For discussion of technical risks

March 13, 2007

Risk evaluation

- The EC launched process of risk evaluation

For the purposes of this exercise, we have divided the analysis of the value risk into two parts:

- *Component Risk*: the uncertainty in the unit cost prices themselves, as produced by the Technical Groups;
- *Technical Risk*: the risk associated with a design feature of the machine, which relies on the positive outcome of either on-going or planned R&D.

extracts from the EC document.

There are two categories of technical risk for which the cost impact needs to be considered:

- *Known or explicit technical risks*: the baseline design assumes that certain known problems will be resolved through the R&D program. In these cases, since the problems are known, an alternative design based on proven technologies can be devised, and the cost associated with the risk is just the cost differential between the baseline design and the alternate design. An obvious example here is the choice of gradient for the main linac.

- *Projected performance risk*: into this category go all assumptions that are based on simulations that cannot be directly confirmed or supported by the current R&D plans. Many of our luminosity performance assumptions fall into this category (emittance preservation and tuning in the Main Linac, for example). These types of risks are much harder to quantify in terms of cost impact, but the cost of *possible* mitigation (risk-reduction) measures can be estimated (adding additional diagnostics or instrumentation is an example).

Methodology

There will be three effective stages to achieving the estimate of the technical risk:

1. Cataloguing the major technical risks for each sub-system, identifying the mitigating design modifications (including, where applicable, any possible impact on other sub-systems), and assigning an initial best-guess to the probability.

2. Assessing the cost impact for each of the alternative designs. This may require input from specific Technical or Global groups, and the RDR management board should be alerted if this is the case.

3. Consolidate and rationalize the results across the sub-systems to produce the final technical risk analysis. Here the RDR Management Board will coordinate across the area systems.

The following simple DR example (numbers are just placeholders) indicates the type of information and format required:

item	Assumption/risk	Probability of Failure	Mitigating design change	Cost differential relative to baseline
1	Clearing electrodes, plus vacuum chamber coatings, will suppress electron cloud buildup below threshold for design bunch spacing	50%	Add 2nd e+ ring	200 M ILCU
2	…			

EC: As a general guideline, only risk items associated with a cost impact of ≥20 M ILCU should be considered.

Risk assessment methodology in US Options study

- The source or reason for a potential failure
- The severity of the failure as characterized by its impact on the project mission goals
- When in the course of the linear collider project the failure will occur or become apparent
- The consequence of the failure characterized by what would have to be done to overcome it

  – **However, cost impact was not evaluated**

http://www.slac.stanford.edu/xorg/accelops

Not very useful listing

- Expectations
  - **beam of certain quality delivered to IP**
  - **beam of certain sizes collide at IP**
  - **certain background is maintained**
  - **certain efficiency for detectors is provided**
  - **beam is extracted & dumped**
- This list is not very useful, for risk analysis, since the underlying reasons are not identified

Tech assumptions & risks

- Transport beam of certain quality to IP
  - **able to measure beam (performance of laser wires -- 1micron resolution) and tune it**
  - **performance (e.g. stability of BPMs)**
  - **stability of magnet centers**
  - **jitter of beamline components**
  - **collimator wakes low enough**
  - **incoming beam certain emittance & jitter**
  - **spoilers survive two bunches**
  - **MPS handles errant beams**
  - **able to tune the ff optics**

Tech assumptions & risks

- Beam of certain size collide at IP
  - **Stability of FD is provided within capture range**
  - **Intratrain feedback handles the jitter**
  - **Crab cavities rotate beam stably & with no beam quality degradation**
  - **Forward & other instrumentation provide signals to tune the beams**

Tech assumptions & risks

- Certain background is maintained
  - **Small enough halo comes from upstream**
  - **Halo not reproduced in BDS**
  - **Halo cleanly collimated**
  - **Muon transport to IP as predicted**
  - **Muon suppression as predicted**
  - **Vacuum is adequate for low beam-gas**
  - **SR near IR is masked out**
  - **Pairs & beam-beam as predicted**
  - **IR fields understood and tuned optimally**
  - **Losses near IR in extraction as expected**

Tech assumptions & risks

- Certain efficiency for detector is provided
  - **the push pull operation can be done fast**
  - **restoring the beam is fast**
  - **alignment of internal detector components is maintained**

Tech assumptions & risks

- Beam is extracted & dumped
  - **beam losses in extraction as expected**
  - **dump window handles the power**
  - **dump operation is reliable at full power**
  - **shielding around dump & collimators is adequate**