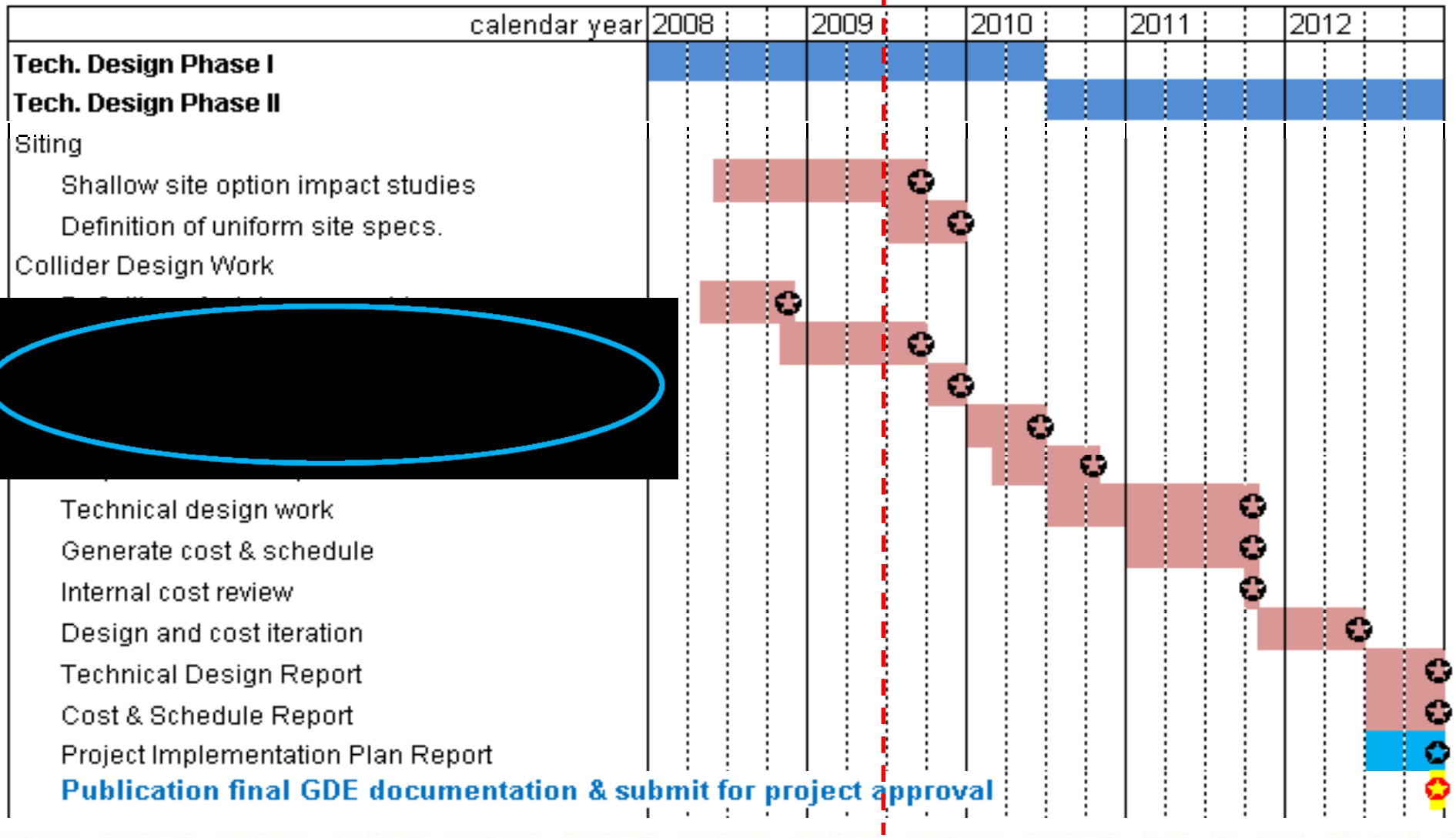
ILC AD&I: Introduction and Overview

Nick Walker
for the Project Management

The R&D Plan

- Stated TDP Goals:
  - [redacted]
    - Results of critical risk-mitigating R&D
  - [redacted]
    - Project Implementation Plan

TDP R&D Plan


calendar year
2008
2009
2010
2011
2012
Tech. Design Phase I
Tech. Design Phase II
Siting
Shallow site option impact studies
Definition of uniform site specs.
Collider Design Work
Technical design work
Generate cost & schedule
Internal cost review
Design and cost iteration
Technical Design Report
Cost & Schedule Report
Project Implementation Plan Report
Publication final GDE documentation & submit for project approval

Updated Baseline Design

- Will reflect choice of new baseline at end of TDP1
  - Layout, integration, gradient etc.
  - Cost-driven
- Level of detail not expected to be beyond RDR
  - Unlikely to have “detailed engineering” resources available
- Better documentation (than for RDR)
  - Structured documents → traceability
  - Use of 3D CAD (“Visualisation”)
  - ILC-EDMS
  - Link to TRIAD and ICET (cost)
- More structured project management providing leadership
  - Of design decisions
  - Of cost estimates

More time than RDR (2 years)

Tools & methodology being developed now (TDP1)

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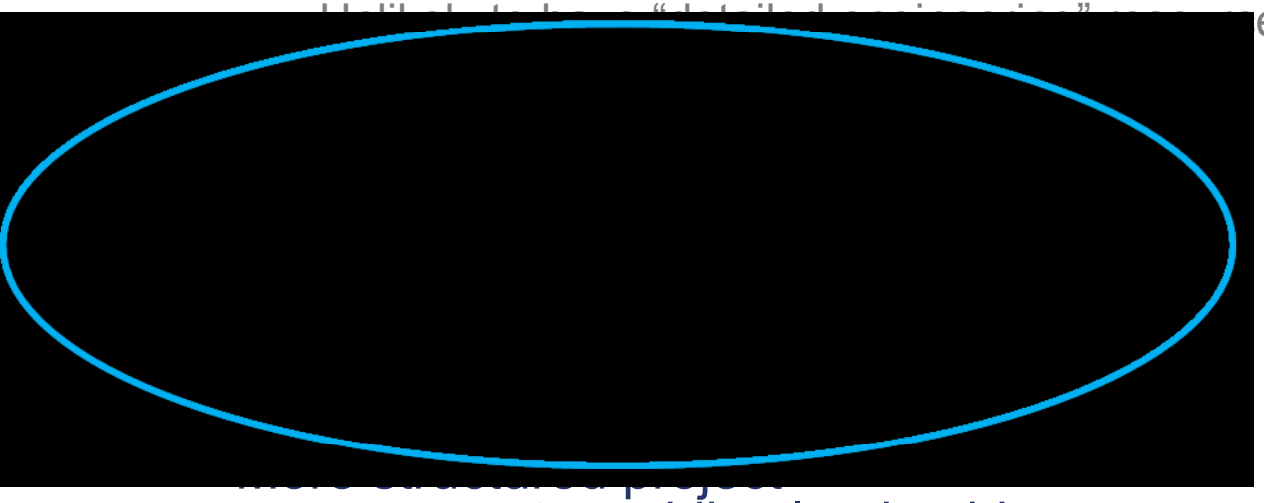

management providing leadership
  - Of design decisions
  - Of cost estimates

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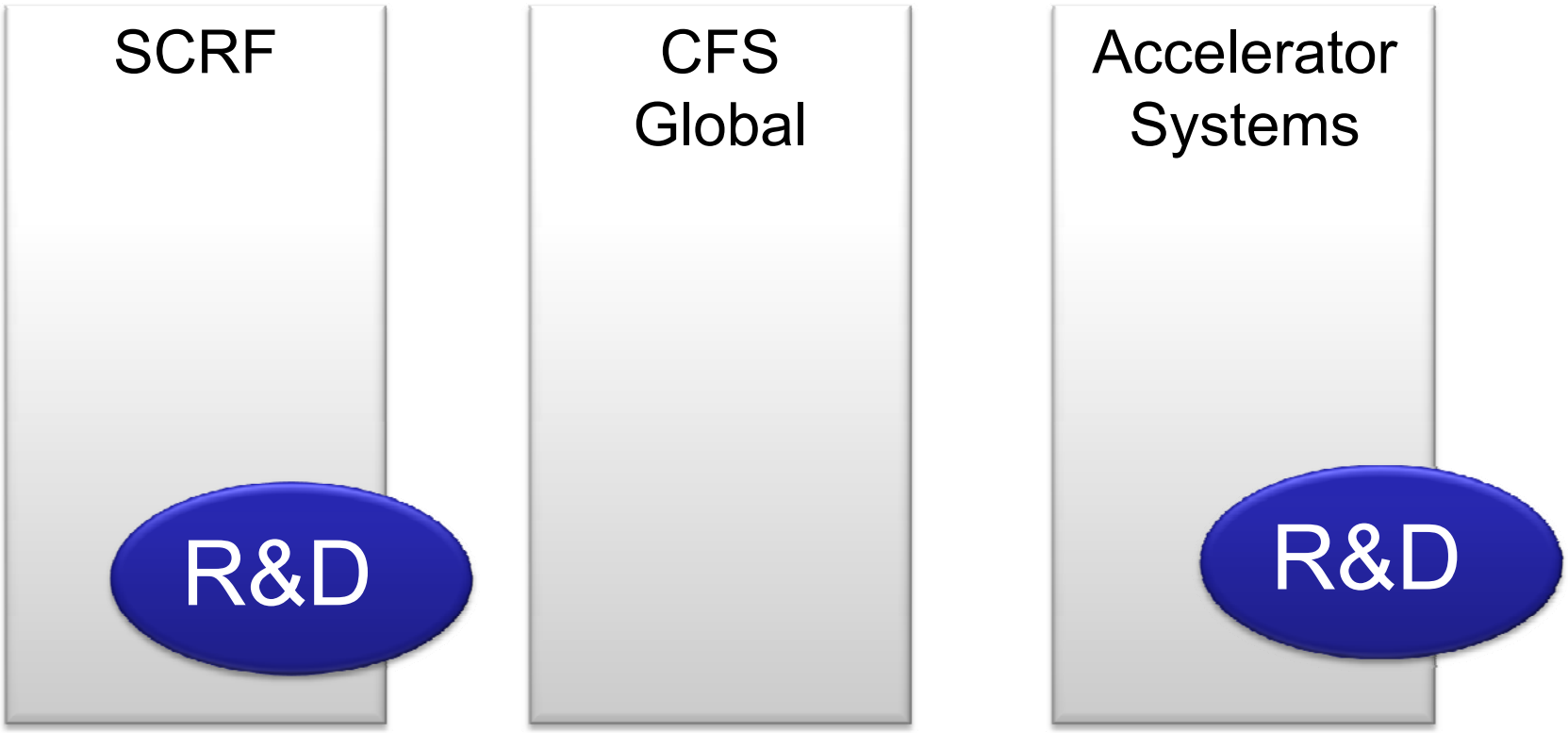
Preparing a Proposal 1/2

- Started with MM document (cost reduction)
  - Basically a result of discussions at Dubna June 08
- Formal preparation begins here at this meeting
  - This meeting is fundamentally a scope and planning meeting
- Concluding discussions for proposal: ALCPG (Sept/Oct 09)
  - Conclusion of process begun at this meeting
  - Final consensus (of this group) on scope and structure of Proposal Document

Preparing a Proposal 2/2

- Formal document end 2010 (Draft)
  - October-December for writing
- Review and acceptance process
  - Initial review by AAP January
  - Release to broader community
  - Feedback / Discussion
  - Final “Acceptance Process” TBD
- This group is responsible for producing the new ILC design
  - Ownership during TDP-2

Integrating the AD&I Team



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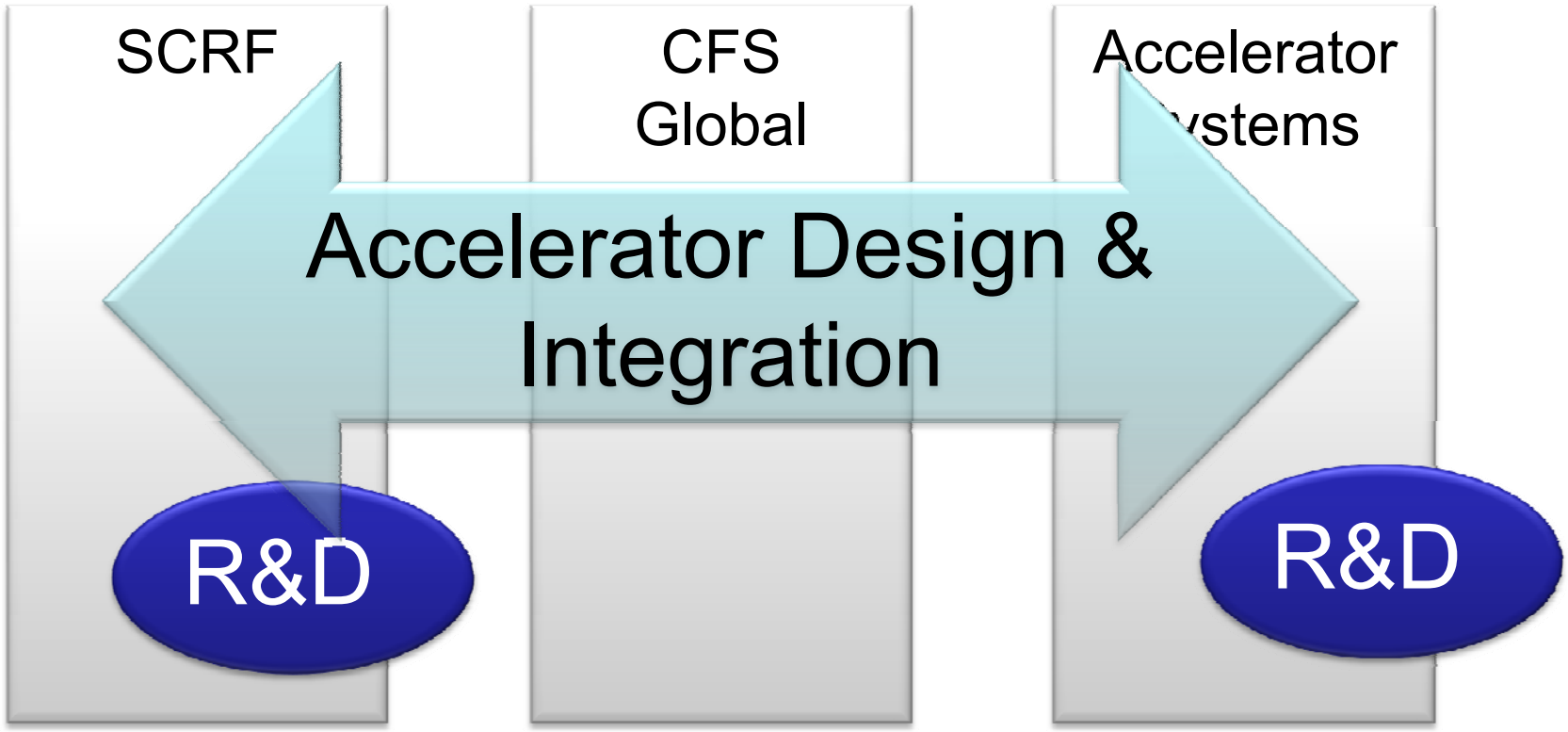


Scope of this Meeting (1)

- To catalogue the ‘facts’ as best we can
- Avoid (too much) debate on the ‘worth’
- Attempt to quantify as many issues as possible
  - Work items with clearly defined deliverables for ALCPG
- Two important aspects:
  - Cost increment – quantifiable (within RDR limits)
  - Risk assessment – more qualitative by nature (consensus driven)
- Discussions (debate) on “merit” will be focus of ALCPG meeting
  - In-part with phys & detector groups

Scope of this Meeting (2)

- Walk through of SB-2009
  - **Working Assumptions** for the remainder of 2009
- Produce catalogue of 'questions'
  - Answer those that are straightforward
  - Prioritise the remaining ones
  - Action items for ALCPG
- Open (and encouraged) discussion of pros and cost
  - Referenced to RDR
  - Keep discussions 'technical'

Concrete Deliverables

- Risk register update
  - For RDR
  - For SB2009 (including agreed variants)
  - Rankings should reflect cost incursion as well as performance (PM action item)
- Top-level comparison table
  - Highlighting what changes (wrt RDR)
  - Pros & Cons
  - (complimentary to Risk Register)
- Update and review at end of meeting
  - Discussion & close-out session Friday PM

SB-2009 Proposal (PMs)

1. A Main Linac length consistent with an optimal choice of average accelerating gradient
   - RDR: 31.5 MV/m, to be re-evaluated

2. Single-tunnel solution for the Main Linacs and RTML, with two possible variants for the HLRF
   - Klystron cluster scheme
   - DRFS scheme

3. Undulator-based e+ source located at the end of the electron Main Linac (250 GeV)
   - Capture device: Quarter-wave transformer

SB-2009 Proposal (PMs)

4. Reduced parameter set (with respect to the RDR)
   - n_b = 1312 and a 2ms RF pulse (so-called “Low Power”)

5. Approx. 3.2 km circumference damping rings at 5 GeV
   - 6 mm bunch length

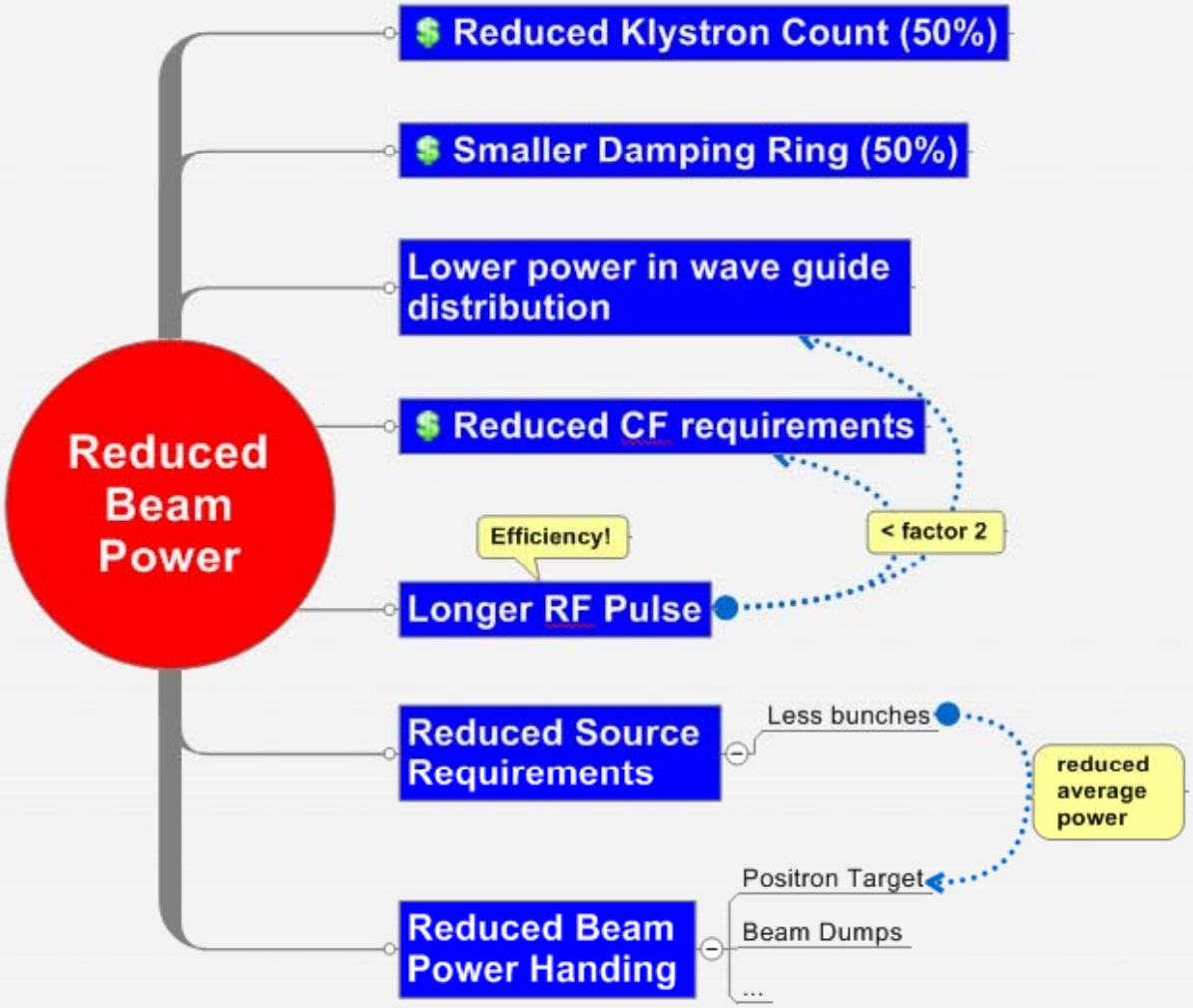
6. Single-stage bunch compressor
   - compression factor of 20

7. Integration of the e+ and e- sources into a common “central region beam tunnel”, together with the BDS.

Importance of an Integrated Baseline

- MM elements where described as ‘separate’ study elements
- Considerable cross-impact of design considerations
  - Reduced bunch parameter set (beam power)
  - Solution for HLRF
- Need to focus on complete solution, and generate consistent design
  - Produce catalogue of **impacts** across the design

Reduced Beam Power



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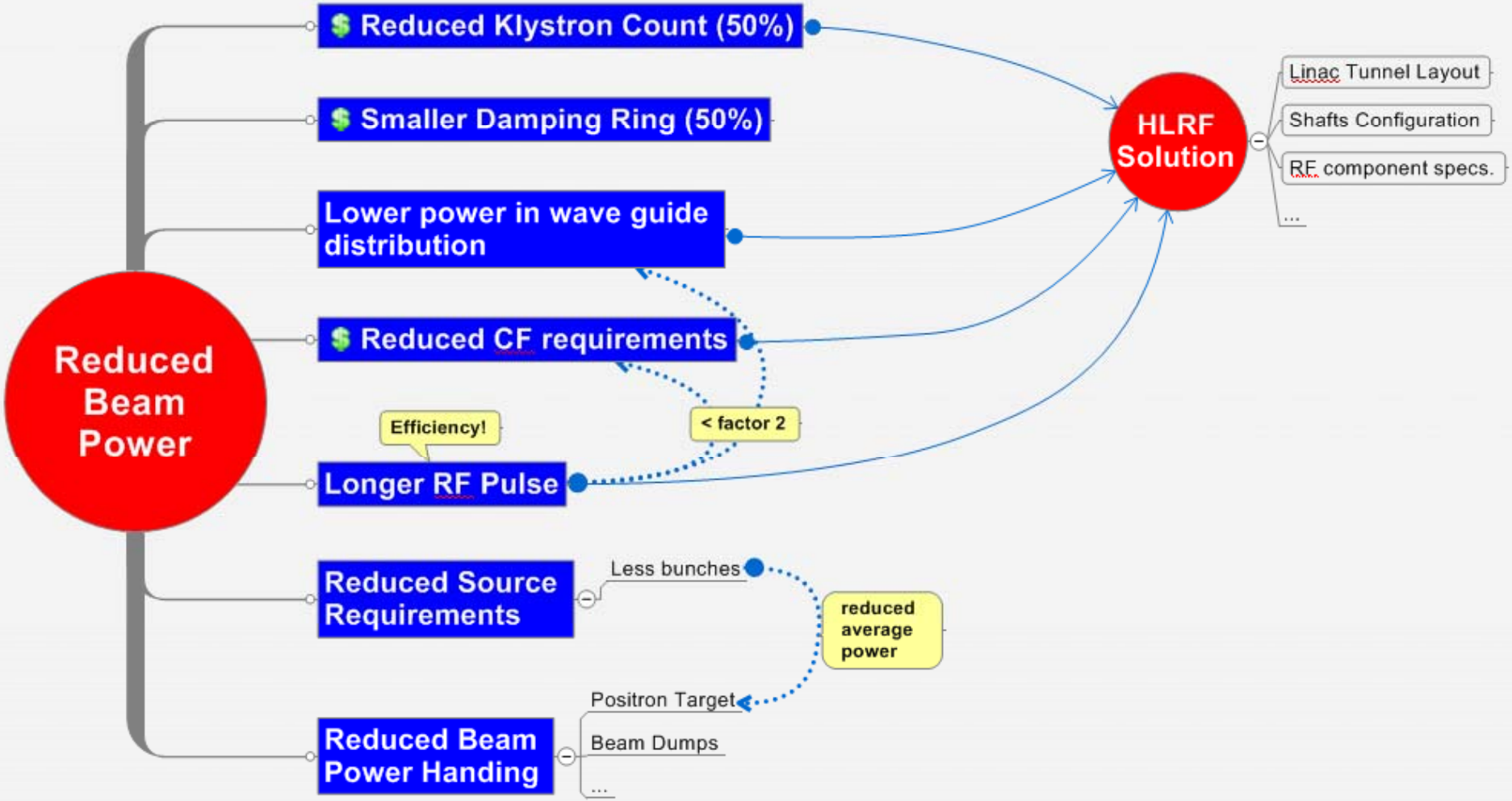
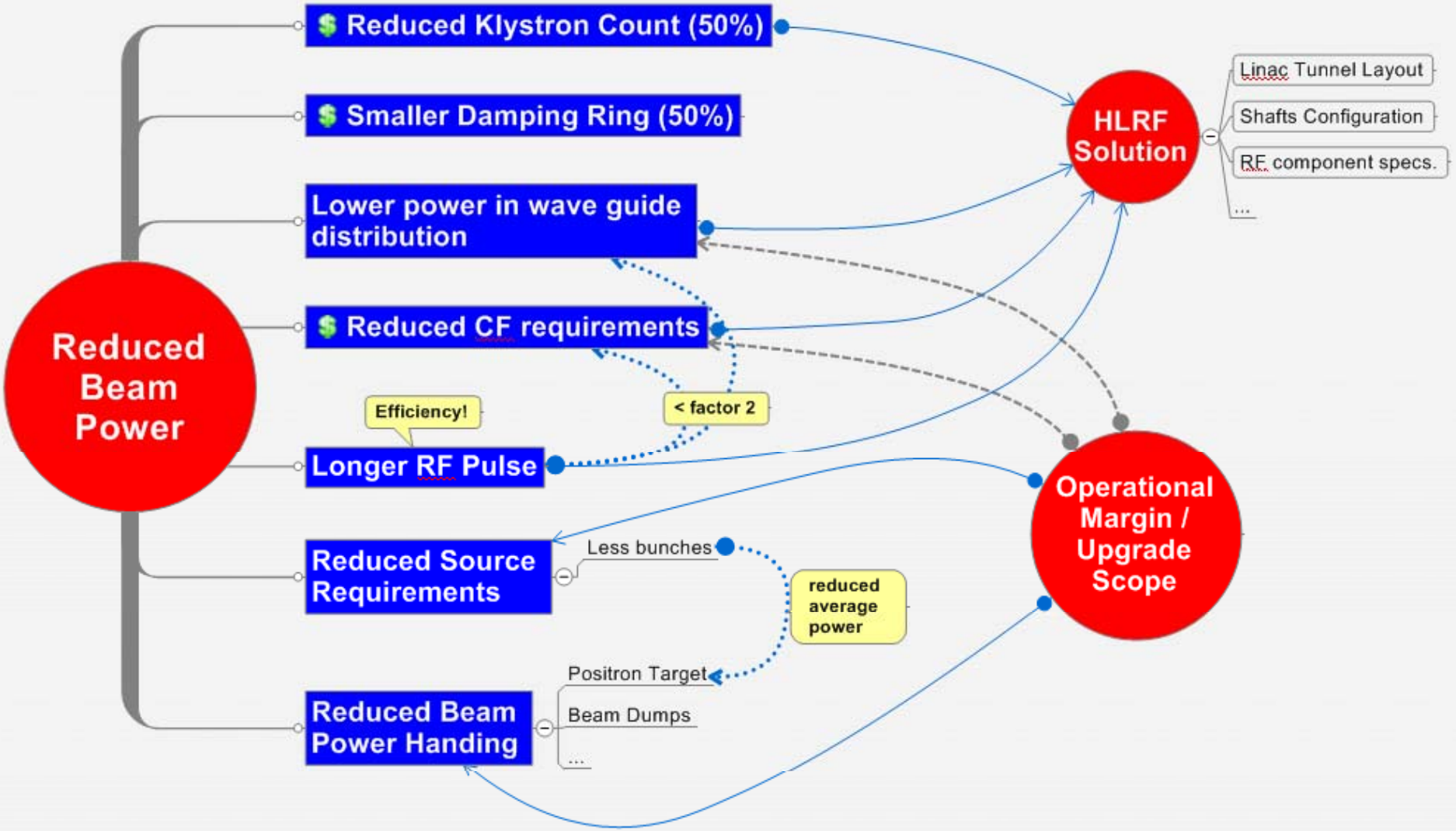


Reduced Beam Power



Upgrade Considerations: Energy

- Need to maintain RDR TeV Upgrade capability
  - i.e. build more linac
  - BDS geometry to support 500 GeV beam energy
  - Main (high-power dumps) rated for max. beam power
- Must consider impact on SB-009 of upgrade scenarios (compared to RDR)
  - Example: positron source

Upgrade Considerations: Luminosity

- Reduced power option opens up scope for Luminosity Upgrade
- i.e. putting back 50% missing klystrons and associated infrastructure
- Up to ×2 increase in L
- Impacts many systems.
- Various scenarios can be considered
  - Impacts on upfront cost saving
  - Should be part of our considerations but not the focus

CFS: Primary Cost Driver

- Assumed primary advantage of SB2009 options is reduced CFS scope
  - Underground tunnel / volume
  - Reduced cooling requirements
- Focus of 2009 activities is to assess impact on CFS solution
  - Removed, added, modified
  - Top-level catalogue (WBS-like list)
- Supplying CFS team with required information is primary focus for remainder of 2009
  - Towards baseline proposal
  - Important to establish methodology this meeting
- Example: Klystron Cluster concept evaluation…

KC: Scope & Approach

- Cost basis: Americas RDR Main Linac Estimate
- Included site-independent WBS sections
  - Electrical, Safety, Handling Equipment, and Survey and Alignment
- The RDR unit costs used (differential cost)
- Some RDR issues where resolved in estimate:
  - An overestimate of the shaft cavern volumes were corrected.
  - The corrected numbers were used in the cost comparison .

Major Civil Changes

- **Eliminated Service Tunnel**
- **Reduced caverns volumes by 25%**
  - comparison made using a corrected excavated volume for caverns

- **Added four; 3 meter diameter shafts**
- **Added four (4) sites locations (Utilities, fencing, etc.)**
- **Added eight (8) full and 2 half buildings for housing KLY Cluster and rack equipment.**
- **Maintained 4.5 meter tunnel diameter for beam tunnel**
- **Added 28 Refuge Areas**

Civil Engineering costs reduced by 28%

Air Treatment & Processed Water

- **Eliminated tunnel fan coils**
- **Eliminated chilled water**
- **Eliminated tunnel LCW Skids**

Process water **reduced** by 54%

Air treatments **increased** by 25%

- ✚ **Added HVAC for the 4 additional shafts**
- ✚ **Added cooling for the KLY cluster at the surface**
- ✚ **Reduced diameter of tunnel process piping but used thin schedule stainless to distribute clean water**

Other Considerations

- **Electrical reduced by 25%**
  - **Judgment used, we reasoned that the electrical distribution reduced with the KLY cluster scheme; plus the elimination of Service Tunnel electrical distribution**
- **Piped Utilities increased by 370% due to automatic fire suppression in Beam Tunnel**
  - **NFPA 520 requires for single tunnel**
- **Reduced Safety Equipment by 20%**
  - **Eliminate potable fire suppression units.**

Scope of Work (2009)

- Interference / Integration
  - Lattice layouts
  - Tunnel cross-section models (CAD)
  - (Installation related)
  - Component placement *etc*
- Operations, Commissioning, Availability
  - Less independent machine operation
  - Reliability issues (accessibility)
  - Commissioning strategies *etc.*
- Hardware development, R&D
  - High-power RF distribution concept
  - Marx modulator (on-going)
  - Increased RF pulse length (low-P)
- Beam Dynamics
  - Emittance preservation
  - BDS tuning
  - Travelling focus ‘stability’
  - …

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Requires CAD (CFS) engineer(s), **Lattice/optics layouts** (accelerator physics) expert(s). Look for a (conceptual) engineering solution.
3D CAD visualisation Team

Cut & Paste RDR lattices (as best we can)

Installation issues: conceptual solutions identified. Impact on CFS. (Task Force)

Primary focus on **Central Region Integration**

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Much more difficult to quantify.
Looks for experienced experts
Brainstorm qualitative concepts (solutions)

Task Force (3-4 people)

Quantify using AVAILSIM

List of well-defined studies for ALCPG.

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On-going: not focus of this meeting

- Beam Dynamics
  - Emittance preservation
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  - …

Generate list of specific well-defined studies for ALCPG

The Relevance of R&D

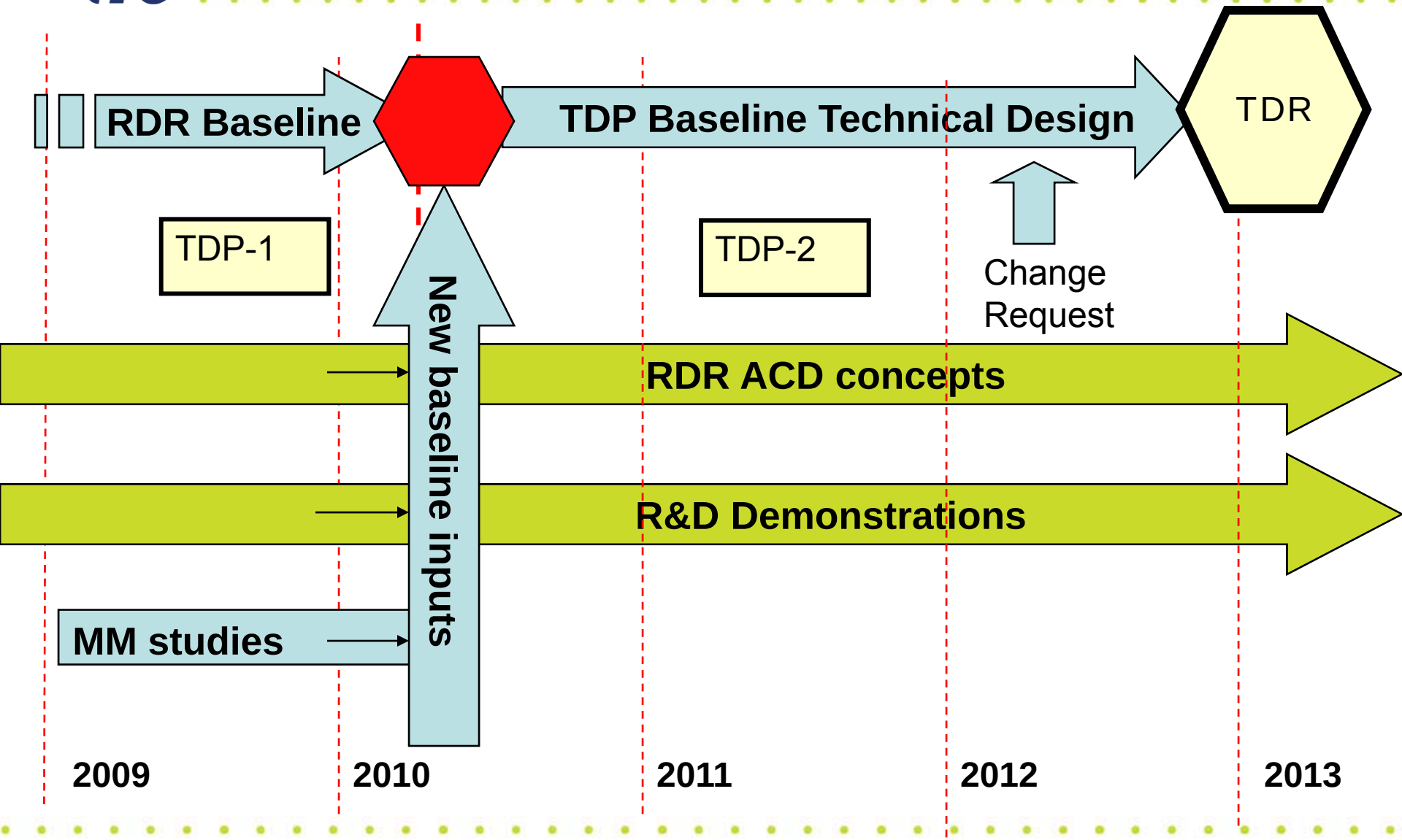
- **Not the primary topic for this meeting**
  - But status and plans need to be considered
- Criticality of required R&D clearly must be taken into account
  - Within scope of this meeting, should be reflected in **Risk Register**
- Clear delineation required between “Proof of Principle” and “R&D that needs to be done, but has acceptable risk”
  - Refining rankings in Risk Register
- Cost impact is important component in this context.

RDR Guidance for Baseline Definition

Baseline: a forward looking configuration which we are reasonably confident can achieve the required performance *and* can be used to give a reasonably accurate cost estimate by mid-end 2012 (→ TDR)

Alternate: A technology or concept which may provide a significant cost reduction, increase in performance (or both), but which will not be mature enough to be considered baseline by mid-end 2012

Technical Design Phase and Beyond



Summary

- This meeting
  - Agree on updated risk register for RDR and SB2009
  - Generate ‘chart’ of pros & cons wrt to RDR
  - Work through SB-2009 system-wise and highlight issues and questions
  - Answer as many as we can (**Working Assumptions**), catalogue prioritise others.

- Action items for ALCPG
  - List of to-do’s (names attached) for ALCPG
  - Critical: Plan to supply CFS with required information
    - Removed / added / changed

- Focus on technical solutions and issues for proposed SB2009
  - Begin to prepare discussions of merit and worth for ALCPG

- Be realistic about scope of what we can do
  - Resources.