Activation of temperature control in the RILAC cooling water

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Fluctuations in cooling water temperature have a significant impact on the accelerator. For example, a change in water temperature deforms the cavity resonator of the accelerator and changes its resonant frequency, resulting in a slight drift in rf voltage and phase despite feedback control. This affects the beam, causing beam loss and making it difficult to maintain a high-intensity beam. Therefore, we decided to activate the temperature control of the cooling water system of RILAC to realize a high-intensity beam and improve availability.

The cooling water of the RILAC is roughly divided into the ion source system, RFQ[1] system, RILAC[2] main system, RILAC booster[3]/SRILAC[4] system, and vacuum pump system. Except for the vacuum system, the secondary cooling water was cooled in the cooling tower, and the primary cooling water, which recovers heat from the load, was cooled through a heat exchanger. Some systems had flow control valves for temperature control, but the majority of them were disabled. In addition, all the fans in the cooling tower were constantly rotating, and the temperature of the secondary water fluctuated greatly depending on the condition of the outside air. As a result, the temperature of the primary water changed several degrees in one day.

The ion source system was originally temperature-controlled, but the cooling tower fan was rotated constantly. This secondary water was also used for the RILAC drift tube cooling system, and the temperature drop in winter caused a vacuum leak from the drift tube, resulting in a severe discharge. Therefore, a temperature controller was added on the control panel to automatically turn fans ON/OFF at 24 ± 1.5°C.

The RFQ system had a heat-exchanger bypass valve on the secondary side, which was sticking and unusable. The control panel was modified to add a primary and secondary temperature controller, and the bypass valve was replaced with a new one. The cooling tower fan is now automatically controlled ON/OFF at 23 ± 1°C, and the primary temperature automatically controls the bypass valve to keep at about ±0.1°C.

The secondary cooling water in the RILAC main system cools the resonator system, amplifier system, and irradiation vault system as the primary side. The number of cooling tower fans can be controlled by adding a temperature controller and rewriting the logic controller program by automatically turning them on and off individually. In addition, the fans are activated in sequence to reduce damage due to startups. Automatic control of the heat exchanger bypass valves in the resonator and irradiation vault systems was enabled, and both systems were maintained within ±0.2°C.

The SRILAC system was originally a cooling system for the RILAC booster, but the automatic control of the flow control valve had been disabled since the water leak in 2009. The control panel was modified to enable automatic ON/OFF control of two fans alternately, and automatic control of the primary temperature control valve was enabled. As a result, the temperature could be controlled to ±0.1°C.

The vacuum pump system used a closed cooling tower. Previously, the system froze during the cold winter, requiring repair. Thus, the control panel was modified, and a temperature controller was added. Currently, the temperature is controlled at 23 ± 2°C, and there is no longer any concern about over-cooling.

Figure 1 shows an example of one day trend for rf voltage and phase in the RILAC resonators. The rf stability is dramatically improved after activating the temperature control, contributing to a further intense-beam supply and increased availability.

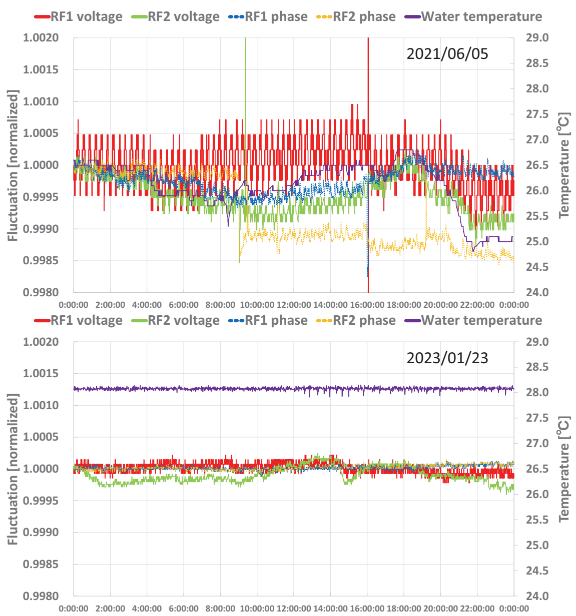

Fig. 1. One day trend of rf voltage and phase in the RILAC resonator no.1 and no.2 before (upper panel) and after (lower panel) stabilizing the water temperature.

References
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