Report of HLRF KOM/ALCPG07

S. Fukuda(KEK)
R. Larsen(SLAC)

Outline

- From KOM
    - Status of HLRF
    - Findings of HLRF
    - Argument
- Work Packages
- Action List

Agenda(1)

HLRF Kick-off Meeting - 1-3 October 2007, SLAC.		
Daily Programme: Monday 1 October 2007		
Management Overview of EDR HLRF task	09:00-09:15	YAMAMOTO, Akira
Discussion	09:15-09:20	
Summaries of ongoing HLRF facilities, R&D Activities, Work packages	09:20-11:50	
(1) Status of the XFEL RF System	09:20-09:50	CHOROBA, Stefan
(2) Status of KEK STF-HLRF	09:50-10:20	FUKUDA, Shigeki
(3) I LC Modulator Talk	10:40-11:10	NEZHEVENKO Oleg
(4) SLAC ILC RF System R&D	11:10-11:40	ADOLPHSEN, Chris
Summaries of RDR Base Design, Cost, Methodology	11:50-12:20	LARSEN, Raymond
discussion	12:20-12:30	
lunch	12:30-13:30	
Heat Load Issues, Water System	13:30-14:00	HUEDEM, Emil
Review Exiting EDR Engineering Plans (Specs, Costing, Vendors)	14:00-15:00	
(1) STF Plan Engineering, Industrialization	14:00-14:20	FUKUDA, Shigeki
(2) US ART Work Packages	14:20-14:40	ADOLPHSEN, Chris
(3) EDR management Work Packages (Non R&D)	14:40-15:00	LARSEN, Raymond
Discussion	15:00-17:00	

Agenda(2)

Daily Programme: Tuesday 2 October 2007		
Review Major R&D Program	09:00-12:30	
(1) SLAC Sheet Beam Klystron	09:00-09:20	JONGEWAARD, Erik
(2) KEK Super MBK	09:20-09:40	YOSHIDA, Mitsuhiro
(3) DESY Power Distribution System	09:40-10:00	KATALEV, Valery
(4) SLAC Power Distribution System	10:20-10:40	NANTISTA, Chris
(5) SLAC Marx DFM Modulator	11:00-11:20	BURKHART, Craig
(6) KEK Bouncer Type Modulator	11:20-11:40	AKEMOTO, Mitsuo
(7) High Availability Charger System Proposal	11:40-12:00	CASSEL, Richard
(8) EDR R&D Work Packages	12:00-12:20	LARSEN, Raymond,
Discussion	12:20-12:30	
lunch	12:30-13:30	
America's Next Year WP	13:30-14:00	ADOLPHSEN, Chris
RF Power Requirements for Cavity Field Regulation(LLRF)	14:00-14:30	MICHISONO, Shinichiro
break	14:45-15:00	
General Discussions, Q&A, Down Selection	15:00-16:30	
Summary	16:30-17:00	
Daily Programme: Wednesday 3 October 2007		
Project Tour	09:00-11:00	1

Attendance

Chris Adolphsen	Mitsuo Akemoto	Wilhelm Bialowons
Craig Burkhart	Richard Cassel	John Carwardine
Mark Champion	Stefan Choroba	Shigeki Fukuda
Hitoshi Hayano	Emil Huedem	Erik Yongewaard
Bob Kephart	Vladimir Katalev	Jobe, R. Keith
Ray Larsen	Sergei Nagaitsev	Chris Nantista
Oleg Nezhevenko	Tor Raubenheimer	John Reid
Mark Ross	Tetsuo Shidara	John. C. Sheppard
Nobe Toge	F. Y. Wang	Vladimir Vogel
Akira Yamamoto	Mitsuhiro Yoshida	

Management review of EDR HLRF task
A. Yamamoto

- Base-line Design and interface parameters to be verified,
  - *Functional design parameters and interface to be unified,*
  - *What have to be achieved and what have to be maintained?,*
  - *What can be plug-compatibly improved?,*
  - *How the tasks can be shared among sub-groups?,*
- Critical Goal:
  - *Technology to achieve E-op = 31.5 MV/m, reliably*
    - Otherwise, need to reduce the gradient or adjust the machine design
    - Need a vital program of both R&D and demonstrations
- Important Work at HLRF tasks
  - *System optimization for the best "value engineering"*
  - *R&D for Marx Generator, ACD-PDS, SBK,*

High Level RF Groups Organization for EDR-tasks

		Modulator	Klystron	PDS	Int. & Control	Charger
US	Cornell Fermilab	C. Jensen	J. Reid	O.Nezhevenko	B. Chase	C. Jensen
	SLAC	C. Burkhart	E. Jongewaard	C. Nantista	R. Larsen	R. Cassel
	ANL J-lab					
EU	DESY CEA-Saclay -Olsay INFN Spain CERN	V. Vogel	S. Choroba	V. Katalev		
AS	KEK	M. Akemoto	M. Yoshida	S. Fukuda		
	Korea Inst. IHEP India Inst.		H.S. Kim			

Defining EDR Engineering /R&D Work package Overview talk

- Choroba (DESY)

  Recent status of DESY was reported

  MBK Klystron, H-MBK delivery, modulator from additional vendor, HV cable test with bouncer mod. At higher potential, New PDS with symmetrical shunt tee,

- Fukuda (KEK)

  Recent status of STF 0.5-1.0 in KEK was reported.

  STF 0.5 and 1.0 plan, 3 BCD modulators test

- Nezhevenko (FNAL)

  FNAL modulator Status was reported

- Addolphsen (SLAC)

  US Activity for ILC-ML was reported. Important key tech. were covered by individual talk.

Reviewing Major R&D Program
Technical discussion

- Jongewaard (SLAC)/SBK
- Yoshida(KEK)/Super MBK

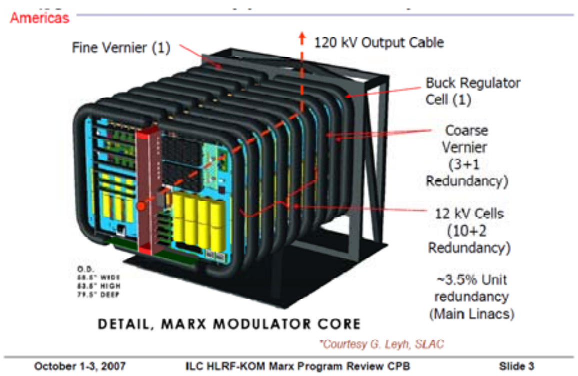
- Katalev (DESY)/DESY PDS
- Nantista (SLAC)/SLAC PDS

- Burkhart (SLAC)/Marx Modulator in SLAC
- Akemoto (KEK)/Bouncer Modulator in KEK

- Cassel (SLAC)/HA Charging System

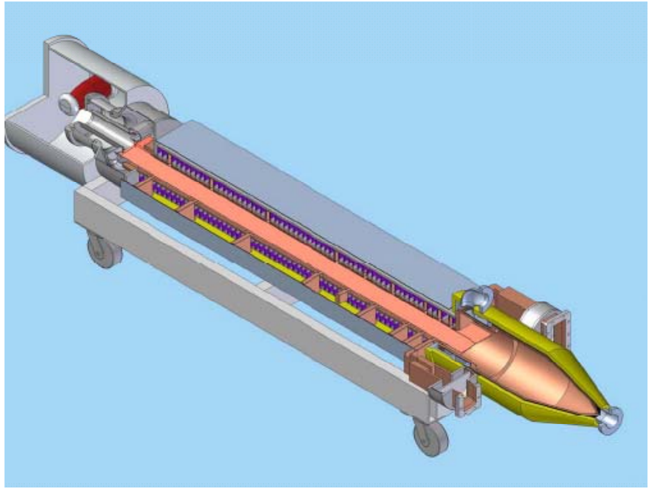
Marx Modulator Development Plan

- Prototype
  - Continue buildup to full power testing (without fine vernier)
  - Complete packaging and interlocks assembly
  - Incorporate fine vernier
  - Continue power testing
  - Move to ESB when Toshiba MBK ready (Spring 08)
- DFM
  - Continue conceptual design proposal
  - Design review
  - Detailed design, documentation
  - Build prototype as funds permit (08-09)
  - Test prototype (09)

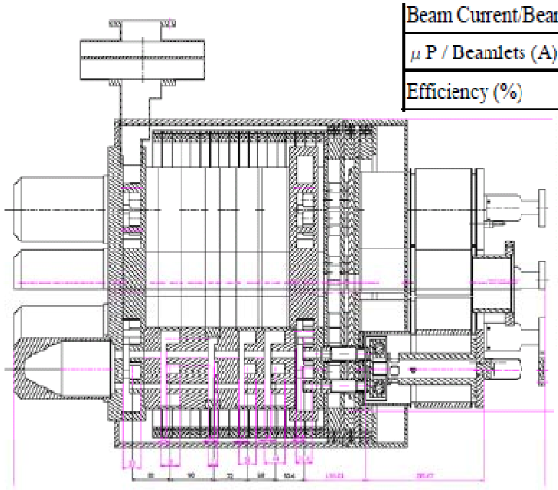


Recap: Mechanical Design

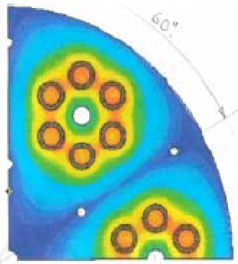
- Electron gun:
  - Cathode order has been placed (3 cathodes)
  - Design of stem, FE, cathode support structure finished
  - Drawings in check
- Anode:
  - Split isolated anode design finished
  - Drawings finished, parts on order
- Beam diagnostic:
  - Design finalized
  - Drawings in check, parts on order
- RF cavity/cold test :
  - Design finalized
  - Drawings in check
- Klystron circuit modeling and analysis underway



Super-MBK KEK



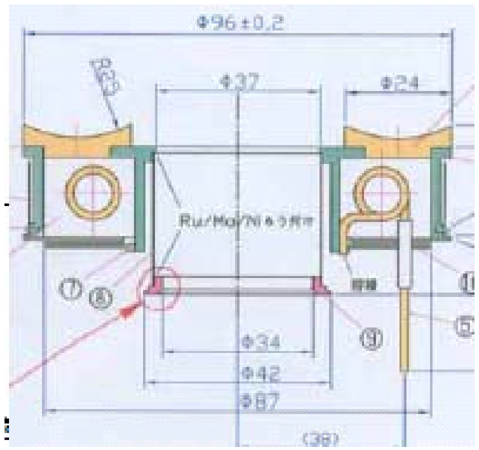
Beam Current/Beamlets (A	86.00	18.57	16.67	12.50	8.33
μ P / Beamlets (A)	1.95	0.46	0.90	0.85	0.75
Efficiency (%)	46.5	65.7	47.6	55.6	66.7

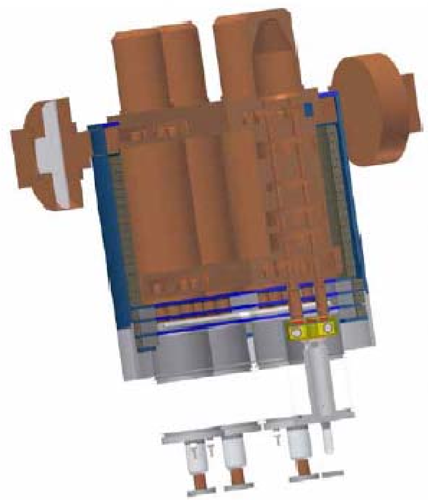


50 kV x 8.5 A x 65

μP=0.75

Cathode





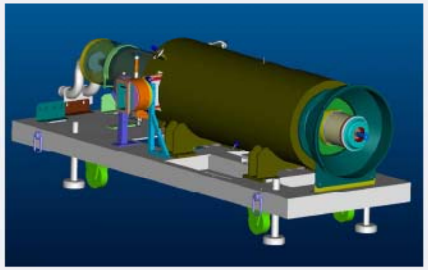
The European X-Ray Laser Project XFEL

RF High Power Source

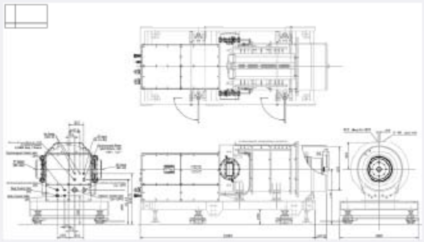
Horizontal MBK prototypes

- Horizontal versions of MBKs by all 3 vendors are under construction (THALES, TOSHIBA, CPI)
- First klystron already delivered to DESY

THALES TH1802



TOSHIBA E3736H



Stefan Choroba, DESY
High Level RFEDR Kickoff Meeting, October 1,2007 — HELMHOLTZ GEMEINSCHAFT 11

Technical highlight DESY **H-MBK**

The European X-Ray Laser Project XFEL

Status of horizontal Toshiba MBK

Test Results (Toshiba)

Peak Output Power at 117kV (MW)	10.3
Efficiency (%)	~67
Beam Pulse Length (ms)	1.7
RF Pulse length (ms)	1.5
Repetition Rate (pps)	10
Saturation Gain (dB)	50

Toshiba E3736H at test stand in August 2007 at Toshiba in Nasu, Japan

- Factory Acceptance Test (FAT) in Nasu successfull on August 22/23, 2007

Stefan Choroba, DESY
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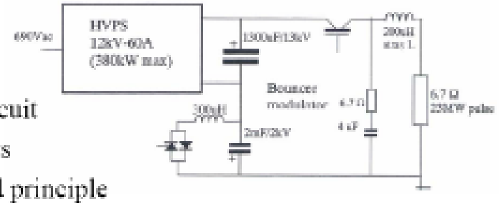
Technical highlight DESY Modulator

Modulator

Qualification of additional vendors

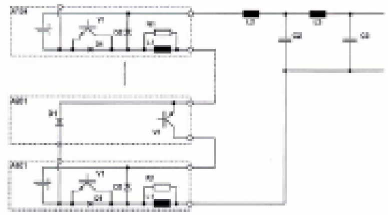
Bouncer Modulator by Imtech/Vonk

- Bouncer Type, as specified by DESY
  - 12kV HVPS
  - Bouncer 300uH/4.6kA
- 7st IGCT main switch
- Digital Regulation Circuit
- Analog In- and Outputs
- Well known and tested principle
- delivery time: 12 month



PSM Modulator by Thomson BM

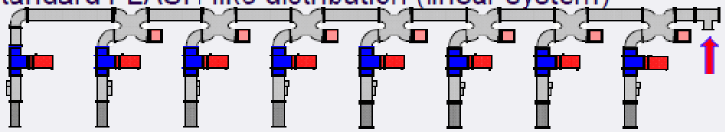
- Different Type:
  - 12kV/2kA w. transformer
  - Pulse Width Modulation
  - 24 switching stages in series
  - FPGA based control
  - 2 stages for redundancy
- Slew rate and pulse shape controllable
- detailed description available, principle already successfully tested (worldwide, i.e. W7/X)
- delivery time: 14 month



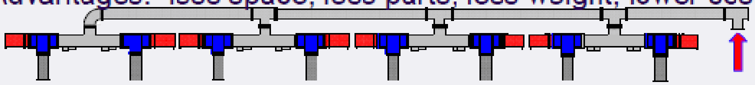
Installation at DESY, location Zeuthen, scheduled for summer 2008

Waveguide Distribution

- Standard FLASH like distribution (linear system)



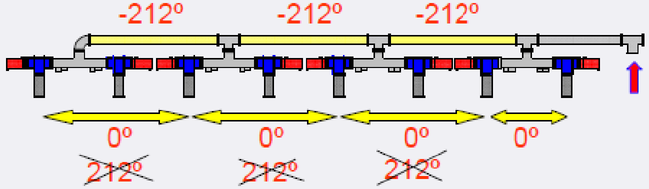
- Combined system with shunt tees (linear system with binary cells)
- Advantages: less space, less parts, less weight, lower costs



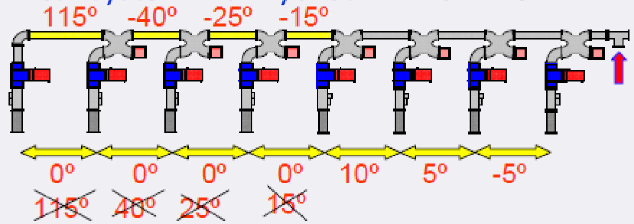
The new distribution has been tested on a test stand at DESY and is now in use at ACC6 at TTF / FLASH.
Prephasing within module successfull with a precission of +-<5degree.
Now operated up to ca. 30MV/m for 4 cavities.

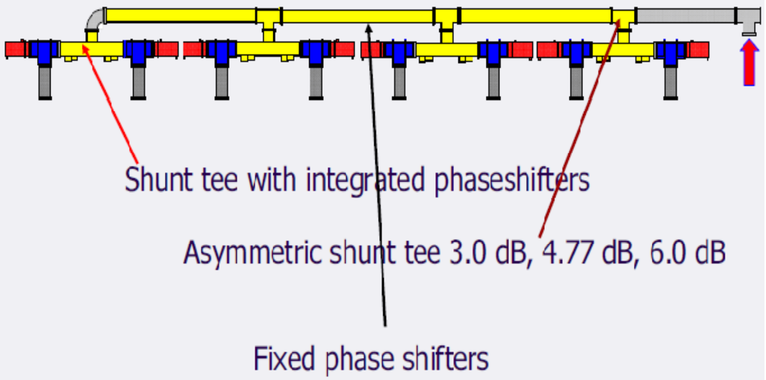
Phasing of waveguide distribution

Combined system with asymmetric shunt tees

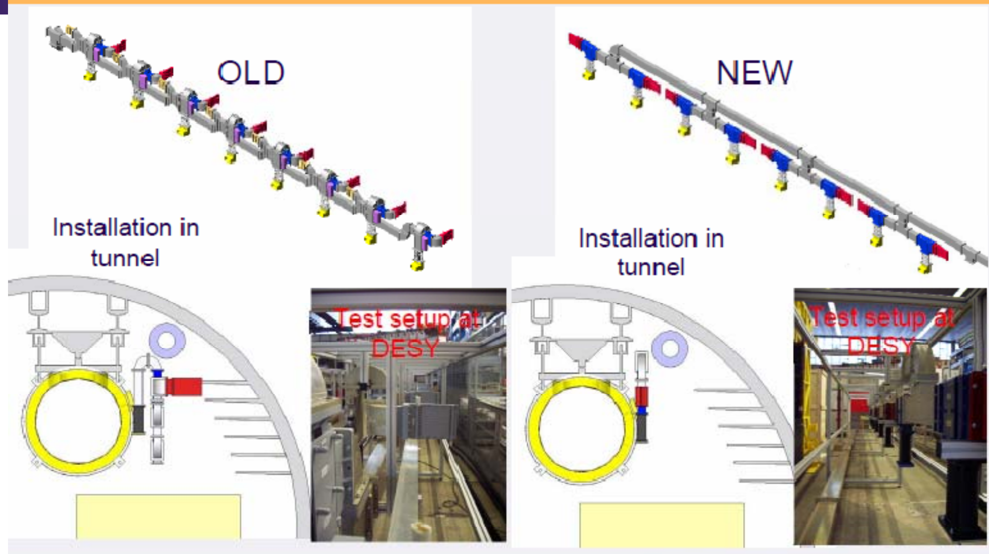


Linear system with hybrids - FLASH like



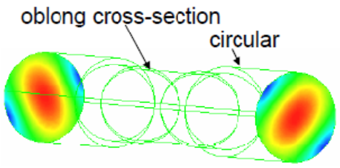


Waveguide Distribution

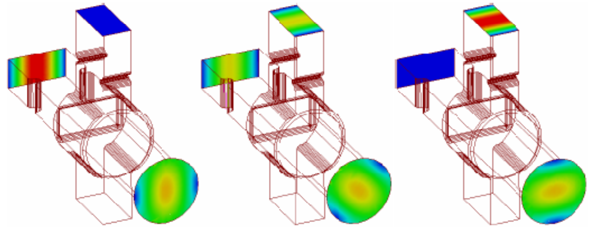


Variable Tap-Off (VTO) Design

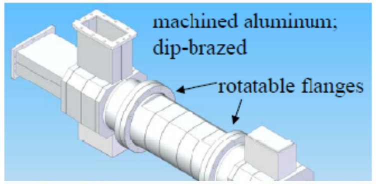
Mode Rotator:



Polarization Selecting 3-Port Junction:



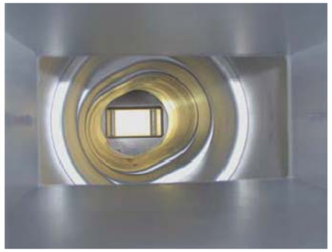
Full 4-Port Assembly:



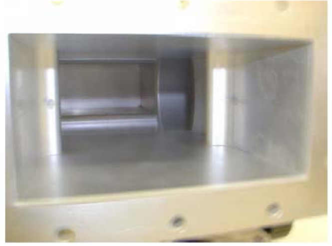
Coupling is a function of center rotation angle α.

$C = P_c / P_i$	$\alpha = 1/2 \sin^{-1}\sqrt{C}$
0	0.00°
1/4	15.00°

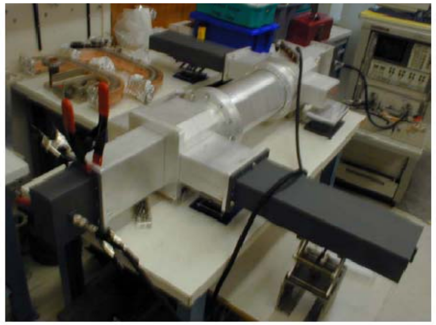
through port



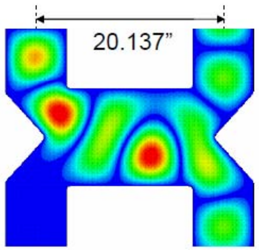
coupled port



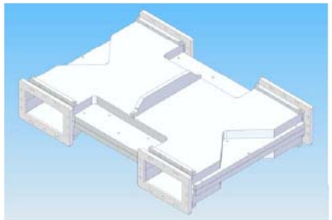
cold test setup



L-Band "Magic-H" 3-dB Hybrid



HFSS Design



Mechanical Design

Aluminum Dip-Brazed Prototype

•Ports oriented for branching distribution (eliminate 2 bends)

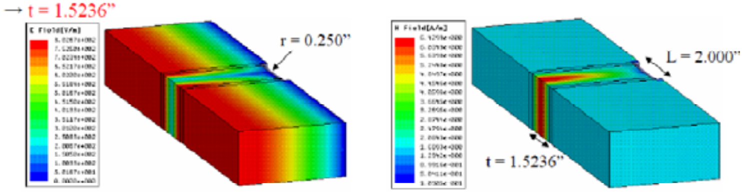
•Design for high accuracy/isolation at 1.3 GHz. Don't need broad bandwidth

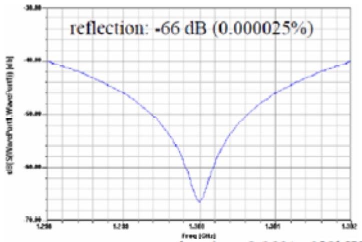
•Fabricate by aluminum dip-brazing milled halves.

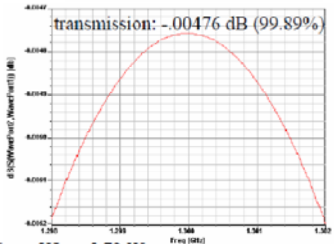
Half Wavelength Dielectric Plug Window

(in fabrication at SLAC)

Alumina:
$\varepsilon = 9.37$, $\tan\delta = 0.00015$
→ t = 1.5236"



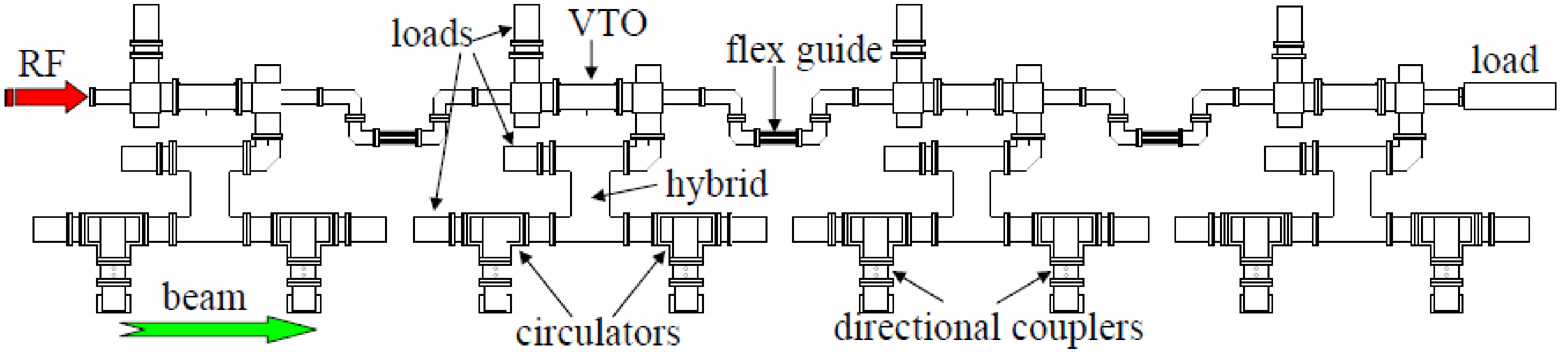




heating: 0.11%×650kW×1.6ms×5Hz = 5.72 W

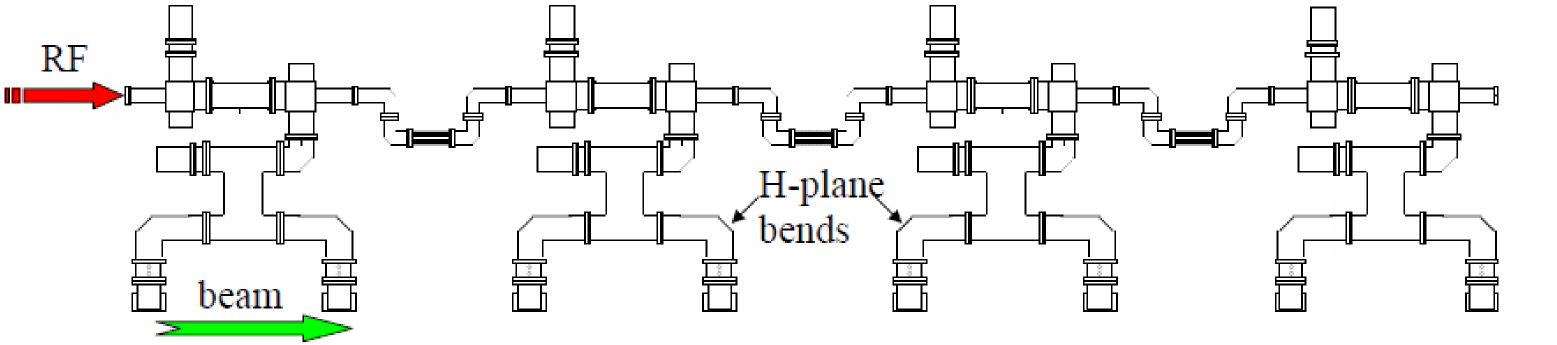
Alternative RF Distribution Layout

with circulators:



VTO's allow pair-wise adjustment of power distribution.

without circulators:



Hybrid feeding of equal-Q cavity pairs directs reflected power into hybrid loads.

Heat problem

- Emil Huedem showed the heat table with marked uncompleted (should be revised) parts
- . → responsible person
  - Klystron-Fukuda
  - PDS-C. Nantista
  - Modulator- C. Jensen
  - Charger – R. Cassel

Heat problem (2)

- We're ask to evaluate LCW water system delta T.
- For evaluation we need more info on the water cooled component.

Getting the table filled will be helpful, **but as minimum, the following for each water cooled components are needed**

- combination of either one of the following (Load/Flow, or Load/Delta T or Flow/ Delta T)
- Maximum allowable temperature
- Pressure drop for a given flow)

Nov 27b 2006

WATER AND AIR HEAT LOAD (all LCW) and 9-8-9 ML

MAIN LINAC - ELECTRON & POSITRON

Components	Quantity Per 36m	Location	To Low Conductivity Water: Heat Load to Water (KW)	Max Allowable Temperature	Supply Temp (variation) (C)	Delta Temperature (C delta)	Water Flow (l / min)	Maximum Allowable Pressure (Bar)	Typical (water) pressure drop Bar	Acceptable Temp Variation delta C	Chilled Water: Heat Load to Water (KW)	keith Jobe load to air Nov 22 06: Power fraction to Tunnel Air (0-1)	Power to Tunnel Air (KW)
RF Components													
RF Charging Supply 34.5 Kv AC-8KV DC	1/36 m	Service Tunnel	2.8		40	40	1.17	18	8	10	0	0.3	1.2
Switching power supply 4kV 50kW	1/36 m		4.5		35	13.6	7.6	13	8	10	0	0.4	3.0
Modulator	1/36 m	Service Tunnel	4.5					28.823			0	0.4	3.0
Pulse Transformer	1/36 m	Service Tunnel	0.7								0	0.3	0.3
Klystron Socket Tank / Gun	1/36 m	Service Tunnel	0.8								0	0.2	0.2
Klystron Focusing Coil (Solenoid)	1/36 m	Service Tunnel	3.6								0	0.1	0.4
Klystron Collector	1/36 m	Service Tunnel	45.8		*35>				2		0		
Klystron Body	1/36 m	Service Tunnel	0.0		*35>				5	+ - 2.5 C	0	0.0	1.4
Klystron Windows	1/36 m	Service Tunnel	[illegible]		*35>				[illegible]		0		
Relay Racks (Instrument Racks)	1/36 m	Service Tunnel	0.0		N/A	N/A		N/A	N/A	None	11.5	-0.2	-1.5
Attenuators	2/36 m	Service Tunnel	0.0										
Circulators	**26/36 m**	**Beam Tunnel**	32.3									0.1	1.7
Loads	**24/36 m**	**Beam Tunnel**								+ - 2.5 C	0		
Waveguide (in service tunnel)	1/36 m	Service Tunnel											
Waveguide (in beam tunnel)	**1/36 m**	**Beam Tunnel**	3.5							+ - 2.5 C	0	0.1	0.4
Total RF			100.0								11.5		26.1

Total Heat load to Chilled water (per RF)	37.6	cooled by chilled water
Total Heat load to LCW (per RF)	100.0	cooled by low conductivity water

3.2.4 RF Power Requirements for Cavity Field Regulation from the LLRF group

Shin Michizono presented the talk about the rf power requirements for cavity field regulation since the rf overhead decreased from the initial BCD. He recommended the following items: better defined modulator regulation (more tighten-up), moterized VTO for the cavity power couplers and power splitters if the cavities are used at different gradient, continued R&D effort into the control of LFD and microphonics, study of minimum control overhead and so on.

Recommendation for topic 3.2.4

HLRF and MLI group will be responsible to discuss these items with LLRF group. It is desirable that session to discuss these items will be held at FNAL GDE meeting.

Shin's Talk

Summary

- In order to satisfy stability requirements under severe llrf tuning overhead, suppressions of perturbations are essential.
  Beam current, **cavity detuning**, rf distribution and so on.

- LLRF team will continue RF simulation based on proper parameters.

- LLRF team want to know the real power overhead.

- We do *not* like the idea that "all unknown issues (such as rf waveguide loss, klystron maximum operation power, modulator stability,…) would be included this llrf overhead."

- Shortage of the llrf overhead results in the lower gradient operation !!

Review existing EDR Engineering plans (specs, costing, vendors)

- STF Plan Engineering, Industrialization (Fukuda)
  STF2&STF3, WP's for them, Industrialization for Asian region
- US ART Work Package (Adolphsen)
  US WP List, Related person list
- EDR Management Work Packages (Non R&D) (Larsen)
  Concerning with this talk, there discussed the relation between the EDR and R&D.

3.3.1 Management structure of EDR

Regional activities of ongoing engineering and R&D plan were presented. Regional work packages were also shown. So next important step is to the summarize work packages of HLRF for all regional activities, and then to generate EOI's (Expression of Interest) for HLRF Work Packages. For the acceptance of the EOI's or collaborative work for the same categories of work packages, resources and exchange of the manpower and information are important management task. These are performed under the global MOU's controlled by the GDE. Project manager play an important role to precede this process.

There was a discussion about the issues for ILC management; how we evolve from existing obsolete BCD used for current cost base line, to new baseline in support of EDR at time of report. For the HLRF, in order to reduce the total cost, main activities are to develop the ACD technologies. Even in XFEL, current BCD for the HLRF is obsolete, and accepting the new technology. These issues are discussed and we should change this situation with the flexible manner.

Recommendation for topic 3.3.1

Summarizing the work packages and generating the EOI's are conducted soon. Global MOU's for suitable work packages are discussed and executed under the administrative work by the project manager.

For the obsolete BCD, proposal for the new configuration among the current ACD are accepted and discussed. Under the agreement of HLRF group, decision will be sent to CCB to change it to the new baseline.

Definitions: *Management* & *R&D* WP's

- Two Task Categories for each WP
  1. EDR WP - *Management:*
     - Subsystem Engineering leaders perform following tasks:
     1. R&D & Overall Project Plans
     2. Cost Analysis & Schedules
     3. Manufacturing & Installation Models
     4. Develop EDR Report
     5. Develop Bid Packages for all Regions (w/R&D)
     6. Build-to-print for first ACD's
     7. Recommend down-selection (or not)
  2. R&D WP – *ACD Prototypes:*
     - Organize collaboration, design, build, test prototypes
     - Documentation for Build-to-Print, Specifications
     - Develop Vendors via prototype procurement
     - Assist Bid Package development. Industry liaison

3.3.2 ACD's Work Packages: Adoption Time Scale, Cost-benefit and Documentation

Relating to the obsolete baseline, many R&D items are considered and proposed as the ACD. Most developed ACD is the Marx modulator and in this case, next important process is showing the reliability test to allow decision. Fot the other ACD's, tightness of the schedule is pointed out by the participants of HLRF KOM. Budget limitation and triage are involved at the same time. For all ACD's,it is required the more detail description: status of development, qualification, and cost-benefit point. These points are to be developed as new documents for EDR.

Recommendation for topic 3.3.2

Concerning about this topics, action items are set and these should be performed..

Work packages

3.3.3 Work Packages

Main work packages are comprised of 6 categories: modulator, klystron, poser distribution system, HV AC and control & interlocks. Each categories include baseline work package, test facility, and ACD's. Some work packages have a tight schedule to show the feasibility of the technology and it is required to develop the long-range plan through EDR. Most important work packages are picked up from many items as follows; (1) it is encouraged to develop the modulator with the cost benefit such as the Marx modulator; (2) evaluation of the ACD klystrons are continued; (3) accumulation of the klystron running data with cavity load and without cavity load respectively and. more than 2000 hours running data are necessary; (4) comparison and scoring the possible PDS and making clear the differences among candidates of PDS. Especially it is important to make a model of ACD PDS (for the circulator-less system) including all possible coupling effects of reflected power into all cavities.

Recommendation for topic 3.3.3

Concerning about this topics, action items are set and these should be performed.

EDR Challenge

- EDR definition implies that interim 08-10 period must be sufficiently staffed, funded to achieve “EDR Readiness” by 2010.
- Requires leadership, strong contributions and collaboration from all Regions
- Requires active involvement of industrial partners
- Building inter-regional and lab-industry collaboration through Work Packages critical to meeting EDR goals.

Technical efforts to EDR

- Complete the critical R&D
  - *as identified by the (R & D Board and) , Prototype, DFM, Preproduction, and ..*
- Establish the base-line design,
  - *Verify the initial EDR base-line design parameters,*
  - *Technologies to be chosen and to be demonstrated through pre-mass-production*
  - *Learn industrialization*
    - Obtain the maximum benefit from the realized project
- Proceed alternate design and development
  - *As technology back-up to achieve the ILC design goal,*
    - with “Plug-compatible” concept, and
    - for maximizing performance/cost (value-engineering)

WP-Modulator

Work Package Details		
Work Package Title	*Modulators*	
Short keyword title	*(For PMO use)*	
Abstract	120 kV, 130 A, 1.7 ms, 5 and 10 Hz modulators are in development at XFEL, FNAL and SLAC. XFEL and FNAL are advancing the baseline Bouncer design. DESY will evaluate an industry-made modulator from PSM. KEK is procuring Bouncers for 120 kV and also plans to build a 120 kV and a 50 kV Marx. SLAC is concentrating on a 120kV Marx prototype that promises a major cost reduction, to be followed by a DFM version.	
Major tasks and objectives	Develop, test ACD Marx Modulator & DFM version. Advance BCD Bouncer design and 50kV design. Down-select by end of EDR.	
Deliverables from Work Package	1. SLAC Marx Prototype operation in LBTA 2. SLAC DFM prototype operation in LBTA 3. FNAL & DESY advanced Bouncer designs at NML & XFEL 4. DESY designs built by industry, new vendor development 5. KEK 120 kV and 50 kV Marx design at STF, built by industry 6. EDR document including costs, schedules, documentation	
Major Milestones (including key decision points)	1. 2000 hr test of Marx prototype 2. Full power test DFM 3. DESY tests industrial designs 4. FNAL tests of bouncers in 5. Technology down-select (Marx or Bouncer) 6. KEK test of 120 kV Marx 7. Complete cost estimate, schedule, EDR documentation 8. KEK test of 50 kV Marx, final down-select	2008 2009 2008-9 2008-9 2009 2010 2010 2011
Resources required (eg expertise, facilities, leader, ...)	Lead roles, manpower resources at the various labs are established. Engineering collaboration invited on design and test programs, system testing, EDR documentation, vendor collaboration and liaison.	

WP-Klystron

Work Package Details		
Work Package Title	*Klystrons*	
Short keyword title	*(For PMO use)*	
Abstract	10 MW multi-beam klystrons (MBK) are the baseline rf source and were developed for TESLA by DESY and will now be used for XFEL. DESY has bought several from industry (from CPI, Thales and Toshiba) and KEK/SLAC has recently purchased one (from Toshiba). KEK will procure a horizontal MBK. SLAC is developing sheet beam (SBK) technology as a possible major cost savings and reliability improvement over MBK. KEK is developing a mega-beam version MBK after a BINP design with 36 beamlets. One MBK manufacturer's tube has achieved full ILC specifications at DESY and a second is very close. Technology down-select will extend past the EDR period due to long development, procurement and testing times.	
Major tasks and objectives	Continue development of MBK's with industry (DESY, KEK). Evaluate MBK's in test facilities (DESY, SLAC). Develop SBK prototype followed by DFM version at SLAC. Develop 50 kV Mega-MBK prototype at KEK in collaboration with industry. Accumulate test data and down-select in post-EDR period.	
Deliverables from Work Package	1. SLAC SBK Prototype, DFM operation in LBTF with Marx 2. DESY, SLAC, FNAL MBK operation in test facilities with Bouncer modulators 3. KEK Mega-MBK prototype operation with 50 kV Marx modulator 4. Down select post EDR after DFM qualification 5. EDR document including costs, schedules, documentation	
Major Milestones (including key decision points)	1. SBK Beam Stick tests at SLAC 2. SBK Prototype initial tests at SLAC 3. Continue horizontal and vertical MBK tests at DESY, SLAC 4. KEK procure, evaluate horizontal MBK 5. SBK DFM design, fabricate, test at SLAC 6. Test Mega-MBK with Marx at KEK 7. Complete cost estimate, schedule, EDR documentation 8. Final M-K technology down-select	2008 2008 2008-9 2008-9 2009-10 2011 2011 2011
Resources required (eg expertise, facilities, leader, ...)	Lead roles, manpower resources established at the various labs. Engineering collaboration invited on design and test programs, system testing, EDR documentation, vendor collaboration and liaison.	

WP-PDS's

Work Package Details		
Work Package Title	*RF Power Distribution System (PDS)*	
Short keyword title	*(For PMO use)*	
Abstract	RF Power Distribution Systems (PDS's) are in development at DESY for XFEL, at KEK for STF, and at SLAC for Fermilab's ILCTA@NML. The ILC baseline is based on the TTF distributions. XFEL plans to use a simpler system with a focus on minimizing numbers of separate components and lowering costs. Initial cost estimates showed the PDS as one of the highest cost elements, which spurred SLAC to begin a development aimed partly at eliminating the expensive circulators. The SLAC design also includes adjustable tapoffs to allow fuller utilization of cavities with a range of sustainable gradients. This ACD design is being prototyped at SLAC for use with the FNAL cryomodules. At KEK, both a 4-cavity baseline PDS and a 4-cavity tree-like, circulator-less PDS have been built to power two half-length cryomodules. KEK will test a full 3-cryomodule PDS on STF 2.0.	
Major tasks and objectives	Complete development and optimization of components with industry, down-select for XFEL (DESY). Complete SLAC ACD variable tap-off, circulator-less design, prototype testing. Complete testing on cryomodules at NML (FNAL) and KEK. Complete new cost estimates for EDR. Down select to new BCD model.	
Deliverables from Work Package	1. DESY final XFEL PDS design 2. SLAC and KEK prototype tests on cryomodules (STF, NML) 3. EDR document including costs, schedules, documentation for BCD and ACD	
Major Milestones (including key decision points)	1. Complete XFEL design, prototypes, vendor qualification 2. Complete SLAC ACD design and 8-cavity prototype 3. Complete KEK tests of 4-cavity PDS's 4. Complete KEK tests of full circulator-less prototype on STF2.0 5. Complete SLAC ACD full prototype, test on NML cryomodule 6. Complete cost estimate, schedule, EDR documentation	2008-9 2008 2008 2009-10 2009-10 2010
Resources required (eg expertise, facilities, leader, ...)	Lead roles, manpower resources established at the various labs. Engineering collaboration invited on design and test programs, system testing, EDR documentation, vendor collaboration and liaison.	

WP- HV Charger

Work Package Details		
Work Package Title	*HV Charger System*	
Short keyword title	*(For PMO use)*	
Abstract	High voltage chargers required for the RF Modulators are under development at FNAL for the BCD Bouncer, at DESY for commercially procured Bouncers and at SLAC for the Marx system. Current designs featuring a single isolated supply per modulator are adequate for a relatively few stations but would present problems for the ILC with over 600 stations due to the pulsed loading of the power lines. For this reason and in an attempt to reduce costs and improve availability, a new topology is being investigated at SLAC. DESY already has settled on a constant-power design per station for XFEL.	
Major tasks and objectives	Design, prototype, test ACD power system based on a 60-80% power main converter unit feeding 20-40% power adders at up to 6 RF stations (SLAC). Install operational system in LBTF (SLAC). Collaborate and track design progress at XFEL to take advantage of developments (DESY).	
Deliverables from Work Package	1. Operational prototype at LBTF for 4-6 RF stations (SLAC) 2. Operational industry-built prototypes at XFEL (DESY) 3. Down-select, industrialization plans 4. EDR document including costs, schedules, documentation	
Major Milestones (including key decision points)	1. Complete design, prototype for XFEL (DESY) 2. Complete design for LBTA system (SLAC) 3. Procure, install, test at XFEL (DESY) 4. Construct, test, install LBTA prototype (SLAC) 5. Design down-select 6. Complete cost estimate, schedule, EDR documentation	2008-9 2009 2009-10 2009-10 2010 2010
Resources required (eg expertise, facilities, leader, …)	Lead roles, manpower established at DESY, SLAC. Engineering collaboration invited on design and test programs, system testing, EDR documentation, vendor collaboration and liaison.	

WP-interlock & Control

Abstract	Interlocks and controls are needed for all test systems. The goal for advancing ILC is to experiment with modern high availability, fully programmable architectures using serial communications links and backplanes. The solution envisaged is for data collection and processing for both fast and slow interlocks to be captured in an ATCA (Advanced Telecom Computing Architecture) standard platform to integrate with a control system on the same platform. The goal is to demonstrate basic operation within the EDR period. DESY has an operating system for XFEL and is considering ATCA-µTCA solutions as well.	
Major tasks and objectives	Develop a programmable fast/slow interlock card in VME and construct and test a complete RF station system for LBTA (SLAC). Using an adapter card being developed under contract with a commercial company, port the application to ATCA together with the HA core system, switches and software. Track similar developments for other test systems and XFEL. Collaborate and down-select ultimate design concepts for EDR. Develop documentation, costs, schedules for EDR.	
Deliverables from Work Package	1. Demonstrate RF station controls and protection system on ATCA high availability platform. 2. Demonstrate software interface to EPICS and/or similar controls operating system 3. Demonstrate shelf management of failover, power management, FPGA program management in working environment 4. EDR document including costs, schedules, documentation	
Major Milestones (including key decision points)	1. Operational test of RF station control & protection on ATCA platform in LBTF (SLAC) 2. Operational test of RF station controls & protection on XFEL. (May be ATCA/µTCA platform) 3. Down-select architecture for ILC technical, cost model 4. Complete cost estimate, schedule, EDR documentation	2008-9 2008-9 2010 2010
Resources required (eg expertise, facilities, leader, ...)	Lead roles, manpower resources at DESY and SLAC established or planned. Labs will collaborate on final selection for ILC. Engineering collaboration invited on design and test programs, system testing, EDR documentation, vendor collaboration and liaison.	

Action list

Reference	Responsible	Action
Topic 3.1.1 (HLRF parameter table)	HLRF Team Leader	Fill in HLRF specifications templates for A. Yamamoto
Topic 3.2.3 (Heat Load issues, water system)	Responsible person for mod., kly., PDS and charger.	Respond to Emil Heudem's table for cooling water flows, pressure drops
Topic 3.2.4 (RF power requirement from LLRF)	MLINS Team Leader	Respond to LLRF list of questions (Shin) to HLRF regarding klystron available overhead.
Topic 3.3.1 (management structure of EDR)	HLRF Team Leader	Generate EOI's (Expressions of Interest) for HLRF Work Packages
Topic 3.3.1 (management structure of EDR)	Project Management Office	Global MOU's: Develop collaborations to get additional required resources for management, R&D WP's
Topic 3.3.2 (ACD's work packages)	HLRF Team Leader	Develop HLRF long-range plan through EDR, down-select strategies, into construction phase.
Topic 3.2.3 (ACD's work packages)	HLRF Team Leader and responsible person of PDS	ACD's: Show all plans for development, qualification, configuration change of baseline (Modulator, Klystron, PDS, HV AC (6-Pack), controls & interlocks.
Topic 3.3.3 (work packages)	HLRF Team Leader	Summarize work packages for HLRF for all Regional activities.
Topic 3.3.3 (work packages)	HLRF Team Leader	Model ACD PDS system (circulator-less) including all possible coupling effects of reflected power into all cavities.
Topic 3.3.3 (work packages)	HLRF Team Leader	Develop new documents showing cost-benefits of all ACD's underway and proposed.