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 Research Institute (JAERI) and the High Energy Accelerator Research Organisation (KEK) met on February 28 - March 1 2005 at KEK, Tsukuba and toured the construction site at Tokai.

The Accelerator Technical Advisory Committee (A-TAC) met in February 2005 just before the IAC. Its interim report, covering the whole accelerator system, was available to the IAC. The Neutron Technical Advisory Committee met in October 2004; reports from the Muon Science Experimental Facilities Advisory Committee (MUSAC), which met in February 2005, and the Nuclear and Particle Physics Advisory Committee were presented at the 28 February IAC. The agenda of the IAC meeting is attached as Appendix II and the membership at Appendix III.

The IAC thanks the Director, Professor Nagamiya, and the project team for the detailed information and discussion provided at the IAC meeting about these developments. The electronic distribution of papers before the meeting was of great help to the meeting and the Director and his colleagues are thanked for this further innovation. The IAC notes with approval the extent to which its recommendations for IAC 2004 have been taken up by the project team and the individual project leaders – as reflected in their presentations.

Great progress has been made with the construction of the buildings as well as parts of the accelerator and the associated target systems. The review of proposals and design processes for the instrument construction are well in hand. The IAC congratulates the project team and the Directors of KEK and JAERI on the work done. The committee's 2002 recommendation is being followed of, a "world class standard in the quality of the construction of the accelerators and the initial suite of supporting instruments even if the number of instruments or experiments has to be limited", is being implemented.

The importance of this project for Japan and the world has not changed – indeed what we have heard this time about progress on the civil engineering and accelerator construction has only enhanced our opinion of the value of the project. The excellence and dedication of the project team from both JAERI and KEK is evident. That these things have been achieved under very tight budgetary conditions is admirable.

A vital phase in the work –the shift of staff, installation and component testing to the Tokai site will begin in 2005. The importance of this phase cannot be overestimated – it and preparation for operation are the focus of the report of the IAC. The construction budget situation for JFY 2005 and JFY 2006 to maintain the momentum of the project, and organisational issues related to the proposed J-PARC Center, are of concern to the IAC and are the subject of IAC recommendations.

In addition it is now timely to think about the operational phase of the Major National Research Facility that J-PARC will become. The combined international experience of the IAC was brought to bear on possible operational structures to draw in the best national and international participants as users in the most effective way. The question of how to provide an operating budget commensurate with the quality of the infrastructure being created exercised the committee and some recommendations to this effect are offered.

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

SUMMARY OF RECOMMENDATIONS

Recommendation 1 The IAC strongly recommends that the governing policy makers for the J-PARC facility move rapidly to secure increased budgetary funding to support the legitimate and necessary incremental construction and operating funding required by J-PARC in JFY 2005 and JFY 2006. We particularly note that JFY 2006 shows a construction budget funding outlook with large and alarming projected shortfalls. We urge the policy makers to find ways to provide needed incremental funding for these next two critical years to avoid the damage such seriously under-funded budgets will incur.

Recommendation 2 The IAC recommends that the J-PARC partners take serious note of the IAC's suggestions on development of the J-PARC Center management structure.

Recommendation 3 The IAC recommends that J-PARC management complete and have externally reviewed in 2005, a comprehensive, bottoms-up analysis of the absolutely essential incremental budgetary amounts required to keep the J-PARC mission on-track for a timely and successful facility utilisation of its world class science programs.

Recommendation 4 The IAC recommends that the 400 MeV linac capability be restored by 2010. The lowered linac energy will limit the ability of the J-PARC program to achieve its full potential during the initial stages of operations.

Recommendation 5 ***The IAC endorses the recommendations of A-TAC with respect to improved intensity for the neutrino experiments in the early operations of J-PARC.***

Recommendation 6– ***The IAC recommends that J-PARC management establish a plan to deliver a day one portfolio of at least 10 neutron scattering instruments prior to initial operation in 2007.***

STATE OF THE J-PARC PROJECT

The presentations to the IAC and a site visit showed the progress made in 2004-2005 at the J-PARC site. The construction of buildings has proceeded apace and all appears to be of high quality. The commonly occurring problems with new buildings settling have been encountered in places and appropriate action will need to be taken in the installation of the accelerators to ensure flexible adjustment of the components until equilibrium has been attained. Major technical components of the neutron scattering, nuclear and particle physics programmes, such as the neutron target station, are being installed and design work on many other technical systems is at an advanced stage. Presentations to the committee by the scientists responsible for this work were clear and enthusiastic, showing the high morale of the team.

The J-PARC facility is realizing its potential, year by year in construction, to become the premier facility in the world for basic research in very important scientific and technology fields connected with the use of protons, neutrons, mesons, neutrinos, muons as well as in the field of nuclear waste transmutation. The J-PARC facility, when completed and operating its scientific program, will bring immense prestige to Japan and will do this in a manner that demonstrates a farseeing and thoughtful integration of many sciences and technologies in a well-conceived and mutually compatible J-PARC array of accelerators, beamlines and experiments that work harmoniously together for their common scientific and programmatic benefit. By its nature, the J-PARC will accomplish this compelling scientific and technical mission in a single operating facility with very significant synergistic and economic benefits.

The value of the J-PARC and its mission was well appreciated by the Japanese Council of Science and Technology Policy (CSTP) that, following its September-October 2004 Review of the J-PARC Project, awarded it the rating of "A = Very Good". The J-PARC International Advisory Committee (IAC), with its expert knowledge of comparable proton based facilities around the world, concurs in the CSTP assessment and urges that the project be kept on its world class and very successful programmatic trajectory as it completes the planned facilities and puts them into operation for science.

With this background, the IAC at its February-March 2005 Meeting was shocked and surprised to learn that far-reaching organizational changes now underway in the Japanese Government, will directly affect J-PARC sponsors, KEK and JAERI, and will result in budget projections for J-PARC in JFY 2005 and JFY 2006 that raise grave concerns for the project's health, especially in the second of these two fiscal years. In response to this new input, the IAC makes an important recommendation.

Recommendation 1 The IAC strongly recommends that the governing policy makers for the J-PARC facility move rapidly to secure increased budgetary funding to support the legitimate and necessary incremental construction and operating funding required by J-PARC in JFY 2005 and JFY 2006. We particularly note that JFY 2006 shows a construction budget funding outlook with large and alarming projected shortfalls. We urge the policy makers to find ways to provide needed incremental funding for these next two critical years to avoid the damage such seriously under-funded budgets will trigger.

The IAC maintains the priorities set in 2004 but also reiterates the comments of 2004 that, after giving first priority to the neutrino programme, attention be given in the construction budget context to ensure that "balance" and stability be provided among individual sector budgets, across the broad J-PARC program (IAC Recommendation 2 from 2004). We compliment the project for securing additional funds from external agencies towards this end (such as those from the Ibaraki Prefecture in 2005 to address this problem). The budget for JFY 2005 JFY 2006 must be adequate to allow instrument construction for the condensed matter and life sciences, transmutation science and technology, and hadron physics.

Equally consistent with our Recommendation 4 in 2004, is our continued view that recovery of the injection energy to 400MeV remains the IAC's highest priority for the post Phase I programme. This matter is further addressed in the Accelerator section below.

ORGANISATIONAL STRUCTURE OF THE J-PARC CENTER

The J-PARC construction is moving ahead very effectively and is well organized and structured for its mission of facilities design and construction. It is now time for thoughtful consideration of the structure that will manage the scientific program of the J-PARC for the maximum benefit of the scientific users and their experiments. We heard presentations and comments about the management concepts from Dr. Y. Totsuka, KEK director and from Dr. S. Nagamiya, J-PARC director. Dr. S. Tanaka, JAERI Vice President did not address this topic. The issues of how experiments would be proposed, considered and approved appeared in a number of the presentations on the progress of the various J-PARC facilities. The IAC did not hear complete unanimity on the expectations of the various presenters.

From the perception of the IAC, the issue of how the experiments in the various programs will be approved, and by whom, was not fully decided or agreed upon. The issue is somewhat complicated by the fact that the present J-PARC organization has as its mission, only the construction of J-PARC but not its operation. Conceptually, an entity called the "J-PARC Center" is used to refer to the operating entity. In his talk, Dr. Nagamiya showed an Organization chart, "Currently Agreed Organizational Structure", reflecting current agreement among

the organizations, J-PARC, KEK and JAERI. He noted that the Japanese Government Agency, MEXT, would have to approve the final organization plan. The director of the Center will report to the KEK director and the JAERI president. This part of the Center mirrors the J-PARC project structure. Under the Center director, are shown two Center vice-directors, one for KEK sponsored programs and one for JAERI sponsored programs. Below this level are the operating and programmatic units. All these are shown as reporting to the Center director.

It is also noted that there is an advisory entity called the "User Consultative Committee" that advises the managers of the Center. Although a number of the presenters of J-PARC facilities referred to a Programme Advisory Committee "PAC", it was not clear what form the PAC would take, how many PACs there would be and to whom the PACs reported their advice. It was also noted that there could arise issues of proton allocation among the programs ('proton economics'), as well as Center-wide administrative issues, that could pit programs against one another. Such issues come on top of the normal competition for approval of experiments within each discipline. All of these potential programmatic conflicts will benefit from a carefully formulated PAC structure that provides advice to the J-PARC director and helps insulate the director from divisive conflicts.

We did not hear a plan or policy for bringing all these issues under a specific organizational structure for the Center. Given the importance of deciding upon and implementing a structure for organizing and approving the scientific programs, as well as putting workable administrative and operational structures in place, the IAC suggests here some science program management principles that have worked successfully at other multi-program laboratories and centers around the world. We offer these as potentially helpful suggestions rather than as recommendations.

J-PARC Center - Science Program Management Observations

1. The IAC generally accords with and endorses the "Currently Agreed Organizational Structure" slide shown by S. Nagamiya in his Status Presentation.
2. The Center director should be (as shown) the decision-maker and responsible officer for all aspects of the Center operation and for the approval and execution of the J-PARC program.
3. The Center director is jointly appointed by the KEK director and the JAERI president; the Center director carries out the missions of the two agencies as they operate their joint venture at J-PARC to accomplish the J-PARC segments of their respective KEK and JAERI programmatic missions.
4. The Center vice-directors are expected to lead the scientific programs that realize the KEK and JAERI scientific missions. They will seek to stimulate and develop healthy and innovative proposals for the J-PARC program and will approve the experiments that can be supported in the J-PARC facilities under their purview. It may be wise for the Center director to apportion particular scientific and administrative responsibilities to the vice-directors from time to time.

5. A number of Program Advisory Committees (PACs) will be appointed by the Center director, with the concurrence of the cognizant vice-director; these program-specific PACs will review and advise Center management on the relative merits of the proposed experiments in each disciplinary group.
6. The Center director will appoint a Center Advisory Council (CAC) to advise on the balance of the overall program and to help resolve potential conflicts among the programs for resources. The chairs of the PACs will be ex-officio members of the CAC, and strong academic involvement at the highest level is suggested..
7. The Center director will, periodically, report to the KEK director and the JAERI president, the status and progress of the scientific programs of J-PARC.
8. The Center director will foster the creation of an active J-PARC Users Organization that will represent the interests and issues of the J-PARC User community; an elected Users Executive Committee (Users Consultative Committee?) will lead the users organization and act as a voice for the users with Center management.

Recommendation 2 The IAC recommends that the J-PARC partners take serious note of the IAC's suggestions on development of the J-PARC Center management structure.

User Services

The team at J-PARC has initiated some User support groups and thinking about ancillary facilities to attract and support multidisciplinary users. Some presentations on these developments were received and good examples of such services are the computing infrastructure and the web interface. The revamping of the J-PARC Web site will go a long way in making J-PARC information available to users in a timely and accurate manner. It will also represent a good outreach tool to showcase J-PARC to the general public. This effort is essential for efficient communication with the user community and will be more and more important as J-PARC enters the exploitation phase. The committee welcomes these developments:

Computing environment

The committee heard a very comprehensive description of the proposed organisational structures proposed for the J-PARC computing center. From a bottom up analysis of the diverse user's requirements at J-PARC, a unified environment respecting KEK and JAERI's own requirements was derived which would provide a seamless J-PARC computing support for users. A one-stop users administration database is proposed to simplify users access to the facility and to centralize all personal information with the ultimate objective of making all user interactions web-based and minimizing direct-contact requirements. An information storage system is proposed for all J-PARC experimental data, taking into account the different requirements of the various scientific groups as well as access to high performance computing resources for data analysis. These steps are envisaged at both the KEK and JAERI super computer centers.

A strategy for LAN and WAN has been adopted, providing reasonable access while preserving security requirements at KEK and JAERI. Manpower has been identified, both within KEK and JAERI computing groups, to support the development of the computing centers. Cost estimates and implementation strategies are being refined, but in any case will be demanding.

The IAC strongly endorses the effort of creating a computing group under Dr. Kawabata to provide user-friendly and effective computing support for all J-PARC users. The proposed organization is going a long way towards giving J-PARC its own recognized identity.

Recommendation: The committee recommends that the resources to develop the J-PARC computing center be identified.

Early Advice to users on the "ramp-up" phase.

As part of the management plan, the IAC suggests that potential users soon be informed about the projected lag-time in the build-up to full intensity that is the usual experience for large accelerator systems. We suggest the production of a "discussion paper", like that produced by the SNS (Oak Ridge) in 2002, anticipating day-one turn-on in 2006 ***("****Discussion Paper, February 6, 2002, Thom Mason/Norbert Holtkamp - The Spallation Neutron Source: Operational aspects and reliability in the transition from commissioning to fully committed User Operation* ***")***

OPERATIONAL BUDGET

To quantify its consideration of J-PARC operations after Phase I completion, the IAC reviewed international experience related to the operating budget needs of user-based accelerator centers like J-PARC. The IAC asked for preliminary estimates from Professor Nagamiya and these were provided. The type of analysis shown was correct – a "bottom-up" evaluation of scenarios for J-PARC use, together with continued maintenance and value-added technical upgrades to the facility. We note that for a successful baseline budget exercise to capture J-PARC operations costs, careful estimation of the required staffing levels across the entire J-PARC facility must be completed.

As an example of the kind of bottoms up evaluation that would be required to validate the proposed operating budget levels, the IAC would like to point out that maintenance, repairs and operational requirements will be driven by the harsh radiation environment that will be experienced at J-PARC. This environment will lead to major challenges in radiation dose management, a strong spare parts policy and the development of remote handling expertise. These factors will ultimately determine the overall availability of beam time. A strong internal technical support team should be trained to provide expert diagnostics and scope assessment for

preventative maintenance and repair activities before turning them over to external contractors. In this way both contingency maintenance cost and downtime periods, including scheduled shutdowns, can be minimized at J-PARC. This could have a major impact on the level of contracted maintenance costs.

Both construction and future operations budgets are at risk from the "far-reaching organizational changes, now underway in the Japanese Government, which will directly affect J-PARC sponsors, KEK and JAERI" (mentioned above in connection with the construction budget.) A most serious issue brought to the attention of the IAC is that a serious administrative problem in the new Japanese organizational structure makes it very difficult to create and sustain a suitable budget to support the operations of J-PARC. The IAC recognizes the vital importance of overcoming this hurdle in the Japanese administrative system and providing for adequately funded operations of the J-PARC in the years ahead. In view of these observations, the IAC makes an associated recommendation.

Recommendation 3 The IAC recommends that J-PARC management complete and have externally reviewed in 2005, a comprehensive, bottoms-up analysis of the absolutely essential incremental budgetary amounts required to keep the J-PARC mission on-track for a timely and successful facility utilization of its world class science programs.

In connection with the longer-term prospects for operating funds, the IAC has been informed of important policy developments, which should have positive effects on the operation and international attractiveness of Japanese Major National Facilities like J-PARC.

ACCELERATOR PROGRAM

Accelerator Status and Recommendations

The IAC received the report from the Accelerator Technical Advisory Committee (ATAC) describing excellent progress on the accelerator construction over the last year. We have accepted and endorsed this report. The J-PARC project is now well advanced, both in terms of civil construction and fabrication of accelerator components. The installation phase is about to begin and will be followed by commissioning shortly thereafter. Issues identified by the ATAC for special attention by management include:

- The budget and schedule to completion
- RCS and Main Ring performance goals
- Installation and commissioning planning, including the transition to operations

<u>Rapid Cycling Synchrotron (RCS) and Main Ring (MR) Performance Goals</u>

The J-PARC project was established with Phase 1 performance goals of 1 MW beam power at 3 GeV in the RCS and 0.75 MW at 40 GeV from the MR. The decision was taken more than a year ago to reduce the linac energy from 400 MeV to 181 MeV in Phase 1. This decision not to restore the 400MeV injection was made to provide funds for the priority decision to incorporate the neutrino beamline into Phase 1 of the project. It has been anticipated that the linac energy will be restored to 400 MeV over the period 2008-2010.

The reduction in linac energy has major implications for the performance of both the RCS and the MR. Mitigation of these effects and evaluation of likely performance in the presence of reduced linac energy was a major topic of discussion at the last two ATAC meetings. Newly established performance goals during the 181 MeV era are 0.6 MW in the RCS and 0.72 MW in the MR. Both of these goals involved modifications to the operating modes of the RCS and MR which, while plausible, were not supported by complete analyses. It was the judgement of the ATAC in its March 2004 meeting that while these goals should be retained, higher confidence level goals were 0.33 MW and 0.45 MW respectively. The ATAC reiterated this assessment at its February 2005 meeting. A number of technical issues relating to these performance extrapolations are contained within the ATAC report and will not be reported here. However, among the options available for restoration of full performance in the RCS and the MR the ATAC felt that the linac energy restoration was the most straightforward and encompassed the least performance risk.

Restoration of the 400 MeV linac energy was estimated at 85 O¥ in the March 2004 ATAC. The provision of funds and manpower for the restoration is of very high priority in the budgets currently under development.

Recommendation 4: The lowered linac energy will limit the ability of the J-PARC program to achieve its full potential during the initial stages of operations. The IAC recommends that the 400 MeV linac capability be restored by 2010.

In the discussion of this recommendation both by the A-TAC and the IAC the scientific priority attached to the neutrino experiments was kept in mind. This programme still has the highest scientific priority consistent with balance in the overall programme and to reaffirm this the IAC resolved:

Recommendation 5 We endorse the recommendations of A-TAC with respect to improved intensity for the neutrino experiments in the early operations of J-PARC.

Accelerator Installation and Commissioning Planning

With the move to the J-PARC site and the beginning of the installation of the accelerator a very important new phase begins. The coordination of the installation

activities, the actual installation of the components and their testing as well as the commissioning of the accelerator requires careful planning. During this phase and while making the transition from commissioning to operation it is of utmost importance that line management functions are clearly described and that roles and responsibilities are captured in a detailed organization chart down to the engineering and technical support level.

Recommendation The IAC recommends the J-PARC management develop and communicate an organization chart for each division that lists all personnel assigned and defines roles and responsibilities clearly.

Developing an integrated installation and especially commissioning plan for this period to come was suggested in the ATAC report. Commissioning steps and goals have to be written down and communicated across the project. In order to successfully finish the installation and commissioning in time, adequate resources, meaning sufficient and experienced, need to be dedicated by KEK and JAERI. During the commissioning period and also going into operation it is likely that components will fail. It is therefore important to have a spares plan and allocate sufficient funding to procure them now or within the time the production lines are up. Failure scenarios for components will help develop such a list and should be discussed for all accelerators and their components.

Recommendation: The IAC recommends that J-PARC management develop an integrated installation and commissioning plan and assign experienced resources. Assemble a list of spares that should be bought as soon as possible and have ATAC evaluate that list.

NUCLEAR AND PARTICLE PHYSICS

The IAC heard a comprehensive review of progress on all the nuclear and particle physics experimental fronts, including the high-priority effort to build the neutrino beamline for the T2K experiment. The goal is still to achieve first beam in the hadron area in 2008 and first neutrino beam operation in 2009. The 2009 goal for neutrino was stated to be required for J-PARC to remain competitive with potentially challenging neutrino projects elsewhere (the reactor-based and Fermilab Nova experiments to measure $\sin^2(2\theta_{13})$ were noted) but the 2009 date will require an improved funding profile as discussed below. There is impressive progress on all the nuclear and particle project fronts and the J-PARC team is clearly demonstrating enthusiasm, competence and commitment.

The hadron area presenter, Dr. K. Tanaka, described nearly complete facility and beamline designs, as well as advanced progress on the high-intensity target plus beam-dump R&D and facility design. He also noted that there was an intensive and successful effort to identify re-usable beamline magnets from laboratories around the world that could be acquired by J-PARC to defray the cost of the new J-PARC

beamlines. The project managers have had good success in the magnet initiative and Tanaka showed a section of proton beam transport that used only re-cycled magnets from other facilities, including KEK, Tristan and SLAC. The design portion of the Hadron Facility seems to be moving ahead more or less on-schedule. For the kaon beams, up to four charged and one neutral kaon beams were sketched out plus a test beam; all derived from a common target. No details were given to make this very interdependent multi-beam design credible but it may be possible to achieve and would then make very efficient use of the primary protons in the hadron area.

Dr. T. Kobayashi made the presentation of the neutrino beam project. In this case, there is a novel proton beam transport utilizing superconducting alternating gradient dipole magnets. This design, a first, was made necessary by the requirement that the primary proton beam be bent inward from the 50 GeV ring to fall on the neutrino target. This requirement demanded higher magnetic fields than are practical for normal conducting magnets. The technical design is complete for the magnets and the first full-size prototype will be completed in March 2005. The project manager hopes that full production of the SC magnets will begin in JFY 2006 in industry. The normal conducting magnets for focusing ad splitting off the primary beam are in production in JFY 2005 and scheduled for installation in JFY 2007 and JFY 2008. The many other technical systems, cryogenics, vacuum, beam monitors, controls, target systems, horn focusing system, He gas decay pipe and beam dump are all moving ahead systematically. Of all these systems, the IAC saw only the civil construction activity at Tokai, where the decay pipe is now installed in the huge civil excavation for the neutrino decay beamline. The neutrino beam construction site was an impressive demonstration of the scale that characterizes the neutrino beam efforts.

As part of his presentation, Dr. Kobayashi made an urgent and passionate plea to the IAC for support of a rescheduling plan for the neutrino beam construction, essentially interchanging construction of the 1st Utility Building with the Target Station (TS) underground enclosures and building. He quoted as support for this plea, the impending challenge from the Fermilab Nova Project, a project that has yet to be proposed to the Fermilab PAC, much less on a competitive schedule. The competition from the approved CHOOZ 2 reactor neutrino experiment or the contemplated ,shorter term Daya Bay reactor neutrino experiment may represent a more serious competition to the T2K effort. At any rate, from his presentation slides, the requested scheduling improvement would *advance* the T2K schedule by about one year, from JFY 2010 to JFY 2009. The IAC agrees that this *schedule* revision will benefit the neutrino program schedule without, as the IAC understands the argument, affecting any other elements of the J-PARC program).

The scope of anticipated experimental activity is very ambitious and there are cash flow and installation restrictions that may affect the start-up dates, even for neutrino beam operation to the existing Super Kamiokande Neutrino Detector. The funding issues were apparent to the review presenters but they were not able to identify

specific plans for addressing the funding issues in a satisfactory way. This issue will loom increasingly large in the next few years if not addressed in the near future

However, in view of the similar situation for the J-PARC project as a whole — in particular in view of the uncertainties in the 2006 construction budget mentioned above — it is not clear yet that these limitations will matter in the end. An even more serious concern is the timetable for achieving full proton beam power in Phase 1 of J-PARC. In the case of the nuclear and particle physics program, the hadron facility presenter, Dr. K. Tanaka, dramatically highlighted this problem with a slide showing that the 50 GeV beam power would be cut from 750 KW with the 400 MeV Linac to 270 KW with the 180 MeV Linac. An important rationale for creating the J-PARC in the first place was the availability of proton beam power substantially above that available anywhere else in the world. J-PARC will be under cutting its own rationale by not moving decisively to restore the 400 MeV Linac as soon as practically possible. This vital concern is linked to our recommendation to give high priority to the injector linac energy recovery that we view as the most important missing funding element of the J-PARC construction budget (also see recommendation 4 of the IAC 2004 Report).

The committee notes the encouraging progress in obtaining commitments from participating countries for T2K. Those can only be realized with the firm commitment of Japan to deliver beam to the T2K experiment, on-schedule, as promised.

CONDENSED MATTER AND LIFE SCIENCES

Neutron Scattering

A balanced science programme at J-PARC will have, as a major component, a strong condensed mater and life sciences activity. The prestige of this area will lie not in a few high profile experiments, but in a wide diversity of multidisciplinary research utilizing J-PARC's world-leading neutron and muon instrumentation. J-PARC will become a world of excellence attracting thousands of researchers – both domestic and international - each year, who will bring novel ideas and new scientific perspectives to the facility and beyond.

The committee was impressed by progress in the construction and planning for initial operation where realistic performance goals were being set and communicated to the user community. On-going R&D on the mercury target lifetime remains necessary for higher power operations and this should be pursued in an international context.

The committee was also impressed by the diverse and innovate nature of the proposed neutron instrumentation approved by a rigorous selection process now under the guidance of Prof Fuji. It remains a challenge for the project to translate

this potential into reality. Although two of the simpler concepts (which have industrial relevance) have been funded by the local prefecture, the greatest urgency remains to identify a funding plan for a comprehensive day one instrument portfolio. Time is running short for this to be realized.

There is a window of opportunity to install instruments in a relatively straightforward manner before activation of the target station by the first proton beam in 2007. After this date, instrument installation will become increasingly difficult and will be in competition, both for resources and for time, with scientific utilization.

Recommendation 6 The IAC recommends that J-PARC management establish a plan to deliver a day one portfolio of at least 10 neutron scattering instruments prior to initial operation in 2007.

Muon Science

The Muon facilities were reviewed by the Muon Science Advisory Committee (MuSAC) at its meeting of Feb 25 and 26Th 2005. A technical advisory panel (M-TAC) was set up and met in December 04 to review all technical issues in details with an expert panel prior to the MuSAC meeting. The muon team responded quickly to the numerous technical recommendations made by M-TAC. Operational requirements are now incorporated into the design, fabrication and installation plans for all beamline and target components. The committee noted the significant progress towards construction of the muon facility. A strong involvement on the J-PARC site in necessary as the civil construction is moving along rapidly and critical decisions must be taken. The beamline magnets and target vessel are being ordered.
At the MuSAC meeting, a number of core project ideas which could augment the muon facilities planned for phase I and phase II were presented. These would provide new resources for developing the Muon scientific program and create effective feedback for the design and construction of the Muon facilities. MuSAC reviewed the process which is proposed for evaluating proposed core projects prior to sending them for funding competition. MuSAC endorsed the proposed format and timeframe for an international call for Letters of Intent (to be submitted by Dec 05) and the proposed reviewing process by both MuSAC and J-PARC management. This will insure that only core projects in line with the facilities being considered in phase I and II of J-PARC will receive approval in principle and will be allowed to go for funding competitions. The proposed implementation of the core projects is in line with last year's recommendation from the IAC. It could lead to significant additional resources to the muon facility which would allow an early start of the scientific program with muons.

Recommendation - ***The IAC endorses the proposed plan for implementation of the core projects and for a first call in 2005 for Letters of Intent at the Muon facilities of J-PARC.***

Creating a user facility requires more than building the source. To turn what will be a technically excellent neutron and muon source into a dynamically creative scientific facility with the capability to stimulate innovation in the materials, nano- and biomedical sciences requires infrastructure and support facilities significantly beyond what is currently planned. Necessary infrastructure will include support laboratories for sample preparation and development, a research environment supporting both in-house and visiting scientists, sophisticated sample environment capabilities and appropriate complementary scientific equipment.

A comprehensive domestic infrastructure – guest house, hotel and recreational facilities at a world standard is also required. Only then will the technical potential of the facility be fully realized. Since J-PARC will have a significant impact on the local economy, it may well be appropriate to seek infrastructural funds from the prefecture.

Recommendation – ***That the Director develops an infrastructure plan and explores all potential funding sources.***

TRANSMUTATION/ADS

An excellent presentation was made showing that the transmutation experimental facility will provide a unique facility for performing neutronics analyses around a critical (for FBR transmutation)/subcritical assembly (TEF-P) and a test-bed for irradiation performance of an Accelerator Driven System (ADS) neutron source and potential structural materials (TEF-T). Such a facility will provide more capabilities than those found at PSI or LANSCE. Materials used in transmutation technologies are put under extreme conditions such as high neutron and high energy proton fluxes at temperatures from 300 to 800ºC. Because of these conditions, materials accumulate displacement doses at very fast rates and also high amounts of hydrogen and helium from spallation reactions within the materials. The TEF-T facility would allow for defining stress allowables for materials used in an ADS system as well as allow for the development of new improved materials that have increased resistance to materials degradation under these extreme conditions. Improved materials with significantly improved stress allowables are looked at as cost savings to industries which would eventually use these technologies in the future.

The international context of the transmutation/ADS component of J-PARC was analysed by three expert members of the IAC and this part of their report is given in Appendix I. The discussions at the committee and this report leads to the following conclusions:

The IAC reaffirms the importance and the priority of ADS technology development at J-PARC for the development of nuclear power and the management of high level nuclear waste. JPARC is the most advanced research facility designed for ADS. This is a great opportunity for seeking international collaborations.

Recommendations:

• ***That the project make a detailed comparison of the capabilities of the TEF-P to other ADS experiments such as RACE, Megapie, and MYRRHA.***
This is required to highlight the benefits obtained in fabricating the TEF-P facility.

• ***That the project create a working group/Technical Advisory Committee consisting of international members from US, France, Switzerland, China, and Industry representatives (Japanese utilities, Cogema, etc).***
This group will aid in design of the facility and design of experiments including the target details and fuel compositions.

• ***That because a review by the committee of AEC is required for starting the ADS facility, the project director and the JAERI management should push the AEC to initiate such a committee before the date that the interim review committee will be held for discussing linac recovery and phase II.***

APPENDIX I

Transmutation-ADS - Analysis by Frois, Maloy and Tanaka

Nuclear power is an essential source of energy in Japan. The present generation of reactors will need to be replaced in the next twenty years. Japan has recently signed an agreement on an important research program concerning sodium and gas fast reactors in the GENERATION IV forum. These reactors have the ambition of burning a significant amount of high level nuclear waste. Because of the introduction of reprocessing plants and new fuels, the amount of nuclear waste will be significantly decreased.

Accelerator driven systems present a complementary approach for the transmutation of a more complete spectrum of radioactive elements. Research programs exist in Europe, in the United States and in Russia. J-PARC is the most advanced program on accelerator driven systems since the abandonment of Carlo Rubbia's TRADE project in Italy.

There is a general consensus on the transmutation potential for various technologies. The results of the various studies indicate the following:

- Economics of energy recovery through transmutation favors thermal reactors.
- Efficiency in transmutation while making the greatest use of uranium resources favors fast reactors.
- Rapid transmutation with low cost per unit mass of transuranics transmuted favors accelerator-driven systems.

The optimal combinations of these technologies depend on country-specific considerations with respect to nuclear energy use and waste management strategies.

The European collaboration EUROTRANS on ADS now needs to reconsider its strategy to fill the gap left by the disappearance of TRADE. J-PARC should as soon as possible contact EUROTRANS to initiate a strong collaboration with Europe in this domain. EUROTRANS has been recently contacted by the USA and Russia, but J-PARC has much to offer to EUROTRANS. The IAC recommends to further the present discussions between EUROTRANS and J-PARC and propose a memo of understanding for foreign collaborations. A series of presentations of J-PARC in some of the major countries participating in EUROTRANS and a dedicated visit to the European Commission in Brussels would be extremely valuable.

France has an agreement with JAERI that should be used more efficiently now that TRADE has disappeared. CEA and CNRS have joined their efforts on ADS. The visit of a delegation of CNRS at KEK in April opens the opportunity to discuss various France-Japan collaborations. JPARC has an important potential for French ADS research.

Support to the nuclear industry is essential. The domain of materials and all the questions about radiation effects in materials subjected to high radiation doses would be interesting to discuss with the nuclear industry to build a strong research program supported by the Japanese industry.

APPENDIX II

Agenda for the 4th International Advisory Committee Meeting
J-PARC

Date: February 28 (Mon) and March 1 (Tue), 2005
Place: KEK

February 27 (Sun)

18:00 – 19:30	Informal Welcome Reception (place TBA)	

February 28 (Mon)

8:50 – 9:10	Executive Session (Committee + Nagamiya + Oyama) Change of comm. members, Points of advice, Agenda, etc.	
9:10 – 9:30	Welcome + KEK and J-PARC	Y. Totsuka
9:30 – 9:50	JAERI and J-PARC	T. Okazaki (or S. Tanaka)
9:50 – 10:10	Coffee Break	
10:10 – 11:10	General Progress of Construction, Budget, Schedule, Organization, Operational Budget, Activities by Committees, Actions for the last year's recommendation items, etc.	S. Nagamiya / Y. Oyama
11:10 – 12:10	Accelerator Progress, Status A-TAC report	H. Kamiya / Y. Yamazaki S. Holmes
12:10 – 12:30	Executive Session (Committee + Nagamiya? + Oyama) Review of the Morning Talks, Writing Tasks, etc.	
12:30 – 13:30	Lunch	
13:30 – 15:00	Materials and Life Experimental Facilities	
	One Year Progress (40)	Y. Ikeda
	NTAC Report (10)	Y. Ikeda
	Neutron Committee (10)	Y. Fujii
	One Year Progress for Muons (20)	Y. Miyake
	Muon Committee (10)	J. –M. Poutissou

15:00 – 15:30	Coffee Break	
15:30 – 17:00	Nuclear and Particle Physics Experimental Facilities	
	Hadron Experimental Area (40)	K. Tanaka
	Neutrino Experimental Area (40)	T. Kobayashi
	Committee Report (10)	S. Sawada
17:00 – 18:00	Executive session	
18:00 –	Dinner Party	

March 1 (Tue)

9:00 – 9:30	Nuclear Transmutation	H. Oigawa
9:30 – 10:00	Network and Computing	S. Kawabata
10:00 – 10:30	Improvement of website	T Komatsubara/ Y. Uno
10:30 – 11:00	Coffee Break	
11:00 – 12:30	Working Hours (1) Open Discussion, Report writing (Up to chairperson)	
12:30 – 13:30	Lunch (could be a working lunch)	
13:30 – 14:30	Working Hours (2) Open Discussion, Report writing (Up to chairperson)	
14:30 – 15:00	Summary Session	
15:00 – 18:00	Tour of the Site (Return to hotels near KEK)	

APPENDIX III
Committee Members

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