Central Region Discussion
Power and Cooling

GDE Beijing-CFS

MAGNET / POWER SUPPLY LOADS

Need updates

Focus on e+

ILC Magnet Power Supply Losses, Heat Loads and Required Input Power as of May 9, 2007

		Data								
Area	Section	Sum of Magnet Quantity	Sum of Total Magnet Power (kW)	Sum of Total Cable Loss (kW)	Sum of Power Supply Quantity	Sum of Total PS Loss to Air (kW)	Sum of Total PS Loss to Water (kW)	Sum of Required Water Flow (gpm)	Sum of Total of All Losses (kW)	Sum of Expected Running kVA
Source Transport	e-	163	418	219	142	40	55	21	732	861
	e+	2,170	6,933	1,711	1,091	289	872	330	8,897	10,467
Source Transport Total		2,333	7,350	1,930	1,233	329	927	351	9,629	11,328
Damping Ring	e-	2,127	2,563	881	1,954	278	238	90	3,960	4,658
	e+	2,127	2,563	881	1,954	278	238	90	3,960	4,658
Damping Ring Total		4,254	5,125	1,761	3,908	556	477	180	7,919	9,317
RTML	e-	2,167	1,588	471	1,916	309	0	0	2,368	2,786
	e+	2,167	1,588	471	1,916	309	0	0	2,368	2,786
RTML Total		4,334	3,177	942	3,832	618	0	0	4,737	5,572
LINAC	e-	840	253	84	840	51	0	0	389	457
	e+	840	253	84	840	51	0	0	389	457
LINAC Total		1,680	507	169	1,680	101	0	0	777	914
BDS	e- Common	63	1,373	93	37	136	84	32	1,685	1,983
	e+ Common	63	1,373	93	37	136	84	32	1,685	1,983
	e- 14mr1	259	2,802	199	179	174	276	105	3,450	4,059
	e+ 14mr1	259	2,802	199	179	174	276	105	3,450	4,059
BDS Total		644	8,348	583	432	620	720	273	10,271	12,084
Grand Total		13,245	24,508	5,384	11,085	2,224	2,123	804	33,332	39,215

HEAT LOADS TO CFS (water/air)

e+ SOURCE

- Need updates
- One for each components of source (undulator, auxiliary source, target & e+transfer)

	Total Power (KW)	Total Heat Load (KW)	Location
RF			service tunnel
Magnets			beam tunnel
Power Supplies			service tunnel
Cables			service & beam tunnel
Dumps			beam tunnel
Racks			service tunnel

CFS CONTACT: ?

HEAT LOADS TO CFS (water/air)

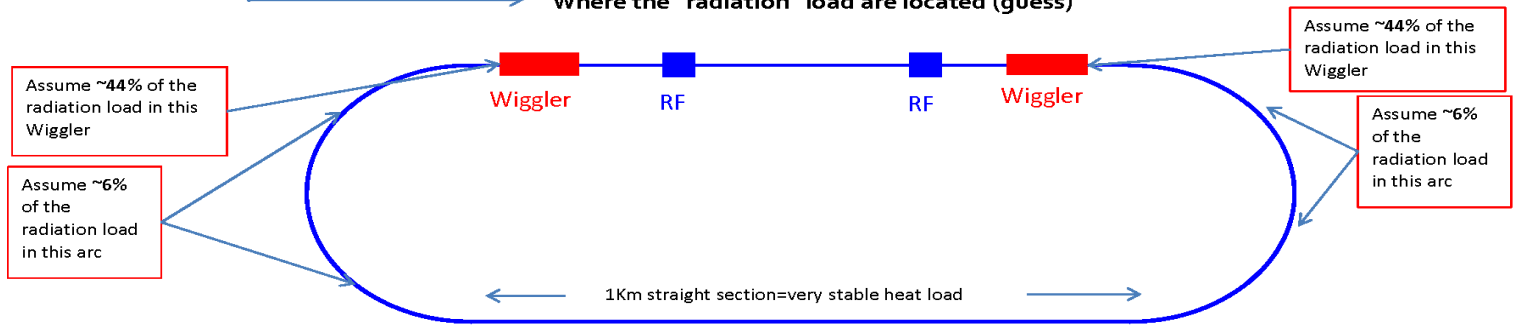
DAMPING RING

- Update SB2009 heat loads

TOTAL DAMPING RING (Heat load to water and air) for 3.2 Km and Low Power Options									SB2009 July 22 2009
	Input kW		Duty factor	Output kW				location	Notes
	wall plug	from beam		to beam	to water	to air in tunnel	to air in alcove		
RF Power (base value)	6300		1	3500	2240		560	(2) alcoves	located in 2 shaft cavern; [07/14/09] reduced to 50% per meeting with Marc, reduction due to "low power option"
RF Power (peak overhead)	700		0.10			70		tunnel	beampipe; [07/14/09] reduced to 50% per meeting with Marc, reduction due to "low power option"
Radiation		3500	1		2800	700		tunnel	Andy (10/24/06) said mostly from wigglers; [07/14/09] reduced to 50% per meeting with Marc, reduction due to "low power option"
Magnet Power Supply Losses	1334		1		1556			tunnel	[07/22/09] reduce to 70% (email from Susana dated 7/15/09), reduction due to decrease of circumference/length to 3.2 Km
aircooled)Magnets	62		1			72		tunnel	
Cables	206		1		240			tunnel	
Magnet Power Supply Losses	175		1				204	(4) alcoves	
TOTAL					6836	842	764		
				TOTAL		8442			
				Reduction in load from 2007 load		*46%*			

Very Stable Heat Loads

Where the "radiation" load are located (guess)



CFS CONTACT: T. LACKOWSKI

DUMPS – page1 (spaces)

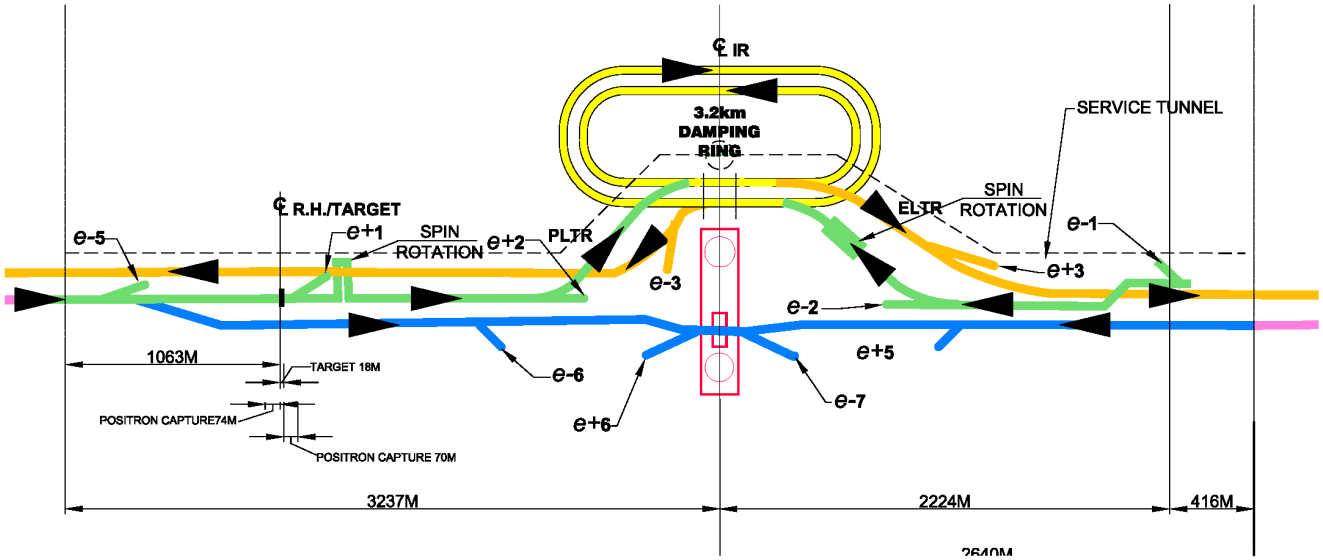
HALLS-Beam Dumps ● = Dump Hall ○ = Service Hall

	RDR			SB2009		
e-source	e- Source Beam Dump @ point 2.3, D&B Excavation (250 CY) ●	191	m^3	e- Source Beam Dump **(part of widening)**	0	m^3
e-source	e- Source Beam Dump Service Hall @ Point 2.3 (500 CY) ○	382	m^3	e- Source Beam Dump Service Hall **(part of widening)**	0	m^3
e+source	e+ Source Beam Dump @ Point 3.4, D&B Excavation (250 CY) ●	191	m^3	e+ Source Beam Dump **(part of widening)**	0	m^3
e+source	e+ Source Beam Dump Service Hall @ Point 3.4 (500 CY) ○	382	m^3	e+ Source Beam Dump Service Hall **(part of widening)**	0	m^3
RTML	e- RTML Beam Dumps, D&B Exc. (Points 11 & 7.1)(2 x 1,607 CY) ● ●	2,458	m^3	e- RTML Beam Dumps, D&B Exc. (Points 11)(1 x 1,607 CY) ●	1,229	m^3
RTML	e+ RTML Beam Dumps, D&B (Points 10 & 6.1)(2 x 1,607 CY) ● ●	2,458	m^3	e+ RTML Beam Dumps, D&B (Points 10)(1 x 1,607 CY) ●	1,229	m^3
BDS	Beam Dump, D&B Exc., (~1650m from IP) (e- BDS) (2,616 CY) ●	2,000	m^3	Beam Dump, D&B Exc., (~1650m from IP) (e- BDS) (2,616 CY) ●	2,000	m^3
BDS	Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e- BDS) (4,120 CY) ○	3,150	m^3	Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e- BDS) (4,120 CY) ○	3,150	m^3
BDS	e+ Final Beam Dump, D&B Exc., (~300m from IP) (2,016 CY) ●	2,000	m^3	e+ Final Beam Dump, D&B Exc., (~300m from IP) (2,016 CY) ●	2,000	m^3
BDS	e+ Final Beam Dump Service Hall, D&B Exc., (~300m from IP) (4,120 CY) ○	3,150	m^3	e+ Final Beam Dump Service Hall, D&B Exc., (~300m from IP) (4,120 CY) ○	3,150	m^3
BDS	Beam Dump, D&B Exc., (~1650m from IP) (e+ BDS) (3,034 CY) ●	2,320	m^3	Beam Dump, D&B Exc., (~1650m from IP) (e+ BDS) (3,034 CY) ●	2,320	m^3
BDS	Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e+ BDS) (4,863 CY) ○	3,718	m^3	Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e+ BDS) (4,863 CY) ○	3,718	m^3
BDS	e- Final Beam Dump, D&B Exc., (~300m from IP) (2,016 CY) ●	2,000	m^3	e- Final Beam Dump, D&B Exc., (~300m from IP) (2,016 CY) ●	2,000	m^3
BDS	e- Final Beam Dump Service Hall, D&B Exc., (~300m from IP) (4,120 CY) ○	3,150	m^3	e- Final Beam Dump Service Hall, D&B Exc., (~300m from IP) (4,120 CY) ○	3,150	m^3
ML	e- ML Beam Dump Cavern D&B Excavation @ Point 3 (3,034 CY) ●	2,320	m^3	e- ML Beam Dump Cavern D&B Excavation @ Point 3 (3,034 CY)	0	m^3
ML	e+ ML Beam Dump Cavern D&B Excavation @ Point 2 (3,034 CY) ●	2,320	m^3	e+ ML Beam Dump Cavern D&B Excavation @ Point 2 (3,034 CY)	0	m^3
		32,190			23,946	

DUMPS – page2 (capacity)

Major DUMPS		RDR	SB2009	
e-1	NC TUNE UP DUMP	11	11	KW
e-2	SC TUNE UP DUMP	311	311	KW
e-3	EDRX TUNE UP DUMP	220	311	KW
e-4	RTML TUNE UP DUMP	220	220	KW
	RTML TUNE UP DUMP	220	0	KW
e-5	e-LINAC FAST ABORT	11	11	KW
e-6	BDS TUNE UP DUMP	18	18	**MW**
e-7	PRIMARY e- DUMP	18	20	**MW**
e+1	TARGET DUMP	300	200	KW
e+2	SC TUNE UP DUMP	311	311	KW
e+3	PDRX TUNE UP DUMP	220	311	KW
e+4	RTML TUNE UP DUMP	220	220	KW
	RTML TUNE UP DUMP	220	0	KW
e+5	BDS TUNE UP DUMP	18	18	**MW**
e+6	PRIMARY e+ DUMP	18	20	**MW**

DUMPS – page 3


℄ IR
3.2km
DAMPING
RING
SERVICE TUNNEL
℄ R.H./TARGET
e-5
e+1
SPIN
ROTATION
e+2
PLTR
e-3
ELTR
SPIN
ROTATION
e-1
e+3
e-2
e+5
1063M
TARGET 18M
e-6
e-7
e+6
POSITRON CAPTURE74M
POSITRON CAPTURE 70M
3237M
2224M
416M
2640M

Power and Cooling Requirements

- Cooling by air systems
  - Temperature Requirements and tolerances
    - Power supply rooms
    - Computer and Control rooms
  - Air flow requirements , delta T, range (temp +/-), stability (allowable change/hour)
  - Humidity Requirements and tolerances
  - Heat loads to air – by area, are loads continuous or intermittent , diversity (min/max/norm)
  - Air exchange rates and purge requirements as it relates to heavier or lighter than air gas use. Hazardous or flammable gas.
- Cooling by water systems
  - System types, ICW, warm LCW, cooled LCW, chilled LCW, chilled water (CHW)
  - Temperature and stability requirements and tolerances
  - Water flow requirements and delta T
  - Heat loads to water – by system and area

Power and Cooling Requirements

- Cryogenic use as it relates to conventional mechanical, electrical, and space requirements

- Electrical Power Requirements (in watts)
  - Experimental Systems power requirements includes detectors, electronic, control rooms, etc.
  - Power Supplies
  - Equipment location
  - Redundancy
  - Primary and “out of beam” detectors
  - Grounding (isolation of grounding systems)
  - Emergency power/UPS

- Fire Protection/Life Safety Systems
  - Use of suppression gases, where, required volumes
  - Sprinkler systems
  - Fire detection – spot type, VESDA, line type heat detection

UNDERSTANDING DRFS – SPACES and CFS REQUIREMENT

- **Load-Need moreinfo?**

CFS POWER REQMNT

DIMENSIONS

Components		Quantity Per 36m	Total Heat Load	Average Heat Load (kW)	To Low Conductivity Water: Heat Load to LCWater (KW)	Max Allowable Temperature (F)	Max Allowable Temperature (c)	Supply Temp (variation) (C)	Supply Temp (C)	Delta Temperature (C delta)	Water Flow (l / min)	Maximum Allowable Pressure (Bar)	Typical (water) pressure drop Bar	Acceptable Temp Variation delta	DIMENSIONS	to rack chiller	To Fan Coil	Source
RF Components																		
--- High Voltage Circuit Breaker (6.6 kV) ---		1/76 m																S. Fukuda 9-4-09
DC Power Supply, 6.6 kV (In), 60 kV, 4 A (Out), 250 kW, 90% eff.	Rack 1	1/76 m		15	15	122	50									0	10	S. Fukuda 9-4-09
DC Power Supply, 6.6 kV (In), 60 kV, 4 A (Out), 250 kW, 90% eff. (Backup)	Rack 2	1/76 m																S. Fukuda 9-4-09
Modulating Anode Modulator, 6.6 kV (Shunt 1.0 A, then 6 kW heat load)	Rack 3	1/76 m		6.00	3.60	122	50									0	2.4	S. Fukuda 9-4-09
Modulating Anode Modulator, 6.6 kV (Shunt 1.0 A, then 6 kW heat load), (Back-up)	Rack 4	1/76 m																S. Fukuda 9-4-09
--- AC Transformer to Low Voltage (400/200/100 V) ---		1/152 m																
Heater PJS, 200V, 36A, 7.2kW	Rack 3	1/76 m		1		122	50									1	0	S. Fukuda 9-4-09
Same as above (Back-up)	Rack 4	1/76 m																S. Fukuda 9-4-09
Pulse Transformer		None																S. Fukuda 9-4-09
Klystron Socket Tank / Gun 0.3 kW X 26		26/76 m		7.80	6.24	140	60									0	1.56	S. Fukuda 9-4-09
Klystron Focusing x 26 (Permanent Magnet)		26/76 m		0														S. Fukuda 9-4-09
Klystron Collector 4.5 kW X 26		26/76 m		117	113.49	187	87									0	3.51	S. Fukuda 9-4-09
Klystron Body & Windows		26/76 m		7.52	5.51	104	40									0		S. Fu
--- LLRF Racks ---																		
LLRF+Amp +Int, 200V, 2.5A /5 modules	Rack 5	1/76 m		0.35		122	50									0.35	0	S. Fu
LLRF+Amp +Int, 200V, 2.5A /5 modules	Rack 6	1/76 m		0.35		122	50									0.35	0	S. Fu
LLRF+Amp +Int, 200V, 1.5A /3 modules	Rack 7	1/76 m		0.21		122	50									0.21	0	S. Fu
(LLRF+Amp +Int, 200V, 1.5A /3 modules, for full power op.)	Rack 7	1/76 m		0.21		122	50									0.21	0.21	S. Fu
(LLRF+Amp +Int, 200V, 2.5A /5 modules, for full power op.)	Rack 8	1/76 m		0.35		122	50									0.35	0.7	
(LLRF+Amp +Int, 200V, 2.5A /5 modules, for full power op.)	Rack 9	1/76 m		0.35		122	50									0.35	1.05	
--- Other Racks ---																		
Timing , 200V, 0.5kW	Rack 10	1/76 m		0.50		122	50									0.50	0	H. Ha
Timing , 200V, 0.5kW	Rack 11	1/76 m		0.50		122	50									0.50	0	
Cavity , 200V, 3 kW	Rack 12	1/76 m	2.95	2.05		122	50									2.05	0	H. Ha
Cavity , 200V, 3 kW	Rack 13	1/76 m	2.95	2.05		122	50									2.05	0	
Cryogenics, 200V, 2.1 kW	Rack 14	1/76 m		2.10		122	50									2.10	0	H. Ha
Cryogenics, 200V, 2.1 kW	Rack 15	1/76 m		2.10		122	50									2.10	0	
BPM & Mag, 200V, 5 kW	Rack 16	1/76 m		5.00		122	50									5.00	0	H. Ha
BPM & Mag, 200V, 5 kW	Rack 17	1/76 m		5.00		122	50									5.00	0	
--- RF Loads ---																		
Attenuator		None																S. Fu
Waveguides in service tunnel		None																S. Fu
Waveguides in penetration		None																S. Fu
Waveguides in beam tunnel		26/76 m		1.60	0											0	1.60	S. Fu
Circulator with load		None																S. Fu
RF Loads		26/76 m		45.60	44.23												1.37	S. Fu
--- Other Loads ---																		
Pulse motor for input coupler/tuner		(26+26)/76 m	1.79	0													0	H. Ha
Vacuum Pumps		(2+2)/76 m		1.26													1.26	Ha
Subtotal RF unit Only (for 2 RF)				*233.90*	*188.07*											*22.12*	*23.66*	

FIRE LOADS (OIL AMOUNT?)

FLOWS? Or DT?

CURRENT INFO GIVEN

- **188.1 KW for LCW Water per 2 RF**
- **Roughly 22-23KW each for rack chiller and heat load to air per 2 RF**