ILC - Main Linac Tunnel Specification Sheet (DRAFT)

FNAL, Jun 23, 2006 DRAFT

MAIN LINAC

BEAM TUNNEL

(BASIS OF CURRENT BEAM TUNNEL CROSS SECTIONAL LAYOUT)

	Quantity				
	(per RF	Size (WxLxH)	Weight	Interface	
System/Component Description	Unit)	(meters)	(Kg)	Point	Source of Information/Comments
Cryomodule with Quad	1	1.6 width x 12.6 Length			Current Design of Type IV from FNAL 3-D Model (Length from L.Lilie Bangalore Slide 3-22-06; Sugahara Email 3-
					23-06)
Cryomodule without Quad	2	1.6 width x 11.3 Length			Current Design of Type IV from FNAL 3-D Model (Length from L.Lilje Bangalore Slide 3-22-06; Sugahara email 3-23 06)
Interconnect Between Cyromodules	2	0.85 Length			Current Design of Type IV from FNAL 3-D Model
Cryogenic System	1	-			Cryogenic distribution lines are shown in cross-section (size needs to be verified). Cryogenic turn- around/disconnect will most likely require an alcove. This is not considered for the typical cross-section layout.
Vacuum System	?	?			Details to be determined.
Waveguide System	1	-			From 3-D Model of Jerry Lebfreitz and HLRF Group as of May 4 2006
Cable Tray	4	0.5			This is an estimate at this time. Four 0.5m (18") wide, divided trays.
Positron Beamline	1	50 cm full width Quad with 15cm tube at one Quad per 3 Cryomodule			50 cm full width Quad with 15cm tube at one Quad per 3 Cryomodules (C.Adolphsen Email 2-23-2006)
Convenience, Welding & Charging Receptacles, Other?		Aisle Wall & Back Wall @ Intervals TBD			1-60A; 480V Welding Recpt @ 108m spacing; 1-Quad Recept each with 2-20A, 120V Duplex Recept and 2-20A,
Area, Emergency, Exit & Task Lighting	-	Energy Efficient Support & Backup Lighting is required 40W Flour; (2) T8 Lamps; 277V			48" Fluorescent Light (2-T8 Lamps; Electronic Ballast) & Wire Guard, 20FC Avg-6m spacing both sides; Emergency and Night lights per Code
Water (Deionized/Low Conductivity Water)	2	Two 50mm (2") Supply and Return from the service tunnel skid (<u>placeholder</u> <u>only</u>)			(from Shigeki heat load spreadsheet)
Other Utilities	-	Assumed as One 50mm (2") Compressed Air and One 50mm (2") Nitrogen			Grounding-500MCM, bare ground cable routed entire length of tunnel with cross connects and risers to surface. (Magnet side) 1-75kVA Transf & Recept Panel; 1 225A (480/277V panel for Mech equip)

Drain/Sump System	1	AMERICA: 120 liters per min	AMERICA: 120 liters per min per Km (50 gpm/mile) flow.					
		per Km (50 gpm/mile) flow.	Data from NLC/SSC info. Sump at every 5 Km. Trench					
		Data from NLC/SSC info.	invert Max depth 12" EUROPE: 10 liters per min per					
		Sump at every 5 Km. Trench	Km					
		invert Max depth 12"						
		EUROPE: 10 liters per min						
		per Km						
HVAC/Air Handling System	1	Refrigerant based	Placeholder					
		dehumidifiers every 36						
		Meter						
Fire Protection System	-	placeholder	CF&S group to provide info.					
Communications System	-		CF&S group to provide info.					
Transport Equipment	_	1.6 wide	This is based on the widest item (Crvomodule=1.6m).					
			Current FNAL transport equipment maximum width is 1.35					
			meters. So, the Cryomodule, itself determines the space					
			required. 0.3m (12") is assumed reasonable space on					
			each side of transported equipment to avoid interference					
			during transport.					
Distance between Service & beam Tunnel	-	7.5m	Basis is 1.5 times the service tunnel for CFS tunneling					
			consideration (The distance due to radiation consideration					
			is less)					
Turn Around Space for Transport Vehicles	-		CF&S group to provide info.					
Egress Path	1	0.9 (36")	Assumed to be the necessary egress path width at all					
-			times. This needs to be confirmed by CF&S group.					
Cross-overs Between Tunnels (personel)			CF&S group to provide info. based on Life Safety Analysis.					

SERVICE TUNNEL

(BASIS OF CURRENT SERVICE TUNNEL CROSS SECTIONAL LAYOUT)

	Quantity		
	(per RF	Size (WxLxH)	
System/Component Description	Unit)	(meters)	Source of Information/Comments
Klystron	1	1.3 x <u>3.4</u> x 1.4	Based on HLRF group estimateof size
		(0.46m gap required	
		between Klsytron & Pulse	
		Transformer)	
Pulse Transformer	1	1.2 x <u>1.3</u> x 1.4	Chris Jensen (FNAL)
Modulator	1	1.1 x 4.3 x 2.0	Reconfigured Size based on info. from Chris Jensen
			(FNAL). No access doors located on wall side.
Charging Power Supply	1	1.22 x 2.44 x 2.0	Reconfigured Size based on info. from Chris Jensen (FNAL)
			(e-mail 2/27/06). Assumes no access necessary on wall
			side.

Waveguide System	1	-	Based on component specification given by Shigeki Fukuda (e-mail 2/27/06) and 3-D model generated at FNAL using commercially available WR650 components. Assumes klystron is rotated with waveguide ports facing up and down. Installation of waveguide through penetrations between tunnels assumes three waveguide through one penetration (<u>43 centimeter minimum</u>) and each waveguide is made up of three equal length sections fed from the service tunnel into the penetration. This needs to be studied in more detail.
Cable Tray	4	0.5	This is an estimate at this time. Four 0.5m (18") wide, divided trays.
Electrical Racks for RF System	6	0.6 x 0.8 x 2.0	Four racks needed for klystron, two racks needed for modulator and charging supply as per Chris Jensen (FNAL). 0.9m (36") clearance in front and back of rack needed for access. Power required 30 KVA per ML sub Rack List (S. Fukuda & H. Hayano; Bangalore; 3-4-06) 45 KVA provided for each set of racks at Service tunnel RF area
Electrical Racks for other Equipment	10	0.6 x 0.8 x 2.0	This is an estimate for all additional equipment in tunnel (vacuum, instrumentation, controls, safety systems, etc.). 0.9m (36") clearance in front and back of rack needed for access. 45 KVA provided for each set of racks at Service Tunnel RF area
34.5 KV -11 kV DC Modulator Power	1 every RF Station	(Data from Chris / Clay) 1.22 x 2.44 x 2.0 Inclusive @ 36 meter intervals	All -in -one Transformer & Power Supply 34.5 KV AC to 8 KV AC to 11 KV DC
34.5 KV -0.48 kV Equipment Power	1 every 4th RF Station	(Data from Clay) 1.219 x 1.245 x 1.346 Inclusive @ TBD Intervals (foot print to be sized to match actual distributed non- RF loads) <u>OR</u> ((Data from Santic) 1.57m (W) x 1.27m (D) x 1.37m (H) and 0.813m (W) x 0.248m (D) x 1.63m (H) Panelboard	AC Equipment Power Transformer w/ Dead Front: Primary Selective Switch-Disconnect, Surge Arrestors, Terminations, Transformer & Secondary Feed Getaways to Equipment Disconnects RF (AC) Power Transformer; 500kVA, 34.5kV (200kV BIL)- 480/277V(30kV BIL); OW; Oil immersed primary fusing; Oil immersed 4 position load break sectionalizing switch; dead front; 1 transformer every 4th RF station.

34.5 KV to 0.208/0.12 kV Emergency	1 every ?? RF	(Data from Clay)	AC Emergency Power Transformer w/ Dead Front:
Power	5	0.965 x 1.245 x 1.346	Primary Selective Switch-Disconnect, Surge Arrestors,
		Inclusive @ TBD Intervals	Terminations, Transformer & Secondary Feed Getaways to
		(foot print to be sized to	Equipment Disconnects
		match actual distributed	
		emergency loads) OR	
		(Data from Santic)	
		1.28 x 1.59 x 2.28H Primary	
		Switch	
		1.37 x 2.13 x 2.28H	
		Transformer 0.92 x 0.92 x	
		2.28H Switchboard	
Convenience, Welding & Charging		Aisle Wall & Back Wall @	1-60A; 480V Welding Recpt @ 108m spacing; 2-Quad
Receptacles. Other?		Intervals TBD	Recept each with 2-20A, 120V Duplex Recept and 2-20A,
			208V Twist Lock Recept every 36m
Area, Emergency, Exit & Task Lighting	-	Energy Efficient Support &	48" Fluorescent Light (2-T8 Lamps; Electronic Ballast) &
		Backup Lighting is required	Wire Guard, 20FC Avg-6m spacing both sides; Emergency
		40W Flour; (2) T8 Lamps;	and Night lights per Code
		277V	
Water (Process water Distribution)	2	300mm (14") diameter	Current basis is ~125KW per RF unit at 35 C supply
		supply and insulated return	temperature and ~45C return temperature, at
		header Process Water pipe	approximately 128 RF units per plant (Shigeki/Clay
		to serve the LCW skid in	spreadsheet)
		Main Linac Service tunnel	
		only (Placeholder only)	
Water (Chilled Water Distribution)	2	200mm (8") diameter	Current basis is about 25KW beat load - 50% to air & 50%
Water (ennied Water Distribution)	2	insulated supply and return	to water cooled racks per RE (Shigeki/Clay spreadsheet)
		header to serve chilled water	at 128 fancoils per plant
		fancoils in each RE unit area	
		and one $1-1/2$ " condensate	
		lines from fancoils	
Water (Deionized / Demineralized / Low	2	Two 50mm (2") Supply and	Current basis is ~125KW per RF unit at 35 C supply
Conductivity Water)		Return pipe from Skid	temperature and ~45C return temperature, at 128 RF
			units per plant (Shigeki/Clay spreadsheet)
Water Skids (pumps and HX) for RF Unit	1 every RF	Assumed as One (4' x 4')	Placeholder of (4' x 4') 2.4m x 1.2m, for water skid at
		1.2m x 1.2m, for water skid	every 36 meter
		at every 36 meter (1 RF	
		unit)	
Water Skid for water cooled racks	1 every 4RF	placeholder	Placeholder of (4' x 4') 2.4m x 1.2m,
Water Skids (pumps and HX) for Quad in		unknown at this time	Need info (Positron Trans Line water cooled components)
Positron Line			
Uther Utilities	-	Assumed as One 50mm (2")	Placeholder
		Compressed Air and One	
		50mm (2") Nitrogen	

Drain/Sump System	1	AMERICA: 120 liters per min	AMERICA: 120 liters per min per Km (50 gpm/mile) flow.
		per Km (50 gpm/mile) flow.	Data from NLC/SSC info. Sump at every 5 Km. Trench
		Data from NLC/SSC info.	invert Max depth 12" EUROPE: 10 liters per min per
		Sump at every 5 Km. Trench	Km
		invert Max depth 12"	
		EUROPE: 10 liters per min	
		per Km	
Oil Containment System	1	None	It is assumed that Secondary containment is part of the
			equipment.
HVAC/Air Handling System	1	two 5 Ton Chilled Water	Current Basis Heat Load Spreadsheet (Shigeki/Clay/Emil)
		Fancoil every 36 meter, with	
		minimal straight duct	
		distribution	
Fire Protection System	-	Placeholder	CF&S group to provide info.
Communications System	-		CF&S group to provide info.
Transport Equipment	-	1.35 wide	This is based on the widest item (Klystron=1.3m).
			Transport vehicle is assumed to be 1.35m wide and is
			therefore the widest device transported through the
			tunnel. 0.3m (12") is assumed reasonable space on each
			side of transported equipment to avoid interference during
			transport.
Distance between Service & beam Tunnel	-	7.5 m	Basis is 1.5 times the service tunnel for CFS tunneling
			consideration (The acceptable distance due to radiation
			consideration should be invesigated and compared)
Turn Around Space for Transport Vehicles	-		CF&S group to provide info.
Egress Path	1	0.9 (36")	Assumed to be the necessary egress path width at all
			times. This needs to be confirmed by CF&S group.
Cross-overs Between Tunnels (personel)			CF&S group to provide info. based on Life Safety Analysis.

Jun 23 2006 WATER AND AIR HEAT LOAD

Total Heat Load (Accelerator Tunnel) Total Heat Load (Service Tunnel)

MAIN LINAC - ELECTRON & POSITRON													
					To Deior	nized Wa	iter			to Chilled	To Air		
							Maxi						
							mum						
					Supply	Delta	Allow						
				Heat	Temp	Tempe	able	Typical	Acceptab	Heat		Max	
			Total Heat	Load to	(variati	rature	Press	(water)	le Temp	Load to	Heat Load	Space	
	Quantity		Load	Water	on) ((C	ure	pressure	Variation	Water	to Air	Temp	
Components	Per 36m	Location	(KW)	(KW)	C)	delta)	(Bar)	drop Bar	delta C	(KW)	(KW)	(C)	Source
LCW Skid Pump 5 Hp (placehodler)	1	Service Tunnel	4.14	0	N/A	N/A	N/A	N/A	None	0	4.14		* emil - 5 HP pump placeholder
Fancoils (5 ton Chilled Water) 1 Hp	2	Service Tunnel	1.66	0	N/A	N/A	N/A	N/A	None	0	1.66		* emil - (2) 1HP 5Ton Fancoil placeholder
Rack Water Skid	0.25	Service Tunnel	1.04	0	N/A	N/A	N/A	N/A	None	0	1.04	I	* emil - 1(5Hp) every 4 RF (placeholder)
Lighting Heat Dissipation ~1.3W/sf		Service Tunnel	1.65	0	N/A	N/A	N/A	N/A	None	0	1.65	I	* Clay - 14 W per sq m
Lighting Heat Dissipation ~1.3W/sf		Accelerator Tunnel	1.65	0	N/A	N/A	N/A	N/A	None	0	1.65	I	* Clay - 14 W per sq m
People Heat Dissipation 500btuh each	0	Accelerator Tunnel	0.00	0	N/A	N/A	N/A	N/A	None	0	0.00	I	* emil - placeholder
People Heat Dissipation 500btuh each	2	Service Tunnel	0.29	0	N/A	N/A	N/A	N/A	None	0	0.29	l	* emil - placeholder
AC Pwr Transformer 34.548 kV	0.25	Service Tunnel	2.00	0	N/A	N/A	N/A	N/A	None	0	2	I	* Clay email 3-14-06 typical 112.5 kVa oil xfmr
Emerg. AC Pwr Transformer 34.548 k		Service Tunnel	1.00	0	N/A	N/A	N/A	N/A	None	0	1.3		* Clay email 3-14-06 typical 75 kVa oil xfmr
DE Charging Supply 24 E Ky AC 11KV													* C.Jensen email 2-27-06 183 kVa 0.84pf oil ps xfmr
C Charging Supply 34.5 KV AC-TIKV	1/26 m	Constant Townsel	10.00	7 50						0	11 5		**Shigeki Apr 18 2006 ** Clay 5-25-06 LLRF
	1/30111	Service Tunnel	19.00	7.50						0	11.5	ł	meeting
Modulator		Service Tunnel	7.50	3.50			28.8			0	4		* Shigeki Fukuda Email 3-1-06 **Shigeki Apr 18 2006
Pulse Transformer		Service Tunnel	6.00	5.00						0	1		**Shigeki Apr 18 2006
Klystron Socket Tank		Service Tunnel	1.00	1.00						0	0		**Shigeki Apr 18 2006
Klystron Focusing Coil		Service Tunnel	8.40	8.40	*34>					0	0		* Shigeki Fukuda Email 4-05-06
Klystron Collector		Service Tunnel	61.00	61.00	*35>			2		0	0	İ	* Shigeki Fukuda Email 3-1-06
Klystron Body		Service Tunnel	10.00	10.00	*35>			5	None	0	0	l	* Shigeki Fukuda Email 3-1-06
Klystron Windows		Service Tunnel	0.50	0.50	*35>			1		0	0	I	* Shigeki Fukuda Email 3-1-06
											_	I	* Shigeki Fukuda Email 3-30-06 **Shigeki Apr 18 2006
Relay Racks		Service Tunnel	13.3	0.0	N/A	N/A	N/A	N/A	None	11.3	0	ł	(chilled water)
Circulators & Dummy Load		Accelerator Tunnel	24.3	24.3						0	0		**Shigeki Email Apr 28 2006
Waveguide		Accelerator Tunnel	4.00	4.00	N/A	N/A		N/A		0	0.00		* Shigeki Fukuda Email 3-30-06
Other components?????		????								0	0	N/A	
Total			168.4	125.2						11.30	30.23		
RF Component only Loads			154.95										
Total Heat load to Air & Chille	d water	per RF		41.5	ĸw			47.804	1.62683	5.71832	29.8775		
Total Heat load to LCW per RI	-			125	ĸw			7.03	3.25375	11.4369			

29.95

138.43

28.3 KW

96.9 KW