

The following are preliminary guidelines for developing the RDR cost estimate. Since there are very different approaches to cost estimating in different parts of the world, it will be necessary to separately estimate construction costs, preparation and R&D, commissioning and operations. The center of mass energy is 500 GeV. Essential components for the 1 TeV option, which will be very difficult to add later, are included.

These estimates will be framed in terms of a common “value” of purchased components and total person hours of in-house labor. In general, the component cost estimate will be on the basis of a world-wide call for tender, i.e. the value of an item is the world market price if it exists. This also applies to the conventional construction and Consultant Engineering. The estimates should be based on the lowest price for the required quality.

There are three different classes of items which must be treated somewhat differently:

Site specific: The costs for many aspects of conventional facilities will be site specific and there will be separate estimates for each sample site. These are driven by real considerations, e.g. different geology and landscape, availability of electrical power and cooling water, etc. Site dependant costs due to formalities (such as local codes and ordinances) are not included. Common items such as internal power distribution, water and air handling, etc., which are essentially identical across regions although the implementation details differ, can have a single estimate.

High technology: Items such as cavities, cryomodules, and rf power sources, where there will be interest in developing expertise in all three regions (Asia, Europe and Americas), should be estimated separately for manufacture by each region. Costs should be provided for the total number of components along with parameters to specify the cost of a partial quantity. These estimates will be combined by some algorithm to be determined later.

Conventional: Components which can be produced in all regions need not be estimated separately for manufacture in each region. The cost should be based on the lowest world market price.

In addition to these general comments, we list some specific guidelines:

1. The construction period extends from first funds authorization until the last component is installed and tested for each system. Necessary infrastructure must be estimated as part of the construction cost. Preparation and R&D costs should be estimated separately. The preparation phase includes the minimum items and activities needed to gain construction approval. Separate estimates are also needed for commissioning and beam tests and for operations.
2. The component cost includes external labor, EDIA, offsite QC and technical tests. In general, the estimate is the lowest world-wide cost for required quality. A single vendor is assumed, or in some cases, two vendors for risk minimization. No costs are assumed for intellectual property rights.
3. In-house labor is estimated in person-hours. Only three classes of manpower are used: engineer/scientist, technical staff, and administrative staff. Additional central staff will be needed for commissioning and operation,.

4. For large numbers of items, learning curves should be used to scale the cost decrease with quantity. The cost improvement is defined by the following equation:

$$P = P_1 N^a,$$

where P is the total price of N units, P_1 is the first unit price and a is the slope of the curve related to learning [1]. The slope a is for large N also the ratio of the last unit price P_N and the average unit price $\langle P \rangle$. This will be described in more detail in the costing instructions. The value is calculated parametrically for the assumed 7 year given construction schedule.

5. Prices for raw material are world prices as of January 1, 2006, i.e. for copper, steel and niobium, etc. Prices for electrical power are those for the region as of January 1, 2006. Quantities should be stated explicitly so the cost can be scaled later.
6. The value unit needs to be defined. For now, one currency per region with fixed exchange rates should be used. The fixed exchange rates are:
1 M€ = 1.2 M\$ = 1.4 Oku¥.
No tax is included. No escalation is used. The costs should be estimated as of January 1, 2006.
7. Contingency is for the moment explicitly excluded. In order to include it at a later stage, the technical groups should do a risk analysis, which will be used by the DCB to generate a probability distribution for the cost estimate. This will be described in more detail in the costing instructions.
8. There will be one common design and footprint, except for unavoidable site-specific differences, such as shaft location. Regional options such as utilizing existing machines can be proposed as alternates for cost savings. A common set of rules, codes and laws to satisfy all regions is used as long as the cost impact is not too significant. Where not covered by existing codes, a set of ILC standards must be developed which specify cost effective solutions, e.g. the distance between personnel crossovers for the two tunnels.
9. All cost estimates must be treated as confidential within the GDE (e.g. not to be publicly presented or listed on a publicly accessible web or wiki site). The Executive Committee shall determine the publication policy for all elements of the cost estimate.

References

[1] Department of Defense, United States of America, *Joint Industry Government Parametric Estimating Handbook*, Second Edition, Spring 1999.