Report of the ILCSC Task Force for Establishment of the International Linear Collider Global Design Initiative

March 31, 2004

The International Linear Collider Steering Committee (ILCSC) established a Task Force to deliberate and recommend to the Committee a framework for an interregional organization that will develop the global design of the International Linear Collider (ILC) based on the technology selected by the International Technology Recommendation Panel (ITRP). Members of the Task Force and its chronology of meetings are found in Appendix 1.

The Sub-group was established with membership given also in Appendix 1. Also found in the Appendix 1 are the details of its first meeting and its mission. The Sub-group is to report back to the Task Force upon completion of its task. Some the Sub-group's preliminary conclusions are incorporated in this report in the form of the "Project Initiation Milestones for the International e^+e^- Linear Collider" in Section 6 and "Guidelines for International Linear Collider Cost Estimation" in Appendix 2.

Introduction:

For more than 10 years, major laboratories around the world have put substantial R&D efforts into the development of the technology to build a 500 GeV to 1 TeV electron-positron linear collider. This R&D included substantial engineering efforts and has led to a number of test facilities (NLCTS, ATF, and TTF). Major resources have been devoted to the technical preparation.

These developments have led to design reports, including cost estimates, in Asia, Europe, and the U.S. The intention is to have an International Technology Recommendation Panel (ITRP) make a recommendation before the end of 2004 on the choice of technology ('warm' or 'cold') based on these developments.

The Linear Collider in the energy range of 500 GeV to 1 TeV is complementary to the LHC now under construction at CERN in its capability to advance the frontier of particle physics. Furthermore, the Linear Collider's value will be enhanced if its physics program runs in parallel with the program at the LHC. For this reason, the community is very eager to move swiftly as soon as the technology choice is made and prepare for an early start of the construction of the machine, while governments are discussing the formal international organization for the ILC.

The International Linear Collider Steering Committee (ILCSC) intends to set up an international design initiative based on teams in three world regions and a new central team, which will be formed as soon as the technology choice has been made.

A phased approach is envisioned in which, initially, a conceptual design based on the recommended technology and based on the already extensive design work is favored. This activity, with input from the widest possible community, provides the opportunity to internationalize the design in a broader sense than that heretofore accomplished. This concept should be embodied in a Conceptual Design Report (CDR) and will define the ILC at the highest scientific and technical level in order to go forward.

Another guiding principle, assumed here, is that the initial work must be supported out of current resources with current agency relationships in force and that the joint work will be backed by MOU's among the participating laboratories and universities.

The next phase envisioned is the creation of a Technical Design Report (TDR), or its equivalent, with prototypes, industrialization and engineering sufficient to support a solid cost estimate and demonstrate viable solutions to all the important technical issues. Early in this phase it will be necessary to establish a more formal international organization with a council mechanism for connecting the project to governments and a chain of authority and accountability extending down to the work performers. Envisioning and bringing about such a transformation will require the combined efforts of government agencies and the international scientific community through ICFA and its ILCSC as well as the Regional Steering Committees.

Under this guideline of the ILCSC, this Task Force was charged to recommend to the Committee a framework for an interregional initiative that will turn the technology for the International Linear Collider, selected by the ITRP and accepted by ICFA, into a conceptual and then a construction-ready design. Such a design, including reliable cost and schedule estimates, will be an essential document to allow a group of governments to formally initiate a major construction project like the ILC.

This initiative will be known as the Global Design Initiative (GDI). The early phase (Phase I) of this Initiative will be known as the Global Design Effort (GDE). In the latter phase (Phase II) of the Initiative, this Effort will transform into the Global Design Organization (GDO) as governments start giving their blessing to the Initiative.

The Overall Concept of the Organization:

1) The ILC-GDE will be established as an inter-regional entity as soon as ICFA approves the technical choice recommended by the International Technology Recommendation Panel.
2) It is desirable for the GDI to last at least through the completion of the technical design. In the beginning it will be under the informal oversight of ICFA/ILCSC as the GDE, and if desired can continue as the GDO under a more formal oversight

by an international group of funding agencies once governments become formally involved.

3) The GDE will be carried out by a Central Team and three Regional Teams from Asia, Europe and North America. While the technical strength and knowledge will continue to reside in the regional teams, the Central Team will hold the pertinent milestones and parameter list, coordinate and guide design activity, and will have the authority needed to make cohesive progress.
4) The GDE will be established using MOU's among the participating institutions, and will be supported by their funds.
5) The mission of the GDE is to quickly progress from the technology decision to a globally agreed-upon CDR of the machine, including its parameters and layout, and to develop the roadmap for future activities including the R&D.
6) ICFA/ILCSC will receive reports on the activities of the organization every six months and perform a major review after two years of the foundation.
7) The mission of the GDE will transform to the GDO in the latter phase (Phase II), by enlarging and strengthening the organization with additional governmental funding and accompanying formal international (governmental) oversight arrangements.
8) The mission in this phase will include more detailed technical designs, cost estimates, industrialization of component manufacturing, and risk assessment. A deliverable item after this phase is the TDR (or equivalent) that includes detailed schedule and cost estimates.

Recommendations

1. The Basic Functionality of the Teams:

- The Central Team:
  - is the focal point for the ILC project planning, holding the schedule, major milestones, and parameter list;
  - provides intellectual leadership under ICFA guidance; and
  - coordinates the R&D and design efforts of the Regional Teams, while performing its own overall system design tasks.
- Regional Teams:
  - perform the R&D and design work of sub-systems in close coordination with the Central Team; and
  - act as the link to the governments in their region.

2. Funding and Governance:

1) Initially, the signatories of the MOU's will fund GDE activities (including the provision of common funds) using the existing funding at participating institutions.
2) The oversight for the GDE will be provided by ICFA through the ILCSC, while discussions with governments continue.

3) For the GDO, a new and more formal oversight mechanism will be introduced with the combined efforts of government agencies. It is hoped, however, that the basic organizational structure of the GDE, engaged in the technical and facility design work, will remain intact for the remaining work.

3. Composition of the Teams:

The Central Team:

1) The Central Team should have a Team Director selected and appointed by the ILCSC with recommendations from the Regional Steering Committees.
2) The Central Team Director will be responsible to the ILCSC for leading the Central Team to design and carry out the supporting R&D efforts to produce a CDR and TDR. The Central Team Directorate will comprise the Central Team Director and the three Regional Directors, and is expected to include a Chief Accelerator Scientist and a Chief Engineer, and its responsibilities are to collectively:

    a. Manage the execution of the design and associated R&D.
    b. Establish technical and administrative controls to ensure that the agree-upon work toward the CDR and TDR is executed within the MOU approved cost, schedule and technical scope.
    c. Maintain and control the machine parameters database and direct overall project planning.

3) The Central Team Director must be skilled and experienced with the management of major projects, must have an established record of working well with a wide variety of people from diverse backgrounds, and should have a good working knowledge of accelerator design and construction.
4) The Chief Accelerator Scientist has line responsibilities for the accelerator physics issues that drive the design and works with the Chief Engineer to ensure that the physics design criteria are correctly interpreted in making the engineering designs. The Chief Engineer has line responsibilities for the engineering decisions incorporated into the design. He/she establishes, maintains, documents and enforces engineering standards across the design, directs the project planning, scheduling and budgeting, and oversees the Project Management Control System. Both of them will be selected by the Central Team Director in consultation with the ILCSC.
5) Should the need for conflict resolution arise, the Central Team Director has the final authority in all areas of the design and personnel in the Central Team. He/she will be the primary representative for the project in interactions and project-status reporting with the stakeholders.
6) The Central Team will have its own staff, estimated to number between 10 and 15, covering various tasks charged to the Central Team. This number will increase in the latter phase as the responsibility of the Central Team increases.

7) In order to maintain the neutrality of the Central Team, its Leader, if practical, should be supported by common funds.

Regional Team:

1) Each Regional Team should have a Team Director, appointed by the Central Team Director, in consultation with the regional ILC Steering Committee. Each Regional Team Director will join the members of the Central Team mentioned above.
2) The respective Regional Steering Committee will determine the local structure and venue of the Regional Team to suit regional commitments and needs.
3) At least initially, the members of the Regional Team are employees of their home institutions, supported by the local funding sources.
4) The number of people in the Regional Team will be determined by the scope of the tasks that each will undertake.

4. Venue of the Central Team

1) The selection of the venue of the Central Team should be done by the ILCSC in consultation with the Regional Steering Committees. The venue should be a large scientific institution with sufficiently good technical infrastructure to support the Central Team's activities. It should also be easily accessible by the international community of scientists and engineers.
2) A suitable site should be sought from among all particle and nuclear physics laboratories that operate major accelerators, irrespective of their current level of involvement with linear collider activities.
3) The ILCSC will issue a call to the worldwide laboratories with a list of selection criteria for the proposal to host the GDE Central Team. Since timing is of the essence, this process should begin before the technology choice is made.
4) Upon negotiations with the host laboratory chosen for the Central Team, ICFA through the ILCSC must establish a clear understanding of the following items:
    a. The Central Team is independent of the host laboratory in carrying out its mission.
    b. The host laboratory is obligated to provide agreed-upon facilities and services to the Central Team under agreed-upon conditions.
    c. Environmental, safety, security, and health-related regulations of the host laboratory would apply to the organization as well as individual members of the Central Team.

5. Tasks of the GDE:

Tasks of the Central Team with help of the Regional Teams:

The following Phase I tasks should be completed as soon as possible after the founding of the GDE:

1) Formulate a proposal for the International Linear Collider based on a conceptual design that will meet the performance requirements set by the ILCSC Parameters Sub-committee. The design should define the basic layout of the collider facility and design of subsystems.
2) Establish the Work Breakdown Structure for the ILC construction project and define the work packages with sufficient detail to allow realistic cost and schedule estimates of the ILC R&D, construction, and commissioning.
3) Develop the configuration management procedure.
4) Survey the Linear Collider R&D done at participating institutions, compare against the work packages set up above, and map out the necessary R&D, engineering study, and industrialization studies that are needed to complete the technical design effort.
5) Coordinate the distribution of tasks, according to the work packages, to regional teams, taking into account the interests and strength of each region with respect to the technical component of the work packages.
6) Establish and disseminate a cost-estimating methodology for the ILC construction, including the definition of the ILC monetary unit. (The direct cost of construction including all material, fabrication, installation and manpower must be included in the cost estimate as described in the guideline given in Appendix 2)
7) Establish a road map for the completion of the construction-ready TDR, including its scope, cost, and schedule, and including those for the necessary R&D and industrialization works.

<u>During this initial period the following activities should be initiated or performed:</u>

1) Report to the oversight group such as the ILCSC, Board of Overseers, etc.
2) Establish a Machine Advisory Committee to critique the program, progress, and proposals.
3) In view of the importance associated with the machine-detector interface to the collider performance, maintain close communication with the physics community (Detector Groups).

The following Phase II tasks (GDO tasks) should be completed as soon as possible consistent with any necessary government actions

1) Complete the TDR with the aim of obtaining governmental approval to begin construction (the ground breaking). The document must be sufficiently complete with engineering details, industrialization plan, construction cost and schedule, and contingency/risk analysis. The cost and schedule plan for the additional R&D and commissioning should be included. A cost estimate must be done in accordance with the methodology developed in Phase I.
2) Examine the assignment of tasks to Regional Teams, and make adjustments if necessary.

3) Report to the oversight group such as the ILCSC, Board of Overseers, etc. on technical/cost/schedule status of the TDR preparation.
4) Maintain close communication with the physics community/detector groups.
5) Continue receiving advice from the Machine Advisory Committee on the program, progress, and proposals.

Tasks of the Regional Teams to be done in coordination with the Central Team:

Participate in Central Team activities and;

1) Perform the tasks assigned to the Team,
2) Propose to the Central Team technical improvements, cost saving measures, etc. that will help the construction project stay within budget and on schedule,
3) Regularly report the status of the tasks, results, and technical as well as financial risks uncovered during the course of the work to the Central Team.

6. Project Initiation Milestones for the International e^+e^- Linear Collider:

The world community has agreed that the value of the linear collider will be greatly enhanced if its physics program can have significant overlap with the LHC program. Accordingly, we have developed the following initiation milestones consistent with first collisions around 2015. Meeting the latter two milestones will require resources that are not committed with certainty.

2004. International technology selection. Multi-laboratory MOU's to define and initiate the Global Design Effort.
2005. Complete the CDR, including site requirements, an initial cost and schedule plan.
2006. Initiate detailed engineering designs under the leadership of the Central Team.
2007. A complete detailed TDR with the cost and schedule plan, establish the roles & responsibilities of regions, and begin the process for site proposals.
2008. Site selection and approval of international roles & responsibilities by the governments.

The CDR would contain a relatively detailed conceptual machine design based on the chosen technology and parameters. The existing design studies provide the majority of the information needed for this exercise.

The TDR would be based on prototypes, industrialization and engineering sufficient to provide a solid cost estimate and demonstrate viable solutions to all the important technical issues.

Appendix 1

Members of the ILCSC Task Force:

Jonathan Dorfan:	Stanford Linear Accelerator Center, U.S.A.,
Brian Foster:	Oxford University, UK,
Won Namkung:	Pohang University of Science and Technology, Korea,
Satoshi Ozaki:	Brookhaven National Laboratory, U.S.A. (Chair),
Yoji Totsuka:	High Energy Accelerator Research Organization, Japan,
Albrecht Wagner:	Deutsches Elektronen Synchrotron, Germany.

The Task Force held telephone conferences on:
11 September, 14 October, and 13 November in 2003,
8 January, 19 January, and 3 February in 2004,

The Task Force met physically in Paris on:
19 November, 2003, in conjunction with the ILCSC meeting, and
on 11 February 2004, before the ILCSC meeting.

Members of the Sub-group:
David Burke, Stanford Linear Accelerator Center, U.S.A.,
Michael Harrison, Brookhaven National Laboratory, U.S.A. (Secretary),
Theodore Lavine, Stanford Linear Accelerator Center, U.S.A.
Satoshi Ozaki, Brookhaven National Laboratory, U.S.A. (Chair)
Franz Peters, Deutsches Elektronen Synchrotron, Germany
Junji Urakawa, High Energy Accelerator Research Organization, Japan
Nicholas Walker, Deutsches Elektronen Synchrotron, Germany
Kaoru Yokoya, High Energy Accelerator Research Organization, Japan

The Subgroup met at BNL on December 3-5, 2003.

Note on the Sub-group:

In the process of its deliberations, the Task Force came to a realization that it is important to understand what have been considered to be the pre-construction activities and expenses, and what have been considered to be the construction activities by the different regions. It was thought that the way to proceed with this issue is to establish a subgroup of experts from three regions who really worked on their cost estimate, and let them carry out the comparison of the bases for their cost estimate of a linear collider prepared by KEK, DESY, and SLAC. It was thought that this comparison would reveal the critical differences in the ways different regions proceeded in planning a major construction project, and thus would provide the means to develop a global procedure for the ILC Project. This, in any means, does not mean that this sub-group of people should re-do the cost estimate, nor should give an opinion on either the basis correctness of the cost figure developed by the regions.

Appendix 2

Guidelines for International Linear Collider Cost Estimation

1) Cost estimation shall be done in person-hours, and use direct costs for purchased items.
2) Support costs such as administrative and management functions should be included as person-hour estimates.
3) Labor categories (e.g. scientific/professional, technician, and administrative) should be distinguished for costing purposes.
4) The estimate should also take into account that a certain fraction of the regional funding will need to be transferred to the central management as a common fund (the rate to be determined).
5) The common funds should cover the support of the Construction Management Team Directorate, including their salaries and benefits, the Central Team's local support costs, and funds to cover unexpected expenses (contingency).
6) On-site support costs such as the cost of incidental materials cost, space charges, communication expenses, and transportation should also be covered by common funds.
7) The cost estimate shall be done in fixed-year currency units (¥, $, €, or ILC Monetary Unit).
8) Cost profiles will be determined by the master schedule (See Section 6 for a possible schedule) recognizing that the associated budget authority profile may differ from country to country.
9) The approach to the indirect cost (e.g., benefit etc), escalation, and contingencies associated with the various risks involved in the fabrication of sub-systems can be handled in the customary fashion of the country responsible for that sub-system.

Figure 1: Schematic for the Global Design Effort: the early phase of the GDI

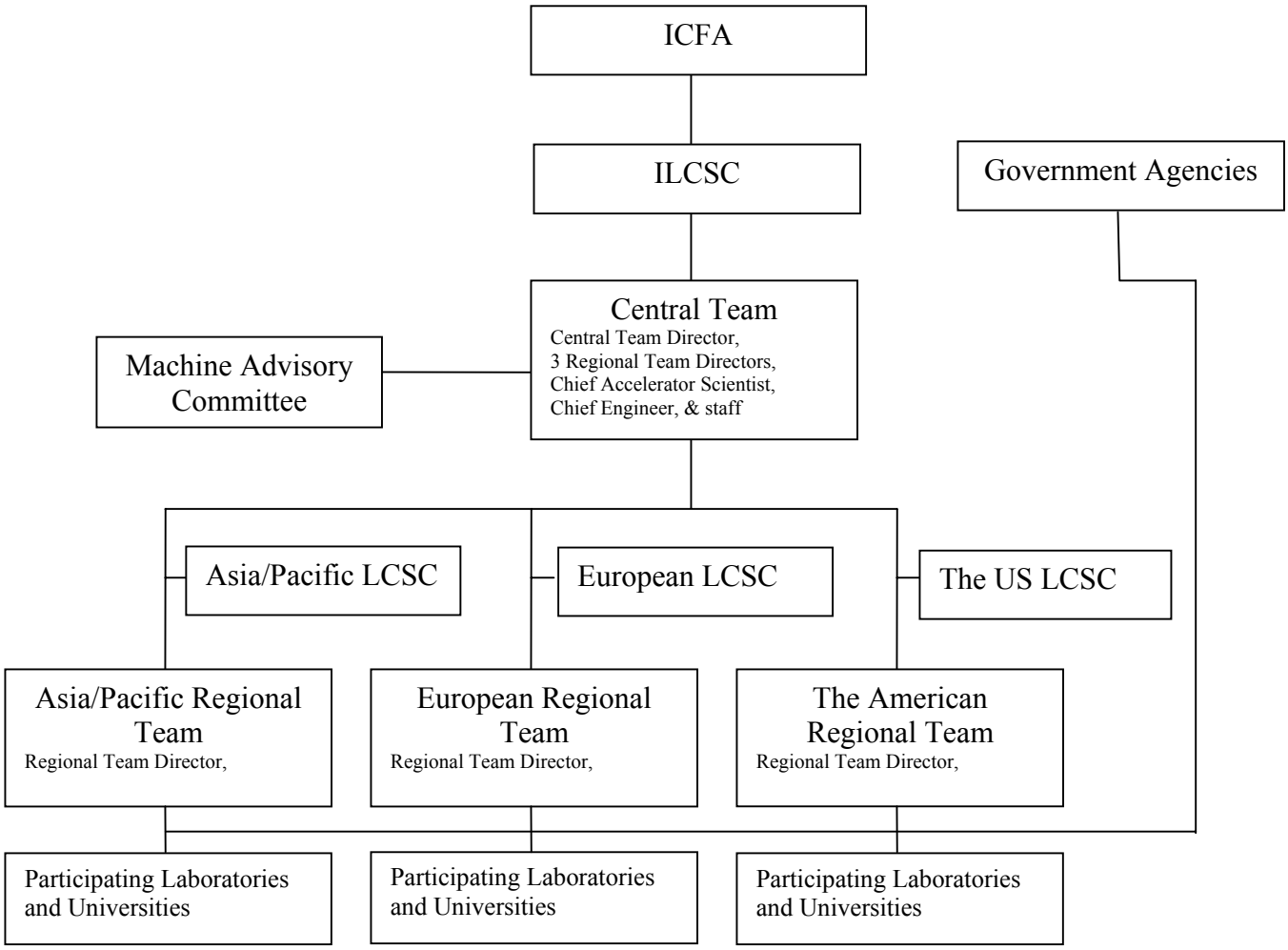

Figure 2: Schematic for the Global Design Organization: the later phase of GDI