

GDE S4 task force on EDR planning for Beam Delivery System. Draft

Starting from the second half of 2006, the BDS area leaders were focusing on developing the internationally coordinated plans for EDR phase and beyond. Since November 2006, the GDE S4 task force was coordinating these planning efforts.

Several high priority areas of development were identified, in BDS area, where the novelty of design and technical challenges are such, that focused efforts are needed in the EDR phase, to verify the performance, reduce risk and cost uncertainty, and develop optimized technical solutions. These areas (some of them is a part or will form the basis of work packages) are:

- development of IR superconducting magnets, integrated design of IR, design study to ensure IR mechanical stability, design of push-pull arrangements;
- development of crab cavity systems;
- design construction, commissioning and operation of ATF2 test facility;
- development of laser wires for beam diagnostics;
- development of intra-train feedback;
- development of collimator design, verification of collimation wake-fields with measurements and verification of collimation beam damage;
- development of beam dump design and study of beam dump window survivability;
- development and tests of MDI type hardware such as energy spectrometers; and other, as shown in materials referenced in the appendices.

In planning the EDR efforts, the S4 assumed that the EDR, till the end of 2009, will follow by two years of approval period, till the end of 2011, after that construction would start, in the beginning of 2012. Although a longer schedule was mentioned, the optimistic schedule was chosen for planning, which may be possible provided that the LHC would give exciting results, the yield of SRF cavities production will reach high stable level, the process of site selection and approval will be expedited, the commitment to invest in ILC will form in all three regions, and the cost uncertainty will be reduced.

Taking into account the above described schedule and that one of the overall goals should be striving for the early start of the ILC construction, the following defining principles of BDS planning for EDR were adopted:

- the efforts should focus on reduction of cost uncertainty, which means designing systems to appropriate level; and verification of performance via developments and tests of critical prototypes;
- should not plan to complete all the work at the end of EDR, instead, need to plan to continue optimization and final design after EDR and during earlier years of construction;
- if some development could have high political visibility, in addition to scientific impact, and could tip the balance for early start of ILC construction, this should be taken into account in planning

Following these guiding principles, the S4 is developing the overall schedule for BDS in EDR and beyond, which is referenced in the Appendices.

To perform planning for EDR, the S4 is conducting series of expanded meetings, where leaders of particular developments or work packages are invited, to discuss the

plans, the technical issues, funding, etc. For the moment, S4 had three expanded meetings: focused on IR and final doublet work, dumps and collimators, and crab cavity systems. Brief summaries and recommendations for these systems are summarized below.

The Final Doublet design and development is led by BNL. The engineering design and prototypes is aimed to show that compact direct wound magnets can provide independent incoming and outgoing apertures separated by mere 49mm defined by 14mrad crossing angle over the L^* distance of 3.5m. The prototype of the long coil is aimed for studies of mechanical stability of the long skinny magnets, when integrated into cryostats, and connected to cryogenic system. According to WP leaders, the FD stability requirements are in 50-100nm range, and it is presently not possible to estimate where the FD design is now, because any existing cryo magnets are too different in design, and also shown vibrations up to microns range, although the S4 would like to see evaluation of luminosity dependence on the FD jitter. The WP leaders reported, and S4 acknowledged with concern, that the level of funds tentatively planned for 2007-2009 in US, is not sufficient to address the increased scope of the work due to recent design change to push-pull, and not sufficient to make full length prototype of FD and perform stability studies, which is pushed out to the end of 2010 or even 2011. For this work, the S4 recommends:

1. for WP leaders, to evaluate the luminosity risk versus FD jitter
2. for GDE and also ART leaders, to consider the ways to provide additional funds to address the increased scope of work in FD and IR integration
3. pending outcome of 1), for WP leaders, to develop an updated plan which would address the luminosity risk, which would be considered again by S4 with possible further recommendation to GDE
4. for WP and BDS leaders, to consider involvement of other groups and institutions into work on supporting tasks of FD/IR work-package

The work on beam dumps and (in less detail) collimation was presented to S4 by UK-US team (primarily RAL and SLAC). The focus of EDR developments, as acknowledged by S4, should be the engineering design of the dump and the radiation water system, including considerations of tritium containment, window replacement, removal of dump and access for service. The accompanying prototype and beam test work would include studies of window irradiation and possibly prototyping the front-end of the mechanism of remote window replacement. It was also reported by UK colleagues that the beam dump work was severely cut in 07-08 and the level of funding for 08-09 and 09-10 is also uncertain. S4 observed: the plans presented by UK team have some educational component as necessitated due to unavailability of the experts and lack of the expertise in this critical area. S4 recommends:

1. for the beam dump collaboration, to re-plan the work, focusing on critical design and test work for baseline, delaying any work on alternatives, and trying to find available experts who have prior experience with beam dump or target engineering design
2. for GDE and BDS leaders, to search for ways to augment the beam dump collaboration with additional funds and especially human resources with relevant prior experience of engineering design.

The work on crab cavity systems was presented to S4 by UK-US (Cockcroft Institute, FNAL and SLAC). The S4 acknowledges with satisfaction that the evolved plans fit much better the EDR goals, take into account possible synergy with developments of other ILC cavities and with developments at non-ILC projects. The S4 endorsed EDR plans would include design of cavity and couplers, fabrication of one cavity and its low power tests, possibly in an adjusted CKM cryostat, developments of RF system and tests of phase stability with two single cell cavities, conceptual design of the integrated system and of the cryostat. This EDR work will follow, in 2010-11, by design of appropriate cryostat and cavity integration, and tests with beam possibly at ILCTA, fabrication of the second cavity and their tests. S4 recommends:

1. for WP leaders, to keep the momentum, watch developments in synergetic areas, and continue strengthening the collaborative efforts;
2. for GDE and BDS leaders, to help this multi-lab collaboration work efficiently, and steer it as needed, possibly via regular external technical reviews
3. since the present minimal program is success oriented, and also assumes that funding in UK in 08-10 will be as expected (which is not guaranteed), GDE and BDS leaders need to watch and ensure that adequate funding level is provided

Before the ILC EDR program review by MAC at the end of May 2007, the S4 plans to have expanded meeting on ATF2, make its assessment and describe in this document. Due to time limits, other expanded meetings may not be possible – the S4 will attempt to describe and assess other work-packages itself and describe recommendations in this document.

Appendices

The following documents are attached, to provide more details to this brief summary.

- 1) S4 charge.
- 2) Overall schedule of developments in BDS in EDR and beyond.
- 3) Risk analysis in BDS.
- 4) Work packages, partners and resources in BDS.

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