A 400m-LONG SUPERCONDUCTING RF LINAC CRYOSTAT DESIGN FOR AN ERL LIGHT SOURCE

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Abstract

A so-called 4th generation synchrotron radiation light source for a large-scale user facility like the 3rd ones has been recently discussed to realize using a superconducting RF linac-based FEL [1] or an energy recovery linac (ERL) light source [2]. In order to realize both of them, we need very large number of low-temperature cryostats to run them routinely and efficiently. A 400m-long superconducting RF linac cryostat is conceptually designed here and discussed to optimize major operational characteristics of the advanced low-temperature cryostat for an ERL light source near future.

CRYOSTAT CONSIDERATION FOR INDUSTRIAL ERL LIGHT SOURCES

In order to realize quickly an industrial energy recovery linac (ERL) light source, a 400m-long superconducting RF linac cryostat is conceptually designed and discussed to optimize major operational characteristics of the advanced low-temperature cryostat for an ERL light source near future. A low temperature cryostat for superconducting RF linacs and other superconducting devices should be designed and made to minimize its heat invasion through the heat bridges between the room and low temperature parts. The cryostat also should be designed and made to minimize total number of the heat cycles for the rest of its life after the initial test. We can expect that the total number of the heat bridges is roughly proportional to the number of the cryostat, and a life interval between two contiguous cryostat malfunctions inversely proportional to the number of the heat cycles. Therefore, if we can design and make a single and long cryostat to realize the operation less than a half cycle for the rest of its life, we can run our cryostat for a very longer interval than tens of years and with minimum electricity. In addition to them, we plan to summarize the JAERI ERL FEL zero-boil off cryostat design, its operational characteristics, and non-stop operation records over these 12 years and other cryostat related activities in the poster presentation.

Each cryostat usually has one or two liquid He feeding ports, and two beam pipes, several RF main and higher mode couplers. Here we assumed that the ERL has 800 cavities, 400m accelerating length, average acceleration gradient of 10-15MeV/m, and total electron energy 4-6GeV. Horizontal axis is number of cavities installed in each cryostat, vertical one total static heat load. Minimal static heat load will be realized if we can choose a single and longest cryostat, and the maximum load the shortest cryostat. Because we intend to use the cryostat for the

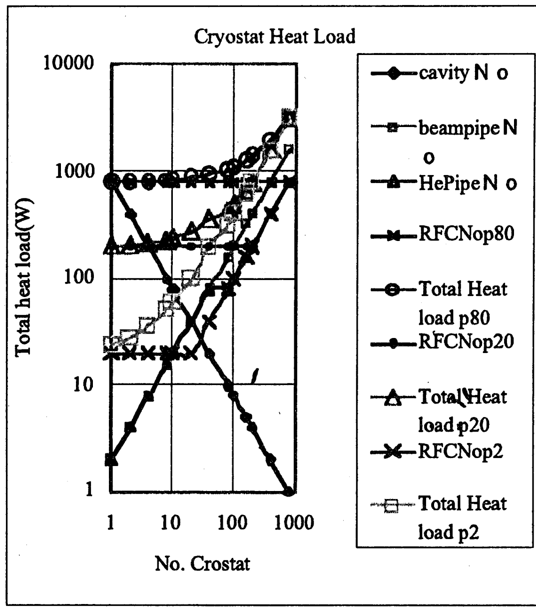

Figure. Static Cryostat Heat Load and No. of Cryostat.

ERL, RF power for the main accelerator linac will be recovered and the power supply will feed a large number of cavities. In the figure, there are 3 cases of cavity number fed by one RF port, i.e., 1, 4, and 40, and "Total Heat Loadp80", "Total Heat Loadp20", and "Total Heat Loadp2" indicate them respectively.. The maximum heat load became 3.2kW at low temperature, and the minimum 24W.

Heat shield of the long and single cryostat will be cooled down by using integrated refrigerators system like existing JAERI zero-boil off cryostat system [3].

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