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Beam loss and beam emittance minimization at J-PARC RCS for simultaneous operation to the MLF and MR

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The 3-GeV RCS (Rapid Cycling Synchrotron) at J-PARC (Japan Proton Accelerator Research Complex) simultaneously delivers high-intensity proton beam to the muon and neutron production targets at the MLF (Material and Life Science Experimental Facility) as well as to the MR (Main Ring). Beam loss mitigation is highly essential not only to keep the machine activation lower for maintaining a stable operation with high availability, but also to ensure a high-quality beam having a lower beam emittance and minimum beam halos. We have performed systematic numerical simulations and beam studies and implemented several measures, such as resonance corrections, optimization of the longitudinal and transverse paintings and also optimization of the betatron tune. We have obtained significant beam loss mitigation as well as beam emittance improvement for the beam delivered to both MLF and the MR. Recently, a transverse painting area of 50π mm·mrad has been increased to 100π mm·mrad implemented for the MR beam. This gives a half reduction of the average foil hitting of the circulating beam. As a result, not only the uncontrolled foil scattering beam losses but also the beam loss at the collimator have been reduced to half. Such improvements in the RCS have also been well recognized at both MLF and the MR by reducing the beam losses at the beam transport as well as each facility. The RCS has been continued a sustainable operation with record high of nearly 99% availability.

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