TESLA Budget Book – Dictionary Version

This tabulation is included here, not to provide any additional cost estimate data beyond what is given in the TESLA TDR, but rather to indicate the extent of the elements considered in preparing the cost estimate. This table was put into a WBS spreadsheet format to facilitate viewing the high level summaries while allowing study of the individual elements. The highest level summary is presented, followed by the expanded listing of the elements considered for each sub-system on subsequent pages.

Level 3 Elements

TESLA Budget Book - Dictionary Version (w/Fermilab WBS)
March 2001 - phg - modified 3dec01
cost estimate in M Euros units - year 2000 costs
includes only level of costs available in TESLA TDR

		# units	1. Cost roll-up	1.a cost roll-up	1.a.b cost roll-up
1	Total - TESLA Collider + XFEL Increments		3,377		
1.1	TESLA Collider - total (not including XFEL)			3,136	
1.1.1	Main Linac Modules				1,131
1.1.2	Main Linac RF System				587
1.1.3	Tunnel & Buildings				546
1.1.4	Machine Infrastructure				336
1.1.5	Damping Rings				215
1.1.6	Auxiliary Systems				124
1.1.7	Beam Delivery System				101
1.1.8	Injection System				97
1.2	XFEL Increments - total			241	
1.2.1	XFEL Increments				241

Level 4 Elements

TESLA Budget Book - Dictionary Version (w/Fermilab WBS)
March 2001 - phg - modified 3dec01
cost estimate in M Euros units - year 2000 costs
includes only level of costs available in TESLA TDR

	# units	1.a.b cost roll-up
1 Total - TESLA Collider + XFEL Increments		
1.1 TESLA Collider - total (not including XFEL)		
1.1.1 Main Linac Modules		1,131
1.1.1.1 Cavity preparation & string assembly		
1.1.1.2 Cryostat modules & sc magnets		
1.1.1.3 Cavity structure & vessel fabrication		
1.1.1.4 Niobium material RRR 300		
1.1.1.5 RF Power & HOM Coupler		
1.1.2 Main Linac RF System		587
1.1.2.1 RF Power Distribution & LLRF		
1.1.2.2 Klystrons & Interlocks		
1.1.2.3 Modulator		
1.1.2.4 Pulse transformer & predriver		
1.1.2.5 HV pulse cable & installation		
1.1.3 Tunnel & Buildings		546
1.1.3.1 Tunnels & access shafts		
1.1.3.2 Site & halls & buildings		
1.1.3.3 General Tunnel Infrastructure		
1.1.4 Machine Infrastructure		336
1.1.4.1 Cryogenic plants & supply		
1.1.4.2 Cryogenic Distribution		
1.1.4.3 Water plants & distribution		
1.1.4.4 AC Power plant & distribution		
1.1.4.5 Various supply systems		
1.1.5 Damping Rings		215
1.1.5.1 Magnets & Power System		
1.1.5.2 Vacuum system		
1.1.5.3 RF Power & cavity system		
1.1.5.4 Beam diagnostics & controls		
1.1.6 Auxiliary Systems		124
1.1.6.1 Global machine control system		
1.1.6.2 Electronic & cabling		
1.1.6.3 Vacuum RF Power coupler		
1.1.6.4 Vacuum modules - Main Linac Cryostats		
1.1.6.5 Various auxiliary systems		
1.1.7 Beam Delivery System		101
1.1.7.1 Magnets & Power System		

1.1.7.2 Beam Stops & cooling
1.1.7.3 Beam diagnostic
1.1.7.4 Vacuum System
1.1.7.5 Fast Kicker & Collimator System

1.1.8 Injection System 97
1.1.8.1 5 GeV Positron Linac & Beamline
1.1.8.2 Positron Source & Injector
1.1.8.3 5 GeV Electron Linac
1.1.8.4 Polarized gun & injector
1.1.8.5 RF Gun & Injector

1.2 XFEL Increments - total
1.2.1 XFEL Increments 241
1.2.1.1 XFEL Tunnel & buildings
1.2.1.2 XFEL Machine additives
1.2.1.3 XFEL Beam switchyard
1.2.1.4 Linac to XFEL Beam lines

Level 5 Elements

TESLA Budget Book - Dictionary Version (w/Fermilab WBS)
March 2001 - phg - modified 3dec01
cost estimate in M Euros units - year 2000 costs
includes only level of costs available in TESLA TDR

	# units	1.a.b cost roll-up
1 Total - TESLA Collider + XFEL Increments		
1.1 TESLA Collider - total (not including XFEL)		
1.1.1 Main Linac Modules		1,131
1.1.1.1 Cavity preparation & string assembly		
1.1.1.1.1 cavity preparation & assembly	20,592	
1.1.1.2 Cryostat modules & sc magnets		
1.1.1.2.1 vacuum vessel & cold mass	1,716	
vacuum vessel		
Cryo supports		
GHeRP (return pipe)		
shields 4.5 degree		
shields 70 degree		
Cryo pipes		
Cold mass pre-assembly		
intermediate transportation		
Final transportation		
management		
1.1.1.2.2 module intercon beam vacuum	1,716	
1.1.1.2.3 magnet package	750	
1.1.1.2.4 module instrumentation	1,716	
1.1.1.2.5 module interconnection	1,716	
1.1.1.3 Cavity structure & vessel fabrication		
1.1.1.3.1 Structure machining	20,592	
1.1.1.3.2 Tuner mechanics + gear box	20,592	
1.1.1.3.3 Titanium vessel, tubes & bellows	20,592	
1.1.1.3.4 Tuner motor & electronics	20,592	
1.1.1.3.5 Assembly & EB Welding	20,592	
1.1.1.3.6 Magnetic shielding Cryoperm	20,592	
1.1.1.3.7 Magnetic shielding fabrication	20,592	
1.1.1.3.8 Piezo tuner		
1.1.1.4 Niobium material RRR 300		
1.1.1.4.1 Niobium 300 material	20,592	
1.1.1.4.2 Niobium 30 material	20,592	
1.1.1.4.3 NbTi flange material	20,592	
1.1.1.5 RF Power & HOM Coupler		
1.1.1.5.1 RF power coupler fabrication	20,592	
1.1.1.5.2 Cavity control inside	20,592	

1.1.2	Main Linac RF System			587
	1.1.2.1	RF Power Distribution & LLRF		
		1.1.2.1.1	RF Power Distribution	572
			RF power circulators	
			RF power hybrid couplers	
			RF wave guides	
			RF transformers	
			RF bellows	
			RF signal couplers	
		1.1.2.1.2	Low Level RF Control	572
			LLC digital feedback	
			LLC monitoring	
			LLC RF components	
			LLC miscellaneous	
			LLC master oscillator & distribution	
		1.1.2.1.3	(blank)	
	1.1.2.2	Klystrons & Interlocks		
		1.1.2.2.1	Klystron, solenoid & socket	572
		1.1.2.2.2	Klystron interlocks	572
		1.1.2.2.3	Klys, aux. PS Fil, Sol, Bias, Vac.	572
		1.1.2.2.4	(blank)	
	1.1.2.3	Modulator		
		1.1.2.3.1	Modulator pulser unit	572
			Pulse transformer assembly	
			HV power supply	
			Control/interlock	
			Switch assembly	
			Crowbar system	
			Capacitor banks	
			Bouncer system	
			Supports, cooling, & ventilation	
			Under shoot circuit	
			Local subsystem control	
			Miscellaneous	
		1.1.2.3.2	Modulator interlock	572
	1.1.2.4	General RF Components		
		1.1.2.4.1	Pulse trans. Unit (incl.fil & container)	572
		1.1.2.4.2	Cavity interlock	572
		1.1.2.4.3	Tunnel cable connections	572
		1.1.2.4.4	PreDriver	572
	1.1.2.5	HV pulse cable & installation		
		1.1.2.5.1	Pulse power cables	572
		1.1.2.5.2	Pulse cable installation	572

1.1.3	Tunnel & Buildings			546
	1.1.3.1	Tunnels & access shafts		
		1.1.3.1.1	Main Linac	33,500
		1.1.3.1.2	Damping ring	4,000
		1.1.3.1.3	Access shaft unit	19
		1.1.3.1.4	Bypass Tunnel positrons	600
		1.1.3.1.5	Engineering costs	
	1.1.3.2	Site & halls & buildings		
		1.1.3.2.1	Site ground	800,000
		1.1.3.2.2	HEP experimental Hall	61,500
		1.1.3.2.3	Site infrastructure - aux halls	8
		1.1.3.2.4	Refrigerator halls	170,520
		1.1.3.2.5	HE dump halls	20,000
		1.1.3.2.6	Cryo Module Test Facility Hall	134,460
		1.1.3.2.7	RF Modulator & Water Plant Halls	113,680
		1.1.3.2.8	Engineering costs	
	1.1.3.3	General Tunnel Infrastructure		
		1.1.3.3.1	Monorail	34,000
		1.1.3.3.2	Traffic lane	37,620
		1.1.3.3.3	Fire safety system	40,000
		1.1.3.3.4	Module supports	3,500
		1.1.3.3.5	Electronic shielding	8,237
		1.1.3.3.6	Handy lossy cable	40,000
1.1.4	Machine Infrastructure			336
	1.1.4.1	Cryogenic plants & supply		
		1.1.4.1.1	Cold boxes	
		1.1.4.1.2	Compressors	
		1.1.4.1.3	Distribution boxes 3,4,5,7	
		1.1.4.1.4	Cold compressors	
		1.1.4.1.5	Distributions boxes 1,6	
		1.1.4.1.6	Purification	
		1.1.4.1.7	Controls	
		1.1.4.1.8	Liquid Helium storage	
		1.1.4.1.9	Warm gas storage	
		1.1.4.1.10	Distribution box 2	
		1.1.4.1.11	Helium	
		1.1.4.1.12	Miscellaneous	
		1.1.4.1.13	Budget value to XFEL Incrementals	
	1.1.4.2	Cryogenic Distribution		
		1.1.4.2.1	Warm Helium gas tube (DN200)	
		1.1.4.2.2	Transfer lines	
		1.1.4.2.3	Vacuum Barriers	
		1.1.4.2.4	Feed boxes	
		1.1.4.2.5	End boxes	
		1.1.4.2.6	Injection feed boxes	
		1.1.4.2.7	Damping ring RF feed boxes	
		1.1.4.2.8	Controls	
		1.1.4.2.9	Booster	
		1.1.4.2.10	Injection distribution box	

1.1.4.3	Water plants & distribution	
	1.1.4.3.1 Water auxiliary halls	
	1.1.4.3.2 Water tunnels	
	1.1.4.3.3 Water XFEL	
	1.1.4.3.4 Water Experiments	
1.1.4.4	AC Power plant & distribution	
	1.1.4.4.1 Low Voltage AC Power distribution	
	1.1.4.4.2 High Voltage AC Power plant	
	1.1.4.4.3 20 KV AC power switchyard stations	
	1.1.4.4.4 Wall plug power	
	1.1.4.4.5 Low Voltage AC Power stations	
1.1.4.5	Various supply systems	
	1.1.4.5.1 Main LINC segment ventilation	8
	1.1.4.5.2 Auxiliary Hall ventilation	8
	1.1.4.5.3 Main Linac first station ventilation	2
	1.1.4.5.4 HEP Experimental hall ventilation	1
	1.1.4.5.5 Damping Ring Infrastructure	
	1.1.4.5.6 Cryo Test facility cryogenics	
	1.1.4.5.7 RF Power test facility	
	1.1.4.5.8 Cryo test facility operation	
	1.1.4.5.9 Cryo test RF Power System	
	1.1.4.5.10 Cryo test control system	
	1.1.4.5.11 Cryo-connection to HERA cryo-plant	
	1.1.4.5.12 Cryo test vacuum	
	1.1.4.5.13 Cryo Test vertical dewar RF	

1.1.5 Damping Rings 215
1.1.5.1 Magnets & Power System
1.1.5.1.1 Special Magnets - Wigglers
1.1.5.1.2 Quadrupoles for Damping Ring
1.1.5.1.3 Dipoles for Damping Ring
1.1.5.1.4 Injection/Extraction Sections
1.1.5.1.5 Sextupoles for Damping Ring
1.1.5.1.6 Magnet assembly
1.1.5.1.7 Solenoids B-line & Bunch Compressor
1.1.5.1.8 Magnetic measurements
1.1.5.1.9 Correctors for Damping Ring
1.1.5.1.10 Quadrupoles for Beamline & B.C.
1.1.5.1.11 multipole girders/supports
1.1.5.1.12 Power supply system
1.1.5.1.13 Dipoles for Beamline and B.C.
1.1.5.1.14 Dipole stands and supports
1.1.5.1.15 Correctors for Beamline & B.C.
1.1.5.1.16 Sextupoles for Beamline & B.C.
1.1.5.2 Vacuum system
1.1.5.1.1 Pumps and power supplies
1.1.5.1.2 Damping Ring Vacuum Chamber
1.1.5.1.3 Vacuum chamber supports
1.1.5.1.4 Manual & auto valves
1.1.5.3 RF Power & cavity system
1.1.5.3.1 RF Cryo-modules
1.1.5.3.2 RF Power sources
1.1.5.3.3 Waveguide network system
1.1.5.3.4 Cryogenic system
1.1.5.3.5 Cooling system
1.1.5.3.6 Electronics, controls, interlocks, etc.
1.1.5.4 Beam diagnostics & controls
1.1.5.4.1 BPM button/strip line monitors
1.1.5.4.2 Beam diagnostics electronics
1.1.5.4.3 Toroidal current transformers
1.1.5.4.4 Wall current monitors
1.1.5.4.5 Emittance measurement system
1.1.5.4.6 Tune monitors
1.1.5.4.7 Beam loss monitors
1.1.5.4.8 Fluorescent screens
1.1.5.4.9 Scrapers
1.1.5.4.10 DC current transformers

1.1.6	Auxiliary Systems			124
	1.1.6.1	Global machine control system		
		1.1.6.1.1	Electronics racks, etc	700
		1.1.6.1.2	Crates, front-end servers	700
		1.1.6.1.3	Control room equipment	100
		1.1.6.1.4	Network equipment	800
		1.1.6.1.5	Expendable Materials	300
		1.1.6.1.6	Network cables	500
		1.1.6.1.7	Alarm interface modules	60
		1.1.6.1.8	Servers & consoles	300
		1.1.6.1.9	Alarm line cables	60
	1.1.6.2	Electronic & cabling		
		1.1.6.2.1	Data acquisition	900
		1.1.6.2.2	Monitor electronics Main Linac	800
		1.1.6.2.3	Beam loss Main Linac	800
		1.1.6.2.4	Beam monitors Main Linac	800
		1.1.6.2.5	Monitor electronics general	500
		1.1.6.2.6	Commercial electronics	100
		1.1.6.2.7	Monitor beam lines	100
		1.1.6.2.8	Miscellaneous items	
	1.1.6.3	Vacuum RF Power coupler		
		1.1.6.3.1	Pump tube d=100	
		1.1.6.3.2	Sputter pump - 60 l/sec	
		1.1.6.3.3	Titanium sublimation pump	
		1.1.6.3.4	Sputter pump power supplies	
		1.1.6.3.5	TSP power supplies	
		1.1.6.3.6	Manual valve ID 35	
		1.1.6.3.7	Vacuum component electronics	
		1.1.6.3.8	Bellows	
		1.1.6.3.9	Pump pots	
	1.1.6.4	Vacuum modules - Main Linac Cryostats		
		1.1.6.4.1	Penning filaments	
		1.1.6.4.2	Pump stations	
		1.1.6.4.3	Manual vacuum valve ID 100	
		1.1.6.4.4	Vacuum installation tools cryostats	
		1.1.6.4.5	Vacuum component electronics	
		1.1.6.4.6	Bridge valves	
		1.1.6.4.7	Pirani filaments	
	1.1.6.5	Various auxiliary systems		
		1.1.6.5.1	DC power supplies Main Linac	
		1.1.6.5.2	Spare linac modules	
		1.1.6.5.3	Alignment & Survey	
		1.1.6.5.4	Cables from general store	
		1.1.6.5.5	Connectors from general store	
		1.1.6.5.6	Main Linac beam vacuum control	
		1.1.6.5.7	Radiation safety interlock system	

1.1.7	Beam Delivery System			101
	1.1.7.1	Magnets & Power System		
		1.1.7.1.1	Magnet Supplies & Cables	1
		1.1.7.1.2	Quadrupoles	180
		1.1.7.1.3	Main Dipoles	370
		1.1.7.1.4	Electrostatic Separators	32
		1.1.7.1.5	SC Doublets	2
		1.1.7.1.6	Sextupoles & Octupoles	26
		1.1.7.1.7	Movers	206
		1.1.7.1.8	Emergency extraction quads	22
		1.1.7.1.9	Emergency extraction dipoles	12
		1.1.7.1.10	Supports	624
		1.1.7.1.11	H/V correctors	400
		1.1.7.1.12	Main extraction quadrupoles	6
		1.1.7.1.13	Main extraction dipoles	4
		1.1.7.1.14	Main extraction septum	2
		1.1.7.1.15	Emergency extraction septum	2
	1.1.7.2	Beam Stops & cooling		
		1.1.7.2.1	Cooling system	2
		1.1.7.2.2	Fast extraction, 30 kicker, 1 m long	2
		1.1.7.2.3	Fast sweep	4
		1.1.7.2.4	Water vessel	6
	1.1.7.3	Beam diagnostic		
		1.1.7.3.1	Laser profile	2
		1.1.7.3.2	Beam electronics	370
		1.1.7.3.3	Final Focus Monitor	2
		1.1.7.3.4	BPM	200
		1.1.7.3.5	Beam loss monitor	370
		1.1.7.3.6	Wire scanner	16
		1.1.7.3.7	Cables & connectors	370
	1.1.7.4	Vacuum System		
		1.1.7.4.1	Copper surfacing	1,800
		1.1.7.4.2	Vacuum tubes	3,400
		1.1.7.4.3	Pumps & valves	200
		1.1.7.4.4	Electronics	200
		1.1.7.4.5	Vacuum utilities	200
	1.1.7.5	Fast Kicker & Collimator System		
		1.1.7.5.1	Spoiler	26
		1.1.7.5.2	Spoiler cooling water unit	26
		1.1.7.5.3	Absorber	12
		1.1.7.5.4	Absorber cooling water circuit	12
		1.1.7.5.5	Instrumentation	2
		1.1.7.5.6	General cables & connectors	3,400
		1.1.7.5.7	Fast Kickers	16
		1.1.7.5.8	Magnet mover electronics & cables	206
		1.1.7.5.9	BPM	10
		1.1.7.5.10	Electronics	1
		1.1.7.5.11	Miscellaneous	

1.1.8 Injection System 97
1.1.8.1 5 GeV Positron Linac & Beamline
1.1.8.1.1 Cryogenic modules
1.1.8.1.2 RF power system
1.1.8.1.3 Accelerating system
1.1.8.1.4 Magnet elements
1.1.8.1.5 Beam Line Magnets
1.1.8.1.6 Beam Line Vacuum system
1.1.8.1.7 Beam Line Instrumentation
1.1.8.1.8 Vacuum
1.1.8.1.9 Instrumentation
1.1.8.1.10 Beam Line DC power supplies
1.1.8.2 Positron Source & Injector
1.1.8.2.1 RF power system
1.1.8.2.2 100 m long undulator (all included)
1.1.8.2.3 Accelerating system
1.1.8.2.4 Target & pulsed magnet (x2)
1.1.8.2.5 Magnets
1.1.8.2.6 Beam Line vacuum
1.1.8.2.7 DC power supplies
1.1.8.2.8 Instrumentation
1.1.8.2.9 Pumps, bellows & valves
1.1.8.3 5 GeV Electron Linac
1.1.8.3.1 Cryo Modules
1.1.8.3.2 Klystrons & Modulators
1.1.8.3.3 Power supplies
1.1.8.3.4 Vacuum
1.1.8.3.5 Magnet packages
1.1.8.4 Polarized gun & injector
1.1.8.4.1 Room temperature Linac
1.1.8.4.2 SC Linac to 500 MeV
1.1.8.4.3 Load-lock system
1.1.8.4.4 Electron gun
1.1.8.4.5 Pre-bunching section
1.1.8.4.6 Matching & analysis line
1.1.8.5 RF Gun & Injector
1.1.8.5.1 Equipped cryostat modules
1.1.8.5.2 RF, vacuum & diagnostics
1.1.8.5.3 10 MW Klystron & modulators
1.1.8.5.4 Klystron & modulator (4.5 MW)
1.1.8.5.5 Laser

1.2	XFEL Increments - total			
1.2.1	XFEL Increments			241
1.2.1.1	XFEL Tunnel & buildings			
	1.2.1.1	XFEL Experimental hall	150,000	
	1.2.1.2	XFEL dump halls	24,000	
	1.2.1.3	XFEL tunnels	8,000	
	1.2.1.4	XFEL tunnel infrastructure	8,000	
1.2.1.2	XFEL Machine additives			
	1.2.2.1	Additional air conditioning		
	1.2.2.2	Radiation safety design & interlocks		
	1.2.2.3	XFEL Gun & Injector		
		1.2.2.3.1 Equipped cryostat modules		
		1.2.2.3.2 2x10 MW klystron/modulator assmbl.		
		1.2.2.3.3 Bunch compressors		
		1.2.2.3.4 Laser		
		1.2.2.3.5 3rd harmonic accel. cavity/coupler		
		1.2.2.3.6 Power supplies		
		1.2.2.3.7 Preparation chamber (mech&vac)		
		1.2.2.3.8 Vacuum & Diagnostics		
	1.2.2.4	Additional water plant & distribution		
	1.2.2.5	Compressor cavities	120	
	1.2.2.6	Compressor RF power system	3	
	1.2.2.7	Cryogenic distribution additives		
	1.2.2.8	Wave guide absorber adds	2,052	
	1.2.2.9	Power supply RF modulator adds	57	
	1.2.2.10	Substation racks & electronics	50	
	1.2.2.11	Ten Degree bend for XFEL		
	1.2.2.12	XFEL Bunch compressor 2 & 3		
	1.2.2.13	Compressor cryostat module	10	
1.2.1.3	XFEL Beam switchyard			
	1.2.3.1	XFEL beam dump components		
	1.2.3.2	Dipole magnets	295	
	1.2.3.3	Quadrupole magnets	537	
	1.2.3.4	Sextupole Magnets	284	
	1.2.3.5	Pulsed dipole magnets	6	
	1.2.3.6	Correction magnets	120	
	1.2.3.7	Octupole magnets	16	
	1.2.3.8	Power supplies & cables		
	1.2.3.9	Beam diagnostic & feedbacks		
	1.2.3.10	Vacuum System		
	1.2.3.11	Cable, connectors & mechanics		
1.2.1.4	Linac to XFEL Beam lines			
	1.2.4.1	Magnets		
	1.2.4.2	Power supplies & cables		
	1.2.4.3	Vacuum per meter		
	1.2.4.4	Beam position monitors		