

GDE Change Evaluation Panel

TLCC-3 – Decision Memo

17 March 11

Proposal: Adopt a reduced parameter data set

Components of the proposal:

1. A *reduction of the number of bunches per pulse* (n_b) by a factor of two from 2625 to 1312.
2. A corresponding *reduction in Main Linac beam current*, and therefore beam power, and an associated reduction in the number of klystrons, modulators, power supplies (primary cost saving) and conventional systems support.
 - Key conventional facilities support for the full RDR RF power will be installed upfront during construction, in support of future possible upgrade to higher bunch numbers (risk mitigation).
3. A corresponding *reduction in the circumference of the damping rings* from 6476 m to 3238 m (i.e. 50%), while maintaining the DR current approximately constant. This includes the associated reduction in DR RF power by approximately 50% (primary cost saving),
4. An increase in the DR tunnel diameter to accommodate the *possibility of installing a third damping ring* (second positron damping ring) at some later date, if required (risk mitigation).
5. Adoption of *stronger focusing at the interaction point* (enhanced beam-beam) - including the possibility of travelling focus - to provide the required luminosity (maintaining performance at higher risk).

Decision:

YES, with considerations below.

Discussion:

The proposal to adopt a reduced beam parameter set is motivated by the cost savings from the reduction of number of HLRF stations and a halving of the damping ring circumference. The idea is to restore luminosity through stronger focusing in the interaction region, including the traveling focus or other such schemes.

Some comments that came up in the CEP discussions are indicated below.

The luminosity recovery strategy includes stronger focussing at the IP and the inclusion of the travelling focus scheme. Both suggestions are associated with higher risks therefore further R&D studies will be required:

1. The stronger focussing at the IP brings the machine into a higher disruption regime. Studies show that the stabilisation of the IP gets more important, e.g. vertical beam jitters need to be controlled with the help of the feedback systems,

- eventually down to levels of 0.1 of σ_y or below. This is challenging and needs to be studied. It is not clear whether the current fast feedback systems could control the vertical position to levels of a couple of hundreds of picometers.
2. The travelling focus scheme is novel and is not fully proven. Idealized studies show that a recovery of the luminosity from 1.5 to $2 \times 10^{34} \text{ cm}^2\text{s}^{-1}$ should be possible. However, realistic studies need to be performed. It is worrisome that this “lifeboat” strategy is not being worked on more intensely.

A realistic path for a luminosity upgrade even beyond $2 \times 10^{34} \text{ cm}^2\text{s}^{-1}$ should be vigorously pursued.

Since SB2009 was widely distributed and it adopts a single stage compressor, the choice of a single or double stage compressor for the new baseline should state explicitly when discussing the new baseline to avoid confusion.

In fact, some panel members disagree with adopting the single bunch compressor scheme, which results in choosing $300\mu\text{m}$ bunch length, yielding an awkward medium physics performance and a high risk traveling focusing scheme. On balance, panel members believe a two bunch compressor will give a better design and performance.

This proposal reduces project cost for the conventional facilities from the RDR mainly in the following areas:

- The KCS and DRFS Main Linac costs are both lower for the “Reduced Bunch Number” option.
- The Damping Ring cost is reduced primarily due to reduced circumference from 6476 m to 3238 m which offsets the increased unit costs of the larger tunnel diameter of 7.5m instead of 5m .

However, it should be noted that the conventional facilities costs reported for this proposal were done in short span of time and most, if not all, are scaled from the RDR cost estimate which were based on a more mature design and done more thoroughly. Also, the RDR costs were based on the connected loads while operating loads in proposal were used for scaling. Further, mechanical and electrical systems costs vary as step functions rather than linear function. This could result in cost saving either more or less than what have been reported.