Proposal

Organisation and Management of an
International Collaboration

on the TESLA Linear Collider

24. Oktober 2002
Executive Summary

In its statement of 12 July 2002 on the TESLA Linear Collider the German Science Council has requested the TESLA Technical Design Report to be made more concrete with respect to the international funding and cooperation of the Project [Ref. 1].

In response to this request the goals and key parameters of the administrative, organisational, and financial aspects are presented in this proposal, followed by a concrete model. It follows the basic principles of the organisation of the ALMA\(^1\) project. It includes aspects described in an OECD report [Ref. 2], in two studies initiated by ICFA [Ref. 3], and in two international workshops on the concept of a Global Accelerator Network.

At the same time this proposal will provide a concrete input for the discussions between the laboratories interested in collaborating on an international linear collider and for discussions with government agencies.

Triggered by the TESLA Project an in-depth international discussion of the organisation of a Linear Collider has started recently at several levels, in the particle physics community, inside government organisations such as the U.S. Department of Energy, and in the Global Science Forum of the OECD. In Europe this discussion is co-ordinated by the European Linear Collider Steering Group (ELCSCG). This steering group has set up a sub-group on organisation which will submit its first finding in summer 2003 and a final report by end of 2003. The sub-group will be composed of scientists, legal experts and representatives of the funding agencies. The International Linear Collider Steering Committee is setting up a similar group on a global scale, with input from the ELCSCG and similar groups in Asia and North America.

- This proposal shows that a well defined way exists for structuring the administrative, organisational, and financial aspects which is partly based on existing structures.

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\(^1\) The Atacama Large Millimeter Array (ALMA) [Ref. 4].
The model which will finally be realised will have to be agreed upon by the participating partners, both at the scientific and governmental level. Therefore the answer presented here to the requests of the German Science Council cannot be final.

The intention of all future partners to come to an agreement is demonstrated by the many steps taken recently by the international community to work out possible models.

1. Introduction

The construction and operation of future accelerator projects working at the energy frontier will require a collaboration on a world-wide scale, in order to make the best use of the available competence, ideas and resources. As there will only be very few such projects, each of them should be part of the national programmes of all participating countries, with a visible presence. In this way, it will be possible to keep the culture of accelerator development alive in the national laboratories and universities and to make the new projects attractive for young scientists, who in this way can contribute to and participate in them.

As outlined in the TESLA Technical Design Report (TDR), one approach to meet these goals is through a Global Accelerator Network (GAN), a collaboration of all interested accelerator laboratories and institutes world-wide. All partners would contribute to the project in full responsibility, through manpower, components or subsystems. The facility would be the common property of all partners, which share the responsibility and cost for both the construction and operation. The project would be of limited duration.

One key aspect of every model is the way in which the stakeholders/funding agencies can exercise oversight, assure the successful completion of the project, help set priorities and policies, and participate in key decisions. This will require a clearly defined management and control, both central and distributed, in which the partners maintain their visibility as well as their responsibility.

In the following, (1) the goals and requirements of an international accelerator collaboration are summarised, and (2) the key parameters of this collaboration are listed. Similar criteria have been developed in the report of the Consultative Group on High-Energy Physics of the OECD Global Science Forum [Ref. 2].
It should be noted that the organisational structure best suited for the construction of the Linear Collider experiment(s) and the X-FEL laboratory might differ from the one chosen for the Linear Collider.

1.1 Goals and Requirements

a) Create a structure which allows to build and operate the Linear Collider as a project of limited duration.

b) Define a mechanism by which the partners agree on the anticipated duration of the project and on an eventual prolongation.

c) Define a mechanism assuring financial stability for the duration of the project, including a certain flexibility which allows for design changes, unforeseen events, and new partners. This flexibility is needed for a scientific project that will evolve as a consequence of results obtained at the facility itself, or elsewhere.

d) Rely upon and exploit as much as possible existing structures. Create a core project administration that will co-ordinate the partner institutions during the construction and operation of the accelerator complex and the scientific exploitation. Do not create a new permanent international institution unless explicitly necessary or desired.

e) Create a structure which will make the project part of the national plans of the participating countries and which enables new partners to join at a later stage or to leave the project.

f) Establish a fair and transparent process for reaching consensus on the terms of the collaboration.

g) Define the tasks and responsibilities of all partners, including the special role of the host country/institution.

h) Establish the appropriate control mechanisms by which the stakeholders/funding agencies can exercise oversight, assure the successful completion of the project, help set priorities and policies, and participate in key decision.

i) Create the environment for an active engagement and open access to the accelerator and experimental programmes by the broad international scientific community. This goal must be balanced with the special status accorded to the scientists who build and operate the accelerator and/or experimental apparatus.
1.2 Key Parameters of an International Accelerator Collaboration

In setting up an international project the following key parameters have to be considered and properly be taken into account:

a) **Nature and identity of the partners:** The partners can be governments, government agencies, laboratories designated by agencies, research institutes, and university departments. To limit their number several partners from one country or several countries should join forces. This multiplicity should be reflected in various rights and obligations (e.g., voting).

b) **Role of the partners:** Individual obligations and benefits that accrue of being a co-owner and participant of the project.

c) **Legal aspects of the collaborative arrangement:** Legal status of the facility, the nature of its founding documents, ranging from an intergovernmental treaty to a series of inter-laboratory Memoranda of Understanding.

d) **Administrative issues:** Governance, i.e., structure and procedures of the various scientific, administrative, and financial bodies; rules for selecting the various members of these bodies.

e) **Finances:** Cash vs. in-kind and manpower contributions; mechanisms for insuring long-term funding commitments by the partners; special considerations for the host.

f) **Procurement:** As most components will be contributed in kind, the procedures and policies for procurement rest with the partners, as well as questions regarding ownership of equipment; customs issues have to be handled together with the host laboratory.

g) **Personnel issues:** In order to build the project in a joint effort of all participating institutes, it is important that the personnel working on the project remains fully associated to their home institutes. Personnel working at the site of the accelerator are either staff of the host laboratory or seconded for a limited time by the partners. The status of employees, hiring practices, salary scales, and pensions remain the responsibility of the partners.

h) **Role of the host:** Special obligations and benefits that accrue to the host country/institution.

i) **Access:** Rules of access to the experimental program and to the data; formal process for putting together the collaborations; rules for the joining of groups (large and small, individuals) while the collaboration is in progress; rules for making the data available to the broad community; rules concerning a possible linkage between contributions to the accelerator and access to data.
2. **The Basic Concept: A Global Accelerator Network**

The following proposal specifies the parameters of the international collaboration, taking into account the goals and requirements as outlined above. The basic concept is based on a network ('Global Accelerator Network', GAN), which has the following features:

- The project is open for participation of international and national research and academic institutions.
- The project is part of the national programs of the participating countries.
- Most of the capital investments is made under the responsibility of the participating institutions.
- The participating laboratories and institutes are able to maintain and foster the scientific and technical in-house culture. They remain attractive for the staff and young scientists and contribute at the same time to and participate in large, unique projects.
- The accelerator facility is maintained and run to a large extent remotely from the participating laboratories, using the modern tools for communication and controls.
- This approach effectively links world-wide competence, ideas, manpower and financial resources necessary to realise the project.

In order to make optimal use of experience, manpower and infrastructure, the accelerator built according to this model should be put close to an existing laboratory. The site selection would lead to specific obligations for the host country.

The model assures for all parties involved the proper representation in the decision making processes. The international nature of the project is reflected in its organisational structure. The international partners are fully and formally involved in all decision-making processes, as it is their project and not a project of the host country to which they contribute.

The concept of a 'Global Accelerator Network' has been investigated by the International Committee for Future Accelerators (ICFA), which has set up two specific working groups, one dealing with the general aspects of the model, the other with the specific questions of remote operation of accelerators. The recommendations and conclusions of these working groups have been published in 2001. The study on the general aspects concludes:

"Much can be learned about some of the aspects of a GAN from the non-member states' contributions to the LHC. They are mostly but not entirely "in kind" and based on national laboratories. The GAN assumes all contributions are "in kind." This should
not represent a problem if it is agreed at the beginning. However there will almost certainly be a need for a cash contribution at the building phase (10-25%). All contributions will be in cash for operations.

Accelerators must achieve promised design specifications within a reasonable time period after turn on (~1-2 years) otherwise there is a significant loss of physics opportunities. This means risks must be reduced to a minimum, and contributions are best delivered from a rather tight laboratory framework. It is presumed that the laboratories can marshal extra resources in cases of emergencies. This implies that the laboratory directors have a line management role in any global LC.

The number of contributing partners to a global LC should be kept small. No one should be discouraged from contributing, but a small institute with a special unique talent for example, should be encouraged to work through collaboration with a national laboratory.

The idea of a LC as a non-profit company with a limited existence could work and deserves further legal and administrative consideration. It removes the considerable hurdle of having to set up an international project in a laboratory. The host lab continues to operate in a national framework. The essence of the Global Accelerator Network has existed historically in some form since large accelerator projects have been realized in major national laboratories. As projects become larger, then collaborative engagements in accelerator physics have to become more formal, finding a parallel in the contributions to major experiments of recent years.

It is premature to be too prescriptive in terms of structures. There will have to be a formal level to engage governments; contributions will be managed by the agencies, and, for the most part, provided by national laboratories. There is existing evidence that a GAN can work with a single national lab (DESY) or a large international lab (CERN).

The host laboratory has a vital role in any global LC, removing completely the feel of a "green field" situation. The provision of civil construction by the host laboratory with the host nation’s support is an issue which needs resolving.

The management of a global LC could consist of a Council, at governmental level, which runs the LC Company contracting services from a host laboratory and linking to the Project Management Group. This system finds parallels in many scientific ventures. The governing bodies of any national laboratory which emerges as a host laboratory will have to be fitted into the structure with some care.

There will be an ongoing need for a small, strong, international local core team to commission and run the LC after it is constructed. Additionally routine maintenance, which cannot be effectively done remotely, will demand a local team.
An important player in any scenario is the project leader. He or she will most likely not be the director of the laboratory, and may not even be a member of the staff of that laboratory. This is often the case with spokespersons of large experiments. The project leader must be afforded considerable freedom to set up appropriate technical management. Governments will feel the need to set up appropriate technical monitoring.”

3. Organisation and Management of the TESLA Project

The organisational and management structure of the TESLA Project is based on the concept that the responsibility for most subsystems is shared between different institutions and even regions, in order to exploit best the know-how available around the globe.

3.1 The Project Parties

The funding sources which create and sustain the TESLA Project are called the Parties. The Parties have two initial responsibilities:

1. To establish jointly, and by agreement, an oversight body for the Project, the TESLA Board. The TESLA Board has the responsibility to establish and supervise the Project.

2. To each appoint Executive Agencies, or Executives, to provide the overall management of those Project tasks and responsibilities that are agreed to belong to each of the Parties. If desired, several parties can appoint a joint Executive.

3.2 The TESLA Board

The TESLA Board is the oversight body for the Project, it has the responsibility to establish and supervise the Project. It is established by the Parties.

The TESLA Board organises the Joint TESLA Office (JTO) that directs and manages the overall Project. It appoints the senior management, specifically the Directors. It defines the responsibilities and authorities of each of the key personnel.

The TESLA Board also appoints the Science Advisory Committee and the Management Advisory Committee.
3.2.1 Joint TESLA Office

The Joint TESLA Office (JTO) carries out its management function by specifying the scope, schedule, and tasks of the Project and then managing the efforts of the Executives to provide the necessary deliverables. The Joint TESLA Office is responsible for the implementation of the Project. It is led by a board of Directors and includes the top-level organisation. The Directors have the responsibilities and authorities as defined by a special agreement. The Joint TESLA Office is composed of the following Directors who report to the TESLA Board:

- Director General
- Director for Management
- Scientific Director
- Director of Accelerator

In addition, the Joint TESLA Office has the necessary staff to provide Project control, scheduling, and supporting administrative functions. The staff of the Joint TESLA Office is located at the site of the TESLA Project. With approval of the TESLA Board, each member of the Joint TESLA Office will be employed by one of the Executives.

Concerning the **Project scope and schedule** the Joint TESLA Office will:

- Define and maintain the top-level scientific goals and scope of the Project. This is done with input from the user communities and with the approval of the TESLA Board.
- Establish the parameters for the Project. Together with the Integrated Product Team (IPT) Leaders and Deputies (see below), the Joint TESLA Office establishes the technical specifications corresponding to the top-level scientific requirements.
- Establish and maintain the Project Work Breakdown Structure (WBS) and Schedule for all Project tasks and work packages.
- Control the Project implementation, including the integration of the subsystems and components. When the specifications or WBS must be changed the Joint TESLA Office controls the change process and manages the consequences of a change.

Concerning the **cost** the Joint TESLA Office will:

- Provide consistent accounting of both the overall cost and the cost to completion. This applies both to the cost of the baseline project and the cost of any approved additions or modification.
• Negotiate an adjustment of the value of contributions in the face of experience where necessary.

Concerning the accountability the Joint TESLA Office will:

• Establish and enforce acceptance criteria for delivered hardware and software.
• Be accountable to the TESLA Board for achieving the operational and scientific goals.
• Be accountable to the TESLA Board for management of the Project.

3.2.2 TESLA Scientific Advisory Committee

The TESLA Board, in consultation with the JTO, will define the terms of reference of the TESLA Science Advisory Committee and appoint its members. The TSAC will provide regular scientific oversight and advice to the Project through reporting to the TESLA Board.

3.2.3 TESLA Management Advisory Committee

The TESLA Board, in consultation with the JTO, will define the terms of reference of the TMAC and appoint its members. The TMAC will provide regular management, cost, and technical oversight and advice to the Project through reporting to the TESLA Board.

3.3 The Executives

The Executive Agencies, or Executives, provide the overall management of those Project tasks and responsibilities that are agreed to belong to their funding Parties. The Executives staff and fund the TESLA Project. The Executives are legal entities and can enter into contracts, employ staff, etc., on behalf of the Project.

It is proposed to have at least three Executives, representing the Americas, Asia, and Europe, combined with a range of regional agreements. In order to carry out their project functions each of the Executives will create a Regional Project Office and secure for that office the staff and resources necessary for the performance of the tasks assigned to that Executive.
In addition, the Executives will establish the Regional Support Centres, whose primary task is the operation of the collider, through Remote Control Rooms and the scientific support to the respective communities in their respective countries.

3.3.1 Regional Project Offices

The work packages will be carried out by existing institutions in the different regions, under the responsibility of the Regional Project Offices. The Regional Project Offices will be responsible for ensuring that the resources are made available to carry out the work packages to performance and schedule. Each work package will be covered by a formal agreement between the institutions concerned.

Each Regional Project Office has a Regional Project Manager who will report to the JTO Project Manager. The Regional Project Manager will be assisted by Integrated Product Team (ITP) Managers (see below) within the region, each having the responsibility for tasks within a given level-1 WBS. The IPT Managers will act either as the IPT Leader or Deputy in the corresponding Integrated Product Teams.

3.3.2 Regional Support Centres

The operation of TESLA is carried out at the Regional Support Centres in each region in a manner to be agreed by the TESLA Board.

The RSC core function is the operation of the accelerators and maintenance of components. They also provide user feedback on the collider performance and on the need for improvements, upgrades and future developments of hardware and software to the TESLA Director. Some RSCs will host a copy of the TESLA accelerator control room.

Each RSC will have its own manager, who reports to the TESLA Director for the core functionalities of the RSCs and to their respective Executive for the additional functionalities.

3.4 The Integrated Product Teams

The project management structure is based on the concept of Integrated Product Teams (IPTs). While the Joint TESLA Office is responsible for the overall Project management, the Integrated Product Teams manage the individual tasks, as defined in the first level of the Work Breakdown Structure.
The implementation of IPTs as task managers reflects the fact that the responsibility for most subsystems are shared between different institutions and even regions. This is to exploit best the know-how available around the globe and to ensure that the know-how is shared between the several Executives. For this reason the leadership for those level-1 tasks is also shared.

Each IPT consists of all those individuals who are assigned by one or several of the Executives with significant responsibility for work elements within a given level-1 WBS task.

The leaders for each task are appointed by the Executives and provide the leadership of each IPT. One of these persons will be identified as the IPT Leader and another will serve as the IPT Deputy Leader. The intent is that these individuals will normally resolve by consensus any technical issues that arise within the IPT. The IPT Leader and the Deputy have the responsibility to assign, coordinate, and monitor subtasks as specified by the TESLA WBS and to complete the assigned subtasks using the resources provided by their respective Executives.

The IPT management structure is set up to organise work carried out across geographic, institutional, and professional boundaries. It allows work packages assigned to different organizations to be effectively coordinated.

The IPT model is to achieve the following goals:

- Provide a single point of integrative responsibility for each major work package. A single individual, the IPT Leader, is identified for each IPT. This Leader is responsible for assuring that the various work packages, when completed, will meet the project schedule and the performance specifications.

- Provide common, coordinated, management of the IPT and the work groups within the Executives. The IPT Leader and the Deputy are themselves the work managers for the Executives. Common management provides the link between the project coordination function and the means to accomplish the work within the Executives.

- Make decisions at the lowest level in the organization where sufficient knowledge is available. Therefore, responsibility will be delegated to the IPTs and will carry with it authority to make decisions within that particular IPT provided that the result is compatible with the overall scope and schedule of the Project.
3.4.1 Project Contributions

Project contributions consist of subsystems/components (hardware), software, contributions to the common fund and operation, and personnel. Each partner assumes responsibility for specific components which are designed, built, tested, installed, operated and maintained under the responsibility of the respective partner. This responsibility for specific components is maintained throughout the project duration and includes also further developments. This allows national money to be spent according to the national rules and not as contribution to an international organisation. It also makes sure that the volume of the financial involvement is directly linked to the technical responsibility of each partner.

It will be necessary for each partner to contribute a fraction of the project cost to a Contingency or Common Fund to be used by the project management to strengthen efforts in necessary areas (see Appendix 1).

The cost of operation of the facilities will be shared among all partners according to a pre-defined procedure.
The personnel working on the Project remain full employees of their individual home institutes. Personnel working at the site of the accelerator are either staff of the host laboratory or seconded for a limited duration by the partners. The status of employees, hiring practices, salary scales, and pensions remain the responsibility of the partners.

The mode of financing of all participating laboratories and institutes would remain unchanged.

### 3.4.2 Management Control

The Joint TESLA Office provides the efficient project leadership and control required to maintain the project schedule and to successfully manage the TESLA construction.

On the other hand, the risks in the TESLA construction are borne by the Executives. It is recognized that there may be instances when the Executives cannot accept the legal, financial, or political risk associated with a proposed JTO decision. In these cases, the JTO will need to seek an acceptable alternative. The Executives agree not to impose their prerogatives unnecessarily, exercising their right after JTO decisions only in cases where the risks are judged to be large.

The details of the management controls are outline in Appendix 1.

### 3.4.3 Work Breakdown Structure, Schedule of Values and Assignment of Deliverables

The TESLA Work Breakdown Structure (WBS) is a detailed description of all the tasks necessary to construct the accelerators and software required for TESLA; to construct the buildings, roads, utilities and infrastructure needed for the support of those instruments and software; to integrate the whole into a properly functioning Linear Collider; and to manage the construction Project on behalf of the TESLA partners.

The details of the Work Breakdown Structure, the schedule of values and the assignment of deliverables are given in Appendix 2.

### 3.5 Specific Role of the Host Laboratory

In order to make optimal use of experience, manpower and infrastructure, the accelerator built according to this model should be put close to an existing
laboratory. The host lab will make its infrastructure, personnel and services available to the Project. A well defined legal relation will be established between the project management and the host laboratory. This will be done on the basis of a management- and service-contract, whereby the host laboratory assumes the responsibility for e.g.

- security, radiation safety,
- site- and facility management,
- technical infrastructure,
- guest-services.

The contract between the project management and the host laboratory must clearly define the respective responsibilities and obligations.

3.6 Legal Structure

A large international project of the size of a linear collider can only be realised on the basis of a long term commitment of the participating institutions and countries, which secure the financing and operation of the Project. Basis for the Project could therefore be an agreement or convention between the participating countries or institutions in which they agree

- to construct and operate TESLA,
- to finance the project construction and exploitation
- to set up a project organisation, and
- to define the basic rules (e.g. financing, purchasing, and settlements of disputes).

In view of the long-term and substantial commitment this agreement should be signed by the governments of the participating countries or by bodies to whom the governments delegate their authority.

The influence of each participant in the decision-making has to reflect the importance of its contribution. However, smaller partners will only identify themselves with the Project if an effective minority-protection is organised. Here the rules of the European Synchrotron Radiation Facility (ESRF), Grenoble, can serve as an example. If the importance of the contribution is measured in shares, simple majority at the ESRF means at least 50% of the shares and the opposition of not more than half of the votes, each partner having one vote; unanimity means 2/3 of the shares and no opposition - abstentions always being possible.
The structure described above can be implemented in any national legal system, in the form of a Limited Liability Company. It might, however, not be necessary to form such a legal entity.

3.7 Safety and Health

Many TESLA construction activities will take place at existing organizations with established safety and health policies and regulations that comply with applicable national or international requirements. The TESLA Project will abide by these established policies and will only create new rules and regulations if no applicable rules and regulations exist. The persons responsible for safety and health management at the participating organizations will report the results of any relevant safety and health audits or reviews to the Joint TESLA Office.

Safety and Health policies and regulations at the site of the accelerator will be the responsibility of the host laboratory, defined as part of the legal relation which will be established between the project management and the host laboratory.

3.8 Upgrades and Developments

The Executives are responsible, at the request of the TESLA Board and in agreement with the user community, for providing upgrades and development of all elements of TESLA. The Executives will carry out these responsibilities in the same manner as the Construction Project, and with the affiliated institutes they deem most appropriate for the task. Such developments may range from hardware aspects to software improvements.

4. Summary and Outlook

The joint construction and operation of large research infrastructure which involves partners from all regions requires new concepts of international collaboration. We present here in the context of the TESLA Project a possible model for the construction and operation of a linear collider in true international partnership.

The model will serve as concrete input into a working group set up by the European Linear Collider Coordination Group which came into existence in June 2002. Similar groups are and will be active in the other regions. This working group, which will be chaired by Prof. George Kalmus (UK) and will become active in November 2002, includes scientists, legal experts and representatives of
the funding agencies. It plans to issue an oral report in summer 2003 and a final written report towards the end of 2003.

There exists an increasing consensus in the community that the global network approach proposed by the TESLA collaboration should be pursued and that the detailed structures have to be worked out in the coming year. This process will therefore take place in parallel with the science policy and priority discussions.

The final form of the management and organisation of the TESLA Project will have to be agreed upon by the governments in close collaboration with the participating institutions and the scientific community.

References

1. TESLA TDR:  
   http://tesla.desy.de/new_pages/TDR_CD/start.html

2. OECD report:  
   http://www.oecd.org/pdf/M00032000/M00032800.pdf

3. ICFA Studies on Global Accelerator Network:  
   http://www.fnal.gov/directorate/icfa/icfa_tforce_reports.html

4. ALMA Project Book:  
   http://www.alma.nrao.edu/projectbk/construction/  
   http://www.alma.nrao.edu/projectbk/construction/chap17/chap17.pdf
Appendix 1

Management Control

The organization of the JTO provides the efficient decision-making and project leadership required to maintain the project schedule and to successfully manage its construction. On the other hand, the project risks are borne by the Executives. It is recognized that there may be instances when the Executives cannot accept the legal, financial, or political risk associated with a proposed JTO decision. In these cases, of necessity, the JTO will need to seek an acceptable alternative. The Executives agree not to impose their prerogatives unnecessarily, exercising their right after JTO decisions only in cases where the risks are judged to be large.

A 1.1 Role of the Regional Project Managers

The Regional Project Managers perform a critical role in maintaining the linkage between the Joint TESLA Office and their respective Executives. In addition to reporting for technical purposes to the JTO Project Manager, the Regional Project Managers, who shall be physically located with their Executives, are responsible for managing the execution of the work packages under their control and for reporting cost, scope and schedule information to their respective Executives in sufficient detail to permit the Executive to exercise their managerial and legal responsibilities consistent with the subsections below.

A 1.2 Budget Process

The value of each work package in the WBS is the estimated cost plus a contingency that reflects the risks and uncertainty of the estimated cost (see also Appendix 2). The budgeted value of each work package will be established as the estimated cost, exclusive of any contingency. A budget based on this value, broken down into the major categories of expenditure (labour, materials, travel, contracts, etc.), will be established and documented for each work package.

The Work Package Manager must request approval of any changes to this budget. Documented requests for budget changes will be directed to the Project Manager of the responsible Executive. This Manager can approve the budget change request, if it can be absorbed within the overall budget, including contingency, of the responsible Executive. The JTO must be informed of any budget change that is so approved. Any budget change that cannot be absorbed within the overall budget of the responsible Executive must be brought to the attention of the JTO. If the responsible Executive wants to request a
corresponding change in the value of its contribution, the change must be submitted to the TESLA Board for approval.

A 1.3 Cost Control

Primary responsibility for cost control rests with each Executive. Each Executive will use their established financial reporting and information system to track expenditures and provide this information to the central JTO. At the lowest level the Work Package Managers regularly monitor expenditures versus the budget (expenditure plan). Financial information comes either from the responsible Executive or the financial reporting and information system of the institution responsible for the work package, as appropriate. In addition, the Work Package Manager produces an estimated cost to complete the work at least twice per year.

The Project Manager of the responsible Executive monitors regularly the cost performance of the aggregate of work packages for which s/he is responsible and reports the status to the JTO. The JTO in turn monitors the total project performance and reports it to the TESLA Board in semi-annual reports and meetings. However, responsibility for taking corrective action and/or requesting a budget change rests with the responsible Executive.

A 1.4 Contingency

The contingency of all of the work packages for which each Executive is responsible will be pooled at the level of the Executive. IPT Managers will be allocated those funds agreed upon to perform the “Task”. The contingency will be held and controlled by the Project Managers of each Executive. When a Work Package Manager is convinced that the tasks in the work package cannot be completed for the budgeted cost, the Work Package Manager will request a budget change.

A 1.5 Business Procedures

Each Executive will use their established business and administrative procedures. These include personnel policies and procedures, contracting and contract management procedures, accounting and financial reporting procedures, travel policies and procedures, and shipping/import/export procedures. Those business procedures required by the JTO can be adopted from either of the Executives, as the Joint TESLA Office chooses.

A 1.6 Schedule Control
Each Work Package Manager will develop and maintain a schedule of activities for their work package. Each IPT will build up a level-1 schedule of the activities for which it is responsible from the schedules for each of its work packages. The JTO will establish and maintain a project master schedule based on the level-1 IPT schedules. Schedule status will be reported up through the project organization – from work packages to IPTs to the JTO. The Project Managers for each Executive will get schedule status through the JTO.

A 1.7 Management Reporting

The Work Package Managers will receive monthly reports of the financial status of their work packages from the responsible Executive and provide a monthly report of technical, schedule, and financial status to the relevant IPT. The IPTs will conduct periodic reviews of the status of the work packages for which they are responsible and provide a report to the JTO. The JTO, through the Project Managers of the Executives, will provide status reports to the Executives. The Director will provide a semi-annual report of the project status to the TESLA Board.

A 1.8 Programmatic Reviews

The IPT reviews will be informal programmatic reviews at the working level. In addition, the Director will conduct formal programmatic reviews of the entire project. Each IPT, including the JTO, will present the technical, schedule, and financial issues that will effect their ability to achieve their goals of the work packages for which they are responsible. The reports from the Director to the TESLA Board will follow from the Director’s programmatic reviews.

A 1.9 Configuration Control

A well-defined and organized process for controlling and communicating changes throughout the complex and geographically diverse TESLA Project is essential. Configuration control processes ensure that changes proposed are accepted only after their impacts are well understood and that all parts of the project are aware of changes in a timely manner. A process involving a Configuration Control Board will be used to control changes affecting scope, schedule and performance.

The TESLA Configuration.
The term “TESLA configuration” refers to all those documents that define the Project. For the purpose of configuration control, the TESLA documents are divided into four groups:

- Board-level documents;
- Project-level documents;
- IPT-level documents;
- Non-controlled documents.

All documents passed by the TESLA Board such as the Management Plan, official cost and task division documents, and international agreements are called Board-level documents. Changes of Board-level documents can be requested by Board members and require direct action by the TESLA Board; it is the responsibility of the Director to implement changes approved by the Board.

**Configuration Control.**

The Configuration Control Board (CCB) is responsible for managing changes to all project-level documents. The CCB is chaired by the Project Manager. The Project Engineer will serve as the CCB Secretary. In addition to the TESLA Project Manager, the CCB shall consist of the following permanent members:

- The Project Managers from all Executives;
- Project Scientist;
- Project Engineer.

Additional temporary CCB members may be added at the discretion of the CCB Chair when she/he feels that a particular issue needs special consultation. In any case, as noted below, the CCB solicits input from all IPTs prior to considering a requested change. It is anticipated that most actions will be carried out by consensus of the CCB membership. If efforts to reach consensus fail, a vote of the members will be necessary. The TESLA Director has the authority to rescind actions of the CCB by informing the TESLA Project Manager and the TESLA Board.

Configuration control acts on the documents that define the project. The process that is used depends on the type of document to be controlled. Configuration control is made up of four main elements:

- A means of formally requesting a change;
• A process for analysing the technical, performance and schedule impacts of the proposed change;
• A process for making a decision concerning the change;
• A process for communicating that decision.

The Project Manager defines which documents are project-level documents and s/he determines when a version of each document is to be submitted to the CCB for approval. Once approved, all change requests must be presented to the CCB. Project-level documents include the Project Book, top-level engineering requirements for each major subsystem, and ICDs between subsystems that cross IPT or WBS boundaries.

Change Requests to project-level documents can be initiated by any of the Work Package or Work Element Managers and require action by the Configuration Control Board. IPT-level documents include detailed drawings and documents intended to implement the contents of project-level documents. It is the responsibility of the IPT management to ensure that these documents are consistent with all applicable project-level documents.
Appendix 2

Work Breakdown Structure, Schedule of Values and Assignment of Deliverables

A 2.1 Work Breakdown Structure

The TESLA Work Breakdown Structure (WBS) is a detailed description of all the tasks necessary to construct the accelerators and the software required for TESLA; to construct the buildings, roads, utilities and infrastructure needed for the support of those instruments and software; to integrate the whole into a properly functioning Linear Collider; and to manage the construction project on behalf of the TESLA partners.

The project is based on a management structure of the Integrated Product Team (IPT) concept. The IPT concept provides a method of managing tasks carried out across multiple organizations and locations. Each Level One WBS element is managed by an IPT responsible for delivering the required products on time, within the specified cost and meeting the project requirements.

The TESLA WBS will be derived in three steps. First, the scientific requirements for TESLA will be specified by the Science Advisory Committee (TSAC). Second, a technical description of the accelerators and experiments capable of meeting those requirements will be outlined by the technical leaders of the project in all regions. Close and frequent interaction will be required between the TSAC and the technical project leadership to assure that the planned technical capabilities meet the science requirements. Third, a plan for design and fabrication, or procurement, of all the hardware modules, subsystems, and software will be established.

Costs will be estimated for all tasks and subtasks. The process will be constrained by the estimated resources the Parties are intending to commit to TESLA. The resulting project description will be organized into the WBS which specifies in sufficient detail the tasks and the resources, both personnel and financial, required to realize those tasks for the completed project.

A 2.2 Schedule of Values

Costs and contingencies will be developed for each subtask of the WBS and rolled up as the summed costs of tasks; the task costs will be subsequently rolled up as the summed project cost. The basis for the cost estimates is a bottom-up sum of the costs associated with each subtask of the project-wide WBS. The
regional technical leaders, working together, develop estimates for the entire task product tree using a standard project-supplied TESLA Cost Data Sheet that asks the technical leaders to provide for each task:

- Task description;
- Task duration (or start and stop dates and predecessor tasks);
- Currency used for materials, supplies and contract expense;
- Basis of the estimate;
- Contingency;
- Staff Effort;
- List of materials and estimated cost of each;
- List of contracts and estimated cost of each;
- Cost parameterisation.

Personnel costs include personnel benefits and, where applicable, a percentage of institutional indirect costs. The institutional indirect cost is a uniform percentage derived from the major partner institutions; this is done to make the personnel cost independent of where the work is performed. Contingency is separately calculated for each subtask. The contingency methodology uses a bottom-up computation of the sum of three separately calculated contingencies. These three contingencies correspond to three different risk factors: the technical risk, the cost risk, and the schedule risk. The technical, cost and schedule risk factors for a particular WBS task are evaluated and then entered as factors in the TESLA Cost Data Sheets.

A 2.3 Assignment of Deliverables

The TESLA Parties will make equal Value contributions to TESLA with the work equally and equitably shared between the regions, with the exception of the infrastructure which will be provided by the country in which TESLA will be sited. Therefore, using the values assigned to level-3 tasks, the tasks will be divided between the Parties in a manner that (a) leads to an equal assignment of value to all sides; (b) leads to a division of equal risk, as measured by contingency, to all sides; and (c) respects particular institutional experience on all sides.

The division of values will also take into account the funding schedules planned by all parties over the ten year duration of the funding of the construction project. The resulting division of value will be presented in the WBS for each level-3 task as a percentage division between the regions. A Cost Summary sheet, included with the WBS, will present explicitly this same information rolled up to level-1.
**Value:** A partner executing a particular level-3 task will receive for the successful completion of that task credit for the *value* assigned in the WBS. The Partner has the discretion to carry out the task in the manner the Partner chooses to be in its best interest, but the *value* is not affected by that choice.

**Responsibility:** Task responsibility is assigned at WBS level-2. The level-2 tasks are referred to as *work packages* that the responsible partner may wish to assign to one of its participating institutions. Each work package is sub-divided into *work elements*. These are the level-3 tasks to which *value* is assigned. Usually the work elements are assigned wholly to one partner or the other. In the case of shared level-3 tasks the division of effort as 100 percent to one side or another is made at a still lower level.