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THE J-PARC INTERNATIONAL ADVISORY COMMITTEE MEETING

REPORT OF MEETING MARCH 2003

Dear Professor Nagamiya,

The International Advisory Committee remains impressed by the scope of the J-PARC project and by the commitment of the partner organizations to this eminent project. The openness of the Director and the project team in providing us with detailed information at this decisive time in the project and their helpful participation in the discussion of the options for an optimum result under the constraints of the program have made our work more valuable.

Our recommendations are succinct.

- Realisation of the full vision of the project and the reinstatement of 400MeV operation of the Linac are our highest priorities.

- The delays due to archaeological work and the recommended focusing of work to get Phase I completed as soon as possible may help these goals and bring forward as quickly as possible the neutrino experiments where Japan has a prime position in world science.

- But without the Materials and Life Sciences component and its large user community added to that in Nuclear Physics, the project will not achieve its full impact. We recommend priority setting to achieve this balance.

The IAC is very conscious of the constraints of finance on the project and encouraged by suggestions that collateral funding proposals are being prepared. We give those proposals our full support. They must be accompanied by appropriate scientific and technical manpower increases. In that respect we note the efforts being made by both JAERI and KEK to provide assistance.

The strong international interest in spallation assisted destruction of nuclear waste suggests to the committee that, in addition to current work in Japan there may be scope for closer international coordination and cooperation towards the many facets of this work. We suggest that the parameters of such a cooperation be explored and some options be brought to the next meeting of the IAC, some of whose members would be in a position to facilitate matters to the benefit of the J-PARC program.

Our thanks once again to you and you colleagues for facilitating our work.

Yours sincerely,

John White (Chairman)

THE INTERNATIONAL ADVISORY COMMITTEE

ON THE J-PARC PROJECT

REPORT

Meeting March 10-11 2003

Tsukuba, Japan

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EXECUTIVE SUMMARY

The International Advisory Committee, (IAC), to the Director of the Japanese Atomic Energy Research Institute (JAERI) - High Energy Accelerator Research Organisation (KEK) J-PARC project met on March 10-11, 2003 at KEK, Tsukuba and inspected the construction site at Tokai.

Since its last meeting the Accelerator Technical Advisory Committee (A-TAC) has met twice (May 2002 and March 2003) and the Neutron Technical Advisory Committee once in October 2002. The Muon Science Experimental Facilities Advisory Committee (MUSAC) also met in February 2003 and the Nuclear and Particle Physics Advisory Committee is due to meet in later March 03.

Responses by the Director and the Project team to IAC's report of March 2002 and to the 2002 meetings of the above committees were considered by the IAC at its march 2003 meeting as well as new information from the Director and the Project team about necessary project changes in 2002 and 2003.

The IAC thanks the Director and the project team for the detailed information and discussion provided at the IAC meeting about these changes.

At its 2002 meeting the IAC said of the project;

> *"The Committee advises that with this project Japan has the opportunity to be a world leader in a number of fields…. The committee furthermore recommends a policy of "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. Our advice to the Director is that he ensure that from day one of the facility's operation the most novel aspects of the programme attract the world's attention to and involvement in the project from the importance of the results produced*".

These comments remain true and the IAC re-endorses the recommendations to this effect made in 2002.

The IAC feels strongly that a key feature of the J-PARC project is the combination of provision for a unique range of capabilities in three scientifically distinct areas of forefront research. This is provided through a well-conceived and synergetic technical facility concept. In support of this view, the IAC offers a set of seven recommendations, each with some explanatory material. Our detailed observations are included in the main body of this report.

Recommendation 1: The IAC recommends that the highest priority for J-PARC is to ultimately realize the full facility concept, even though the sequence of specific steps might be subject to constraints such as the time of realization for the 400 MeV Linac.

Commentary: In emphasizing this advice, the IAC also suggests choices among the project options facing the project team at present. The project is currently the world's most far-reaching accelerator project with its emphasis on excellence in the three principal goals highlighted by the IAC in 2002. These are:

(1) Nuclear and Particle Physics –(Neutrino physics top priority)
(2) Materials and Life Science through Neutron Scattering and by Muon Probes and,
(3) Spallation assisted destruction of nuclear waste.

The committee sees no reason to change this advice but rather to emphasise it and suggest choices among the options facing the project team at present. Some of these choices will be hard and require skill and the closest cooperation between JAERI and KEK over the next year or so. They arise from correct decisions in 2002 to enlarge the physical size of the 3GeV rapid cycling synchrotron (RCS) and the associated cost increase. The choices concern:

- completion of Phase I as soon as possible;
- advancement of the neutrino oscillation experiment from Phase II to Phase IA with an appropriate cash endowment;
- modification of the LINAC Energy Recovery program to reinstate 400MeV as the immediate goal for the first stage of proton acceleration;
- rescheduling aspects of the 50GeV ring construction to allow archaeological work on the recently discovered "ancient salt farms";
- facilitating national and international cooperation in the project through decision by JAERI and KEK on an unambiguous governance structure and a "one stop shop" user/collaborator" interface, and;
- recognition of J-PARC transmutation research (ADS).

Recommendation 2: The IAC recommends that Phase I of the project be finished as quickly as possible taking into account the priorities set out below.

Commentary: The completion of Phase I as quickly as possible will provide important benefits to the vigor and scientific benefits of the entire J-PARC program. Unforeseen delays (such as the "salt farm" or the necessary upgrade of the 3GeV ring) occur for most big projects and are managed in other countries by a "contingency" budget. In large projects like J-PARC, loss of momentum may be serious because of active international competition (e.g. to follow up the Japanese discoveries in neutrino physics) or because international interest becomes uncertain about the manner and schedule of cooperation. To avoid these problems – with the project still at full momentum- as illustrated by the excellent and hard work shown to the IAC by the project team, the IAC urges major efforts to manage the program and bring in supplementary funding.

Recommendation 3: The IAC strongly recommends that the neutrino oscillation experiment be brought into Phase I with additional supplementary funding. This would send a clear signal for international collaboration in this area.

Commentary: Neutrino oscillation physics is a field in which J-PARC can provide world-leading experimental capability to a field of great current scientific interest. Bringing the neutrino oscillation experiment from Phase II to Phase IA will send a strong message of support to the world by the Japanese Government. Japanese excellence in the understanding of neutrino physics is undoubted. The recent discovery of the neutrino mass through the evidence of phase mixing of the neutrino wave functions is a "hot topic". The high intensity, 50GeV proton beam from J-PARC will be the best in the world for exploring this physics and aspects of CP violation – physics at its most fundamental level. To bring this program forward will mean strains on the personnel resources of J-PARC and will need additional funding – estimated at about $US 160 million. But it can also be expected to attract immediate international collaboration with some 45 physicists in Japan, 110 from Canada, China, France, Italy, Korea, Poland, Russia, Spain, Switzerland UK and USA having expressed interest.

One way of achieving early start up of Phase I and the provision of a high energy proton beam to the neutrino oscillation experiment would be to follow the "recovery program" presented at the IAC meeting to cope with the extra expense involved in the 3 GeV ring enlargement. We call this program Version I . This "recovery program" would involve the LINAC providing only 181MeV protons to the 3GeV RCS, some changes to the operation of that ring which would be irreversible and damaging to the neutron beam program. The committee does not favour that option because of the change in balance of the whole program.

Recommendation 4: The IAC feels that the potential negative impact on J-PARC performance from the lower Linac energy represents too great a risk to accept, and hence we recommend that a plan be developed with a goal of restoring the 400 MeV linac capability by the time of RCS commissioning.

Commentary: The IAC understands and supports the need to enlarge the physical size of the 3 GeV RSC to secure a stable high-power operation of this RSC. The IAC also understands the reason to reduce the Linac energy to 181 MeV in order to secure funding. However, the IAC strongly feels that a Linac energy recovery program to reinstate 400 MeV should be set as the immediate goal for the first stage of proton acceleration. This is the option recommended by the IAC. The Committee does not favour the 181MeV option. This matter was considered by the Accelerator Advisory Committee at its meeting immediately preceding the IAC. We are told that this option would require an additional 85 OKU Yen and consider that the benefit of restoring 400 MeV Linac capability to the program highlights of *Neutrino physics, Materials and Life Science through Neutron Scattering and, Spallation destruction of nuclear waste* will be of cardinal value. Maintaining these "flagship' programs should be a consistent high priority for Japan.

The committee attaches high priority to this recommendation on the basis of IAC's express opinion that J-PARC should adopt a principle of "no compromise" with respect to the quality of the primary installations. In ten or fifteen years the accelerator complex will have uses unforeseen at present – its basic features should ensure this value. Moreover uncertainty in possible international collaborators about the quality of all aspects of the accelerator performance should be avoided.

Recommendation 5: The IAC recommends that the partners JAERI and KEK develop with the Director of J-PARC an organizational structure for the various modalities of operation of the facility, the costing of access, the policy on visitors, the returns on investment (e.g. in instrument construction) and on Memoranda of Understanding with collaborating institutions nationally and internationally.

Commentary: The IAC of commends the efforts JAERI and KEK to create J-PARC as a top national and international facility. Members of the committee have experience in the creation and operation of such facilities in such a way as to maximize national and international participation. The committee has perceived that the process of J-PARC governance and access rules is not yet complete enough to offer a smooth pathway for potential users and proposers to become involved.

Discussions are underway on the organization/management issues of J-PARC after commissioning. A joint committee between KEK and JAERI is reviewing the options for the future governance of J-PARC when it becomes operational. However this issue is also relevant for the selection of the initial scientific program and the initial suite of experimental facilities. While the pending reorganization at KEK(new Institute) and at JAERI(merger with JNC) are clearly affecting the process, we believe that is most important to identify as soon as possible the structure of J-PARC with which Users will interact.

The committee commends the Director for the establishment of Program advisory committees in 2002 and these committees for the work that they are doing. The large number of Letters of Intent signifies to the interest in the scientific community but more will have to be done. J-PARC may have to adopt a single logo – and it could do this without damage to the proper interests of the partners JAERI and KEK. Such presentational points have worked well in other organizations – even complex multinational ones like CERN and ILL. The user does not need to perceive the complex political processes leading to a successful Institute but does need to have assurance of uniform processes for proposal appraisal and funding (for example). It may be argued that this recommendation is too soon in the life of J-PARC but clarity as soon as possible appears to be a good policy in user facility management.

The selection of the initial scientific program should be made first on scientific merit and it is not clear yet how this will be accomplished. The step for going from letter of Intent to fully developed proposals must be defined soon. The lack of a clear funding scenario for the experimental facilities and experiments may favor decision based on availability rather that scientific merit. International Scientific Program Advisory

committees should be organized to review scientific proposals. The Advisory Committees set up so far are not constituted to do such a prioritization of the science but are advising on the development of facilities. They could be restructured to do so. At the end of the process, the International Advisory Committee could be the vehicle for providing advice on the relative merit of experiments across the broad scope of science envisaged at J-PARC.

Recommendation 6: The IAC recommends that the Project provides a leadership role in planning the neutron scattering instrument suite and works closely with potential funders to achieve a balanced portfolio of scattering instruments to serve the best long term interests of the broadest possible user community.

Commentary: A coordinated approach to developing the entire instrument suite is required to maximise the utilisation of this potentially world leading facility. Evidence worldwide is that this is most effectively achieved by leadership from within the project itself.

Recommendation 7: The IAC recommends that the goal of JPARC transmutation technology development should be reaffirmed and should occur in an international context and in the context of a clear understanding of the ADS system role in the larger P/T and nuclear fuel cycle context.

Commentary: The planned merger of JAERI and JNC is for Japan an opportunity to define a coordinated, integrated advanced nuclear fuel cycle program in an international context that would consist of research, development, and demonstration in all facets of P/T – advanced separations, advanced nuclear fuels, advanced reactor technology, and ADS.

ACCELERATOR PROGRAM

The J-PARC Project entails the construction of a state-of-the-art proton accelerator complex consisting of a 400 MeV linac, a 3 GeV rapid cycling synchrotron, and a 50 GeV synchrotron. The two synchrotrons are designed to deliver extremely high average power: 1 MW from the 3 GeV accelerator and 0.75 MW from the 50 GeV ring. These capabilities are beyond those of any other accelerators operating elsewhere in the world today.

The status of the design and construction activities related to the accelerator complex was reviewed by the Accelerator Technical Advisory Committee (A-TAC) at a meeting held on March 7-8, 2003, immediately in advance of the IAC meeting. A summary of the findings of that review were reported to the IAC during its meeting. Significant progress has been made on the project over the last year. The most relevant points are:

- Performance criteria have been established and designs are now complete for all accelerators in the complex.
- Procurements have been initiated and approximately 50% of the technical components are now on order.
- Civil construction has been initiated on the Tokai site.
- An archeological find will probably delay completion of the 50 GeV ring by 6-12 months relative to the current schedule.
- In response to cost growth elsewhere in the project it is currently proposed to initiate operations of the complex with a Linac energy of 181 MeV, rather than the design value of 400 MeV. A recovery plan has been identified for implementation once an additional 85 oku yen of funding are identified.
- The staffing level on the accelerator team has grown by 19 (about 17%) over the last year.

Linac Energy

The proposed change in the initial operating energy of the linac is the most critical new development. The project team estimates the impact on performance is a reduction of beam power delivered from the 3 GeV ring to the range 0.4-0.6 MW when not supporting simultaneous 50 GeV ring operations, and 0.32-0.48 MW when simultaneous 50 GeV operations are required. The 50 GeV operating scheme is designed to recover nearly all of the lost performance in the Main Ring, but uncertainties exist in this projection related to the strong space-charge forces at injection. The best-case scenario for the recovery plan is initiation of 400 MeV linac operations in 2008.

It is the committee's judgment that there is a significant possibility that the change in linac energy could lead to a factor of two shortfall relative to the established performance criteria of the J-PARC complex. The committee believes this is an unacceptable risk and offers the following recommendation relative to this situation:

The committee feels that the potential negative impact on J-PARC performance from the lower linac energy represents too great a risk to accept, and hence the committee recommends that a plan be developed with a goal of restoring the 400 MeV linac capability by the time of RCS commissioning.

Several other issues were identified as worth of consideration by management in last year's report. We believe two are deserving of continued attention:

Human Resources

The Accelerator Group Leader stated last year that a staff of approximately 200 people was required to construct the accelerator facility. Over the last year the assigned/available staff has grown from approximately 110 to 130 people. While the expanded effort is a positive development the strategy for closing this gap, as required for a successful project, is not evident to the committee. The committee reiterates its recommendations that Project Management develop a strategy for assuring that sufficient manpower is assigned to the accelerator project to assure successful completion. In developing such a strategy management may wish to consider the size of the staff that will be required to support the accelerator facility during its operational phase as well as the opportunities presented to train new people in the technologies of accelerators. It is noted that an initial look at operations planning indicates that the staff required for maintenance and operations of the complex is beyond the size of the current staff.

Availability Criteria

The committee believes that the users of this facility will expect an extremely reliable operation, approaching 95% defined as actual/scheduled operational time. However, it still does not appear that availability/reliability criteria have been relayed to the accelerator group nor are formally reflected in their planning. The committee reiterates its recommendation from last year that availability/reliability criteria be developed and formally communicated to the accelerator team.

NUCLEAR AND PARTICLE PHYSICS

General Observations:
The particle and nuclear physics mission of J-PARC as described to the IAC will position the laboratory to take the world lead in experiments investigating fixed-target nuclear and particle physics, fields that are entering a renaissance of opportunity for new discoveries and continuing measurements in previously established scientific areas. The envisioned spectrum of experiments encompasses the fields of hypernuclear physics, rare kaon and muon decays and, of particular importance in the near term future, the new field of neutrino oscillations. The scientific vision for this program is clear and the technical planning and design steps being taken are appropriate and vigorous to move towards this goal. The IAC observes, however, that overall budget constraints and other strategic planning issues connected with the approval of specific experiments and their budgetary support have begun to compromise this vision. For example, we note that the initial primary proton beam, "A-Line", will be identified and budgeted along with the conventional facilities for the initial Kaon Hall beamlines, while plans for the secondary beams in the Kaon Hall appear to be fragmentary at this point and there is no clear plan for supporting construction of the first complement of experiments. We also note that the neutrino beam is not included in the Phase-I plan at all and that an application of the J-PARC to secure supplementary funding to add the neutrino mission to the first phase was rejected by the Government. We next comment on specific parts of the nuclear and particle physics program.

Awarding of the 2002 Nobel Prize in Physics to Prof. M. Koshiba established the world leading status of the Japanese program of neutrino physics at the start of the 21st century. This dominant position comes as a result of the construction and operation of the Super Kamiokande detector in Japan during the decade of the 1990s and, lately, with the important contributions of the Kamland Experiment, also located in Japan. The achievement of this front-runner status also positions the J-PARC facility, combined with the Super Kamiokande Detector, to maintain world leadership in neutrino physics for the decade ahead. We also note that recent theoretical developments in understanding the larger implications of neutrinos oscillations for the evolution of the early universe will continue to sustain the interest of the particle and cosmology communities over the next decade in the full determination of the numerical parameters of the neutrino system, including the determination of CP-violation in the neutrino system. This entire program can be met in the projected J-PARC neutrino program, albeit with a later upgrade of the proton target to 4 MW.

The rare kaon and muon experimental program is similarly positioned to make a leading contribution to the world program in the coming decade if the beamlines and experimental facilities envisioned by the J-PARC scientists can be realized as planned. We comment on the prospective scientific value of this program in the next section. There is also the interesting program for advancing hypernuclear physics, a field dominated by Japanese scientists for years as the facilities of the J-PARC mature in the second phase. In the case of this group of experiments, the beamlines and facilities will need to be developed and a plan for construction put in place.

NP HALL AND PHYSICS PROGRAM:

Strangeness physics with kaon beams promises important insights into several key areas of nuclear physics and the standard model of particle physics. The proposed facility at J-PARC represents to the respective scientific user communities the long desired kaon factory, which can deliver secondary kaon beams of sufficient intensity to pursue this physics to an unparalleled degree of sensitivity and precision. Rare kaon decays can provide unambiguous tests of the standard model and, with the intensities expected at J-PARC, quantitative measurements of some of its key parameters. Intense kaon beams can also lead to the production of yet unachieved numbers of hypernuclei, i.e. nuclei with strangeness quantum numbers different from zero, and thus to benchmark tests for the fundamental theory of the strong interaction, quantum chromo dynamics (QCD).

The important opportunities that the scientific community sees in J-PARC is illustrated by the impressive number of letters of intent that were submitted following a first call by the J-PARC director. These letters of intent, as well as the subsequent workshop in the Fall of 2002 to discuss these in depth, corroborated, through strong international participation, the broad worldwide interest in this program. This was evident to the IAC also through the massive report containing the letters of intent, and its broad author lists, that was handed to the IAC members during the meeting.

The unique prospects for quantitative and precise measurements will, however, only be realized with a corresponding effort towards experimental equipment. The IAC was presented the current status of planning, testing, and R&D towards these experimental facilities. The presentation focused on the Kaon Hall, which is laid out for slowly extracted beams of 15 microamperes of 50 GeV proton beam. Considerable work has gone into the design of a double-stage, large solid angle, separated kaon beamline for kaons up to 1.8GeV/c momentum. A lot of design has gone into production target, collimator design, and beam dump for the horrendous requirement of controlling 0.75 MW of beam power at high proton energy in a very backgroung-sensitive yet high-radiation level environment. Most of this design is completed or approaching its final stages.

However, much work is still needed to design, develop, and engineer the actual spectrometers and detectors for the experiments. Some prototyping has been done for the development of magnet coils wound from mineral insulation cable, a completely inorganic high power cable, to resist radiation damage. Some thoughts were mentioned in the presentation concerning the use of a common target for several parallel experiments. This, we assume, includes the future study of rare neutral-kaon decay.

The IAC assumes that much of the development of the plans for the experimental facilities has to happen with outside participation. This will hopefully also contribute to some of the cost. (The IAC noted with satisfaction that the J-PARC team has been very successful in collecting a wide variety of used magnets from laboratories worldwide that

will hopefully find use in the spectrometers). However, the Committee also feels that major progress in preparing for this part of the J-PARC program requires substantial efforts and investments from within the facility. The IAC feels that it would be helpful to have a more detailed update of the plans for the experimental facilities of the kaon and hypernuclear program at its next meeting.

NEUTRINO BEAM AND EXPERIMENT:

Prof. K. Nishikawa presented the J-PARC plans for the next generation measurements of neutrino oscillation phenomena, with emphasis on determination of the presently unknown parameter θ13 and improvement of the precision of measurement of other, already known parameters such as Δm2 32, sin2(θ 23). The determination of the CP-violation parameter δ is envisioned to be addressed only in a later phase of the program when comparable anti-neutrino running can be added in a practical time span by the achievement of a target power of 4 MW. In support of this important particle physics goal, we were given a copy of a Letter of Intent signed by 144 physicists in 51 institutions in 11 countries, who propose to use the Super Kamiokande Detector in place and operated by a skilled collaboration of physicists as a key springboard for starting the J-PARC neutrino physics program as soon as the proton target and neutrino beam can be made ready. The detector availability circumstance, along with the very high scientific importance of the neutrino oscillations physics program, drives our recommendation in the Executive Summary to seek advancement of the neutrino program into the Phase-1 construction program.

OTHER PARTICLE AND NUCLEAR EXPERIMENTS:

The 50 GeV proton beam facility provides opportunities for a broad spectrum of forefront research in particle and nuclear physics. This is demonstrated by the 30 letters of intent recently submitted to J-PARC, from strong worldwide collaborations. The IAC commends the management of J-PARC on the expeditious organization of this process and the subsequent workshop, and thus for documenting the science goals and the proposed first experiments.

The programs that have been presently proposed involve - beyond neutrinos - rare kaon decays, polarization experiments, studies of strangeness in nuclei (hypernuclei) and their (weak) nuclear decays, spectroscopy with positive and negative kaon beams, di-muon production and hadron spectroscopy in abroad sense. This is a wide spectrum. Now the process needs to be defined how to evaluate and select the most promising research projects. This is particularly important in view of the fact, that this also is needed for the preparation of the very complicated experimental facilities to run these experiments. The IAC waits for discussions in the Nuclear and Particle Physics Facility Committee (pre-Program Advisory Committee) held soon.

The management of J-PARC indicated during the meeting, that the definition of the next phases of this process is of high priority over the next year. The IAC fully concurs and hopes that the results can be presented at the next Committee meeting.

NEUTRON SCIENCES

The Committee welcomed the progress report on the spallation neutron source and instrumentation for the Material and Life Science Experimental Facility (MLF). It was very pleased to see the eminent progress in detailed technical planning and realization of the MLF complex. The number of beam lines with an individual shutter has been maximized at 23, with 11 viewing the coupled moderator, 6 viewing the decoupled one, and 6 the poisoned one. The Japanese Spallation Neutron Source Technical Advisory Committee (N-TAC) chaired by Guenter Bauer was formed under IAC to review the technical progress of JSNS. It met at Tokai on October 28-30, 2002and made a number of recommendations. The project team has responded by initiating further studies in items such as the Hg flow type in the mercury target, more realistic remote handling scenario of the target, the required size of the ortho-para hydrogen converter, and a re-examination of the proton beam dump.

The committee noted excellent experimental progress in evaluation the pitting damage on a mercury target container using an electro-magnetic impact testing machine. A hardening surface treatment of container significantly suppresses the damage, leading to realistic life times for the target vessel

Instrument selection procedures are being developed. Following IAC's recommendation that "*well defined priorities be set by the Director during the coming year to allow a broad suite of instruments to be ready as soon as the first beam will be available*", the Project Director formed the Neutron Instruments Planning Committee (NIPC) chaired by Professor Y. Fujii to select instruments to be installed at JSNS. In September 2002, the Director's call for a Letter of Intent (LOI) was sent to both domestic and international groups. By the deadline of December 6, 2002, 18 LOI's had been received, 10 from within the J-PARC project team, 7 from Japanese teams and 1 from an internationally organized team. These will be reviewed by five Review Working Groups (RWG) under the auspices of the NIPC. Each RWG will review and evaluate the LOI's from a viewpoint of scientific merit, scientific/technical capability of group, etc. Reviewing is now in process and the final selection this year will be made in April or May 2003. Such a call for LOI will be repeated each year.

Re-iterating the N-TAC recommendations, the committee is concerned by the level of coordinated planning and resource commitment from within the Project to developing the neutron instrument suite. Consultation with the user community by the project team has been excellent by any standards, through numerous meetings and workshops since 1996, and the expertise within the project – as witnessed by the 10 internal LOIs – is not in doubt. The committee recognizes that there are insufficient funds within the project at

present to construct a full set of instruments, and that funding must be sought from a diverse set of sponsors. However the committee recommends that the Project provides a leadership role in planning the neutron scattering instrument suite and works closely with potential funders to achieve a balanced portfolio of scattering instruments to serve the best long term interests of the broadest possible user community.

There is a real concern over (1) the serious impact on neutron source performance if the proton beam power is changed from the original 1MW to 0.6MW (the 181MeV Linac scenario), and (2) the lack funding for instruments by the project team.

(1) This causes a serious setback in achieving the goal set by the 1st IAC and in attracting not only domestic but also international users to J-PARC. We recommend that the 400MeV linac is reinstated without delay.

(2) Remembering the previous recommendation that "*very high priority be attached to the world class construction of these facilities (instruments)*" and "*the Director develop ways of doing this (finding funds for instruments), in the budgetary context, during the coming year*", we recommend that these become more important as the day-one approaches. Since not all instruments can be built at once, we recommend that a scheme is worked out to establish priorities for the realization of proposed instruments.

In neutron scattering, the internationally accepted model is that the core instrument suite is developed for the user community by the facility itself. Instruments proposed by private consortia are welcomed, given that they conform to the technical standards set by the facility and are synergetic with the overall scientific vision for the facility. The level of private – as opposes to community – use of such instruments needs to be determined carefully, bearing in that at J-PRAC such consortia are being given access to a source with world-leading capability, and will inevitably draw on the technical expertise of the facility itself, during construction, operation and subsequent development.

We also recommend that in order to promote international interest, participation and collaboration for JSNS, the Neutron Instrument Planning Committee should have foreign members.

MUON FACILITIES:

Dr. Y. Miyake gave a report on the design of muon facilities for supporting a muon science program at J-PARC. In responding to the IAC recommendation that muon facilities be designed to make use of the 3 GeV high intensity RCS beam, active consultations with the international community took place during the last year which have led to a technical proposal which envisages one (and eventually two) thin muon production targets placed in tandem ahead of the spallation neutron source. In the initial phase four muon channels will be viewing a 20 mm thick water cooled graphite target providing conventional decay and surface muons, dedicated high polarized surface muons, high momentum positive or negative muons and high intensity low energy muons.

This slate of channels would service a large program in material science using the MuSR techniques which is well established both in Japan and abroad, which has very good linkages with the new material developers and would provide complementary tools to the neutron community in material science research. A program in muon catalyzed fusion (MuCF) and experiments of fundamental nature (tests of QED, muonic atoms and molecules, lifetime measurements..) are also envisaged.

The technical aspects of the facilities are well developed and a review took place last February which concluded that a strong proposal had been produced which would satisfy the needs of the Japanese and of the international community and provide new unique capabilities. The initial budget foresees only one muon beam line at the beginning with elements relocated from the current KEK MSL superconducting channel.

The IAC endorses the report from the MUSAC committee which calls for a continuation of the design effort with extensive coordination at the engineering level with other J-PARC groups facing similar technical issues (Targetry, handling and maintenance of beamline elements, shielding and safety constraints…). A Mechanism for providing beam parameter requirements to the beam dynamic team of J-PARC must also be established. A strong program in instrumentation development must also be started to provide the experimental tools for exploiting the unprecedented large fluxes expected from such a facility.

Continuation of the development of high acceptance channel based upon the DAI-Omega concept presently being commissioned at KEK is seen as a very promising avenue for developing high fluxes of low energy muons, micro beams etc.

The committee recognizes the very high potential for early delivery of fore front science from such a muon facility and recommends that J-PARC management make every effort to include such facilities in its initial operation. The committee also recognizes a shortage of fund to secure a full shielding around the muon target on Day-1. This issue should be also addressed.

J-PARC TRANSMUTATION RESEARCH (ADS)

General Discussion

Transmutation research is one of three principal goals of JPARC. Its funding (approx $6M per year) and priority are well below those of the areas of materials/life sciences (3 GeV) and nuclear/particle physics (50 GeV). The IAC observations and recommendations concerning ADS that follow aim at strengthening the effort and defining it better (in the context of other Japanese and international technology efforts). In the view of the IAC such steps are necessary now to create a program plan that can achieve JPARC transmutation goals. The steps will also ensure that JPARC-ADS has maximum impact in the international field of partitioning and transmutation.

Specific Observations and Recommendations

Observations

1) Existence of the linac at 400 MeV is essential if ADS research is to be done at JPARC.
2) An ADS system is only one part of a partitioning/transmutation (P/T) system, which in itself is a component of a broader, much larger nuclear fuel cycle system.
3) Definition of ADS technology development should occur in the context of a clear understanding of the ADS system role in the larger P/T and nuclear fuel cycle context. This understanding should allow priorities for ADS technical development and demonstration at JPARC to be made, from which the focus and impacts for JPARC transmutation research can be understood clearly in both technical and policy communities.
4) The planned merger of JAERI and JNC is for Japan an opportunity to define a coordinated, integrated advanced nuclear fuel cycle program that would consist of research, development, and demonstration in all facets of P/T – advanced separations, advanced nuclear fuels, advanced reactor technology, and ADS. This top-level plan, updated regularly, should be a major element in defining ADS roles in P/T and priority ADS technical research at JPARC.

Recommendations

(A) The IAC recommends the timely establishment of a JPARC ADS advisory and review group made up of nuclear fuel cycle, nuclear safety, spallation neutron source, and reactor design expertise. This group would provide input and advice on planning for accelerator technology development, target and subcritical assembly development and use, and, importantly, linkages to other P/T technology development areas.

(B) The upcoming (March 25,26) Japanese workshop on ADS and P/T should be used as the first step in identifying and defining unique roles that the JPARC-ADS effort can play in the context of the international P/T effort.

Finally the IAC requests that a program plan for JPARC ADS technology development be provided at the IAC review in 2004 in lieu of a sole focus on technology development results.

CONCLUSIONS:

The International Advisory Committee remains impressed by the scope of the J-PARC project and by the commitment of the partner organizations to this eminent project. The openness of the Director and the project team in providing us with detailed information at this decisive time in the project and their helpful participation in the discussion of the options for an optimum result under the constraints of the program have made our work more valuable.

Our recommendations based on our own discussions and also on the most helpful input from the specialist advisory committees, are succinct. Realisation of the full vision of the project and towards the reinstatement of 400MeV operation of the Linac as the highest priorities is our definite view. The delays due to archaeological work and the focusing of work to get Phase I completed as soon as possible may help these goals and bring forward as quickly as possible the neutrino experiments where Japan has a prime position in world science. But without the Materials and Life Sciences component and its large user community the project will not achieve its full impact. The IAC is very conscious of the constraints of finance on the project and encouraged by suggestions that collateral funding proposals are being prepared. We give those proposals our full support. They must be accompanied by appropriate scientific and technical manpower increases. In that respect we note the efforts being made by both JAERI and KEK to provide assistance.

The strong international interest in spallation assisted destruction of nuclear waste suggests to the committee that, in addition to current work in Japan there may be scope for closer international coordination and cooperation towards the many facets of this work. It may be that for the next meeting of the IAC the parameters of such a cooperation could be explored with possible international partners and some possibilities brought to the IAC, some of whose members would be in a position to facilitate matters to the benefit of the J-PARC program.

RECOMMENDATIONS SUMMARY

Recommendation 1 The IAC recommends that the highest priority for J-PARC is to ultimately realize the full facility concept, even though the sequence of specific steps might be subject to constraints such as the time of realization for the 400 MeV Linac.

Recommendation 2 The IAC recommends that Phase I of the project be finished as quickly as possible taking into account the priorities set out below.

Recommendation 3 The IAC strongly recommends that the neutrino oscillation experiment be brought into Phase I with additional supplementary funding. This would send a clear signal for international collaboration in this area.

Recommendation 4 The committee feels that the potential negative impact on J-PARC performance from the lower Linac energy represents too great a risk to accept, and hence the committee recommends that a plan be developed with a goal of restoring the 400 MeV linac capability by the time of RCS commissioning.

Recommendation 5 That the partners JAERI and KEK develop with the Director of J-PARC an organizational structure for the various modalities of operation of the facility, the costing of access, the policy on visitors, the returns on investment (e.g. in instrument construction) and on Memoranda of Understanding with collaborating institutions nationally and internationally.

Recommendation 6 The IAC recommends that the Project provides a leadership role in planning the neutron scattering instrument suite and works closely with potential funders to achieve a balanced portfolio of scattering instruments to serve the best long term interests of the broadest possible user community.

Recommendation 7 The goal of JPARC transmutation technology development should be reaffirmed and should occur in the context of a clear understanding of the ADS system role in the larger P/T and nuclear fuel cycle context.

APPENDIX I

Committee Members
The members of the Committee were:

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