Report from the 6th Meeting of the Accelerator Technical Advisory Committee for the Japan Proton Accelerator Research Complex (J-PARC)

March 1-3, 2007
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 sixth meeting over the period March 1-3, 2007 at the JAEA site in Tokai, Japan. The committee heard presentations from project staff on March 1-2, held several closed sessions to discuss reactions and opinions, and presented a verbal report to project management on March 3. In addition the committee was given a comprehensive tour of the J-PARC facility. 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 committee heard excellent presentations covering all aspects of the project. The committee appreciates that these presentations were generally responsive to recommendations from the February 2006 meeting. Significant progress has been made over the last year on all fronts highlighted by the achievement of full energy beam commissioning of the linac and the development of a viable strategy for overcoming the problems in the RCS and 50 GeV Main Ring rf systems as described in last year's report. The committee offers congratulations on these achievements to the entire J-PARC team !

The J-PARC project is now nearing completion both in terms of civil construction and accelerator component fabrication. Installation is complete and beam commissioning is underway in the linac. RCS beam commissioning is scheduled to start in September of this year with Main Ring beam commissioning following in May 2008. This schedule is unchanged from a year ago—an excellent achievement—and will lead to a startup of accelerator operations in support of the research program in the 3rd quarter of JFY2008. Commissioning plans for the RCS and MR are also more developed and detailed than 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:

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

These items are discussed in this report. Because of the importance to the successful completion of the J-PARC Project, and the difficulties being experienced a year ago, we have devoted a single chapter to issues related to the rf accelerating cavities.

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

Summary and Major Recommendations

Linac

Excellent progress has been made since last year's meeting. Linac installation is now complete and beam was accelerated to 181 MeV in January, 2007. The committee congratulates the Linac team on the achievement of this important milestone, ahead of the schedule presented a year ago. 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 I. A prototype of the ACS buncher has been fabricated and tested and preparations are aimed at constructing, installing, and commissioning the ACS linac over the period JFY08-11. The committee applauds the start of preparations; however funding for the upgrade remains unsecured.

Comments and Recommendations

- The ion source remains a concern. The development of a non-cesiated tungsten filament source has had difficulty meeting the 33 mA current specification. In response a LaB_6 filament is now under development. This filament provides the required current at a 150 μsec pulse length, but is unstable at the required 600 μsec pulse length. A stabilization system has been proposed and testing will start in roughly a week.

  Recommendation: The ion source requires continuing management attention. If the LaB_6 source does not meet performance specifications in the next month or two, consider alternative designs for the operation phase.

- The committee was not presented with a comparison between achieved (to date) beam parameters, commissioning goals, and operations goals. See recommendation under Commissioning and Initial Operations.

- Residual activation levels in the vicinity of the debuncher have been measured at 88 μSv/hour. This translates into a fairly significant level when extrapolated to full power (a few mSv/hour).

- Many of the beam diagnostic devices have been exercised, but are not yet in a state to support full characterization of the linac beam as will be required to support RCS beam commissioning starting in September. (For example BLMs, intensity monitors, and emittance diagnostics).

  Recommendation: Diagnostics need to be providing reliable information by the time of RCS commissioning.

- The closed loop control on the rf system is still a ways from being complete and working effectively. The feedback response looks to the committee to be slower than it should be. In addition the feedforward systems still need to be implemented.

- The committee remains concerned about noise from the pre-chopper. Since this device has not yet been powered there is no further information relative to last year. We suggest continued attention to this item.

- The prototype ACS buncher module exhibits a shunt impedance that looks low to the committee. We suggest that the result be confirmed.

- The spares situation in the linac was highlighted as a concern by the linac team. However, a complete risk analysis, which would include expected failure rates and performance impacts of failures, was not available to the committee. See recommendation under Commissioning and Initial Operations planning.
- 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)

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

<u>Comments and Recommendations</u>

- A problem with loosening of bolts holding quadrupole magnets together has been identified. The problem was observed during tests of magnets with the design excitation fields and appears to be due to the torquing procedures. The problem appears to the committee to be understood and should not pose a threat to performance provided that it receives continuous attention in the future.
- The RCS commissioning plan presented to the committee looked very good. However, we are concerned that the plan does not extend beyond the start of MR commissioning (at which point the RCS is operating at 10 kW).

  Recommendation: Extend the RCS commissioning plan to cover the MR commissioning period and the first several years of operation (see more general recommendation under the heading Commissioning and Initial Operations Planning).
- The problem of field flatness in the extraction kicker has been solved by offsetting (in time) kicker modules to provide cancellation of non-uniformities. The price is a longer risetime that does not quite meet the specification. While nominally acceptable the timing is now tight and leaves little flexibility.

  Recommendation: Evaluate the relative impact of not meeting the design value for the RCS extraction kicker risetime, which is 263 ns, and pulse flatness, which is 1%.

- The committee found the RCS simulations to be much more realistic than a year ago, now including power supply tracking, BPM resolution, and magnetic interferences. However, the simulations indicate that the 4 kW loss budget cannot be met with a delivered beam power of 600 kW, based on a 181 MeV injection energy. The simulations extrapolate satisfactorily to 1 MW of beam power with a 400 MeV injection energy.

  Recommendation: Continue to improve the integrated tracking simulation, including the longitudinal dynamics.

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

  Recommendation: Prepare an improvement plan for the RCS collimator system to provide sufficient margin to cope with realistic operations scenarios.

- In last year's report we recommended coating the ferrite and aluminum surfaces of the extraction kicker with TiN to suppress secondary electron yield. This recommendation appears to have been misinterpreted to be aimed at improved vacuum. The recommendation is repeated here.

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

- Tests of the stripping foil with H-, as suggested by the committee last year, have been initiated. However, the stripping foil still does not show the required lifetime. A new foil material, hybrid boron carbon (HBC), is under development and shows promise for being more robust than commercially available carbon foils.

- Several items are on the critical path to the scheduled start of beam commissioning in September (corrector power supplies, rf stations (10 stations minimum), and septa). While our judgment is that the schedule is achievable these items represent a schedule risk and will require continuing attention.

- The transverse impedance of the extraction kicker has now been measured, as recommended in last year's report. The result is higher than anticipated. The level is high enough to provide a potential limitation in beam intensity in the RCS.

  Recommendation: Verify the impedance measurement and, if confirmed, prepare appropriate remedies and a back-up plan.

- The committee concurs with prior years' assessments relative to RCS performance: 0.33 MW beam power represents a lower limit on achievable performance in the RCS with a 181 MeV injection energy. 0.4-0.6 MW remains plausible, but will require successful solutions to the collimator and, possibly, the kicker impedance issues described above. Recovery of 1 MW performance will also require restoration of the linac energy to 400 MeV.

- To summarize: The committee has assessed the most significant impediments to full (1 MW) performance in the RCS as follows:

– 181 MeV injection energy
– Collimation system/loss budget
– Potential beam instabilities due to either kicker impedance and/or electron cloud

MR (Other than Accelerating Cavities)

Good progress has been made on many fronts. Dipole, quadrupole, and sextupole installation are roughly 90% complete and very significant progress has been made on the rf structures problem identified last year. Activities are aimed at a May 2008 start of beam commissioning, consistent with last year's schedule. Accelerator modeling has incorporated several improvements suggested by the committee a year ago. The modeling raises several concerns in our mind as described below.

Comments and Recommendations

- The single pulse accident, identified in the worst case as an unintended extraction kicker fire, is now recognized as potentially destructive to the extraction septum. The proposed solution, a passive mask in front of the current septum, appears to the committee as a potentially viable solution and should be pursued.
- Serious problems have been identified in the extraction kicker including failure to meet both risetime and voltage requirements. Potential solutions have been identified but will take a while to confirm and implement. A strategy has been developed for operations through the summer of 2010 including: MR operations with 6 bunches, rather than 8, and modification of the kicker magnet to increase the voltage capability. The committee notes that this mode of operation implies a 25% reduction in beam power.

  Recommendation: Develop and install a kicker meeting the performance specification as a high priority item.

- Comprehensive modeling was presented which indicates that the loss budget for the MR (450 W on an individual collimator) cannot be met with a beam power above 150-200 kW. The committee regards this as a serious issue that must be overcome.

  Recommendation: Reassess the operating scenario to establish a goal of 450 kW performance with the 181 MeV linac. Such a reassessment could include increasing the loss budget at 3 GeV, means for providing longer bunches, and/or possible reduction in the cycle time.

  Recommendation: Depending upon the outcome of the above reassessment, reexamine the decision to operate the neutrino program at 30 GeV, rather than 40 GeV.

- The issue with the extraction kicker, plus problems with cracked ceramics in the extraction septum, represent the primary risks to achieving the May 2008 date for start of MR beam commissioning.
- The transverse impedance measurement described above on the RCS kicker has not been completed on the MR extraction kicker.

  Recommendation: Complete transverse impedance measurements of the MR kicker including the powering cables and the pulse forming network.

- The commissioning schedule and initial operations plan shows operations at 100 kW through 2010. The committee believes this is too modest a goal (especially in 2010).
- The plan for restoration of full (~750 kW) beam power with the 181 MeV linac is now based on 8 bunch (h=9) operations in the MR, coupled with h=1 operations of the RCS. There are sufficient accelerator physics uncertainties associated with such a scenario that the committee is unable to comment on viability. Among the issues that need to be studied are modifications to the RCS rf system, space charge, and beam stability issues in the MR.
- The committee concurs with last year's assessment relative to MR performance with h=9 and 181 MeV linac: 0.45 MW should be achievable in this mode contingent on resolution of the loss management and kicker issues described above. The committee remains convinced that the minimal risk path to 750 kW in the MR includes a 400 MeV linac
- To summarize: The committee has assessed the most serious impediments to full (0.75 MW) performance in the MR as follows:
  - Management of losses in the 3 GeV transfer line and during injection into the MR
  - 181 MeV linac
  - Extraction kicker
  - Possible beam instabilities related to either kicker impedance or electron cloud

RF Cavities for the RCS and MR

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

Comments and Recommendations

- A very significant mobilization of effort was undertaken over the last year to address the rf issues. Two new test stands were brought on line, one at KEK and one at JAEA, supporting extended testing of a wide variety of cavity configurations.
- The initial RCS rf system is being fabricated from uncut cores, augment by parallel inductors to provide the required cavity Q. Water cooling has been retained. Performance on the test stand has been good. All stations are subject to 300 hour high power testing before installation in the RCS.
- The initial MR rf system is being fabricated from cut cores, with the gap subject to diamond polishing. This process eliminates the acid etch that was deemed the primary source of the problems. Because the polished surface does not allow for utilization of a sealant, deoxygenated water is used as the coolant. Two such accelerating cavities have been successfully subjected to more than 1000 hours of high power testing. Only five cavities are planned to be available for commissioning. Adequate resources remain to be allocated for modifying an existing prototype which would provide a sixth system.

Recommendation: Provide adequate resource for the sixth rf system to be installed in the MR.

- In acknowledgement that problems could occur over the long term an R&D team has been assembled and is investigating the possibility of developing a cavity based on utilization of oil (paraffin) as the cooling medium.

  Recommendation: Studies of alternative cooling schemes should be actively pursued.

- The committee believes the strategy being pursued is technically sound and is likely to support the needs of the J-PARC complex throughout commissioning and the first year or two of operations. However, long term performance remains a risk.

  Recommendation: Continue to follow the new strategy for the RCS and MR rf systems, including the development of longer term solutions. One additional system of each type should be built to allow this effort to be pursued and to serve as potential spares in case of a major failure.

- The committee is concerned that the capability for high power testing of complete accelerating cavities at JAEA will disappear shortly as the test stand is relocated into the RCS as part of the RCS rf system. It is the opinion of the committee that this capability must be retained to support the long term goals of the J-PARC complex.

  Recommendation: Retain a high power test stand on the JAEA site.

Controls and Global Systems

The controls system has successfully supported the commissioning of the linac. This significant achievement demonstrates the basic viability of the system. The committee offers our congratulations to the controls group.

<u>Comments and Recommendations</u>

- The committee is concerned about the development of high level applications programs to support the commissioning and operations of all machines. The development and implementation of HLAs requires close coordination between the controls group and the commissioning teams. Although there are regularly meetings between these two teams, it did not appear to the committee that a master list of required applications, accompanied by detailed specifications, manpower estimates, and assignment of responsibilities, had yet been developed.

  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 staffing level of the controls group appears marginal to the committee. However, we do not have sufficient information to assess the overall need. We suggest that management review the staffing level of the group.

Recommendation: Management should review the staffing level of the controls group in parallel with the identification of needs implied by the above recommendations.

Commissioning and Initial Operations Planning

The ATAC found fairly detailed plans covering the period of final installation and commissioning of the RCS and MR.

Comments and Recommendations

- The committee did not see the level of integration across machine boundaries, the identification of required resources, and specification of required HLAs that we would have expected. The committee believes that successful integration of this activity and the transition to operations can only be accomplished under the direction of a full time dedicated leader with the responsibility and authority for commissioning the accelerator complex.

  Recommendation: Identify a commissioning team leader with responsibility and authority for coordinating the commissioning of the entire J-PARC complex, including the transition to operations. An integrated commissioning plan should be developed containing the roadmap towards Phase I design goals and defining technical, schedule, cost, and personnel requirements.

- While the RCS and MR commissioning plans were well thought out and sufficiently detailed, the RCS plan did not extend beyond the start of MR beam commissioning, and the MR plan extended through first year of operations.

  Recommendation: The integrated commissioning plan should include the transition to operations and should be discussed with, and made available to, the user community. The published plan should include estimates of performance, anticipated reliabilities, and the time allocation between users and accelerator physics.

- The committee feels establishment of a downtime log, and an equipment tracking log, is an important component of optimizing efficiency of operations within the complex. Such a log should be established immediately.

- The committee found it difficult to assess progress against commissioning goals because no document exists in which operational and commissioning performance goals are succinctly described and compared with current achievements.

  Recommendation: Establish and maintain tables of major beam parameters containing Phase 1 design goals, commissioning goals, and currently achieved performance for each element of the accelerator complex.

- The committee is concerned about the availability of spare parts and components as commissioning and subsequent operations are initiated. For example, the number of spare klystrons currently available is based on an expected (but unconfirmed) lifetime (30,000 hours) and the leadtime for procuring a klystron (1 year).

Recommendation: Establish a spares strategy based on a risk analysis incorporating mean time between failure (MTBF), performance impacts of failures, fabrication/procurement lead times, costs, etc. Such a strategy should be used as a basis for establishing the spares component of the operations budget.

LINAC

Three presentations were given on the progress and commission of the linac. The Committee was impressed with the great progress on the Linac commissioning: achievement of a 5 mA, 50 _s, 2.5 Hz, 181 MeV beam after a very short time and on schedule. Further progress included single shot operation and beam to the 0˚ and 30˚ beam dumps.

The ease with which the beam set up was achieved owed much to the accurate alignment of the linac components and to the foundations which showed good stability following the initial settlement of a few mms.

Linac operation, at the current intensity, is now licensed following a satisfactory government inspection.

Ion Source

A new ion source has been selected since ATAC in 2006 using a LaB6 filament to increase the source life time and increase the ion current. This source can operate at the beam current and duty factor required for the J-PARC #1 stage. The problem with this source is the unstable operation at high duty factor at 30 mA of H^- current. The plans are to install a new hybrid arc power supply to stabilize the arc current. The hope is that this power supply will solve the stability problem and the pulse current sag of about 10% for the 600 _s beam pulse.

Pre-chopper and chopper

The pre-chopper and ion source have been installed in a shielded enclosure but the the pre-chopper has not been used for first four linac commissioning runs. The plan is to only use the chopper for the 5 mA beam current and short pulse lengths needed for the preliminary commissioning of the RCS. The chopper will be able to chop the beam and the chopper slits will tolerate this low beam current. Preliminary test indicate a Graphite target may withstand full beam of 30 mA, 25Hz and 500 _sec with chopping ratio of 50%. These tests were only for one hour so the life time of the chopping target at this high current has not been proven to be sufficient. Chopping the beam is required for injection of the beam into the RCS. It is important to test the pre-chopper as soon as possible to test the effectiveness of the shielded enclosure. In addition, making the pre-chopper and chopper work together to minimize the beam striking the chopper target is difficult. The committee remains concerned about noise from the pre-chopper and we suggest continued attention to this item.

RF

The 20 Klystron rf systems are now operating well with closed loop control over the field amplitude and phase. This includes many systems with one klystron feeding two SDTL cavities and control is via the summed vector cavity fields of the two cavities, leading to a good reduction in the number of klystrons. The trip rate on the Klystrons may be a little high for full operation but it is assessed that this is due to noise in the crowbar trigger circuits which is being worked on.

The 12 MHz optical reference has been replaced with a 312 MHz reference to remove a source of phase error. The 312 MHz reference is used directly as the local reference frequency eliminating most sources of phase error. The 312 MHz optical reference line has proven to be very stable.

The performance of the feed back system could be improved. There appears to be about a 6% over shoot when filling the cavities. The beam loading from a 5 mA 20 _s pulse caused the amplitude in the cavity to drop by about 2%. The response time of the feedback appears to be about 20 _s so the feedback system will not be able reduce this transient and when the beam current is increase to 30 mA the drop in the cavity field will increase proportionally. Feed forward will be required to reduce the drop in the cavity fields when the beam is turned on. The plans are to implement feed forward.

MEBT, DTL, and SDTL tuning.

The bunchers in the MEBT were commissioned with the aid of fast current transformers (FCT). The FCT's were used to measure the time of flight of the beam to measure the energy. By scanning the phase of the bunchers and measuring the beam energy the phase and amplitude of the bunchers could be measured. This technique showed the bunchers could be adjusted to within 5% and 5 deg. of the required accuracy.

The DTL's were also adjusted with the aid of the FCT's. The amplitude and phase of the SDTL tanks were scanned and a particular signature of the variation of the beam energy exiting the DTL versus phase and amplitude was used to set the phase and amplitude of each of the 3 DTL tanks in turn.

The SDTL's are too short to look for a particular signature to adjust the amplitude and phase. So the phase of the SDTL's were scanned over a much larger phase range to measure the full change in energy the SDTL could apply to the beam. The amplitude and phase were then set from this information. For the initial tuning of the SDTL only the 2 FCTs that were placed between pairs of SDTL tanks were used so that the measurement could proceed quickly. The entire SDTL was commissioned in only one day with this quick procedure. The commissioning of the SDTL was accomplished by adjusting the amplitude and phase from the local control panels at each klystron, not from the control room. A more accurate procedure is planned with more widely spaced FCT's, but this more accurate procedure requires the SDTL tanks between the FCT's be detuned.

Beam Diagnostics.

Use of the beam diagnostics for intensity, beam position and beam loss monitoring allowed testing of all these devices and provided a useful start to beam parameter measurements. Some electronic noise problems were detected.

The beam loss monitor (BLM) near the debuncher 2 entrance showed some signal of beam loss and a steering magnet was adjusted to minimize this signal. The residual radiation level after run 3 was 88 _Sv/h at the entrance of the second debuncher. This is a fairly high radiation level after a short run with low beam current. The beam loss monitor signal was small so it may not be sensitive enough to minimize the beam loss.

Debuncher tuning.

FCT's and time-of-flight measurements of centroid beam energy will be used to tune the phase and amplitude of the debunchers. This may be sufficient to set the phase and amplitude to the theoretical values that give the minimum energy, but without some means to measure the energy spread of the beam there is no guarantee the debunchers will be set correctly.

ACS accelerator.

Conventional Annular Coupled Structures (ACS) with two coupling slots between the accelerating cells and coupling cells are subject to problems from higher order modes in the annular coupling cavity. The J-PARC ACS structure has been designed with four coupling slots so the quadrupole mode in the coupling cavity is not coupled to the accelerating cavity. This completely eliminates problems with higher order modes in the coupling cavity. The first higher order mode in the coupling cavity that could couple to the accelerating mode would be an Octupole mode. The Octupole mode will be much higher in frequency and can safely be ignored.

Good progress has been made with the ACS cavities. The manufacturing technique has been established with the component machining and brazing being carried out in industry. The method for obtaining the correct frequency of the bridge couple cavities is well established. However, with only one company involved it is estimated to take three years to manufacture a full set of cavities for the 400 MeV upgrade. The prototype ACS buncher module exhibits a shunt impedance that looks low to the committee. We suggest that the result be confirmed.

3 GeV RAPID CYCLING SYNCHROTRON

The 3 GeV Rapid Cycling Synchrotron(RCS) is located in a 348 m long tunnel and will provide proton beam to a high power neutron spallation target as well as to the 50 GeV Main Ring (MR). With a beam intensity of 8.3×10^{13} protons per cycle, a repetition rate of 25 Hz and an injection energy of 400 MeV, the RCS can deliver 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 is likely to exceed beam loss limits in the RCS and in the transport lines to the neutron spallation target and the Main Ring.

In many excellent presentations the impressive progress in the component construction and equipment installation in the RCS tunnel was described to the committee. Although the completion of the hardware construction has slipped significantly compared to last year's schedule 90% of the subsystems are complete. Four out of the ten rf accelerating systems are installed and the remainder will be installed from April along with 54 calibrated beam position monitors. The project is still planning to start beam commissioning in the RCS by September 2007 and a detailed commissioning plan has been prepared.

Note that findings, comments and recommendations with regard to the RCS rf system are included in the separate rf section.

Comments and Recommendations

- The new Hybrid-Boron Carbon (HBC) foils, developed by the project team, have been tested both with low energy Ne beam that simulates the foil heating of the full intensity H^- beam as well as with 750 keV H^- beam. The performance was compared with the performance of diamond foils that are used by SNS and Carbon foils used at LANL. The HBC foils have a very long lifetime exceeding the performance of the diamond foils by an order of magnitude. The only concern is the existence of a number of pinholes in fresh HBC foils that increases with irradiation. This may be overcome with better manufacturing or use of multiple thinner foils. The project has also increased the power capacity of the beam dump for the unstripped H^- to 4 kW.

  Recommendation: None

- In the RCS five transverse collimator systems are being 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. 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. The project's simulations show a 20% margin for each jaw and it has decided to test the current system during commissioning and upgrade or replace it later if needed. The committee still thinks that it is likely that under operational conditions, with up to 36 kW of beam power from the 181 MeV linac, the heat load on an individual collimator jaw will exceed the specification. The design of a new collimation system for the RSC with improved cooling and shielding should start as soon as possible.

Recommendation: Prepare an improvement plan for the RCS collimator system to provide sufficient margin to cope with realistic operations scenarios. Ensure radioactive handling equipment, such as container flasks, is available for exchanging the collimators.

- First measurements of the longitudinal and transverse impedance of the RCS extraction kicker system that included the powering cable and the pulse forming network were presented. The measurements agree reasonably well with calculations. Due to reflections in the cable the transverse impedance reached values of up to 10^5 Ohms/m. This is significantly above the calculated instability threshold. Possible schemes to suppress the reflections with diodes were discussed. Alternatively the kicker impedance could be matched to the cable impedance at a significant loss of kicker strength. It is difficult to accurately predict whether this impedance will actually lead to instabilities in the RCS. However, contingency plans for this possibility should be developed as soon as possible, which could include the construction of a transverse damper and/or a redesign of the RCS extraction kicker.

Recommendation: Verify the impedance measurement and, if confirmed, prepare appropriate remedies and a back-up plan.

- The pulse flatness of the extraction kicker magnets was improved to ± 2.7% by better impedance matching and by compensation from the induced flux from the opposite c-type core. The design flatness of 1% was then achieved by miss-timing individual modules at the expense of increasing the kicker rise time from about 250 ns to about 360 ns. This rise time is now slightly bigger than the bunch gap of 350 ns. The project should continue with its program to improve the RCS extraction kicker rise time and pulse flatness and also evaluate the relative beam loss associated with not meeting the design value for rise time (263 ns) and pulse flatness (1%).

Recommendation: Evaluate the relative impact of not meeting the design value for the RCS extraction kicker rise-time, which is 263 ns, and pulse flatness, which is 1%.

- The full hardware commissioning of the resonant power supplies powering the seven quadrupole circuits in the RCS ring has mainly been completed and the commissioning of the main dipole power supply will start in April. Tracking errors were reduced to less than 1.5% by adjusting amplitude and phase of the power supplies. The resulting expected tune swing is less than 0.05. Further reduction to the design value of 0.01 will require additional higher harmonic drive of the power supplies. Detailed measurements of the effect of close placement of one magnet to another showed that few problems existed and that any that did could be corrected by small changes in the correcting magnet currents.

  After powering the quadrupole magnets a problem with loosening of bolts holding quadrupole magnets together has been identified. The problem appears to be due to the torquing procedures. The problem appears to the committee to be understood and should not pose a threat to performance provided that it receives continuous attention in the future.

Recommendation: None.

- An improved multiple particle tracking calculation with space charge was presented that includes the multi-pole components and field and alignment errors of the dipoles and quadrupoles and the measured power supply tracking errors. For 0.3MW operation the losses were less than 1 kW. For the 0.6MW operation the losses exceeded the collimator limit of 4 kW. These tracking calculations should be extended to include longitudinal injection painting and the proper evolution of the RF bunch shape throughout the whole magnet cycle.

  Recommendation: Continue to improve the integrated tracking simulation, including the longitudinal dynamics.

- 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.

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

- The RCS commissioning plan includes storage ring operation of the synchrotron at the injection energy. Use will be made of the extraction kickers to extract the beam after about 100 _s by independently triggering two halves of the kicker to deal with the lower rf at injection. An alternative method to consider would be use of the steering magnets to dump the beam on the collimators. This would also allow the safe dumping of an unbunched beam or a beam that is debunching due to its inherent momentum spread when no rf is on. The debunching time provides a good measure of the linac momentum spread after passing through the injection foil.

50 GeV MAIN RING

Installation of magnets, vacuum vessels, and other equipment is underway almost on schedule for the end of Nov. 2007. All components except for injection and extraction septa (to be installed in Feb. 2008 tentatively) will be installed and machine commissioning will be started from Dec. 2007 without beam. The first stage of beam commissioning including beam injection, COD correction, RF capture will be performed in May and June, 2008. The second stage of beam commissioning, which is assumed to take place tentatively from Dec. 2008 to Feb. 2009 includes beam acceleration to 30 GeV and slow extraction. The third stage including fast extraction to the neutrino facility is tentatively assumed to be performed from Apr. 2009. Every stage is expected to attain at least the 20% power level of commissioning goal in order to be approved from the point of view of radiation safety. Although the attainable beam power for day 1 operation of 0.1MW will match the user's minimum requirement for T2K collaboration (asking for 0.1MW beam delivery up to 2010 summer shutdown), the strategy to realize a final goal of beam power of 0.75MW with 50 GeV has not been clearly demonstrated.

The beam loss during the injection/extraction process of MR has been investigated. Matching between the beam emittance and hardware aperture is investigated in connection with beam collimation and emittance growth taking the loss budget into account. The beam loss during the injection process of four butches (8 bunches) is investigated including space charge effects by simulation and this beam loss seems to be in the acceptable range of beam collimator of MR only up to beam powers in the range 150-200 kW. Additionally, a protection device like a "dummy septum" might be needed to protect the extraction septum from single shot beam loss damage in the case of fire failure of the extraction kicker. The rise time of the extraction kicker is found to be too long at 1.6 μsec. If its modification is confined in the range of technically reliable one, then 6 (rather than 8) bunch operation with harmonic number 9 is proposed at the first stage in order to cope with this situation. As for the intensity upgrade plan to 0.6 MW, the harmonic 1 operation of RCS is mentioned, which, however, seems to require careful numerical studies concerning the space charge effects due to higher beam line density.

The magnets of the MR are evaluated in detail by field measurement with AC excitation including the effect of eddy current in the vacuum duct and they seem to be well in the tolerance for real usage, although evaluation of the AC characteristics at the beginning of ramping is further required for dipole and quadrupole and sextupole magnets.

Many technical problems related to the injection and extraction equipments are presented together with the possible improvement scheme. It is required to list the attainable beam parameters at each stage of beam commissioning with use of the presently available equipment in connection with the strategy to reach to the final design goal of the project with reference to the required additional resources.

RF status is discussed in the RCS and MR RF section of this report.

Comments and Recommendations

- The commissioning strategy for the MR, including the interdependencies with the other accelerators, is not yet totally well developed. See our recommendation under Commissioning and Initial Operations Planning.

- Simulation of slow beam extraction including the space charge effect is still to be performed.

  Recommendation: Slow beam extraction is also required to be simulated including space charge effect.

- It is pointed out that no storage space to keep activated equipments to cool down is prepared for MR.
- For the purpose of reducing the human exposure to radiation, a linear motion guide rail will be provided in order to expedite the servicing of highly activated components. Such a driving and positioning mechanism is found to be tolerable up to 10 MGy irradiation.

  Recommendation: Storage space of radioactive materials should be prepared before the first beam commissioning also for MR in order to restrict the human exposure to the radiation at the minimum possible level.

- Beam simulation including space charge effects and beam losses has been performed, demonstrating allowable beam losses during the injection process for the beam power from RCS up to 200 kW. Because some modification of injection equipment is expected, it is not clear if the simulation is performed assuming the real magnetic field errors.

  Recommendation: Re-assess the operating scenario to establish a goal of 450 kW performance with the 181 MeV linac. Such a reassessment could include increasing the loss budget at 3 GeV, means for providing longer bunches, and/or possible reduction in the cycle time.

  Recommendation: Establish the equipment list (especially for equipment such as kickers and septa to be modified or replaced) to be utilized for day 1 operation, and incorporate their field characteristics and dynamic performance into the simulation as soon as possible. Careful review of the reliability of the calculation and the tolerable power level on beam collimators is inevitable.

  Recommendation: Complete transverse impedance measurements of the MR kicker including the powering cables and pulse forming network.

- It is pointed out that the floor level is still varying. As almost all large facilities have been already constructed the floor level variation will become smaller.

  Recommendation: Carefully monitor floor variations and modify magnet alignments as necessary.

- The committee remains convinced that the minimal risk path to 750 kW in the MR includes a 400 MeV linac.

RCS & MR RF SYSTEMS

Magnetic Alloy (MA) disk-loaded cavities are planned for the RCS and MR synchrotrons of the J-PARC facility. This new type of cavity can provide a larger accelerating gradient than conventional ferrite-loaded devices, without needing any tuning system. It introduces however technological difficulties due to the nature of the magnetic alloy material and to the large heat dissipation which requires a very efficient cooling scheme, presently based on immersion of the cores in a flow of cooling water. The reports made during the ATAC meeting in 2006 showed that these issues were not yet satisfactorily resolved, the cores degrading fast in typical operating conditions for the RCS and MR. The ATAC report therefore recommended a vigorous set of actions to demonstrate as soon as possible the benefits of the planned improvements during test runs exceeding 1000 hours and to start investigating alternative possibilities.

Each cavity requires an amplifier capable to deliver 600 kW of RF power. A number of these devices had already been built and operated since a few years, and series construction was planned during the year 2006.

A sophisticated low level RF system is necessary in both synchrotrons to provide the traditional phase and radial loops, to allow for synchronization between the accelerators at beam transfer and to compensate beam loading in the cavities. The fundamental design principles were reported in 2006, and construction of most of the electronics was foreseen during the following months.

Findings

Cavities technology

The "natural" Q with uncut MA cores is lower than 1. To minimize potential well distortion from the high beam current, a slightly reduced cavity bandwidth and hence a slightly higher Q are necessary. This can be obtained by cutting the MA cores and providing a small gap between the two halves. Control of the gap size enables control of the cavity Q.

Because of the need of immersion in cooling water, water-tight coating is needed.

Although the development of the coating and cutting techniques have been refined for many years by the RF team, many processes combine to degrade the cores after testing during a few hundred hours at high beam power. Efforts have been considerably increased during the last twelve months to address these problems, and two additional RF test stations have been set-up, one at J-PARC and one at KEK. As a result, significant progress has been made in the understanding and cure of these phenomena.

For the uncut cores, the following sources of troubles are now diagnosed:

- anomalous reduced resistance between layers,
- scratches on the core surface.

Their treatment involves numerous changes in the production process, like the silica coating, the winding of the cores which has to be horizontal with dual ribbons and with a rather weak tension, epoxy immersion, etc. Moreover, a very careful handling during manufacture and a detailed quality control procedure based on visual checks and electrical measurements are now systematically applied. In total, some 150 cores have been characterized during 2800 hours of high power tests.

The situation seems now reasonably mastered, uncut cores fabricated with that last procedure having successfully passed the 1000 hours high power test in an RCS cavity.

For the cut cores, many problems have been understood as related to short-circuits between layers of the FineMet winding and chemical activity of the remaining acid used in some cases to "clean" the cut pieces. Many different cutting and cleaning techniques have been tried.

Good results have finally been obtained combining water-jet cutting with diamond polishing of the cut part. Because of the very smooth surface after diamond polishing ("mirror-like"), epoxy coating does not hold and therefore cannot be applied. Therefore very low oxygen-content water must be used as the cooling fluid. Two 1000 hours high power tests have validated this solution and series production of cut-cores for the MR has now started.

For the RCS, the initial plan was to use cut cores also. However, since a Q of ~2 is needed (instead of ~10 for the MR), the gap between the half cores has to be smaller than 1 mm (instead of ~10 mm for the MR). This is uncomfortably small in terms of machining precision and for cooling reasons. Therefore the proposal has been made to connect an external inductor in parallel with the cavity using uncut cores, to reduce the overall inductance and increase the quality factor of the resonator.

After testing, this new technique has been properly demonstrated and will be systematically applied in the RCS.

A longer term work program has been launched in parallel to investigate the possibility to avoid using water as the cooling fluid. Normal paraffin has been selected as the most promising material, because of its characteristics and because of the existing experience in KamLAND and KEK-B. Preliminary investigations have shown that similar cooling performance to water can in principle be obtained (although at higher flow), and that radiation should not noticeably alter the characteristics.

A mock-up test for the oil flow is in preparation and a full design of a cavity will be ready for the summer 2007. The construction of a prototype system will then be considered, but no time scale has been given.

Cavities fabrication

For the RCS, 10 cavities will be available in time for commissioning (4 are already installed). For safety, they will not operate beyond 85% of the nominal accelerating field. No spare is included. The RF team asks for 2 more systems, to bring the total number to the initially foreseen amount of 12.

For the MR, six cavities are foreseen. Five are being prepared for installation according to the MR planning. The 6th one being a prototype, it will take more work and resources for preparation. For safety, these cavities will be limited to 90 % of the nominal accelerating field. The RF team asks for the construction of an additional system as a spare.

For the needs of installation in the RCS and MR, the existing test stands will be dismantled, so that no more high power tests will be possible outside the rings.

RF amplifiers

All high power amplifiers have been built (10 for the RCS, 6 for the MR), as well as the DC power supplies. The 10 drive amplifier units (CERN-designed 8kW) for the RCS are available. Three units for the MR will be delivered in March 2007; the remaining three will be ordered in April for delivery in August 2007. Four parasitic resonances have been found in the high power amplifier and cavity combination. The frequencies range from just over 1MHz to 20 MHz. The causes and damping mechanisms are being considered.

Low Level RF

The LLRF for the RCS and MR includes all the necessary loops to stabilize the beam, to control the field in the cavities even in the presence of heavy beam loading and to synchronize RFs for beam transfer. The design and construction of the VME-based electronics is well advanced (almost fully ready for the RCS – in construction for the MR) and most functionalities have already been tested. A procedure for adjusting the beam loading compensation has been elaborated. The principles for the generation of the beam-related timing and for the synchronization between successive accelerators have been well thought-out.

Comments & recommendations

- The ATAC acknowledges the large efforts made in the study of the MA-loaded cavities and of the FineMet cores. We note that last year's recommendations have been seriously taken into consideration.
- Remarkable progress has been obtained, to the point where cavities can be confidently prepared and installed in the RCS and MR, with the perspective of at least a few years of operation without trouble. The solution selected for the RCS is original and allows for using uncut cores while providing adequate RF performance for full beam power for the RCS. The solution adopted for the MR is also satisfying, but will require a carefully controlled water cooling circuit with minimum oxygen content.
- In all cases, experience is lacking on the long term evolution in operational conditions and high RF power. Therefore the committee is satisfied that the study of oil-cooling has been launched as a potential alternative solution in the long term.

  Recommendation: Actively pursue the study of the solutions that will be implemented in both rings and the possibility to improve them, as well as the development of alternative cooling schemes. Consider the safety requirements associated with the use of paraffin.

- The foreseen dismantling of the existing high power test places will not allow for these mandatory developments to continue.

  Recommendation: Preserve at least one high power RF test stand. Use the test facility to find solutions for damping the parasitic resonances in the cavity amplifier combination that may be excited by the intense beam current.

- Moreover, the planned number of RF systems to be installed in both rings will be marginal, especially considering the need to operate them 10 to 15% below their nominal gradient, no spares are included, and no system will be left available outside of the rings.

  Recommendation: Provide adequate resource for a sixth RF system to be installed in the MR and for building one additional system of each type to allow the development effort to be pursued and to serve as potential spares in case of a major failure.

CONTROLS AND GLOBAL SYSTEMS

The committee notes the important contributions made by the controls team to the successful and timely commissioning of the linac. All critical systems – including the PPS, MPS, timing and network infrastructure – were available when needed and performed well. The control room was equipped to support initial operations and some high-level applications were available to support the physics program. Equipment installation for the RCS is keeping pace. Together, this is a notable achievement for so small a group.

Comments and Recommendations

- The committee is concerned about the development of high level application programs (HLAs) to support the commissioning and operation of all machines. The development and implementation of HLAs requires close coordination between the controls group and the commissioning team. Although there are regular meetings between these two teams, and a detailed commissioning plan was presented for both the RCS and the MR, it did not appear to the committee that a master list of required applications, accompanied by detailed specifications, required dates, manpower estimates and responsibility assignments, had yet been developed. In addition to preparing for RCS and main ring commissioning, improvements are required to existing applications, including automation of phase scanning support for the linac and improvements to orbit correction programs.

  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.

- Some existing applications, in particular those relating to the setting of or the collection, analysis and distribution of waveforms, do not yet operate at the necessary 25Hz rate. Some redesign of drivers or even of interface hardware may be required to meet this requirement. It is important to be realistic with the requirements specification here – not all waveforms may need to be collected at the full repetition rate.

- The proposed use of virtual servers to help address some of the configuration management concerns related to large numbers of servers is applauded. Care must be taken in the configuration of such a set-up, however, and precautions taken against single points-of-failure.

- There is no consistent tool in use for alarm handling. This is not a satisfactory situation for operations, where a consistent view and response is required.

  Recommendation: Identify one tool for alarm handling in the control room, and apply it uniformly to all parts of the accelerator complex. Any one tool will do – more than one will not.

- The staffing level of the controls group appears marginal to the committee. We do not have sufficient information to assess the overall need; however the controls group leader acknowledged difficulty himself in assessing availability of resources, and concern about achieving “full device control” in time for RCS commissioning. Device control is below the level of the HLAs, and a necessary prerequisite.

Recommendation: Management should review the staffing level of the controls group in parallel with the identification of needs implied by the above recommendations.

COMMISSIONING, INITIAL OPERATIONS, AND ACCELERATOR PHYSICS

Beginning in November 20, 2006, 9 linac beam commissioning runs are planned each lasting for 12 days. During each run, beam is on 12 hours a day. At the time of this A-TAC review, 4 such runs have been concluded. At run-1, the H- beam energy reached 3 MeV with a pulse width of 50 us and a peak current of 30 mA at a repetition rate of 5 Hz. At run-3, the H- beam energy reached 181 MeV with a pulse width of 50 us and a peak current of 5 mA at a repetition rate of 2.5 Hz. At run-4, the beam was chopped at 50% duty within the macro-pulses.

Beam commissioning of the RCS is scheduled to start in September 2007. Beam commissioning of the MR is scheduled to start in May 2008. Experiments are scheduled to start sometime in Japanese Fiscal Year 2008.

Comments and recommendations

- As the project approaches the final period of construction, budget, schedule, and personnel needs are increasingly demanding. It is necessary to clearly define the project goals of phase I and the commissioning goals in comparison with the achieved status in terms of major machine and beam parameters including energy, intensity, repetition rate, emittances and momentum deviation, and beam loss/activation through all major sections of the accelerator complex. It is also necessary to develop a clear roadmap towards the phase I goals so that budget, schedule, and personnel needs can be planned.

  Recommendation: Establish and maintain tables of major beam parameters containing phase I design goal, commissioning goal, and currently achieved performance on each section of the accelerator complex. Develop a roadmap towards the phase I design goals defining technical, schedule, cost, and personnel requirements.

- As the committee has observed and recommended in previous years, J-PARC is a complex facility consisting of linac, RCS, MR, transfer lines connecting various accelerators, transfer lines to various experimental stations, and beam dumps. It is essential to identify a leader on accelerator physics coordinating the overall physics design, interfacing, and design and construction “quality assurance”. This leader should coordinate the overall commissioning and plan the path beyond.

- Presently, the committee did not see the level of integration across machine boundaries, the identification of required resources, and specification of required HLAs that we would have expected. The committee believes that successful integration of this activity and the transition to operations can only be accomplished under the direction of a full time dedicated leader with the responsibility and authority for commissioning the accelerator complex.

Recommendation: Identify a commissioning team leader with responsibility and authority for coordinating the commissioning of the entire J-PARC complex, including the transition to operations. An integrated commissioning plan should be developed containing the roadmap towards Phase I design goals and defining technical, schedule, cost, and personnel requirements.

- For SNS, effects of beam coupling impedance from extraction kickers and their power supply PFN have been of major concern. Many years of efforts were made including terminating the PFN to a resistor, optimizing the inner dimension of the kickers, and selecting the permeability of the ferrite, resulting in orders-of-magnitude reduction of impedances comparing with non-optimized designs. Another SNS concern was on bare ferrite surfaces without TiN coating, since the electron secondary emission yield can be exceedingly high resulting in excessive electron-cloud formation causing performance degradations. ISIS experience indicated that programming of the transverse tunes with trim quadrupoles was essential in avoiding resistive wall instabilities after injection painting. Such experiences should be carefully studied and compared.

Recommendation: Perform beam collective-effect analysis assessing the impact of extraction kicker coupling impedance and realistic electron secondary-emission yield from uncoated surfaces of the beam chamber including the extraction kickers in both RCS and MR. Develop remedies and back-up plans. Optimize back-up designs under the guidance of impedance measurement and analysis.

- As the project team realized, spares is an important issue affecting commissioning progress and project cost. Two classes of spares can be defined: construction spares and operational spares, and non-constructional funds may be sought after to cover part of the needed spares. A formal document containing performance risks, mean-time-between-failure, procurement lead time, and cost of all major components can be important both in the planning and in convincing the management agencies.

Recommendation: Prepare a document on construction and operational spares containing mean-time-between-failure, performance impact of failures, procurement/fabrication lead time, and cost of major components.

- Areas of bottlenecks will exist limiting the intensity/power performance and upgrade of the facility. Activation level will be high in such "hot spots". For example, a possible spot is the collimation region of the transfer line between RCS and MR when the acceptance reduces from more than 320 pi mm mr to 53 pi mm mr at the collimators. Special attention is needed in assuring machine performance, maintenance, and future upgrades.

Recommendation: Continue to identify potential "hot spots" and intensity/power bottlenecks across the whole accelerator complex. Develop back-up plans on the operation and maintenance of such areas, for example the collimation region of the RCS-to-MR transport line.

- As shown in SNS ring construction and commissioning experience, injection region demands special attention due to technical challenges of the pulsed systems, complexity of the devices, space limitation between the components, and maintenance demands.

Recommendation: Perform beam-dynamics simulations of both the circulating beam and the beam to the injection dump of the RCS incorporating measured

magnetic fields, magnet interferences, magnet and stripping foil placement, and chamber aperture of the entire injection region.

- According to the experience at ISIS and BNL AGS/Booster, transverse tune control with trim quadrupole and resonance correction with multipole correctors are essential in beam loss reduction and high intensity operations. Presently, trim quadrupoles are not in the project baseline for RCS, and implementation may require significant modification of the installed components.

  Recommendation: Develop designs and implementation plans of trim quadrupoles for tune programming in the RCS and resonance corrections in both RCS and MR.

Appendix: Meeting Agenda

ATAC2007 Agenda

March 1, Thursday

time		period (min)	Category	Title	Speaker
910	925	15	**Accelerator Overview**		Y Yamazaki
925	945	20	**Executive session**	*in camera*	
945	1000	15	**Linac**	Status of Linac	K Hasegawa
1000	1040	40		Beam Commissioning Results for the Linac	M Ikegami
<< coffee break >>		20			
1100	1120	20		Ion Source Issues	H Oguri
1120	1140	20		Conditioning and Tuning of the RF system & Cavities	T Kobayashi
1140	1200	20		R &D Status of the ACS for the Linac Energy Recovery	H Ao
<< lunch >>		70			
1310	1340	30	**RCS**	Status of RCS	H Suzuki
1340	1400	20		Beam Commissioning Strategy	H Hotchi
1400	1420	20		Beam Simulations in the RCS	P Saha
1420	1440	20		Field Measurements and Power Supply Commissioning	N Tani
1440	1500	20		Charge Exchange Stripping Foil	I Sugai
<< coffee break >>		20			
1520	1540	20	**Project status**		S Nagamiya
1540	1620	40	**Ring RF**	Status of Ring RF	M Yoshii
1620	1635	15		RF Cavity with Oil Cooling MA Cores	J Kameda
1635	1705	30	**Control**	Status of Control System	N Yamamoto
1705	1805	60	**Executive session**	*in camera*	
RECEPTION					
1845 ~ 2045 (Bus starts at 18:25 from the meeting place to the restaurant)					

March 2, Friday

830	900	30	**Executive session**	*in camera*	
900	930	30	**MR**	MR overview	H Kobayashi
930	950	20		Beam Loss Estimate of MR Injection/Extraction	M Tomizawa
950	1010	20		Space Charge Simulation and Beam Losses of MR with Realistic Conditions	A Molodozhentev
1010	1025	15		Maintenance Scenario for Radioactive Component	M Yoshioka
<< coffee break >>		20			
1045	1100	15		Commissioning and Initial Operation Plan	T Koseki
1100	1115	15		Magnet Tracking	K Niki
1115	1155	40		Pulse Device Issues	H Matsumoto
1155	1215	20	**Impedance and instability**	Impedance and Instability of RCS/MR	T Toyama
<< lunch >>		60			
1315	1630	195	**Tour J-PARC**		N Ouchi (Linac) / M Kinsho (RCS/HENDEL) / M Yoshioka (MR)
1630	1800	90	**Executive session**		

March 3, Saturday

900	1100	120	**Executive session**	*in camera*	
1100	1200	60	**Report to project team**		S Holmes
<< lunch >>		75			

adjourn