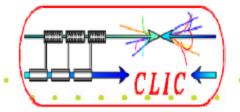


CLIC-ILC Cost & Schedule Working Group Meeting TILC09 – Sunday, April 19, 2009

reported by Peter H. Garbincius CLIC_ILC_phg_21april09.ppt

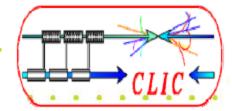




* Philippe Lebrun: CLIC Cost & Schedule W.G. mandate, organization, & activities 2009 * Philippe Lebrun: Probabilistic Cost Analysis * Katy Foraz: LHC Scheduling Applied to CLIC & LHC * Brian Foster: Issues Relating to ILC Governance Peter Garbincius: Demonstration & Status of Triad's ICET All: Work toward common CLIC-ILC document on Cost Risk Also participating: Germana Riddone, Tetsuo Shidara, Jean-Pierre Delahaye, John Carwardine, Emmanuel Tsesmelis, Claude Hauvillier, Louis Rinolfi, Vic Kuchler, Chris Adolphsen

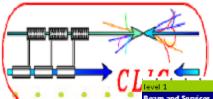
Program

* denotes presentations posted on TILC09 INDICO website

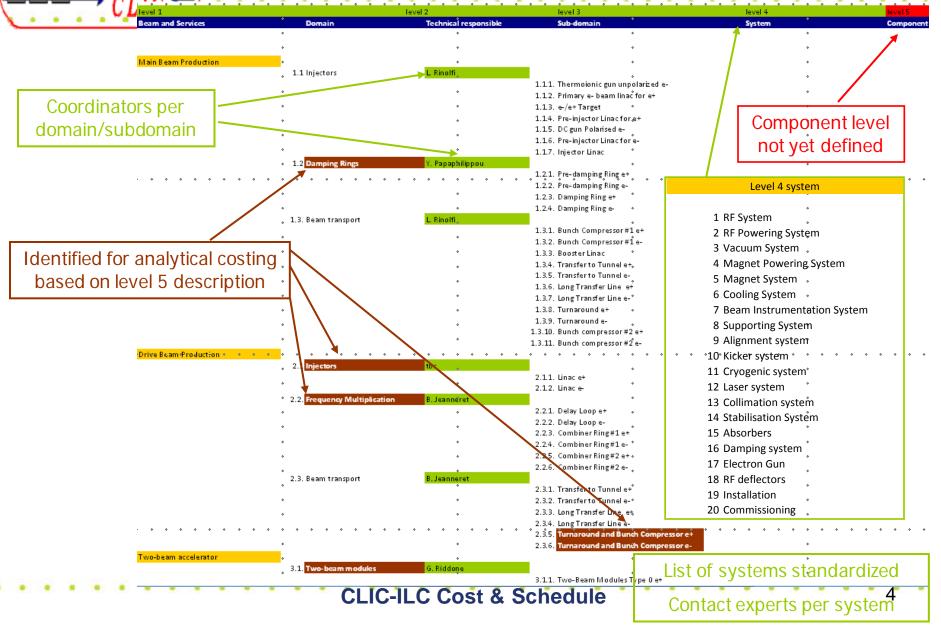


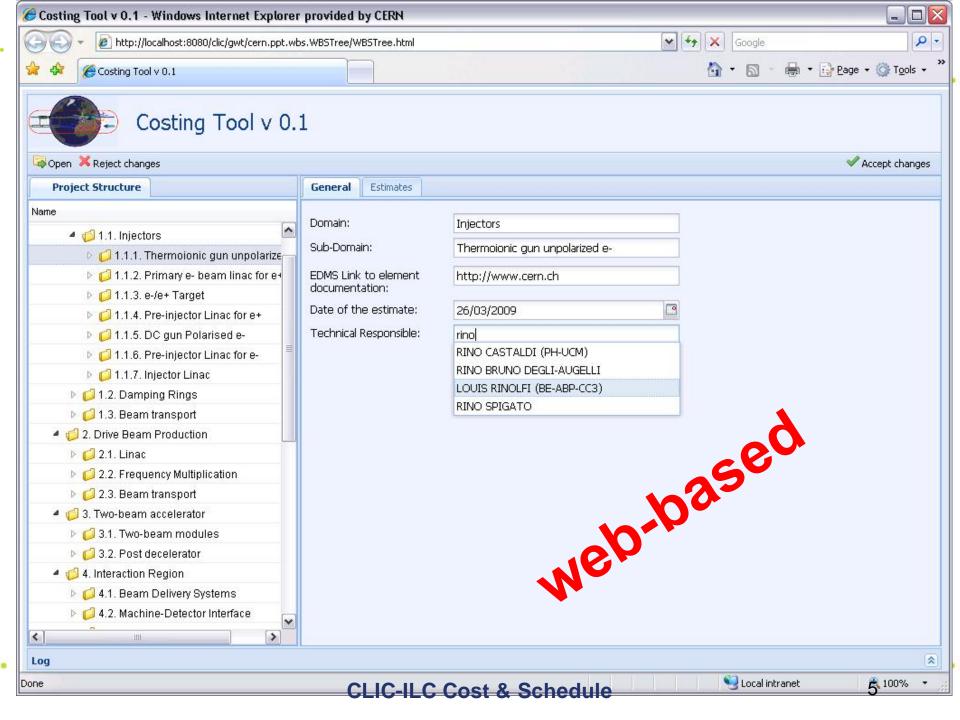
CLIC Cost & Schedule Mandate

- Establish and optimize the cost of the CLIC complex at the nominal colliding beam energy of 3 TeV, as well as that of an optional first phase with a colliding beam energy of 500 GeV
- Define and optimize the general schedule for the 3 TeV and 500 GeV projects defined above
- Estimate the electrical power consumption of the 3 TeV and 500 GeV projects defined above
- Identify possible modifications of parameters and/or equipment leading to substantial capital and/or operational cost savings, in order to define best compromise between performance and cost
- Develop collaboration with ILC project on cost estimate methodology and cost of common or comparable systems, aiming at mutual transparency
- Document the process and conclusions in the CDR in 2010 (see posting for Methodology & Activities)

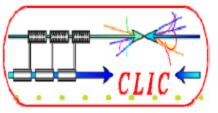


Analytical basis is PBS

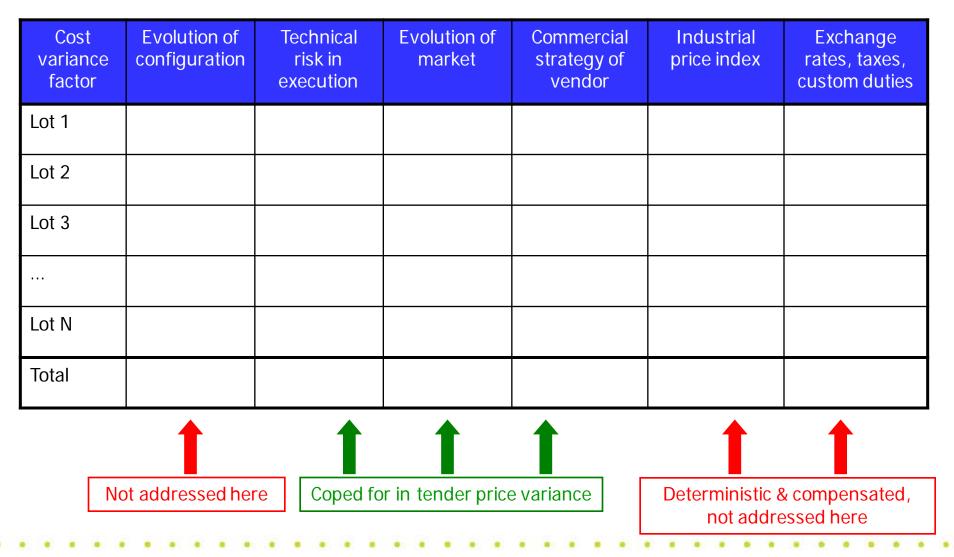




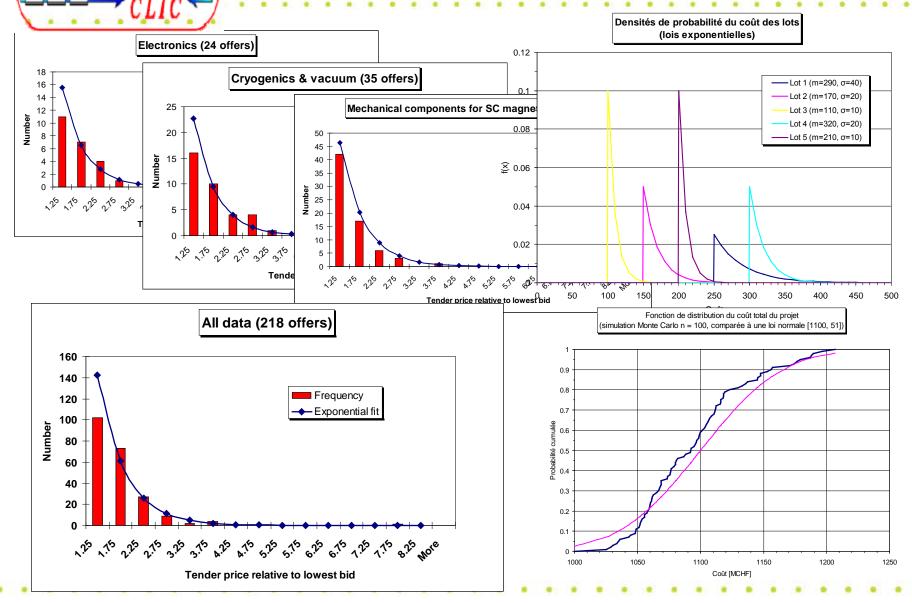
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Project Structure	General Estimates						1
Name	Property	Unit		3 TeV	500 GeV	Uncertainty	Comments / references
🔺 📁 3. Two-beam accelerator 📩	🛛 Industrialisation and tenderin	g					
🖻 📁 3.1. Two-beam modules	Start date (after project start)	years	×	0.00	0.00	C1	
🕨 📁 3.2. Post decelerator	Duration	months		1.00	0.00	C1	
🔺 🧔 4. Interaction Region	Material cost	weeks		10,000.00	0.00		see EDMS doc 12345
🖻 📁 4.1. Beam Delivery Systems	Manpower - Tech.	years		1.00	0.00		details in EDMS docume
🖻 📁 4.2. Machine-Detector Interface 📃	Manpower - Eng.	man-years		2.00	0.00		
🕨 📁 4.3. Experimental Area							
▶ 💋 4.4. Post-collision line	Procurement						
4 🧔 5. Infrastructure and Services	Start date (after project start)	years		0.50	0.00	2	
4 🥵 5.1. Civil Engineering	Duration	years		2.00	0.00	C1	
🖉 🥵 5.1.1. Underground Facilities	Fixed cost	CHF		15,000.00	0.00	{	
🧔 5.1.1.1. Shafts 📃	Proportional cost	CHF		16,500.00	0.00		
6.1.1.2. Tunnels	Manpower - Tech.	man-months		24.00	0.00		
💋 5.1.1.3. Experimental Area Cav	Manpower - Eng.	man-months		36.00	0.00		
6.1.1.4. Caverns							
🧔 5.1.1.5. Miscellaneous works	Reception						
▷ □ 5.1.2. Surface Structures	Start date (after project start)	Veere		0.00	0.00	v.	
5.1.3. Site Development	Duration	years years		0.00	0.00		
▷ 10.2. Electricity	Fixed cost	EUR		20,000.00	0.00		
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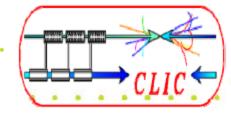


Cost variance analysis => Probabilistic approach depends on *correlations* between estimated items



LHC experience on tenders

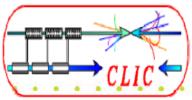




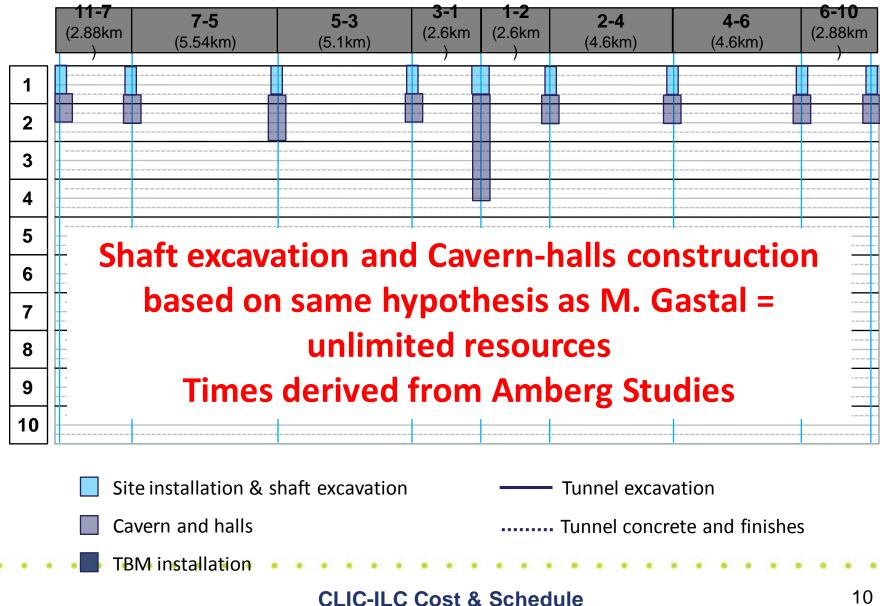
Conclusion: proposed procedure for probabilistic cost analysis

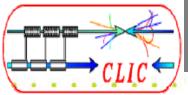
- Identify sources of cost variance and separate deterministic effects
- Identify correlated random effects and estimate their standard deviations (not to be added quadratically!)
 - Estimate mean value and standard deviation of independant elementary costs and modelize by simple skew law, e.g. exponential
- Apply central-limit theorem and/or Monte-Carlo on sum of independant elementary costs
- Apply uncertainty due to correlated random effects on previous result
- Apply compensation of deterministic effects by established factors (e.g. currency exchange rates & industrial price indices)

vital question: what items are or what fraction is correlated?

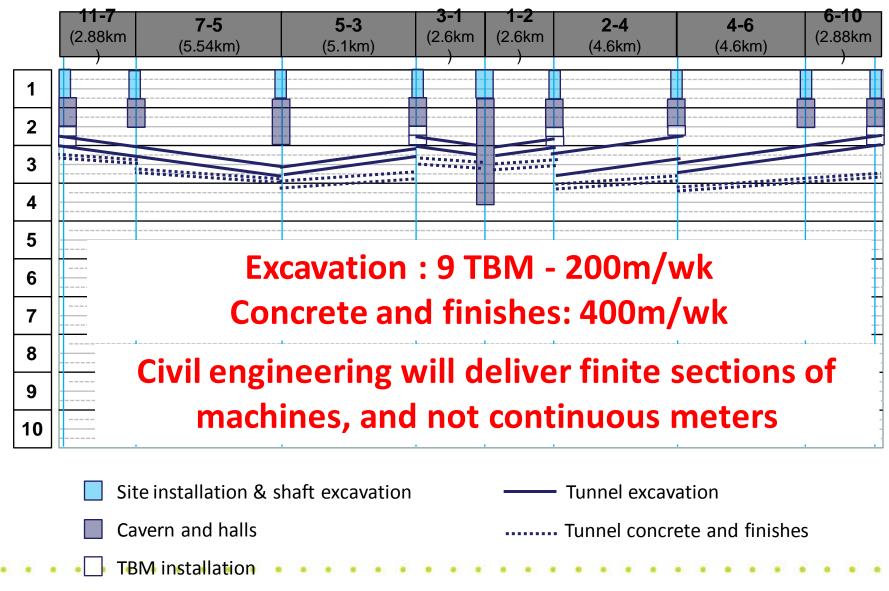


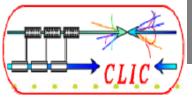
LC - Civil engineering works



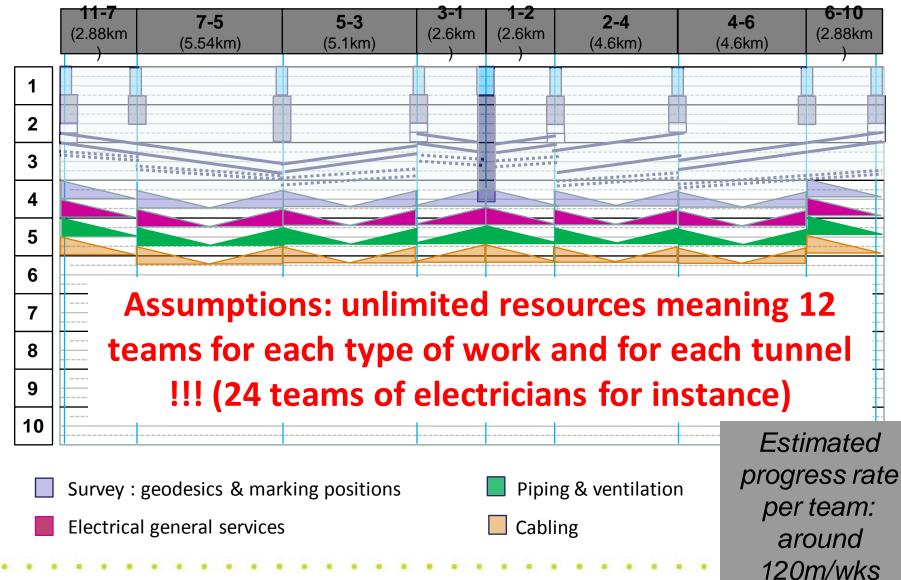


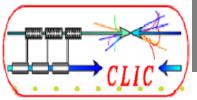
ILC - Civil engineering works





LC - General Services

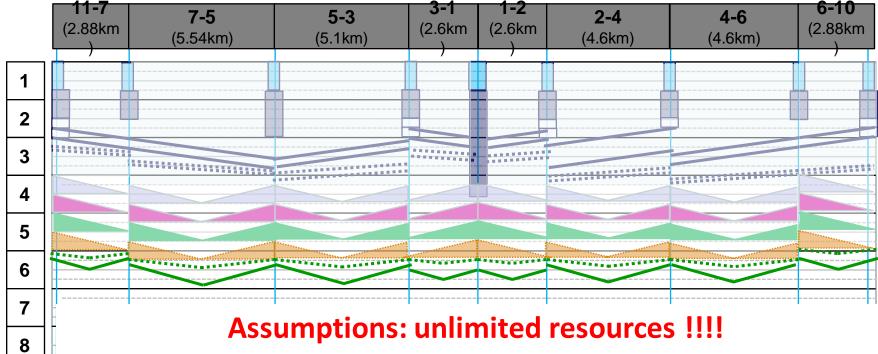




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LC - Machine installation



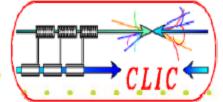
Assumptions: unlimited resources !!!! In summary for 7 years installation 9 TBM, 24 electricians teams, 12 cooling and ventilation teams, 12 teams for machine installation

•••••• Support installation and alignment (250m/wk)

Machine inst.: transport and interconnections (progress rate to be confirmed 100m/wk)

maybe more realistic: -4-TBM, 8 elec, 4-hvac, 2 mach inst => 8.5 yrs
 CLIC-ILC Cost & Schedule





- How to optimize commissioning earliest dates?
 Electron source, Auxiliary positron source, DRs
- Need entire Main Linac tunnel completed and people excluded to bring beam to far end to study RTML transport, turn-around, bunch compressors and to start beam @ low energy end of Main Linac
- Do you concentrate on 1 ML early or both later?
- Personnel exclusion during RF (cryo?) testing
- Need ILC plan learn from LHC experience!

ICET – WBS Configuration File.xls

sets links -

"atomic"	
parts —	>

Par	t WBS	Description	Workbook	Worksheet	Quantity
	1	TEC - test Construction format	TopLevel.xls	Level_1	1
	1.1	Construction - Americas Region	TopLevel.xls	Construction	1
	1.1.1	Civil Construction	Construction.xls	Civil	1
	1.1.1.1	Engineering, study work, documenation	Civil.xls	Civil_Eng	1
	1.1.1.1.1	In-house Engineering	Civil_Eng.xls	In-house	1
р	1.1.1.1.1.1	Electron Source	in-house.xls	Electron_Source	1
р	1.1.1.1.1.2	Positron Source	in-house.xls	Positron_Source	1
р	1.1.1.1.1.3	Damping Rings	in-house.xls	Damping_Rings	1
р	1.1.1.1.1.4	RTML	in-house.xls	RTML	1
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p	1.1.1.1.1.6	BDS	in-house.xls	BDS	1
p	1.1.1.1.1.7	Experimental Area	in-house.xls	Exp_Area	1
p	1.1.1.1.1.8	Common	in-house.xls	Common	1
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p	1.1.1.1.2.2	Positron Source	consultancy.xls	Positron_Source	2
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p	1.1.1.1.2.8	Common	consultancy.xls	Common	2
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CLIC-ILC Cost & Schedule

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Cost Estimate Module example

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12 Caving Materials, Production, Preparation (Yried)	27 28			linit of		Fixed Costine	Exchange			Tota			Total Cos	t Vith Risk		
33 Nobum PRP30 (Pesci Crade) 9 20% \$	27 28	Name	Qty Risk %		Material Cost (K)		Exchange Rate to	Eng (hrs)		Tota	al Cost		Total Cos Material			Entered By
14 Mobulum PRPR201(Plastor Grade) 9 201 47.27 Dolars 100 \$8962.50 0.00 \$ 70.002.23 0.00 35 Cupperm 9 201 47.2775 Dolars 100 18806.53 0.00 \$ \$7.779 0.00 36 Cupperm 9 201 45.474 Dolars 100 59.44275 0.00 0.00 \$ \$45.0754 0.00 37 Mashing 9 201 45.4744 Dolars 100 59.44275 0.00 0.00 \$ \$175.070.2 0.00 38 Cavity Frepretion 9 201 45.444 Dolars 100 126.471.75 0.00 0.00 \$ \$1267.243.8 0.00 40 Per Cavity find dependent on Cavity Yield 9 201 42.455 Dolars 100 200 0.00 0.00 \$ 2267.423 0.00 41 Traismin Vessel 9 201 54.455 Dolars 100 200 0.00 \$ 2167.237.51 0.00 0.00 17.287.51 </td <td>27 28 29 30 31</td> <td>Supporting Items and Systems</td> <td></td> <td></td> <td>Material Cost (K)</td> <td></td> <td>Exchange Rate to</td> <td>Eng (hrs)</td> <td></td> <td>Tot. Material (US K Dollars)</td> <td>al Cost Eng (hrs)</td> <td></td> <td>Total Cos Material (US K Dollars)</td> <td>Eng (hrs)</td> <td></td> <td>Entered By</td>	27 28 29 30 31	Supporting Items and Systems			Material Cost (K)		Exchange Rate to	Eng (hrs)		Tot. Material (US K Dollars)	al Cost Eng (hrs)		Total Cos Material (US K Dollars)	Eng (hrs)		Entered By
38 Cryoperm 9 201 \$\$,5,44 Dollars 100 \$\$,8943,75 0.00 0.00 \$\$ \$\$,90,016 0.00 39 Assembly & Electron Beam Velding 9 201 \$\$,80,94 Dollars 100 \$\$,77,75 0.00 0.00 \$\$ \$\$,98,03,44 0.00 30 Cavity Frepataion 9 201 \$\$,80,94 Dollars 100 \$\$ \$\$,77,75 0.00 0.00 \$\$ \$\$,77,75 0.00 \$\$ \$\$ 0.00 40 Per Cavity (not dependent on Cavity Yield) * * 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$ 0.00 \$\$ \$\$	27 28 29 30 31 32	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield)	20%			Currency	Exchange Rate to dollars	Eng (hrs)		Tot: Material (US K Dollars) 0.00	al Cost Eng (hrs) 0.00	0.00	Total Cos Material (US K Dollars) \$.	Eng (hrs)		Entered By
37 Machining 9 20x \$\$6,034 Dollars 100 \$56,032,44 0.00 \$\$6,032,44 0.00 38 Assembly Electron Deam Veiding 9 20x \$\$10,042 Dollars 100 126,712,75 0.00 0.00 \$\$15,823,244 0.00 39 Cavity Preparation 9 20x \$\$10,052 126,712,75 0.00 0.00 \$\$12,872,4318 0.00 41 Transity Vessel 9 20x \$\$10,052 0.01 0.00 0.00 \$\$25,642,22 0.00 42 Magnetic Shedding 9 20x \$\$10,07 0.01 0.00 0.00 \$\$17,877,51 0.00 43 Turrer Mechanics 9 20x \$\$1,977 Dollars 100 0.00 0.00 \$\$11,75,11 0.00 44 Turrer Mechanics 9 20x \$\$13,075 Dollars 100 202,000 \$\$11,75,11 0.00 0.00 \$\$11,75,11 0.00 45 Flexo Turrer Mechanics 9 20x \$\$13,075 Dollars 100 \$33370,50 <td< td=""><td>27 28 29 30 31 32 33 34</td><td>Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Niobium RBR300 Niobium RBR30 (Reactor Grade)</td><td>20% 9 20% 9 20%</td><td></td><td>\$158,929 \$7,763</td><td>Currency Dollars Dollars</td><td>Exchange Rate to dollars 1.00 1.00</td><td>Eng (hrs)</td><td></td><td>Tot: Material (US K Dollars) 143038.75 63862.50</td><td>al Cost Eng (hrs) 0.00 0.00</td><td>0.00 0.00 0.00</td><td>Total Cos Material (US K Dollars) \$ 4 •</td><td>Eng (hrs) 0.00 0.00 0.00</td><td></td><td>Entered By</td></td<>	27 28 29 30 31 32 33 34	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Niobium RBR300 Niobium RBR30 (Reactor Grade)	20% 9 20% 9 20%		\$158,929 \$7,763	Currency Dollars Dollars	Exchange Rate to dollars 1.00 1.00	Eng (hrs)		Tot: Material (US K Dollars) 143038.75 63862.50	al Cost Eng (hrs) 0.00 0.00	0.00 0.00 0.00	Total Cos Material (US K Dollars) \$ 4 •	Eng (hrs) 0.00 0.00 0.00		Entered By
33 Cavity Preparation 9 20% \$140,524 Dolars 0.00 1264717.75 0.00 \$ 0.00 41 Tranium Vessel 9 20% \$22,457 Dolars 100 265110.0 0.00 0.00 \$ 255,542.23 0.00 42 Magnet Shielding 9 20% \$1377 Dolars 100 265110.0 0.00 0.00 \$ 255,542.23 0.00 43 HGM Coupler 9 20% \$1377 Dolars 100 31075.1 0.00 \$ 31175.1 0.00 44 Tumer Mechanics 9 20% \$140,524 Dolars 100 310544.00 0.00 00 \$ 31175.11 0.00 45 Tumer Mechanics 9 20% \$140,577 Dolars 100 310544.00 0.00 \$ 323370.50 0.00 \$ 323370.50 0.00 \$ 32,583.44 0.00 46 Precorumer 9 20% \$103,775 Dolars 100 \$ 323370.50 0.00 \$	27 28 29 30 31 32 33 34 35	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nicobium FIRF300 Nicobium FIRF30 (Reactor Grade) Nicobium Titanium	20% 9 20% 9 20% 9 20%		\$158,929 \$7,763 \$2,076	Currency Dollars Dollars Dollars Dollars	Exchange Rate to dollars 1.00 1.00 1.00	Eng (hrs)		Tot. Material (US K Dollars) 0.00 1430258.75 63862.50 16880.63	al Cost Eng (hrs) 0.00 0.00 0.00	0.00 0.00 0.00 0.00	Total Cos Material (US K Dollars) \$ 1,433,218,47 \$ 1,433,218,47 \$ 1,430,218,47 \$ 1,433,218,47 \$ 1,433,218,47 \$ 1,433,218,47	Eng (hrs) 0.00 0.00 0.00 0.00		Entered By
40 Per Cavity find dependent on Cavity Yield \$ 0.00 \$ 0.00 \$ 0.00 41 Titanium Yessel \$ 20% \$\$23,457 Dollars 100 \$2651.00 \$2656.43.23 0.00 42 Magnetic Shielding \$ 20% \$100 \$17,257.51 0.00 \$27,247.51 0.00 43 HOM Coupler \$ 20% \$100 0.00 0.00 \$0.00 \$17,257.51 0.00 44 Ture Mechanics \$20% \$100 \$0.00 0.00 \$0.00 \$11,751 0.00 45 Ture Electronics \$20% \$16,652 Dollars 1.00 \$144,752.43 0.00 46 Piccoupler \$20% \$100,755 Dollars 1.00 \$57070.00 0.00 \$0.00 \$258,83.44 0.00 47 Cavity String Assembly (pro-rate per cavit) \$20% \$100,755 Dollars 1.00 \$37070.00 0.00 \$258,83.44 0.00 48 Power Coupler \$20% \$100,757 Dollars 1.00 \$37070.00 0.00	27 28 29 30 31 32 33 34 35 36 37	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Niobium RIR300 Niobium RIR30 (Reactor Grade) Niobium Titanium Cryoperm Machining	20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,929 \$7,763 \$2,076 \$5,434 \$66,094	Currenog Dollars Dollars Dollars Dollars Dollars	Exchange Rate to dollars 1.00 1.00 1.00 1.00 1.00 1.00	Eng (hrs)		Tot. Material (US K Dollars) 0.00 143058.75 69862.50 18680.63 4890.37 59463.37	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00 0.00 0.00	Total Cos Material (US K Dollars) \$ 1,433,218,47 \$ 70,002,23 \$ 18,717,39 \$	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00		Entered By
42 Magnetic Shielding 9 20% \$137 Dollars 100 \$72,87,51 0,00 43 HOM Coupler 9 20% \$0 Dollars 100 0,00 0,00 \$0,	27 28 29 30 31 32 33 34 35 36 37 38	Supporting Items and Systems Cavity Materials, Froduction, & Preparation (Yield) Nibolum RFR30 (Peactor Grade) Nibolum Titanium Cryoperm Machining Assembly & Electron Beam Velding	20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,929 \$7,763 \$2,076 \$5,434 \$66,094 \$19,418	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exchange Rate to dollars 1.00 1.00 1.00 1.00 1.00 1.00	Eng (hrs)		Tot. Material (US K Dollars) 0.000 14/30356.75 63962.50 18680.63 48303.75 554843.75 174757.50	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00	Material (US K Dollars) \$ 1433.218.47 \$ 70,002.23 \$ 18,77.39 \$ 430.0156 \$ 556.033.44 \$ 176.107.02	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00		Entered By
10/10 Coupler 9 20% 9 Dollars 100 000 000 000 \$	27 28 29 30 31 32 33 34 35 36 37 38 39 40	Supporting Items and Systems Cavity Materials, Froduction, & Preparation (Yield) Nibobum FIR530 (Pesactor Grade) Nibobum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Freparation Per Cavity (Tot dependent on Cavity Yield)	20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,329 \$7,763 \$2,076 \$5,434 \$66,034 \$13,418 \$140,524	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exchange Rate to dollars 100 100 100 100 100 100 100 100 100	Eng (hrs)		Material (US K Dollars) 0.00 143058;75 68962;50 18890;83 48903;75 59443;75 124713;75 0.00	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Material (US K Dollars) \$	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
15 Tuner Electronics 9 20% \$\$16,052 Dollars 100 \$\$14,752,43 0.00 47 Cavitg String Assembly [pro-rate per cavit 9 20% \$\$2,250 Dollars 100 \$\$2020,50 0.00 \$\$00 0.00 \$\$00 0.00 \$\$2020,50 0.00 48 Power Coupler 9 20% \$\$3030 Dollars 100 \$\$57000.00 0.00 \$\$58,534.00 0.00 49 Power Coupler 9 20% \$\$103,775 Dollars 100 \$\$33370.50 0.00 0.00 \$\$58,538.44 0.00 40 Cryosta - - 0.00 \$\$35,838.44 0.00 50 Cryosta - - 0.00 \$\$00 \$\$00.00 \$\$18,63.7 0.00 52 Module Berum Pipe Connection 1 20% \$\$22,241 Dollars 100 22245.00 0.00 \$\$22,243.80 0.00 54 Module Berum Pipe Connection 1 20% \$\$13,100 100.00 \$\$1300.00 0.00 \$\$3,124.74 0.00 \$\$100.00	27 28 29 30 31 32 33 33 34 35 36 36 37 38 39 40 41	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibobium RIR300 (Reactor Grade) Nibobium Titanium Crupoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Tranium Vessel	20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,929 \$7,763 \$2,076 \$5,434 \$56,094 \$19,418 \$19,418 \$19,418 \$140,524 \$29,457	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exchange Rate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Tot: Material (US K Dollars) 0.00 1430358.75 0.8882.63 18880.63 48902.75 554643.75 174757.50 124713.75 0.00 225113.00	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Material (US K Dollars) \$ 1,433,218,433,218,433,218,433,218,433,218,433,218,433,443,433,444,433,444,443,4444	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
46 Pieco Tuner 9 20% \$2,20 Dollars 100 20,200,0 0,00 \$2,20,00 0,00 47 Cavity String Assembly (pro-rate per cavity 9 20% \$563,000 Dollars 100 \$567000,00 0,00 \$568,134.00 0,00 48 Cavity Control 9 20% \$10,3775 Dollars 100 \$33370.50 0,00 0,00 \$358,844 0,00 49 Cavity Control 9 20% \$13,3775 Dollars 100 \$33370.50 0,00 0,00 \$358,844 0,00 49 Cavity Control 9 20% \$17,370 Dollars 100 7186,00 0,00 \$00 \$18,337.3 0,00 50 Vacuum Vessel and Cold Mass 1 20% \$18,337.3 Dollars 100 18337.00 0,00 \$00 \$18,337.3 0,00 52 Module Barn Pie Connection 1 20% \$13,200 Dollars 100 318,50 0,00 \$3,124,74 0,00 56 SC Magnet, Corrector, EPM Package 20% <t< td=""><td>27 28 29 30 31 32 33 34 35 36 37 38 39 40</td><td>Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibolum RIR300 (Reseator Grade) Nibolum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shielding</td><td>9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%</td><td></td><td>\$158,929 \$7,763 \$5,434 \$66,094 \$19,418 \$140,524 \$29,457 \$1,917</td><td>Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars</td><td>Exohange Rate to dollars 100 100 100 100 100 100 100 10</td><td>Eng (hrs)</td><td></td><td>Tot. Material (US K Dollars) 0.00 143058.75 63986250 18680.63 45930.75 594493.75 174757.50 124713.75 124713.75 0.00 265113.00 17253.00</td><td>al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.</td><td>0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0</td><td>Total Cos Material (US K Dollars) \$ 1.433,218.47 \$ 70,002.23 \$ 18,717.99 \$ 49,00156 \$ 596,033.44 \$ 176,107.02 \$ 1267,243.18 \$ 265,643.23 \$ 265,643.23</td><td>Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.</td><td></td><td>Entered By</td></t<>	27 28 29 30 31 32 33 34 35 36 37 38 39 40	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibolum RIR300 (Reseator Grade) Nibolum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shielding	9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,929 \$7,763 \$5,434 \$66,094 \$19,418 \$140,524 \$29,457 \$1,917	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exohange Rate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Tot. Material (US K Dollars) 0.00 143058.75 63986250 18680.63 45930.75 594493.75 174757.50 124713.75 124713.75 0.00 265113.00 17253.00	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Total Cos Material (US K Dollars) \$ 1.433,218.47 \$ 70,002.23 \$ 18,717.99 \$ 49,00156 \$ 596,033.44 \$ 176,107.02 \$ 1267,243.18 \$ 265,643.23 \$ 265,643.23	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
47 Cavity String Assembly (pro-rate per cavity 9 20% \$\$3,000 Dollars 1.00 \$\$67,000.00 0.000 \$\$68,154.00 0.00 49 Power Coupler 9 20% \$\$103,775 Dollars 1.00 333705 0.00 \$00 0.00 \$\$05,838.44 0.00 49 Cavity Control 9 20% \$\$103,775 Dollars 1.00 \$\$0,7160.650 0.00 0.00 \$\$05,838.44 0.00 50 Cryostat - 0.00 \$\$00,000 \$\$\$05,838.44 0.00 50 Cryostat - 0.00 \$\$\$\$00,000 \$\$\$\$00,000 \$\$\$\$\$\$\$\$\$\$\$00,000 \$	27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibolum RIR300 (Research Grade) Nibolum Titranium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shelding HOM Coupler Turer Mechanics	9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,323 \$7,763 \$5,434 \$56,094 \$19,418 \$19,418 \$140,524 \$23,457 \$1,317 \$3,457 \$3,450	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exohange Flate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Tot. Material (US K Dollars) 0.00 140358.75 05986.25 18880.63 48903.75 19483.75 174767.50 124713.75 0.00 265113.00 0.00 310554.00 30556.00 3	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Total Cos Material (US K Dollars) \$ - \$ 1,433,219.47 \$ 70,002.23 \$ 18,717.99 \$ 430,0156 \$ 556,033.44 \$ 175,07.02 \$ 1267,243.18 \$ 265,643.23 \$ 1267,243.18 \$ 265,643.23 \$ 17,287.51 \$ 31(175.11)	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
49 Cavity Control 9 20% \$7,7979 Dollars 100 \$7,9601 \$7,9601 000 \$7,9601 000 50 Cryostat 0 0.00 \$0.00 \$0.00 \$0.00 \$7,9601 0.00 51 Vaoum Vessel and Cold Mass 1 20% \$118,337 Dollars 1.00 \$0.00 <td>27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45</td> <td>Supporting Items and Systems Cavity Materials, Froduction, & Preparation (Yield) Nibobum RIR300 (Resotor Grade) Nibobum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shielding HOM Coupler Tuner Mechanics</td> <td>9 20% 9 20%</td> <td></td> <td>\$158,929 \$7,783 \$5,474 \$5,434 \$56,094 \$19,418 \$19,418 \$19,418 \$140,524 \$29,457 \$1377 \$1377 \$10 \$34,506</td> <td>Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars</td> <td>Exohange Pate to dollars 100 100 100 100 100 100 100 10</td> <td>Eng (hrs)</td> <td></td> <td>Material (US K Dollars) 0.00 143058 53962.50 1880.63 48903.75 53943.75 124713.75 0.00 255113.00 17253.00 0.00 310584.00 144468.35</td> <td>eng (hrs) Eng (hrs) 000 000 000 000 000 000 000 000 000 0</td> <td>0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0</td> <td>Material (US K Dollars) \$ 143321847 \$ 143321847 \$ 18,77.39 \$ 4300166 \$ 556,03344 \$ 1267,243,18 \$ 1267,243,18 \$ 285,643,23 \$ 1267,243,18 \$ 265,643,23 \$ 17,287,51 \$ 311,775.11 \$ 144,7762,43</td> <td>Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.</td> <td></td> <td>Entered By</td>	27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45	Supporting Items and Systems Cavity Materials, Froduction, & Preparation (Yield) Nibobum RIR300 (Resotor Grade) Nibobum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shielding HOM Coupler Tuner Mechanics	9 20% 9 20%		\$158,929 \$7,783 \$5,474 \$5,434 \$56,094 \$19,418 \$19,418 \$19,418 \$140,524 \$29,457 \$1377 \$1377 \$10 \$34,506	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exohange Pate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Material (US K Dollars) 0.00 143058 53962.50 1880.63 48903.75 53943.75 124713.75 0.00 255113.00 17253.00 0.00 310584.00 144468.35	eng (hrs) Eng (hrs) 000 000 000 000 000 000 000 000 000 0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Material (US K Dollars) \$ 143321847 \$ 143321847 \$ 18,77.39 \$ 4300166 \$ 556,03344 \$ 1267,243,18 \$ 1267,243,18 \$ 285,643,23 \$ 1267,243,18 \$ 265,643,23 \$ 17,287,51 \$ 311,775.11 \$ 144,7762,43	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
50 Cigostat \$\$ - 0.00 51 Yaoum Yessel and Cold Mass 1 20% \$\$118,397 Dollars 100 \$\$118,397,30 0.00 \$\$118,397,30 0.00 52 Module Beam Pipe Connection 1 20% \$\$2,2241 Dollars 100 \$\$2240,50 0.00 \$\$0,000 \$\$22,244,38 0.00 53 Module Instrumentation 1 20% \$\$1300 Dollars 1.00 1300,00 0.00 \$\$0,000	27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibolum RIR300 (Resolution Grade) Nibolum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (Inot dependent on Cavity Yield) Titanium Vessel Magnetic Shielding HOM Coupler Tuner Mechanics Tuner Electronics Piezo Tune Cavity String Assembly (pro-rate per cavit	20x 20x 9 20x		\$158,323 \$7,763 \$5,434 \$56,094 \$15,418 \$13,418 \$140,524 \$29,457 \$10 \$24,450 \$34,605 \$16,052 \$2,250 \$16,052	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exchange Flate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Material (US K Dollars) 0.00 1430358.75 63962.50 18580.63 44303.75 1244713.75 0.00 285113.00 17255.00 310554.00 144483.5 567000.00	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Material (US K Dollars) \$	Eng (hrs) 0,00 0,00 0,00 0,00 0,00 0,00 0,00 0,		Entered By
52 Module Beam Pipe Connection 1 20% \$22,241 Dollars 100 22,243 98 0.00 51 Module Instrumentation 1 20% \$1,300 Dollars 100 100 0.00 \$0,000 \$1,302,50 0.00 54 Module Connection 1 20% \$3,118 Dollars 100 3118,50 0.00 0.00 \$ 3,124,74 0.00 55 Module Connection 20% \$10 Dollars 1.00 3118,50 0.00 0.00 \$ 3,124,74 0.00 55 SC Magnet, Corrector, EPM Package 0 20% \$ - 0.00 56 - 0.00 - \$ - 0.00 57 - 0.00 \$ - 0.00 \$ - 0.00 56 - 0.00 \$ - 0.00 \$ - 0.00	27 28 29 30 31 32 33 34 35 36 39 40 41 42 42 43 44 45 46 45 48	Supporting Items and Systems Cavity Materials, Production, & Preparation (Yield) Nibolum RIR300 Nibolum RIR300 (Reactor Grade) Nibolum Titanium Cryoperm Machining Assembly & Electron Beam Velding Cavity Preparation Per Cavity (not dependent on Cavity Yield) Titanium Vessel Magnetic Shielding HOM Coupler Tuner Mechanics Tuner Electronics Piezo Tuner Cavity String Assembly (pro-rate per cavit Power Coupler	20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20% 9 20%		\$158,929 \$7,783 \$2,076 \$5,434 \$56,094 \$19,419 \$140,524 \$29,457 \$1,917 \$0 \$3,45,056 \$16,052 \$1,250 \$3,500 \$3,000 \$3,000	Currency Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars Dollars	Exchange Flate to dollars 100 100 100 100 100 100 100 10	Eng (hrs)		Tot. Material (US K Dollars) 0.00 1430356.75 63962.50 18880.63 48903.75 554443.75 1264713.75 0.00 1264713.75 0.00 310554.00 144462.50 20250.00 537307.64	al Cost Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Material (US K Dollars) \$ 1,433,218 + 3,433,218 + 3,433,218 + 3,433,218 + 3,177,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 18,777,39 \$ 12,67,243,18 \$ 12,65,643,23 \$ 17,267,51 \$ 20,230,50 \$ 311,175,11 \$ 144,752,43 \$ 20,230,50 \$ 568,134,00 \$ 568,134,00 \$ 354,834,41	Eng (hrs) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		Entered By
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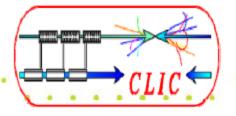
/ Sheet2 / Premium) CM_9C0Q / CI_8C2Q / CM_8C1Q / CM_6C6Q

Example of Report – studying tags

atomic	WBS	Description	Materials (U: Qty	y I	Region Area	Tech & Global Sys
	1.02	Electron Source	33,192	1	0 Electron Source	
parts	1.02.01	electrons	33,192	1	0	
•	1.02.01.01	electron part 1	8,192	1	8192 Electron Source	Dumps & Collimators
S	1.02.01.02	electron part 2	0	1	0 Electron Source	Magnets & Power Supplie
- 	1.02.01.03	8C1Q	5,000	5	0 Electron Source	Cryomodules
$ \rightarrow$	1.02.01.03.01	costs for 8C1Q	1,000	1	1000	Cryomodules
S S S S S S S S S S S S S S S S S S S	1.02.01.04	9C0Q	20,000	10	0 Electron Source	Cryomodules
ryomodules.xls	1.02.01.04.01	costs for 9C0Q	2,000	1	2000	Cryomodules
<u> </u>	1.03	Positron Source	50,000	1	0 Positron Source	
D	1.03.01	positrons	50,000	1	0	
2	1.03.01.01	a pot full of positron parts	0	1	0 Positron Source	Vacuum System
	1.03.01.02	8C1Q	10,000	10	0 Positron Source	Cryomodules
$\circ \longrightarrow$	1.03.01.02.01	costs for 8C1Q	1,000	1	1000	Cryomodules
	1.03.01.03	9C0Q	40,000	20	0 Positron Source	Cryomodules
→	1.03.01.03.01	costs for 9C0Q	2,000	1	2000	Cryomodules
~	1.04	Damping Rings	0	1	0 Damping Rings	
from	1.04.01	rings	0	1	0 Damping Rings	
0	1.05	RTML	0	1	0 RTML	
	1.05.01	turn-arounds	0	1	0 RTML	Construction (Conv. Facili
parts	1.06	Main Linac	2,500,000	1	0 Main Linac	
ピー	1.06.01	Linacs	2,500,000	1	0	· · · · · · · · · · · · · · · · · · ·
D	1.06.01.01	linac item 1	0	1	0 Main Linac	Cryogen cs
<u>0</u>	1.06.01.02	linac item 2	0	1	0 Main Linac	RF or er system
2	1.06.01.03	8C1Q	500,000	500	0 Main Linac 🛛 🔪	Chromodules
$\overline{o} \longrightarrow$	1.06.01.03.01	costs for 8C1Q	1,000	1	1000	Cryomodicles
3	1.06.01.04	9C0Q	2,000,000 1	.000	0 Main Linte	Cryomo dit
Common Common	1.06.01.04.01	costs for 9C0Q	2,000	1	2000	Cryumodules
	1.07	Beam Delivery System	0	1	0. Be im Denvery System	
N N	1.07.01	deliveries	0	1	0 Learn Delivery System	Cryogenics
U	1.08	Experimental Facilities	0	1	0 Experimental Fabilities	
	1.08.01	experiments	0	1	0 Experiment I vacilities	Installation
	1.09	Common	0	1	0 Columin	
	1.09.01	commonalities	0	1	0 Common	Phase & Timing (?)

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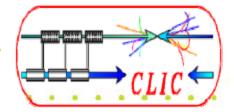




- V CLIC-ILC Cost & Schedule Working Group WEBEX Meetings 1400 GMT - 2nd Thursday of each month
- V Keep work towards cost estimate mutually transparent
- Profit by synergies
- V Understand and communicate unavoidable differences in the methodologies used for the two projects
- V Construction & installation schedules for CLIC & ILC w same methodology 6/09
- Common ILC/CLIC notes (for mid '09)
 - Tunnel safety underground compliance *defer to:* Fabio Corsenego - ILC-CFS and CLIC-CES groups
 - Standardization methods to estimate cost of warm magnets including cabling and power supplies – Braun & Garbincius gathering materials, but international magnet fabrication experts – are just not available! - defer
 - Description of cost risk assessment Lebrun, Riddone, Lehner, Garbincius reviewed other applications, started outlining this mgt – outline soon!

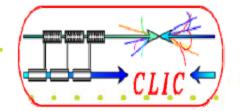


Backup slides



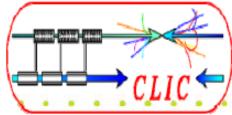
Methodology

- Establish rules & practices for cost estimation
 - Analytical based on PBS at system/component level per subdomain
 - Synthetic estimators when detailed PBS not available
 - Key actors are PBS domain/subdomain coordinators
 - Address system experts through corresponding group leaders
 - Currency conversion & price escalation
 - Use of cost software tool
- Identify major cost drivers & impact of alternative solutions and technological breakthroughs
- Whenever possible, define a parametric model for estimating variation of cost upon main technical parameters
- Identify sources of variance & conduct cost risk analyses
- Organize, maintain & update documentation with restricted access
- Report periodically to CLIC Steering Committee



Activities 2009

- Reception specified cost tool, including currency conversion & price escalation procedures, and start applying it
- Establish responsibilities, procedures & workpackages in cost assessment
- Identify domains of analytical costing and perform estimates
- Identify areas of potential cost reduction and perform studies
- Conduct proper technical/cost scaling of first phase at 500 GeV
- Refine general schedule and derive manufacturing/reception testing/installation constraints
- Update estimates of power & energy consumption, including part load operation
- Collaborate with ILC on previously defined cost topics
 - Cost risk analysis
 - Cost of normal conducting magnets

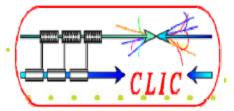


e.g. PBS to level 4 & cost coordinators

	0	.1	Cost coordinator
level 0 le	evel 1	level 2	level 3
Project B	eam and Services	Area	Sub-area
CLIC			
	1ain Beam		
		Injectors	H. Braun
			Thermoionic gun unpolarized e-
			Primary beam linac for e-
			e-/e+target
			Pre-injector linac for e+
evel 4 systems	Experts		DC gun Polarised e-
			Pre-injector linac for e-
f system	W. Wuensch		Injector linac
f powering system	G. McMonagle	Damping Rings	H. Braun
ollimation system	R. Assmann		Pre-damping Ring e+
acuum system nagnet system	P. Strubin D. Tommasini, T. Zickler		Pre-damping Ring e-
owering system	TBD		Damping Ring e+
ooling system	G. Riddone		Damping Ring e-
eam instrumentati	on T. Lefevre, H. Schmickler	Beam transport	B. Jeanneret
upporting system	G. Riddone	beam transport	Bunch compressor #1 e+
tabilisation system	C. Hauviller		Bunch compressor #1 e+
lignment system	H. Mainaud-Durand, JP. Quesnel		
arget system	K. Elsener	•	

Peter H. Garbincius November 20, 2008

Cost Management



PBS comparison

level 0	level 1	level 2		
Project	Beam and Services	Area		
CLIC			1	TEC
	Main Beam		1.01	Management
		Injectors		Management
		Damping Rings	1.02	Conventional Construction
		Beam transport Linac Accelerators		
			1.03	Electron Source
		Beam Delivery Systems Post-collision line	1.04	Positron Source
	Drive Beam	Post-conision line		
	Drive Beam	Injectors	1.05	Damping Rings
			1.06	Ring To Main Linac
		Beam transport		
		Linac Decelerator	1.07	Main Linac
		Dumps	1.08	Beam Delivery System
	Interaction Region		1.09	Experimental Systems
		Machine-Detector Interface		
	of and familian	Experimental Area	1.10	Global Systems
	CE and Services	Civil Engineering	1.11	Common
		Electricity		Common
		Access and Communication	าร	
		Fluids		
		Transport / installation	_	
		Safety	_	
		Survey	_	

Peter H. Garbincius November 20, 2008 Cost Management

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Basis of probabilistic cost analysis

- Following the PBS, the project is split in i lots, the cost of which are random variables X_i with
 - mean value m_i

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- standard deviation σ_{i}
- The total cost of the project is a random variable $X = \Sigma X_i$
 - with mean value $m = \Sigma m_i$
- In the case when the X_i are statistically independant, X = Σ X_i is characterized by
 - standard deviation $\sigma = (\Sigma \sigma_i^2)^{\frac{1}{2}}$
 - probability density function (PDF) asymptotically tending to Gaussian (central-limit theorem)
- Statistical independance or correlations between X_i is more important to probabilistic analysis of total cost, than detailed knowledge of the specific PDFs of X_i

Statistical modeling of component costs

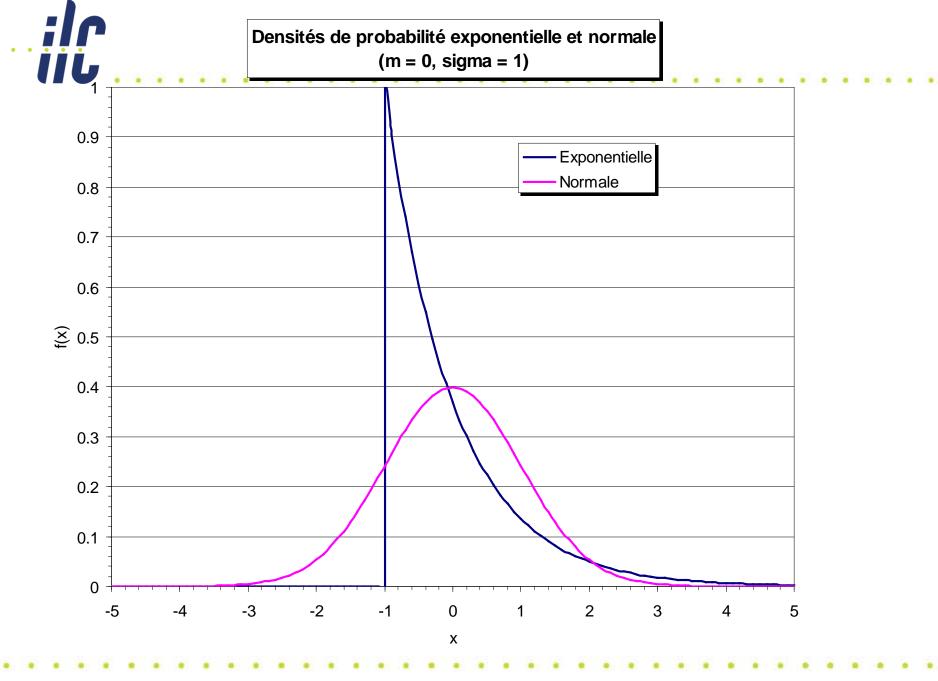
- Heuristic considerations
 - things tend to cost more rather than less ⇒ statistical distributions of X_i are strongly skew
 - PDFs f_i(x_i) are equal to zero for x_i below threshold values b_i equal to the lowest market prices available
 - commercial competition tends to crowd prices close to lowest ⇒ PDFs f_i(x_i) are likely to be monotonously decreasing above threshold values b_i
- The exponential PDF is a simple mathematical law satisfying these conditions

f(x) = 0for x < b $f(x) = a \exp[-a(x-b)]$ for $x \ge b$

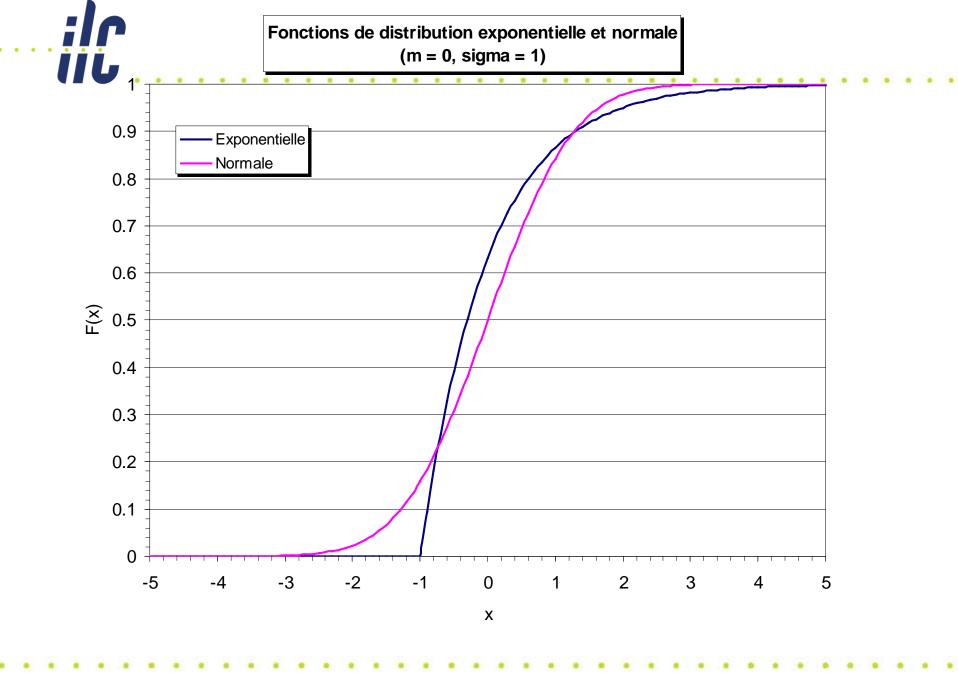
- Characteristics of the exponential law
 - only two parameters a and b
 - threshold
 - mean value m = 1/a + b
 - standard deviation $\sigma = 1/a = m b$
 - « mean value = threshold + one standard deviation »

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CLIC-ILC Cost & Schedule



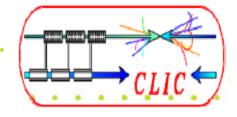
CLIC-ILC Cost & Schedule



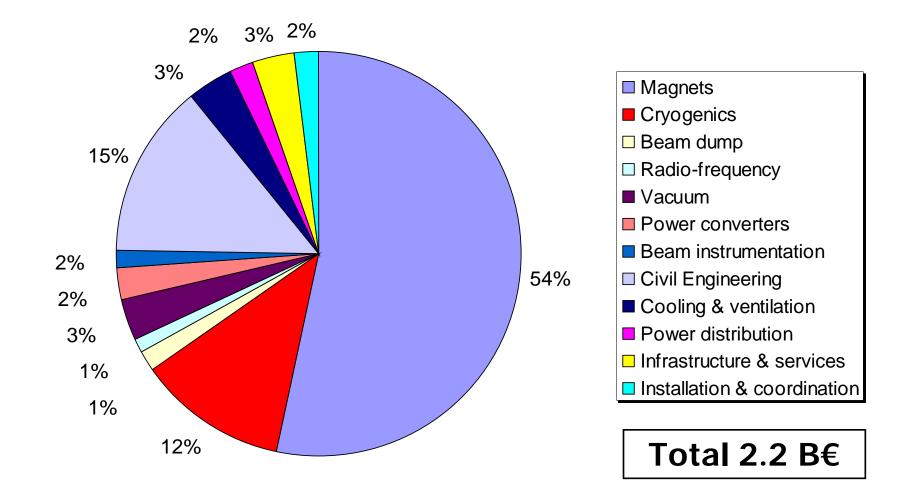
Gaussian

iiL

- X ≤ m σ at confidence level 15,9%
- X ≤ m at confidence level 50%
- X ≤ m + 1,28 σ at confidence level 90%
- X ≤ m + 1,65 σ at confidence level 95%
- X ≤ m + 2,06 σ at confidence level 98%
- Exponential
 - X ≤ m σ at confidence level 0
 - X ≤ m at confidence level 63,2%
 - X ≤ m + 1,30 σ at confidence level 90%
 - X ≤ m + 2,00 σ at confidence level 95%
 - X ≤ m + 2,91 σ at confidence level 98%

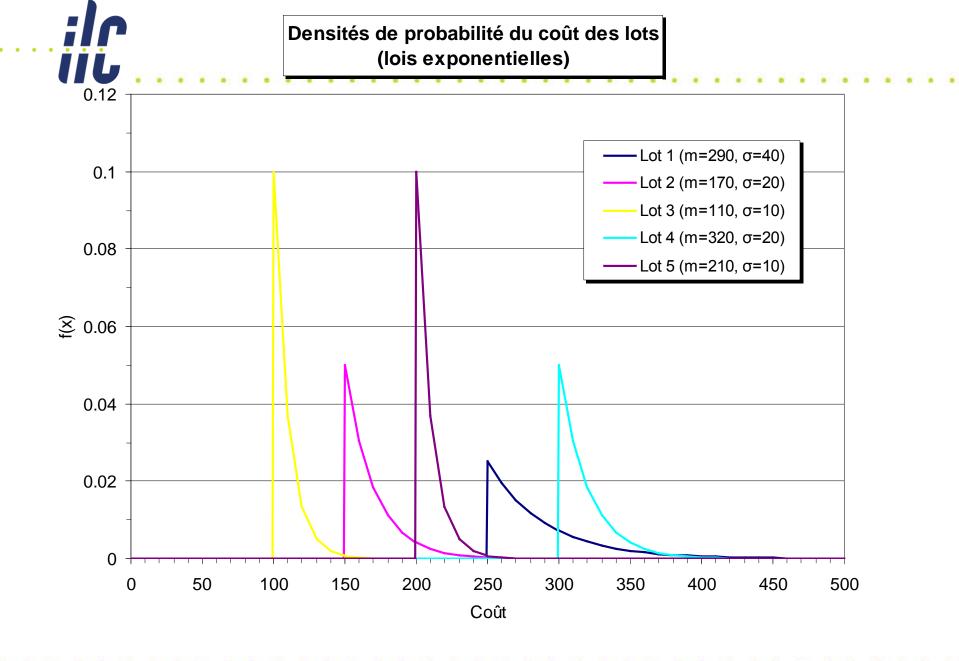


LHC cost structure for contracts > 750 K€

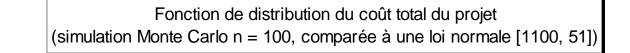


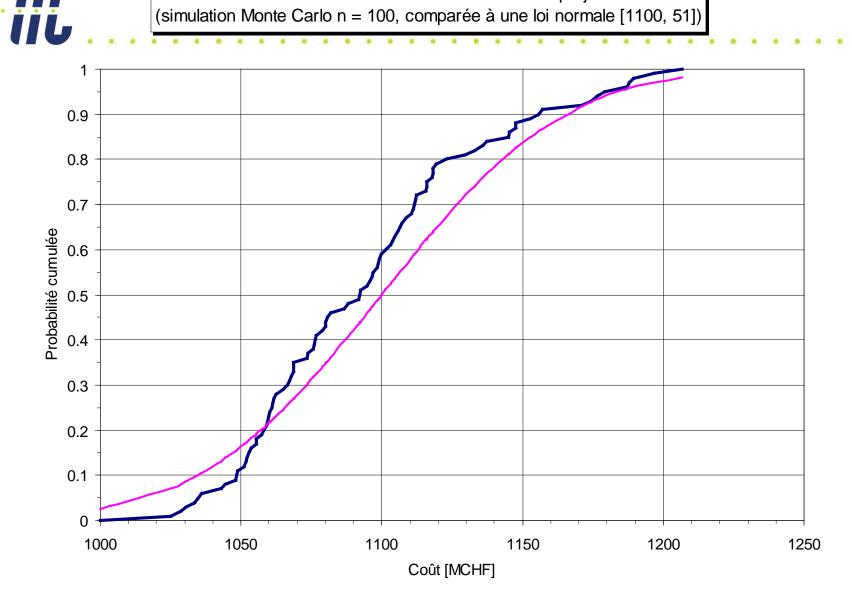


- <u>Available data</u>: CERN purchasing rules impose to procure on the basis of lowest valid offer ⇒ offers ranked by price with reference to lowest for adjudication by FC
- <u>Postulate:</u> scatter of (valid) offers received for procurement of LHC components is a measure of their cost variance due to technical, manufacturing and commercial aspects
- Survey of 218 offers for LHC machine components, grouped in classes of similar equipment
- Prices normalized to that of lowest valid offer, i.e. value of contract
- Exponential PDFs fitted to observed frequency distributions with same mean and standard deviation



CLIC-ILC Cost & Schedule





Remaining question for Philippe

 Distribution desired is not the distribution of all vendor quotes (which includes higher quotes which were not accepted), but given a model for how many vendors will quote under that distribution, what is the distribution of the *lowest* acceptable quotation. • Consider a project made of 5 lots according to the table below

Lot	Seuil	Ecart-type	Moyenne	Variance
-	250	40	290	1600
	2 150	20	170	400
3	3 100	10	110	100
4	300	20	320	400
Ę	5 200	10	210	100
Somme	1000	100	1100	2600
Sigma				50.9901951

 In case the elementary costs are statistically independent, the total cost is a random variable with

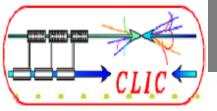
- mean value m $= \Sigma m_i = 1100$

-standard deviation $\sigma = (\Sigma \sigma_i^2)^{\frac{1}{2}} \approx 51$

- Its PDF tends towards a Gaussian law [1100, 51]
 - $-X \le 1165$ at confidence level 90%
 - $-X \le 1184$ at confidence level 95%

$-X \le 1205$ at confidence level 98%

 This law can be compared to the result of a Monte-carlo simulation based on exponential PDFs for elementary costs, treated as independent



Nh of TBM

Resources comparison with CLIC

CLIC (\otherwordsymbol{0})	CLIC (¢2)	ILC
	2	9

2

7.2v

7.2v

10.5v

10.5**y**

	~	0
Nb of teams for elec. general services	4	24
Nb of teams for cooling and ventilation	4	12
Nb of teams for cabling	4	24

Nb of teams for machine installation

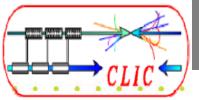
What would be the ILC schedule if machine installation is performed

with 2 teams,

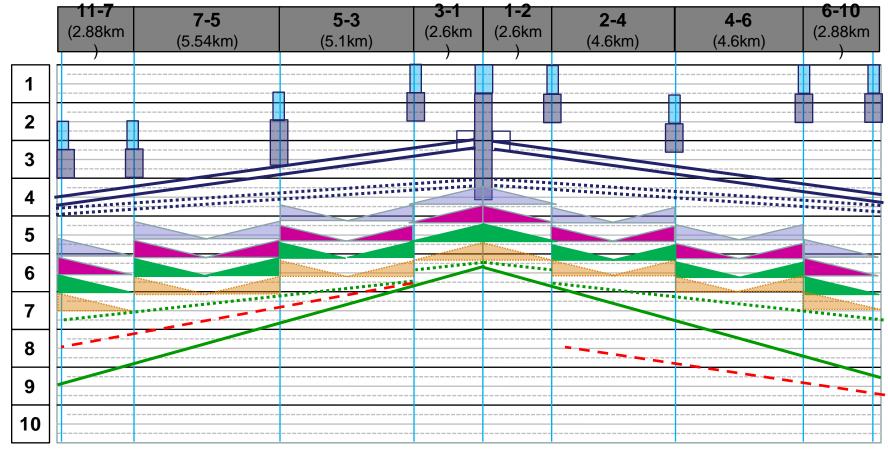
& what shall be the other resources ?

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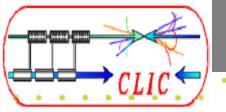
9.5



C Schedule smoothed



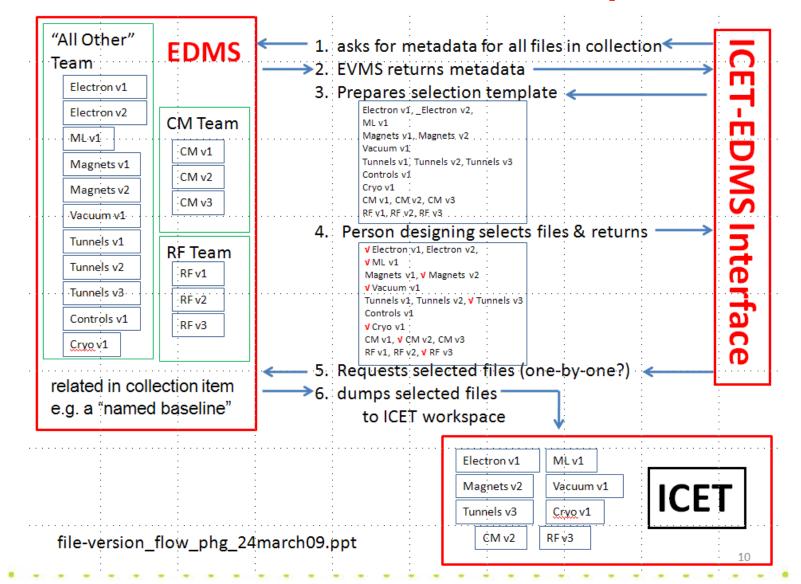
- Alternative deployment of machine installation crews (PHG)
- Support installation and alignment (250m/wk)
- Machine inst.: transport and interconnections (progress rate to be confirmed 100m/wk)



Resources comparison with CLIC

	CLIC	CLIC	ILC	
	(¢ 1)	(¢ 2)		
Nb of TBM		2	4	
Nb of teams for elec. general services	2	4		
Nb of teams for cooling and ventilation	2	4		
Nb of teams for cabling	4	4	8	
Nb of teams for machine installation		2	2	
	7.2y	10.5y	9.5y	

Use EDMS for archive, approval, Use control – *current emphasis*



Common Cost Risk Document

- Philippe and Peter: What do we need on Cost Risk Document? And who does what?
- Joined by Vic Kuchler and Chris Adolphsen
- •
- This isn't including contingency.
- •

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- Assign and add a variance due to each of these.
- Should we provide the suggested variance due to each of the elements?
- Go to vendors (or Means), get their suggestions for uncertainties?
- •
- Project uncertainty:
- Evolution of Configuration is design mature? Are the specifications known? E.g. heat loads
- But regulations could change.
- E.g. didn't know actual number of circuits (unknown requirements or heat loads)
- Had new problem => electron clouds
- Breakthrough => HTSC leads reduced heat loads
- Vendor strategy off-shelf, or custom –
- Qualification and experience of vendor
- Technical difficulties in execution
- Write specification too early, e.g. before having operational prototype
- Rejection rate of industrial process high rejection rate => higher costs
- Qualification of vendor
- Evolution of Market
- Raw material and Vendor is available, e.g. laminations by auto industry
- Long term average may tend to industrial price index
- Monopoly or oligopoly (few companies) in the business
- Commercial Strategy of Vendor
- Is vendor interested in entering new market.
- •

ic

- Not Industrial Price Index an add-on, not part of variance analysis
- Not Exchange Rates an add-on, not part of variance analysis
- •
- Checklist for estimator, qualitative, how many of these factors are applicable
- What is important?
- •
- These topics above seem to be trying to develop an uncertainty checklist/calculation similar to that used for a long time by DOE from Gary Sanders/Lockheed? Is there a reference?
- Such a general procedure is for early cost estimate studies, should use more detailed, particular information if available.
- •
- Not necessarily to try to control
- Estimate of variance or variability
- •
- Quantitative or semi-quantitative analysis of cost variance
- Important to understand approach before starting
- If you do it properly, you have problems with funding agency.
- •
- What do we write?
- Principles
- Different implementations
- •
- How do the uncertainties for the ILC and CLIC compare?
- Do we want to use DOE risk table? Or something else or similar?
- What is random and what is not? See Philippe's table?
- •
- Treating uncorrelated is easy, fully correlated is easy, determining which is which is difficult