



Minimum Machine Definition: Next Steps

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AS TAG leaders meeting
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Basic Philosophy Revisited

- **Minimum Machine concept is about Possible Cost Reduction**
 - Focus for machine design activities in TDP-1
 - Complimentary to on-going R&D activities
 - As defined in R&D Plan
- **The Minimum Machine should represent reduced cost alternative to the current RDR Baseline**
 - CFS is primary focus (identified RDR cost driver)
 - Aggressive use of systems integration leading to reduce underground volume (∴ cost)
 - Less conservative approach to specific sub-systems
 - e.g. water cooling.
 - Other – potentially novel – ideas for cost reduction
 - e.g. HLRF distribution system
- **Minimum Machine must be defined by end of ILC08**
 - Basic layout and design decisions
 - List of questions to be addressed
 - Plans for further studies in 09
- **Note these activities are somewhat parallel to the more basic activities into looking for cheaper solutions to specific problems (e.g. vacuum, PS distribution).**
 - strongly encouraged!
- **Conclusions to be reviewed beginning on 2010 for formal re-baseline of ILC**



State of Current Discussions

- **Central campus integration (CCI)**

- Inclusion of e+ and e- source systems into upstream sections of BDS (downstream of main linacs)
- KAS replaced by 'minimal' e+ auxiliary source in same tunnel
- (DR in same plane but horizontally displaced to avoid IR hall)

- **BDS (specific)**

- Minimum 500 GeV lattice (no upgrade support)

- **RTML**

- Single stage factor 20 compressor

- **Main Linac**

- Single tunnel solution
- Use of novel HLRF distribution system
- Marx modulator
- Specification for water cooling and power distribution

- **Other?**

Focus of discussions (to date)
within this group
(Paterson/Walker)

Issues for discussion with ML
Tech. and CFS/Global
(Ross/Yamamoto)



Known Issues (Questions for 09)

- **Does it fit?**
 - General issue for CCI.
 - Basic assumption is integration will lead to reduced underground volume and reduced cost
 - Engineering solution (albeit conceptual) needed to justify this
 - questions like “will it fit in a 4.5m tunnel” is something to be worked on. Assume it can and look for solutions!
 - If necessary, allow tunnel diameter to increase (but cautiously).
- **Impact on installation and commissioning**
 - Again, make basic assumption and look for cost-effective solution.
 - Look for installation/construction strategies that will support early commissioning of injectors
 - Estimate impact on time to commission etc.
- **Impact on operationals**
 - Sketch our possible PPS zoning *within basic layout assumption* and work through scenarios.
 - Catalogue reduced access possibilities (wrt to RDR baseline) and discuss impact
 - (Can we quantify such things with a Himel-like approach?)
- **Proof of principle R&D, etc.**
 - More specific to Main Linac systems (e.g. HLRF distribution, Marx)

understand what can be done with proposed cost-reduced layout, rather than allow pre-conceived (and potentially unjustified) requirements drive the design.



Issues pertaining to Physics Scope

- **Cost reduction strategy first presented at Sendai (later re-stated at Dubna). Two 'steps' outlined (→ as sold to the detector community):**
 1. Reduce the cost of the machine but maintain the RDR physics scope (→ minimum machine)
 - primarily CFS focused via discussions of machine layout
 2. About above 'working point', quantify cost of performance
 - so-called performance derivatives
- **(1) and (2) can proceed in parallel (resource permitting), but initial focus should be (1)**
- **e+ source integration does not strictly adhere to (1)**
 - Lower energy luminosity running will be compromised
 - Needs to be quantified for pending discussions with WWS
- **Single-stage compressors 'reduces parameter plane'**
 - and has impact on 'low-power-like' options (see later)
- **Impact on TeV upgrade should be documented**
 - There should be no technical show-stoppers!
 - (Is cost a show stopper? – rhetorical question!)
 - (Do we need to do more within the scope of the MM studies for 09?)
- **3km ring (reduced # bunches) discussions: is this part of (1) or (2)?... (see next slides)**



Example scenarios: reduced n_b by $\div 2$

Step	Comment	Recoverable
Remove ~50% klystrons and modulators	RDR-like RF unit now ~6 CM [Proposed novel HLRF distribution system becomes easier]	YES – can install missing klystrons/modulators over time
Minimum conventional support for reduced RF station count, + injectors, dumps <i>etc</i>	Install only water cooling and power for reduced set	YES but harder. Additional water cooling etc also required. Scope of upgrade becomes larger
Minimum civil construction for reduced set	Do not leave ‘extra space’ for Klystrons, modulators and associated conventional facilities.	Not possible to upgrade without major C.E. works
Reduced RF power in DR	Half current = half power	YES
Remove CFS support for above	As above for ML	Major hurdles
Go to 3km ring	True minimum solution	Very difficult to recover/upgrade

Example of the types of ‘scenarios’ that can be considered.

Cost saving ranges from 150 MILCU to possibly ½ BILCU, but ‘recoverability’ scales inversely

Other implications need discussion (impact on energy-upgrade for example)



Reduced n_b : impact on physics?

- **Zeroth-order approach: 50% loss of luminosity**
 - Certainly the easiest option.
 - Clearly belongs to step (2)
- **Recover lumi by pushing IR parameters** (→ Ewan's presentation)
 - Complete or partially recover? (step 1 or 2 or in-between?)
 - Increase in beamstrahlung / backgrounds
 - Need for a two stage compressor?
 - 200 micron needed elsewhere in parameter plane – impact of single-stage option requires study.
 - Need for concepts such as travelling focus?
 - General increased risk of achieving published peak luminosity
 - Compromised “area” of published RDR parameter plane
- **Bottom line: potential cost savings too large to ignore, and studies should be pursued in parallel**
 - include the scenario(s) in our ILC08 report



Minimum Machine Report Outline

1. Introduction

- rationale, scope of document etc.

2. Minimum Machine Layout

- textual description of assumed machine layout
- Including sketches, tables of parameters (where applicable) etc.
- Working assumptions (mostly for linac)
- Options and alternatives can be included
 - But will ultimately depend on our resource situation

3. Comparison to RDR baseline

- Critical comparison which focuses on the identified areas of increased risk and performance reduction.
 - Either sub-section across Accelerator Systems, or
 - sub-section across “themes”:
 - Installation, commissioning, availability, luminosity performance (parameter plane etc.)

4. Low-Power Option (reduced *nb*)

- Technical arguments and possible cost savings. Physics impact should be dealt with below.

5. Potential Impact on Physics Scope (including TeV upgrade)

- A single section that covers all potential impact on physics scope (including the low-power option stuff)
- This section will be scrutinized by WWS! Keep it short and factual.

6. Potential Cost Impact (rough initial estimates; under discussion – policy decision)

- Rough initial guestimates of possible savings
- Sensitive: needs further discussion (EC)

7. Further studies and required resources

- Outlining of plans for 09 to address
 - layout and design issues, allowing for a better cost saving estimate
 - studies specifically aimed at quantifying (solving) questions and issues raised in the previous sections

A very first draft!

Clearly expected to be qualitative rather than quantitative

Not much detail

Relatively terse, but enough information to define 09 studies

Note: minimum machine definition to be discussed at KEK EC meeting 5-6.09



Next steps (tbc)

				Deadline	Responsible
August	22.08.2008	AS TAG			
	29.08.2008			Finalised draft outline of report - action items for TAG leaders	EJP/NW/MCR/AY
September	05.09.2008 - 06.09.2008		EC F2F (KEK)	Presentation of MM machine proposal	PM(NW)
	12.09.2008				
	19.09.2008	AS TAG		First draft of selected sections (MM description), ready for feedback/discussion	EJP/NW/...
	26.09.2008				
October	03.10.2008				
	10.10.2008				
	17.10.2008	AS TAG	CLIC workshop	Reports from AS TAG action items, iteration of existing sections	
	18.10.2008 - 20.10.2008		PAC (Paris)		
	24.10.2008				
	31.10.2008				
November	07.11.2008				
	14.11.2008	AS TAG		draft - ready for discussion at ILC08	
	17.11.2008 - 21.11.2008		ILC08 (Chicago)	During ILC08, 09 studies should be developed and prioritised. Necessary resources identified etc. This will form the basis of 'planning' section of report.	
	12.12.2008	AS TAG		Final complete draft - submission to EC	
	19.12.2008			Publish report.	



Comments and Suggestions to Ewan and Nick

(Comments on outline by end of next
week)

It is important to communicate between
our WebEx meetings!