< WBS detail level
< is adjustable using
< buttons at upper left

8 GeV Linac $369M

($284M plus 30% contingency on all items)

WBS LEVEL 1	2	3	4	5	ITEM	Unit	M&S Cost $	Quantity	M&S Tot. $k	Eng/Mgr FTE-yr (Labor Rates (Burdened) $160k)	Tech FTE-yr ($60k)	Phys FTE-yr ($0k)	Labor $k	Total $k	Estimated Cost Basis & Person Legally Responsible for Accounting Accuracy
					PROJECT TOTAL				**234,280**	**265**	**116**	**44**	**49,360**	**283,640**	
1.					**Project Management**				**5,000**	**125**		**25**	**20,000**	**25,000**	***S. Holmes***
2.					**Civil Construction**				**44,361**	**71**	**8**		**11,840**	**56,201**	***J. Sims - FESS***
2.	**1.**				**Construction Management**					**68**			**10,880**	**10,880**	
2.	1.	1.			**In-House EDIA (15% of M&S)**					**41**			**6,560**	**6,560**	
2.	1.	2.			**Contracted EDIA (10% of M&S)**					**27**			**4,320**	**4,320**	
2.	**2.**				**Site Work**				**7,085**					**7,085**	
2.	2.	1.			**Surface Work**				**4,735**					**4,735**	
2.	2.	1.	1.		Wetland Mitigation	acre	100,000	5	500					500	
2.	2.	1.	2.		Erosion Control	ls	4,000,000	1	4,000					4,000	
2.	2.	1.	3.		Stream Rerouting	acre	100,000	1	100					100	
2.	2.	1.	4.		Topsoil Stripping	acre	3,000	25	75					75	
2.	2.	1.	5.		Fine Grading and Seeding	acre	3,000	20	60					60	
2.	2.	2.			**Roads**				**700**					**700**	
2.	2.	2.	1.		Temporary Roadway Including Signage	lf	100,000	1	100					100	
2.	2.	2.	2.		Bituminous Pavement w/ base for Roadw	sy	25	18000	450					450	
2.	2.	2.	3.		MI road realignment	ls	150,000	1	150					150	
2.	2.	3.			**Cooling Ponds**				**1,650**					**1,650**	
2.	2.	3.	1.		Pond Excavation	cy	5	150000	750					750	
2.	2.	3.	2.		Pond Embankment	cy	5	80000	400					400	
2.	2.	3.	3.		Pond Lining	sy	4	75000	300					300	
2.	2.	3.	4.		MI Pond Expansion	ls	200,000	1	200					200	
2.	**3.**				**Utilities**				**5,300**	**3**	**8**		**960**	**6,260**	
2.	3.	1.			**Electrical**				**2,600**					**2,600**	
2.	3.	1.	1.		Duct Bank Extension	lf	100	4000	400					400	
2.	3.	1.	2.		Electrical Feeder	lf	100	20000	2,000					2,000	
2.	3.	1.	3.		Telecom	sys	200,000	1	200					200	
2.	3.	2.			**LCW Systems in Enclosures**				**600**	**3**	**8**		**960**	**1,560**	*Maurice Ball*
2.	3.	2.	1.		Klystron Gallery LCW				300	1	4		400	700	*Maurice Ball*
2.	3.	2.	2.		Linac Tunnel LCW				250	1	3		310	560	*Maurice Ball*
2.	3.	2.	3.		Beamline Tunnel LCW				50	1	2		250	300	*Maurice Ball*
2.	3.	3.			**Other Piping Systems**				**2,100**					**2,100**	
2.	3.	3.	1.		ICW Piping	lf	1,500,000	1	1,500					1,500	
2.	3.	3.	2.		Gas Piping	lf	200,000	1	200					200	
2.	3.	3.	3.		DWS and Sanitary Sewer Extension	lf	100	4000	400					400	
2.	3.	3.	4.		MI Pond Piping	ls	100,000	1	100					100	
2.	**4.**				**Beamline Tunnel Enclosure**	**lf**	**3,592**	**3200**	**11,494**					**11,494**	
2.	4.	1.			**Enclosure Construction**				**8,224**					**8,224**	
2.	4.	1.	1.		Excavation	cy	5	200000	1,000					1,000	

2.	4.	1.	2.	Mud Slab	cy	100	1200	120	120
2.	4.	1.	3.	Cast In Place Slab	cy	350	3400	1,190	1,190
2.	4.	1.	4.	Cast In Place Concrete walls and Roof	cy	450	10200	4,590	4,590
2.	4.	1.	5.	Dampproofing	sy	5	14000	70	70
2.	4.	1.	6.	Crushed Stone Fill	cy	25	8000	200	200
2.	4.	1.	7.	Drainage	lf	6	3200	19	19
2.	4.	1.	8.	sump pump and pit	each	20,000	3	60	60
2.	4.	1.	9.	Backfill	cy	5	140000	700	700
2.	4.	1.	10.	Embankment	cy	5	55000	275	275
2.	4.	2.		**Cable tray**	**lf**	**100**	**3200**	**320**	**320**
2.	4.	3.		**Electrical Outfitting**	**lf**	**150**	**3200**	**480**	**480**
2.	4.	4.		**Fire Protection/detection**	**lf**	**100**	**3200**	**320**	**320**
2.	4.	5.		**MI carrier pipe**	**lf**	**1,000**	**150**	**150**	**150**
2.	4.	6.		**Access stairways**	**each**	**500,000**	**4**	**2,000**	**2,000**
2.	**5.**			**Klystron Gallery**	**lf**	**3,264**	**2300**	**7,506**	**7,506**
2.	5.	1.		**Gallery Construction**	**lf**	**2,234**	**2300**	**5,139**	**5,139**
2.	5.	1.	1.	Excavation	cy	5	50000	250	250
2.	5.	1.	2.	Mud Slab	cy	100	1500	150	150
2.	5.	1.	3.	Cast In Place Slab	cy	350	2500	875	875
2.	5.	1.	4.	Cast In Place Concrete walls and Roof	cy	450	7600	3,420	3,420
2.	5.	1.	5.	Dampproofing	sy	5	16000	80	80
2.	5.	1.	6.	Crushed Stone Fill	cy	25	8000	200	200
2.	5.	1.	7.	Drainage	lf	6	2300	14	14
2.	5.	1.	8.	Backfill	cy	5	10000	50	50
2.	5.	1.	9.	Embankment	cy	5	20000	100	100
2.	5.	2.		**Cable tray**	**lf**	**100**	**2300**	**230**	**230**
2.	5.	3.		**Electrical Outfitting**	**lf**	**150**	**2300**	**345**	**345**
2.	5.	4.		**Fire Protection**	**lf**	**100**	**2300**	**230**	**230**
2.	5.	5.		**Access Buildings**	**each**	**150,000**	**4**	**600**	**600**
2.	5.	6.		**Transformers**	**each**	**130,000**	**3**	**390**	**390**
2.	5.	7.		**Air Switches**	**each**	**50,000**	**2**	**100**	**100**
2.	5.	8.		**Bituminuous Parking Lot**	**sy**	**25**	**2500**	**63**	**63**
2.	5.	9.		**Waveguide chases**	**each**	**10,000**	**41**	**410**	**410**
2.	**6.**			**Front End Building**				**4,113**	**4,113**
2.	6.	1.		**Front-End High Bay**	**sf**	**300**	**9000**	**2,700**	**2,700**
2.	6.	1.	1.	Frame					
2.	6.	1.	2.	Roof and walls					
2.	6.	1.	3.	Finishing					
2.	6.	1.	4.	Concrete Floor					
2.	6.	1.	5.	Electrical Outfitting					
2.	6.	1.	6.	Fire Protection					
2.	6.	1.	7.	HVAC					
2.	6.	1.	8.	Crane					
2.	6.	2.		**Office Space in Front End Bldg.**	**sf**	**200**	**3000**	**600**	**600**

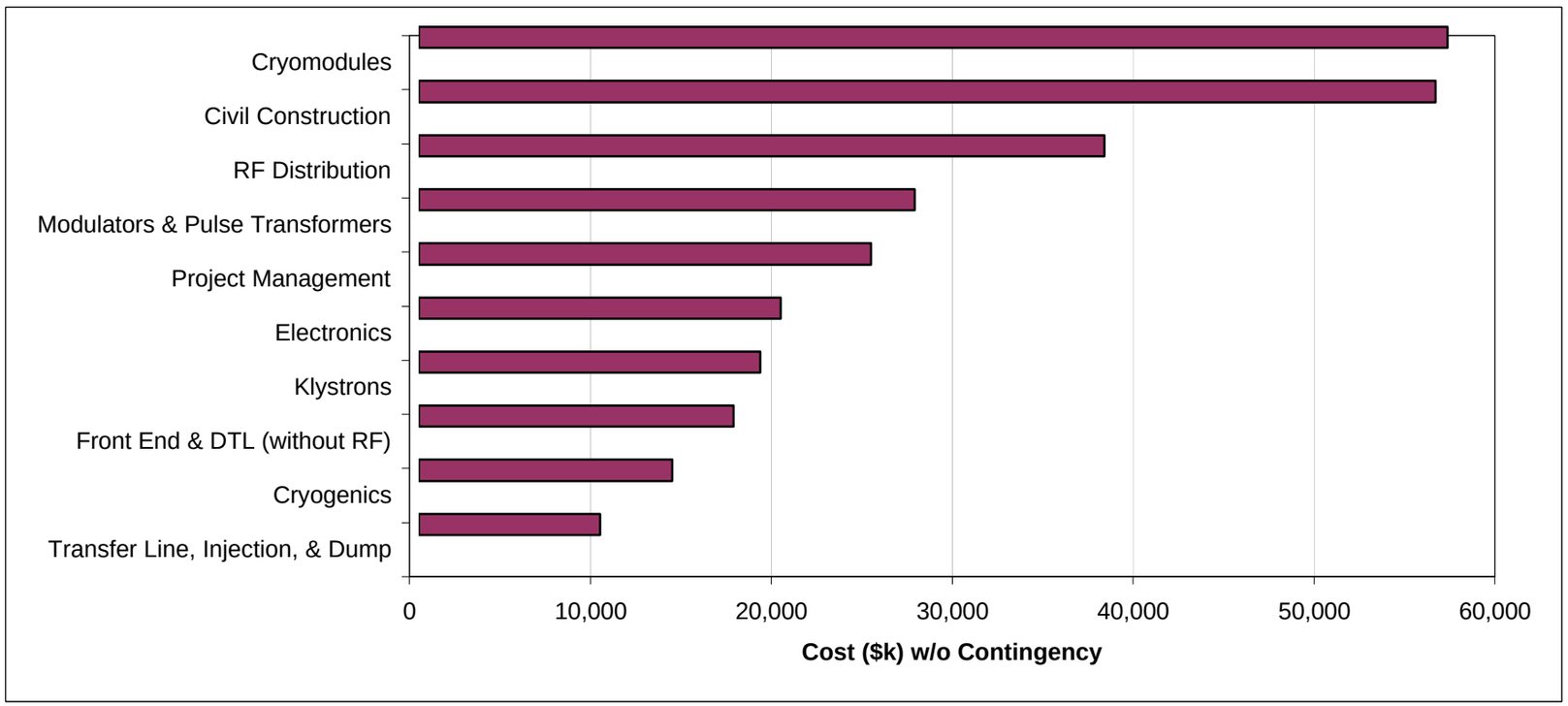
2.	6.	2.	1.	Frame									
2.	6.	2.	2.	Roof and walls									
2.	6.	2.	3.	Finishing									
2.	6.	2.	4.	Concrete Floor									
2.	6.	2.	5.	Electrical Outfitting									
2.	6.	2.	6.	Fire Protection									
2.	6.	2.	7.	HVAC									
2.	6.	3.		**Excavation**	**ls**	**100,000**	**1**	**100**					**100**
2.	6.	4.		**Below grade structural concrete**	**ls**	**500,000**	**1**	**500**					**500**
2.	6.	5.		**Utilities**	**ls**	**150,000**	**1**	**150**					**150**
2.	6.	6.		**Bituminous Parking Lot**	**sy**	**25**	**2500**	**63**					**63**
2.	**7.**			**Dump Enclosure**				**250**					**250**
2.	7.	1.		**Enclosure**	**ls**	**150,000**	**1**	**150**					**150**
2.	7.	2.		**Access**	**ls**	**50,000**	**1**	**50**					**50**
2.	7.	3.		**RAW system**	**ls**	**50,000**	**1**	**50**	**1**			**160**	**210**
2.	**8.**			**Cryogenics/ICW HTX Facility**				**7,093**					**7,093**
2.	8.	1.		**Building Including:**	**sf**	**300**	**12000**	**3,600**					**3,600**
2.	8.	1.	1.	Frame									
2.	8.	1.	2.	Roof and walls									
2.	8.	1.	3.	Finishing									
2.	8.	1.	4.	Concrete Floor and Foundations									
2.	8.	1.	5.	Electrical Outfitting									
2.	8.	1.	6.	Fire Protection									
2.	8.	1.	7.	Crane									
2.	8.	1.	8.	HVAC									
2.	8.	2.		**Pump Stations**	**each**	**100,000**	**3**	**300**					**300**
2.	8.	3.		**Piping**	**ls**	**1,000,000**	**1**	**1,000**					**1,000**
2.	8.	4.		**Heat Exchangers**		**1,000,000**	**1**	**1,000**					**1,000**
2.	8.	5.		**Pumps**	**ls**	**1,000,000**	**1**	**1,000**					**1,000**
2.	8.	6.		**Transformers**	**each**	**130,000**	**1**	**130**					**130**
2.	8.	7.		**Bituminous Parking Lot**	**sy**	**25**	**2500**	**63**					**63**
2.	**9.**			**Debuncher Building (Optional)**				**1,520**					**1,520**
2.	9.	1.		**Debuncher Building Construction**	**sf**	**300**	**5000**	**1,500**					**1,500**
2.	9.	1.	1.	Frame									
2.	9.	1.	2.	Roof and walls									
2.	9.	1.	3.	Finishing									
2.	9.	1.	4.	Concrete Floor and Foundations									
2.	9.	1.	5.	Electrical Outfitting									
2.	9.	1.	6.	Fire Protection									
2.	9.	1.	7.	Crane									
2.	9.	1.	8.	HVAC									
2.	9.	2.		**Bituminous Parking Lot**	**sy**	**25**	**800**	**20**					**20**
3.				**Front End & DTL (without RF)**				**13,885**	**16**	**16**	**8**	**3,520**	**17,405**
3.	**1.**			**Ion Source**	**ea**	**240,000**	**2**	**480**	**2**	**2**	**1**	**440**	**920**

D. Young - FNAL (ret.)
Fermilab Estimate (D. Young)

3.	**2.**			**Low Energy Beam Transport**		**112,500**	**2**	**225**	**1**	**2**		**280**	**505**	Fermilab Estimate (D. Young)
3.	**3.**			**RFQ**	**1200**	**1,200,000**	**1**	**1,200**	**2**	**2**	**1**	**440**	**1,640**	Scaled from ACCSYS PL-7 Linac
3.	**4.**			**MEBT (3 Quads, 1 buncher with P.S.)**	**150**	**150,000**	**1**	**150**	**2**	**2**	**1**	**440**	**590**	Fermilab Estimate (D. Young)
3.	**5.**			**DTL TANKS**				**10,400**	**5**	**4**	**2**	**1,040**	**11,440**	Scaled from ACCSYS PL-7 Linac
3.	5.	1.		**DTL Tank #1**	**1000**	**1,000,000**	**1**	**1,000**					**1,000**	Scaled from ACCSYS PL-7 Linac
3.	5.	2.		**DTL, Tanks #2,3,4,5,&6**	**9400**	**9,400,000**	**1**	**9,400**					**9,400**	Scaled from ACCSYS Estimate, includes Input
3.	**6.**			**Beam Diagnostics and Controls**	**1430**	**1,430,000**	**1**	**1,430**	**4**	**4**	**3**	**880**	**2,310**	Fermilab and Industrial Estimate
4.				**Cryomodules**				**52,634**	**14**	**33**	**10.6**	**4,220**	**56,854**	***T. Nicol - Tech. Div.***
4.	**1.**			**Cryomod.Unit Cost Rollup w/o Quads**	**C.M.**	**$966k/CM**	**52**	**50,258**	**12**	**29**	**8**	**3,660**	**53,918**	Cost Rollup for 8-cavity Cryomods w/o Quadru
4.	1.	1.		**Cavity Assemblies**	**ea**	**72,000**	**8 /CM**	**$576k/CM**	**5**	**5**	**5**	**1,100**	**1,676**	SNS Actual Costs for completed cavity Assemb
4.	1.	1.	1.	Cavity incl. Nb and HOM couplers	ea	40,000	8 /CM	$320k/CM					320	SNS cost of $40,000 each. All but final chemis
4.	1.	1.	2.	Cavity Final Chemistry & Prep	ea		8 /CM	$0k/CM						SNS Labor Est (rollup above)
4.	1.	1.	3.	Helium vessel	ea	10,000	8 /CM	$80k/CM					80	SNS cost
4.	1.	2.		**Tuners**	**ea**	**11,000**	**8 /CM**	**$88k/CM**	**1**	**1**	**1**	**220**	**308**	SNS estimate for production design
4.	1.	2.	1.	Motor	ea	2,200	8 /CM	$18k/CM					18	SNS estimate
4.	1.	2.	2.	Harmonic Drive	ea	1,000	8 /CM	$8k/CM					8	SNS estimate
4.	1.	2.	3.	Frame	ea	6,000	8 /CM	$48k/CM					48	SNS estimate
4.	1.	2.	4.	Piezo Tuners	ea	1,800	8 /CM	$14k/CM					14	SNS estimate
4.	1.	3.		**RF Power Coupler**	**ea**	**30,000**	**8 /CM**	**$240k/CM**	**2**	**7**	**1**	**740**	**980**	SNS cost.
4.	1.	4.		**Vacuum vessel components & Assy**	**ea**	**30,880**	**1 /CM**	**$31k/CM**	**2**	**12**		**1,040**	**1,071**	LHC Q2 scaled by diameters (40/36), plus 10%
4.	1.	4.	1.	Vacuum vessel	ea	30,880	1 /CM	$31k/CM					31	LHC Q2 scaled by diameters (40/36), plus 10%
4.	1.	4.	2.	MLI (all)	ea	6,730	1 /CM	$7k/CM					7	LHC Q2 MLI plus one additional shield blanket.
4.	1.	4.	3.	50K to 70K shield	ea	7,865	1 /CM	$8k/CM					8	LHC Q2 shields,extrusion,transition joints,mach
4.	1.	4.	4.	5K shield	ea	7,865	1 /CM	$8k/CM					8	LHC Q2 shields,extrusion,transition joints,mach
4.	1.	4.	5.	Support	ea	5,500	8 /CM	$44k/CM					44	LHC IRQ supports.
4.	1.	4.	6.	Invar tie bars	ea	1,650	14 /CM	$23k/CM					23	Based on Q2P1 parts.
4.	1.	4.	7.	Gas return pipe	ea	1,000	1 /CM	$1k/CM					1	LHC Q2 heat exchanger outer shell.
4.	1.	4.	8.	2K two-phase supply	ea	500	1 /CM	$1k/CM					1	LHC Q2 pumping line.
4.	1.	4.	9.	Cooldown/warmup line	ea	500	1 /CM	$1k/CM					1	LHC Q2 cooldown line.
4.	1.	4.	10.	Piping supports	ea	350	8 /CM	$3k/CM					3	LHC IRQ pipe supports.
4.	1.	4.	11.	Helium vessel attach brackets	ea	580	16 /CM	$9k/CM					9	Based on Q2P1 parts.
4.	1.	4.	12.	Magnetic shields	ea	10,000	2 /CM	$20k/CM					20	SNS cost of $500,000 total for 23 sets (2 shield
4.	1.	5.		**Interconnect parts**	**ea**	**27**	**1 /CM**	**$27k/CM**	**1**	**2**		**280**	**307**	
4.	1.	5.	1.	Intercryomodule bellows	ea	750	1 /CM	$1k/CM					1	Estimate. Bellows between cavities and in inte
4.	1.	5.	2.	Interconnect shield bridge	ea	250	1 /CM	$0k/CM						SSC interconnect shield bridge.
4.	1.	5.	3.	Squirm protectors	ea	1,250	1 /CM	$1k/CM					1	Based on Q2P1 parts.
4.	1.	5.	4.	Interconnect piping	ea	500	1 /CM	$1k/CM					1	
4.	1.	5.	5.	Vacuum sleeve	ea	5,000	1 /CM	$5k/CM					5	Based on MTF turnaround end sleeve.
4.	1.	5.	6.	Gas return bellows	ea	1,141	1 /CM	$1k/CM					1	Estimate. Bellows between cavities and in inte
4.	1.	5.	7.	2K two-phase bellows	ea	1,640	1 /CM	$2k/CM					2	SSC interconnect shield bridge.
4.	1.	5.	8.	Cooldown/warmup bellows	ea	750	1 /CM	$1k/CM					1	LHC IRQ.
4.	1.	5.	9.	Shield bellows	ea	475	4 /CM	$2k/CM					2	Based on Q2P1 parts.
4.	1.	5.	10.	Beam tube bellows	ea	435	1 /CM	$0k/CM						
4.	1.	5.	11.	Vacuum bellows	ea	5,000	1 /CM	$5k/CM					5	Based on MTF turnaround end sleeve.

4.	1.	5.	12.	Gate Valve on Beam Tube	ea	4,000	2 /CM	$8k/CM				8	
4.	1.	6.		**Instrumentation Inside Cryomodules**	**lot**	**5,000**	**1 /CM**	**$5k/CM**	**1**	**2**	**1**	**280**	**285**	Est
4.	**2.**			**Quadrupoles**				**2,376**	**2**	**4**	**2.6**	**560**	**2,936**	
4.	2.	1.		**Beta=0.47 Quadrupole Fabrication**	**ea**	**15,000**	**18**	**270**	**0.2**		**0.4**	**56**	**326**	*V. Kashikhin*
4.	2.	2.		**Beta=0.61 Quadrupole Fabrication**	**ea**	**15,000**	**15**	**225**	**0.2**		**0.4**	**56**	**281**	*V. Kashikhin*
4.	2.	3.		**Beta=0.81 Quadrupole Fabrication**	**ea**	**15,000**	**21**	**315**	**0.2**		**0.4**	**56**	**371**	*V. Kashikhin*
4.	2.	4.		**Beta=1.00 Quadrupole Fabrication**	**ea**	**20,000**	**72**	**1,440**	**0.4**	**1**	**0.4**	**112**	**1,552**	*V. Kashikhin*
4.	2.	5.		**Cold Test & Measurement**	**ea**	**1,000**	**126**	**126**	**1**	**2**	**1**	**280**	**406**	
5.				**Cryogenics**				**12,593**	**5**	**10**		**1,400**	**13,993**	***A. Klebaner - Beams Div. Cryo***
5.	**1.**			**Cryoplant Equipment**				**10,570**					**10,570**	CERN/LHC
5.	1.	1.		**4.5 Refrigeration system**	**ea**	**5,962,500**	**1**	**5,963**					**5,963**	CERN/LHC
5.	1.	2.		**Cold Box, 2K**	**ea**	**1,258,750**	**1**	**1,259**					**1,259**	CERN/LHC
5.	1.	3.		**Cold Compressor**	**ea**	**198,750**	**4**	**795**					**795**	CERN/LHC
5.	1.	4.		**Oil Removal System**	**ea**	**374,180**	**1**	**374**					**374**	SNS
5.	1.	5.		**Ancillary Equipment**	**ea**	**1,590,000**	**1**	**1,590**					**1,590**	SNS
5.	1.	6.		**Refrigerator Controls**	**ea**	**589,625**	**1**	**590**					**590**	CERN/LHC
5.	**2.**			**Helium Distribution & Piping**				**981**					**981**	Vendor quote
5.	2.	1.		**Warm Header, 6"IPS**	**ft**	**30**	**2700**	**81**					**81**	Vendor quote
5.	2.	2.		**Feed Box**	**ea**		**1**							DESY/TTF
5.	2.	3.		**Transfer Line (Plant/Feed Box,~50m)**	**ft**	**1,500**	**150**	**225**					**225**	SNS & BD/Cryogenic Department experience
5.	2.	4.		**Transfer Line to Debuncher~130m**	**ft**	**1,500**	**450**	**675**					**675**	SNS & BD/Cryogenic Department experience
5.	**3.**			**System installation contracts**	**ea**	**801,625**	**1**	**802**					**802**	CERN/LHC
5.	**4.**			**Misc. (ODH sys, instrument air,etc.)**	**ea**	**240,488**	**1**	**240**					**240**	CERN/LHC
6.				**Modulators & Pulse Transformers**				**25,002**	**11**	**11**		**2,420**	**27,422**	***D. Wolff - Beams Div. Elec.***
6.	**1.**			**Modulators (no Pulse Transf.)**	**ea**	**505,416**	**33**	**16,679**	**6**	**4**		**1,200**	**17,879**	1996 Actuals for FNAL/TTF modulator, scaled
6.	1.	1		**Modulator Parts**	**ea**	**258,096**	**33**	**8,517**	**3**			**480**	**258,576**	
6.	1.	1	1.	Power Transformer	ea	46,400	33	1,531					46,400	
6.	1.	1	2.	IGBT Switch including Backup	ea	26,400	33	871					26,400	
6.	1.	1	3.	Modulator Controls	ea	22,120	33	730					22,120	
6.	1.	1	4.	Main Cap Bank	ea	18,768	33	619					18,768	
6.	1.	1	5.	Power Line Conditioning	ea	18,560	33	612					18,560	
6.	1.	1	6.	Cabinet	ea	8,920	33	294					8,920	
6.	1.	1	7.	SCR Controller	ea	6,496	33	214					6,496	
6.	1.	1	8.	Machine shop	ea	6,496	33	214					6,496	
6.	1.	1	9.	Bouncer Choke	ea	5,568	33	184					5,568	
6.	1.	1	10.	Bouncer Caps	ea	5,568	33	184					5,568	
6.	1.	1	11.	Power Resistors	ea	5,568	33	184					5,568	
6.	1.	1	12.	Klystron Filament PS	ea	4,640	33	153					4,640	
6.	1.	1	13.	Solenoid PS	ea	4,640	33	153					4,640	
6.	1.	1	14.	480VAC Contactor	ea	3,712	33	122					3,712	
6.	1.	1	15.	HV Diodes	lot	3,712	33	122					3,712	
6.	1.	1	16.	Ignitron Tubes	ea	3,712	33	122					3,712	
6.	1.	1	17.	Other Misc. Parts	ea	66,816	33	2,205					66,816	
6.	1.	2.		**Assembly Labor & vendor profit**	**ea**	**237,320**	**33**	**7,832**	**2**			**320**	**237,640**	in-house labor OR vendor labor & profit

6.	1.	3.		**Installation (electrician)**	**ea**	**10,000**	**33**	**330**	**1**		**160**	**10,160**	
6.	1.	4.		**Test in situ**	**ea**					**4**	**240**	**240**	
6.	**2.**			**Pulse Transformers & Oil Tanks**				**4,593**	**3**	**4**	**720**	**5,313**	1996 Actual Costs
6.	2.	1.		**Pulse Transf. 402 MHz Klystron**	**ea**	**107,741**	**8**	**862**	**1**	**1**	**220**	**1,082**	1996 Actuals for FNAL/TTF transf.&tank, scale
6.	2.	2.		**Pulse Transf. 805 MHz Klystron**	**ea**	**105,235**	**11**	**1,158**	**1**	**1**	**220**	**1,378**	1996 Actuals for FNAL/TTF transf.&tank, scale
6.	2.	3.		**Pulse Transf. 1207 MHz Klystron**	**ea**	**98,971**	**26**	**2,573**	**1**	**2**	**280**	**2,853**	1996 Actuals for FNAL/TTF transf.&tank, scale
6.	**3.**			**Klystron Modulator Ancillary Equpt.**				**270**	**1**	**1**	**220**	**490**	
6.	3.	1.		**Oil Handling Equipment**	**cart**	**30,000**	**4**	**120**	**0.5**		**80**	**200**	
6.	3.	2.		**Klystron Installation/Transport Device**	**ea**	**15,000**	**10**	**150**	**0.5**	**1**	**140**	**290**	
7.				**Klystrons**				**16,518**	**11**	**10**	**0**	**2,360**	**18,878**	***A. Moretti - Beams Div. Linac***
7.	**1.**			**402.5 MHz Klystrons**				**2,642**	**4**	**3**	**0**	**820**	**3,462**	
7.	1.	1.		**402.5 MHz Prototype Klystron**	**ea**	**1,600,000**	**1**	**1,600**	**1**			**160**	**1,760**	SNS Actual
7.	1.	2.		**402.5 MHz Klystron Test Stand**	**ea**	**200,000**	**1**	**200**	**1**	**1**		**220**	**420**	modulators & RF included elsewhere
7.	1.	3.		**402.5 MHz Production Klystron**	**ea**	**104,199**	**8**	**834**	**1**			**160**	**994**	Marconi # KP3525L (SNS Actual)
7.	1.	4.		**402.5 MHz Klystron Production Test**	**ea**	**1,000**	**8**	**8**		**1**		**60**	**68**	
7.	1.	5.		**402.5 MHz Klystron Installation**	**ea**				**1**	**1**		**220**	**220**	
7.	**2.**			**805 MHz Klystrons**				**1,650**	**3**	**3**	**0**	**660**	**2,310**	
7.	2.	1.		**805 MHz Prototype Klystron**	**ea**		**0**						**0**	use SNS design as-is (no prototype)
7.	2.	2.		**805 MHz Klystron Test Stand**	**ea**	**200,000**	**1**	**200**	**1**	**1**		**220**	**420**	modulators & RF included elsewhere
7.	2.	3.		**805 MHz Production Klystron**	**ea**	**130,849**	**11**	**1,439**	**1**			**160**	**1,599**	Thales #TH2168 (SNS Actual)
7.	2.	4.		**805 MHz Klystron Production Test**	**ea**	**1,000**	**11**	**11**		**1**		**60**	**71**	
7.	2.	5.		**805 MHz Klystron Installation**	**ea**				**1**	**1**		**220**	**220**	
7.	**3.**			**1207.5 MHz Klystrons**				**12,226**	**4**	**4**	**0**	**880**	**13,106**	
7.	3.	1.		**1207.5 MHz Prototype Klystron**	**ea**	**1,600,000**	**1**	**1,600**	**1**			**160**	**1,760**	SNS Actual (for 402MHz Klystron)
7.	3.	2.		**1207.5 MHz Klystron Test Stand**	**ea**	**200,000**	**1**	**200**	**1**	**1**		**220**	**420**	modulators & RF included elsewhere
7.	3.	3.		**1207.5 MHz Production Klystron**	**ea**	**400,000**	**26**	**10,400**	**1**			**160**	**10,560**	Thales #TH-1801 (modified for 1207MHz) VE
7.	3.	4.		**1207.5 MHz Klystron Production Test**	**ea**	**1,000**	**26**	**26**		**1**		**60**	**86**	
7.	3.	5.		**1207.5 MHz Klystron Installation**	**ea**				**1**	**2**		**280**	**280**	
8.				**RF Distribution**				**34,287**	**12**	**28**	**0**	**3,600**	**37,887**	***A. Moretti - Beams Div. Linac***
8.	**1.**			**402.5 MHz RF Distribution**				**1,207**	**2**	**4**	**0**	**560**	**0**	**1,767**	
8.	1.	1.		**Components per 402 MHz Klystron**			**8**	**1,207**	**4**	**4**	**0**	**880**	**0**	**2,087**	
8.	1.	1.	1.	WR2100 H-sweep bend on Klystron Outpu	ea	999	8	8					8	SNS Actual
8.	1.	1.	2.	Fwd&Rev Power Monitors at Klystron	ea	1,499	8	12					12	SNS Actual
8.	1.	1.	3.	402 Circulators 0.6 MW pk, 150kW avg	ea	100,766	8	806					806	SNS Actual (9% Duty Factor)
8.	1.	1.	4.	Dual RF Power Monitor (on water load)	ea	1,499	8	12					12	SNS Actual
8.	1.	1.	5.	402 MHz Water Loads	ea	24,375	8	195					195	SNS Actual (9% Duty Factor)
8.	1.	1.	6.	WR2100 30-degree E-sweep (down bend)	ea	999	8	8					8	SNS Actual
8.	1.	1.	7.	WR2100 20ft Straight Guide (through chas	ea	3,024	8	24					24	SNS Actual
8.	1.	1.	8.	WR2100 30-degree E-sweep (up bend)	ea	999	8	8					8	SNS Actual
8.	1.	1.	9.	WR2100 Straight Guide (Tunnel Traverse)	ea	1,665	8	13					13	SNS Actual
8.	1.	1.	10.	WR2100 H-mitre (bend down to cavity)	ea	999	8	8					8	SNS Actual
8.	1.	1.	11.	Dual RF Power Monitor (cavity)	ea	1,499	8	12					12	SNS Actual
8.	1.	1.	12.	WR2100 Flex Waveguide	ea	2,565	8	21					21	SNS Actual
8.	1.	1.	13.	WR2100 misc. gaskets, hangers, etc.	ea	10,000	8	80					80	

8.	**2.**			**805 MHz RF Distribution**				**9,437**	**4**	**10**	**0**	**1,240**	**0**	**10,677**	
8.	2.	1.		**Components per 805 MHz Klystron**			**11**	**153**	**2**	**4**	**0**	**560**	**0**	**713**	
8.	2.	1.	1.	WR975 H-mitre on Klystron Output	ea	531	11	6						6	VQ (MEGA Industries)
8.	2.	1.	2.	Fwd&Rev Power Monitors at Klystron	ea	976	11	11						11	SNS Actual
8.	2.	1.	3.	WR975 30-degree E-sweep (down bend)	ea	522	11	6						6	VQ (MEGA Industries)
8.	2.	1.	4.	WR975 20ft Straight Guide (through chase	ea	1,952	11	21						21	SNS Actual
8.	2.	1.	5.	WR975 30-degree E-sweep (up bend)	ea	522	11	6						6	VQ (MEGA Industries)
8.	2.	1.	6.	WR975 Straight Guide (Tunnel Traverse)	ea	390	11	4						4	SNS Actual
8.	2.	1.	7.	WR975 H-mitre (bend parallel to beam lin	ea	531	11	6						6	VQ (MEGA Industries)
8.	2.	1.	8.	Space Frame for 805 MHz Fanout	ea	3,500	11	39						39	
8.	2.	1.	9.	WR975 misc. gaskets, hangers, etc.	ea	5,000	11	55						55	
8.	2.	2.		**Components per 805 MHz Cavity**		**1,000**	**104**	**9,283**	**2**	**6**	**0**	**680**	**0**	**9,963**	
8.	2.	2.	1.	WR975 Sidewall Couplers (8 varieties)	ea	4,998	104	520						520	VQ (MEGA Industries)
8.	2.	2.	2.	WR975 misc. Straight Waveguides	ea	732	104	76						76	SNS Actual
8.	2.	2.	3.	E-miter Panty for Directional Coupler	ea	852	208	177						177	VQ (MEGA Industries)
8.	2.	2.	4.	Reverse Power Load (air cooled)	ea	4,000	104	416						416	
8.	2.	2.	5.	Dual RF Power Monitor (circulator input)	ea	976	104	102						102	SNS Actual
8.	2.	2.	6.	805 Circulators 0.6 MW pk, 150kW avg	ea	19,000	104	1,976						1,976	VQ (Advanced Ferrite Tech)
8.	2.	2.	7.	Dual RF Power Monitor (on water load)	ea	976	104	102						102	SNS Actual
8.	2.	2.	8.	805 MHz Water Loads	ea	8,195	104	852						852	SNS Actual (9% Duty Factor)
8.	2.	2.	9.	805 Ferrite Tuner Including Magic Tee	ea	45,000	104	4,680						4,680	VQ (Advanced Ferrite Tech)
8.	2.	2.	10.	Dual RF Power Monitor (cavity)	ea	976	104	102						102	SNS Actual
8.	2.	2.	11.	WR975 Flex Waveguide	ea	1,707	104	178						178	SNS Actual
8.	2.	2.	12.	WR975 misc. gaskets, hangers, etc.	ea	1,000	104	104						104	
8.	**3.**			**1207.5 MHz RF Distribution**				**23,643**	**6**	**14**	**0**	**1,800**	**0**	**25,443**	
8.	3.	1.		**Components per 1207 MHz Klystron**			**26**	**418**	**2**	**4**	**0**	**560**	**0**	**978**	
8.	3.	1.	1.	WR650 H-mitre on Klystron Output	ea	421	52	22						22	VQ (MEGA Industries)
8.	3.	1.	2.	Fwd&Rev Power Monitors at Klystron	ea	976	52	51						51	SNS Actual (WR975 price)
8.	3.	1.	3.	WR650 30-degree E-sweep (down bend)	ea	438	52	23						23	VQ (MEGA Industries)
8.	3.	1.	4.	WR650 20ft Straight Guide (through chase	ea	1,952	52	102						102	SNS Actual (WR975 price)
8.	3.	1.	5.	WR650 30-degree E-sweep (up bend)	ea	438	52	23						23	VQ (MEGA Industries)
8.	3.	1.	6.	WR650 Straight Guide (Tunnel Traverse)	ea	390	52	20						20	SNS Actual (WR975 price)
8.	3.	1.	7.	WR650 H-mitre (bend parallel to beam lin	ea	421	52	22						22	VQ (MEGA Industries)
8.	3.	1.	8.	Space Frame for 1207 MHz Fanout	ea	2,500	52	130						130	EE
8.	3.	1.	9.	WR650 misc. gaskets, hangers, etc.	ea	1,000	26	26						26	
8.	3.	2.		**Components per 1207 MHz Cavity**		**1,000**	**312**	**23,226**	**2**	**10**	**0**	**920**	**0**	**24,146**	
8.	3.	2.	1.	WR650 Sidewall Couplers (8 varieties)	ea	3,756	312	1,172						1,172	VQ (MEGA Industries)
8.	3.	2.	2.	WR650 misc. Straight Waveguides	ea	732	312	228						228	SNS Actual (WR975 price)
8.	3.	2.	3.	E-miter Panty for Directional Coupler	ea	659	624	411						411	VQ (MEGA Industries)
8.	3.	2.	4.	Reverse Power Load (air cooled)	ea	2,500	312	780						780	
8.	3.	2.	5.	Dual RF Power Monitor (circulator input)	ea	976	312	305						305	SNS Actual (WR975 price)
8.	3.	2.	6.	1207 Circulators 0.6 MW pk, 150kW avg	ea	11,500	312	3,588						3,588	VQ (Advanced Ferrite Tech)
8.	3.	2.	7.	Dual RF Power Monitor (on water load)	ea	976	312	305						305	SNS Actual (WR975 price)
8.	3.	2.	8.	1207 MHz Water Loads	ea	4,000	312	1,248						1,248	

8.	3.	2.	9.	1207 Ferrite Tuner Including Magic Tee	ea	45,000	312	14,040	14,040	VQ (Advanced Ferrite Tech)
8.	3.	2.	10.	Dual RF Power Monitor (cavity)	ea	976	312	305	305	SNS Actual (WR975 price)
8.	3.	2.	11.	WR650 Flex Waveguide	ea	1,707	312	533	533	SNS Actual (WR975 price)
8.	3.	2.	12.	WR650 misc. gaskets, hangers, etc.	ea	1,000	312	312	312	
9.				**Electronics**				**20,000**	**20,000**	***GW Foster***
9.	**1.**			**RF Instrumentation**						
9.	1.	1.		**Timing Fanout**						
9.	1.	2.		**RF Protection/Interlock**						
9.	1.	3.		**Klystron Control**						
9.	1.	4.		**Cavity Resonance Control**						
9.	**2.**			**Beam Instrumentation**						
9.	**3.**			**Power Supplies**						
9.	**4.**			**Interlocks**						
10.				**Transfer Line, Injection, & Dump**				**10,000**	**10,000**	***GW Foster***
10.	**1.**			**Magnets**						
10.	**2.**			**Vacuum**						
10.	**3.**			**Collimation**						
10.	**4.**			**Beam Dump**						
10.	**5.**			**H- Injection**