuple magnet installation are roughly 90% complete and very significant progress has been made on the rf structures problem identified last year. Activities are aimed at a May 2008 start of beam commissioning, consistent with last year's schedule.

Accelerator modeling has incorporated several improvements suggested by the committee a year ago. However, the modeling presented indicates that the loss budget for the MR (450 W on an individual collimator) cannot be met with a beam power above 150-200 kW. The committee regards this as a serious issue that must be overcome. The ATAC recommended a reassessment of operating scenarios aligned with a performance goal of 450 kW based on the Phase I configuration. Such a reassessment could include increasing the loss budget at 3 GeV, means for providing longer bunches, and/or possible reduction in the cycle time**.** In addition the ATAC recommended a reexamination of the decision to operate the neutrino program at 30, rather than 40, GeV.

The IAC agrees with the recommendations of ATAC that a reassessment of operating scenarios be aligned with a performance goalof 450kW in the main ring based on Phase I configuration.

As a second concern, serious problems have been identified in the extraction kicker including failure to meet both rise time and voltage requirements. Potential solutions have been identified but will take a while to confirm and implement. A strategy has been developed for operations through the summer of 2010 including: a MR operation with 6 bunches, rather than 8, and modification of the kicker magnet to increase the voltage capability. The ATAC notes that this mode of operation implies a 25% reduction in beam power. Development and installation of a kicker meeting the performance specification is a high priority item.

In consideration of the above situation the ATAC concurs with prior years' assessments relative to MR performance with a 181 MeV LINAC, namely: 0.45 MW should be achievable in this mode contingent on resolution of the loss management and kicker issues described above. The committee remains

convinced that a necessary component of any path to 750 kW in the MR includes a 400 MeV LINAC.

RCS Performance With the 181 MeV LINAC

Excellent progress has been achieved on many fronts over the last year. Very significant progress has been made on the rf structures problem identified last year. Installation is well advanced and hardware commissioning has begun. These activities are heading towards a September 2007 commissioning period, consistent with the schedule established a year ago. While there is little float associated with this milestone, the committee regards the September beam-commissioning goal as achievable. Accelerator modeling has incorporated several improvements suggested by the committee a year ago. The modeling demonstrates, and the committee continues to believe, that the full potential of the RCS will not be realised until the injection energy is raised to 400 MeV.

The ATAC believes the collimators still represent a major performance risk. The collimation design requires that the 4 kW of loss power be distributed over the ten collimator jaws in a manner than none receive more than 400-700 W of load. The simulation presented to the committee indicated that the individual jaw specification would be achieved with 20% margin at 0.6 MW of total beam power. The committee does not regard this margin as adequate.

The IAC agrees with the recommendation of ATAC that improvement plan for the RCS collimation system to provide sufficient margin to cope with realistic operations scenarios.

In addition, the simulations show that the 4 kW loss budget cannot be met with a delivered beam power beyond 300 kW, based on a 181 MeV injection energy. The simulations extrapolate satisfactorily to 1 MW of beam power with a 400 MeV injection energy.

In consideration of these issues, the ATAC concurred with prior years' assessments relative to RCS performance, namely: 0.33 MW beam power represents a lower limit on achievable performance in the RCS with a 181 MeV injection energy. A beam power between 0.4 and 0.6 MW remains plausible, but will require successful solutions to the collimator issues described above. The committee remains convinced that a necessary component of any path to 1 MW in the RCS includes a 400 MeV LINAC.

A decision to forgo the restoration of the full 400 MeV LINAC beam energy would likely result in a factor of 1.5 to 2.9 reduction in integrated beam

power, and therefore scientific productivity, from both the RCS and the MR relative to the full capability of the facility over the long-run.

An important consequence of this would be a serious effect on the timeliness of the neutrino program as well as the early realisation of international attractiveness of the neutron and muon facilities. *Full realisation of the capabilities of the J-PARC facility cannot be achieved with the current 181 MeV LINAC energy.*

Recommendation 3: The IAC again recommends that the 400 MeV LINAC capability be restored as the immediate priority following successful completion of the Phase I construction project and the transition to initial operations. This should not be achieved at the expense of the fullest user program.

RF Cavities for the RCS and MR

Significant effort has been invested in the last year in overcoming the serious difficulties that had become evident in the accelerating structures for the RCS and MR. Great progress has been made on understanding the source of a variety of problems, developing a strategic approach that addresses short, long term, and, initial operations needs, and engineering innovative solutions. As a result cavity fabrication and testing is proceeding and four (of the 10 required) rf stations have been tested and are now installed in the RCS.

A very significant mobilisation of effort was undertaken over the last year to address the rf issues. Two new test stands were brought on line, one at KEK and one at JAEA, supporting extended testing of a wide variety of cavity configurations.

The initial RCS rf system is being fabricated from uncut cores, augmented by parallel inductors to provide the required cavity Q. Water cooling has been retained. Performance on the test stand has been good. All stations are subject to 300-hour high power testing before installation in the RCS.

The initial MR rf system is being fabricated from cut cores, with the gap subject to diamond polishing. This process eliminates the acid etch that was deemed the primary source of the problems. Two such accelerating cavities have been successfully subjected to more than 1000 hours of high power testing. Only five cavities are planned to be available for commissioning. Adequate resources remain to be allocated for modifying an existing

prototype, which would provide a sixth system, as recommended by the ATAC.

In acknowledgement that problems could occur over the long term an R&D team has been assembled and is investigating the possibility of developing a cavity using oil as the cooling medium.

The ATAC believes the strategy being pursued is technically sound and is likely to support the needs of the J-PARC complex throughout commissioning and the first year or two of operations. However, long-term performance remains a risk. The ATAC recommended retaining the high power test stand at JAEA, augmented by the construction of one additional rf system of each type to support longer-term development.

Commissioning and Initial Operations Planning

The ATAC found fairly detailed plans covering the period of final installation and commissioning of the RCS and MR. These were considered to be well thought out and sufficiently detailed. However, the committee did not see the level of integration across machine boundaries, the identification of required resources, and the specification of required high-level applications that they would have expected. In addition the RCS plan did not extend beyond the start of MR beam commissioning, while the MR plan extended through first year of operations. The ATAC believes that successful integration of the commissioning activity and the transition to operations can only be accomplished under the direction of a full time dedicated leader with the responsibility and authority for commissioning the accelerator complex.

In addition, we recognise that performance expectations, both in the near-term transition to operations as well as in the long run, remain to be communicated with the various user constituencies. Those expectations, which need to be clearly defined and communicated, include beam power, anticipated availability, user “production” hours, as well as beam quality measures as required. The ATAC offered a recommendation in this regard, and the IAC strongly concurs:

Recommendation 4: The IAC recommends that a commissioning team leader with responsibility and authority for coordinating the commissioning of the entire J-PARC complex, including the transition to operations. An integrated commissioning plan should be developed

containing the roadmap towards Phase I design goals and defining technical, schedule, cost, and personnel requirements. The integrated commissioning plan should be discussed with, and made available to, the user community. The published plan should include estimates of performance, anticipated reliabilities, and the time allocation between users and accelerator physics.

A concern at this stage of the project is the availability of critical spares; in particular, those “one-of-a-kind” components with very long lead-time. The IAC strongly endorses the ATAC recommendation with regards to performing a risk-based spares analysis and acquiring the critical spares.

The measurement of LINAC output beam quality parameters is essential to ensure that input design specifications for the RCS are achieved. We urge a concerted effort to measure and understand the critical beam quality measures at the next opportunity. The strength of the J-PARC accelerator team is evident in the progress to date. It is important to sustain that level of focus into the operating phase of the project.

Recommendation: The IAC urges that the plan for involvement and engagement of KEK staff in accelerator operations, improvement and upgrades be formulated already at this stage.

A number of interface issues exist between the accelerator and the experimental facilities. The IAC encourages continued dialogue through the commissioning team leader to manage those interfaces. The IAC feels that it would be appropriate for the ATAC to consider those interfaces, in particular between the accelerator and neutron production target. In addition the IAC asks how is J-PARC receiving independent advice on the delivery of beam from the accelerator system to the experimental facilities (the MLS target and the neutrino experiment)? These beam lines will be among the highest beam power transport systems worldwide and independent advice is necessary.

Expectation Management

In the section on the user office we mentioned an important role of expectation management. This point was also raised by N-TAC. There is a need to manage what the users are expecting from the accelerator as it ramps up in power against what can actually be delivered at a particular time. As illustrated above, the whole accelerator system is a complex entity whose

optimum parameters for delivery of expectations are interdependent. Optimum parameters will be achieved when energy recovery of the LINAC has been done and compromises made for lower energy injection eliminated. This is most important in the delivery of the highest power for the neutrino target (below) but also in bringing the materials and life science facility to the top position in the world from the points of view of the power delivered to the target, the number of instruments available and the interfacing of those instruments to the national and world user community.

HADRON AND NEUTRINO EXPERIMENTS

We first address the two nuclear and high-energy thrusts we heard described and then address an organisational issue that will be important to all users of J-PARC.
As initial hadron experiments J-PARC has chosen appropriately a number of experiments involving hypernuclei. The proponents of these experiments are researchers who have led similar experiments at facilities with less capability in flux and instrumentation at KEK and the AGS and so are primed to do these experiments efficiently and effectively. They will be able to use some components developed for earlier experiments and are developing better ones. The cost and size of the experiments are modest and are thus also appropriate for an initial program. While the experimental hall looks to be in an early stage of development, the hadron program appears to be on schedule and once beam is available should be able to come on line quickly.

The T2K experiment to send neutrinos to Kamiokande is an exciting one but also one that is of a very different size and complexity to the experiments described for the hadron program. As such, it has different requirements. The experiment has a multitude of funding sources and many collaborators from different countries. Thus, it requires a much more formal management structure to assure that it is built on time and within budget. While significant progress is being made on a number of subsystems we caution that the current management structure appears to be too informal and suggest a project director be appointed to manage the day-to-day construction phase of the project. This is a different coordination requirement to that in Recommendation 4.

Since an experiment of a similar nature (K2K) was performed at KEK it would also seem to be appropriate to draw more on the expertise involved in

that experiment to aid in building T2K in as efficient and cost-effective way as possible. There is another caution that the experimenters need to be aware of: their expectation of a 5-year experiment at a beam power of 750kW may turn into a significantly longer time because with the current LINAC the maximum beam power is expected to be 450kW. It is important that the LINAC energy is increased to 400 MeV, but it is also important that the proposers and J-PARC Directors communicate regularly about expectations.

There is currently a missing part of the J-PARC organisation that will impact T2K, but will also impact all types of users and experiments. Specifically, at a user facility like J-PARC it is crucial that there be a technical support organisation that helps experiments get up and running. Such organisations exist at all successful major user facilities in the world and as J-PARC will be a facility with outstanding capabilities it is vital to create such an organisation. This experiment support organisation provides local knowledge of how to get things done with resources that are either internal or external to the lab. It also helps provide a link between the experimenters and the accelerator operations.

COMPUTER NETWORKS AND REMOTE ACCESS

A layered approach to user access to computer networks at the Tokai campus is recommended. It will be an expectation that ***all visitors*** to the J-PARC campus are able to achieve seamless wireless access to facilitate interaction with their home institution via open access to the internet – both from within the J-PARC Center, Guest House and Support Laboratories. **J-PARC** users will require restricted and controlled access to J-PARC systems, in order to monitor experiments and access data. Some ***specific collaborators*** will require privileged access to J-PARC system in order to remotely control experimental systems and diagnostics.
As an example of the later category, the T2K collaboration has already identified the need for experts resident in partner institutes worldwide to have such access to systems associated with the neutrino target, neutrino detectors and beam transport. Such privileged access – with administrator authority over appropriate subsystems – is standard for international laboratories – but needs to be limited and demonstrated to be secure with respect to JAEA systems.

MATERIALS AND LIFE SCIENCES

Target System

The IAC was able to inspect the neutron target system and associated handling equipment as it was being assembled. The committee was seriously impressed by the quality of technical construction in the Materials and Life Science target station. The whole facility illustrates the care and ingenuity in design and construction of this essential element that was analysed in detail in the N-TAC Committee report from its November 2006 meeting. Development work for the minimisation of damage in the target as it accepts progressively greater power from the accelerator must continue to occur. The standard of realisation of remote handling systems is exceptional, and will surely pay dividends in easing potential operational difficulties in the years to come. The suggestions from the N-TAC are endorsed and the credit for the present progress reiterated.

Instruments

The committee congratulates J-PARC on progress and is impressed by both the quality and innovative nature of these plans. Good progress has also been made in developing advanced capabilities in techniques such as optics, novel detector systems and focusing and polarising devices: this activity must continue to be funded and expanded through international collaboration.

The suite of six instruments available when the beam power is first delivered to the target and the moderators supplying them with neutrons are "on track" for initial operation, a fact which reflects to the great credit of the instrument team. These new instruments will be at least as good as the best in the world. What is lacking are the funds for the next group of instruments and there are many very interesting proposals awaiting this. The contribution to the current success from the Ibaraki Prefecture is once again acknowledged as is the expertise coming from both JAEA and KEK scientists.

For the neutron scattering area the increase in intensity at J-PARC - possibly even in its first year of commissioning, will be nearly an order of magnitude higher than KENS - the former KEK facility. An increase in the number of instruments in the period 2008-2011 would surely be a very good investment from the point of view of scientific return before energy recovery in the LINAC is completed. The instrument portfolio after LINAC energy recovery would then be able to take advantage of both an increased scientific community as well as the new intensity available at the neutron target.

Standardisation of component systems and a strategic approach to the development of instrumentation in the Materials sand Life Sciences facility is recommended. Experience world-wide – on both synchrotron and neutron facilities - shows that a coherent approach under the control of the J-PARC Center to design, operation, scheduling and support is to be preferred, to maximise the impact of this key aspect of the facility.

J-PARC already has a core of highly skilled neutron scientists in their design team. In operational mode, this will need to be expanded by attracting specialists in a wide range of scientific disciplines – solid state physics, materials science, soft matter, biology and engineering science - as well as building up a team of technical support in detectors, data acquisition and analysis, cryogenic systems and other sample environments. A vibrant scientific atmosphere needs to be established in the J-PARC Center – to attract and retain such marketable staff and to make the user experience world-class. Cross fertilisation of ideas in this interdisciplinary atmosphere - between users and staff alike - will be a hallmark of success at J-PARC.

Recommendation 5: The IAC recommends a model for operation where "in house" scientific staff have the dual responsibility of supporting the user program and developing an individual research program. In addition, some staff - scientists, engineers and technicians will be needed to maintain and develop the facility

User Interface

The Materials and Life Science facility at J-PARC should be capable of providing for thousands of users each year when in full operation. These experiments are "small science" where the quality of the infrastructure related to experiments has a big impact on the complexity of experiments that can be attempted. As we expect J-PARC to be at the "cutting edge" of neutron science, the secondary infrastructure should also be world class.

In practical terms this means that many samples (particularly chemical and biological samples) may have to be prepared within easy reach of the instruments. Associated laboratory facilities as at the best international centers Institut Laue-Langevin, Grenoble, NIST USA, SNS USA, and the OPAL reactor Australia, must be of high standard and furnished, through the operating budget, with adequate materials and support instruments to make

sure that all samples are in the best condition before neutron experiments are performed. This should be the responsibility of the user office.

Related to this is the provision for external access and accommodation for large numbers of visitors (national and international) as well as the electronic access to data during measurement and standardised data processing programs maintained by the J-PARC Center. The matter of Recommendation 5 also bears upon this issue of the expectations of visiting users. Other major centers in neutron scattering have all of this available and it is especially useful for new users who often bring new types of problems, whose data can be treated - at least in the first instance - by the standard programs. This is another aspect of expectation management - a particularly important one - for ensuring change and renewal in the scientific program in neutron scattering.

***Recommendation 6*: The IAC urges the J-PARC Center to develop plans for the strategic population of the Neutron and Muon Instrument Suite, creating, as early as possible, a balanced portfolio to satisfy the large and dynamic Materials and Life Science Community in Japan.**

MLF Muon Facility

The construction of the Phase I MLF Muon Facility is nearing completion. It includes the muon target complex with four secondary beam ports and the 3-GeV proton channel from RCS extraction to JSNS (tunnels M1 and M2). For phase I, the existing superconducting decay channel of KEK will be moved to J-PARC and installed in one of the ports. It will produce a wide spectrum of μ^+ or μ^- with first beam expected in fall 2008. It could be supplemented initially by a surface muon facility provided by JAEA-ASRC or by a second extraction provided by Toyota Labs as a core project.

The other muon beam lines are scheduled to be built in phase II. They will comprise multipurpose surface muon beams suitable for a large suite of μSR experiments, and as an important new development, a high acceptance surface muon channel coupled to the **"Dai Omega"** beam line, which could be used for producing ultra-slow muons of highest intensity and luminosity applicable to studies of materials surface phenomena. This beam, based on a new special method of muonium laser ionisation was developed by Japanese physicists from KEK working at the RIKEN-RAL facility at ISIS and will open attractive and unexplored research fields.

We recommend, that the construction of the "Dai Omega" channel receive the highest priority of the phase II muon projects.

Concerning the time structure of the 3 GeV proton beam there is still a conflict between crucial needs of the muon experiments to obtain a pulse width below 100 ns and accelerator requirements of maximising intensity.
We recommend that the accelerator team continues to work on reducing the 3GeV proton beam pulse width to 100 ns or less.

NUCLEAR TRANSMUTATION

The feasibility of transmutation through neutron irradiation is well established from a scientific point of view; fast neutron spectra have a high potential for transmutation. Future nuclear reactors (Generation IV) using fast neutrons are expected to significantly reduce the amount of wastes by transmutation. Their commercial development is expected beyond 2040.

Japan has planned an outstanding R&D program on transmutation in the Monju sodium reactor and in J-PARC using a hybrid system using the J-PARC accelerator coupled to a subcritical reactor. R&D has a major role to play in clarifying the technical feasibility of transmutation and assessing the gain achieved with regard to the radiotoxic outcome. The IAC believes research on nuclear wastes management is of special importance for the development of nuclear energy since public perception of nuclear energy in many countries is that there is no satisfactory solution to the long term problem of nuclear wastes management.

The J-PARC nuclear transmutation programme was presented by H. Oigawa. The objective of the programme is to study in depth transmutation to reduce the radiotoxicity, volume and heat of high level nuclear waste that has to be put in a final repository. In its previous report, the IAC reaffirmed its full support to the J-PARC nuclear transmutation project and recommended that "J-PARC transmutation programme should be integrated in an international roadmap. The user community should be developed in Japan and in other countries in particular in Asia."

The IAC was most pleased that collaboration with SCK-CEN was concluded on November 23, 2006, on ADS design, material studies and Pb-Bi technology. H. Oigawa and his colleagues also collaborate on the MEGAPIE spallation target at PSI in Switzerland. Following the recommendations of the IAC they have joined the European project EUROTRANS, proposed by a large collaboration of research institutions together with industry partners.

The IAC believes that now the J-PARC group is well integrated as part of the efforts of the international ADS transmutation community. The IAC strongly recommends J-PARC to continue its efforts to network the ADS activities with international partners.

The proposed programme of the J-PARC TEF facility will benefit from these studies and will be in a unique position to provide important information on the potential of ADS for nuclear waste management and advanced materials. This programme should establish the ADS efficiency for transmutation. Information on possible high power operation feasibility of sub critical systems is still to be demonstrated.

The IAC committee believes that ADS research at J-PARC, will need increased support to realize the full potential of the facility. The J-PARC group should be in close contact with the other groups from JAEA to contribute to the next “JAEA 5-year plan”. This plan will be critical to find the resources needed to complete the accelerator and build the TEF facility.

APPENDIX I

Agenda for the 6th International Advisory Committee Meeting
J-PARC

Date: March 5 (Mon) and March 6 (Tue), 2007
Place: J-PARC Center – Tokai

March 5 (Mon)

8:50 - 9:10	Executive Session Committee + Nagamiya, Oyama, Yamazaki	
9:10 - 9:30	JAEA and J-PARC	K. Noda
9:30 - 9:50	KEK and J-PARC	F. Takasaki
9:50 – 10:10	-- Coffee Break –	
10:10 – 11:10	Status of J-PARC - J-PARC Center - User Policy	S. Nagamiya/Y. Oyama
11:10 – 12:30	Accelerators - Progress report - A-TAC report	 Y. Kamiya/Y. Yamazaki S. Holmes
12:30 – 13:30	-- Lunch –	
13:30 – 15:00	Nuclear and Particle Physics Experimental Facility	
(13:30-13:40)	- PAC report	J. Imazato
(13:40-14:20)	- Hadron Experiment	T. Nagae
(14:20-15:00)	- Neutrino Experiment	David L. Wark (T2K Co-Spokesperson, Imperial)
15:00 – 15:30	-- Coffee Break –	
15:30 – 17:00	Material and Life Science Experimental Facility	
(15:30-16:20)	- Progress report of Neutron Status, Neutron Source, Instruments, Organisation, Access Policy, LOI and N-TAC report (5min reserved)	Y. Ikeda
(16:20-16:45)	- Progress report of Muon	Y. Miyake
(16:45-16:55)	- MUSAC report	J.-M. Poutissou
17:00 – 17:30	Nuclear Transmutation	H. Oigawa
17:30 – 18:30	Closed Session	
18:30 -	Reception (Akogi-ga-ura Club)	

March 6 (Tue)

9:00 – 9:15	Network and Computing	S. Kawabata
9:15 – 9:30	Users Office	M. Ieiri
9:30 – 9:50	Future Plan LINAC recovery, Second phase	S. Nagamiya

10:00 – 11:30	Closed Session & Working
11:30 – 13:00	-- Lunch –
13:00 – 15:30	-- Site Tour --
15:30 – 16:30	Working Hour

APPENDIX II
Committee Members

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