Report from the
5^{th} Meeting of the Accelerator Technical Advisory Committee for the Japan Proton Accelerator Research Complex (J-PARC)

February 23-25, 2006
JAEA
Tokai, Japan

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INTRODUCTION, SUMMARY, AND MAJOR RECOMMENDATIONS

The Accelerator Technical Advisory Committee (ATAC) for the J-PARC Project held its fifth meeting over the period February 23-25, 2006 at the JAEA site in Tokai, Japan. The committee heard presentations from project staff on the 23rd and 24th, held several closed sessions to discuss reactions and opinions, and presented a verbal report to project management on the 25th. In addition the committee was given a comprehensive tour of the project on the 24th. The meeting agenda is attached in the Appendix.

Committee members in attendance at this meeting included: R. Garoby/CERN, D. Gurd/ORNL, I. Gardner/RAL (deputy chair), S. Holmes/Fermilab (chair), A. Noda/Kyoto, T. Roser/BNL, L. Young/LANL (retired), and J. Wei/BNL.

Y. Cho/ANL and I. Hoffman/GSI were unable to attend.

The ATAC wishes to express its appreciation to JAEA and KEK management and support staff for their hospitality during this meeting.

Excellent progress is evident on a wide range of fronts over the last year. The committee offers its congratulations to the entire J-PARC team! The committee heard excellent presentations covering all aspects of the project. These presentations were very responsive to recommendations from the March 2005 meeting.

The J-PARC project is now well advanced both in terms of civil construction and accelerator component fabrication. Installation is underway and planning for commissioning is well advanced relative to a year ago. Nonetheless there are several areas of concern that the committee feels will require particular attention to bring the project to successful completion:

- Performance of rf accelerating cavities for the RCS and 50 GeV MR
- RCS and Main Ring performance with the 181 MeV linac
- The budget and schedule to completion
- Installation and commissioning planning, including the transition to operations

These will all be discussed in this report. In particular we have devoted a single chapter to the issues related to the rf accelerating cavities in acknowledgement of their critical role in the successful completion of the J-PARC project.

Summary and Major Recommendations

Linac

Excellent progress is evident on all fronts. The linac enclosure and service buildings are complete and installation is underway, aimed at a December 2006 start for beam commissioning. The decision has been made to utilize a non-cesiated tungsten filament ion source for initial operations. All DTL tanks are complete and installed. SDTL tanks are complete and are in the final phase of high power testing/installation. The long range plan remains to upgrade the linac energy to 400 MeV based on the addition of an annular coupled structure (ACS) linac following completion of Phase 1. Prototyping is now underway. The committee applauds the start of preparations; however, funding for the upgrade remains unsecured.

- The ion source lifetime remains a concern. The expected 800+ hour lifetime is based on extrapolation and not on performance of a functioning source in the proposed configuration. The performance characteristics and lifetime of the source need to be confirmed before the start of linac commissioning.

  Recommendation: Efforts should be pursued with the goal of a full demonstration of the ion source Phase 1 design specification by the start of linac beam commissioning.

- Resources required to meet the installation and commissioning schedule appear marginal. Forty-three people are currently assigned full time in the linac group. It is estimated that an additional six are required to support critical items within the commissioning plan.

  Recommendation: Augment the staff of the Linac Group as necessary to support commissioning goals.

- The committee concurs with prior years' assessments that the linac is likely to achieve design performance goals at 181 MeV operations. However, performance of the RCS and MR will suffer from the lowered linac energy.

  Recommendation: We continue to urge the identification of funding for restoration of the linac energy to 400 MeV as a high priority item.

RCS (Other than accelerating cavities)

Good progress has been achieved on many fronts over the last year. Component procurements for the RCS are well advanced, with the exception of the accelerating cavities, and the initiation of installation in the RCS enclosure is imminent (March 2006). Delays have been induced in the schedule relative to last year due to funding shortfalls and difficulties in the accelerating cavity development program. The longer range plan is now to initiate hardware commissioning in April 2007 (9 month delay relative to a year ago) and beam commissioning in September 2007 (4 month delayed). Extensive measurements of magnets have been undertaken and results are being incorporated into a more comprehensive simulations program as recommended in last years report. Vacuum chambers are also progressing satisfactorily. In response to prior year recommendations a design has been developed for momentum collimation in the L3BT line. Many constraints exist due to the location of magnets in the line being fixed at this point in time, but the design is still able to achieve a momentum acceptance of ±0.5%.

- The committee notes that more realistic simulation of the injection process has led to the conclusion that the circulating beam remains on the foil approximately three times as long as previously estimated. The lifetime of standard carbon stripping foil remains a concern to the committee. The test proposed last year at KEK has not yet been accomplished. The plan is to do the test soon, following the shutdown of the KEK PS in March.

Recommendation: Test new foils with H^- beam as soon as possible and compare the stripping foil tests with the lifetime tests performed at BNL with H^- beam.

- Single particle tracking simulations are more comprehensive than a year ago, including the integration of measured magnetic field errors, longitudinal painting and tracking up the ramp, and transverse painting with space charge. The simulations show significant (7%) beam loss for operations at 0.6 MW and 181 MeV injection. However they are still not comprehensive and could be improved in their treatment of the following:
  - Magnetic field interferences
  - Leakage fields from septum magents
  - Power supply tracking
  - BPM resolution

Recommendation: Continue to improve the integrated tracking simulation to include all relevant effects.

- The committee remains concerned about the operational margin designed into the collimation system. Total design load on collimators is 4 kW (at 1 MW operation). The collimator design has been modified to provide enhanced cooling via cooling fins and forced air flow. As a result the collimators are now considered capable of 0.7 kW (horizontal, per jaw) and 0.4 kW (vertical, per jaw). However, no operational scenario has yet been developed to assure that no collimator operates above its specification. The committee suggests being more conservative on the design specifications.

Recommendation: Design the RCS collimator system with sufficient margin to cope with realistic operations scenarios.

- The extraction kicker appears to the committee as a potentially important component of the impedance budget. The committee heard a presentation on the measured impedance of the device but the measurement did not appear to include the PFN and cabling (transverse).

Recommendation: Complete the transverse impedance measurement of the RCS kicker that includes the powering cables and pulse forming network.

- Currently assigned resources appear marginal for meeting the schedule. Fifty people are assigned, of which 33 are permanent. The shortfall for meeting project goals is estimate to be 10 persons.

Recommendation: Augment the staffing needs of the RCS Group as necessary to support commissioning goals.

- The committee concurs with prior years' assessments relative to RCS performance: 0.33 MW beam power represents a lower limit on what will be achieved with the RCS in Phase 1; 0.4-0.6 MW with 181 MeV injection into the RCS is plausible, but requires more developed simulations and a better understanding of losses to provide confidence. This assessment assumes success in overcoming issues in the rf system as described below. Recovery of 1 MW performance will require restoration of the linac energy to 400 MeV.

MR (Other than Accelerating Cavities)

Good progress has been made on many fronts. Dipole, quadrupole, and sextupole fabrication are complete and installation into the MR enclosure is underway. The schedule shows the start of beam commissioning in May 2008 (6 month delayed relative to a year ago). Delays are due to funding shortfalls and difficulties in the accelerating cavity development program.

The committee received very comprehensive and responsive presentations on the installation schedule, the strategy for dealing with activated components, single pulse accidents, and the electron cloud instability. In addition an integrated plan was presented for commissioning and transition to operations as requested.

- The plan for initial operations remains to utilize the h=9 rf system in the MR. This will limit performance to roughly 0.45 MW based on the 181 MeV linac. This approach is based on the expectation that the 400 MeV linac upgrade will occur within the first few years after Phase 1 completion. While the h=18 plan has not been further developed in the last year, several alternative options have been identified.

  Recommendation: Continue work to identify alternative routes to 0.75 MW, and then develop an implementation plan as a fallback in case the 400 MeV linac upgrade is delayed.

- A self-consistent model of electron cloud effects has been developed and indicates that stability is not an issue in the MR.

  Recommendation: Continue to mitigate sources of electrons at the source to the extent practical. Look for other implications of electrons beyond beam instability.

- A model of single pulse accidents based on simplified and conservative assumptions indicates a potential problem in the MR.

  Recommendation: Develop a more realistic model and evaluate plausible fault conditions, and corrective actions if indicated.

- Potential performance issues (mechanical stability and risetime) have been identified with several pulsed devices associated with beam transfers into the MR. These need to be resolved as soon as possible.

  Recommendation: Resolve issues with the pulsed devices as soon as possible.

- Currently assigned resources appear adequate for meeting the schedule. Sixty two people are now assigned full time and the inflow from KEK has started. The issue of staff for longer term operational support, estimated at 44, is now under discussion with KEK and JAEA.

- The committee concurs with last year's assessment relative to MR performance with h=9 and 181 MeV linac: 0.45 MW is the likely performance level in this mode. This assessment assumes success in the RF development program. Recovery of the 0.75MW performance goal will require restoration of the linac energy to 400 MeV (preferred) or implementation of alternative harmonic number operations in the MR or RCS.

RF Cavities for the RCS and MR

Difficulties have been encountered in the fabrication of accelerating cavities for the RCS and MR. The current design is based on a "cut" core which raises the Q of the cavity to tailor the bandwidth to high intensity operational requirements. A grind stone cutting method has been developed over the last year which replaces the previous water jet method that produced unacceptable results. A number of cut cores have failed under high power testing in both the RCS and MR cavities. Failures have developed rather quickly—all in time periods under 200 hours. Uncut cores have also been tested and seem to be much more robust. The current theory is that acid, that is used for etching to remove short circuits between Finemet layers after cutting, is being trapped by the water sealant inside the cores and subsequently does damage when exposed to high power.

The current delay in the development program is endangering the installation and commissioning schedule of both the RCS and MR. The strategy proposed by the project team is to assemble one RCS accelerating cavity with cut cores fabricated under a modified fabrication process in April. The cavity will then be tested in May, and if it performs satisfactorily procurement of the balance of cores for the remaining nine cavities will commence. If the testing is unsatisfactory the RCS cavities will be produced entirely with uncut cores for the initial RCS operation. The current assessment of project staff is that uncut cores will support roughly 100 kW of beam power in the RCS. While the committee believes such an implementation will limit RCS intensity we do not have sufficient information to make a quantitative assessment.

The ATAC views on this issue are as follows:

- The committee is deeply concerned about the status of the RCS and MR RF systems. There is no convincing demonstration that cavities with an acceptable life-time can be built, no operational parameters for reliable, long lived cavities have been established and time is now very short if program milestones are to be met. Only one off-line test stand exists for both RCS and MR and it is not yet equipped with the low level RF electronics to allow correct amplitude and frequency control.

- If issues are not resolved correctly performance of these systems could severely compromise the J-PARC project.
- We believe that MA-based cavities remain a valid and promising technology for J-PARC. Similar cavities have been run for extended periods at the KEK PS booster synchrotron, where uncut cores with force air cooling produce 14 kV/m with 40 kW/m input power. Systems have also been operated, although at much lower power and/or gap voltages, at COSY, HIMAC, CERN, BNL, and FNAL.
- Meeting the installation and commissioning milestones, even at reduced initial power, is critical for the J-PARC Project.
- The ATAC believes the proposed strategy for resolving this problem is unrealistic. It assumes that the underlying problem is understood and will be solved on the first pass. It also assumes that one month testing of a single cavity will be sufficient to establish confidence in the long term performance of complete systems. We do not believe either of these assumptions is justified. It is the view of the committee that developing a robust solution will require an extended effort beyond the three months allocated in the current schedule.

Recommendation: The committee recommends a two component, parallel approach:

1. **Establish a short term solution that will support installation and commissioning goals for the RCS and MR. We suggest an initial installation based on uncut cores in the RCS and an immediate evaluation of the need for cut cores in the MR at reduced beam intensities. The staff should establish immediately the safe operating power/voltage for such cavities, via an extended testing (>1000 hours) program, and implement on a schedule consistent with the current installation schedule.**

2. **In parallel pursue a comprehensive development program that aims to support the 1 MW RCS and 0.75 MW MR performance goals. This program could extend over a year or two without impacting the long term J-PARC goals. Given that the MR production schedule is delayed by 10 months relative to the RCS we suggest that it would make sense to develop the MR cavities first.**

   The development program should be focused both on identifying the underlying problem and solving via revised fabrication techniques, and on examining alternative design approaches for both the cavities and/or the RCS itself. Among the alternatives that might be considered are:
   - **Increase the number of cavities in the RCS and MR.**
   - **Oil cool uncoated cores instead of water cooling coated cores.**

- **Consider ferrite loaded cavities.**

- Time is unlikely to permit two off-line test stands in the short term but there should be one for the RCS and one for the MR for the long term development. Two cavities for each system should be obtained to allow testing on one while modifications are installed in the other.

  Recommendation: Construct an additional rf test stand, including full capability for driving cavities with the operational voltage and frequency programs, that can be dedicated to ongoing test and development.

- If problems persist, they will have to be recognized quickly and alternative solutions developed.

  Recommendation: Conduct a review to assess progress on the rf systems, utilizing internationally recognized experts in rf technology, prior to the initiation of fabrication of cut cores. Participation of a few ATAC members in such a review would ensure continuity of the ATAC understanding of the rf issues into the spring 2007 meeting.

- Implementing such an approach will require augmenting existing resources.

  Recommendation: Additional experienced people should be made available to assist in solving this problem.

Controls and Global Systems

- The controls group needs the participation of the accelerator physics groups in defining/creating these applications programs that will be used during the commissioning effort.

  Recommendation: Based upon the commissioning plan presented, specify the high-level physics applications needed to carry out this plan and begin development of these applications as soon as possible.

- The Personal Protection System (PPS) is being implemented using what is now a conventional redundant PLC-based technology. During periods of overlapping installation and commissioning, it is likely that temporary configurations of the PPS, possibly including temporary walls and/or gates, will be required. Each of these configurations will have to undergo a time-consuming certification, and these certifications demand that certain equipment be operational. (You need to be able to turn on what the PPS will turn off.) It is important that these activities and constraints be anticipated and included in the overall project schedule.

  Recommendation: Review the project schedule to assure that adequate time is included for certification of the PPS in possibly required temporary configurations.

- The committee heard a presentation on the strategy for dealing with electromagnetic compatibility (EMC) issues. The action plan appears reasonable and should be pursued.

Installation, Commissioning, and Operations Plan

The ATAC found that planning for installation, commissioning, and the initial operations phase is advanced relative to a year ago. A first pass at the evolution of beam power in both the RCS and MR during the initial operational period has been developed. We regard the present level of planning as a reasonable start. However, we suggest that the next steps include; integration of plans across machine boundaries, identification of resource requirements, and identification of applications program needs during the commissioning period. The ATAC believes that this task can only be accomplished by establishing a single commissioning team, lead by a full time dedicated leader with the responsibility and authority for commissioning the accelerator complex.

> **Recommendation: Establish a commissioning team to coordinate planning and execution of commissioning activities across the entire complex.**
>
> **Recommendation: The long-term commissioning plan should be discussed with and published to the user community as soon as possible in order to manage expectations realistically. The published plan should include estimates of anticipated reliabilities and the time allocation between users and accelerator physics.**

Management Issues

The overall accelerator construction and commissioning schedule has slipped by roughly 6 months in the last year. This is due primarily to the JFY2005 funding shortfall, but technical issues are also contributing. It is clear there is little-to-no margin on completing Phase 1 in JFY2007. The current management strategy is to hold the JFY2007 completion date for Phase 1 and JFY2008 completion of the neutrino beamline. The priority is placed on the second of these dates.

The operating budget for the J-PARC facility has now been estimated at 190 OkuYen/year and this number has been confirmed by an independent review. The 400 MeV linac upgrade is not included in this number, and funding is now being pursued in parallel with operations funding.

- The J-PARC staffing level, and in some instances financial resources also, appears marginal for meeting project goals across all machines. The symptoms are that technical development is occurring at the last moment in several systems (rf, pulsed devices, and collimators) and at the same time installation and preparation for commissioning is occupying a greater share of peoples time. The level of activity is expected to increase as installation is completed and beam commissioning is initiated shortly. The committee believes the project requires additional people with experience in installation, commissioning, and operations assigned during the upcoming year. The assessment received from the machine group leaders totals roughly 20 people. Migration of KEK staff out of the PS program, along with some reassignment of staff from KEK-B, has started. This is a welcomed sign and needs to continue.

Recommendation: Do everything possible, including increasing staff support, to hold the schedule, but don't assume undue risk in the process

- The committee reiterates that the full potential of the J-PARC complex cannot be realized with a linac energy of 181 MeV. Our assessment is that the RCS and MR will be limited in power to roughly 0.4 MW in this configuration. We believe that restoration of the originally specified 400 MeV should be pursued with a high priority.

  Recommendation: Funding for the 400 MeV upgrade should be pursued with high priority.

LINAC

Progress with the preparation of the linac has been the subject of 4 presentations. The Committee was very favorably impressed by the care taken by the project staff to address the issues raised by ATAC in 2005 and to adopt the associated recommendations.

Ion source

After due analysis by the project team, a specific type of source has been selected. Degradation processes are claimed to be understood. Additional corrective measures are expected to make this source capable of meeting the required current and life-time (> 500 h) without resorting to the use of Cesium. This remains however to be demonstrated on a real device. The source itself was installed at the front end of the Linac in September 2005 and the high voltage power supply arrived in February 2006.

Pre-chopper and chopper

The pre-chopper and chopper line have been fully assembled and tested with beam. Overall performance is at the required level. The driver of the pre-chopper as well as the ion source and pre-chopper will all be installed in a shielded enclosure to minimize the electrical disturbance to the nearby electronics.

RF

All accelerating structures have been delivered to Tokai and 23 of them are installed. Racks are in place in the equipment hall and numerous components of the RF systems are ready (reference distribution, a number of amplifiers, most of the waveguide networks…). High power RF tests of klystrons have begun two weeks ago.

The Low Level RF uses a combination of Digital and Analog feedback loops. (The analog feedback loop is just around the klystron which avoids the problem of integrating incompatible Analog with Digital feedback systems.) Prototype hardware has been built (cPCI standard) and its performance on a complete RF chain has been shown to precisely match the simulations and comfortably exceed specifications. In particular, RF tests on the SDTL showed that driving two SDTL tanks with a single klystron resulted in excellent control of the relative phase of the two tanks. The phase was controlled by moveable tuners in the two tanks. Tuning errors were automatically corrected with the LLRF system controlling the moveable tuners. The Vector Sum control of the amplitude and phase worked very well in this test.

Debunching

A new set-up has been designed for the debunchers, which reduces the total energy range of the linac beam to 0.27 MeV (Jitter: 0.17 MeV – Spread: 0.1 MeV). No simulation has been shown of the longitudinal capture process in the RCS with these new parameters.

Energy upgrade to 400 MeV

An ACS prototype is under construction, preparing for a full blown implementation. Delays were encountered during the construction of the ACS prototype structure (buncher using 5+5 cells and a bridge cavity), partly because of an accident in the factory. It will be tested with high RF power in a few months.

However, as decided three years ago, the beam energy will be limited to 181 MeV in Phase 1, and the beam current to 30 mA. The nominal parameters (400 MeV and 50 mA) need supplementary resources which have not yet been allocated.

Planning

Hardware commissioning will last between April and November 2006. Commissioning with beam will start in December 2006 – September 2007. Injection into the RCS area begins in September 2007.

Comments and Recommendations

The impressive progress achieved since last year's ATAC meeting leaves little to be desired. The linac is now in an advanced stage of construction. The assembly of the L3BT line is almost complete. These are all reasons to believe that the foreseen goal to start beam tests in December 2006 will be met. Nevertheless, for the sake of completeness, the following issues still deserve some attention:

- Ion source: adequate characteristics can theoretically be expected from the device now installed. However, this remains to be observed on a real device.

  Recommendation: Efforts should be pursued with the goal of a full demonstration of the ion source Phase 1 design specification by the start of linac beam commissioning.

  Recommendation: The shielded enclosure surrounding the ion source and pre-chopper system should be installed and tested as soon as possible to make sure it reduces adequately the electrical disturbance to the nearby electronics.

- The LLRF system appears to be working well. However, the communication between the cPCI host and the server and/or PLC is still under development. In addition, the Server data acquisition software is under development. **This development must be completed for the commissioning of the linac with beam to commence in December, 2006.**
- Longitudinal capture in the RCS has to be optimized for the new set-up of the debunchers.
- Electromagnetic compatibility: analysis has started, and a reasonable action plan has been presented. In this domain also, success will only come from the continuity of the efforts.
- Bringing the linac energy to its nominal value of 400 MeV is essential for the JPARC facility to reach the foreseen beam power both at 3 and 50 GeV. **The Committee considers that the planning presented for this upgrade is realistic. We underline that 4 years are necessary after the decision is made to reach 400 MeV.**
- The schedule for the ACS buncher has slipped by nearly 1 year since ATAC 2005.

  Recommendation: More effort should be placed on development of the ACS accelerator so that once the decision is made to extend the linac to 400 MeV, the personnel responsible for the fabrication of the ACS accelerator will be ready.

3 GeV RAPID CYCLING SYNCHROTRON

The design parameters for the 3 GeV Rapid Cycling Synchrotron (RCS) consists of a beam intensity of 8.3×10^{13} protons per cycle, a repetition rate of 25 Hz and, with an injection energy of 400 MeV, a 1 MW beam power at the 3 GeV extraction energy. The lower injection energy of 181 MeV that is part of the present Phase I construction project reduces the beam power of the RCS to .33 to .6 MW ($2.6\text{-}4.8\times10^{13}$ protons per cycle). At the upper end of this range the beam loss may exceed limits in the RCS and in the transport lines to the neutron spallation target and the Main Ring.

In many excellent presentations the present status of the RCS was described to the committee. The civil construction was complete in April 2005. The component construction is proceeding well and is about 70% complete. Installation is starting now and is expected to be completed by the end of 2006. After component testing first beam is expected by September 2007. This constitutes a delay relative to the last year's schedule of about 4 months mainly due to reduced budget. Note that findings, comments and recommendations with regard to the RCS rf system are included in the separate rf section.

Comments and Recommendations

All dipole and quadrupole magnets for the RCS were measured and the field uniformity is within the design value of $\pm 5\times10^{-4}$. The magnets were measured with a cycle that goes from 181 MeV to 3 GeV with the design rate of 25 Hz. The measurement of the sextupole and steering magnets is starting.

- The excitation functions of the dipole and quadrupole magnet and the tracking differences with the 25 Hz cycle were measured. Higher harmonic components (50 Hz and higher) were less than 2%. The data has not yet been used to determine the variation of the lattice functions and parameters throughout the magnet cycle.

  Recommendation: Use the measured magnet data to determine the lattice parameters throughout the magnet cycle and develop remedies if the variations are outside of acceptable limits.

- The RCS dipole vacuum vessel with its rf screen and its support looked good. Full power AC tests on more than one magnet and vacuum vessel should be considered to ensure no problems arise from vibration. Short circuit failure of two or more RF screen capacitors should also be checked to ensure the resulting eddy currents cause no problems. It may be better to consider ceramic rather than plastic capacitors and to avoid soldering as repair may have to be carried out when the vacuum vessels are active.

  Recommendation: Consider if re-soldering capacitors is possible if the vacuum vessels are active.

- Multiple particle tracking calculation with space charge were presented that include the multi-pole components and field and alignment errors of the dipoles and quadrupoles, longitudinal injection painting and the proper evolution of the bunch shape. For 0.3MW operation the losses were less than 1%. For the 0.6MW operation the losses were unacceptably high. These tracking calculations should be extended to include magnetic field interferences, leakage fields from the septum magnets, and power supply tracking throughout the whole magnet cycle. Also consider extending the search for good tune working points to the whole range of vertical and horizontal tunes between 6 and 7.

Recommendation: Continue to improve the integrated tracking simulation to include all relevant effects.

- The predicted beam loss levels assumed very good correction of the COD. This relies on good accuracy of the beam position monitors (<0.5 mm) and very good stability of several magnet power supplies.

Recommendation: Ensure that these accuracies are achievable.

- The utilization of trim quadupoles to provide control of tunes throughout the acceleration schedule is planned but not formally included in the baseline of the project. The committee believes that a trim quadrupole system will be necessary to provide optimum performance of the RCS and should be formally incorporated into the project baseline.

- Impedance calculations and measurements for the RCS components were presented that were generally quite complete and the agreement between measurement and calculations are good. Transverse and longitudinal impedances were measured for the extraction kickers. However, the important measurement of the transverse impedance of the extraction kickers that include the powering cables and the pulse forming network has not yet been done. The result should then be included in the RCS stability analysis.

Recommendation: Complete the transverse impedance measurements of the RCS kicker that include the powering cables and the pulse forming network.

- The pulse flatness of the extraction kicker magnets was measured to be 6.4%. To achieve the design flatness of 1% it was proposed to miss-time the individual modules, which improves the overall flatness at the expense of the kicker rise time. This is a serious degradation of the kicker performance. The project should reevaluate the specification for the kicker flatness and, if less than 9.3% is indeed needed, it should attempt to improve the presently existing impedance miss-match to achieve the necessary flatness but preserve the present good kicker rise time.

Recommendation: Reevaluate the RCS extraction kicker flatness requirement and meet the requirement by improving the impedance matching between power supply and kicker magnets.

- All ceramic vacuum chambers are being coated with TiN to reduce the secondary electron yield. This should suppress the formation of an electron cloud, which otherwise can lead to beam instability and residual gas pressure rise. There is presently no plan to coat the Ferrite and aluminum surfaces of the extraction kicker but instead outgas these surfaces by baking. These surfaces have large SEY coefficients, which can only be improved by coating them. Such surfaces have been successfully coated at BNL for the SNS project. This should also be done for the RCS. The TiN coating should also be extended to the collimator jaws. Coating the collimator jaws is superior to applying a solenoid field to suppress electron multi-pacting.

Recommendation: Consider coating the Ferrite and aluminum surfaces of the extraction kicker and the surfaces of the collimator jaws. Coating with TiN was successfully achieved for the SNS project.

- No new studies of the stripping foils were presented. The plan is still to test foil life time with the 750 keV H minus beam at KEK. These tests should proceed as soon as possible and results should be compared with to foil lifetime tests performed with H^- at BNL.

  Recommendation: Test new foils with H^- beam as soon as possible and compare the stripping foil tests with the lifetime tests performed at BNL with H^- beam.

- In the RCS five transverse collimator systems will be installed to capture halo particles. Each collimator jaw is capable of absorbing 0.4 kW beam power in the vertical plane and 0.7 kW in the horizontal plane. The total design beam loss on all collimators is 4 kW. No operational scenario has been developed to assure that the heat load on an individual collimator jaw doesn't exceed its specification. The RCS collimator system should be designed much more conservatively since it will be difficult to operate with little or no margin of beam load on the collimator system.

  Recommendation: Design the RCS collimator system with sufficient margin to cope with realistic operations scenarios.

- A careful and conservative analysis of single pulse failures in the RCS was presented to the committee. It showed that the RCS can not be damaged by a single beam load. With a fast Machine Protection System (MPS) that inhibits further injection after a fault condition has been detected the RCS can therefore be fully protected from beam induced damage.

50 GeV MAIN RING

The installation plan of the magnets is reported, which extends until the early part of 2007 and assumes their precise alignments at the later part of the year. Day-1 beam commissioning is scheduled from May to July and October to November in 2008 sharing the beam with MLF. At this stage protons with an intensity of 0.8 x 10^{12} ppp are assumed for acceleration up to 40 GeV with 1 batch injection (h=9). Beam commissioning of slow extraction and the hadron beam line is scheduled for December of 2008, while commissioning of 40 GeV fast extraction and the neutrino line is to be done in April 2009. Beam intensity is to be raised up gradually until 2010 utilizing 8 batches injection and finally arrive at 400 kW beam power, which seems reasonable.

Comments and Recommendations

- The allowable injection time from the point of view of beam loss is estimated to be less than the design injection time.

  Recommendation: Carefully review the injection simulation both for reliability of the calculation and for the tolerable power level on beam collimators.

- A scheme to produce the neutrino beam with 30 GeV instead of 40 GeV protons was discussed as a possible means of increasing the repetition rate and available beam power. The committee notes that such a scheme could result in somewhat higher beam loss and suggests integrating study of such losses into any further development of the 30 GeV concept.

- Following the tour of the Main Ring it was evident that the water and electrical connections to the magnets appeared to be made on the inside of the ring where there was not much room. It may be better if these connections are extended to the outside of the ring for easier servicing when the components become active.

- The commissioning schedule should account for time and manpower needed for studies involving the tracking between magnets, calibration of beam monitors, and beam loss survey.

- Assignment within the straight sections for injection and extraction equipment, beam monitoring, and RF cavities should be carefully studied, using the detailed drawings of the equipment including the vacuum vessels, with the goal of eliminating interferences and possibly creating room for additional rf cavities.

- Realistic beam loss simulations, including both slow extraction and 30 GeV fast extraction to the neutrino beamline, and including measured magnetic fields, should be performed as early as possible.

- Tracking program between dipole and quadrupole magnets should be analyzed taking into account the measured characteristics on saturation.

- The assumed beam losses based upon the simulation at various stages, the radiation levels at the boundary of the radiation controlled area and the J-PARC site need to be carefully investigated in connection with the radiation regulations. Radiation margins to support the operating program should be understood.

- Consider the actions necessary to remove a magnet when it has become active. Local shielding can be very effective in reducing radiation dose and this may be more effective for personnel working on the outside of the ring.

- The plan for initial operations remains to utilize the h=9 rf system in the MR. This will limit performance to roughly 0.45 MW based on the 181 MeV linac. This approach is based on the expectation that the 400 MeV linac upgrade will occur within the first few years after Phase 1 completion. While the h=18 plan has not been further developed in the last year, several alternative options have been identified.

  Recommendation: Continue work to identify alternative routes to 0.75 MW, and then develop an implementation plan as a fallback in case the 400 MeV linac upgrade is delayed.

- A model of single pulse accidents based on simplified and conservative assumptions indicates a potential problem in the MR.

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- Potential performance issues (mechanical stability and risetime) have been identified with several pulsed devices associated with beam transfers into the MR. These need to be resolved as soon as possible.

  Recommendation: Resolve issues with the pulsed devices as soon as possible.

- Currently assigned resources appear adequate for meeting the schedule. Sixty two people are now assigned full time and the inflow from KEK has started. The issue of staff for longer term operational support, estimated at 44, is now under discussion with KEK and JAEA.

- The committee concurs with last year's assessment relative to MR performance with h=9 and 181 MeV linac: 0.45 MW is the likely performance level in this mode. This assessment assumes success in the RF development program. Recovery of the 0.75MW performance goal will require restoration of the linac energy to 400 MeV (preferred) or implementation of alternative harmonic number operations in the MR or RCS.

<u>RCS & MR RF SYSTEMS</u>

The RCS RF system needs to produce up to 450 kV, h=2 accelerating voltage at 0.9 – 1.7 MHz. The use of 181 MeV compared with 400 MeV injection energy has increased both the frequency range and the required accelerating voltage. The increased acceleration voltage is offset, to some extent, by the reduced beam power for Phase 1. Magnetic Alloy (MA) disk loaded cavities with Q=2 are proposed to achieve this in a minimum of straight section space, achieving a factor of two improvement in voltage gradient compared with ferrite loaded cavities. The low Q removes the need for a tuning loop and allows an h=4 component to be fed through the same RF chain providing a larger stable phase area and thus a more intense beam. Ten three gap cavities are proposed, a reduction of one from last year, giving a maximum gap voltage of 15 kV. High Power Drives (HPDs) with two push-pull tetrodes in each provide up to 600 kW of drive for each cavity and its beam power. It is estimated that the accelerating voltage will vary over the range 60 – 450 kV during the acceleration cycle. The maximum voltage will occur at 1.6 MHz.

The MR RF system needs to produce up to 280 kV, h=9 at 1.67-1.72 MHz. Six RF systems similar to the RCS are proposed. However, unlike the RCS the frequency is almost constant and the accelerating voltage also remains constant inferring a gap voltage of 16 kV during the acceleration period of about 1.5 s. Some consideration is also being given to operation with h=18 as an alternative means to recovering the full specified beam power prior to upgrade of the linac injector to 400 MeV.

RF amplifiers

All high power amplifiers have been built (10 for the RCS, 6 for the MR) and the power supplies will be delivered by March 2006. RCS cavities will be installed in January-February 2007, and MR cavities in October – November 2007. The first drive amplifier (CERN-designed 8kW) built by Japanese industry was delivered and successfully tested in 2005. The 10 units necessary for the RCS will be built in 2006 and the rest will be ordered during FY2006.

Low Level RF

The design of the VME-based Low Level RF started in 2004 and testing is progressing satisfactorily. All RF signal generator and frequency pattern cards are planned to be built in 2006. The other cards for feedback and feed-forward will be ordered during FY2006. Beam synchronization between RCS and MR has been studied and a procedure for the generation of the reference signal to be used by the RCS beam control has been worked out.

Cavities

Based on their outstanding capability to attain large accelerating gradient, at low frequency, FineMet-based cavities were selected early in the JPARC project for the RCS and MR synchrotron. This technology has been demonstrated at other locations using lower peak gradient and mean power dissipation. However, the JPARC project will be their first, full scale operational application in high current / high power particle accelerators.

The high gradient requirement means high power dissipation in the MA cores. During the development phase, this lead to the decision to directly immerse the cores in the cooling water, the consequence being that an adequate coating has to be applied to avoid corrosion.

To minimize potential well distortion from the high beam current it is estimated that a Q of 2 is needed to limit the bandwidth of the cavity. The MA cores are therefore cut by grind stone to provide a small gap between the two halves. Control of the gap size enables control of the cavity Q. A technique has been developed to cut the cores without creating short-circuits between successive turns of the FineMet strip. The cut surface must be very smooth to prevent overheating from the RF power.

The development of the coating and cutting techniques has been actively pursued by the RF team for many years. Good progress was achieved up to 2005 although a final solution had not been found. Solutions were expected prior to construction starting this year. However, although progress has been made, the cores are still damaged after a few hundred hours of high power tests. First signs of degradation are color changes, followed by dark/burned spots and sometimes peeling of the coating material. A very thorough investigation has been conducted and identified four possible causes of damage to the cores, namely; chemical (oxidation at the contact of water, acid etching…), average power levels, peak power levels and forces from the mechanical supports.

The proposed future work program will test the next batch of cut cores which have been processed differently to remove any contamination and with different core supports. If the cavity operates with no apparent damage then it will be subjected to longer term testing. If the cavity shows damage then the production cavities will be completed with uncut, coated cores. This will result in operation with lower Q, reduced gap voltage and reduced beam power. The estimated beam power that these cavities could produce is ~100 kW but this figure was not substantiated. Mixed cut and uncut cores have also been considered.

Comments

The ATAC committee is deeply concerned about the status of the synchrotron RF systems. There is no convincing demonstration that cavities with an acceptable life-time can be built. No operational parameters for reliable, long lived cavities have been established and time is now very short if program milestones are to be met. Only one off-line test stand exists for both RCS and MR and it is not yet equipped with the low level RF electronics to allow correct amplitude and frequency control.

However, MA-based cavities remain a valid and promising technology for the JPARC synchrotrons. Moreover, the impact of a delay in the installation of the RF cavities would be highly detrimental to the whole JPARC project. Therefore, a 2-prong approach is recommended to develop RF systems that work for phase 1 and at the same time develop RF systems that work for full beam power.

Recommendations

- **RCS cavities should be equipped with uncut cores. The resulting limitations in accelerator performance should be detailed during the next ATAC meeting.**
- **Operational parameters for reliable, long lived cavities using uncut cores should be established.**
- **When the next tests are completed on the cut-cores at the end of March 2006, the ATAC committee would like to receive a summary of the test results.**
- **Realistic tests are necessary. The correct voltage and frequency program should be used for the RCS and MR cavities. A cavity design must correctly survive a test run exceeding 1000 hours before it can be considered as viable.**
- **Every effort should be made to arrive at a conclusive demonstration for cut-cores prepared with the latest technique within 10 months (before the end of 2006), so that the MR cavities could still benefit from cut-cores.**
- **If no convincing result is obtained before the end of 2006, it is likely that the only possible solution to start the MR on time will be to equip the cavities with uncut cores. The resulting limitations in accelerator performance should be detailed during the next ATAC meeting.**
- **Time is unlikely to permit two off-line test stands in the short term but there should be one for the RCS and one for the MR for the long term development. Two cavities for each system should be obtained to allow testing on one while modifications are installed in the other.**
- **If problems persist, alternative solutions should be pursued and presented in detail at the next ATAC meeting. The following could be considered:**

    1. Increase the number of cavities in the RCS and MR. ATAC04 RCS drawing shows 12 cavities with room in the extraction straight for 6 more. (An increase from 10 to 14 would half the power dissipation in the cavities and reduce the gap voltage to 10kV).

    2. Oil cool uncoated cores instead of water cooling coated cores.

    3. Ferrite loaded cavities.

CONTROL AND GLOBAL SYSTEMS

General: The controls team is now assembled at the J-PARC site and has made considerable progress during the past year. Network equipment for the central control room has been installed and tested. Controls equipment for the Linac, L3BT and RCS has also been installed and is currently under test. Basic application programs for the Linac have been developed and successfully tested. Equipment for the Linac Machine and Personnel Protection Systems has been installed in the klystron gallery and in the control room and are also currently under test.

Schedule and staffing: Staff currently numbers 16.5 FTEs, including staff members and contractors from both KEK and JAEA. The staffing plan calls for this number to increase to 19 (increase of 2.5 FTEs) effective April 1. It is important that this increase take place as and when planned, because software development appears to have fallen behind by 2-3 months and without the planned new staff members is at risk of falling even farther behind. Because higher-level beam commissioning applications are necessarily done last, it is these that would be compromised in the event of a schedule slip.

> **Recommendation: Assure that the increase in software manpower in the current staffing plan is carried out as soon as possible.**

Commissioning Plan and High-Level Applications: In response to a specific recommendation made at last year's A-TAC meeting, the committee was pleased to hear preliminary details of a commissioning plan for the entire accelerator chain. It is essential that this plan be "fleshed out" in more detail, with specifics as to the measurements to be made, with what instruments, as a function of what machine parameters and finally what calculations and/or actions are to be done with the results. These details are required at least six months before commissioning is scheduled to begin for any machine, so that high-level applications can be developed and tested well in advance. This is particularly urgent for the Linac, the commissioning of which is scheduled for later this year. If possible, it is preferable that these applications be written by the Accelerator Physics staff as they will be the primary "customers."

> **Recommendation: Based upon the commissioning plan presented, specify the high-level physics applications needed to carry out this plan and begin development of these applications as soon as possible.**

> **Recommendation: The long-term commissioning plan should be discussed with and published to the user community as soon as possible in order to manage expectations realistically. The published plan should include estimates of anticipated reliabilities and the time allocation between users and accelerator physics.**

Personal Protection System: The Personal Protection System (PPS) is being implemented using what is now a conventional redundant PLC-based technology. Two independently developed ladder-logic programs are used. Certification of the first part of this system is planned for March. During periods of overlapping installation and commissioning, it is likely that temporary configurations of the PPS, possibly including temporary walls and/or gates, will be required. Each of these configurations will have to undergo a time-consuming certification, and these certifications demand that certain equipment be operational. (You need to be able to turn on what the PPS will turn off.) It is important that these activities and constraints be anticipated and included in the overall project schedule.

> **Recommendation: Review the project schedule to assure that adequate time is included for certification of the PPS in possibly required temporary configurations.**

Machine Protection System (MPS): The MPS design and installation (in the Linac) is well advanced, and it appears that the system will meet the timing requirements imposed by the worst-case accident scenario outlined to the committee. The system will have of order 1000 inputs all of which are potential sources of annoying "false positives." All of these inputs can be easily bypassed in software and the temptation to bypass will be great during commissioning, both because of equipment failure and because of the need for unusual and possibly unanticipated operating modes.

> **Recommendation: To avoid compromising machine protection during commissioning, a philosophy and protocol for controlling and monitoring MPS bypasses should be developed and implemented before commissioning begins.**

Security Plan: In response to a recommendation last year that a computer security plan be developed, the committee was shown an architecture that protects the accelerator network making use of firewalls and protected access policies. Perhaps the most difficult issue in a modern distributed system such as J-Parc's is preventing infected or malicious computers from connecting directly to the network by simply plugging in to an available port. There are many good reasons to facilitate the connection of a standard PC laptop to the accelerator network – programming a PLC is only one – so a protocol needs to be established and then enforced to prevent access by unauthorized or unscreened (for viruses) computers. A policy requiring any computer plugged into the network to have been scanned in advance may be appropriate.

Configuration Management: In response to a recommendation made last year the committee learned that a uniform Application Development Environment (ADE) using the Concurrent Version System (CVS) is being developed. At the same time, a mechanism for producing EPICS database and graphical user interface files directly from a relational database has been successfully deployed. This approach has many advantages; however it could provide a mechanism for bypassing the CVS control mechanisms. Procedures should therefore be developed and enforced to assure reliable configuration management of all control system EPICS (and other) files.

LLRF Controls: The committee heard an excellent report on impressive progress and performance with the LLRF systems. These systems communicate with the EPICS layer by a roundabout path through a PLC to the PCI interface. EPICS has access only to those data which are explicitly transmitted to the PLC. In the spirit of the excellent design principal of "No Hidden Data," it would be wise to make a practice of sending all LLRF data, including tuning parameters, to (and from) the PLC which is used to communicate with EPICS, rather than adding one parameter at a time when it is found to be required.

Equipment Testing: Most equipment testing (non-beam testing) appears to be done using the EPICS software. It is important to follow this approach wherever possible because any testing that is done stand-alone will have to be repeated later in end-to-end tests, adding unnecessary schedule delays. Testing this way puts pressure on the controls team to be ready (not a bad thing); but encourages early reliance (and hopefully confidence) in the control system.

COMMISSIONING AND ACCELERATOR PHYSICS

Due to adjusted funding profiles, the projected commissioning dates were adjusted. The newly projected beam commissioning is from December 2006 to October 2007 for the linac, from October 2007 to April 2008 for the RCS, from May to June 2008 for the MR slow extraction/hadron program, and from October to November 2008 for the MR fast extraction/neutrino program.

Projected beam power ramp-up profiles were shown for both RCS and MR with and without the energy upgrade. Significant progresses have been made to address important accelerator physics issues associated with the physical design and technical engineering, and to respond to concerns raised in the previous review.

During the 2005 ATAC review, there were seven recommendations raised in the area of accelerator physics. They were:

1. Evaluate the optics design of the linac and the mechanisms of beam quality deterioration along the linac using measurements performed in the linac commissioning.

2. Optimize the L3BT optics within the present hardware constraints to facilitate momentum diagnostics and momentum collimation.

3. Optimize the layout and design of the collimation systems based on a comprehensive evaluation of beam loss distribution in the collimator region under both normal and fault conditions, emphasizing engineering robustness, operational reliability, and maintainability.

4. Perform comprehensive impedance and instability analysis of the extraction kicker assembly including the kicker modules, the pulse-forming network, and the cabling as a guide in optimizing the engineering design.

5. Implement an integrated tracking simulation including alignment errors, real fields including both systematic and random, space charge, injection chicane, and magnet interferences. Evaluate correction strategy in the presence of such complications.

6. Evaluate electron cloud formation using actual beam and vacuum surface parameters (e.g. coating pattern and measured SEY) and optimize mitigation scenarios in both RCS and MR

7. Benchmark electron-proton instability calculation with observed thresholds in machines like PSR, and improve the model if necessary.

Several talks were presented during this review addressing these topics.

During the commissioning on September 2004, H- beam of up to 30mA peak current and 250 μs pulse length were accelerated at 25 Hz to the end of the DTL tank-1 with energy of 19.7 MV.

The transmission efficiency was near100%. The set point accuracy of 1 degree and 1% was achieved. After further analysis during the last year, the measured rms emittances were determined to be 0.28 (H) and 0.26 (V) mm mr. In comparison, the design goal for the phase I of 181 MeV linac operation is 30 mA, 500 us, 25 Hz. The design goal for 400 MeV linac operations is 50 mA, 500 us, 25 Hz. The design transverse emittance is 0.25 mm mr.

A momentum collimation design was presented for the L3BT capable of cleaning the beam at ±0.5% momentum deviation. The budget needed to implement the design is not yet available.

For the RCS collimators, the heat capability is 700 (x2) W on horizontal jaws, and 400 (x2) W on vertical jaws. The expected beam loss is 1.2 kW. For the 3 GeV beam transport collimator, the capability is 450 W, while the expected beam loss at 0.6 MW (181 MeV) operational scenario is 1.2 kW.

Measurements were performed on the longitudinal beam coupling impedance of the RCS extraction kicker together with the PFN and cables, and on the transverse impedance of the extraction module alone.

High electron-cloud concentration is identified for the RCS collimation and extraction areas in the absence of mitigation. The electron neutralization is near 100% at the extraction area due to the high secondary emission yield of the ferrite surfaces. The chance of electron-proton instability is predicted to be small due to available Landau damping of the beam.

Comments and Recommendations

Commissioning of the J-PARC accelerator complex, first on major engineering systems and then with the beam, is a challenging task demanding a dedicated team experienced with accelerator commissioning and technology. We encourage the project to organize and strengthen a central accelerator physics/commissioning team with experienced physicists and engineers from KEK and other institutes, and to extensively collaborate with high intensity accelerator teams in the world to benefit from the expertise of the community.

> **Recommendation: Establish a commissioning team to coordinate planning and execution of commissioning activities across the entire complex.**

Several key J-PARC systems are at the engineering frontier of accelerator technology: the RCS and MR RF system, the injection, extraction, and switching magnets and power supplies, the large-size braided-coil magnets and their power supplies with tight tracking and field specifications, the ceramic vacuum chamber with external RF shielding, etc.

> **Recommendation: Perform full duty factor tests as early as possible on all major state of the art systems and components in order to identify possible engineering problems that can either delay the commissioning or compromise future operations**.

We commend the practice of developing back-up scenarios for challenging engineering systems like the ring RF and MR septum magnet.

Recommendation: To ensure high reliability of the project, back-up scenarios should be developed on items including the above-mentioned challenging engineering systems and beam scraping/collimation system.

We reiterate our comments at the last review that the present collimation philosophy needs to be critically reviewed for a robust performance not only under normal operations but also under off-normal and fault conditions, with increased complexity of mitigating electron cloud in the region. In comparison, we note that the ISIS collimator can take beam loss of their entire linac beam power at about 15 kW; the SNS collimators can each take beam power from 2 to 10 kW.

The momentum collimation scheme developed at L3BT is encouraging. We feel that collimation at ±0.5% can effectively protect the system and enhance the performance. Further analysis can be made on optimizing its performance along with the selected locations of the debunchers. Studies are also encouraged on developing beam scraping at low energy, possibly at the location of the MEBT bending dipole.

The present study of machine protection from one-shot accident needs to be expanded to analysis of plausible fault conditions, especially in the MR.

Recommendation: Develop a more realistic model and evaluate plausible fault conditions, and corrective actions if indicated.

Measurement of the transverse beam coupling impedance of the extraction kicker needs to be expanded to include the pulse-forming network and cabling. Theoretical results should be closely communicated to the engineering team to optimize the design.

The study on electron cloud should include not only electron-proton instability but also other effects including vacuum pressure rise and system interferences. Present studies identified the extraction and collimation areas where electron cloud concentration is significant. Mitigation scenarios should be developed possibly including patterned coating of the extraction module, coating of all interior surfaces of the collimation area, and implementation of solenoids and clearing electrodes.

Recommendation: Continue to mitigate sources of electrons at the source to the extent practical. Look for other implications of electrons beyond beam instability.

Computer simulation is a powerful tool to enhance our understanding of complex mechanisms. On the other hand, the simulation results should be carefully validated with physical understanding and detailed benchmarking with experimental observations and with other simulation codes.

Applications software needs to be planned and developed for the commissioning of the machines. A database should be developed and filled with design parameters and engineering data.

APPENDIX: A-TAC Meeting Agenda

2006/1/27

ATAC2006 Preliminary Agenda

February 23, Thursday

time		period (min)	Category	Title	Speaker
900	920	20	Project status		S Nagamiya
920	940	20	Executive session	*in camera*	
945	1015	30	Linac	Status of Linac	K Hasegawa
1015	1035	20		Injector	H Oguri/A Ueno
<< coffee break >>		20			
1055	1115	20		LLRF	S Michizono
1115	1135	20		Accelerator Physics Issues in Linac and L3BT	M Ikegami
1135	1205	30	RCS	Status of RCS	H Suzuki
<< lunch >>		55			
1300	1320	20		Simulations in Ring with More Realistic Conditions	F Noda
1320	1340	20		Magnet	Y Watanabe
1340	1400	20		Injection/Extraction/Collimator	M Yoshimoto/ J Kamiya
1400	1420	20	Injection/Extraction /Transport	Simulations in Injection/Extraction/3-50 Beam Transport	M Shirakata
<< coffee break >>		20			
1440	1510	30	MR	MR Overview	H Kobayashi
1510	1525	15		Magnet	K Niki
1525	1540	15		Slow Extraction	M Tomizawa
1540	1600	20		Space Charge Simulation and Losses	A Molodojentsev
1600	1620	20		Installation/Alignment/Maintenance	M Yoshioka
1620	1645	25	Ring RF	Status of Ring RF	M Yoshii
1700	1900	120	Executive session	*in camera*	

RECEPTION
1900 ~ 2100

February 24, Friday

time		period (min)	Category	Title	Speaker
830	855	25	Executive session	*in camera*	
900	930	30	Integrated plan	Integrated Installation, Commissioning, and Initial Operations Plan	M Tomizawa
930	955	25	Control	Status of Control System	T Katoh
955	1015	20	Alignment	Overall Alignment	N Tani
<< coffee break >>		20			
1035	1055	20	Impedance and instability	Impedance and Instability in Rings	Y Shobuda
1055	1110	15		Electron Cloud Effect	K Ohmi
1110	1140	30	Electro-magnetic compatibility	EMC	E Chishiro (linac) / K Okamura (ring)
1140	1200	20	Single pulse accident	Criterion for Single-Shot Beam Loss	H Takei
<< lunch >>		90			
1330	1630	180	Tour J-PARC		
1630	1800	90	Executive session		

February 25, Saturday

time		period (min)	Category	Title	Speaker
900	1100	120	Executive session	*in camera*	
1100	1200	60	Report to project team		S Holmes
<< lunch >>		60			

adjourn