



# Single Tunnel Proposal: intro 1

- **The proposal to go to a single tunnel solution for the Main Linac technical systems remains essential that outlined in the SB2009 report.**
- **The primary motivation was and remains a reduction in project cost due to the removal of the service tunnel for the Main Linac.**
- **The original proposal was based on the adoption of two novel schemes for the HLRF:**
  - KCS
  - DRFS
- **KCS has been identified as a preferred solutions for ‘flat land’ sites where surface access (buildings) is not restricted**
- **DRFS has been identified as being preferred solutions for mountainous region where surface access (buildings) is severely limited.**
- **Having both R&D programmes in parallel can be considered as risk-mitigation against one or other of them failing.**
- **It is acknowledged that both these schemes require R&D**
  - Programmes are detailed in the R&D Plan Release 5
- **At the time of submission in December 2009, the two primary obstacles to adoption of a single tunnel were identified as**
  - Safety egress
  - Operations & Availability



# Single Tunnel Proposal: intro 2

- **Both these issues were addressed during the 2009 and the successful results reported in the SB2009 proposal.**
  - The conclusions of these studies were later accepted by both AAP and PAC
- **The remaining identified issues were with the technical feasibility and cost of the HLRF solutions upon which the single-tunnel proposal was based.**
- **Two components to successful adoption were identified**
  - Definition of acceptance criteria for TD Phase R&D for successful demonstration of one or more of the novel proposed schemes
  - Inclusion in the designs of a risk-mitigation strategy, whereby a fall-back to the RDR HLRF Technical Solution (in a single-tunnel) could be adopted, should the associated R&D not be considered successful.
- **The remainder of these slides deals with these two additional points**



# RDR HLRF Tech. Solution 1

- **Two scenarios have been cursorily studied for support of an RDR-like HLRF solution in a single-tunnel**
  1. 10MW MBK + (Marx) Modulator in the tunnel
  2. XFEL-like solution with modulators (low-voltage) accessible in cryo refrigeration builds/caverns, with long pulsed cables feeding 10MW MBKs (via a pulse transformer) in the tunnel.
- **Both are considered technically feasible.**
- **For 1, early investigations show the tunnel diameter would need to increase to 6.5m**
  - This represents an estimated 10% increase in cost/unit tunnel length (~0.5% TPC) considered acceptable.
  - Current availability\* simulations (cf SB2009 proposal) suggest an additional ~5% linac overhead (~2.5% TPC)
- **For 2:**
  - additional space for modulators in halls/caverns is required.
  - Cost of 3000 km of pulsed cable will be required.
  - Re-design of tunnel cross-section needed to accommodate cables.
  - Current availability\* simulations (cf SB2009 proposal) suggest an additional ~2.5% linac overhead (~1.3% TPC)

\* see later comments on availability



# RDR HLRF Tech. Solution 2

- **It is proposed that these RDR-like single-tunnel solutions be carried forward in parallel, to enough detail to support a cost estimate (incremental)**
- **This estimate – together with the scope of the necessary re-design work to adopt one of the scenarios, will be factored into the TDR Risk Assessment**
- **The main R&D and AD&I effort will continue to pursue the preferred baseline solutions for KCS and DRFS.**
- **In order to reduce the number of scenarios to be developed, we propose to phase out one of these RDR-like options within the next six-months**



# Technical Issues DRFS (R&D criteria)

- **Basic concept of configuration (feasibility) will be tested this year at S1-g**
- **Preparation for this test has advanced design in 2010 (progress since January)**
- **Technical issues remain:**
  - Cost effectiveness
    - STF2 and Quantum Beam prototype klystrons)
  - Klystron MTBF
    - scaled from KEK-B linac experience
  - Radiation sensitivity for tunnel hardware
    - Further 'tunnel tests' planned
    - XFEL experience / R&D
- **Significant progress on power overhead analysis has been made.**
  - relevant for number of klystrons and AC power



# Technical Issues KCS (R&D criteria)

- **2010 – successfully built waveguide and CTO prototypes (cold-tested).**
- **Full field tests of all prototype components within TD Phase.**
- **Breakdown test (energy deposition) close ILC spec.**
- **Significant progress in understanding operational aspects**
- **Technical issues:**
  - Better understanding extrapolation of proposed tests to full system (risk assessment)
  - Quantification of system tolerances and assumptions (combiner etc.)
  - Further detailed FMEA (task force)



# Technical Issues RDR

- ***We will follow X-FEL development (and ultimately experience) closely***
  - *we get this for free.*
- ***No specific ILC-related R&D is proposed***
- ***Some AD&I activity (layout/design work), is required for cost analysis and feasibility***
  - *Allowing rapid adoption into design and cost for TDR if necessary*



# Availability

- **Availability Task Force (AvTF) report (included as appendix in SB2009 proposal) concluded that an additional 10% linac overhead was required for RDR single-tunnel solution (RDR scenario 1).**
  - compared to 3% for KCS and 5% for DRFS
- **Estimates were based on 40kHr/50kHr MTBF for MBK and modulator respectively.**
- **Scenario (2) XFEL not directly studied, assume additional overhead reduced to 5% in this case (to be checked).**
- **Simulation (and assumptions) need review (work for AvTF in TDP2).**
- **Possible R&D to increase MTBF**
  - Higher MTBF expected for Marx (scenario 1).
  - 100kHr quoted by Toshiba for MBK (needs review)
- **We expect to be able to reduce this margin**





# Japanese solution for a mountainous site (CFS)

- **Current site-development in Japan represents a significant step forward from ‘conceptual/generic’ sample site designs in RDR.**
- **Analysis by experienced tunnel construction engineers have proposed the need for a pilot tunnel to reduced risk associated with the boring of the main accelerator tunnel.**
- **This pilot tunnel – while not considered mandatory for a safety concept, could be beneficially incorporated into the accelerator tunnel emergency egress strategy.**
- **It is still proposed to retain the single main tunnel for the technical linac solutions.**
  - the pilot tunnel will remain relatively ‘basic’, supporting only water drainage and emergency egress.
- **Costing for the Asian CFS solution will not be available until (probably) end of 2011.**



## Costs (in general)

- *I would propose to note the SB2009 estimate for the cost saving here (re-cap)*
- *And then say something about when updated costs will be available*
- *Note that our proposal to include the RDR scenario as back-up will mitigate the risk of the costs for KCS/DRFS coming in much higher than expected*
- *(Should also note that we expect a single tunnel solution with RDR to be at worst cost-neutral and likely to still be a cost saving – ask Peter to comment/quantify).*