6 - 23 Design of Circulating Cooling Water System for LEAF

Zhu Tieming, Zhang Bin, Chen Wei, Wang Lishi and Wang Dingjiu

The Low Energy Accelerator Facility(LEAF) comprises a superconducting ion source, a LEBT, an RFQ, a MEBT and a test terminal. It comprises a lot of power electronics and consumes a large amount of electricity, which will eventually be converted into heat. The function of process circulating cooling water is to absorb and transfer the heat produced by these equipments, and realize the constant temperature regulating means of certain temperature sensitive parts, so as to ensure the long-term, reliable and stable operation of the LEAF equipment. The design requirement parameters are shown in Table 1. Primary water subsystem 1.

Table 1 Design requirement parameters of LEAF water cooling system.

Device name	Number	Flow/(m^3/h)		Pressure/bar	Temp/℃	Resistivity/(MΩ·cm)
		Single	Total			
Primary water subsystem 1			216.4			
LEBT	1	7.4	7.4	5.0	25.0	≥ 1
Buncher	1	15.0	15.0	5.0	25.0	≥ 1
RFQ	2	40.0	80.0	5.0	25.0	≥ 1
MEBT	1	6.0	6.0	5.0	25.0	≥ 1
Power source	4	10.0	40.0	5.0	25.0	≥ 1
45G Microwave machine	1	10.0	10.0	5.0	25.0	≥ 1
dummy load	1	5.0	5.0	5.0	25.0	≥ 1
Electron accelerator	1	20.0	20.0	5.0	25.0	≥ 1
Coating cavity power source	6	5.5	33.0	5.0	25.0	≥ 1
Primary water subsystem 2			14			
High voltage platform	1	14.0	14.0	6.0	25.0	≥ 5

The following problems should be considered in the design of water cooling system:

(1) For a large number of LEAF equipment, their circuits and waterways are often integrated. The water insulation quality is required to reduce the current leakage of these electrical equipment;

(2) Effective measures should be taken to prevent corrosion fouling and water equipment pipeline blockage, especially the copper corrosion at high water pressure and flow rate, to improve the cooling efficiency of water equipment;

(3) To prevent electrical short-circuit caused by the deposition of oxide on the inner wall of ceramic fittings such as ceramic joints, the dissolved oxygen in the water needs to be kept at a low level;

(4) The activation of water should be minimized to prevent the emission of activated particles.

Based on the above factors and related engineering experience, the process circulating cooling water system adopts double-cycle cooling method as primary circulating water system, and the low conductivity circulating water directly contacts with cooling object to take away thermal power from the power and electronic equipment. The plate heat exchanger, which transfers heat to secondary circulating water system and ultimately, heat from power electronic equipment the towers of secondary circulating water system. Water-cooled system consists of the following parts: Primary circulating water system, secondary circulating water system, a pure-water system and a monitoring system. The diagram of water cooling system is shown in Fig. 1.

As an open mechanical loop, primary circulating water system consists of pumps, plate heat exchangers, chiller (thermostatic water machine), filters, circulating water tanks, supply and backwater dry pipes and distribution pipes, as well as flow, temperature, pressure, liquid level, water quality and other monitoring instruments, corresponding power facilities and control systems. The polishing resin filter is set up to maintain a certain water quality index, and an independent inland water subsystem (such as HV platform) is adopted for the subsystem of some high requirements.

The secondary circulating water system, which consists of pumps, circulating tanks, cooling towers and piping, and provides a cooling source for primary water system. Secondary water is usually softened. Secondary water system need to be supplemented periodically circulating water loss caused by evaporation, sputtering, sewage, leakage and the amount of water required for sewage. We also need to put the scale inhibitors and fungicides to stabilize the water quality and prevent the fouling, corrosion and sterilization of algae at runtime.

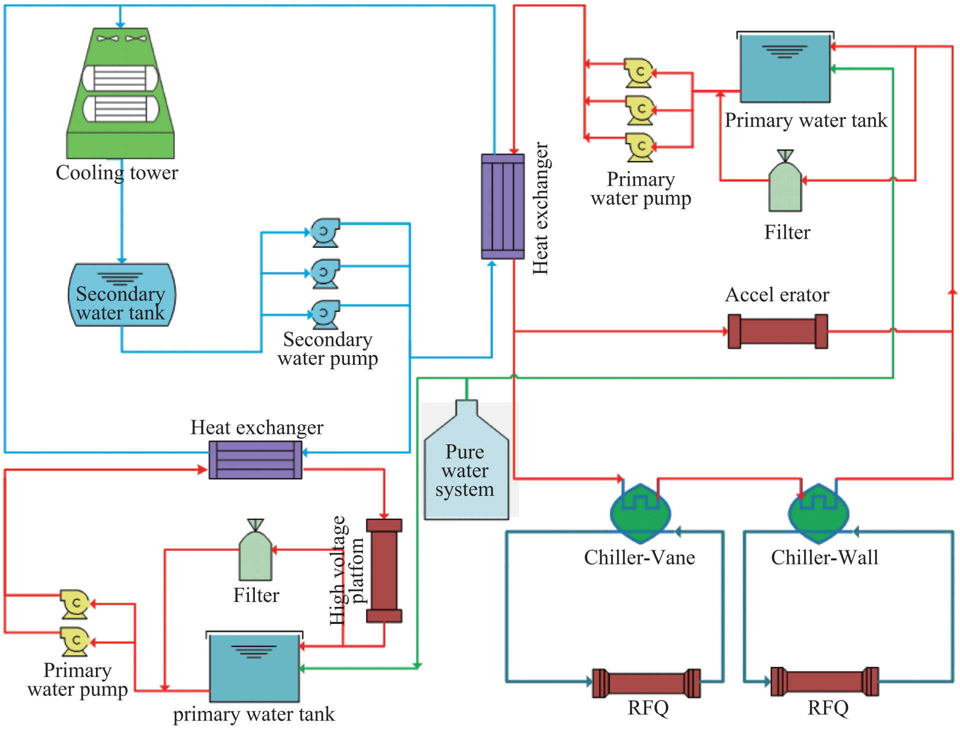

Fig. 1 (color online) Diagram of water cooling system.

According to the equipment requirements, for all equipment, piping, valves, pipe fittings of the water system, stainless steel was chosen; for flange gaskets and other sealing materials need to have the resistance to radiation, anti-aging performance; For equipment, pipes of external circulating water system, carbon steel was selected in order to save project cost.

6 - 24 State Report of 320 kV High-voltage Platform in 2016

Li Jinyu, Liu Huiping, Kang Long and Zhang Tongmin

In 2016, the total operation time is 6 500 h, including 4 500 h for experiments, 740 h for ion source tuning and beam changing, 400 h for machine preparation and beam waiting at the site. The percentages for these activities mentioned are 69%, 11% and 6%. The failure time is 900 h, accounting for 14% of the running time, and this value is at the highest level in years. 37% of the experimental time was contributed to IMP, 11% was to institutes other than IMP, 47% to universities and 5% to enterprises (shown in Fig. 1). Among the research purpose, 71% of the experimental time was for material research, 20% for atomic and molecular dynamics, 9% for plasma physics, nuclear astrophysics, and atom and molecular spectroscopy (presented in Fig. 2).

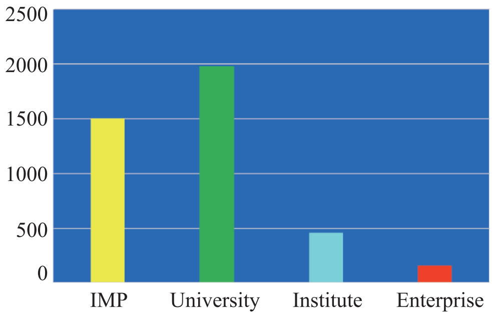

Fig. 1 (color online) Beam time distribution in terms of affiliation.

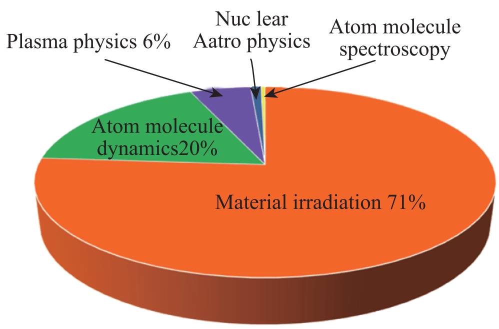

Fig. 2 (color online) Beam time distribution in terms of research area.

During 2016, more than 120 ion species from 16 kinds of gas elements and metal material were produced and delivered at 320 kV platform, such as H, He, C, N, O, Ne, Ar, Kr, Xe, Bi, Fe, Li, Ni, and so on. Among them, Li and Ni ions beams were newly tuned. The ion beams were changed about 233 times according to the user's requirements. The energy of ion beams ranged from 10 keV to 7 MeV, the extraction voltage was 10~280 kV.