Construction of STF(Superconducting RF Test Facility)

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0) Overview of this memorandum

The first priority role of STF(Superconducting RF Test Facility) is to verify a stable high gradient and high efficient SC-Cavity within two years using well equipped 'Proton Linac Building' of J-PARC. The STF also facilitate ILC cryomodule assembling, test and various R&D of mass-production studies. The full unit test stand which will be constructed in the phase 2 stage, will be used for checking stand of module mass-production.

1) Importance of STF project

The purpose of building STF in KEK are as follows;

For STF 1;

1. Provide a stable and reliable 35MV/m with reasonable yield rate.
2. Provide reliability data of 45MV/m gradient.
3. Provide a solution to the issues of existing ILC-SC engineering using KEK SC engineering experience.
4. Construct cavity treatment facility in KEK.

For STF 2;

1. Construct assembling facility of ILC cryomodule.
2. Assemble ILC cryomodules.
3. Construct cryomodule test facility.

For both;

1. To be a base facility for international collaboration.
2. To provide a basis of realistic cost estimation and mass production.
3. To promote LC researchers and industries for production of SC-Cavities and cryomodules.
4. To give an opportunity to train up young researchers and students.

In order to utilize the facility more efficient,

1. STF should be considered to include FEL or ERL light source accelerator upgrade.
2. An expansion of tunnel for carrying 17m cryomodule in will be necessary. In this circumstance, the space of FEL undulator and experiment hall should be considered.

Furthermore, the importance of beam in STF is considered as follows;

1. The development and verification of Low-level RF feedback system requires beam loading in the cavities.
2. In the high power RF system test, beam loading is essential for high power operation, and accelerating gradient will be directly verified by accelerated beam energy.
3. The study of cavity alignment is facilitated using cavity-HOM measurement.
4. Will facilitate the development of beam instrumentation, such as BPM.
5. The generated beam will fit to FEL light source.

2) Urgency of STF project

In order to contribute to ILC construction from Asian region, it is obvious for KEK and Asia researchers and industries to have SC engineering experience. The unified test facility for superconducting RF engineering including beam provides all aspect of ILC main linac engineering experience, will be one of base facility of world-wide ILC collaboration. Since KEK has a reasonable high

potential of superconducting technology for ILC, STF will be constructed with minimum time scale, establish a basis of ILC-SC technology, and be one of international test facility dedicated to ILC development and industrialization. The issues in the existing ILC-SC technology are identified by the review discussion in the ILC-Asia WG2 and by the ILC WS discussion. They are, for example,

1) Reliability of cavity gradient greater than 35MV/m,
2) Complexity and cost consuming of input coupler,
3) Rigidity of cavity-jacket relating to Lorentz detuning,
4) Reliability of tuner mechanism,
5) Reliability of Piezo tuner in cold state,
6) Cavity alignment distortion after cooling down,
7) Cost optimization of RF waveguide system,
8) Cost optimization of cryomodule.

STF should also provide a solution to these issues.
Therefore, ILC dedicated STF by KEK leadership has an urgency to promote further ILC developments and industrialization.

3) Participants in the project and their responsibility

Since STF is relatively big and wide spread project, existing big teams are coordinated to have responsibilities of each engineering. The detail of their responsibilities will be discussed soon. Followings are rough assignment of teams and responsibilities. Total number of people for STF contribution is around 52. The net man power(FTE) is around 23.

1. Helium refrigerating system : team of Kenji Hosoyama
   (Hosoyama, Morita, Kabe, Kojima, Nakai, Hara, Honma)
2. High power RF system including LLRF : team of Shigeki Fukuda
   (Fukuda, Shidara, Akemoto, Honma, Nakajima, Yoshida, Michizono, Katagiri, T. Matsumoto, Nakao, Takenaka)
3. Cryomodule (except cavity) : team of Shuichi Noguchi
   (Noguchi, Kako, Shishido)
   and team of Kiyosumi Tsuchiya (Tsuchiya, t.b.d.)
4. SC-Cavity : team of Kenji Saito
   (Saito, Ueno, H.Matsumoto, Tsuchiya, Morozumi, Higashi, Saeki, Higo, Yamaoka, Kume, Enami, Inoue, Wake, Toge)
5. Electron gun system : team of Osawa (Osawa, Kuriki, Ikeda, Sugimura)
6. Control and Operation : team of Junji Urakawa(ATF group)
   (Urakawa, Hayano, Kubo, Kuroda, Terunuma, Kuriki, Okugi, Naito, Araki)
   XTF group
   (Higo, Kudo, S. Matsumoto, Tokumoto, Saeki)
7. Surface process facility of SC-Cavity : team of Kenji Saito,
   team of Kenji Ueno(Mechanical Engineering Center)

4) Cooperation with Industries

There will be two aspects: open discussion of general engineering, and business contract with specific company. The open discussion will be made by ILC-Asia working group, and engineering discussion coordinated by LC forum of Japan. The business contract will be made by a bid after open discussion. The direction of discussion with industry is a cost reduction with highest priority.

5) Collaboration with oversee laboratories

Having two more test facilities in KEK and FNAL is important and not

duplication. Assuming share of cryomodule production in three region, each region must have expertise and experience in SC engineering in order to lead local industries. The test facilities and its construction will provide a chance to have ILC cryomodule engineering and production experience for the researchers and industries. The collaboration and competition among three test facilities will make reducing risks of engineering and reducing development term, will realize three times big scale engineering verification. These test facilities will be the base of mass-production test and inspection facilities.

KEK will have active collaboration with TTF and SMTF for engineering information exchange, developed engineering and device exchange, and people exchange. The regular workshops will be held positively among them. As for collaboration with Asian laboratories, STF will be a base of people and engineering collaboration.