NEW SRF FACILITY AT KEK FOR MASS-PRODUCTION STUDY IN COLLABORATION WITH INDUSTRIES

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Abstract

The building construction of new SRF facility next to the superconducting RF test facility (STF) in KEK has started from 2014 for the mass-production study of SRF accelerators in collaboration with industries. This new building has a dimension of 80m x 30m, and the plan is to install clean room for cavity string assembly, cryomodule assembly tools, cryogenic system, vertical test facility, cryomodule test facility, input coupler process facility, cavity electro-polish (EP) facility, and control rooms in it. The purpose of this new SRF facility is to establish a close collaboration between SRF researchers and industries in order to prepare for the upcoming large-scale future SRF project, ILC [1]. This paper describes the infrastructure detail and the plan to utilize future SRF accelerator.

INTRODUCTION

The STF in KEK is the facility to demonstrate the ILC Main Linac accelerator technology and to have experience of high current and high beam power superconducting accelerator operation. In STF underground tunnel, the STF accelerator construction and installation has been started from 2009. We conducted several experiments, such as S1-Global cryomodule experiment [2], and Quantum-beam experiment for a compact high-flux X-ray generation [3]. The Quantum Beam accelerator part is now used to the STF accelerator, as an injector. At the downstream of an injector, ILC-type cryomodule, CM-1 and a half size cryomodule CM-2a were installed and waiting for cool-down test.

Since the STF facility does not have enough space to assemble the full-size cryomodule, so the full-size cryomodule has been assembled using the accelerator tunnel underground. Once it has built and equipped, no more full-size cryomodule is assembled in the STF.

In order to prepare ILC mass-production of cavities and cryomodule, and to equip ILC testing function of cavities and cryomodule, a new SRF facility to accommodate cavity testing, cryomodule assembly and testing is desired. By using new funding of "International Science Center of Innovation 2013" of MEXT (Ministry of Education, Culture, Sports, Science and Technology in Japan), a new SRF facility "Superconducting Accelerator Development hall" has been started its building construction and equipment fabrication. This new SRF facility has a function of development of ILC cavity test and ILC cryomodule assembly, test for a model equipment of ILC mass-production support function.

NEW BUILDING

The location of the new building, should be next to the STF building for close connection of SRF accelerator development and operation. Joint work and easy access of people, joint operation of helium cryogenics system are the main reason. There is open space in the 30m north of the STF. The building construction has been started by cut out trees and making the land flat. Satellite view of the new SRF facility location and the STF is illustrated in figure 1.

Figure 1: Satellite view of the new SRF facility building location and the STF, ATF.

The size of the new facility is 80m long (east-west) and 30m width (north-south) and 12.5m height. This dimension is determined to accommodate minimum number of required equipment and to have maximum space from available funds. Birds view (from south-east) of the new SRF facility building is illustrated in figure 2.

Figure 2: Birds view of the new SRF facility building.

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Figure 3: Picture of current view (from north-east) of the new SRF facility building construction, as of 23 August 2014.

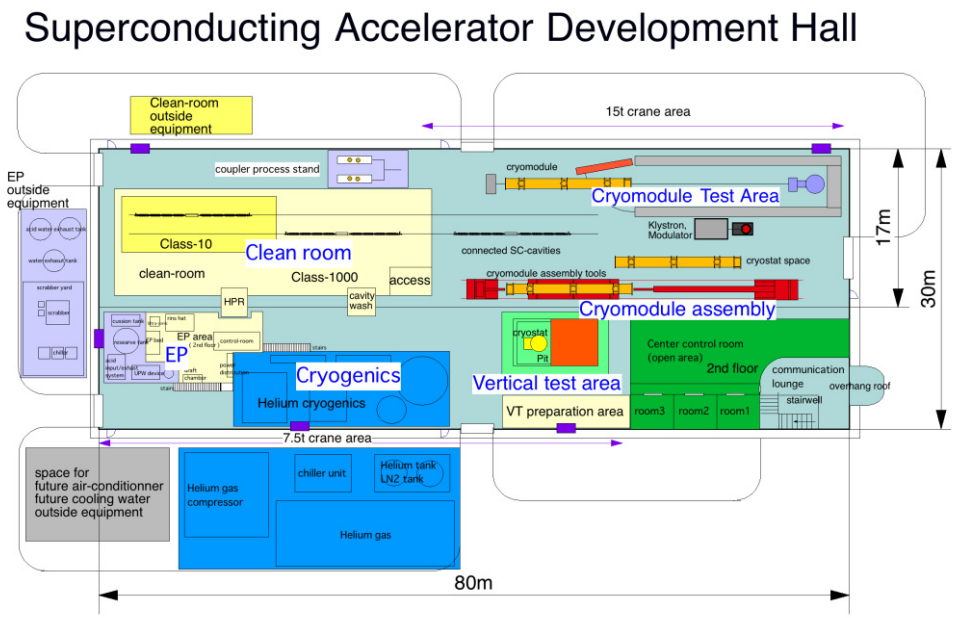

Figure 4: Plan view of the Equipment of the new SRF facility.

EQUIPMENT OF SRF FACILITY

The equipment installation is for clean room for cavity string assembly, cryomodule assembly tools, helium cryogenic system, cavity vertical test facility, cryomodule test facility, input coupler process facility, cavity EP facility, and, control rooms and preparation rooms. SRF cavity fabrication including EP treatment and helium tank welding is assumed to be done in industries in ILC. The cryomodule is also fabricated in industries. ILC hub-laboratory is assumed to take care of cavity testing, cryomodule assembly and testing, and input coupler RF processing. Following to the Euro-XFEL cavity test and cryomodule assembly and test, the equipment designs are made. The EP equipment is a model of industrial EP to be installed in cavity fabrication industries. We will develop simplified vertical EP using this facility.

By the limited funds, clean room, cryomodule assembly tool, part of vertical test, part of helium cryogenics, and part of EP facility, are fabricated in 2013. They were already delivered and stored in ATF hall, and waiting for installation after the building completion. Other equipment will be procured later.

The clean room is 9.75m x 33.9m ISO class 6, where 6m x 16.5m ISO class 4 included. Down-flow air from ULPA filters is collected to sideways into the return shaft. Two cavity train rails will be equipped in the floor long pits. High-pressure water rinsing room and cavity outside washing room are connected to the ISO class 6.

The cavity test cryostat handles 4 cavities in the same time. Jacketed and no-jacket cavities can be mounted. The cryostat is a standalone type, with no direct connection to the cryogenics to avoid high-pressure regulations.

The cryomodule assembly tool is based on the design of Euro-XFEL tool. The several modification on dimensions to accommodate ILC cryomodule are adopted. Active movement of cold-mass hanging and vacuum vessel mounting are adopted. In figure 5, stored cryomodule assembly tool are shown.

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The performance of the cryogenics system is similar to the STF cryogenics. Liquid helium is supplied to the vertical test cryostat and cryomodule 2K cold-box. For future application, it is considered to connect with STF cryogenics system to accommodate more cooling power for STF accelerator operation.

For the industrial EP treatment, more simple and cost effective EP system is required for ILC mass production. Vertical EP concept is a candidate. Development of vertical EP is now under progressing with industry collaboration. After completion of the development, this new EP facility will be the demonstration of the system operation test. Figure 6 picture shows EP bed in vertical attitude with electrode insertion mover equipment in the left.

Figure 5: Picture of the ILC-type cryomodule assembly tool temporally stored in ATF hall.

Figure 6: Cavity bed of vertical EP equipment.

OPERATION OF SRF FACILITY

The new SRF facility is operated by the laboratory-industry collaboration. The building equips 5 rooms for renting to industries as an exclusive area. Every equipment and tools are for rent to industries. Participation of laboratory researcher to the industry development is possible as an open collaboration. Exclusive use of equipment only for renting industry is also possible, such as using EP facility, clean room and vertical test. The operation of whole equipment is connected to the closed LAN, and controlled from the centre control room. The experiment data can be controlled under restricted access method. The renting rooms, open meeting room, control room, and laboratory researcher rooms, exhibition area are located at the south-east corner of the building with two-stories.

ILC PROSPECT AND THE NEW SRF FACILITY

The LCC, Linear Collider Collaboration, requested to the Japanese Government (MEXT) to host the ILC in Japan, and recommend the reasonable ILC construction site in Japan. The MEXT started to explore the project procedure. It will take one to two years to get a report of ILC project hosting. In parallel, LCC promotes the engineering study of ILC with more detailed and with site-specific design.

Since there is no ILC specific cryomodule assembly tool and cavity test equipment for mass-production in KEK, the new SRF facility construction and operation are proceeded as model equipment for ILC mass production. After successful operation, these equipment will be copied to a ILC laboratory facility at the ILC site.

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