



# ***DAMPING RING BASELINE TECHNICAL REVIEW***

## ***CONVENTIONAL FACILITIES AND SITING GROUP***

### ***CFS Damping Ring Mechanical Overview***

***L. Hammond/E. Huedem***



## Conventional Mechanical Utilities

- **Process Water**
  - Takes care of the majority of the heat rejection
- **Air Handling/Ventilation**
  - Local Units for Air Temperature Control and Stability
  - Large Surface Units for required ventilation
  - AOR pressurization, ODH and Ozone Purge TBD
- **Current Thermal Heat Loads (Excluding Cryo and conventional equipment)**
  - 12.4 MW (baseline 10Hz – 2 rings)
  - 14.8 MW (upgrade 5Hz – 3 rings)...**currently used for design**

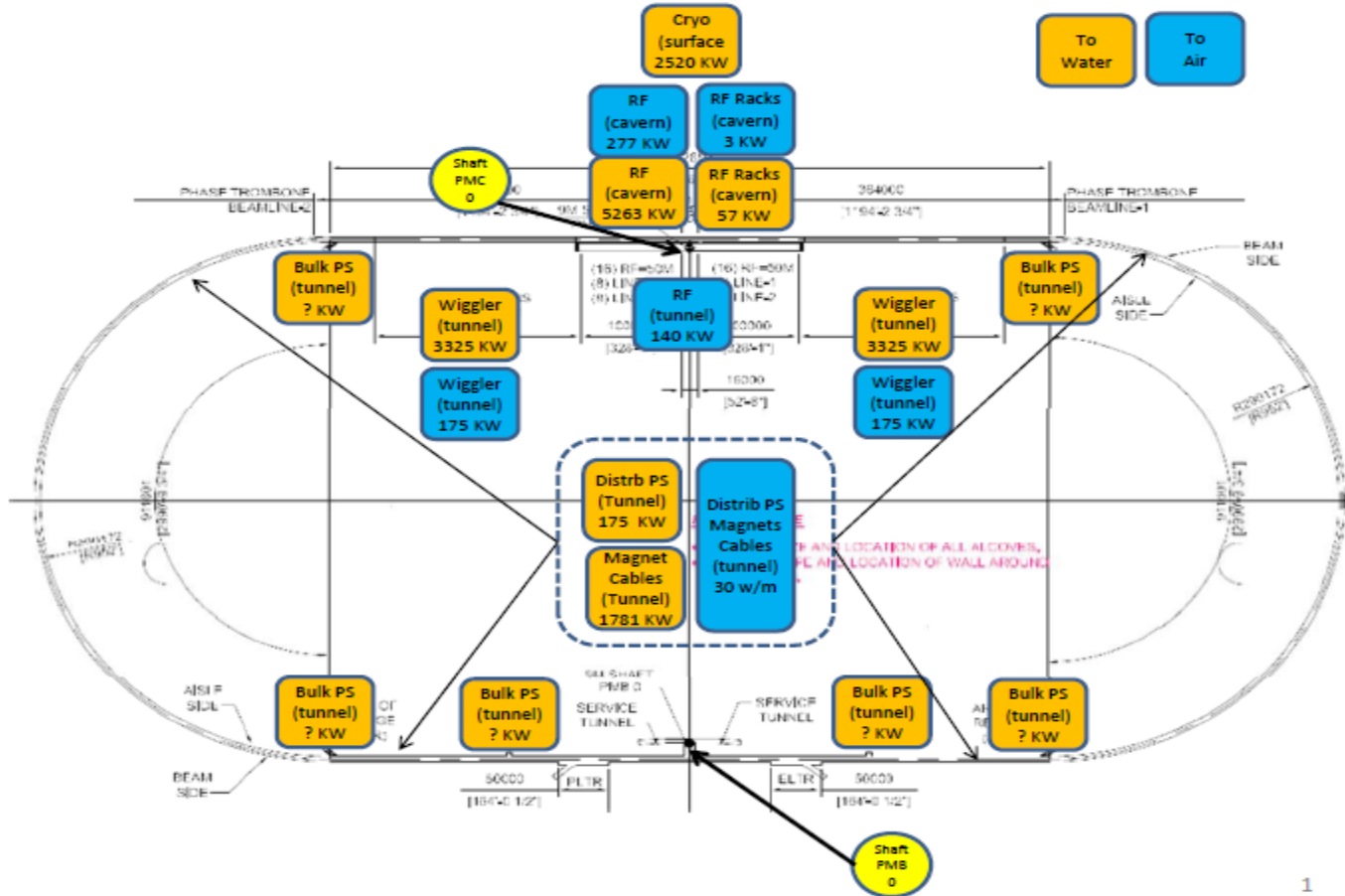


## Current Total Thermal Load Distribution

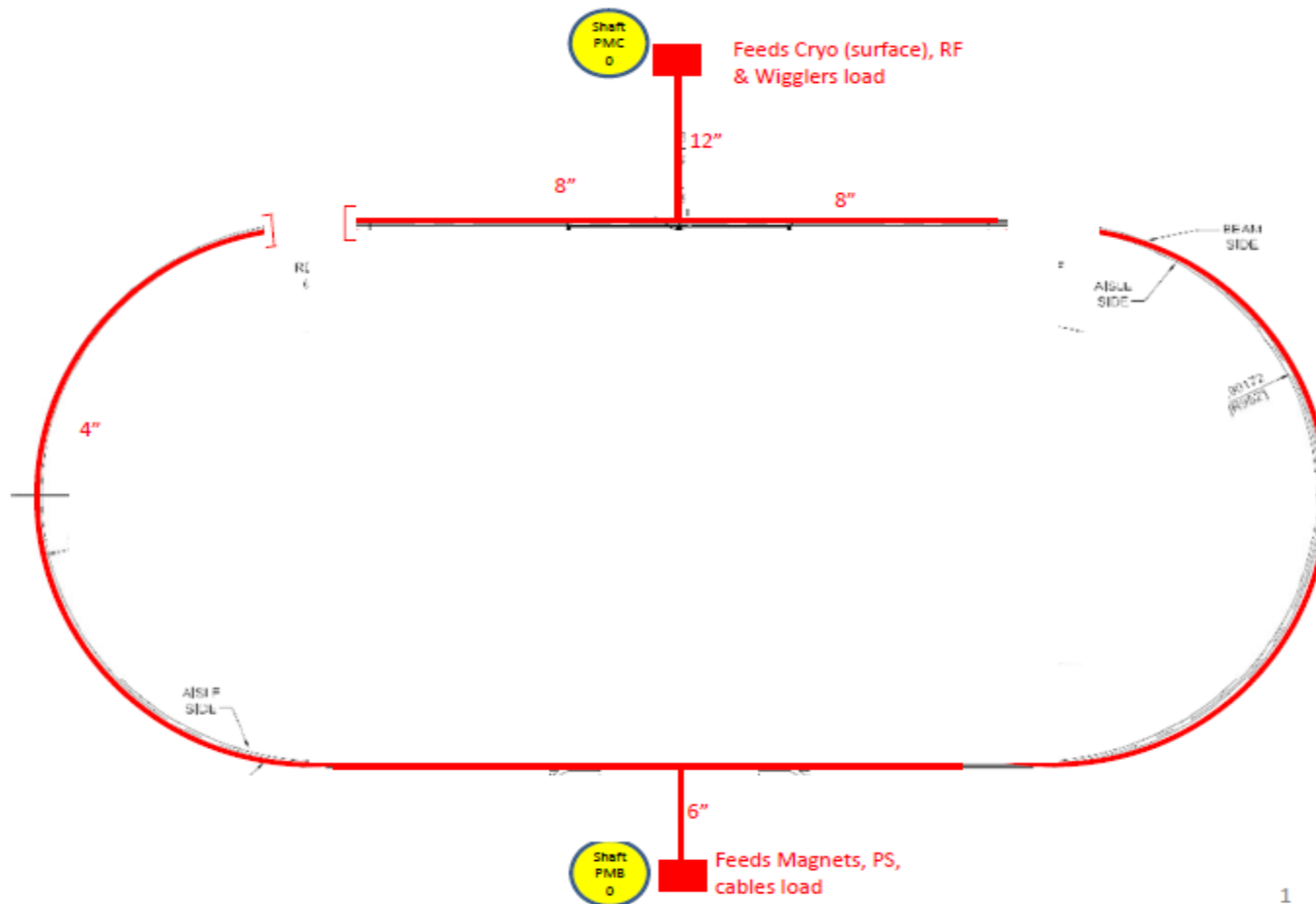
- **14.8MW**
  - **94% into process water, 6% in air – fancoils/air handlers**
- **85% of the load goes to Shaft PMC-0**
- **15% of the load goes to Shaft PMB-0**



# Heat Load Locations



## Water Plant Sample Distribution





## What's next?

- *The CFS Mechanical Group would like to thank S. Guiducci and M. Palmer for their help in the development of the CFS Damping Ring Criteria*
- *Check LOADS (hopefully total still the same)*
- *Loads, Count, Locations of bulk power supplies*
- *Check # of distributed power supplies (revisit since each might just require a trickle flow, low delta T)*
- *Continuous ventilation requirement (airflow)*
- *RF rack KW currently placeholder*
- *ODH, Cryo, Ozone Purge requirements*
- *Enclosing wiggler area for airtight stability isolation*



## DR ( DAMPING RING ) DESIGN CRITERIA FOR CFS

Other Utilities Criteria*		Items highlighted in yellow/Green = require further info
		New items highlighted in yellow <b>DRAFT JUN 17, 2011</b>
		DATA* [Source of Info]
1	Power Supply typical water pressure drop	Assume typical 40 PSID [6/16/2011 email]
2	Power Supply typical water delta T	12-18°FdT/7-10°C DT [6/16/2011 email]
3	Power Supplies maximum allowable temperatures	104°F (40°C) [6/16/2011 email]
4	Magnet typical water pressure drop	100 PSID
5	Magnet typical water delta T	per design. Max 40F dt
6	Magnet maximum allowable temperatures	140°F (60°C)
		[from RDR Magnet group info 2006] [6/16/2011 email]
7	Dump typical water pressure drop	N/A (CFS is not designing any RAW system)
8	Dump typical water delta T	N/A
9	RF system typical water pressure drop	Assume typical 40 PSID [placeholder] - [6/2/2011 meeting]
10	RF system typical water delta T	45F DT shown is ok - [6/2/2011 meeting]
11	RF system maximum allowable temperatures	40C - [6/16/2011 email]
12	Racks system typical water pressure drop	Assume typical 40 PSID [placeholder] - [6/16/2011 email]
13	Racks system typical water delta T	Typical 10C - [6/16/2011 email]
14	Racks system maximum allowable temperatures	40C - [6/16/2011 email]
15	Max Space/Air Temperature in Beam Tunnel	90F [Metrology 2007]; 104F [PM Marc]; ~77F [Susana 2010 CFS wkshp]; 77F to 87F range [6/2/2011 meeting]
16	Max Space/Air Temperature in Cavern/Occupied Zones	85°F (29.5°C) [placeholder- continuous occupancy]- LCW temp dependent
17	Air Temperature Stability in Beam Tunnel	+ - 0.18°F DT (+ - 0.1°C DT) [GDE2007, 2007discussions, SB2009 Heat Table & CFS2010 wrkshp]; stability required during beam on
18	Dew Point Temperature	dewpoint based on 55%RH max RH @ 77-87Fdb [6/2/2011 meeting]
19	Maximum Relative Humidity (%)	55%RH [6/2/2011 meeting]
20	Minimum Relative Humidity (%)	none [6/2/2011 meeting]
21	Process Heat Load to Air	See Heat/Power Load Tables, [From various email correspondence with Susanna Jul 2009 & Jan 2011, Marc Jul 2009]; Adjusted load table - still verifying. Needs component list (magnet & RF) [6/16/2011 email]
22	Process Load to CHW	
23	Process Load to LCW	
24	Ventilation (number of persons in space)	Not per personnel but continuous ventilation reqd due to ozone, final numbers TBD, current assumption air speed @ 1mph [6/2/2011 meeting]
25	Ventilation (Cu M/Hr or cfm)	



## Global Design Effort - CFS

26	Space Pressurization (Negative milliBars or inch W.C)	no requirement - [6/16/2011 email]
27	Space Pressurization Stabilization (+/- milliBar or inch W.C. )	no requirement - [6/16/2011 email]
28	Shaft/Egress Pressurization (Positive milliBar or inch W.C.)	will follow life safety report recommendation
29	LCW Supply Temperature	[assume 65F (18C) to 95F(35C) depend on water system &/or site weather]-coupled with item 16 -[6/16/2011]
30	LCW Supply Temperature Stability	same as air @ + - 0.1 C [ 6/2/2011 meeting]
31	LCW delta T	[placeholder of 18F(10C) or 40F(22C)DT depending on equipment/space temperature limit; water system &/or site ambient conditions]
32	LCW Pipe vibration impact	no info received [assume typical industry practice on pipe water velocity]. ok for now [ 6/2/2011 meeting]. will need further discussion [6/16/2011]
33	ODH Purge (Y/N - Cu M/ Hr if Y)	current assumption is none, although RF system have nitrogen shield, vent thru discharge space, to be further checked [6/2/2011 meeting]; Mark reviewing with Cryo [6/16/2011]
34	Activated Air Purge/ Radiation ventilation (Y/N - Cu M /Hr if Y)	no requirement based on previous ML discussions [6/16/2011 email]
35	Dessicant Dehumidification	no requirement based on previous ML discussions [ 6/16/2011 email]
36	Any power quality reqmnt (clean / dirty power?)	Mark will double check [6/2/2011 meeting]
37	Can you maintain min power factor? Op Power characteristics, pf?	Assume 85% pf
38	Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc)	There's high power supply (13.2 or 7.2KV) for RF only, the rest are normal voltage 480v [ 6/2/2011 meeting]
39	Utility (water system ) interface	CFS terminate @ valve near main or distribution pipe, near equipment.
40	Utility (electrical ) interface	CFS terminate at panelboards
41	How stable are the heat loads?	Magnets, Power Supplies, Cables are very stable and constant; Load from Radiation (see heat table) are distributed 88% in wigglers ( 2 locations), and 12% in the arc (2 locations) and slightly vary but no info how much variance, assume relatively stable for now; The 1 Km straight section are very stable heat load. [Jul 14 & 15 2009, Marc/Susana Phone conversation]-See diagram; Beam power-related loads range 0-100% wo/w beam. All others should be stable [6/16/2011 email]
42	Whats the largest equipment in the tunnel? & in transport?	Wiggler cryostat, bulk PS [6/16/2011 email]
43	Penetrations between cavern/alcove and beam tunnel?	to be identified later. MP working on sketches [6/16/2011 email]
44	Whats the relationship of the injection from e+ to 3ring DR	Needs further review. From Positron Daresbury Meeting [Feb 10 2011]; MP identifying designer [6/16/2011]
45	OTHER ITEMS from [6/2/2011 meeting]; (a) occupancy is not required while the beam is running; (b) shaft/cavern will be in the inner ring side; (c) cavern in the RF area to be 216 meter long; (d) isolation of wiggler and RF to be considered due the thermal stability reason; (e) discussed the reduction of shaft, however it was decided that but both shafts are still needed; (f) distributed power supplies concept for the magnets; (g) wigglers will require local power supplies (AC to local DC) due to high DC currents	
[FEB 10 2011] refers to the positron/edms meeting discussion at Daresbury and accessible at this ilc url addres <a href="http://ilcagenda.linearcollider.org/getFile.py/access?contribId=3&amp;resId=2&amp;materialId=slides&amp;confId=5036">http://ilcagenda.linearcollider.org/getFile.py/access?contribId=3&amp;resId=2&amp;materialId=slides&amp;confId=5036</a>		
*some items were discussed in CFS 2010 workshop		





# Global Design Effort - CFS

## DR ( DAMPING RING ) DESIGN CRITERIA FOR CFS

draft Jun 17 2011

CFS

### DR Heat Load (Totals DR shown) for "5 HZ -2652 bunches - 3 rings - upgrade from SB2009 (CFS FACILITIES BASELINE)"

for total DR					Items highlighted in yellow=new items added or items that changed as compared to the previous Jan 05 2011 power table				Load to water-LCW				Load to Air	Beam tunnel Temperature (F)	Notes
Operating Loads	Total KW Heat Load	rough location	Qty	Distribution Assumption	KW heat load	LCW supply temperature (F)	Delta T (F)	or Flow (gpm)	KW heat load						
<b>DR components (surface)</b>															
Cryo	2520	surface		one location	2520	85 to 90F (tower water)	10	1721						*ventilated space	Jan 28 2011 Tom Peterson Meeting; Jun 2, 2011, IMP confirmed located in one shaft
<b>DR components (tunnels and caverns)</b>															
Magnets	1628	tunnel		equally distributed	1553			20	530	75	65 F if using chiller, 95F if using just towers	77F to 87 F	30 w/m		
Cables (watercooled bus)	240	tunnel		equally distributed	229			N/A	N/A	11					
Power supplies (distributed )/ Rack style	184	tunnel	350?	equally distributed in tunnels	175			10	119	9					
Power supplies (Bulk style)- 480V	20	cavern & alcoves	14?	2 in cavern, 1 each in alcove	20			18	8	1					
RF in Cavern (Klystron, Modulator, Power supply etc)- High Power CFS feed - 13.8KV	5540	in cavern		RF (base value)	5263			45	799	277					
RF Racks (assumed 1% of RF base value total)	60	in cavern	12?		57			10	39	3					
RF in tunnel (waveguide?)	140	beam tunnel		RF (peak overhead)	0			N/A	N/A	140					
Radiation (from RF)- mostly Wigglers	7000	(mostly wigglers )		12% total radiation load in two arc; 88% of radiation load in two wiggler area; 1km straight section has stable load	6650			20	2270	350					
<b>Totals for tunnel/cavern DR components</b>															
	14812				13947					866					
<b>Conventional Facilities Equipment</b>															
AC Power /Emerg Transformer Losses															
Fancoils		beam													
Water Pumps															
Lighting															
	0				0					0					



**DR ( DAMPING RING ) DESIGN CRITERIA FOR CFS**

draft Jun 17 2011

CFS

**DR Heat Load (Totals DR shown) for "10 HZ - 1326 bunches-2 rings-SB2009 baseline (approved-Jan 2011 baseline)"**

for total (2) DR

Items highlighted in yellow=new items added or items that changed as compared to the previous Jan 05 2011 power table

Orange highlighted=items that changed from 5Hz-3rings to 10Hz-2 rings

Operating Loads	Total KW Heat Load	rough location	Qty	Distribution Assumption	Load to water-LCW				Load to Air	Beam tunnel Temperature (F)	Notes
					KW heat load	LCW supply temperature (F)	Delta T (F)	or Flow (gpm)	KW heat load		
<b>DR components (surface)</b>											
Cryo	2520	surface		one location	2520	85 to 90F (tower water)	10	1721		*ventilated space	Jan 28 2011 Tom Peterson Meeting; Jun 2, 2011, MP confirmed located in one shaft

30 w/m

<b>DR components</b>											
Magnets	1628	tunnel		equally distributed	1553	65 F if using chiller, 95F if using just towers	20	530	75	77F to 87 F	<p>(07/22/09) reduce to 70% from RDR, Susana email 7/15/09, due to decrease in circumf to 3.2 KM. [06/02/2011] reduce heat load to air, distributed power supplies to be watercooled</p> <p>Located in 2 shaft cavern: Info from 07/14/09 meeting w Marc reduction 50% from RDR due to "low power option"; [AUG 2 2010 from Susana; same beam power as RDR] [ PeterG email Jan 4 2011. 50% RF Power rfrom full-5Hz-2rings + fullRF power from low-5Hz-2rings]. [ 06/02/2011] added RF rack, assumed 1% of total base value, Reduce the wiggler (radiation) heat load to air to 5% -the component will be insulated. [06/17/2011] Reduce RF Heat to Air to 5% the component will be insulated.</p>
Cables (watercooled bus)	240	tunnel		equally distributed	229		N/A	N/A	11		
Power supplies (distributed )/ Rack style	184	tunnel	350?	equally distributed in tunnels	175		10	119	9		
Power supplies (Bulk style)- 480V	20	cavern & alcoves	14?	2 in cavern, 1 each in alcove	20		18	8	1		
RF in Cavern (Klystron, Modulator, Power supply etc)- High Power CFS feed - 13.8KV	4510	in cavern		RF (base value)	4285		45	650	226		
RF Racks (assumed 1% of RF base value total)	40	in cavern	8		38		10	26	2		
RF in tunnel (waveguide?)	114	beam tunnel		RF (peak overhead)	0		45	0	114		
Radiation (from RF)- mostly Wigglers	5700	(mostly wigglers )		12% total radiation load in two arc; 88% of radiation load in two wiggler area; 1km straight section has stable load	5415	20	1849	285			
<b>Totals for tunnel/cavern DR components</b>											
	12436				11714.5			723			

<b>Conventional Facilities Equipment</b>										
AC Power /Emerg Transformer Losses										
Fancoils / Air Handler										
Water Pumps										
Lighting										
	0				0			0		



## XXX

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