This Review: the Charge

The Committee is asked to review whether the design of the project will be able to support the design performance and whether the engineering design of the project, including all technical subsystems, is sufficiently complete to proceed to detailed designs and start of construction.

The Committee believes that the baseline design as described in the design report is consistent with both the KPP and the UPP parameter sets.

The engineering design is sufficiently mature to warrant the start of construction activities. However we believe that further design iterations (e.g. system integration, value engineering) and more detailed engineering specifications will be beneficial in several areas (survey, BPM resolution).

This Review: the Charge

- Does a baseline parameter set and lattice layout exist?

The design report does contain a series of tables which specify the baseline parameters for both the single and four-turn scenarios. The lattice is well defined as evidenced by the simulation results such as orbit correction and beta-beat evaluation.

This Review: the Charge

- Are the specifications for the four-pass ERL as well as all technical subsystems complete?

As previously stated the physics specifications for the four pass ERL are determined. The technical subsystems are sufficiently well defined to proceed on the upcoming procurements to reach the next series of milestones. A more comprehensive set of technical specifications and drawings will be required for many subsystems to proceed through procurement and fabrication to initial operation.

This Review: the Charge

- Do engineering designs (~~drawings~~) for the major components exist?

We note several significant components exist already (Gun, ICM, MLC, dump, diagnostic line). Major components including FFAG magnets, BPM electronics and controls have engineering designs. Girders, splitters, vacuum and other subsystems are still somewhat conceptual in places.

This Review: the Charge

- Does a baseline parameter set and lattice layout exist?

Comments

- *However, it would be nice to see a complete loop for the tolerance / specifications discussion (alignment, temperature versus number and strength of the corrector elements) that demonstrates that the most cost effective solution has been adopted (for example: could one reduce the number of corrector magnets if the alignment tolerances are set tighter?).*

- *We would recommend to include the space reservations for the diagnostics boxes in the splitter section from the beginning on and to include these items in the layout drawings.*

This Review: the Charge

- Does a baseline parameter set and lattice layout exist?

Comments

- *We would recommend to prepare a simulation tool for testing the LLRF system in multi-turn ERL operation mode. This operation mode might not be a straight forward scale from previous operation experience. This would certainly help in achieving the transition from single turn to multi-turn ERL operation within the targeted period of 3 month.*
- *It would be nice to see a more complete discussion on the maximum expected beta-beat for the uncorrected quadrupole errors in the machine for different installation scenarios (e.g. random versus sorting) and to see how this evaluation translates into maximum acceptable magnet field errors.*
- *It would be nice to see a thorough robustness study (e.g. orbit and optics function range for various field errors and magnet alignment error implementations and with BPM errors) to define the minimum required alignment tolerances with the expected BPM accuracies.*

This Review: the Charge

- Does a baseline parameter set and lattice layout exist?

Comments

- *There could be another very interesting test program based on single turn ERL operation with high current (up to 140mA to 200mA!) that is not strictly speaking part of the NYSERDA program.*

- *It would be nice show the flexibility of the present lattice parameters, tune vs momentum and tof vs momentum. Depending on the availability of MLC energy gain etc, a slightly different scenario, e.g. lower energy injection into the FFAG arc may be needed. It is not clear at this point whether it is possible given the low momentum acceptance of the FFAG.*

- *Transition in the lattice from 1 pass operation for the momentum scan, to a 1 pass ERL mode, and to a 4 pass operation mode are not clear. How much modification of the lattice is involved at the splitter and combiner sections? Is the established tuning method at each stage valid also at the next stage?*

This Review: the Charge

- Does a baseline parameter set and lattice layout exist?

Comments

- *To what extent can the twiss parameters, phase advance, dispersion functions, etc, be characterized and how can they be measured during operation?*

- *At KPP level, the machine modelling without intensity effects is still valid. A staged approach of developing an online model and high level software should be considered for modelling the machine when the intensity is being increased.*

- *Eventually, the total path length will be measured by BAM. It would be good to know what contribution comes from each section, FFAG arc, transition, straight section when the orbit is distorted.*

This Review: the Charge

- Are the specifications for the four-pass ERL as well as all technical subsystems complete?

Comments

- *The number of excess magnet blocks to be ordered can be calculated from the assumption for the strength distribution*
- *Assembly and disassembly of Halbach magnets was not presented*
- *The design of the straight section requires significant strength shimming of magnets. The capability of magnetic measurement and shimming needs to be maintained throughout the CBETA operating time in order to expediently replace a magnet if necessary.*

This Review: the Charge

- Are the specifications for the four-pass ERL as well as all technical subsystems complete?

Comments (continued)

- *The required resolution of path length measurement does not seem to be completely determined.*
- *Cross talk between all splitter-combiner magnets has not been investigated yet*
- *Orbit corrections simulations were done without BPM errors*
- *Orbit correction schemes with a reduced number of correctors (e.g. half) could provide guidance for scope reduction*
- *Mechanical noise from water pumps, AC, and the Kinney pumps may interfere with operation especially the cryomodule.*
- *Large microphonic noise on the unstiffened cavities in the MLC is a concern for stable operation*
- *The margin on the HOM power in MLC was not presented*

This Review: the Charge

- Are the specifications for the four-pass ERL as well as all technical subsystems complete?

Comments (continued)

- *The types, numbers, and location of beam loss monitors is not yet finalized*
- *Adding passive insulation near the roll-up door may improve temperature stability in the CBETA hall*
- *To complete the requirement for the electrical infrastructure final design specification from several system are needed (magnet PS, beamline components, instrumentation and control, RF HPA and pump skids, lighting and outlets, AC and ventilation, metering)*

This Review: the Charge

- Do engineering designs (~~drawings~~) for the major components exist?

Comments

- *We recommend a formal value engineering cycle be performed before releasing major contracts*
- *The Project should evaluate effect of radiation on magnet field quality and tolerance to beam loss and implications for fault protection with beam test*
- *Validate shielding calculations with fault studies*
- *Finalize magnet offsets on the girders.*
- *Vibration from water pumps?*
- *Specification of BPM resolution and magnet misalignment tolerance*
- *Build and test series of prototype FFAG magnets*
- *Finalize magnet power supply specifications*