RILAC operation

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We report on the operations, maintenance, and improvement works for RILAC in 2023. Table 1 shows the statistical data regarding RILAC operation in the period.

Table 1. Statistical data of RILAC operation from January 1st to December 31st, 2023.

Operation time of RILAC	4178.6	h
Mechanical problems	83.8	h
Standalone RILAC	3802.9	h
Injection into RRC	0.0	h
Total beam service time of RILAC	3802.9	h

The following enumerates notable machine issues that occurred throughout the beam supply period.

1) Failure of semiconductor amplifiers in SRILAC SC07, SC08
2) Halt of Gifford-McMahon/Joule-Thomson refrigerator for R28G-K ion source due to a loosened fuse
3) Water leakage at coolant piping for RILAC A1 end drift tube.
4) Failure in the plate power phase-loss relay for RILAC A1
5) Increase of X-ray emission from SRILAC SC08.
6) Frequent WatchDog errors from steering power supplies in low energy and high energy beam transport lines
7) Decrease in discharge pressure of the cooling water pump in the secondary system of the main unit
8) Failure of the high voltage switch circuit used in the beam chopper
9) Failure of G1 voltage detection relay in RILAC #3 mid-stage amplifier
10) The decrease in flow rate of the deionized water pump in the SRILAC system
11) Failure of a diode in the clover circuit of RILAC A2 plate power supply
12) Failure of amplifier vacuum tube at RILAC #2 end stage
13) Failure of ceiling fan on RILAC #6 mid-stage plate power supply
14) Failure of amplifier in the BEPM1 DOWN signal
15) Failure of automatic phase control (APC) circuit for RILAC #2 and #5
16) Failure of programable logic controller (PLC) module for RILAC #5
17) Failure of RILAC #5 transistor amplifier
18) Failure of uninterruptible power supply (UPS/ 30 kVA) for SRILAC control

We resolved issues 1) to 17) through readjustment and repair, ensuring continuous supply of the beam. The issue 18) occurred on November 27th during an interruption period due to experimental considerations. The new UPS was installed in January 2024.

We outline the major maintenance and improvement works conducted during the maintenance period in 2023.

1) Maintenance of the temperature control device of the RILAC drift tube cooling system
2) Update the electromagnet power supply and control system of LEBT and HEBT
3) Replacement of the torn buncher's mesh electrodes
4) Replacement of the mid-stage filament power supplies for RILAC #1, #2, and #6
5) Replacement of phase-loss relays on RILAC #5 and #6 mid-stage plate power supplies
6) Replacement of the phase-loss relays for the RILAC A1 and A2 plate power supplies
7) Installation of contact fingers for RF shield on the RILAC #3 and #4 tank

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DOI:10.34448/RIKEN.APR.57-084

8) Removal of the old flowmeter inside RILAC #4 power amplifier and valve replacement

9) Replacement of valves and joints in the RILAC #5 and #6 power amplifier cooling system with stainless steel

10) Replacement of valves and joints in the RILAC A1 resonator cooling system with stainless steel

11) Replacement of valves and joints in the RILAC A1 and A2 amplifier cooling system with stainless steel

12) Parallelization of the cooling water piping for vacuum system in RILAC #3 and #4

13) Disassembly and maintenance of the deionized water pump in the RFQ cooling system

14) Replacement of the turbomolecular pump in the RILAC #4 tank (5000 L/s $\rightarrow$ 2400 L/s)[1)]

15) Installation of nitrogen piping for the RILAC tank leak.

16) Cleaning of drive device for slit SL-014

17) Construction of RI production courses

18) Installation of new UPS (40 kVA) SRILAC control system

Furthermore, regular maintenance was performed on each device. As indicated in Table 1, beam supply in RILAC accounted for 91% of the total operating time, achieving stable operation in 2023.

More details of operations and other problems and developments are reported in Ref. 2).

References

1) T Nishi *et al.*, in this report.
2) A. Yusa *et al.*, Proc. of PASJ2023, Funabashi, Japan, August, 2023, TWSP05, (2024), pp. 1024–1028.