

# ILC Meeting HLRF1

March 30/31, 2006

# Agenda HLRF1

1. **Cost goals vs. R&D Programs -- keeping them separate**
2. **Milestones for Vancouver first cost review meeting. Identifying cost teams, POC's.**
3. **Defining cost models, goals for Modulators, Klystrons, Distribution, Controls/Interlocks/Protection**
4. **Specific Technical Issues**
  - A. **Tunnel routing, cooling for waveguide**
  - B. **Tunnel Cooling loads**

# 1. Cost Goals

- For cost models:
  - Agree on BCD topology at general conceptual level
  - Generate block descriptions, diagrams, WBS outline (Level 6?)
  - Develop Manufacturing, Assembly Model
  - Estimate *parts costs* from one or more of:
    - A. Vendors – Prior Purchases
    - B. Experience – Scale from Prior Projects
    - C. Bottom-up estimate – new designs not yet built
    - E. Materials & Supplies – convert to \$USD
    - D. Labor *in FTE's*, engineering & Shops
  - Estimate *manufacturing & assembly costs* from:
    - Apply learning curves for quantities
    - Get commercial quantity quotations
  - Add in other costs -- to be discussed (Factories, QA, Storage, System integration, installation, testing etc.)

# 1. R&D Goals

- Alternate Conceptual Designs, ACD
  - To be proposed by Technical Systems or Area Systems
  - Must be approved by management for significant cost, technical or operational benefit
    - Cannot interfere with RDR cost modeling
    - May later impact cost modeling through CCB action
    - Cost models cannot be held hostage to impending ACD improvement programs.

# 1. Cost Goals

- Cost Model Detail- WBS
  - Understand current BCD's & include all significant components in cost model.
  - Build up WBS to represent all Areas.
  - Coordinate models with POC's for each Area

# HLRF WBS DRAFT

	A	B	C	D	E	F	G	H
2	<b>HIGH LEVEL RF WBS ITEM</b>							<b>Dictionary</b>
3	1.5.1.1	<b>RF System - Main Linacs</b>						All components from the high voltage transformer panel output to the RF power output fed to cryogenic accelerating cavities.
4		1.5.1.1.1	Klystron					10 MW peak 1.3GHz tube and all supports from modulator input to provide RF output.
5		1.5.1.1.1.1	Klystron Body					Unit as delivered from Manufacturer
6		1.5.1.1.1.2	Solenoid					Focussing magnet, mounting hardware
7		1.5.1.1.1.3	Socket & Tank					Tube socket, mounting, oil tank,
8		1.5.1.1.1.4	Vacuum pumps, instrumentaion					Vacuum pumps, instrumentation, cabling
9		1.5.1.1.1.5	Power supplies Solenoid, Filament					Solenoid, filament power supplies, wiring, monitoring, rack space.
10		1.5.1.1.1.6	RF Pre-driver					RF Solid state Driver, cabling. Monitoring. Hose connections to/from body, solenoid; flow meters
11		1.5.1.1.1.7	Water Cooling					Protection devices, wiring to/from all protection system inputs, PLC system cards, PLC interface to control system
12		1.5.1.1.1.7	Local Diagnostics-Controls-Protection					
13	1.5.1.1.2	Modulator						Moduator as delivered from Manufacturer
14		1.5.1.1.2.1	Modulator Assembly					
15		1.5.1.1.2.2	Pulser Forming Unit					
16		1.5.1.1.2.3	Charging Supply					
17		1.5.1.1.2.4	HV Cable Plant					
18		1.5.1.1.2.5	Pulse Transformer					
19		1.5.1.1.2.6	Water Cooling					
20		1.5.1.1.2.7	Local Diagnostics-Controls-Protection					
21	1.5.1.1.3	RF Distribution						
22		1.5.1.1.3.1	Waveguide distribution					
23		1.5.1.1.3.2	Cavity Coupler Matching tuners					
24		1.5.1.1.3.3	Hybrids and Loads					
25		1.5.1.1.3.4	Motor drivers					
26		1.5.1.1.3.5	Gas & Vacuum Systems					
27		1.5.1.1.3.6	Water Cooling					
28		1.5.1.1.3.7	Local Diagnostics-Controls-Protection					
29	1.5.1.1.4	Integrated Controls-Diagnostics- Interlocks-Protection-PPS						
30		1.5.1.1.4.1	PLC Hardware					
31		1.5.1.1.4.2	Database					
32		1.5.1.1.4.3	System programming					
33		1.5.1.1.4.4	System integration					
34	1.5.1.1.5	Infrastructure						
35		1.5.1.1.5.1	Instrument Racks & Cabling					
36		1.5.1.1.5.2	Cable Trays					
37		1.5.1.1.5.3	Electrical Distribution - Primary, secondary					
38		1.5.1.1.5.4	Cooling water primary system					
39	1.5.1.1.6	RF Integrated Fire & Safety Systems						

	A	B	C	D	E	F	G
40	1.5.1.2	<b>RF Systems - Sources</b>					
41		1.5.1.2.1	<b>Electron Sources</b>				
42			1.5.1.2.1.1	10MW RF Stations Warm Structures( Rollup)			
43			1.5.1.2.1.2	10 MW RF Stations - 5 GeV Linac (Rollup)			
44			1.5.1.2.1.3	Bunch Compressor RF Systems			
45				1.5.1.2.1.2.1	Solid State Amplifier System		
46				1.5.1.2.1.2.2	LLRF System		
47				1.5.1.2.1.2.3	Infrastructure		
48			1.5.1.2.1.4	RF Integrated Safety Systems			
49		1.5.1.2.2	<b>Positron Source</b>				
50			1.5.1.2.2.1	10MW RF Stations Warm Structures( Rollup)			
51			1.5.1.2.2.2	10 MW RF Stations - 5 GeV Linac (Rollup)			
52			1.5.1.2.2.3	Bunch Compressor RF Systems			
53				1.5.1.2.2.2.1	Solid State Amplifier System		
54				1.5.1.2.2.2.2	LLRF System		
55				1.5.1.2.2.2.3	Infrastructure		
56			1.5.1.2.2.3	RF Integrated Safety Systems			
57	1.5.1.3	<b>RF Systems - Damping Rings</b>					
58		1.5.1.3.1	<b>Electron Damping Rings</b>				
59			1.5.1.3.1.1	CW RF Stations			
60				1.5.1.3.1.1.1	Klystrons		
61				1.5.1.3.1.1.2	Waveguide		
62				1.5.1.3.1.1.3	Cavities		
63				1.5.1.3.1.1.4	Tuners		
64				1.5.1.3.1.1.5	LLRF		
65				1.5.1.3.1.1.6	Infrastructure		
66				1.5.1.3.1.1.7	RF Integrated Safety Systems		
67							
68		1.5.1.3.2	<b>Positron Damping Rings</b>				
69			1.5.1.3.2.1	CW RF Stations			
70				1.5.1.3.2.1.1	Klystrons		
71				1.5.1.3.2.1.2	Waveguide		
72				1.5.1.3.2.1.3	Cavities		
73				1.5.1.3.2.1.4	Tuners		
74				1.5.1.3.2.1.5	LLRF		
75				1.5.1.3.2.1.6	Infrastructure		
76				1.5.1.3.2.1.7	RF Integrated Safety Systems		
77	1.5.1.4	<b>Ring to Main Linac (RTML)</b>					
78		1.5.1.4.1	<b>Electron RTML Systems</b>				
79			1.5.1.4.1.1	10MW RF Stations			
80			1.5.1.4.1.2	High Performance LLRF			
81			1.5.1.4.1.3	Infrastructure			
82			1.5.1.4.1.4	RF Integrated Safety Systems			
83		1.5.1.4.2	<b>Positron RTML Systems</b>				
84			1.5.1.4.2.1	10MW RF Stations			
85			1.5.1.4.2.2	High Performance LLRF			
86			1.5.1.4.2.3	Infrastructure			
87			1.5.1.4.2.4	RF Integrated Safety Systems			

# 1. HLRF WBS Top Level Worksheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	DRAFT 031706 rsl									Estimates					Estimate	
2	HIGH LEVEL RF WBS ITEM							Dictionary	Qty	ED&I- hrs	M&S- K\$	Labor- hrs	Cost Basis Code**	Cost Book Refs.	1st Mfg Unit Cost (50%) (\$K)	
3	1.5.1.1	RF System - Main Linacs						All components from the high voltage transformer panel output to the RF power output fed to cryogenic accelerating cavities.								
4		1.5.1.1.1	Klystron					10 MW peak 1.3GHz tube and all supports from modulator input to provide RF output.								
5			1.5.1.1.1.1	Klystron Body				Unit as delivered from Manufacturer								
6			1.5.1.1.1.2	Solenoid				Focussing magnet, mounting hardware								
7			1.5.1.1.1.3	Socket & Tank				Tube socket, mounting, oil tank,								
8			1.5.1.1.1.4	Vacuum pumps, instrumentaion				Vacuum pumps, instrumentation, cabling								
9			1.5.1.1.1.5	Power supplies Solenoid, Filament				Solenoid, filament power supplies, wiring, monitoring, rack space.								
10			1.5.1.1.1.6	RF Pre-driver				RF Solid state Driver, cabling, Monitoring.								
11			1.5.1.1.1.7	Water Cooling				Hose connections to/from body, solenoid; flow meters								
12			1.5.1.1.1.7	Local Diagnostics-Controls-Protection				Protection devices, wiring to/from all protection system inputs, PLC system cards, PLC interface to control system								

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	Learning Curve Parameters & Results						Estimate	50% Conf.	Max Delta	Min. Delta	"5 Horsemen" - % Total Acq. Cost Adders					Space	Estimate	Estimate	Estimate	
2	Materials	Labor	Batch Size/ No. Vendors	Mfg ED&I %	Mfg Profit %	Mfg Cost Unit 1	Avg Acq. Cost (\$K) N Units	Est. Unit Mfg. Cost (50%)	Est. Max Unit Cost (+%)	Est. Min Unit Cost (-%)	Concept Design	R&D	Design	Sustaining Engrg, Test Systems	Install-Integrate-Test	Factory Test Systems, Space	On-Site Storage, Assy, Test (sq m)	Total System Cost (\$K)	Total FTE's Engrg. (py person-years)	Total FTE's Labor (py person-years)

<b>Date</b>	<b>Meeting/Action</b>	<b>Responsible Lead</b>
<b>March 30</b>	<b>Organization for RDR effort</b>	
<b>April 6</b>	<b>HLRF Cancelled (FNAL Review Mtg)</b>	
<b>April 7</b>	<b>Assign all tasks, team members</b>	
<b>April 14</b>	<b>Modulator – review cost models, costs</b>	
<b>April 18</b>	<b>Main Linac Video Review</b>	
<b>April 21</b>	<b>Klystron – review cost models, status</b>	
<b>April 29</b>	<b>Distribution – review cost models, status</b>	
<b>May 4</b>	<b>Contrls/Intlks/Protection, Safety, Infrastructure, Racks, Cooling, Inst'n</b>	
<b>May 11</b>	<b>Cost development Main Linac</b>	
<b>May 11-13</b>	<b>Main Linac Review DESY</b>	
<b>May 16</b>	<b>HLRF Video Status Review</b>	
<b>May 18</b>	<b>Cost development Damping Rings</b>	
<b>May 25</b>	<b>Cost development Sources, RTML</b>	
<b>June 1</b>	<b>Preliminary Cost Estimates Status Reviews</b>	
<b>June 8</b>	<b>Model adjustments, CCB's if any</b>	
<b>June 15</b>	<b>Cost development</b>	
<b>June 22</b>	<b>Cost development</b>	
<b>June 28</b>	<b>Second Cost Estimates Status</b>	
<b>July 7</b>	<b>Full HLRF WBS Rollup</b>	
<b>July 14</b>	<b>Final Reviews</b>	
<b>July 18-23</b>	<b>GDE Vancouver Meeting HLRF1</b>	

## 2. HLRF RDR Road -map



# 3. Defining Cost Models

- Modulator
  - BCD is DESY-FNAL Bouncer Model (ACD= Marx)
  - Commercial costs, bottoms up drafts available from FNAL, DESY
  - Re-do comprehensive bottoms up, select mfg model, get vendor costs all components
- Klystron
  - BCD is 10 MW tube
  - Get quotes from 3 vendors
  - Do expert in-house bottoms up and mfg model
- Distribution
  - Get vendor quotes Commercial Off-The-Shelf (COTS) components
  - Develop ACD design proposal (R&D)
    - Issues: Isolation, Matching, Losses, Flange Arcing, Welding, Cooling, Stability
  - CCB action, optimized quotes
- Controls/Interlocks/ Infrastructure
  - Develop comprehensive specifications, requirements
  - Bottoms up estimates based on commercial parts pricing

# 4. Specific Technical Issues

- Open Discussion

- Waveguide routing, cooling, problems
- Tunnel penetration, WG, cable plant issues (ongoing)
- Tunnel cooling model, requirements
- Racks space, cooling requirements
  - Identify modest cost drivers that can be dealt with “parametrically”.