Focus Group B Summary

--- ILC Cooling-Water System ---

Convener
Atsushi Enomoto (KEK)

ILC GDE Meeting
6 June 2008, JINR (Dubna)

Presentation Lists

June 5 14:00-16:00

***Marc Ross**, PM Introduction*
***Emil Huedem**, Specific Value Engineering Overview (WEBEX)*
***Wilhelm Bialowns**, Parametric Measures*

16:30-18:00

***Ullrich Frank**, XFEL Cooling (WEBEX)*
***Shigeki Fukuda**, Heat Loads and Delta*
***Atsushi Enomoto**, Cost Reduction Studies at KEK*

June 6 9:00-10:30

***Lee Hammond**, HVAC Overview*
***K. Foraz**, LHC Experience*

Discussions

P.Garbincious, L.Hammond, E.Huedem, V.Kuchler, T.Lacowski, M.Ross (FNAL)
C.Adolphsen, J. Dorphan (SLAC), J.Cawardine (ANR), W.Bialowns, U. Frank, F.Lehner (DESY), K.Foraz, P.Derahare, J. Osbone, S. Weisz (CERN), A.Enomoto, S.Fukuda, R.Sugahara, M.Tanaka, A..Yamamoto, S.Yamada (KEK), S.Shkarovsky (JINR)

Goals of Focus Group-B

To discuss High Delta T possibility and to establish the goal of VE work up to November FNAL meeting.

To discuss chilled water elimination or alternative system to cool room air and special RF precision apparatus.

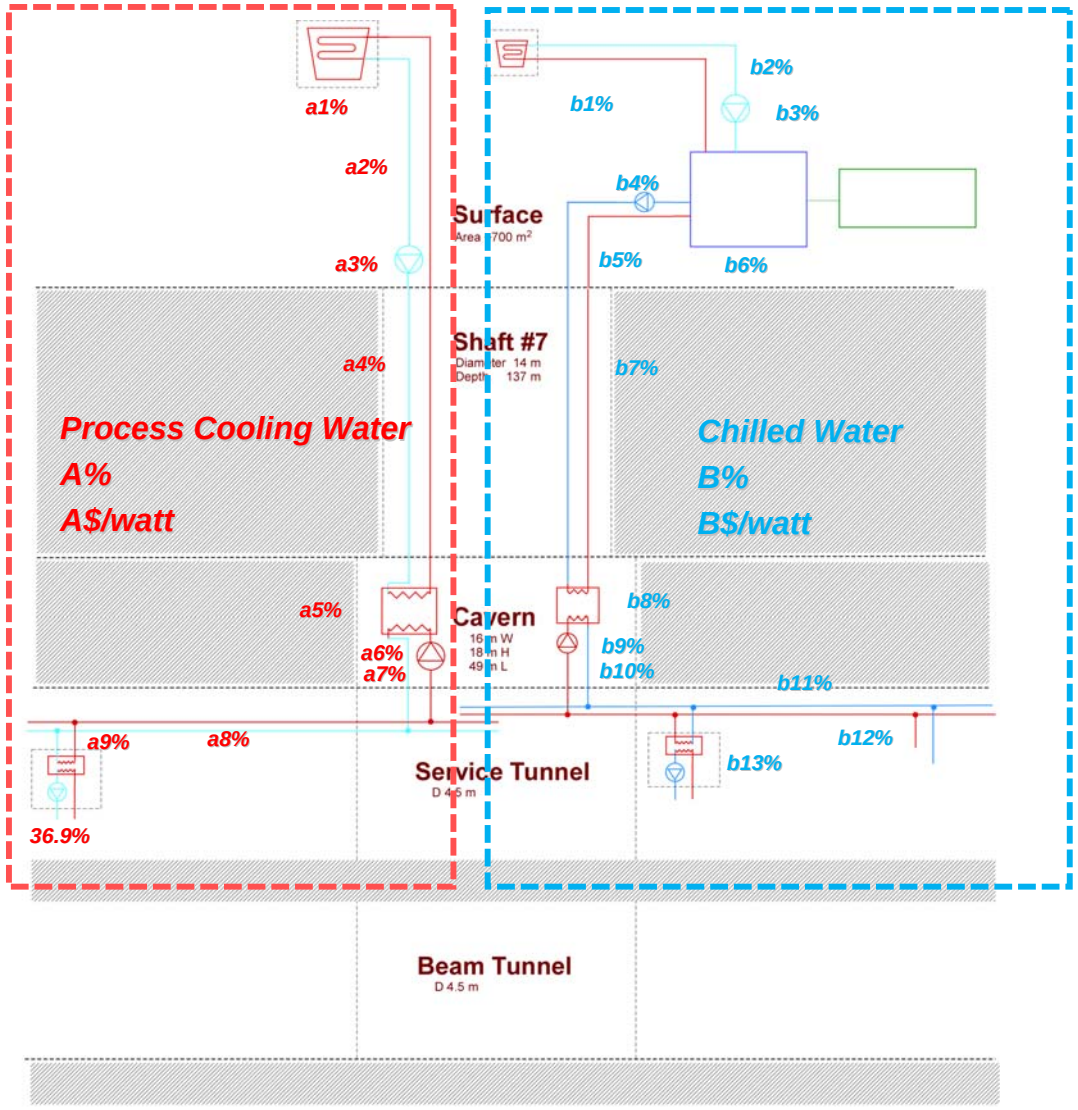
Highlights and Brief Notes from Presentations

Cost Profile

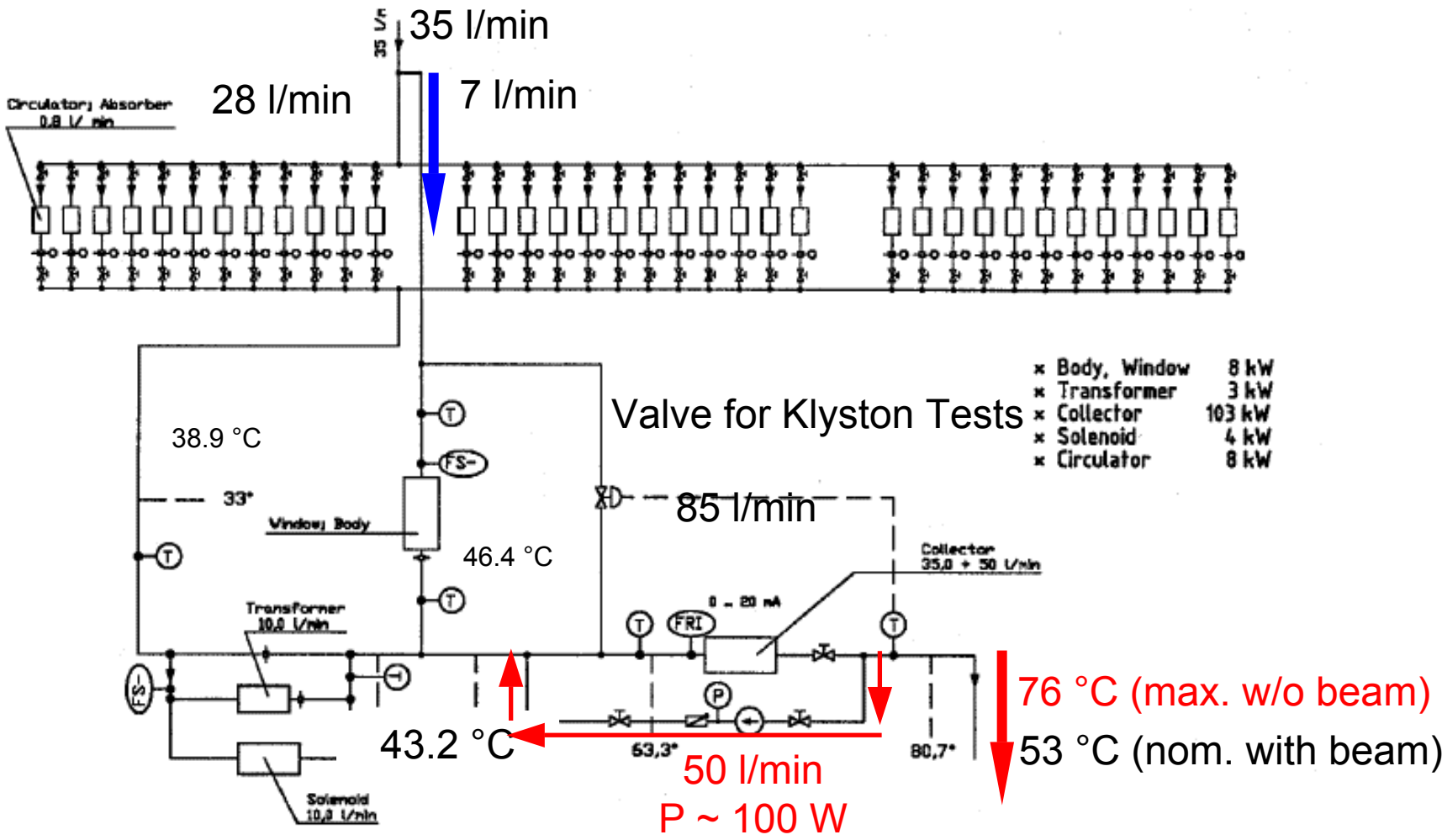
ML cooling system cost is ~half of total area

Process Cooling Water piping cost is expensive, including high percentage of LCW skids system ()

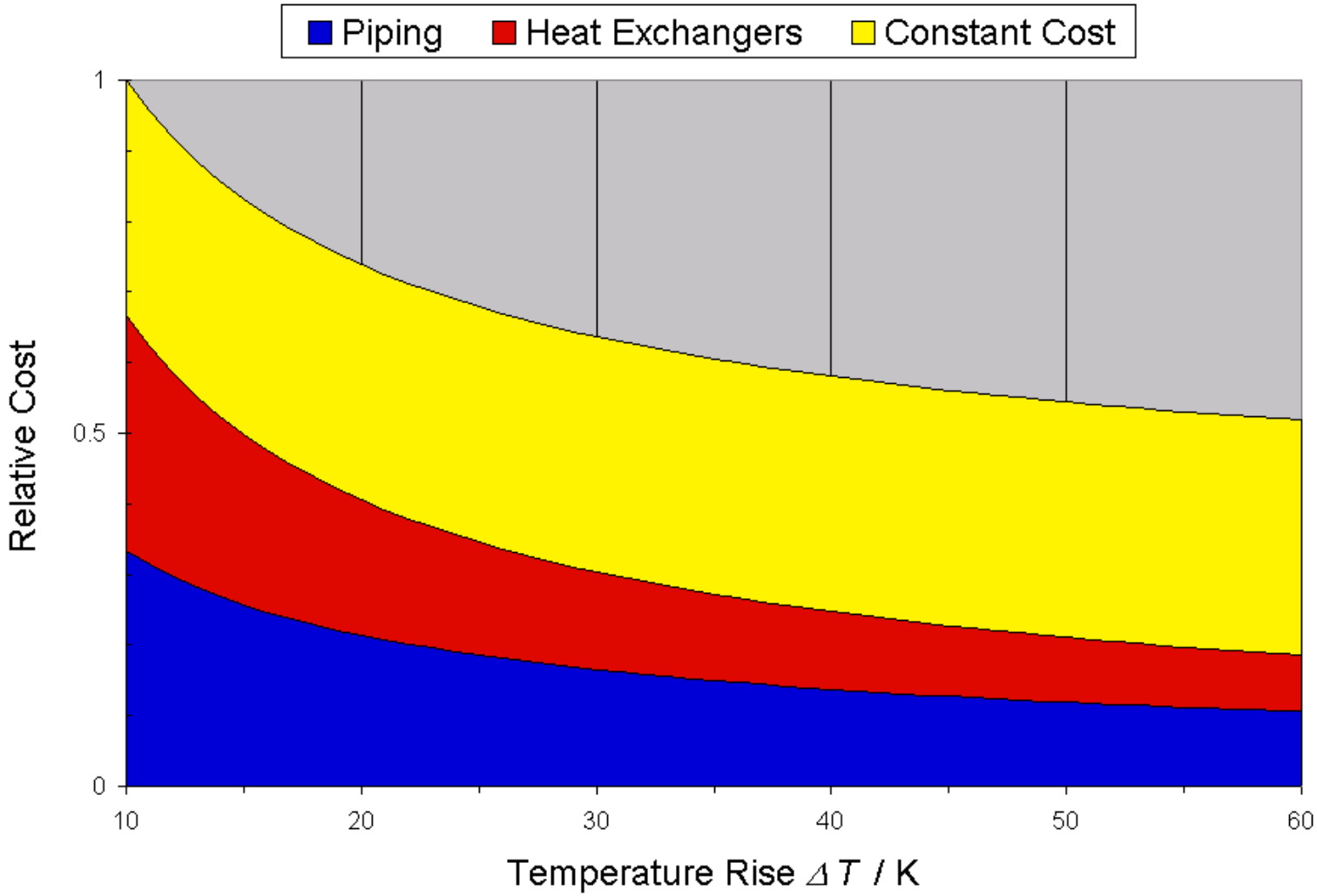
Low cost performance of Chilled water system



TESLA Cooling Scheme @ 5 Hz



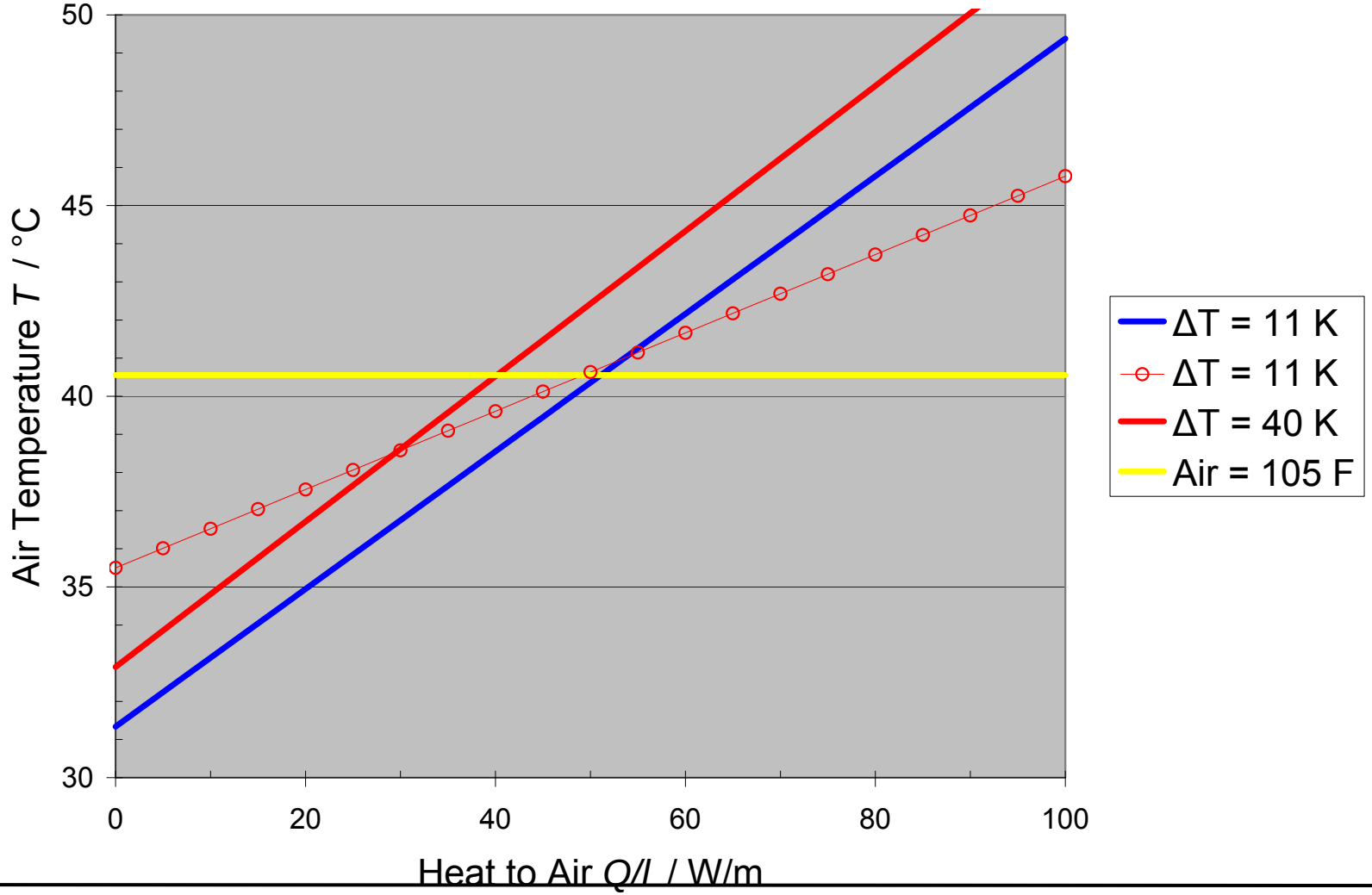
Scaling of Process Water Costs



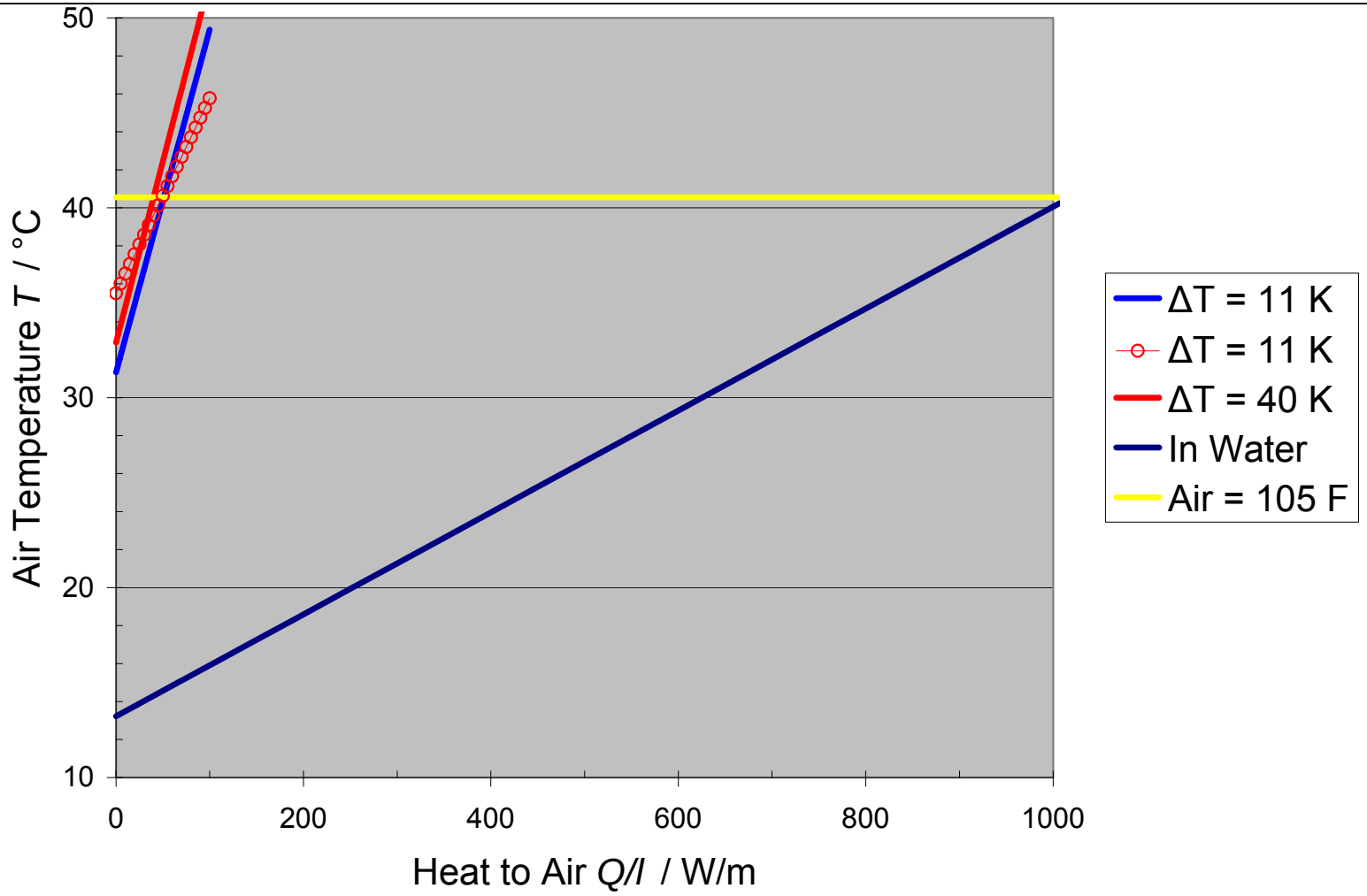
Very preliminary results

- Cost reduction in approx. 7%

Air Temperature of Tunnel in Bedrock



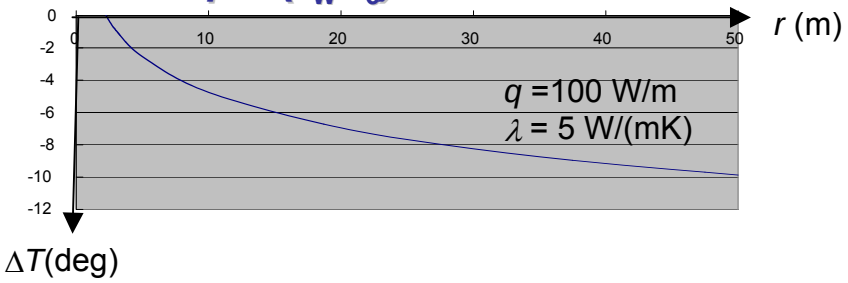
Air Temperature of Tunnel in Water

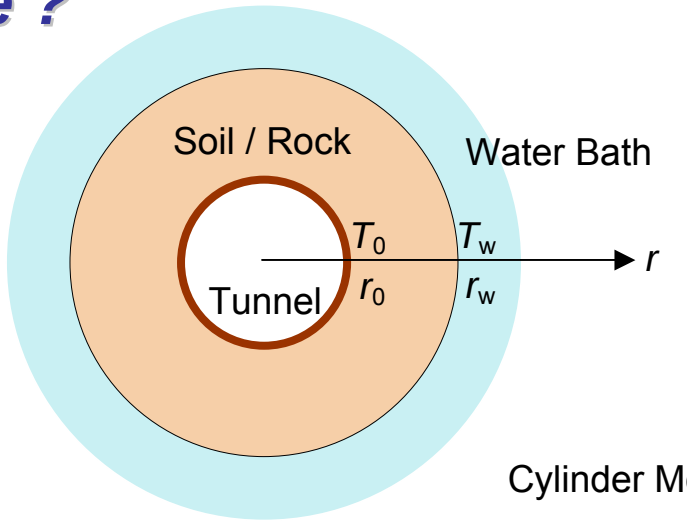


How is tunnel wall Temperature ?

Cylinder Model

$\Delta T = -q \ln (r_w/r_0) / 2\pi\lambda$

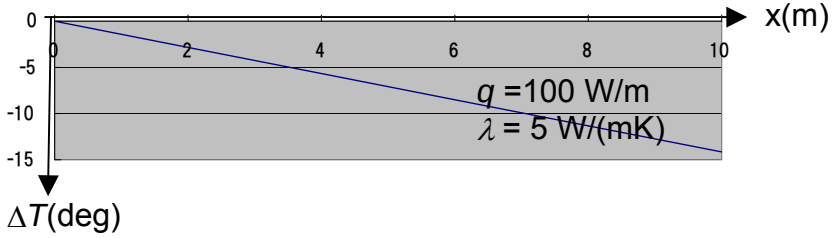


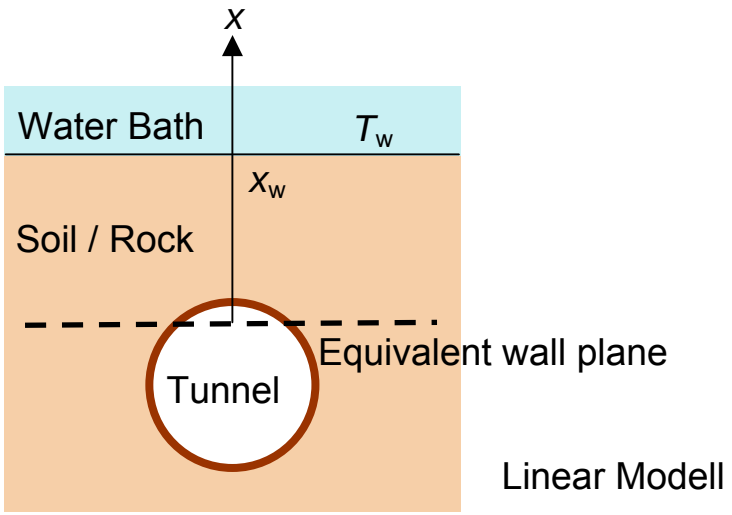


Assuming a bath, r_w-r_0 = 50 m, ΔT = 10 deg, 100 W/m could be removed from the tunnel

Linear Model

$\Delta T = -Q \times / \lambda, \quad Q = q \times 2\pi r$ (guess)

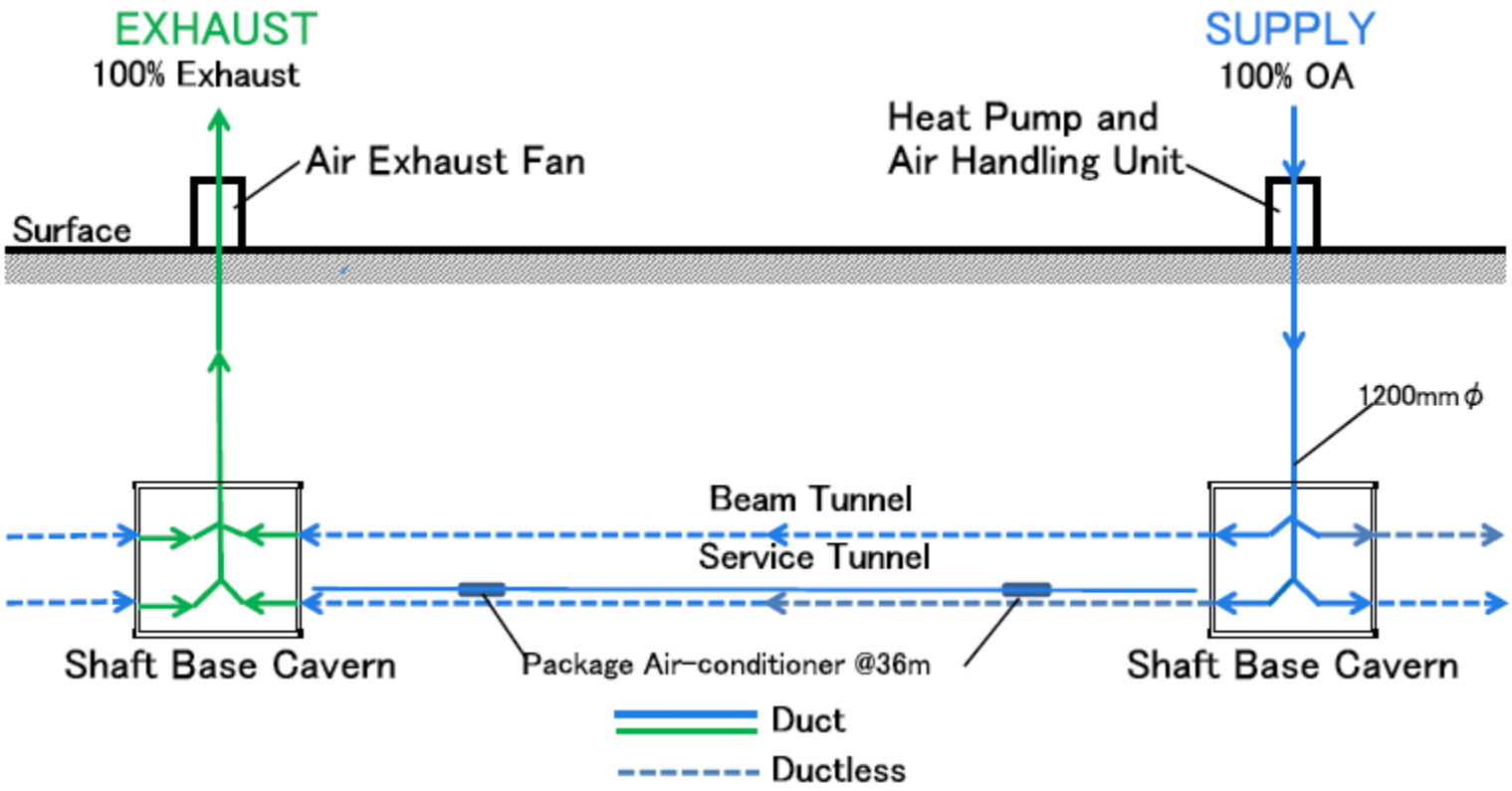




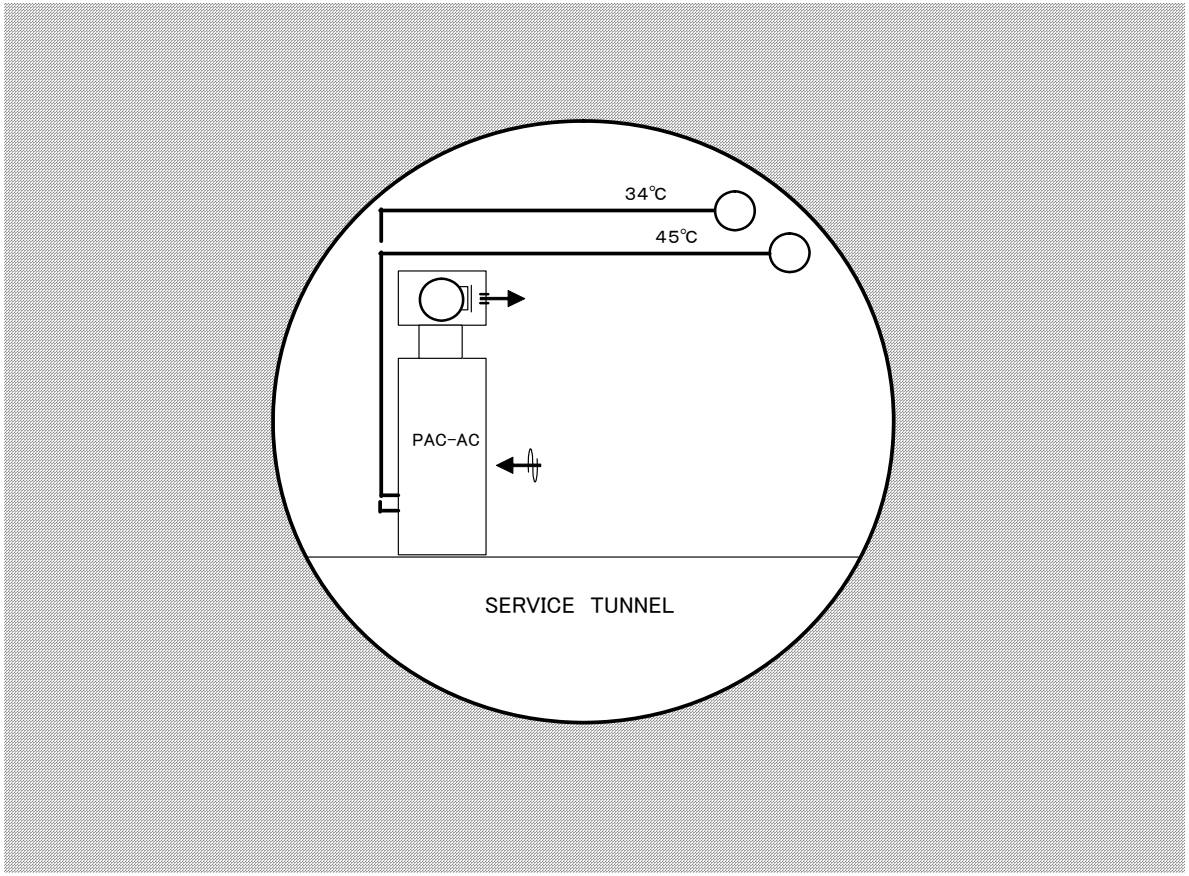
Assuming a bath, r_w-r_0 = 7 m, ΔT = 10 deg, 100 W/m could be removable

Alternative HVAC scheme for tunnels

- *supply & exhaust @ every other shafts*

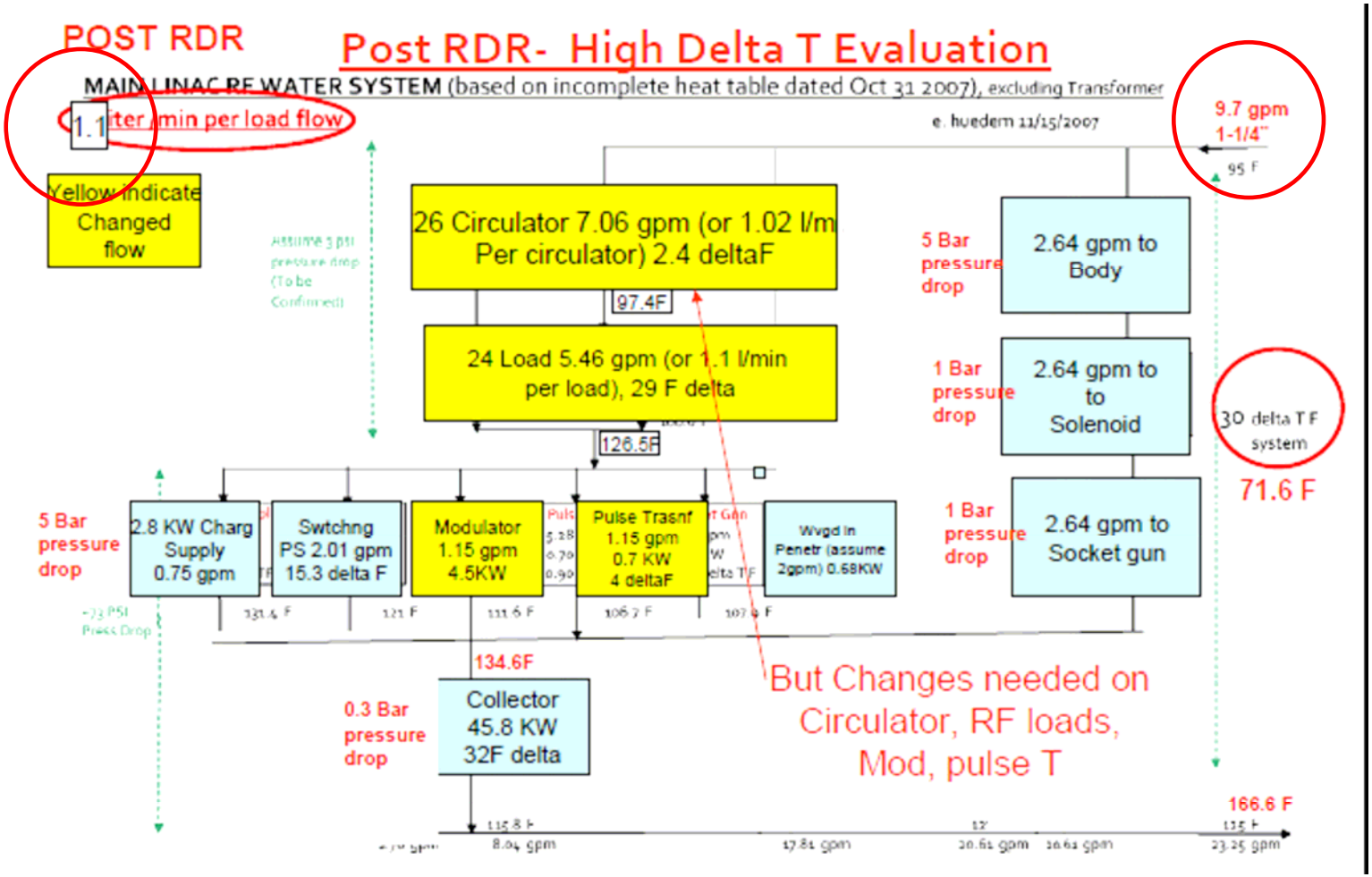


Size and space of package unit



Plans to November

--- Alternative Proposal for Delta T ---



Summary

(1) Many useful discussions.

(2) Delta T increase and Chilled Water Decrease are potential measures to reduce cooling costs. Effect of high ΔT to room T may be suppressed by insulator with relative low cost.

(3) Effect of high ΔT to equipment and beam instability should be studied separately.

(4) Alternative air cooling system using package air conditioner is proposed and under consideration.

(5) More investigation and effort to decrease heat load to air are necessary.

(6) Cooling effect by tunnel wall depends on geology of the site, though an order of ~100 W/m may be cooled under some conditions.

(7) High DT study where kly col temp up to 75deg will be studied with a colaboration between KEK, FNAL and DESY.

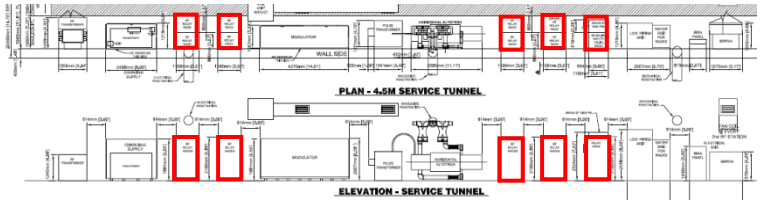
Top-5 heat loads to Air/ChW

Dec 14 2007

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

MAIN LINAC - ELECTRON & POSITRON					To Low Conductivity Water	to Chilled Water	keith Jobe load to Air Nov 22 06	
Components	Quantity Per 36m	Location	Total Heat Load (KW)	Average Heat Load (KW)	Heat Load to Water (KW)	Heat Load to Water (KW)	Power fraction to Tunnel Air (0-1)	Power to Tunnel Air (KW)
Non-RF Components								
LCW Skid Pump 1 per 4 rf -Motor/Feeder Loss	0.25	Service Tunnel	0.60	0.60	0	0	1.00	0.60
I^2R Loss and Motor Loss (misc)	1	Service Tunnel	8.99	8.22	0	0	1.00	8.22
Fancoils (5 ton Chilled Water) 1.5 Hp	2	Service Tunnel	2.91	2.91	0	0		
Rack Water Skid	0.25	Service Tunnel	0.20	0.20	0	0	1.00	0.20
Lighting Heat Dissipation ~1.3W/sf		Service Tunnel	1.65	1.65	0	0	1.00	1.65
AC Pwr Transformer 34.5-.48 kV	0.25	Service Tunnel	2.00	2.00	1.50	0	0.25	0.50
Emerg. AC Pwr Transformer 34.5-.48 kV		Service Tunnel	1.00	1.00	0	0	1.00	1.00
RF Components								
RF Charging Supply 34.5 Kv AC-8KV DC	1/36 m	Service Tunnel	4.0	4.0	2.8	0	0.3	1.2
Switching power supply 4kV 50kW	1/36 m	Service Tunnel	7.5	7.5	4.5	0	0.4	3.0
Modulator	1/36 m	Service Tunnel	7.5	7.5	4.5	0	0.4	3.0
Pulse Transformer	1/36 m	Service Tunnel	1.0	1.0	0.7	0	0.3	0.3
Klystron Socket Tank / Gun	1/36 m	Service Tunnel	1.0	1.0	0.8	0	0.2	0.2
Klystron Focusing Coil (Solenoid)	1/36 m	Service Tunnel		4.0	5.5	0	0.1	0.4
Klystron Collector	1/36 m	Service Tunnel	58.9	47.2	45.8	0	0.0	1.4
Klystron Body & Windows	1/36 m	Service Tunnel			4.2	0		
Relay Racks (Instrument Racks)	1/36 m	Service Tunnel	10.0	10.0	0	11.5	-0.2	-1.5
	2/36 m	Service Tunnel			0			0.0
	1/36 m	Service Tunnel			0			1.166
RF Distribution (Attenuators, Loads, Waveguide, Circulators all in series connection)	1/36 m	Penetration			0.676			
	1/36 m	Beam Tunnel			0.0	0		5.9
	26/36 m	Beam Tunnel			2.49	0		0.0
	24/36 m	Beam Tunnel			30.05			0.0
Subtotal RF unit Only			90	82	102.0			
Total RF			107	99	103.5	11.5		21.4

Total Heat load to Air/Chilled water in service tunnel (per RF)	32.9
Total Heat load to LCW (per RF)	103.5
Total Heat load to air in beam tunnel (ignore rock contribution for now)	5.9



1. Racks 11.5 kW
2. I^2R & Motor Loss 8.2 kW
3. Waveguides (B.T.) 5.9 kW
4. Switching P.S. 3.0 kW
5. Modulator 3.0 kW

Total of top 5 = 31.6 kW

….. 82% of Air/Chilled Water Loads

But are these loads real and cannot we reduce?…