# DAMPING RING BASELINE TECHNICAL REVIEW

# CONVENTIONAL FACILITIES AND SITING GROUP

CFS Damping Ring Mechanical Overview

L. Hammond/E. Huedem

# **Conventional Mechanical Utilities**

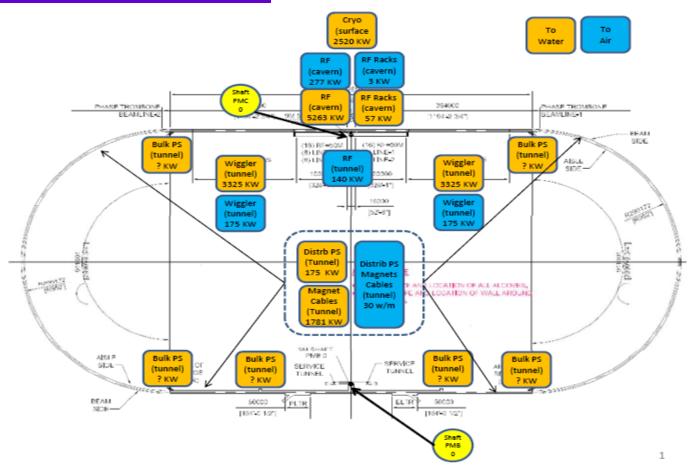
- Process Water
  - Takes care of the majority of the heat rejection
- Air Handling/Ventilation
  - Local Units for Air Temperature Control and Stability
  - Large Surface Units for required ventilation
  - AOR pressurization, ODH and Ozone Purge TBD
- Current Thermal Heat Loads (Excluding Cryo and conventional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

# **Current Total Thermal Load Distribution**

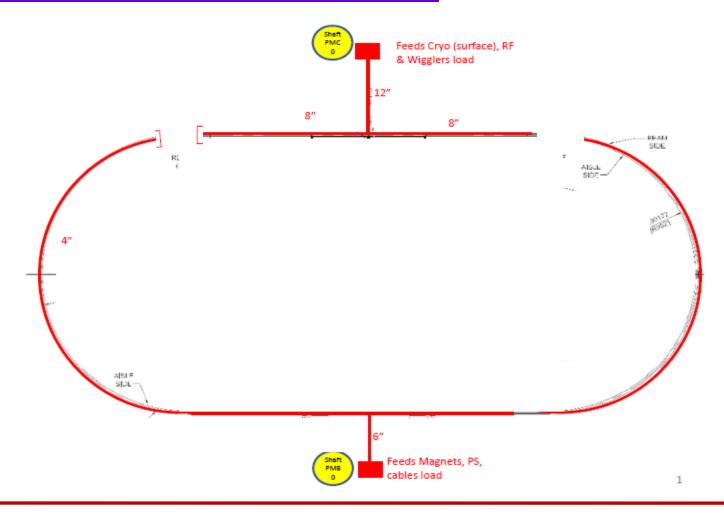
- 14.8MW
  - □ 94% into process water, 6% in air fancoils/air handlers
- 85% of the load goes to Shaft PMC-0
- 15% of the load goes to Shaft PMB-0



# **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



# Global Design Effort - CFS

## DR (DAMPING RING) DESIGN CRITERIA FOR CFS

		items highlighted in yellow/Green = require further info				
Ot	ner Utilities Criteria*	New items highlighted in yellow	DRAFT JUN 17, 2011			
		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	(from DDD Magnet group into 2000)			
_	Magnet typical water delta T	per design. Max 40F dt	[from RDR Magnet group info 2006] [6/16/2011 email]			
6	Magnet maximum allowable temperatures	140°F (60°C)				
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 Sus				
22		Jul 2009 & Jan 2011, Marc Jul 2009]				
23	Process Load to LCW	table - still verifying. Needs component list (magnt & RF) [6/16/2011 em				
24	Ventilation (number of persons in space)	Not per personnel but continuous ventilation regd due to ozone, final numbers TBD				
25	Ventilation (Cu M/Hr or cfm)	current assumption air speed @ 1mph [6/2/2011 meeting]				



LCW Supply Temperature  1. CW Supply Temperature Stability  2. CW Pipe vibration impact  3. Course a samption is none, although RF system have nitrogen sheld discharge space, to be further checked [6]/2011 meeting], Mark reversible for one for impact on the form of [67/2011]  3. Cat you maintain min power quality reqmnt (clean / dirty power?)  3. Can you maintain min power factor? Op Power characteristics, pf?  3. Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc)  3. Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc)  3. Will titly (electrical ) interface  4. Utilitity (electrical ) interface  4. Whats the largest equipment in the tunnel? & in transport?  4. Whats the largest equipment in the tunnel? & in transport?  4. Whats the relationshop of the injection from e+ to 3ring DR  4. OTHER ITEMS from [6/2/2011 meeting]; (a) occupancy is not required while the beam is running; (b) shaft/cavern will be in the lineer ring side; (c) cavern in the RF or the properties of the prope	_							
28 Shaft/Egress Pressurization (Positive milliBar or inch W.C.)  29 LCW Supply Temperature  29 LCW Supply Temperature (assume 65F (18C) to 69F (3SC) depend on water system &for site to coupled with item 16 - {6F (18C) 211}  30 LCW Supply Temperature Stability  31 LCW delta T  32 LCW Pipe vibration impact  33 LCW Pipe vibration impact  34 LCW Pipe vibration impact  35 LOW Pipe vibration impact  36 LOW Pipe vibration impact  37 LOW Pipe vibration impact  38 LOW Pipe vibration impact  39 LOW Purge (Y/N - Cu M/ Hr if Y)  30 LOW Purge (Y/N - Cu M/ Hr if Y)  31 Activated Air Purge/ Radiation ventilation (Y/N - Cu M / Hr if Y)  32 LOW Pipe vibration impact  33 LOW Pipe (Y/N - Cu M/ Hr if Y)  34 Activated Air Purge/ Radiation ventilation (Y/N - Cu M / Hr if Y)  35 Dessicant Dehumidification  36 Any power quality requnt (clean / dirty power?)  37 Can you maintain min power factor? Op Power characteristics, pf?  38 Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc)  49 Utilitity (electrical) interface  40 Utilitity (electrical) interface  40 Utilitity (electrical) interface  41 How stable are the heat loads?  42 Whats the largest equipment in the tunnel? & in transport?  43 Penetrations between cavern/alcove and beam tunnel?  44 Whats the largest equipment in the tunnel? & in transport?  45 OHER ITEMS from [6/2/2011 meeting]: (a) occupancy in ont required while the beam is running; (b) shaft/cavern will be in the inner ring side; (c) cavern in the Fr. 216 meeting; (d) isolation of wiggler and RF to be considered due the thermal stability reason; (e) distributed power supplies (AC to local DC) due to high DC currents  45 OTHER ITEMS from [6/2/2011 meeting]; (a) occupancy in ont required while the beam is running; (b) shaft/cavern will be in the inner ring side; (c) cavern in the Fr. 216 meeting; (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 needed; (f) distributed power supplies concept for	26	ce Pressurization (Negative milliBars or inch W.C) no requirement - [6/16/2011 email]						
29 LCW Supply Temperature 30 LCW Supply Temperature Stability 31 LCW delta T 32 LCW Pipe vibration impact 33 CM Purge (Y/N - Cu M/ Hr if Y) 34 Activated Air Purge/ Radiation ventilation (Y/N - Cu M / Hr if Y) 35 Dessicant Dehumidification 36 Any power quality reqmnt (clean / dirty power?) 37 Can you maintain min power factor? Op Power characteristics, pf? 38 Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc) 49 Utility (water system Sey interface 40 Utility (electrical ) interface 41 How stable are the heat loads? 41 How stable are the heat loads? 42 Whats the largest equipment in the tunnel? & in transport? 43 Penetrations between cavern/alcove and be methanism of the magnets; (g) wiggler systap lead for the magnets; (g) wiggler systappies (AC to local DC) due to high DC currents 44 Whats the relationshop of the injection from e+ to 3 ring DR 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) accern in the first power supplies (AC to local DC) due to high DC currents 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) accern in the first power supplies (AC to local DC) due to high DC currents	27	ace Pressurization Stabilization (+/- milliBar or inch W.C. )  no requirement - [6/16/2011 email]						
LCW Supply Temperature    Coupled with item 16 - [6/16/2011]   CW delta T	28	Shaft/Egress Pressurization (Positive milliBar or inch W.C.)	ion (Positive milliBar or inch W.C.) will follow life safety report recommendation					
1 LCW delta T	29	LCW Supply Temperature	[assume 65F (18C) to 95F(35C) depend on water system &/or site weather]- coupled with item 16 -[6/16/2011]					
temperature limit; water system & for site ambient conditions in for received [assume typical industry practice on pipe water wok for now [672/2011 meeting], will need further discussion [8] current assumption is none, although RF system have introgen sheld discharge space, to be further checked [872/2011 meeting]. Mark rev Cryo [87:18/2011] meeting], Mark rev Cryo [87:18/2011] meeting] mark rev Cryo [87:18/2011] meeti	30	LCW Supply Temperature Stability	bility same as air @ + - 0.1 C [ 6/2/2011 meeting]					
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discharge space, to be further checked [6/2/2011 meeting]: Mark rev Cryo [6/16/2011]  A Activated Air Purge/ Radiation ventilation (Y/N - Cu M /Hr if Y)  Dessicant Dehumidification  Any power quality reqmnt (clean / dirty power?)  Nark will double check [6/2/2011 meeting]  Voltage Regulation/Optimum Utilization Voltage (480V? 208V? etc)  Utilitity (water system) interface  Utilitity (electrical) interface  There's high power supply (13.2 or 7.2KV) for RF only, the rest are not 480V [6/2/2011 meeting]  Assume 85% pf  There's high power supply (13.2 or 7.2KV) for RF only, the rest are not 480V [6/2/2011 meeting]  Utilitity (water system) interface  CFS terminate @ valve near main or distribution pipe, near equiper of the stable are distributed 88% in wigglers (2 locations) the arc (2 locations) and slightly vary but no info how much variance relatively stable for now, The 1 Km straight section are very stable her relatively stable for now, The 1 Km straight section are very stable her relatively stable for now, The 1 Km straight section are very stable her 14 & 15 2009, Marc/Susana Phone conversation]-See diagram; Be related loads range 0-100% work beam. All others should be stable email]  Whats the largest equipment in the tunnel? & in transport?  Whats the relationshop of the injection from e+ to 3 ring DR  Whats the relationshop of the injection from e+ to 3 ring DR  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 216 meeter 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 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	32	ok for now [ 6/2/2011 meeting], will need further discussion [6/16/2011]						
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[FEB 10 2011] refers to the positron/edms meeting discussion at Daresbury and accessible at this ilc url addres	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						
http://ilcagenda.linearcollider.org/getFile.py/access?contribId=3&resId=2&materialId=slides&confld=5036  *some items were discussed in CFS 2010 workshop	E							



# Global Design Effort - CFS

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

0

draft Jun 17 2011

0

DR Heat Load (Totals DR shown) for "5 HZ -2652 bunches - 3 rings - upgrade from SB2009 (CFS FACILITIES BASELINE)" Items highlighted in yellow=new items added or items that changed for total DR Load to water-LCW as compared to the previous Jan 05 2011 power table Beam Air tunnel LCW supply Temper Total KW rough KW heat Delta T or Flow KW heat **Operating Loads** Qty Distribution Assumption temperatur Notes Heat Load location load load DR components (surface) 85 to 90F an 28 2011 Tom Peterson Meeting; Jun 2, 2011, Cryo 2520 surface 2520 1721 one location (tower 10 MP confirmed located in one shaft 30 w/m DR components (tunnels and caverns) 75 1628 1553 20 530 Magnets tunnel equally distributed Cables (watercooled bus) 240 tunnel equally distributed 229 N/A N/A 11 (07/22/09) reduce to 70% from RDR, Susana Power supplies (distributed )/ email 7/15/09, due to decrease in circumf to 3.2 184 350? equally distributed in tunnels 175 119 9 tunnel 10 KM. [06/02/2011] reduce heat load to air, Rack style distributed power supplies to be watercooled Power supplies (Bulk style)cavern & 20 2 in cavern, 1 each in alcove 18 8 1 RF in Cavern (Klystron, Modulator, in 65 F if 5540 RF (base value) 799 277 5263 45 Power supply etc)- High Power CFS feed cavern using 77F to Located in 2 shaft cavern: Info from 07/14/09 13.8KV chiller, 95F meeting w Marc reduction 50% from RDR due f using just o "low power option"; [AUG 2 2010 from RF Racks (assumed 1% of RF base in 12? 57 10 39 3 towers Susana; same beam power as RDR] [ PeterG value total) cavern mail Jan 4 2011, 50% RF Power rfom full-5Hz-Prings + fullRF power from low-5Hz-2rings]. [ beam 5/02/2011] added RF rack, assumed 1% of to RF in tunnel (waveguide?) 140 RF (peak overhead) 0 N/A N/A 140 tunnel ase value, Reduce the wiggler (radiation) heat and to air to 5% -the component will be 12% total radiation load in two sulated. [06/17/2011] Reduce RF Heat to Air (mostly Radiation (from RF)- mostly arc; 88% of radiation load in to 5% the component will be insulated. 7000 wigglers 6650 20 2270 350 two wiggler area; 1km straight Wigglers section has stable load Totals for tunnel/cavern DR components 14812 13947 866 Conventional Facilities Equipment AC Power /Emerg Transformer Losses Fancoils beam Water Pumps ighting

0

CFS



## DR (DAMPING RING) DESIGN CRITERIA FOR CFS

0

draft Jun 17 2011

0

**CFS** 

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				Load to water-LCW			Load to Air	Beam	Orange highlighted=items that changed from 5Hz-3rings to 10Hz-2 rings	
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	tunnel Tempera ture (F)	Notes
DR components (surface)		·									_
Cryo	2520	surface		one location	2520	85 to 90F (tower water)	10	1721			Jan 28 2011 Tom Peterson Meeting; Jun 2, 20 MP confirmed located in one shaft
30 w/m											
DR components											
Magnets	1628	tunnel		equally distributed	1553		20	530	75		(07/22/09) reduce to 70% from RDR, Susana email 7/15/09, due to decrease in circumf to 3 KM. [06/02/2011] reduce heat load to air, distributed power supplies to be watercooled
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	65 F if using chiller, 95F	45	650	226		PF to Located in 2 shaft cavern: Info from 07/14/09 meeting w Marc reduction 50% from RDR due "low power option"; [AUG 2 2010 from Susana same beam power as RDR] [ PeterG email Jan 4 2011. 50% RF Power from full-5Hz-2rings + full power from low-5Hz-2rings]. [ 06/02/2011] added RF rack, assumed 1% of total base valu Reduce the wiggler (radiation) heat load to ait to 5% -the component will be insulated. [06/17/2011] Reduce RF Heat to Air to 5% the component will be insulated.
RF Racks (assumed 1% of RF base value total)	40	in cavern	8		38	if using just towers	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 stabke load	5415		20	1849	285		
Totals for tunnel/cavern DR components	12436				11714.5				723		
Conventional Facilities Equipment											
AC Power /Emerg Transformer Losses											
Fancoils / Air Handler											
Water Pumps Lighting											

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