GDE Change Evaluation Panel

TLCC-2 – Decision Memo
9 Nov 10

Proposal: Single Tunnel Main Linac Configuration

"We propose to change the main linac tunnel configuration to one with only a single, accelerator-enclosure tunnel, thereby eliminating the support equipment tunnel proposed in the Reference Design. We propose to develop and include in the baseline two novel High Level RF power source and distribution schemes, ('KCS' and 'DRFS'), that are better suited to a single-tunnel solution than the scheme proposed in the RDR. A fall-back to the RDR HLRF Technology can be adopted should the R&D on KCS or DRFS not be considered successful."

Decision:

YES, with considerations given below:

Discussion and comments:

The decision for a double tunnel RDR configuration was based on two main considerations: 1) safety, and 2) availability. Since that time, much progress has been made on how safety can be handled in a single tunnel and simulations of availability indicate that a single tunnel configuration may be possible that doesn't have a major impact on availability. The newer problem is how the HLRF can be accommodated within a single tunnel configuration and two different variants that have been proposed, due to regional differences..

Some general considerations:

1) It was noted that the levels of design maturity of the new RF configurations are not the same as for the RDR. To bring the single tunnel solution to same level of design maturity of the two tunnel solution of the RDR, further work needs to be done.
2) Without adding extra energy margin for reliability beyond that assumed for the two-tunnel RDR configuration, the cost savings for the single tunnel KCS, DRFS, backup #1 RDR-like, and backup #2 XFEL-like, range from 1.2% to 2.2%. Adding extra energy margin to retain the desired machine availability substantially reduces these savings relative to the two-tunnel RDR.
3) The amount of equipment in the tunnel is a concern. Detailed layouts are needed to see how well all this equipment can be accommodated. Is there sufficient space in a single tunnel to allow access to klystrons (and modulators) for installation, servicing, maintenance, repair, or replacement?

4) There are issues related to having all the electronics (modulators, LLRF, magnet power supplies etc.) in the accelerator tunnel that should be studied. Ameliorating effects of Single Event Upsets via electronics design or radiation shielding is the biggest concern as multiple accelerators have removed electronics from the tunnel to solve such problems. (LHC is the latest example.) Making sure there are enough diagnostics built into all the electronics to allow subtle beam related problems to be remotely debugged is another.
5) The PAC urged maintaining the option of upgrading from half-power to full power. How can this be accomplished for both HLRF options?
6) Is the backup viable? Is there sufficient space in a single tunnel to allow access to klystrons (and modulators) for installation, servicing, maintenance, repair, or replacement?
7) We urge reducing the number of RF options being pursued as soon as practical. In particular, reducing the number of backup options from two to one should be done quite soon. Do we need to maintain two single tunnel backup options based on the 10 MW RDR configuration: 1. Placing klystrons, modulators, and power supplies in the beam tunnel, and 2. Placing klystrons in the beam tunnel and modulators and power supplies either above ground or in a beam-on accessible cavern, and connecting with pulsed HV cables as for the XFEL design?
8) We find that the TLCC-2 proposal is not controversial for the physics/detector community.

Some KCS considerations:

1) How will the RF power be adjusted cavity-by-cavity to accommodate the spread in gradients?
2) Extra costs for KCS because of the extra RF power needed have been included in the total cost impact.
3) A big concern with KCS, assuming technical feasibility is demonstrated, is that this system represents a single-point failure that can bring down a substantial section of the linac. The probability of this happening is not known at this time.
4) Full-power testing of the KCS scheme requires building a full KCS unit.

Some DRFS Considerations:

1) We need reliable cost information, as there is at least the impression that a single larger klystron is more cost-effective than several smaller klystrons.
2) Failure rate, maintenance plan, and costs of maintaining must be determined.
3) Upgrade from low power to full power may be more serious issue for in-tunnel DRFS system.
4) Will we know by the end of the TD phase whether the permanent magnet solenoid for the DRFS klystron will work?
5) Does the permanent magnet klystron allow for the 10 Hz alternate operation (e.g. 125 and 150 GeV)?