



RDR Estimates for the Damping Rings

no-cost version for posting

as of June 1, 2007

further developments are not included

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Fermilab

November 5, 2007

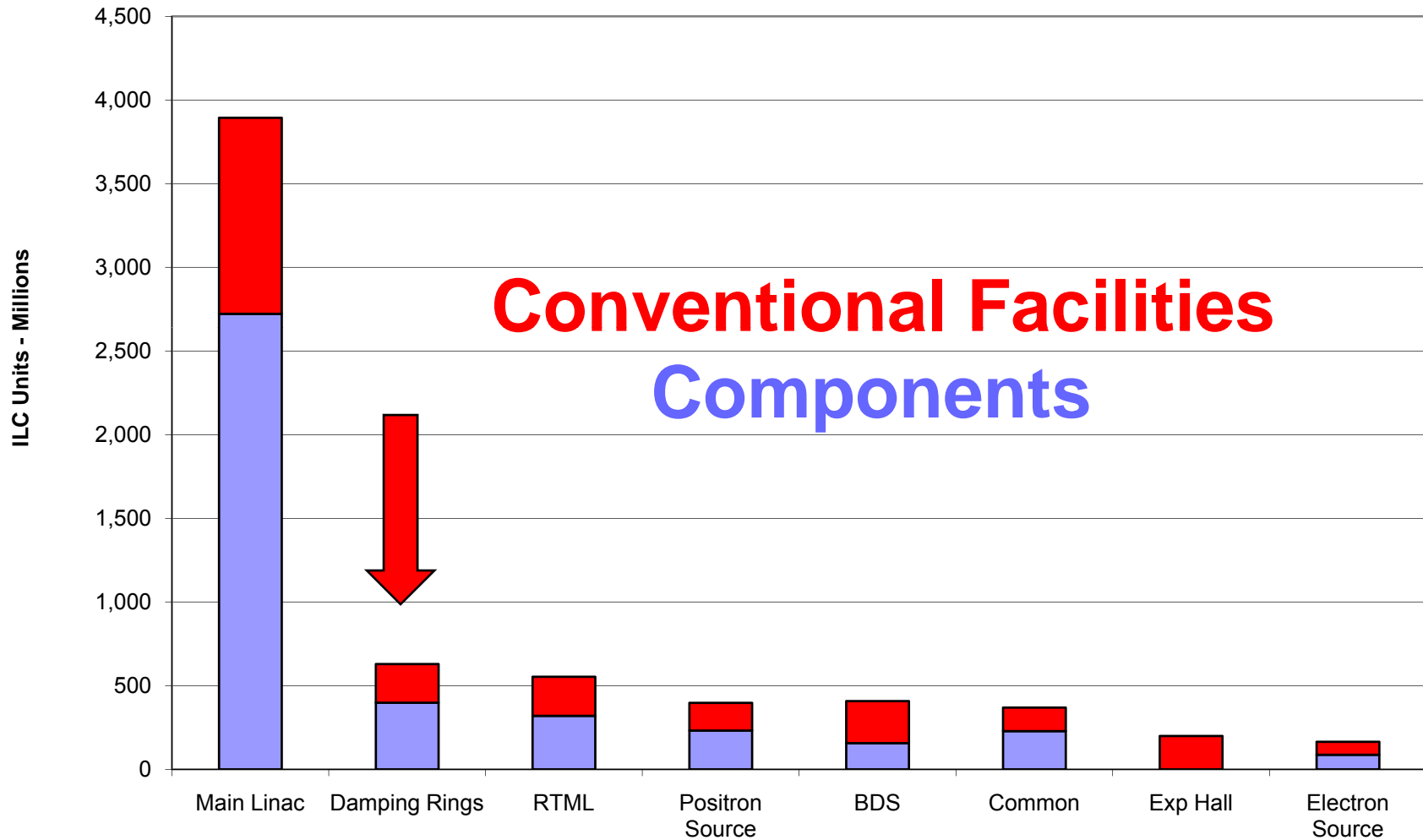


Contents & Preamble

- Estimate information in the **RDR => PUBLIC**
- Est. **details** provided by Global & Technical Sys groups => **Confidential**
- Confidentiality Pledge – for “review access” – this meeting only, **don't post!**
- Presentation: Estimates => RDR => Damping Rings => GS & TS details
- ILC Value Unit = \$ 1 in 2007 – Explicit Labor in units of K person-hours
- Estimates delivered in 2006 \$, €, ¥ => translated & escalated to 2007 \$
- Construction costs only, **no** R&D, pre-construction, commissioning, ops
- **Used the CF&S and Cryogenics group estimates, rather than DR's**
- Estimate does **not** include contingency or escalation to construction year
- Damping Rings in 2007 \$, avg DR escalation (2006 => 2007) = **3.7 %**
- Will show Global and Technical System estimate details in 2006 \$,
since that's the way estimates were sent, allow easy comparison
- DR total: **630 M ILCU ± 94 M ILCU ± 15% = ± 1σ (RMS)**
- DR avg CFS: **231 M ILCU ± 36 M ILCU ± 16%** **these # are**
- DR non-CFS: **398 M ILCU ± 58 M ILCU ± 15%** **from RDR**

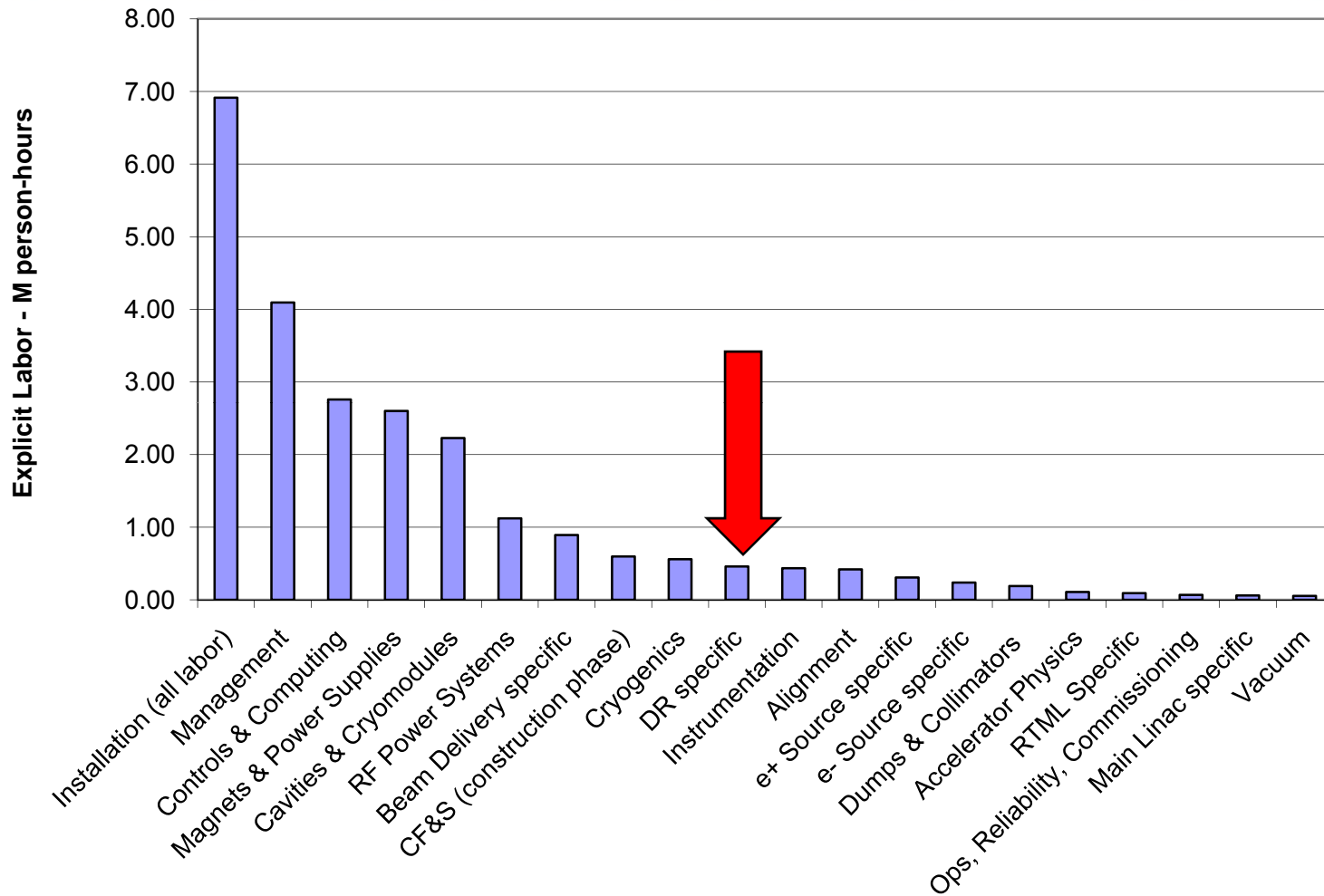


Total ILC Value Estimate = **6.62 B ILCU (2007)**





Total Explicit Labor Est. = **24.2 M** person-hrs





first page of DR estimate spreadsheet

Baseline Configuration:				US\$/US\$	1.00							
			1 x 6.7 km electron ring	US\$/Euro€	1.20							
			1 x 6.7 km positron ring	US\$/GB£	1.85							
			Both rings in a single (central) tunnel, with two shafts/main alcoves	US\$/JP¥	0.0086							
			24 MV RF for 9 mm bunch length	US\$/RMB	0.1250							
			OCS 6 lattice					Cost	Level 4 Subtotal	Level 3 Subtotal	Level 2 Subtotal	
1			Version: 20 April 2007	Quantity	Units	Unit Cost	Currency	Escalation	2007 US k\$	2007 US k\$	2007 US k\$	2007 US k\$
1	2		Damping Rings									
1	2	1	Electron Damping Ring Injection Line									
1	2	1	Vacuum system									
1	2	1	1 Arcs standard chamber	0	10 m sec		1.20	1.0200				
1	2	1	2 Straights standard chamber	3	10 m sec		1.20	1.0200				
1	2	1	3 Arcs/straights flange joint + fixing	3	flange joi		1.20	1.0200				
1	2	1	4 Arcs/straights heater wrapping	0	heater wr		1.20	1.0200				
1	2	1	5 Arcs/straight pumping chamber	3	pumping		1.20	1.0200				
1	2	1	6 Roughing carts	1	carts		1.20	1.0200				
1	2	1	7 Ion pumps	3	pumps		1.20	1.0200				
1	2	1	8 Ion pump controllers	2	pump cor		1.20	1.0200				
1	2	1	9 Pirani gauges	1	gauges		1.20	1.0200				
1	2	1	10 NEG coating license	0	license		1.20	1.0200				
1	2	1	11 NEG coating rig	0	rig		1.20	1.0200				
1	2	1	12 Arc/Straights Gate Valves	2	valves		1.20	1.0200				
1	2	1	13 Roughing valves	2	valves		1.20	1.0200				
1	2	1	14 Cabling and connectors	1	lot		1.20	1.0200				
1	2	1	15 Miscellaneous items	1	lot		1.20	1.0200				
1	2	1	2 Magnets and magnet supports									
1	2	1	1 Dipoles (6 m)	0	6 m dipok		1.00	1.0000				
1	2	1	2 Dipoles (RTML6 type)	1	dipole		1.00	1.0000				
1	2	1	3 Dipoles tooling/construction	0	unit		1.00	1.0000				
1	2	1	4 Quadrupoles (variant 1)	0	quadrupo		1.00	1.0000				
1	2	1	5 Quadrupoles (variants 2,3,4)	6	quadrupo		1.00	1.0000				
1	2	1	6 Sextupoles	0	sextupole		1.00	1.0000				
1	2	1	7 Orbit correction magnets	0	magnets		1.00	1.0000				
1	2	1	8 Skew quadrupole magnets	0	magnets		1.00	1.0000				
1	2	1	9 Dipole supports (6 m)	0	supports		1.00	1.0000				
1	2	1	10 Dipoles supports (RTML6 type)	1	supports		1.00	1.0000				
1	2	1	11 Quadrupoles supports (variants 2,3,4)	6	supports		1.00	1.0000				
1	2	1	12 Quadrupole/Sextupole supports	0	supports		1.00	1.0000				
1	2	1	3 Magnet power supplies									
1	2	1	1 Dipole power supplies (275 kW)	1	power su		1.00	1.0323				
1	2	1	2 Quadrupole power supplies (0.2 kW)	6	power su		1.00	1.0323				
1	2	1	3 Orbit correction magnets power supplies (0.1 kW)	0	power su		1.00	1.0323				
1	2	1	4 Controllers etc.	1	lot		1.00	1.0323				



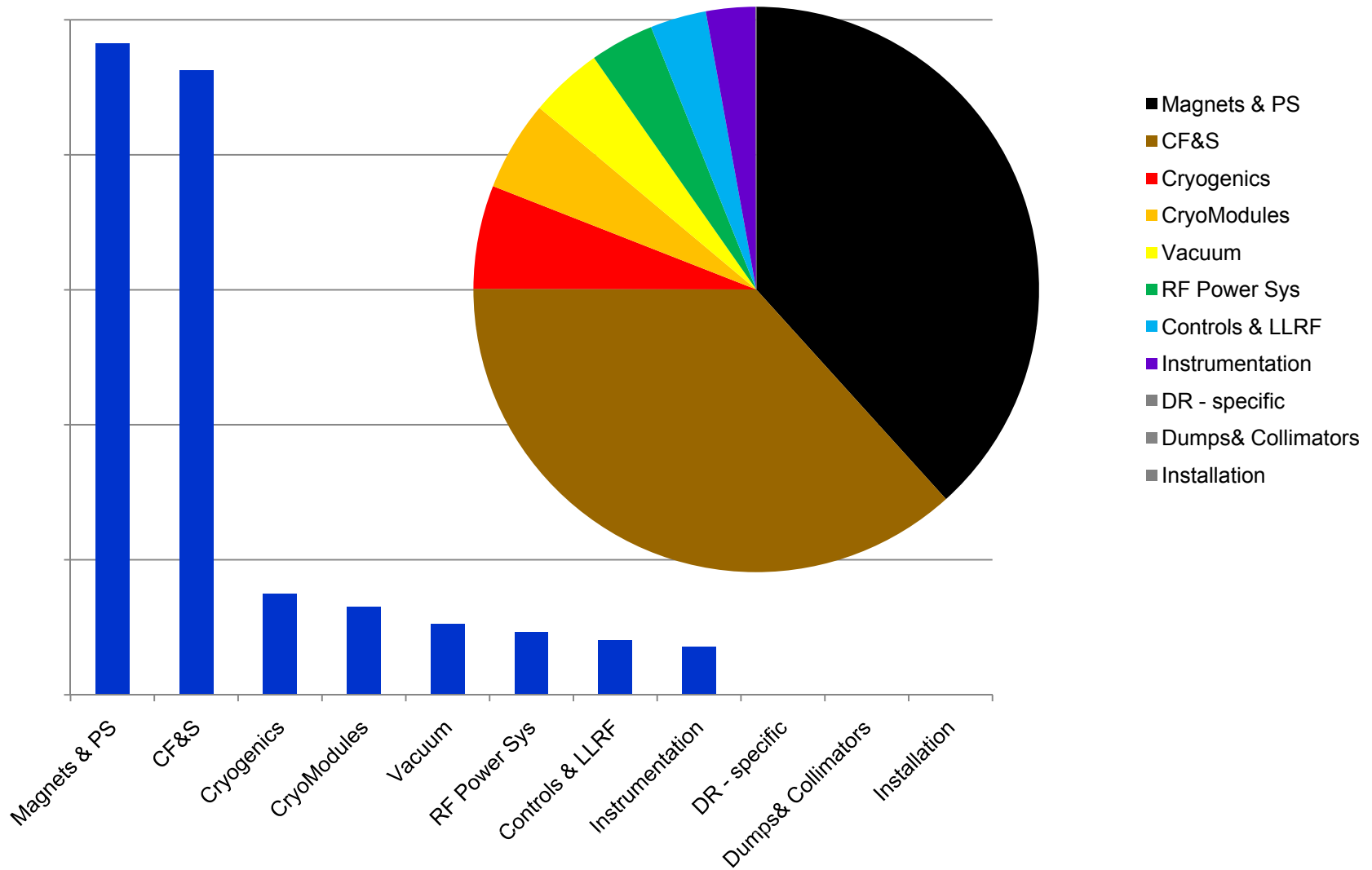
same showing references

		OCS 6 lattice		Quantity	Units	Cost Source	Date	Comments	Unit Cost	Currency	Escalation	Cost 2007 US k\$
		Version: 20 April 2007										
Damping Rings												
1	1	Electron Damping Ring Injection Line										
1	1	Vacuum system										
1	1	1	Arcs standard chamber	0	10 m section			none in beamline				
1	1	2	Straights standard chamber	3	10 m sec	EDR-VAC-chmb-002	12-Apr-07	scale to 30 m beamline length				
1	1	3	Arcs/straights flange joint + fixing	3	flange joint	EDR-VAC-flng-001	3-Jul-06					
1	1	4	Arcs/straights heater wrapping	0	heater wrappings			assume no bake-out				
1	1	5	Arcs/straight pumping chamber	3	pumping	EDR-VAC-pchm-001	3-Jul-06					
1	1	6	Roughing carts	1	carts	EDR-VAC-pmp-001	3-Jul-06					
1	1	7	Ion pumps	3	pumps	EDR-VAC-pmp-002	3-Jul-06	assume one pump every 10 m				
1	1	8	Ion pump controllers	2	pump con	EDR-VAC-ctrl-001	3-Jul-06					
1	1	9	Pirani gauges	1	gauges	EDR-VAC-gge-001	3-Jul-06					
1	1	10	NEG coating license	0	license			included under EDR Vacuum 1.2.2.1.10				
1	1	11	NEG coating rig	0	rig			included under EDR Vacuum 1.2.2.1.10				
1	1	12	Arc/Straights Gate Valves	2	valves	EDR-VAC-vlv-001	3-Jul-06	placeholder				
1	1	13	Roughing valves	2	valves	EDR-VAC-vlv-002	3-Jul-06	placeholder				
1	1	14	Cabling and connectors	1	lot		12-Apr-07	scale with beamline length from damping rings				
1	1	15	Miscellaneous items	1	lot		12-Apr-07	scale with beamline length from damping rings				
1	2	Magnets and magnet supports										
1	2	1	Dipoles (6 m)	0	6 m dipoles			none in beamline				
1	2	2	Dipoles (RTML6 type)	1	dipole	email M. Palmer	12-Apr-07					
1	2	3	Dipoles tooling/construction	0	unit			included under 1.2.2.2.3				
1	2	4	Quadrupoles (variant 1)	0	quadrupo	email M. Palmer	12-Apr-07	none in beamline				
1	2	5	Quadrupoles (variants 2,3,4)	6	quadrupo	email M. Palmer	12-Apr-07					
1	2	6	Sextupoles	0	sextupoles			none in beamline				
1	2	7	Orbit correction magnets	0	magnets	email M. Palmer	18-Dec-06					
1	2	8	Skew quadrupole magnets	0	magnets			none in beamline				
1	2	9	Dipole supports (6 m)	0	supports			none in beamline				
1	2	10	Dipoles supports (RTML6 type)	1	supports	email M. Palmer	12-Apr-07					
1	2	11	Quadrupoles supports (variants 2,3,4)	6	supports	EDR-SUPT-supt-003	20-Nov-06	supports EDRI and PDRX quadrupoles				
1	2	12	Quadrupole/Sextupole supports	0	supports			none in beamline				
1	3	Magnet power supplies										
1	3	1	Dipole power supplies (275 kW)	1	power su	email P. Bellomo	24-Dec-06	placeholder- needs update				
1	3	2	Quadrupole power supplies (0.2 kW)	6	power su	email P. Bellomo	24-Dec-06	placeholder				
1	3	3	Orbit correction magnets power supplies (0.1 kW)	0	power su	email P. Bellomo	24-Dec-06	placeholder				
1	3	4	Controllers etc.	1	lot	guess scaled with PS number	12-Apr-07	placeholder				

These data sheets are available on DR Wiki, without estimates.
How does Project Management Team get access w/estimates?



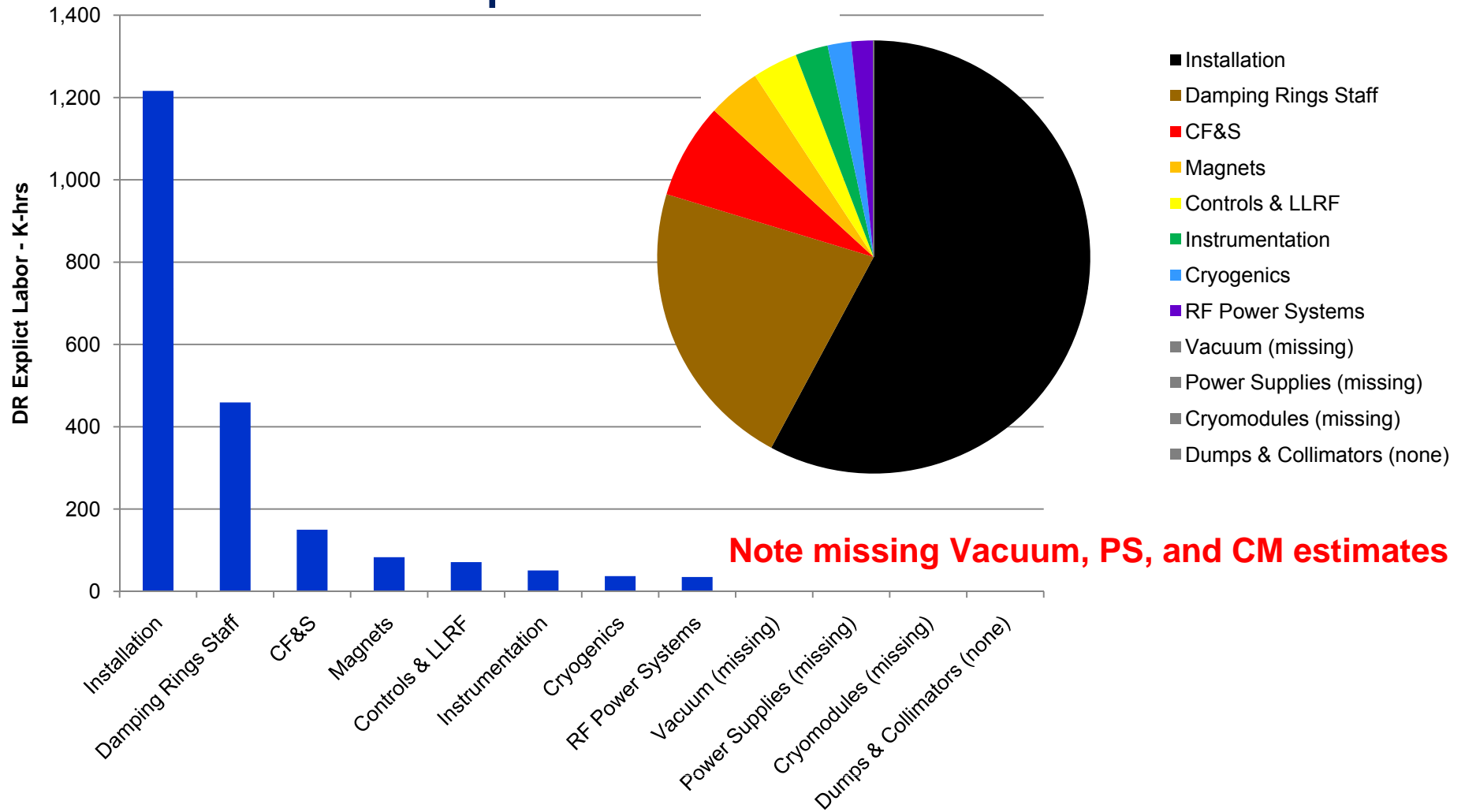
RDR Value for DRs = 630 M ILCUs





Damping Rings Explicit Labor

2.1 M person-hours = 8.7% of total





Notes on Damping Rings Value Est 2007

- CF&S: average over 3 regions **xxx M** details below
- Controls: RF ϕ dist (**xx M**) + FE (**xx M**) + LLRF (**xx M**)
- DR sheet adds: Fast Feedback (**xx M**) + LLRF (**xx M**)
Is this LLRF double counted?
- Installation: all costs are considered Labor (**1.2 M-hr**)
- Dumps & Collimators (**xx M**) only 2 uncooled blocks
- See details below for:

Instrumentation (**xx M**), Cryogenics (**xx M**)

Vacuum (**xx M**) – see DR sheet for details & refs

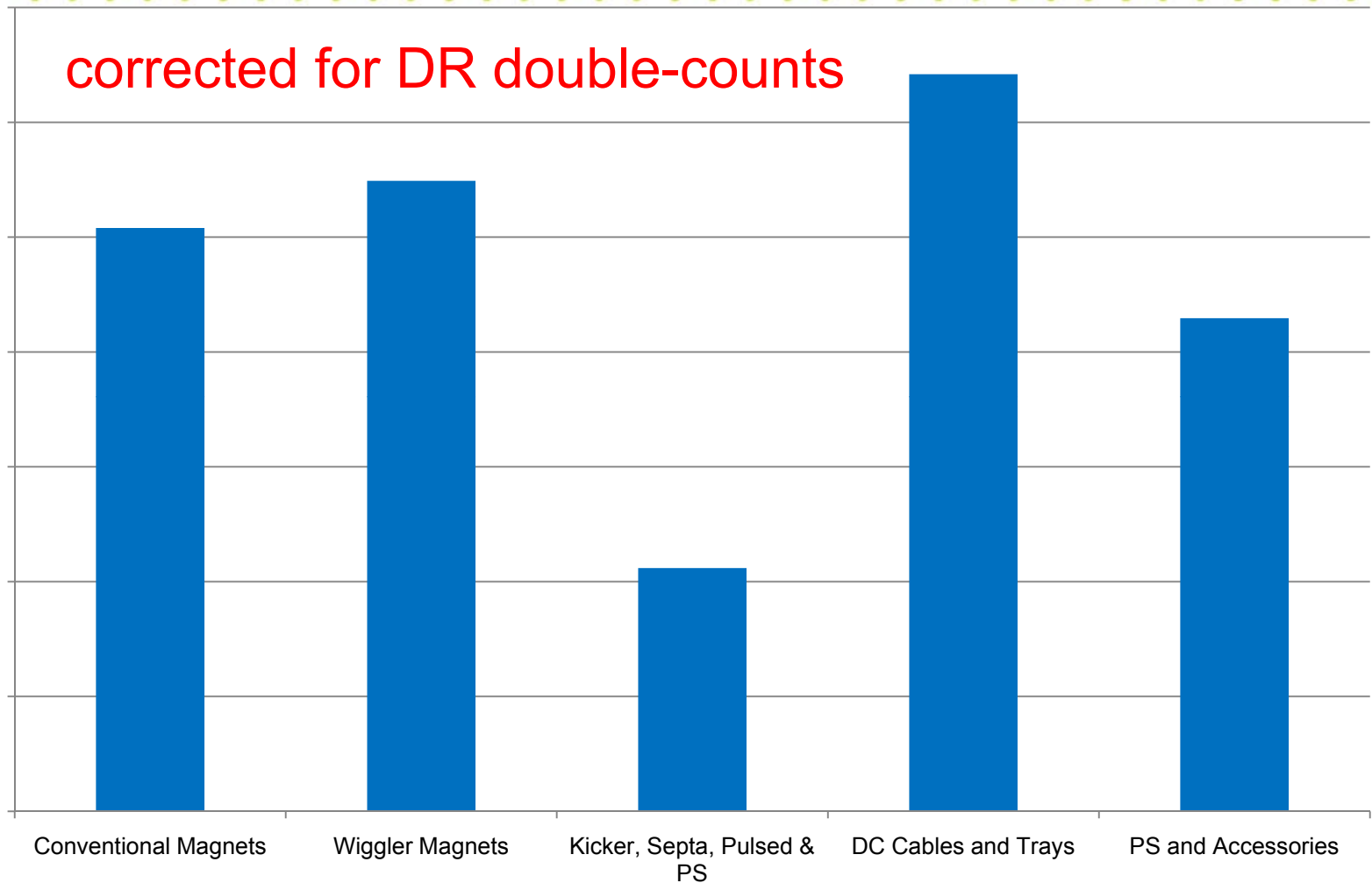
DR: Magnets (**~ xxx M**) & Power Supplies (**~xxx M**)

TS has: Magnets (**xxx M**), Power Supplies (**xxx M**)



Damping Ring Magnets & PS - xxx M ILCU (2007)

corrected for DR double-counts



Accessories include: controller, transducer, PLC, I&C Cables & Tray, IGBT, Heat Sink, Dump Resistor, Heater Firing Unit, Rack, AC Cable/Conduit



DR Magnets (xx M) – no EDIA

Magnet Cost Summary by Area System: uberSummary_allStyles_070502_v6.xls										
Magnet Engineering Name (Style)	Revised Count (070419, 070501)	Magnet Unit Cost	Number Req	Total Magnet Cost EDI Removed (070419)	Mover Unit Cost	No. Movers Req	Total Mover Cost	Stand Unit Cost	Total Stand Cost	Total Cost EDI removed (070419)
Damping Rings System Magnets										
<i>Damping Ring Conventional Magnets</i>										
D60L250	600		600							
D60L3000	24		24							
D60L6000	228		228							
D60L2000	6		16							
Q60L300V1	1102		1112							
Q60L300V2, V3, V4	416		534							
Q60L250	480		480							
SX60L250	960		1008							
<i>Damping Ring Wigglers</i>										
WG76L2500	160		160							
Damping Ring Magnet Total	3,976		4,162							
DC Magnets Totals	3,976		4,162			0	0			
Kicker, Septum, and Pulsed Magnets										
Magnet Engineering Name (Style)	Revised Count (070419)	Magnet Unit Cost	Number Req	Total Magnet Cost EDI Removed (070419)	Pulsar Cost	No. Pulsar Req	Total Pulsar Cost	Stand Unit Cost	Total Stand Cost	Total Cost EDI removed (070419)
Damping Rings Magnets										
Ring abort kicker	1		1			1				
Ring abort kicker	1		1			1				
Ring abort septum	1		1			1				
Ring abort septum	1		1			1				
Thick pulsed septum	2		2			2				
Thick pulsed septum	2		2			2				
Thin pulsed septum	2		2			2				
Thin pulsed septum	2		2			2				
Ultra-fast kicker	40		40			80				
Ultra-fast kicker	40		40			80				
Damping Rings Magnet Total	92		92			172				
Kicker, Septum, and Pulsed	92		92			172				
Overall Magnet Totals	4,068		4,254							



DR Power Supplies (xxx M)

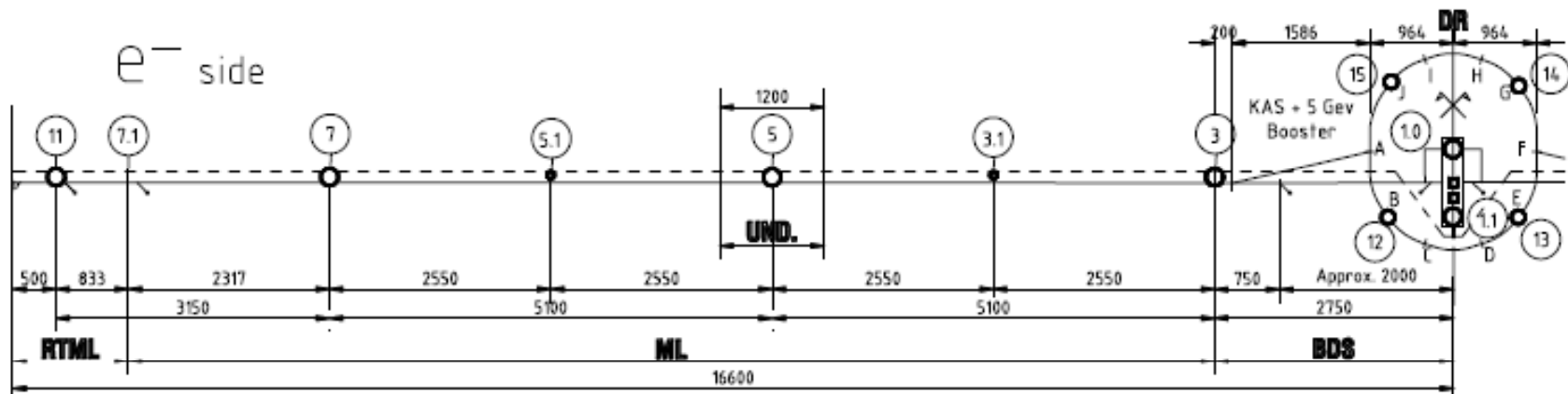
07-02-28 ILC Magnet Power Supply List.xls

Area	Se	Data	Sum of Power Supply Quantity	Sum of DC Cable Cost (k\$)	Sum of DC Power Cable Tray Cost (k\$)	Sum of PowerSupply Cost (k\$)	Sum of Controller Cost (k\$)	Sum of Transductor Cost (k\$)	Sum of PLC Cost (k\$)	Sum of 50m of I & C Cables and Cable Tray (k\$)	Sum of IGBT, Heatsink and Dump Resistor (k\$)	Sum of Heater Firing Unit (k\$)	Sum of FPGA PLC (k\$)	Sum of Rack and Accessories Cost (k\$)	Sum of AC Cable/Conduit Cost (k\$)	Sum of System M & S Cost (k\$)
Damping Ring			3,908													

3,908 PSs not including pulsed supplies

2006 estimate

much more data 7.5 MB available from Paul Bellomo's spreadsheets

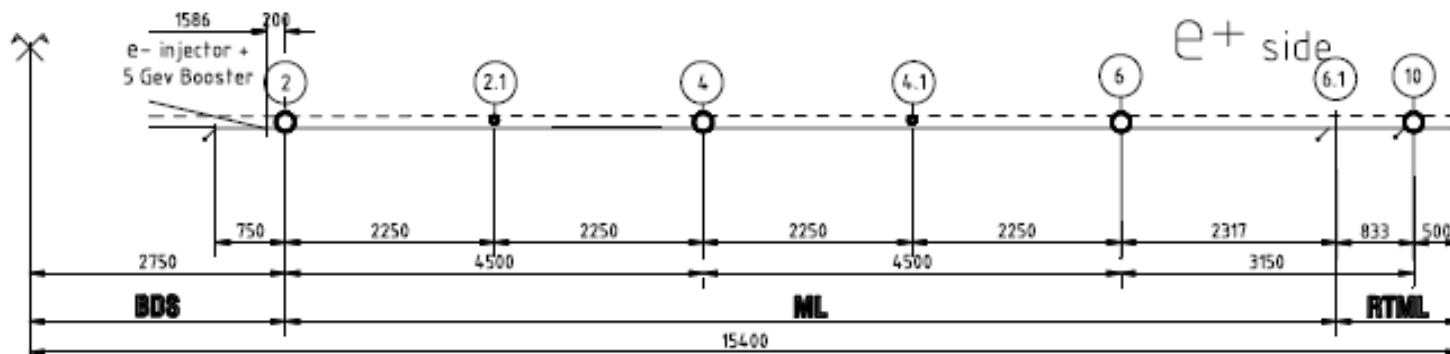


SITE / TUNNEL LENGTHS (m)

e- side ML + RTML	e+ side ML + RTML	BDS + DR + sources	TOTAL
13 850 / 27 700	12 650 / 25 300	5500 / 20 900	32 000 / 73 900

TUNNELS

Area	e- inject_KAS (beams)	DR	RTML beam + serv	ML beam + serv	BDS beam + serv	BDS Survey
φm	4.5 + cavern	4.0	4.5 + 4.75	4.5 + 4.75	4.5 + 4.75	1.5 x 2.2



SHAFTS

Point	1.0	1.1	2	3	4	5	6	7	10	11	12/B	13/E	14/G	15/J
φm	16	16	14	14	14	14	9	9	14	14	9	9	9	9

SURVEY BORINGS

Point	2.1, 3.1, 4.1, 5.1
φm	0.80

SHAFT BASE CAVERNS

Point	2, 3, 4, 5, 6, 7, 10, 11
(LxWxH) m	50 x 16 x 18 + 3 storeys

DR ALCOVES

Point	A, D, F, H	12, 13, 14, 15
(LxWxH) m	16 x 8 x 8	46 x 10.5 x 10 + 1 storey

DETECTORS HALL

Point	1.0, 1.1
(LxWxH) m	detector 110 x 25 x 35

MAIN BEAM DUMPS

Point (2x)	1.0, 1.1, 6.1, 7.1, 10, 11
	26 x 13 x 15 + 1 storey

ILC - UNDERGROUND STRUCTURES SCHEMATIC LAYOUT - PP ALTERNATIVE

(2 mobile Detectors - Push Pull - CMS like)

EUROPEAN REGION



GROUP : TS-01
 CIVIL ENGINEERING
 SUPERVISEUR : J.L.BALDY
 DESIGNER : N.BADDAMS

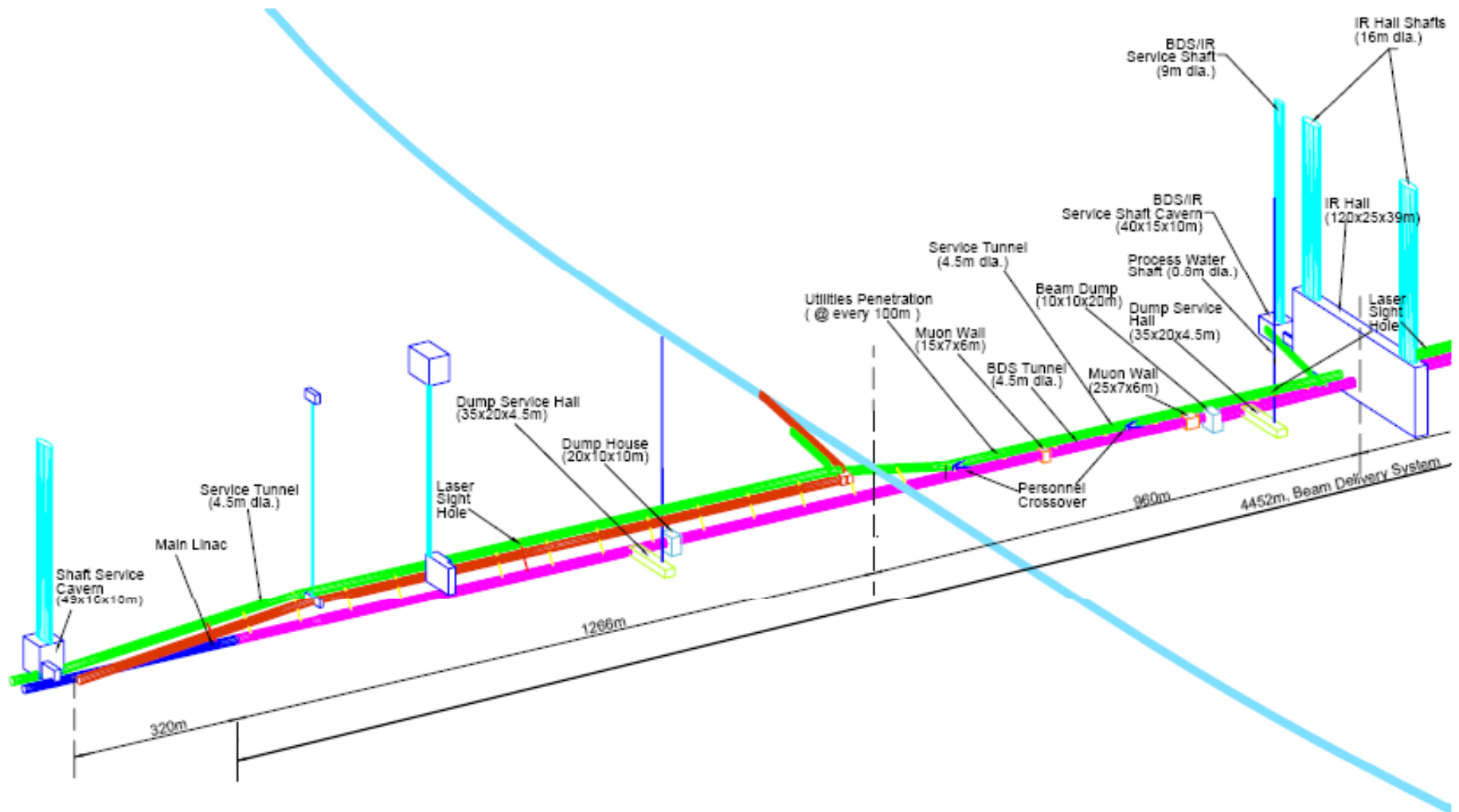
SCALE : 1/50000(A3_FORMAT) DATE : 03-OCT-2006

ILC-CE-1.1649.0009 3 A



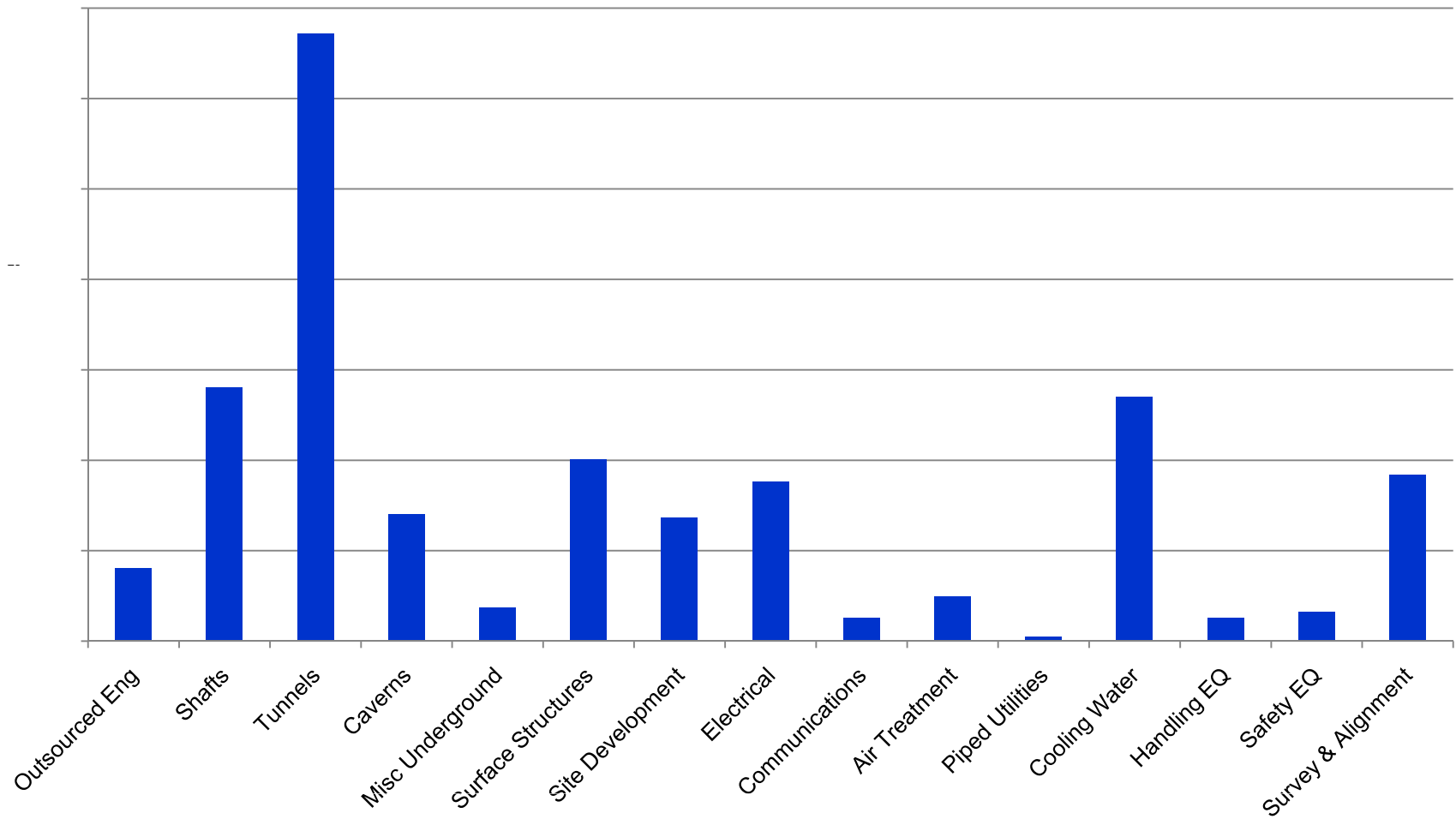
Underground Construct – tie into DRs

Tomski should have better DR drawings





CF&S Value Est. for DRs = M ILC Units



CONVENTIONAL FACILITIES & SITING - Americas Region

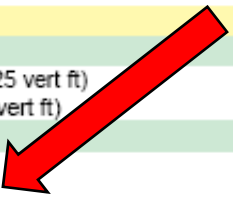
A3
DR

Effective Date of this Estimate is Shown in Footer at Bottom of Page

All costs are based upon Drawings titled "Americas ILC Basis of Cost" dated 11/6/06

All costs herein are in Jan.2006 US\$

						FINAL CONTRACT COST		
						Man-Hours Total	\$ Total	
1.7		Conventional Facilities				96,119	Man-Hrs	
				Quantity	Unit	Unit Cost	Extension	Section Total
1.7.1		CIVIL ENGINEERING				81,870	Man-Hrs	
	1.7.1.1	Engineering, study work and documentation						
		1.7.1.1.1 In-house Engineering		\$90	/ man-hr			
		In-house Engineering		4%	%			
		1.7.1.1.2 Outsourced Consultancy Services						
		Outsourced Engineering		11%	%			
	1.7.1.2	Underground Facilities						
		1.7.1.2.1 Shafts						
		Points 12, 13, 14, 15 (DR) 9m dia. Shafts (4 x 425 vert ft)		518	vert m			
		Surface Grouting of DR 9m dia. Shafts (4 x 425 vert ft)		4	ea.			
		1.7.1.2.2 Tunnels						
		DR 5m dia. Tunnel, Excavation (21,946 lin ft)		6,689	lin m			
		DR 5m dia. Tunnel, Conc. Invert (21,946 lin ft)		6,689	lin m			
		<i>DR 5m dia. Tunnel, CMU Fire-Rated Enclosure (21,946 lin ft @ \$208 / lin ft)</i>		6,689	lin m			
		Provide Tunnel Construction Water Treatment Plant		1	ea.			
		Maintain and Operate Tunnel Construction Water Treatment Plant		1	ea.			
		Treatment of Tunnel Construction Water		1	ea.			
		1.7.1.2.3 Halls						
		1.7.1.2.4 Caverns						
		Passageways to Cryo Controls Alcoves @ C,D,H,I (D&B Exc.) (4 x 389 CY)		1,190	m ³			
		Cryo Controls Alcoves @ C,D,H,I (D&B Excavation) (4 x 111 CY)		340	m ³			
		Passageways to DR Alcoves @ Inj. / Extract. (D&B Exc.) (2 x 389 CY)		595	m ³			
		DR Alcoves @ Injection / Extraction (D&B Excavation) (2 x 610 CY)		934	m ³			
		DR Shaft Base Caverns / Alcoves @ RF (D&B Excavation) (4 x 7,624 CY)		23,315	m ³			
		D&B Exc. for Moveable Shield Door (in Base Caverns) (4 x 748 CY)		2,289	m ³			
		Shield Doors @ Base Caverns @ Points 12-15		4	ea.			
		1.7.1.2.5 Miscellaneous works						
		DR Waveguides (16)		16	ea.			





DR Americas CF&S – 2006 – page 2

1.7.1.3	Surface Structures		
1.7.1.3.1	Central Lab Buildings		
1.7.1.3.2	Detector Assembly Buildings		
1.7.1.3.3	Office Buildings		
1.7.1.3.4	Service Buildings		
	Points 12 - 15 Electrical Service Buildings (4 x 1,500 sq ft)	557	sq m
	Points 12 - 15 Cooling Towers & Pump Station Bldgs. (4 x 7,500 sq ft)	2,787	sq m
	Points 12 - 15 Cooling Ventilation Building (4 x 2,500 sq ft)	929	sq m
1.7.1.3.5	Cryo- Equipment Buildings		
	Points 12 - 15 Warm Compressor Buildings (4 x 2,500 sq ft)	929	sq m
	Points 12 - 15 Surface Cold Box Buildings (4 x 5,000 sq ft)	1,858	sq m
1.7.1.3.6	Control Buildings		
1.7.1.3.7	Workshops		
1.7.1.3.8	Site Access Control Buildings		
1.7.1.3.9	Shaft Access Buildings		
	Points 12 - 15 Shaft Access Buildings (4 x 2,500 sq ft)	929	sq m
1.7.1.3.10	Miscellaneous Buildings		
1.7.1.3.11	User Facilities		
1.7.1.4	Site Development		
1.7.1.4.1	Off-site Site work		
1.7.1.4.2	Network of Monuments		
1.7.1.4.3	Construction Support		
1.7.1.4.4	Site Preparation		
	Points 12 - 15, Clearing, Grubbing, and Initial Site Preparation (4 sites)	4	ea.
1.7.1.4.5	Utility Distribution		
	Points 12 - 15, Utility Corridors (Gas, DWS, San., Storm, Elec., Comm.)	4	ea.
	Points 12 - 15, Sanitary (assumed on FNAL site)	4	ea.
	Points 12 - 15, Domestic Water (assumed on FNAL site)	4	ea.
1.7.1.4.6	Road, Sidewalks & Parking Areas		
	Points 12 - 15, Service Roads (4 sites x 1250 lin ft / site)	1,529	lin m
	Points 12 - 15, Paved Areas (4 sites x 8750 sy / site)	29,265	sq m
	Points 12 - 15, Flatwork (4 sites x 2,500 sq ft / site)	929	sq m
1.7.1.4.7	Landscaping		
1.7.1.4.8	Environmental		
	Points 12 - 15, Sediment & Erosion Control (4 sites)	4	ea.
1.7.1.4.9	Miscellaneous Site Works		



FINAL CONTRACT COST	
Man-Hours Total	\$ Total

1.7.4		PIPED UTILITIES		
1.7.4.1		Engineering, study work and documentation		
	1.7.1.1.1	In-house Engineering	\$90 / man-hr	
		In-house Engineering	4%	%
	1.7.4.1.2	Outsourced Consultancy Services		
		Outsourced Engineering	18%	%
1.7.4.2		Plumbing		
	1.7.4.2.1	Potable Water		
	1.7.4.2.2	Sanitary Sewer		
	1.7.4.2.3	Sump Systems		
		Sump Systems at Points 13, 15	2	ea.
1.7.4.3		Fire Suppression		
1.7.4.4		Fuel System Distribution		
1.7.3		AIR TREATMENT EQUIPMENT		
1.7.3.1		Engineering, study work and documentation		
	1.7.1.1.1	In-house Engineering	\$90 / man-hr	
		In-house Engineering	4%	%
	1.7.3.1.2	Outsourced Consultancy Services		
		Outsourced Engineering	14%	%
1.7.3.2		HVAC Equipment		
	1.7.3.2.1	OA & Exhaust Air Processing		
		OA Supply/Exhaust Systems @ Points 12 - 15	4	ea.
	1.7.3.2.2	Air-conditioning for Tunnels		
		Beamline Tunnel A/C, DR	6,689	lin m
	1.7.3.2.3	Air-conditioning for General Areas		
E:\for Valencia - ILC CFS Americas Cost Estimate\2006_1102 ILC CFS Americas Construction Cost Estimate.xls\A3 DR				
1.7.6		HANDLING EQUIPMENT		
1.7.6.1		Engineering, study work and documentation		
	1.7.1.1.1	In-house Engineering	\$90 / man-hr	
		In-house Engineering	4%	%
	1.7.6.1.2	Outsourced Consultancy Services		
		Outsourced Engineering	18%	%
1.7.6.2		Lifts		
		Elevators, Points 12 - 15 Shafts (4 x 425 vert ft)	4	ea.
1.7.7		SAFETY EQUIPMENT		
1.7.7.1		Engineering, study work and documentation		
	1.7.1.1.1	In-house Engineering	\$90 / man-hr	
		In-house Engineering	4%	%
	1.7.7.1.2	Outsourced Consultancy Services		
		Outsourced Engineering	18%	%
1.7.7.2		Safety Alarms		
		Fire Detection, DR Tunnel	6,689	lin m



DR Americas CF&S – 2006 – page 4

1.7.5		PROCESS (COOLING) WATER		
1.7.5.1		Engineering, study work and documentation		
	1.7.1.1.1	In-house Engineering	\$90 / man-hr	
		In-house Engineering	4%	%
	1.7.5.1.2	Outsourced Consultancy Services		
		Outsourced Engineering	18%	%
1.7.5.2		Primary Stations		
	1.7.5.2.1	Cooling Towers & Pumping Stations		
		Cooling Towers for Process Water	1	ls
		Cooling Towers for Chilled Water	1	ls
		Tower Pump and Accessories for Process Water	1	ls
		Tower Pump and Accessories for Chilled Water	1	ls
		Chilled Water Pump	1	ls
		Controls	1	ls
	1.7.5.2.2	Primary Stations and Piping		
		Chillers	1	ls
		Tower Piping for Process Water (surface)	1	ls
		Tower Piping for Chilled Water (surface)	1	ls
		Tower Piping for Process Water (shaft)	1	ls
		Chilled Water Piping (surface)	1	ls
		Chilled Water Piping (shaft)	1	ls
1.7.5.3		Secondary Stations		
	1.7.5.3.1	Demineralized Water Stations and Distribution Piping		
		Demineralized Pump/Skid System w/ Materials & Installation	1	ls
	1.7.5.3.2	Chilled Water Stations and Distribution Piping		
		Heat Exchangers (cavern)	1	ls
		Distribution Pumps (cavern)	1	ls
		Piping (cavern)	1	ls
		Piping (tunnel)	1	ls
		Piping Connections to End Equipment	1	ls
	1.7.5.3.3	Water Stations and Distribution Piping		
		Water Stations and Distribution Piping	1	ls
	1.7.5.3.4	Compressed Air		
		Compressed Air	1	ls
	1.7.5.3.5	Process Water Distribution		
		Heat Exchangers (cavern)	1	ls
		Distribution Pumps (cavern)	1	ls
		Piping (cavern)	1	ls
		Piping (tunnel)	1	ls
		Piping Connections to End Equipment	1	ls



Damping Rings CF&S components (avg - all regions)

- Cooling Water: **xx M** ILC Units 2007
18 MW LCW + **2 MW** chilled water – Emil H. 8/23/07
- Electrical: **xx M**
- Communications: **xx M**
- Air Handling: **xx M**
- Piped Utilities: **xx M**
- Handling Equipment: **xx M**
- Safety Equipment: **xx M**
- Survey & Alignment: **xx M**



DR Cryogenics (xx M)

ILC RDR Cryogenic Cost Estimate
 ILC_WBS_Cryogenics-27Feb07.xls

		2 x 250 GeV ILC				
Identifier	Item description	Unit	Materials & Services		Notes	
			No. of units	FY06 M\$ per unit		Total M&S M\$
1.7.2	Cryogenic Plant & Distribution					
1.7.2.1	Cryogenic Plants					
1.7.2.1.4	Damping Ring cryogenic plants				2 plants each serving half of e- and e+ rings	
1.7.2.1.4.1	Damping Ring refrigeration system (4.5 K and 40 - 80 K)	each	2			
1.7.2.1.4.2	Damping Ring cooling tower system	each	2			
1.7.2.1.4.3	Damping Ring warm gas storage system	lot	2		Size for storage of full inventory (625 kg)	
1.7.2.1.4.4	Damping Ring vertical transfer line	m	600			
1.7.2.1.4.5	Damping Ring purification system	each	2			
1.7.2.1.4.6	Damping Ring installation contracts	each	2			
1.7.2.1.4.7	Damping Ring cryogenic control system	each	2			
1.7.2.1.4.8	Damping Ring liquid helium storage system	lot	2		Size for storage of full inventory (625 kg)	
1.7.2.1.4.9	Damping Ring misc. (ODH, gas analysis, instrument air, etc)	each	2			
1.7.2.1.4.10	Damping Ring helium	K liters	5		estimate 200 m x 25 l/m = 5000 l/plant (=625 kg)	
1.7.2.2	Cryogenic Distribution					
1.7.2.2.4	Damping Ring cryogenic distribution					
1.7.2.2.4.1	Damping ring cryogenic distribution boxes	each	2			
1.7.2.2.4.2	Electron damping ring wiggler cryogenic end boxes	each	8			
1.7.2.2.4.3	Electron damping ring RF module cryogenic end boxes	each	4			
1.7.2.2.4.4	Electron damping ring transfer lines	km	1.1			
1.7.2.2.4.5	Positron damping ring wiggler cryogenic end boxes	each	8			
1.7.2.2.4.6	Positron damping ring RF module cryogenic end boxes	each	4			
1.7.2.2.4.7	Positron damping ring transfer lines	km	1.1			



DR Instrumentation (xx M)

BEAM INSTRUMENTATION - InstrWBS_rev041907_mw_phg_24april07					
ACCELERATOR	# of areas	BEAM INSTRUMENT	Material & Services		
			2006 Estimated Costs		
	WBS		Unit Cost (\$, k\$)	Qty	Cost (k\$)
Damping Ring	2	damping rings			
	3.1	Button BPM		747	
	3.2	Laserwire (IP)		1	
	3.3	X Sync light		1	
	3.5	Streak Camera		1	
	3.6	Toroid		1	
	3.7	BLM - ion chamber		4	
	3.8	BLM - PMT - discrete IC		40	
	3.9	Feedback - special		2	



Next Steps: organizing for EDR

- The leading priority for allocating resources, both manpower and funding is the verification of cavity gradient
- We are organizing a Project Management Office with responsibility to provide a comprehensive, integrated, resource-loaded schedule using Primavera



for EDR, we need:

- updated value and labor estimates
 - but **no overall increase!**

Marc: a 10% decrease would be better!
how much manpower will be available for this?
- better understanding of the cost risks =>
distributions of probable costs
 - => 90% or 95% upper confidence limit
= what the funding agencies
should be prepared to pay
- that comprehensive, resource-loaded schedule
- mitigation (or plan to mitigate) the technical risks
as compiled in Ewan's Risk Register



DR Technical Risks & Mitigation Paths from Ewan's at Orsay Cost Review

- (1) Secondary Emission Yield too high > 1.2
 - return to two e⁺ ring design after extensive R&D programs
- (2) Vacuum system design not robust
 - redesign vacuum system with more distributed pumping
- (3) High impedance of vacuum chamber components
 - more engineering design or DR re-optimization
- (4) RF Margin
 - increase klystron/cavity system by 50%
- (5) Combination of concerns with RF and Wiggler layouts
 - increase in number of shafts and alcoves
- (6) Plan for having room for future double ring, later decision
 - increase tunnel diameter and include above (5)
- (7) General concern with injection/extraction kicker performance –
increase number of kicker units and/or restrict parameter ranges



Beside ML cavity performance, I worry:

- That the unit cost per linear meter for TBM and other underground construction will be higher than our estimates
 - Optimization of Conventional Facilities
 - What are the next steps in development of estimates and cost/performance optimization? ***Interdisciplinary!***
 - Remember, this is confidential estimating data, so **DO NOT POST** these details on INDICO or elsewhere!
- I will provide .pdf file ***without*** the confidential costs for posting