Report of the 20th Meeting of the Accelerator Technical Advisory Committee for the Japan Proton Accelerator Research Complex (J-PARC)

February 1 – 4, 2021
Remote Zoom Meeting

The Accelerator Technical Advisory Committee (ATAC) for the J-PARC Project held its twentieth meeting from February 1 to 4, 2021 via remote Zoom contention due to COVID-19 precautions. The ATAC members participating were: Alexander Aleksandrov (ORNL), Wolfram Fischer (BNL), Simone Gilardoni (CERN), Mats Lindroos (ESS), Toshiyuki Shirai (QST), John Thomason (STFC), Sheng Wang (IHEP), Robert Zwaska (FNAL) and Jie Wei (MSU, chair) (Appendix 1).

The ATAC thanks the J-PARC management and staff for their thoughtful arrangement of this remote Zoom meeting under the COVID-19 circumstances, and all the presenters for their excellent and comprehensive talks. Presentations were mostly given around midnight local time to accommodate the committee members distributed globally. In addition, the accelerator team responded appropriately arranging specific talks to the requests made at the last ATAC Review and to the questions and homework requests from the committee at this review.

Executive Summary

Since the last ATAC review held in February 2020, the J-PARC accelerator complex has been maintaining high beam power at an impressively high machine availability for a scientific user facility for both discovery and applications. The beam power for MLF operation is steadily above 600 kW with an availability of 95% and further power increases depend on the neutron target performance. The beam power for MR-SX to the hadron (HD) experimental facility has been maintained at 55 kW with 86% availability. The J-PARC RCS operated at 1 MW (MLF operating at 0.9 MW beam-on-target) power for 38 hours. The J-PARC MR operates at world's highest particle-in-pulse intensity (2.66×10^{14}) among synchrotrons. The MR slow extraction system operates at an impressive extraction efficiency of 99.5%.

The J-PARC team is commended for maintaining high user availability and work efficiency during the period of COVID-19 pandemic. Despite the COVID-19 challenges, J-PARC experience only a 25-day interruption to beam in JFY2020. Overall, The MLF operated regularly, with some interruptions due to target station issues. The MR operated minimally due to upgrades in its neutrino fast-extraction program, and licensing issues with its slow extraction program. J-PARC continued to show flexibility where possible to re-schedule user time when interruptions occur. User hours this year were limited, though availability was high, > 95% in the MLF when running. J-PARC has plans to increase user time in future years with adequate funding. Extended studies were performed at 1 MW and identified a number of issues with RF and cooling capacity in the RCS.

The MEXT Roadmap 2020 included J-PARC Accelerator, Neutrino, Hadron, part of

MLF-n, and Muse. The J-PARC Accelerator Division's responsibilities include (1) new power supply for MR, (2) beam power upgrades, and (3) commissioning towards high power within the Accelerator scope. The J-PARC Nuclear Transmutation Division's responsibilities on ADS R&D include (1) irradiation facility design, construction and operation, superconducting low-beta linac prototyping, beam controlling technology development, and (3) Pb-Bi target development, irradiation tests at PSI, and corrosion test with OLLOCHI.

Dr. Kazuo Hasegawa left J-PARC on March 2020. Since then, Dr. Michikazu Kinsho has been heading the J-PARC Accelerator Division.

The J-PARC accelerator team has addressed most of the twelve 2020 ATAC recommendations. Presentations were given at this review on the four topics requested by ATAC at the 2020 Review. Responses to three written questions and five homework assignments at the 2021 Review were timely and comprehensive. The committee commends the J-PARC team on their dedication and vigor addressing pressing issues.

In the following, we summarize the main recommendations of the 2021 ATAC. Each of the thirteen recommendations (**R1** – **R12**) will be elaborated multiple times across the main body of this report following committee findings and comments. The order of the main body of this report follows the thirteen talks (Appendix 2) and five homework assignments presented at this review.

The J-PARC acceleration complex has operated for over ten years. That operations and the previous construction of the J-PARC accelerators was performed with a relatively small, but very skilled group of accelerator scientists and engineers. Many members of the workforce have advanced in their careers and moved to other positions or retired. Continued loss of expertise will occur, while the demands of operating the machines continue. Work demands upon the staff have increased, and are acute in some areas, introducing significant risk. We encourage J-PARC to develop a strategy of organizing its workforce, understanding its strengths and weakness, and acting with purpose to develop its future workforce and skill base through aggressive hiring and training. This will be critical for any future developments at J-PARC.

R1: Develop a recruitment and succession plan for J-PARC staff. Particularly, catalog areas of expertise needed at J-PARC, and proactively plan to grow the skilled workforce. Identify areas of present labor shortage and work overloads, and work to address them.

The latest MPS failure to stop beam when an elevated radiation level was detected reinforces our concerns raised in the past reviews that the MPS system can have deficiencies in its logic, hardware design and configuration or operation practices. A lack of documentation available to the committee makes it difficult to provide good, practical advice on how to overcome possible deficiencies.

R2: Create and present at the next review the following documents:

a) **A document describing the MPS design, which includes description of the allowed beam destinations; of the means of confirming the proper beam destination; of the means for limiting beam power to the low power targets; of the beam shut off and abort devices with their trigger logic and reaction time.**

b) **A document describing the authority and approval chain for the MPS design changes; the long term configuration changes i.e., trip thresholds, abort trigger delays, etc.; the short term configuration changes i.e., temporary bypasses for beam study.**

c) **A document describing the MPS testing procedure after return from maintenance or after a significant configuration change.**

The MPS design started as a relatively simple system and many new functions have been added over years to cover newly discovered fault scenarios and to accommodate the expansion of the accelerator complex. It is not clear to us how well these additions were reviewed and if their integration into the original MPS is seamless. It is possible that a complete redesign can be an opportunity to incorporate all the lessons learned in a uniform way across the accelerator complex as a cost-effective long-term solution.

R3: Evaluate the capability of the MPS from the ground up, and explicitly consider options of upgrade or replacement. Assemble detailed requirements for MPS inputs and capability; they should be uniform across the accelerator complex and incorporate the lessons learned over years of operation. Include target station machine protection inputs. Report results of cost and benefit analysis at the next review.

The advantages of replacing the existing RFQ-MEBT system with a shorter RFQ and a new three buncher cavity MEBT wasn't evident for the panel. Furthermore, it was not clear for the panel why one needs new improved beam instrumentation in the MEBT before one can perform the necessary simulation and design work. A presentation of the expected gains with this change, the beam physics and machine studies needed and a plan for how to address the engineering aspects of the installation in a regular maintenance period would be welcome at the next ATAC meeting.

R4: Make a detailed presentation of the new "Short RFQ and MEBT1" system explaining the advantages of the new system from both a beam physics and an engineering perspective which justifies this change to the linac. As part of this, clarify why one needs the new and improved beam instrumentation for the simulations needed.

Many of the klystrons in the linac RF system are approaching their expected life-time with only a limited set conditioned spares being available. It is urgent to now condition the existing unconditioned klystrons off-line and to purchase enough spares to at least be ready to replace the eight 324 MHz and twenty-one 972 MHz klystrons within a few years.

R5: Continue to condition and purchase klystrons to assure that at least all klystrons which now approach their expected life time have a spare.

The beam loss studies have continued and the beam losses seem acceptable for 50 mA operation and possibly also for 60 mA operation. However, there was no convincing arguments presented that the origin of these losses are understood. We encourage the group to continue the beam loss studies in the linac with the aim to understand the mechanism behind the losses.

R6: Continue the beam loss studies at both 50 mA and 60 mA with the aim to improve the understanding of the main factors driving these losses.

The committee would have liked to have heard more about the planning for the July JFY2021 high power trial, and how this will build on previous experience.

R7: Study and present a detailed plan for the next 1 MW trial (presumably summer JFY2022), including any specific hardware and utilities upgrades that have been implemented, and identifying clear success criteria.

It is not completely clear what the J-PARC strategy is to overcome cooling issues for high power running during summer months. Three approaches have been mentioned: (1) reduction of RCS power consumption by replacement of RF cavities, (2) design of a new cooling water system, and (3) optimization of operational schedules (e.g. 1 MW in winter and 0.7 MW in summer). But no analysis has been presented of the overall picture.

R8: Develop a strategic roadmap for dealing with RCS power load as operation is ramped up to 1 MW and beyond.

It appears that cooling capacity is now the only limit to 1 MW operation of the RCS, and should therefore be addressed with some urgency, also taking into account the future requirements for future higher power operation.

R9: Study and present the analysis of the expected cooling and ventilation performances required for continuous, year-round 1 MW operation of the RCS at 1 MW and MR at 1.3 MW, including any progress on cooling system design work and indicating what further upgrades would be required for future higher power operation.

Losses induced by the beam instability occurring during the SX debunching process limits the maximum power delivered on target and risks to become a bottle neck for any further power increase. Losses are also creating further activation, on top of the natural and unavoidable ones inherent to the slow extraction process, to the various machine elements. While pursuing mitigation measurements to reduce the occurrence of this instability, its root cause should be possibly identified and eliminated, starting from the improvement of the impedance model and the analysis of electron-cloud build up and electron-cloud driven instabilities.

R10: Study and present in details the studies related to the instability observed during the de-bunching process, in particular the ones concerning the development of the impedance model and the observed e-cloud build up.

The MR beam power increase for both SX and FX needs an upgrade of the existing, or the introduction of new, beam intercepting devices. The collimation system will be upgraded but its use as two-stage collimation system should be studied in detail, taking into account the machine alignment, COD, real machine aperture and different halo populations. Machine studies should be used to validate the understanding of the existing one and to validate the simulated prediction of the future collimation insertion. A new protection device for the extraction septa, installed during the last beam stop, will be tested in Feb. 2021, so it would be important to exploit beam time to commission it, and explore the possibility to put it in operation if considered sufficiently safe and effective.

R11: Review the machine protection devices, i.e. the collimation systems and the slow extraction septum protection elements (beam diluter and crystal) and present their measured and simulated performances.

While the large dipole PS were qualified with a heat run and ripple measurement, the other new PS were not yet tested in a heat run, and ripple measurements were done only for flattop conditions with a load not exactly the same as in future operation due to, e.g., different cable length. A vertical tune ripple of +-0.01 (p-p) at 70 Hz was reported for the MR at injection, likely contributing to beam losses. It is important to understand the current ripple and magnet transfer functions over the full operating cycle, and the new power supplies have the potential to not only shorten the operating cycle but also to reduce beam losses

R12: Perform heat runs and current ripple measurements over the full operating cycle with all new quadrupole and sextupole PS as soon as this is possible.

Items for the Next Meeting (ATAC 2022)

The committee would like to hear from the J-PARC accelerator team in particular to:

1. Present both the simulation and measurement results for the short-RFQ and MEBT 1 studies and plans for its implementation (see recommendations **R4**)
2. RCS commissioning toward high power and beam loss mitigation
3. Beam dynamics studies on MR instability, e-cloud, impedance, collimation
4. Status and plans for the site-wide global systems: controls, global timing, configuration data bases and archivers
5. Problem of aging and obsolescence of electronics across all systems of the accelerator complex. Describe the current status and mitigation strategy
6. Present the overall planning, the list and the status of the interventions in the different accelerators during the long shutdown, with particular attention to conflicting activities in term of hardware and personnel resources, and the activities potentially on the critical path for restarting beam operation on time. Moreover, discuss in detail the planning for the hardware and beam commissioning for the entire accelerator complex.

02 J-PARC Accelerator Overview (RZ, AA, ML)

Findings

JFY2020 was a year that saw serious challenges from the COVID-19 pandemic. Nevertheless, J-PARC experience only a 25-day interruption to beam. The MLF operated regularly, with some interruptions due to target station issues. The MR operated minimally due to upgrades in its neutrino fast-extraction program, and licensing issues with its slow extraction program. J-PARC continued to show flexibility where possible to re-schedule user time when interruptions occur. User hours this year were limited, though availability was high, > 95% in the MLF when running. J-PARC has plans to increase user time in future years with adequate funding. Extended studies were performed at 1 MW and identified a number of issues with RF and cooling capacity in the RCS.

[statistics JFY2020 through Dec 22]

RCS for MLF:

- The RCS provided >600 kW to the MLF in the previous year, limited by the MLF target capability, while also further demonstrating that the RCS is capable of 1 MW in some circumstances, and identifying issues to address. J-PARC is preparing plans for increasing beam power to 1 MW over the next 2-5 years, limited by the capability of the MLF target and newly found issues of beam loading compensation and cooling capacity.
    - 1676 hours of beam delivery were achieved out of 1759 scheduled for the MLF. The downtime remained low, achieving an availability of 95.3%, well exceeding the goal of 90%. The scheduled number of hours was low due to COVID and a needed target replacement
    - For the near term, operation will be limited to 600-700 kW until targets developments allow 1 MW (anticipated within 2-5 years)
- 1 MW equivalent beam operation was further tested during the last year
    - Beam experiments demonstrated sustained 1 MW operation to users for a two-day period
    - The experiments demonstrated the changes needed for 1 MW operation, and identified an issue with inadequate cooling during warm weather

MR with fast extraction for neutrinos:

- Scheduled beam delivery was minimal in JFY2020, though the accelerator remains capable of greater than 500 kW. Further beam power improvements will be possible with replacement of the MR magnet power supplies (after JFY2021) to allow a shorter cycle time and then other enhancements to the machine allowing higher beam intensity.
    - No significant beam operation is expected in JFY2021, and beam will only restart in JFY2022 when the upgrades are complete.
- J-PARC will reduce the MR cycle time to < 1.3 sec to achieve >750 kW in the MR. Reducing the cycle time is the most straightforward path to higher power. Combined with other improvements to loss control and RF power, J-PARC should be able to produce

high-power beam for the Hyper-K experiment, and be capable of 1.3 MW by 2028, and perhaps sooner.
    - Power supplies are all under construction, several have been tested under full load and in operation. They will be installed in a full-year MR shutdown in JFY2021.
    - The power supply upgrade and 1.3 s cycle will be available in JFY2022.
- A further program of modest improvements to the MR will result in increased beam intensity. When combined with the power supply upgrade (and further exploitation to 1.16 s cycle time), 1.3 MW should be available from the MR for fast extraction. These plans are now well understood. The mid-term plan has been consistent with a gradual rise to 1.3 MW in JFY2028 to be available for Hyper-K. The technical improvements will be in place by 2025 allowing time for commissioning.

MR with slow extraction to the Hadron Facility:

- Beam of up to 55 kW was delivered to the Hadron Facility in JFY2020. Further improvements are planned to 70 kW in 2021 and >80 kW in future years.
    - 93.5 hours of beam were delivered out of 108.5 scheduled, for an availability of 86.2%, short of the J-PARC goal of 90% availability.
    - Beam delivery was substantially delayed by licensing of the new target, which occurred during COVID-19 restrictions.
    - The slow extraction program will also not see any beam during the upgrade of JFY2021.

J-PARC plans to operate the MLF for 7.2 cycles = 159 days in 2021, though optimal operation is considered 9 cycles per year. Future planning is for 9 cycles per year. The MR will operate until the summer shutdown, and then remain off until the fall of the following year.

The J-PARC accelerator division has essentially demonstrated 1 MW capability for the MLF, but is waiting for a capable target. Once 1 MW is achieved routinely with a MLF target, J-PARC foresees a period of developing stability in that mode of operation while preparing for further upgrades. A series of individual activities have been identified for the Linac and RCS over the next 5 years. Further beam intensity improvements have been explored through preliminary Linac and RCS studies.

J-PARC is at risk of losing key expertise in the next 10-15 years as it potentially has more than half of its staff retire, and has recently also lost staff due to career advancement. A number of issues contribute to this including the stability in staff since the start of the lab, and the lack of new hiring. J-PARC still plans to address this issue.

Comments

The 1 MW and >1 MW studies in the RCS show outstanding results in terms of beam loss and the J-PARC teams has plans to improve them further. Extended delivery to users was a significant accomplishment. Issues were identified, particularly with the cooling capacity during the warm summer weather. The power dissipation is increased during 1 MW operation, though only marginally. The ATAC notes that stable operation may be an issue at any beam power during the summer periods. J-PARC notes that the options for increasing cooling capacity are challenging, and will continue to study this.

Operating hours continue to be a challenge for J-PARC, while availability within those hours continues to improve, being excellent (> 95%) for the MLF where it is most significant. The number of assigned hours starts from a low level due to a number of issues: funding, user availability, and technical issues. J-PARC has secured support for future, higher up-time for the MLF in future years, but FY2021 will be constrained, and show almost no MR operation. Future users have high expectations for J-PARC and need to have a plan that achieves greater operating time in addition to operating power. A reasonable benchmark is 5000 scheduled hours of operations per year – J-PARC should determine planned hours of operation in advance number and attempt to achieve those numbers. Efforts should also be taken to reduce the impact of commissioning and studies, perhaps through more automation of the equipment switching between different modes.

Licensing emerged in FY2020 as a potential delay for operations. This past year the license for the new HD target was significantly delayed, significantly reducing user operations. The cause of this change is unclear, particularly as it coincided with COVID-19 restrictions. J-PARC has adjusted its strategy to plan for longer licensing periods, and to combine more new facilities, into fewer applications. This approach is reasonable, though the combination introduces some risk of one facility being affected by another's license.

J-PARC has developed a strategy with a period of "stability improvement" for the Linac and RCS, after reaching 1 MW operation. There is a program of improvements for each portion of the machine to be able to achieve this stability. This program should be pursued, even though 1 MW target will be 2-5 years away. The committee notes that many of these improvements may be useful for ~1.5 MW operation. Therefore, it would be useful for J-PARC to decide the operating scenario for 1+ MW (choose power, linac current, pulse length, etc. – perhaps also a second target station) so that these mid-term upgrades can be designed to be compatible with that mode.

J-PARC previously identified staffing as an issue and intended to address it. However, circumstances have prevented J-PARC from making progress this past year, and the issue has become more urgent. Short-term hiring is mostly only planned for temporary positions. Staffing levels are already lean for the responsibilities of operation. The workforce is highly bunched in age and retirements are expected to occur at a rate of between 5-10% per year for the next 15 years. Furthermore, there is no margin of labor available for new projects. This staffing issue is potentially critical for J-PARC, and J-PARC must develop a staffing plan. This staffing plan should attempt to:

- Transfer knowledge between generations of workers.
- Develop the depth of the team by moving persons between areas of responsibility over time, so that there are multiple experts on various systems.
- Develop the capabilities of individuals by issuing them new responsibilities, and other forms of professional development or education.
- Anticipate the future needs of J-PARC, particularly for future projects.

Succession planning is vital as any employee could be lost at any time to another position, illness, or other personal issues. One of the functions of management is to predict the future for the organization and make decisions based on that expected future: hiring is one of the most important activities to perform. There are many methods to develop a staffing plan, and the J-PARC management should choose a method with which they are comfortable. These approaches can vary from a more mechanistic accounting of skill areas, to a developmental model of individuals.

J-PARC has produced world leading science and benefited greatly from the long service of a very talented and dedicated workforce. As J-PARC attempts to build its future, it must renew this workforce, and particularly look for permanent hires who will provide 20, 30, 40 years of service. Permanent positions should be prioritized over temporary positions.

Recommendations

R1: Develop a recruitment and succession plan for J-PARC staff. Particularly, catalog areas of expertise needed at J-PARC, and proactively plan to grow the skilled workforce. Identify areas of present labor shortage and work overloads, and work to address them.

03 Diagnostics (AA, ML, SW)

Findings

J-PARC accelerator complex has a large suite of beam instrumentation. A comprehensive review of all diagnostics systems was presented at the review.

The available beam instrumentation is sufficient to set up and operate the complex at up to 1MW beam power.

Several systems were identified as requiring improvement for routine 1 MW operation. The largest of the systems being upgraded is 200 of MR BPM processing electronics.

The beam instrumentation systems operate reliably, no significant downtime is attributed to the diagnostics.

Comments

None.

Recommendations

None.

04 Status of Utilities (ST, ML, SW)

Findings

A comprehensive description of Utilities (e.g. electric power, air conditioning system and water cooling system) at J-PARC was given.

The maintenance policy of the utilities were also presented. There are two type of policy at J-PARC. One is a non-redundant system and the regular replacement for RCS and Linac. The other is a redundant system for MR.

While J-PARC accelerator has been conducting a lot of experiments in the Linac, RCS, and MR, it is also carrying out the planned upgrades included 1.3 MW operation of MR and 1 MW operation of RCS. The utility system is under the pressure to support these upgrades, such as enhanced RCS cooling systems to enable the 1 MW operation of RCS.

Comments

The anti-aging and the upgrade plan of the J-PARC utility should be prepared toward next decade according to the roadmap of the J-PARC upgrade.

1 MW operation of RCS is an important and urgent issue for J-PARC. The required performance of RCS cooling and ventilation system should be evaluated and the improvement plan should be constructed as soon as possible through discussions with RCS machine group and user group.

Similarly, toward MR 1.3 MW and higher beam power operation, the required performance of utilities should be studied with MR machine group.

Recommendations

R9: Study and present the analysis of the expected cooling and ventilation performances required for continuous, year-round 1 MW operation of the RCS at 1 MW and MR at 1.3 MW, including any progress on cooling system design work and indicating what further upgrades would be required for future higher power operation.

05 Spares (SW, ST, JT)

Findings

Large amount of work was performed on spare parts management, which is helpful to risk control, and contributed to the high availability of the J-PARC accelerator in user operation.

Responding to **R4** from ATAC 2020, an inventory list has been created, and the downtime risk has been evaluated by sorting all items into three categories according to MTBF and MTTR. Categories A, B and C indicate the level of risk, with category C components having the most potential for causing significant downtime. This process has allowed some urgent spares requirements to be figured out, such as the power supply for the pulsed bending magnet in MR, and has meant that some components originally in category C have now been improved to category B.

Responding to **R5** from ATAC 2020, the number of conditioned spare klystrons was increased, and the remaining spare klystrons will be conditioned in 2021.

Comments

Existing klystrons, both for 324 MHz and 972 MHz, are already aged 60,000 hours and some are aged more than 75,000 hours. In case of operation with higher filament, the risk is increased. Considering the long period of procurement, many more spare klystrons – more than 50% of the number of operational klystrons – are needed.

It is urgent to prepare the slow extraction septum spare and power supply spares in category C.

As a user facility, spare parts management should ensure that the downtime should not exceed one month under any failure conditions. In this case, all spare parts in category C should be considered in the long-term. For expensive, long-life spare parts, a long-term plan should be made according to the annual operating cost.

Recommendations

None.

06 MPS (AA, JT)

Findings

The presentation on the J-PARC MPS showed the recent effort to accommodate best practices in MPS development, documentation and configuration control. An example of CERN process was considered and found to be too demanding for manpower, which is not available at J-PARC. As a first step in enhancing the MPS oversight, it was decided to include MPS specific discussions in the regular divisional safety meeting.

Currently, there is no formal MPS review, configuration and testing process. An intention was expressed to introduce a new process and documentation scheme.

A dedicated database was created during the J-PARC construction phase to track maintenance tasks, failures and system changes. This system has been available but has not been consistently and regularly used.

A thorough review of the prior MPS incidents and mitigation measures was presented. In total, 4 events happened in the last 5 years, the last one in December 2020. Two of the events resulted in a vacuum breach. All the incidents, in general, fall into these three categories: hardware malfunctions; faults unforeseen in the original MPS design; MPS misconfigurations or human error.

Several new functions were added to the MPS during the development of the J-PARC accelerator complex to mitigate previously unforeseen beam fault scenarios.

A recent event in December 2020 did not damage any equipment, but was a near-miss causing an elevated activation level. The event was caused by low quality beam and should have been prevented by the nearby BLM detecting the elevated radiation level and triggering the MPS abort. The root cause was identified as a configuration problem associated with a human error.

Comments

The latest MPS failure to stop beam when an elevated radiation level was detected reinforces our concerns raised in the past reviews that the MPS system can have deficiencies in its logic, hardware design and configuration or operation practices. A lack of documentation available to the committee makes it difficult to provide good, practical advice on how to overcome possible deficiencies.

The MPS design started as a relatively simple system and many new functions have been added over years to cover newly discovered fault scenarios and to accommodate the expansion of the accelerator complex. It is not clear to us how well these additions were reviewed and if their integration into the original MPS is seamless. It is possible that a complete redesign can be an opportunity to incorporate all the lessons learned in a uniform way across the accelerator complex as a cost-effective long-term solution.

Recommendations

R2: Create and present at the next review the following documents:

a) A document describing the MPS design, which includes description of the allowed beam destinations; of the means of confirming the proper beam destination; of the means for limiting beam power to the low power targets; of the beam shut off and abort devices with their trigger logic and reaction time.

b) A document describing the authority and approval chain for the MPS design changes; the long term configuration changes i.e., trip thresholds, abort trigger delays, etc.; the short term configuration changes i.e., temporary bypasses for beam study.

c) A document describing the MPS testing procedure after return from maintenance or after a significant configuration change.

R3: Evaluate the capability of the MPS from the ground up, and explicitly consider options of upgrade or replacement. Assemble detailed requirements for MPS inputs and capability; they should be uniform across the accelerator complex and incorporate the lessons learned over years of operation. Include target station machine protection inputs. Report results of cost and benefit analysis at the next review.

07 Linac (ML, ST)

Findings

The LINAC has operated reliably with the required performance to support the user program in 2020. Noticeable is the record long operation of the ion-source at 60 mA, the reduction of time user time lost due to the RFQ auto-restart system and the machine studies with 72 mA from the ion source for the 60 mA LINAC studies. A few aged and failing klystrons were replaced with two more klystrons (one 324 MHz and one 972 MHz klystron) being conditioned off-line. The replacement of a capacitor bank the modulator systems has been done and plans are being made for further replacements including a study of possibly using a more modern switched modulator design. The cleaning of the SDTL tank suffering multipacting with diluted sulfuric acid appears successful compared to earlier attempts to clean with acetone. Improvements are being made to the beam instrumentation for the MEBT with the goal to improve lifetime and data quality so that targeted machine studies for the detailed design of the MEBT so that the short RFQ-MEBT1 system can be completed and installed. The beam studies seems to have focused on beam loss studies to reduce activation at 50 mA operation but also to demonstrate that beam losses can be managed at 60 mA LINAC operation.

Comments:

The use of the auto-restart system for the RFQ has successfully improved availability of the LINAC for the client machines. Good work to have pushed this change through into operation.

The reliability of the ion source at 60 mA extracted beam is impressive. Not performing a preventive replacement in the maintenance period represents a risk but as long as the accelerator management is clear on that and have a clear mitigation plan for how to replace a possibly failed ion source quickly it could be an acceptable risk.

The advantages of replacing the existing RFQ-MEBT system with a shorter RFQ and a new three buncher cavity MEBT wasn't evident for the panel. A presentation of the expected gains with this change, the beam physics and machine studies needed and a plan for how to address the engineering aspects of the installation in a regular maintenance period would be welcome at the ATAC meeting.

Many of the klystrons in the LINAC RF system are approaching their expected life-time with only a limited set conditioned spares being available. It is urgent to now conditioning the existing unconditioned klystrons off-line and to purchase enough spares to at least be ready to replace the 8 324 MHZ and 21 972 MHz klystrons.

The modulator system is being renovated and we welcome the opens from the accelerator division to study a possible future use of a more modern and less energy and space requiring technologies.

The beam loss studies have continued and the beam losses seems acceptable for 50 mA operation and possibly also for 60 mA operation. However, there was no convincing arguments presented that the origin of these losses are understood. We encourage the group to continue the studies with the goal to improve the understanding of the mechanism behind it.

Recommendations:

R4: Make a detailed presentation of the new "Short RFQ and MEBT1" system explaining the advantages of the new system from both a beam physics and an engineering perspective which justifies this change to the linac. As part of this, clarify why you need the new and improved beam instrumentation for the simulations needed.

R5: Continue to condition and purchase klystrons to assure that at least all klystrons which now approach their expected life time have a spare.

R6: Continue the beam loss studies at both 50 mA and 60 mA with the aim to improve the understanding of the main factors driving these losses.

08 RCS (JT, BZ, SW)

Findings

The RCS has continued in stable user operation, delivering 500 – 600 kW beam to the MLF and 51 – 55 kW for MR-SX to the hadron (HD) experimental facility. 515 kW for MR-FX to the neutrino (NU) experimental facility was also produced, but only for a limited period. Availability for the RCS only has again been very good, at ~98.5%. Next year it is hoped that, while the MR upgrade is being carried out, > 700 kW will be delivered to the MLF.

The J-PARC team has successfully addressed the problems with distortion in the RCS RF amplifier chain, following **R9** from ATAC 2020. By increasing the filament current and the screen grid voltage of the vacuum tube, the $h = 6$ component can now be fully compensated on all cavities. The expectation is that vacuum tube lifetimes may now be somewhat shorter and so an increase in spares holding is being promoted.

In line with **R12** from ATAC 2020, the J-PARC team considered development of a mechanical arm and robot technology for maintenance work on high dose rate components in the injection area. However, as this would have required considerable investment in new infrastructure, an alternative solution of installing a 0.5 ton radiation shield next to the injection point was pursued. The shield, and a new base to support it, were installed in the JFY2020 summer shutdown and this approach has proved to be effective in reducing worker dose rates.

A high-power trial at 1 MW for 2 days of continuous operation was held immediately before the summer shutdown. While stripping foil performance was good and beam losses were within expectation, problems were encountered with RF systems deteriorating and cooling water getting too warm when the outside air temperature and humidity became too high.

Comments

The committee congratulates the RCS team on another year of stable user operations, with excellent availability.

Extensive studies to optimize the beam painting pattern at injection have mitigated vertical tune shift and reduced beam loss by 40%. This is very impressive. Further to this, studies of reduction of the injected beam size have indicated that this would allow a smaller foil to be used, reducing the number of foil hits from the circulating beam and therefore helping to address activation in the injection area. The J-PARC team is to be commended for this excellent work.

A further 1MW trial is planned for July JFY2021, however, as temperature and humidity are again expected to be high, a recurrence of problems with cooling water is anticipated. A design for a new cooling system has been started, but will not be implemented before the trial. It is hoped that running RF systems to fully compensate the h = 6 component, allowing lower anode power supply currents, will reduce the heat load on the RCS.

The committee would have liked to have heard more about the planning for the July JFY2021 trial, and how this will build on previous experience.

It appears that cooling capacity is now the only limit to 1 MW operation of the RCS, and should therefore be addressed with some urgency, also taking into account the future requirements for future higher power operation.

Discussions with users to optimize the operational schedules (*e.g.* 1 MW in winter and 0.7 MW in summer) have been started, but this should be part of a full cost/benefit analysis compared with upgrading the cooling capacity to allow year-round 1 MW operation.

The measurements of residual dose rates after the 1 MW trial are almost proportional to the values measured after 600 kW user operation, and because the cool down times before survey are similar, the comparison is easy to interpret.

Recommendations

R7: Study and present a detailed plan for the next 1 MW trial (presumably summer JFY2022), including any specific hardware and utilities upgrades that have been implemented, and identifying clear success criteria.

R9: Study and present the analysis of the expected cooling and ventilation performances required for continuous, year-round 1 MW operation of the RCS at 1 MW and MR at 1.3 MW, including any progress on cooling system design work and indicating what further upgrades would be required for future higher power operation.

09 MR (SG, WF)

Findings

The MR operated at about 515 kW for the FX and up to 55 kW for the SX, with an extraction efficiency up to 99.5%. It is worth noting, as presented in the SX dedicated talk, that high-power SX operation suffered from recurrent beam instabilities occurring during the de-bunching process and sometimes preventing extraction due to too large losses.

The SX beam power delivered to the users increased from May 2020 to Dec 2020 from 51 kW up to 55 kW. The plan for 2021 foresees SX operation above 60 kW, while the FX operation will be limited to only few days and at about 500 kW on target.

Vacuum degradation was observed at the beginning of the run after the summer shutdown, identified as related to the new second harmonics cavities and beam diffuser. Few days of scrubbing were necessary to recover good vacuum conditions and push the SX extracted beam power from 20 to 55 kW.

Different studies were performed to improve beam losses and increase further the SX beam power, with the goal of reaching a stable 60 kW operation. Working point studies led to some improvements, but a significant 10% power increase could be achieved thanks to the introduction of a "2 step voltage" RF function to improve the de-bunching process. This brought to a reduction of the beam instabilities observed at the end of the de-bunching. SX operated steadily above 99.5% extraction efficiency.

Concerning the FX, no operation was possible during JFY2020. For this reason, the commissioning of the longitudinal feedback was postponed.

During JFY2019 515 kW operation, losses were limited to 800 W, well below the maximum of 2 kW that the collimator insertion is able to absorb.

Studies at low energy for the FX beam, in particular concerning working point optimization and resonance compensation, improved the understanding of the sources of losses. An 8^{th} order space charge driven resonance has been identified and simulations were done to improve its understanding.

As requested in **R10** of the 2020 ATAC, an inventory of the status of the spare magnets of the 3-50 BT line was presented. Impedance measurements of all the BT magnets will be done at every summer shutdown, to identify in advance any potential electrical issue.

The plans for the collimation system upgrade were presented, to be able to cope with 3.5 kW beam losses after JPY2022.

Comments

Beam scrubbing was sufficient to solve the issue of the local vacuum degradation introduced by the newly installed elements, the diffuser to protect the SX electrostatic septum and the second harmonics cavities. It would be advisable to study if scrubbing could also be beneficial for the e-cloud formation detected during the SX de-bunching.

The longitudinal damper test with the prototype LLRF could not be commissioned due to lack of beam time. The new LLRF system, which fully includes the multi-harmonic vector voltage feedback and longitudinal damper, will be delivered soon. Its commissioning should be pursued with high priority with 500 kW beams to ensure the beam operation after the long shutdown.

The spare coil policy for the BT magnets seems to be appropriate, considering also the introduction of regular controls during the summer shutdown on the installed equipment.

More investigations and simulation studies should be done to assess the performances of the future collimation system as planned after JFY2022, but resource permitting, already during JFY2021.

Recommendations

R11: Review the machine protection devices, i.e. the collimation systems and the slow extraction septum protection elements (beam diluter and crystal) and present their measured and simulated performances.

10 MR Beam Commissioning Plan (WF, SG)

Findings

The MR beam power upgrade will increase the beam power from presently 500 kW (2.6×10^{14} ppp, 2.48 s cycle time) to 1.3 MW (3.3×10^{14} ppp, 1.16 s cycle time). The beam power will gain a factor of 2 from the shorter cycle time, and 30% from the higher intensity. The beam power is to be increase gradually with the full beam power goal to be reached in JPY2028.
All new hardware will be manufactured by the end of 2025, and three more years are planned after that to reach the goal of 1.3 MW.

In addition to new power supplies for the shortened acceleration cycle, 4 additional RF cavities at the fundamental frequency, and two 2nd harmonic cavities are needed. The manufacturing of the cavities is to be completed in JPY2025. Upgrades to the injection and extraction systems are proceeding.

Space charge simulations with SIMPSONS show reduced beam losses with a lower emittance beam from the RCS, and tune optimization scans were done which show the potential for further loss reduction.

The intensity that was already accelerated in the RCS would yield 1.9 MW beam power from the MR with 1.16 s acceleration cycle. So far, an 8 GeV booster ring between the RCS and MR is considered as a long-term future upgrade to take advantage of this available intensity.

Comments

The MR upgrade commissioning plan follows the hardware installation plan. After the installation of the new power supplies, it starts with a goal of 700 kW in 2022 and has annual increases of 100 kW each year until the goal of 1.3 MW is reached in JPY2028. With no hardware to be installed in the last 3 years, there is a possibility that the overall goal could be reached before the end of JPY2028.

The RCS can accelerate enough intensity for the MR to reach 1.9 MW with a 1.16 second cycle, although beam losses are expected limit the power at a lower value. The insertion of an 8 GeV booster between the RCS and MR was contemplated to take advantage of the higher RCS intensity, and up to 3.2 MW are expected in the MR. While this can be a solution (possibly realized with an FFA lattice), it is an expensive solution, and it would be worthwhile investigating less costly alternatives.

Recommendations

None.

11 Status of MR power supply (WF, SG)

Findings

The new MR power supplies will allow for a reduction in the cycle time from presently 2.48 s to 1.32 s. The upgrade is to be completed by June 2022.

The PS upgrade, with capacitive energy storage for the BM, QFN and QDN circuits, will reduce the input power variation from presently 66 MVA to 30 MVA. Smaller quadrupole and sextupole PS will not have capacitive energy storage. Some quadrupole PS are reused.

The new BM PS has undergone significant testing. It operated for 50 h with a T = 1.3 s cycle and reduced peak-to-peak power from 14 to 2 MVA, the current ripple was by order of magnitude at all frequencies. The large quadrupole PS has also been tested with a T = 1.3 s cycle, although not in an extended heat run. Ripple measurements that would directly translate into tune ripple were performed at flattop but not yet over the operating cycle. Ripple measurements were not yet performed for the sextupole PS either.

At MR injection a vertical tune ripple ±0.01 (peak-to-peak) at a frequency of 70 Hz was observed.

Comments

The new MR power supplies are making good progress. While the large dipole PS were qualified with a heat run and ripple measurement, the other new PS were not yet tested in a heat run, and ripple measurements were done only for flattop conditions with a load not exactly the same as in future operation due to, e.g., different cable length.

The reported vertical tune ripple of ±0.01 (peak-to-peak) at 70 Hz is likely contributing to beam losses. It is important to understand the current ripple and magnet transfer functions over the full operating cycle, and the new power supplies have the potential to not only shorten the operating cycle but also to reduce beam losses

Recommendations

R12: Perform heat runs and current ripple measurements over the full operating cycle with all new quadrupole and sextupole PS as soon as this is possible.

12 Slow Extraction (SG, WF)

Findings

In view of future high-power operation, a new version of the SX hadron target under study was presented. This should be able to cope with a maximum delivered power of 150 kW every 5.52s, compared to the maximum 95 kW of the existing one.

Beam instabilities occurring at the end of the debunching, and prior the slow extraction process, were regularly observed. In some cases, the instabilities were so severe to inhibit the extraction. Losses appear together with a microwave longitudinal structure at high frequency, e-cloud formation and coherent transverse beam oscillations. While the source of these instabilities could not be clearly identified yet, mitigation measurements were investigated. The two most effective ones consist first in the introduction of a phase offset at injection to increase the longitudinal emittance, the second in forcing a non-adiabatic longitudinal phase-space rotation with a double voltage step at the beginning of the debunching process. These led to a final extraction efficiency of 99.51% with 55.7 kW delivered on target.

Other effective countermeasure against beam losses, like the dynamic bumps, septa position optimization and linear coupling correction, contributed also to keep losses at a minimum.

Despite all of these, improved control of the longitudinal emittance is pursued to try to reduce even further the occurrence of the beam instabilities, thus the losses. In particular, a VHF cavity has been proposed, but not funded, to improve the control of the longitudinal emittance growth.

Septa protection devices are under study to reduce the residual dose in the extraction region. A beam diffuser has been installed and will be tested in Feb. 2021. A second device, based on a crystal used in channeling mode, is planned in collaboration with CERN.

The spill structure presents a significant ripple that will not be compatible with higher power operation. A first improvement was achieved by acting on the control of the quadrupoles for example. For the future operation, the new power supply current ripple of the main bends and a part of the quadrupoles will be improved by one order of magnitude with respect to today. On top of this, a transverse RF field feedback and a ripple canceller will be tested with beam in JFY2021.

Collaborations with other institutes will bring also a multi-harmonic carrier frequencies for transverse RF fields and machine learning based spill control.

In preparation of the SX operation for COMET, beam extinction tests were continued. Further improvement are expected from JFY2021 beam tests.

The SX upgrade plan foresees a steady increase of the beam power from 55.7 kW in JFY2020 to 95 kW in JFY2026. The introduction of a better control of the longitudinal emittance should allow operating at 60 kW already in JFY2021 and the high repetition rate in JFY2022 should bring the maximum power to 80 kW.

Comments

Further studies of a controlled longitudinal emittance increase could be pursed, for example by varying the relative phase between the fundamental and second harmonics cavities, or by introducing some controlled phase noise in the second harmonic systems.

Further studies should be also pursued to understand the source of the beam instabilities, by continuing improving the impedance model but also by trying to investigate the source of e-cloud and its possible alleviation with beam scrubbing. Concerning the impedance model, the contribution from beam instrumentation devices should be evaluated, on top of the planned measurements of the extraction elements up 1 GHz.

The proposed change of the momentum compaction factor of the lattice might be beneficial for the control of the instability, but it might also change the dynamics of the debunching process itself and requires further investigation.

Recommendations

R10: Study and present in details the studies related to the instability observed during the de-bunching process, in particular the ones concerning the development of the impedance model and the observed e-cloud build up.

R11: Review the machine protection devices, i.e. the collimation systems and the slow extraction septum protection elements (beam diluter and crystal) and present their measured and simulated performances.

R12: Perform heat runs and current ripple measurements over the full operating cycle with all new quadrupole and sextupole PS as soon as this is possible.

13 MLF Target (BZ, JT)

Findings

The MLF liquid mercury neutron production is a remarkable technology that has allowed the J-PARC users to perform ground-breaking research for over a decade now. These state-of-the-art targets are well known to be challenging and J-PARC has worked diligently to increase their capability (beam power) and reliability.

The present target operates in excess of 600 kW for users, and will be increased to 700 kW in April. Recent post-irradiation examination (PIE) of previous targets gives high confidence of operation at this level. The dominant mode of damage is gradual erosion through cavitation, so short periods of 1 MW operation are allowable, and valuable for J-PARC. Recent operations was impacted by COVID-19 and a misalignment of cooling pipes that required exchange of targets before operation began.

Mitigation of the pitting is achieved by aggressive injection of helium microbubbles and high flow-rate. These have each shown very promising results and by JFY2022 a target capable of 700-1000 kW will be installed. User time is extremely important, so higher power operation will only be conducted when damage is proven to be understand.

Disposal of targets is a major issue for J-PARC. Targets cannot be transferred off-site, and are held in long-term storage buildings. J-PARC proposes to mitigate this through extending lifetime to two years and exploring volume reduction of the targets by designing in the capability for disassembly. An alternate is to build more storage capability.

Comments

Protection of the MLF target is extremely important and it could be better integrated into the accelerator Machine Protection System (MPS). A number of inputs already exist, but specific limits on per-pulse intensity and beam power at appropriate time scales would also be useful. More monitoring of support systems could also be implemented. For example, a clogged needle valve reduced helium flow and is suspected to have anomalously increased the pitting damage in target 9. Existing instrumentation could have identified this issue if it were input to the MPS.

International collaboration on target research, particularly with SNS, has been very valuable. J-PARC is encouraged to extend these efforts, particularly as they are now to develop 1.5 MW targets, and a 2nd target station. Understanding the radiation damage of the related materials will also continue to be valuable. Developing the operating parameters of the 1.5 MW target and 2nd target station will also be useful for the Acceleration Division which is designing the accelerator upgrades.

The J-PARC attempt to extend target lifetimes is an excellent path to improving its spent target storage situation. This approach has many associated efficiencies, as noted by the J-PARC team. Volume reduction through disassembly is a potential approach, however it carries many risks. Designing the target for disassembly could very well compromise the performance of the target. Furthermore, the disassembly process could create a larger volume of waste and contamination. Long-term disposal off the J-PARC site should always be pursued. Other laboratories are capable of this, and the Japanese regulators should appreciate that a permanent storage facility is superior in terms of public health. The J-PARC facility is likely to operate for several decades and perhaps have a second target station. It will also have used neutrino, hadron, and muon targets. A common approach should be developed, with the long-term goal of shipping items off-site.

Recommendations

None.

Questions (answered during ATAC 2021 Review):

1. Please provide more detail on the proposal for J-PARC operation which was included in the MEXT Roadmap 2020. How will this maximize operating periods at both the MLF and MR in balance with the upgrade strategy, and will resource be made available for infrastructure improvements, such as enhanced RCS cooling systems to enable year-round > 1 MW operation?

2. Please describe recent applications for licenses with the nuclear regulatory authority. Include the number of licenses, and their subjects, over the last few years; also how long the process takes. Does every new enclosure require a license? (e.g. COMET, TEF-T, Muon telescope, etc.) Does every new target design require a license? What is the size of power increase that will trigger a new license?

3. On J-PARC upgrade programs like SC low-beta linac prototyping, which division is/will be responsible? Does J-PARC plan to pursue low-beta SRF technology intended for a new linac in parallel to the present J-PARC linac upgrade with 50 Hz operations for cycle splitting?

Homework 1: Diagnostics elaboration: (a) Please provide an organizational chart for the group(s) responsible for development, operation and maintenance of beam diagnostics for all parts of the accelerator complex. (b) Please provide more details on what beam diagnostics need to be improved or newly developed to support stable operation at 1MW (e.g. orbit correction for the full beam?). (AA)

Findings

The J-PARC has three independent groups responsible for the beam instrumentation development, operation and maintenance in the three areas of the accelerator complex: Ion Source and Linac, RCS, and MR. The corresponding numbers of scientists and engineers in the three groups are six, five and six. Majority of them have permanent positions, but some do not. Approximately same number of technicians are outsourced.

There are no one-person-per-system responsibility assignments but rather a significant overlap of responsibilities within each group.

The beam instrumentation needs are determined by the commissioning team. Some development is done as general beam instrumentation R&D.

Three systems are identified as requiring improvement or to be added for 1MW operation of the IS+Linac and RCS: the RCS DCCT/SCT accuracy improvement to better than 1%; adding a Bunch Shape Monitor to the Front End; and development of 25Hz data acquisition system for beam faults analysis.

Two systems are identified as requiring improvement for 1MW operation of the MR: the MR DCCT accuracy improvement to better than .1%; the MR BPM system upgrade to reduce the position error by a factor of about three and increase the temporal resolution by a factor of two.

Comments

The beam instrumentation personnel numbers are comparable to other facilities with similar complexity.

Recommendations

None

Homework 2: Spares strategy elaboration: (a) Slow extraction septum spare; (b) Power supply spares in category C (ML)

Findings

Two electrostatic septa and three magnetic septa (low, mid, and high-field) are used for the slow beam extraction. The low-field magnetic septum has failed once in 2013 and the electrostatic septum has failed once in 2017. As there was no spare for the magnetic septum (no spare coil) it took about 6 weeks to make a new coil and replace it. There are only spare materials in stock for the mid-field septum as the delivery time is long for this material. For the electromagnetic septum a test area has been made available in which a spare unit been assembled and conditioned.

For the power supplies, there are in general spare parts. The exception is the power supply for the pulse bending magnets on 3-50 transport line where there is no spare and where a key component (Gate Turn-Off thyristor) now is obsolete. Design and manufacturing of a new power supply will be done JFY 2021.

Comments

The strategy to priorities long-lead time spares and components is appropriate

With a constrained budget, it is difficult to have all spares and components in stock but it can be worthwhile to prepare design and tendering documents even if the orders can’t be launched immediately. In case a failure, weeks can be gained if these documents are ready.

Recommendations

None.

Homework 3: Utility backup scenario: Backup scenario for utility failures (backup power, UPS, water and air incidents …) (ST)

Findings

The electricity for control and safety system of J-PARC are protected by emergency power supplies against power outages. MLF has independent emergency power supply to secure the negative pressure of the target. After the unscheduled power outage, the total system of J-PARC was recovered after about half day.

Regarding the cooling system and the air conditioning system, a failed device automatically switches to a redundant system of MR. In non-redundant system of RCS and Linac, preventive replacements of mechanical equipment are performed according to summer maintenance. The spares are also prepared.

Comments

Make the inventory lists according to the downtime risk from failures and share the list and the spare policy with the machine group.

Recommendations

None.

Homework 4: MR PS ripple data: Please present power supply ripple data for main ring quadrupole and sextupole pertaining to MR slow extraction. (WF)

Findings

Data presented.

Comments

See comments for Talk 11.

Recommendations

None.

Homework 5: RCS power load: (a) What is the difference in power load for the RCS in normal operation and for high-power operation? (b) What are the causes of additional power load for high-power operation and how much load does each source add? (c) Particularly, how much of the added power load has been caused by the instability in the RF amplifiers, and how much is caused by the feedback? (d) Are there other options to reduce heat loads in the RCS? (JT)

Findings

The RCS power consumption is ~22.8 MW for 660 kW operation and ~24.7 MW for 1 MW operation. The 1.9 MW increase in power consumption is attributed to beam loading compensation.

Changing RF tube operation parameters to allow full compensation of the $h = 6$ component will result in lower anode power supply currents. This should reduce the heat load on the RCS, but not by much.

In the long term, replacing all 12 RF cavities in the RCS with single-ended FT3L cavities would reduce power consumption drastically. High power testing of a prototype new cavity has just been started, but replacement of all the cavities will require a large budget and a long time.

Comments

It is not completely clear what the J-PARC strategy is to overcome cooling issues for high power running during summer months. Three approaches have been mentioned:

- Reduction of RCS power consumption by replacement of RF cavities
- Design of a new cooling water system
- Optimization of operational schedules (*e.g.* 1 MW in winter and 0.7 MW in summer)

But no analysis has been presented of the overall picture.

Recommendations

R8: Develop a strategic roadmap for dealing with RCS power load as operation is ramped up to 1 MW and beyond.

Appendix 2 – Agenda

Agenda for A-TAC2021 (Q&A included for each report) **2021/1/7**

February 1, Monday Venue: Remort

Time(JPN.ST)		Period	Category	Title	Speaker	File Name
21:40	22:00	0:20	Time for LAN Connection			
22:00	22:15	0:15	**Executive Session**	*Closed*		
22:15	22:50	0:35	**Project Status**		N. Saito	
22:50	23:20	0:30	**Accelerator Overview**	J-PARC accelerator overview	M. Kinsho	
23:20	23:30	0:10	**Coffee break**			
23:30	23:55	0:25	**Required items from last ATAC**	Diagnostics	T. Toyama	
23:55	0:20	0:25		Status of utilities	Y. Yamzaki	
0:20	0:45	0:25		Spares	M. Yoshii	
0:45	1:10	0:25		MPS	N. Hayashi	
1:10	1:55	0:45	**Executive Session**	*Closed*		

February 2, Tuesday

21:40	22:00	0:20	Time for LAN Connection			
22:00	22:15	0:15	**Executive Session**	*Closed*		
22:15	22:45	0:30	**Status**	Linac	H. Oguri	
22:45	23:15	0:30		RCS	K. Yamamoto	
23:15	23:45	0:30		MR	Y. Sato	
23:45	23:55	0:10	**Coffee break**			
23:55	0:25	0:30	**MR upgrade**	Beam Commissioning plan	S. Igarashi	
0:25	0:50	0:25		Status of MR power supply	Y. Kurimoto	
0:50	1:15	0:25		Slow Extraction	M.Tomizawa	
1:15	2:00	0:45	**Executive Session**	*Closed*		

February 3, Wednesday

21:40	22:00	0:20	Time for LAN Connection			
22:00	22:15	0:15	**Executive Session**	*Closed*		
22:15	22:40	0:25	MLF target		K. Haga	
22:40	23:40	1:00		Answer for homework		
23:40	23:55	0:15	**Coffee break**			
23:55	2:25	2:30	**Executive Session**	*Closed*		

February 4, Thursday

21:40	22:00	0:20	Time for LAN Connection			
22:00	0:00	2:00	**Executive Session**	*Closed*		
0:00	1:00	1:00	**Recommendations to J-PARC**		J. Wei	

adjourn