

*A Preliminary Draft proposed – 2008/11/16, and
to be discussed in the SCRF-WG session in ILC-08*

Agreement for S1 global Program

Draft C: 2008/11/16

Preamble

This is an agreement (proposed) among High Energy Physics Research Organization (KEK, Tsukuba, Japan), Deutsches Elektronen-Synchrotron (DESY, Hamburg, Germany), Fermi National Accelerator Laboratory (FNAL, Batavia, USA), SLAC National Accelerator Laboratory (SLAC, Stanford, USA), Istituto Nazionale di Fisica Nucleare (INFN, Milano, Italy) and Global Design Efforts (GDE) for the International Linear Collider, concerning the collaborative work on construction and operation (in 2008-2010) of two units of horizontal cryostats which house up to total eight 9-cell cavities at KEK. This work is done in the context of technical development coordinated by GDE for the International Linear Collider. The collaborative work covered by this MoU is called the “S1-global” collaboration. The institutions and the organization above (KEK, DESY, FNAL, SLAC, INFN and GDE) are henceforth called “the parties”. This agreement defines the outlines of the goal, mission, timeline and work sharing during execution of the S1-global by the parties. This agreement is devised in the framework of ILCSC MoU, and in part by higher-level agreements on academic exchanges among participating parties.

1. Mission of the S1-global

The mission of the S1-Global is to facilitate the international collaborative work on the production and operation of cryomodules in the framework of ILC-GDE and to aim at operating at least one cryomodule with an average accelerating gradient of 31.5MV/m. Specific goals of the S1-global include the following:

- (1) To advance the implementation of the ‘plug-compatibility concept’ for the cavity packages, by installing up to 8 cavities from laboratories across the world into a common module, and by operating them with pulsed RF power at a cryogenic

temperature of 2K.

(2) To examine the engineering designs of cavity packages from participating parties by assembling them into a common module and by following through the alignment procedures.

(3) To demonstrate that the specifications on the heat loads for the cavities and the cryomodules can be met as per RDR.

(4) To conduct comparative studies of performance of cavities from the participating parties, in particular, in the area of Lorentz detuning and its compensation in a common setting.

(5) To attempt to attain an average accelerating gradient of 31.5MV/m in a pulsed RF operation at 5 Hz with 1 ms flat-top length, 0.07% rms amplitude variation and 0.35 degree rms phase variation.

2. S1-global collaboration profile

The S1-Global is to be completed by the end of December 2010, consistent with the timeframe of TDP1. The cryomodule of S1-global consists of a 6m-long “module A” which contains four TESLA-like cavities from KEK, and another 6m-long INFN “module C” which contains two TESLA-type cavities from DESY and two TESLA-type cavities from FNAL. These cryomodules are assembled at KEK-STF and will be installed into the KEK-STF tunnel. The cryomodules are connected to an existing STF cryogenics system and the STF klystron #1. A power distribution system from SLAC is used/contributed to deliver the RF power to the cavities in module C.

The assembly, RF process, performance study, and disassembly are conducted in cooperative work of the participating parties.

3. Ownership of the progress and authorship of publications/reports

Any report and publications related to S1-global experiment should quote ‘S1-Global Collaboration’ as a co-author. The membership of S1-Global Collaboration is to be determined by consultation among the contact persons, who are responsible for maintaining the list appropriately.

4. Expenses

(1) The transportation fees for in-kind contributions are paid-for/covered as follows:

- The originating laboratory covers the fees up to Narita airport, when the item is being brought to KEK.
- KEK covers the customs-clearance process fees (is responsible for duty-free

process) and transportation fees in Japan, when the item is being brought to KEK.

- KEK covers the transportation fees up to the airport in the closest neighborhood of the originating laboratory, when an item is being returned to the originating laboratory.
- The originating laboratory covers the customs fees and domestic transportation fees, when the item is being returned to the originating laboratory.

(2) Each of the participating parties will cover the travel and subsistence expenses for their own personnel. KEK will assist the visitors in the area of making reservations for accommodations, obtaining the radiation worker status, office space and work space.

5. Execution of the Collaboration and Contact Persons

Execution plan of the collaboration is outlined in Appendices. Each of the participating parties will assign a contact person. These contact persons are responsible for directing more details of the design, planning, schedule and execution of this collaboration, in consultation with Project Managers of GDE.

6. Undertaking

Each party's agreement to contribute to the S1-Global collaboration shall be subject to

- the availability of resources, which it shall attempt to secure at maximum levels appropriate for the successful and timely completion of its completion. It shall notify all other participating parties in writing without delay, if such resources cannot be secured, or the agreed-upon schedule cannot be met;
- compliance with its internal rules and regulations, its agreements with funding agencies and the laws, regulations and policies of its Government;
- updates of the scope, objectives and schedule of the S1-Global collaboration which is established through consultation of the participating Parties.

7. Amendment

This agreement may be amended by written agreement of all the Parties. The accession of a new participant as a signatory to this MoU shall be subject to prior written agreement by its initial signatories. While the Parties recognize that a sustained effort is required to realize the purpose of this MoU, in case of an irreconcilable situation, any Party may resign upon giving one year prior written notice to all the other Parties.

8. Duration of the Agreement

This agreement shall become effective upon the date of final signature. It shall remain in effect until superseded or suspended by agreement of KEK, DESY, FNAL, INFN and SLAC.

9. Approval

The following concur in the contents of this Agreement:
(It shall be also discussed, if the signatures would be necessary,)

Xxx xxxx,
KEK

xxx xxxx,
DESY

Date

Date

Xxx xxxx,
FNAL

xxx xxxx,
SLAC

Date

Date

Xxx xxxx,
INFN

xxx xxxx,
GDE

Date

Date

Appendix A. Contact Persons

(Candidate names for the contact persons, to be discussed)

KEK: Norihito Ohuchi

DESY: Lutz Lilje

FNAL: Mark Champion

INFN: Carlo Pagani

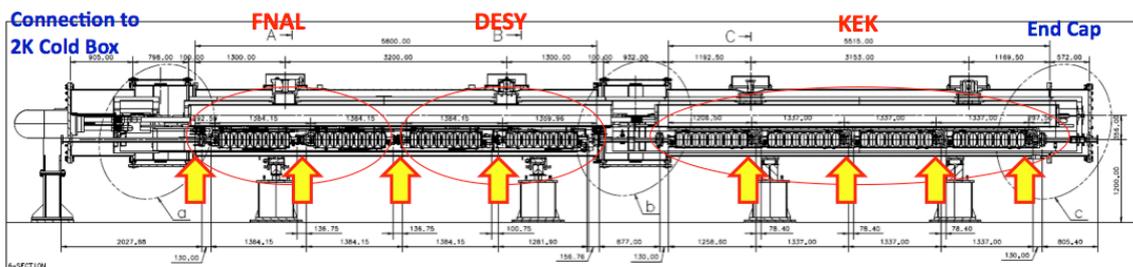
SLAC: Chris Adolphsen

GDE-PM: Akira Yamamoto

Appendix B. Layout of Components of S1-Global and their Operation

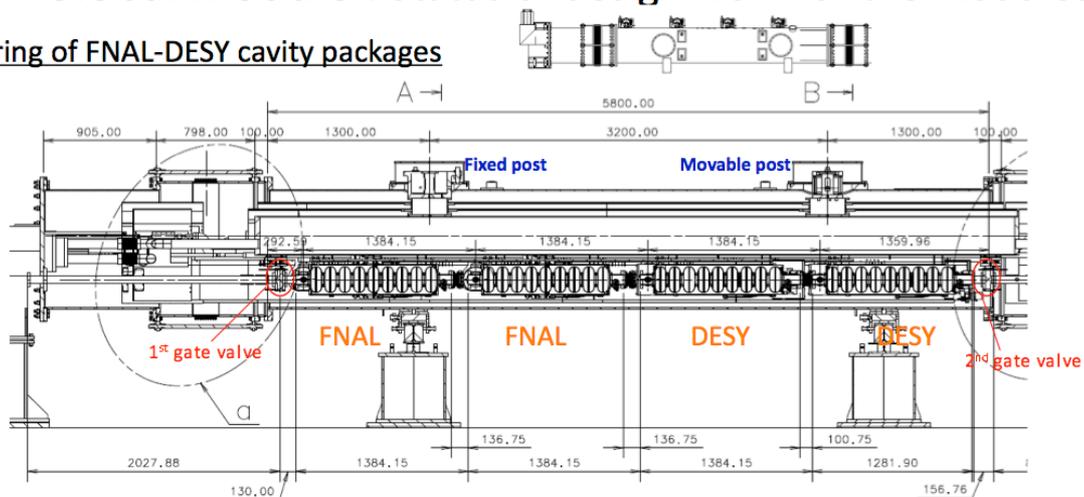
The layout of the cryomodule and related hardware in the STF tunnel is described. In the following “upstream” in the STF tunnel means the portion that is closer to the access elevator (left-hand side of the attached figures.). The module C is installed upstream relative to the module A. The upstream end of module C is connected to the 2K cold box, and the downstream end of module A is just a cover plate. Wire position monitors will be installed, if possible, for monitoring the movement of the GRP and the cavities. Many temperature sensors will be installed to measure the heat load performance. The connections of the cavities, beam line chambers, and gate valves are to be finalized through discussion among contact persons from participating parties. A 5MW klystron will provide the pulsed RF power. A LLRF system provides the feed-forward and feedback controls. The flexible power distribution waveguide is capable of supplying the RF power to each of the four cavities separately, four cavities in combination, and eight cavities in combination. RF Operation of S1-Global at cryogenic temperatures is done only from Tuesday through Friday, from 13:00 up to 19:00. During weekend (Saturdays, Sundays and National holidays) and night (after 19:00), the refrigerator at STF will stop. Whole Monday is spent to cool down of the cryomodule. As an exception, when the heat load measurements of the cavities are conducted, with an advanced consultation the cryogenic operation can be extended till around 23:00 each day and 80K shield cooling with liquid Nitrogen will be continued during night for stabilizing the temperature.

General Design of Cryomodules



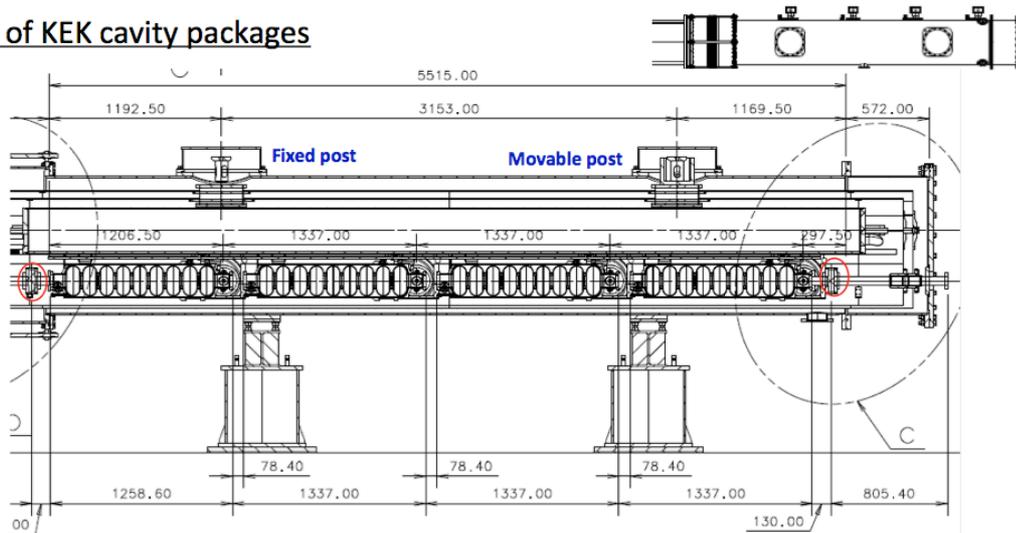
- Module C: 2 FNAL cavities and 2 DESY cavities, Module A: 4 KEK Tesla-like cavities
- The total length=14778mm
 - Module-C = 5800 mm, Module-A = 5515 mm
 - Vacuum bellows to 2K cold box = 795 + 100 mm, Vacuum bellows between modules = 932 + 100 mm
 - Connection to 2K cold box = 905 + 28 mm, End cap = 572 + 28 mm

String of FNAL-DESY cavity packages



- Distance between input couplers = 1384.15 (same as XFEL module)
- Cavity length (flange to flange)
 - FNAL = 1247.4 mm, DESY = 1283.4 mm
 - 1st cavity to 2nd cavity = 136.75mm, 2nd to 3rd = 136.75mm, 3rd to 4th = 100.75 mm
 - 1st gate valve center to 1st cavity = 130 mm, 2nd gate valve to 4th cavity = 130 mm

String of KEK cavity packages



- Distance between input couplers = 1337.0
- Cavity length (flange to flange)
 - KEK-Tesla-like = 1258.6 mm \Rightarrow 1247.6 mm
 - Cavity to cavity = 78.4 mm \Rightarrow 89.4 mm
 - The gate valve to the cavity flange = 130 mm

Appendix C. Details of the Cavity Packages

The list of the items to be included in cavity package to be brought into S1-Global cryomodule from each of DESY and FNAL is as follows:

Two 9-cell cavities within helium jackets, helium supply piping including bellows, pickup antennas for E-field and HOMs, mechanical tuners (complete set), piezo tuners (complete set), input couplers (complete set), magnetic shield, RF monitor cables with thermal anchor and feed-through flange for the vacuum vessel, one beam pipe bellows (inter-cavity connection), one gate valve for beam line attached to the cavity beam pipe flange, sufficient amount of vacuum sealing materials, bolts and nuts if non-standard ones are required, adaptors to mount the cavities on the KEK rail system, fixtures needed for alignment, fixtures needed for assembly and installation of warm parts of the input coupler.

The details of these items, including dimensional constraints etc, are to be finalized through discussion among contact persons from participating parties.

Appendix D. Timeline

With an assumption that the cool-down work and RF power operation take minimum 4 months, the cryomodules must be installed in the STF tunnel by the end of August 2010. However, with the desire of conducting a sufficient amount of studies on the cryomodules themselves, all the installation of S1-Global has to complete sooner, and it

should be done by the end of May 2010. To meet this installation schedule, the delivery of equipment to KEK is to meet the following set of deadlines.

Module C

- (1) INFN Cryostat: end of October 2009
- (2) DESY cavity packages: end of October 2009
- (3) FNAL cavity packages: end of October 2009
- (4) SLAC power distributions: end of January 2010

Module A

- (5) KEK module A cryostat modification: end of November 2009
- (6) KEK cavity packages: end of November 2009
- (7) KEK power distributions: end of January 2010

Common to Module C and Module A

- (8) KEK Cryogenics and cold box: end of January 2010
- (9) KEK RF power source including LLRF: end of April 2010
- (10) KEK Instrumentations and controls: end of April 2010

Appendix E. Responsibilities

- (1) INFN Cryostat: The responsibility of INFN is described in the INFN-KEK MOU.

- (2) DESY cavity package: The responsibility of DESY for in-kind contributions is as follows:
 - (a) Items
Two units of 9-cell cavity packages. (**)
(**): The item details are described in Appendix C.)

(b) Processing

Prior to putting into cavity packages, the two cavities are vertical-tested and the gradient performance validated to be preferably better than 32MV/m ($Q_0 > 1 \times 10^{10}$) on average. Two couplers should be pre-processed with a pulsed RF power greater than 400kW at the full pulse length. Transportation of the cavity packages is to be done either vacuum-sealed or Argon-gas-filled. One of beam pipe flange of each cavity should have pumping port with valve.

(c) Interfaces

The interface conditions for the assembly of the cold mass and the cryostat are defined by the following components.

- upstream and downstream of beam pipe flange
- upstream end and downstream end of 2K helium supply pipe
- pre-cooling pipe
- input coupler vacuum vessel flange
- input coupler rectangular waveguide flange
- input coupler pumping port flanges
- 4 support tabs
- Invar rod fixture.

These components are to be built and be located as per the drawings which supplement this MoU.

(3) FNAL cavity package: The responsibility of FNAL for in-kind contributions is as follows:

(a) Items

Two units of 9-cell cavity packages. (**)

(**): The item details are described in Appendix C.)

(b) Processing

Prior to putting into cavity packages, the two cavities are vertical-tested and the gradient performance validated to be preferably better than 32MV/m ($Q_0 > 1 \times 10^{10}$) on average. Two couplers should be pre-processed with a pulsed RF power greater than 400kW at the full pulse length. Transportation of the cavity packages is to be done either vacuum-sealed or Argon-gas-filled. One of beam pipe flange of each cavity should have pumping port with valve.

(c) Interfaces

The interface conditions for the assembly of the cold mass and the cryostat are defined by the following components.

- upstream and downstream of beam pipe flange
- upstream end and downstream end of 2K helium supply pipe
- pre-cooling pipe
- input coupler vacuum vessel flange
- input coupler rectangular waveguide flange

input coupler pumping port flanges

4 support tabs

Invar rod fixture.

These components are to be built and be located as per the drawings which supplement this MoU.

(4) SLAC power distributions: The responsibility of SLAC for in-kind contributions is as follows:

(a) Items

An RF power distribution system which delivers the RF power to two DESY cavities and two FNAL cavities. This system is capable of adjusting the RF amplitude and phase for each cavity individually. The distribution system comes with a support frame to make it stand and fix to the floor on its own. The system is equipped with one RF port for the incoming RF power from klystron, and four RF output ports to be connected to the input couplers of four cavities. The system has a directional coupler in each coupler branch.

The details of the specifications for these items will be fixed after discussion between contact persons of each laboratory by end of January 2009.

(b) Processing

The RF performance of this power distribution system must be validated before shipment to KEK. The RF power for this system validation should be greater than 400kW at each of the coupler branch, and should be done with both the matched termination and shorted termination.

(c) Interfaces

The interface conditions for the assembly of the RF power distribution system with respect to the rest of the S1-Global hardware are defined by the following components.

One input waveguide flange

Four output waveguide flanges

Pick up connectors of the directional couplers

These components are to be built and be located as per the drawings which supplement this MoU.

(5) KEK responsibility

The rest of S1-global system except described above (1) to (4), are prepared by KEK.

(6) GDE responsibility: GDE is responsible for conducting the following tasks for successful execution of the S1-Global collaboration:

(a) Communication

The GDE contact person remains in a close contact with the S1-Global collaboration and maintains continuous and timely communication of information on technical development from the S1-Global collaboration to the GDE Executive Committee, and on relevant information of executive nature from the GDE Executive Committee to the S1-Global collaboration.

(b) Coordination

The GDE contact person participates in the technical discussion by the contact persons of the S1-Global collaboration, advises them on overall technical directions, and coordinates the negotiation process in case of issues which cannot be promptly resolved by the parties directly involved.

Appendix F. Contributions to the Assembly, Installation and Alignment

(1) Assembly of cavity packages into the module

String assembly of the cavity packages in the clean room, cavities for cold mass hanging and alignment of the cavities:

At least two personnel (one being an expert) from DESY will participate in the assembly work at KEK for the DESY cavity packages.

At least two personnel (one being an expert) from FNAL will participate in the assembly work at KEK for FNAL cavity packages.

KEK people will assist the colleagues from DESY and FNAL in the entire assembly process.

Colleagues from DESY and FNAL people participate also in the installation at KEK of KEK cavities.

(2) Assembly of the SLAC Power distribution system

At least one personnel from SLAC will participate in the installation work at KEK of the SLAC power distribution system, and will be responsible for directing the installation procedure and for checking the components after installation.

Appendix G. Procedures for and contributions to other components used in the

experiments

(1) Processing of input couplers at a room temperature, cavities at a low temperature, and measurement of cavity performance at 2K

The processing and performance measurements are conducted as follows:

For DESY cavities, personnel from DESY takes the initiative with participation of personnel from KEK, FNAL, etc.

For FNAL cavities, personnel from FNAL takes the initiative with participation of personnel from KEK, DESY, etc.

For KEK cavities, personnel from KEK takes the initiative with participation of personnel from DESY, FNAL, etc.

(2) Measurement of heat load

Same as above 6-(1).

(3) Studies of power distribution systems with and without cavity connection

The performance measurements are conducted as follows:

For the SLAC distribution system, personnel from SLAC takes the initiative with participation of personnel from DESY, FNAL, KEK, etc.

For the KEK distribution system, personnel from KEK takes the initiative with participation of personnel from DESY, FNAL, SLAC, etc.

Appendix H. Contributions to the Disassembly Work

(1) Disassembly of Cavities from the module

Cavity disassembly from the cold mass and in the clean room will be conducted as follows:

At least two personnel (one being an expert) from DESY will participate in the disassembly work at KEK for the DESY cavity packages.

At least two personnel (one being an expert) from FNAL will participate in the disassembly work at KEK for FNAL cavity packages.

KEK people will assist the colleagues from DESY and FNAL in the entire disassembly process.

Colleagues from DESY and FNAL people participate also in the disassembly at KEK of KEK cavities.

KEK then will ship the cavity packages removed from the assembly to each laboratory

with appropriate packing.

(*) INFN, DESY and FNAL may leave the disassembly work for KEK, if they decide to trust the work by KEK.

(2) Disassembly of the Power distribution system

The disassembly of the power distribution system will be done by KEK with participation of at least one SLAC personnel. The SLAC personnel is responsible for directing KEK people for the disassembly procedure and for checking the components after dismount.

KEK then will ship the disassembled components to SLAC with appropriate packing.

(*) SLAC may leave the disassembly work for KEK, if it decides to trust the work by KEK.

Appendix I. Related Agreements

This MoU is devised in the framework of ILCSC MoU, and in part by higher-level agreements on academic exchanges among participating parties including the following:

- Memorandum of Understanding for the Establishment of a Technical Design Phase of the Global Design Effort concerning the International Linear Collider.
- Agreement on Academic Exchanges between Deutsches Elektronen-Synchrotron (DESY) and High Energy Accelerator Research Organization (KEK)
- Collaboration Agreement between the High Energy Accelerator Research Organization (KEK), Japan and the Istituto Nazionale di Fisica Nucleare (INFN), Italy
- Japan-US Cooperation Program in the Field of High Energy Physics.
- Memorandum of Understanding between the High Energy Accelerator Research Organization (KEK), Tsukuba, Japan and Fermi National Accelerator Laboratory, Batavia, Illinois, USA.