no-cost version

SB2009 Cost Differential Impacts

confidential cost info has been removed for posting

I've provide password protected link for CMG:

https://www-ilcdcb.fnal.gov/estimates/PHG-SB2009_Cost_Impact_DESY_3dec09.ppt

purpose:
not to generate a new ILC estimate,
but to support SB2009 decisions

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What can we learn from RDR?

- Looking at the 2-dimentional matrix of Area Systems vs. Technical/Global System fractions, one can easily estimate the cost savings by going to a single tunnel configuration for ML or by reducing the circumference of the DR tunnels by a factor of 2. It is also evident that the largest leverage is in ML energy and Low Power options. Another important thing to note is that the total ML cost is still only $\leq$ 60% of the total ILC cost

Consistency

- Apples-to-apples comparisons
- Correct (or at least compensate) for errors or omissions
- I'll try to say what was done at each stage
- Starting points:
  - RDR CFS drawings: Jean-Luc Baldy – 5dec06
  - RDR CFS estimates: 30march07 & backup
  - Area/Technical/Global estimates: 2007
  - SB2009 CFS drawings: 20nov09
  - SB2009 ***Americas*** CFS estimates: 20nov09
  - Revised Area/Technical/Global ests: Oct-Nov09 consistent with 2009 CFS drawings

What do I do about:

- Inconsistencies with drawings, estimates, RDR?
  Must do corrections by hand!
- Factorization and independence:

  RTML 1 stage BC is independent of other stuff

  6.7 => 6.4 => 3.2 km DR interacts with e+ source transfer line, RTML lines, does it affect length of RDR's e- and e+ source tunnels?
  DR length does STRONGLY affect e+ timing drift!
- e+ flux concentrator => QWT affects # undulators,
  dE(undulator) => e- ML length, and
  length of e- RTML

Start listings

- RDR => Amercias CF&S RDR estimate
- Correct Americas CFS for caverns, floors, engineering
- Value Engineering for higher dT Cooling (ML only)
  should we add ~ 4% extra savings for RTML?
- Sendai: 6.7 km Hexagonal DR => 6.4 km Racetrack DR
  - Need revised magnet counts (asked Susanna)

  the shorter bunch length from Racetrack DR enables:
- Sendai: 1-stage Bunch Compressor for RTML
  - Need extra transport to intersect 6.4 km DR & e+ Src
  - These should probably be charged against DR
  - Can 90-deg tunnels exit BDS anywhere? Constraints?
- I take Sendai decisions as given, not for SB2009 debate

Positron Timing Drift

- Not included for RDR estimate
- Tomski calculated 416 m for SB2009 without any energy margin for reliability – included in SB2009 CFS drawings (30nov09 – Tom says closer to 460 m – PHG calculated 450 m)
- Interacts with length of e+ RTML
- Length could be shared with energy margin on e+ side

Central Region Integration

- Besides reduced tunnels vs. more widenings:
- Main issue is moving undulator positron source to 250 GeV end of e- ML (recent N. Collomb info)
  => hot-button for Experimenters!
- The following were described in RDR & associated discussions but were ***not*** included in RDR estimate:
  - Energy measurement chicane DS of e- ML 150
  - MPS for undulator
  - 150 GeV e- bypass around undulator (necessary?)
  - 150 GeV e- dogleg back to bypassed line (necessary?)
- SB2009: flux concentrator => QWT - many impacts
  - dE(undulator) to CFS – 3.0 or 4.9 GeV? & RTML length

for either RDR or SB2009

Replace Bouncer Modulator by Marx Modulator for either RDR or Klystron Cluster @30% savings

RDR	-$ yyy M	- z.z%
Klystron Cluster	-$ yyy M	-z.z%
Klystron Cluster Low P	-$ yyy M	-z.z%

w-costs-SB2009-display_phg_29nov09.doc you pick however you want to compare!

$ 6,618 M – RDR estimate – 3 regional estimates

\/

$ 6,677 M – RDR with Americas Regional CFS estimate

\/ - $ yy M correction for shaft base cavern volumes, RTML invert floor, and

\/ outsourced civil engineering

$ x,xxx M

\/ - $ yy M Value Engineering for higher dT Cooling Water for ML only

\/ (mult by 1.04 for RTML 5-15 GeV)

$ x,xxx M

\/ + $ yy M = 6.7 km hexagonal DR => 6.4 racetrack DR

\/ **need updated magnet counts from Susanna**

$ x,xxx M

\/ - $ yy M – 1 stage Bunch Compressor for RTML (enabled by racetrack DR)

$ x,xxx M

\/ - $ yy M – remove 2*394 m empty tunnel for energy margin

\/ (actually 4*394 for beam & service tunnels)

$ x,xxx M = “starting point” for SB2009 considerations, no extra tunnel for e+ timing, dE(undulator) = 3 GeV

continue SB2009 impacts

RDR	Klystron Cluster	Klys Clus Low P	DRFS	DRFS Low P
6.4 km DR	6.4 km DR	6.4 km DR	6.4 km DR	6.4 km DR

2dec – Chris Nantista – added extra klystrons to account for attenuation & redundancy

dE = 3	dE = 3	dE = 3	dE = 3	dE = 3
\/	\/	incl. travelling focus	\/	incl. traveling focus
$ x,xxx M	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)
\/	3.2 km DR	3.2 km DR	3.2 km DR	3.2 KM DR
\/	w traveling focus	(have trav foc)	w traveling focus	(have trav foc)
\/	**need updated magnet counts from Susanna**			
$ x,xxx M	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)
\/	add Central Injector Complex with OMD Flux Concentrator			
\/	(dE = 3 GeV) => QWT (dE = 4.9 GeV) (+13)			
$ x,xxx M	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)	$ x,xxx M (-yyy)
starting pt.	-z.z%	-z.z%	-z.z%	-z.z%

\/ add Energy Margin – get to Tom Himel's blue line – for all configurations, incl RDR & RTML

3.5 % (+yyy)	3.5 % (+yyy)	3.5 % (+yyy)	5.0 % (+yyy)	5.0% (+yyy)
$ x,xxx M	$ x,xxx M	$ x,xxx M	$ x,xxx M	$ x,xxx M
+ z.z %	-z.z %	-z.z %	-z.z %	-z.z %

SB2009 “updates” to RDR

$ x,xxx M - RDR
starting point

$ x,xxx M - 3.2 km DR
& traveling focus (-yyy)
$ x,xxx M - Central complex
with dE = 9 GeV (-yyy)
-z.z%
$ x,xxx M – add 3.5 % margin (+yyy)
-z.z%

RDR Low P
$ x,xxx M -remove ½ Klystrons & Modulators
but remember Learning Curve(+12%) and
longer modulator pulse (+21%) (-yyy net)
$ x,xxx M - add traveling focus (+yy)
$ x,xxx M - 3.2 km DR (-yyy)

$ x,xxx M - Central complex
with dE = 9 GeV (-yyy)
-z.z%
$ x,xxx M - add 3.5 % energy margin (+yyy)
-z.z%

tunnel lengths & excavation volumes

For Central Complex Integration only.
This includes: e- Source, e+ Source, DR, BDS

Configuration	RDR	SB2009	Difference
Tunnel length	15.7 km	11.7 km	4.0 km
Excavation vol.	28.1 km^3	25.3 km^3	2.8 km^3

Neither the RDR nor the SB2009 include positron timing drift or empty tunnel for energy margin. Also the underground “hot cell” caverns for undulator & KAS targets were removed for RDR