

Conventional Mechanical Updates

Emil Huedem
Lee Hammond

Sep 29 2011,
Granada Spain

OUTLINE

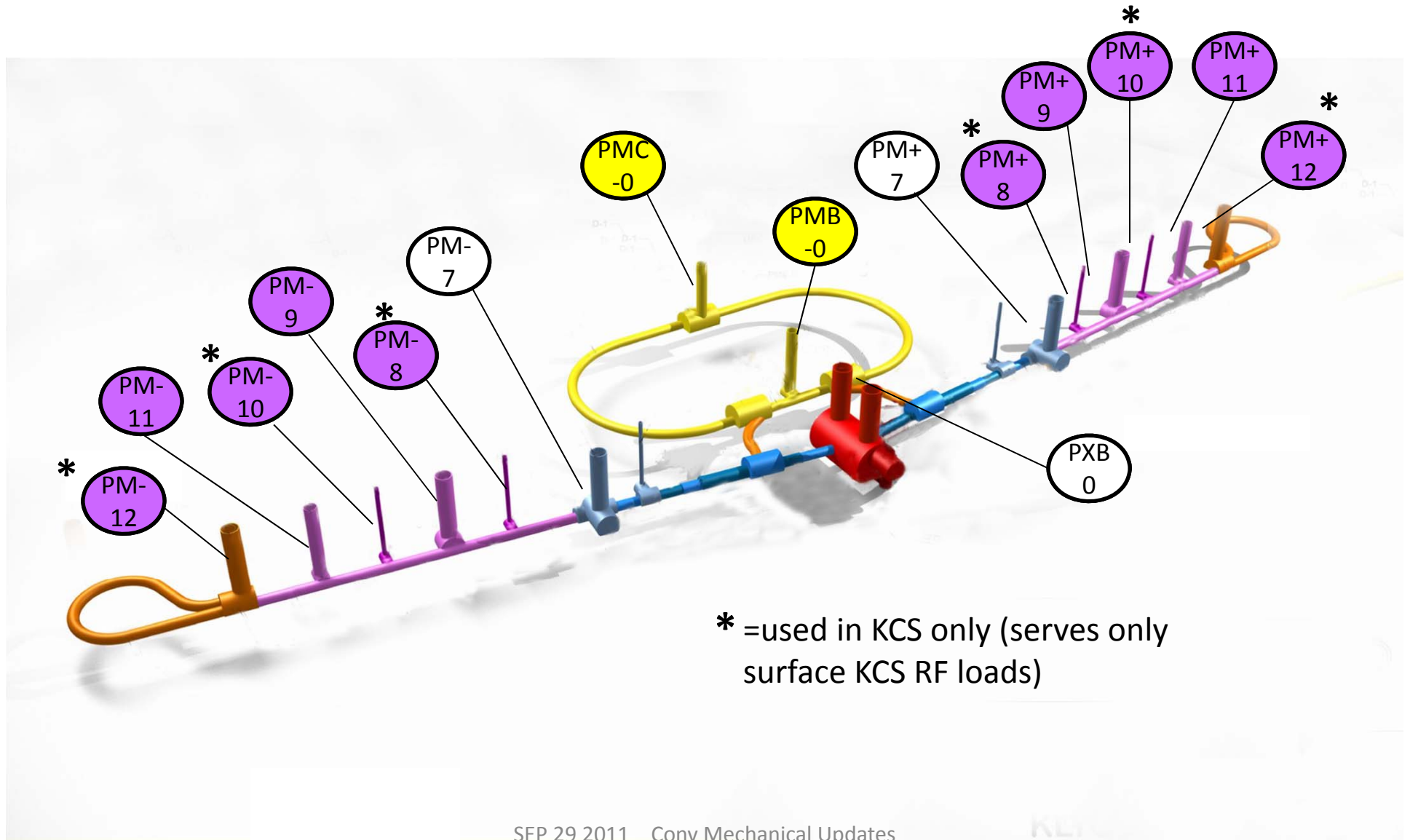
- Scope / WBS
- Plant Locations
- Loads
- Scheme for ML, CR, DR, IR
- Airflow scheme / Sump System
- Interfaces
- (Backup Slides/Reference)- Load tables from Area systems

SCOPE:

- Conventional Mechanical scope includes Air Treatment (Ventilations), Sumps systems (part of pipe utilities wbs), and Process Cooling Water system
- Follows the RDR WBS system

1.7.3 AIR TREATMENT (HVAC)		1.7.5 PROCESS (COOLING) WATER	
1.7.3.1	Engineering, study work and documentation	1.7.5.1	Engineering, study work and documentation
1.7.3.1.1	In-house Engineering	1.7.5.1.1	In-house engineering
1.7.3.1.2	Outsourced Consultancy Services	1.7.5.1.2	Outsourced Consultancy Services
1.7.3.2	HVAC Equipment	1.7.5.2	Primary Stations
1.7.3.2.1	Ventilation Units - MUA	1.7.5.2.1	Cooling Towers & Pumping Stations
1.7.3.2.2	Tunnel Fancoils / air handler	1.7.5.2.1.1	Cooling Towers for Process Water
1.7.3.2.3	Air-conditioning for General Areas	1.7.5.2.1.2	Cooling Towers for Chiller Water
1.7.3.2.4	Alcoves / Caverns HVAC	1.7.5.2.1.3	Tower Pump & Accessories for Process Water
1.7.3.2.5	HVAC surface racks	1.7.5.2.1.4	Tower Pump & Accessories for Chiller Water
1.7.3.2.6	Surface RF equipment Ventilations	1.7.5.2.1.5	Chilled Water Pumps
1.7.4 PIPED UTILITIES		1.7.5.2.1.6	Controls
1.7.4.1	Engineering, study work and documentation	1.7.5.2.1.7	Heat Exchanger for RF Water system
1.7.4.1.1	In-house Engineering	1.7.5.2.1.8	reserved
1.7.4.1.2	Outsourced Consultancy Services	1.7.5.2.2	Primary Stations and Piping
1.7.4.2	Plumbing	1.7.5.2.2.1	Chillers
1.7.4.2.1	Potable Water	1.7.5.2.2.2	Tower piping for Process Water (surface)
1.7.4.2.2	Sanitary System	1.7.5.2.2.3	Tower piping for Chilled Water (surface)
1.7.4.2.3	Sump Systems	1.7.5.2.2.4	Tower piping for Process Water (shaft)
1.7.4.2.4	GroundWater Lift Systems	1.7.5.2.2.5	Chilled Water Piping (surface)
1.7.4.3	Fire Suppression	1.7.5.2.2.6	Chilled Water Piping (Shaft)
1.7.4.4	Fuel System Distribution	1.7.5.2.2.7	reserved
1.7.5 PROCESS COOLING WATER		1.7.5.3	Secondary Stations
1.7.5.1	Engineering, study work and documentation	1.7.5.3.1	LCW Systems
1.7.5.1.1	In-house engineering	1.7.5.3.1.1	LCW Skid (Pumps & Heat Exchangers)
1.7.5.1.2	Outsourced Consultancy Services	1.7.5.3.1.2	LCW Pumps - Surface
1.7.5.2	Primary Stations	1.7.5.3.1.3	LCW Piping - Surface
1.7.5.2.1	Cooling Towers & Pumping Stations	1.7.5.3.1.4	LCW Piping - Tunnel
1.7.5.2.2	Primary Stations and Piping	1.7.5.3.1.5	LCW Piping Connections
1.7.5.3	Secondary Stations	1.7.5.3.1.6	MISC LCW (DI processing / LCW Controls etc)
1.7.5.3.1	Deminerlized Water Stations and Distribution Piping	1.7.5.3.2	Chilled Water Stations and Distribution Piping
1.7.5.3.2	Chilled Water Stations and Distribution Piping	1.7.5.3.2.1	Heat Exchanger (Cavern)
1.7.5.3.3	Water Stations and Distribution Piping	1.7.5.3.2.2	Distribution Pumps (Cavern)
1.7.5.3.4	Compressed Air	1.7.5.3.2.3	Piping (Cavern)
1.7.5.3.5	Process Water Distribution	1.7.5.3.2.4	Piping (Tunnel)
		1.7.5.3.2.5	Piping Connections to End Equipment
		1.7.5.3.2.6	reserved
		1.7.5.3.3	Water Stations and Distribution Piping
		1.7.5.3.3.1	Water Stations and Distribution Piping
		1.7.5.3.3.2	reserved
		1.7.5.3.4	Compressed Air
		1.7.5.3.5	Process Water Distribution
		1.7.5.3.5.1	Heat Exchanger (Cavern)
		1.7.5.3.5.2	Distribution Pumps (Cavern)
		1.7.5.3.5.3	Piping (Cavern)
		1.7.5.3.5.4	Piping (Tunnel)
		1.7.5.3.5.5	Piping Connections to End Equipment
		1.7.5.3.5.6	reserved

PROCESS WATER PLANT LOCATIONS

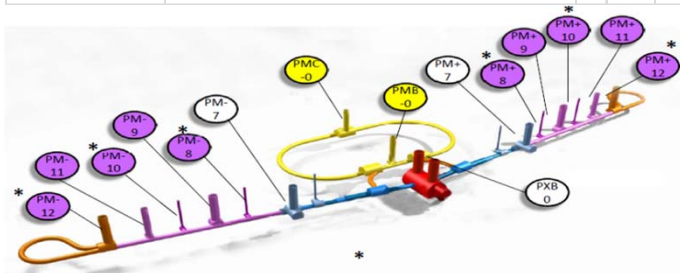


* =used in KCS only (serves only surface KCS RF loads)

PROCESS WATER PLANT LOADS-KCS (Technical components only shown)

(sample load distribution) *EXCLUDING non-technical components

New Shaft Nos	PM-12	PM-11	PM-10	PM-9	PM-8	PM-7	PMC-0	PMB-0	PXB-0	PXB-0	PM+7	PM+8	PM+9	PM+10	PM+11	PM+12				
Old Shaft Nos	Shaft 11	Shaft 7	Shaft 14	Shaft 5	Shaft 15	Shaft 3	Shaft 13	Shaft 12	Shaft 1.1	Shaft 1.2	Shaft 2	Shaft 16	Shaft 4	Shaft 17	Shaft 6	Shaft 10	TOTAL MW (cooling)*			
	2.1	21.0	4.85	17.3	4.85	16.54	11.9	14.5	2.8	2.3	36	9.9	16.54	4.85	17.3	4.85	20.8	1.8	210	
RTML		45% rtml 3.87					5% 0.43					5% 0.43				45% rtml 3.87			8.61	
ML (surface)	28 RF 2.12	64 RF 4.85	64 RF 4.85	64 RF 4.85	64 RF 4.85	64 RF 4.85						64RF 4.85	64RF 4.85	64RF 4.85	64 RF 4.85	64 RF 4.85	24 RF 1.82		79.59	
ML (tunnel)**		105 RF 4.91		108 RF 5.04		81 RF 3.74						81 RF 3.74		108 RF 5.04		101 RF 4.73				
e+							100% 6.22													6.22
e-												100% 4.3								4.30
BDS							50% 5.20					50% 5.20								10.4
DR								85% 11.97	15% 2.84											14.81
Dumps											36									36.00
CRYO (surface)		7.37		7.37		7.96		2.52	0	1.730		7.96		7.37		7.37				49.63
IR										0.576										0.576
	** includes 0.914 KW nc magnet over 5 plants										* excluding conventional non-technical components (By Parsons)						210			

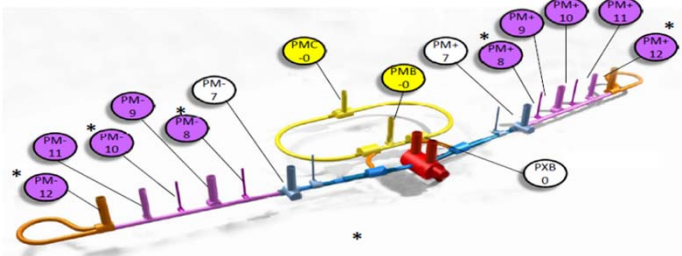


DRAFT
7/19/2011
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PROCESS WATER PLANT LOADS-DRFS (Technical components only shown)

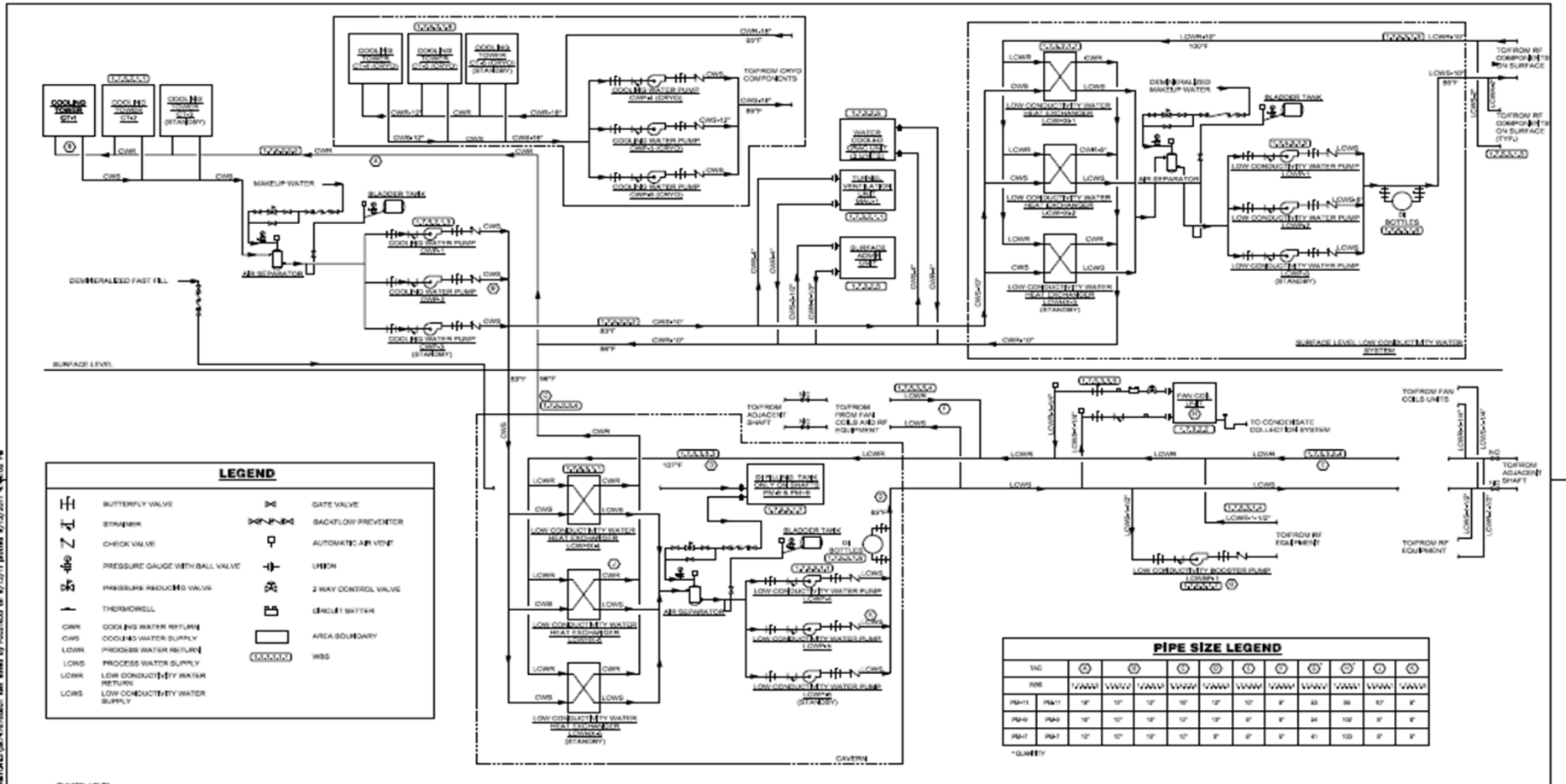
(sample load distribution) ***EXCLUDING** non-technical components

New Shaft Nos	PM-12	PM-11	PM-9	PM-7	PMC-0	PMB-0	PXB-0	PXB-0	PM+7	PM+9	PM+11	PM+12														
Old Shaft Nos	Shaft 11	Shaft 7	Shaft 5	Shaft 3	Shaft 13	Shaft 12	Shaft 1.1	Shaft 1.2	Shaft 2	Shaft 4	Shaft 6	Shaft 10	TOTAL MW (cooling)*													
				(central region)				near this shaft	(central region)																	
	0.0	33.2	30.9	19.61	11.9	14.5	2.8	2.3	36	9.9	19.61	30.9	32.4	0.0	244											
RTML		45% rtml 3.87			5% 0.43					5% 0.43		45% rtml 3.87			8.61											
ML (surface)															113.5											
ML (tunnel)**		113 RF 21.96	121 RF 23.51	60 RF 11.66						60 RF 11.66	121 RF 23.51	109 RF 21.18														
e+					100% 6.22										6.22											
e-										100% 4.3					4.30											
BDS					50% 5.20					50% 5.20					10.4											
DR						85% 11.97	15% 2.84								14.8											
Dumps									36						36.00											
CRYO (surface)		7.37	7.37	7.96		2.52	0	1.730		7.96	7.37	7.37			49.63											
IR								0.576							0.576											
	** includes 0.914 KW nc magnet over 5													* excluding conventional non-technical component												244



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08/09/2011
E. Huedem

ML-KCS Process water System



LEGEND

	BUTTERFLY VALVE		GATE VALVE
	STRAINER		BACKFLOW PREVENTER
	CHECK VALVE		AUTOMATIC AIR VENT
	PRESSURE GAUGE WITH BALL VALVE		UNION
	PRESSURE REDUCING VALVE		2 WAY CONTROL VALVE
	THRESHOLD		CIRCLE BUTTERFLY
	COOLING WATER RETURN		AREA BOUNDARY
	COOLING WATER SUPPLY		WSS
	PROCESS WATER RETURN		
	PROCESS WATER SUPPLY		
	LOW CONDUCTIVITY WATER RETURN		
	LOW CONDUCTIVITY WATER SUPPLY		

PIPE SIZE LEGEND

TAG	SYMBOL	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	15"	18"	24"	30"	36"	42"	48"	60"
PM+1	PM+1	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"
PM+2	PM+2	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"
PM+3	PM+3	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"	12"

* QUANTITY

COOLING WATER FLOW DIAGRAM MAIN LINAC SHAFTS
PM+7, PM+9, PM+11
 SCALE: NETS

NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION

PARSONS
 10 SOUTH RIVERSIDE PLAZA, SUITE 400
 CHICAGO, ILLINOIS 60606
 OFFICE: 312.930.5100
 FAX: 312.930.0918
 WWW.PARSONS.COM

NO.	DATE
DESIGNED	3/2/2011
DRAWN	3/2/2011
CHECKED	3/2/2011
APPROVED	3/2/2011
SUBMITTED	

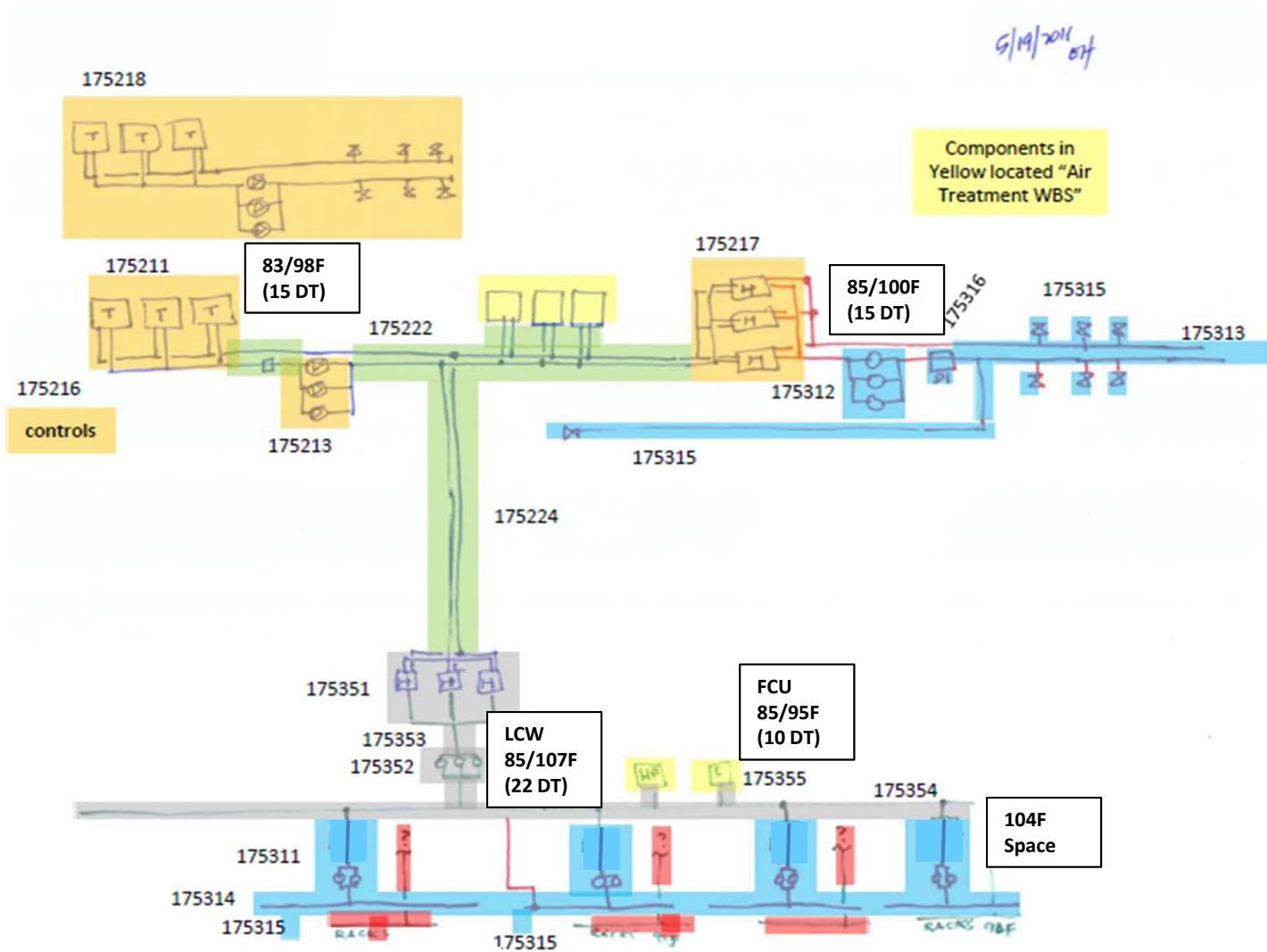
SCALE:

ILC GLOBAL DESIGN EFFORT

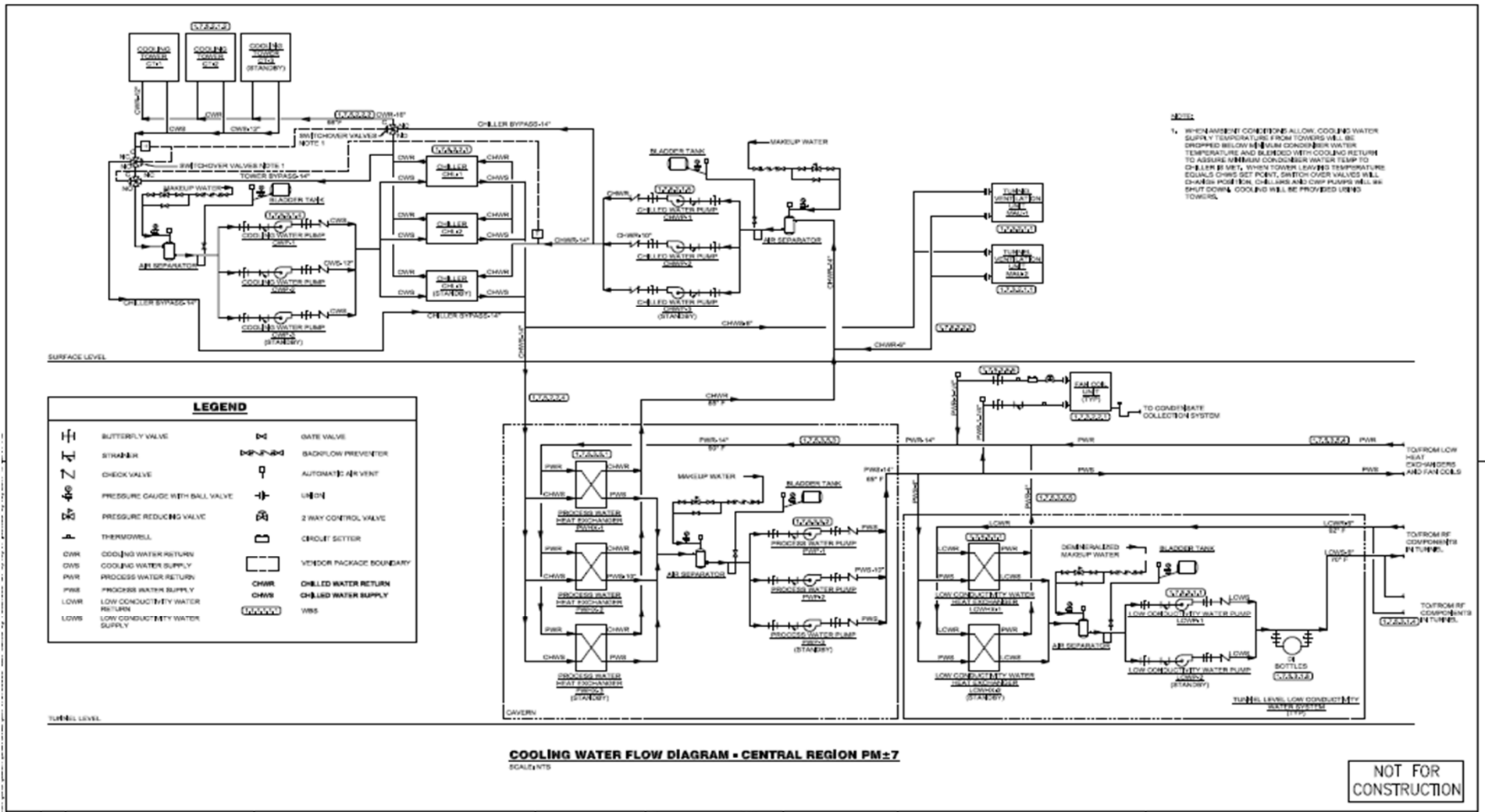
FERMILAB LINEAR COLLIDER
 COOLING WATER FLOW DIAGRAM
 MAIN LINAC SHAFTS PM+7, PM+9, PM+11

DRAWING: **X-X-X** **XX** **M-601** REV. **A**

ML-KCS Process water System (simplified)



Central Region Process water System



REV	DATE	DESCRIPTION

PARSONS
10 SOUTH RIVERSIDE PLAZA, SUITE 400
CHICAGO, ILLINOIS 60606
OFFICE: 312.930.5100
FAX: 312.930.0518
WWW.PARSONS.COM

DESIGNED		DATE	
DRAWN			
CHECKED			
APPROVED			
SUBMITTED			

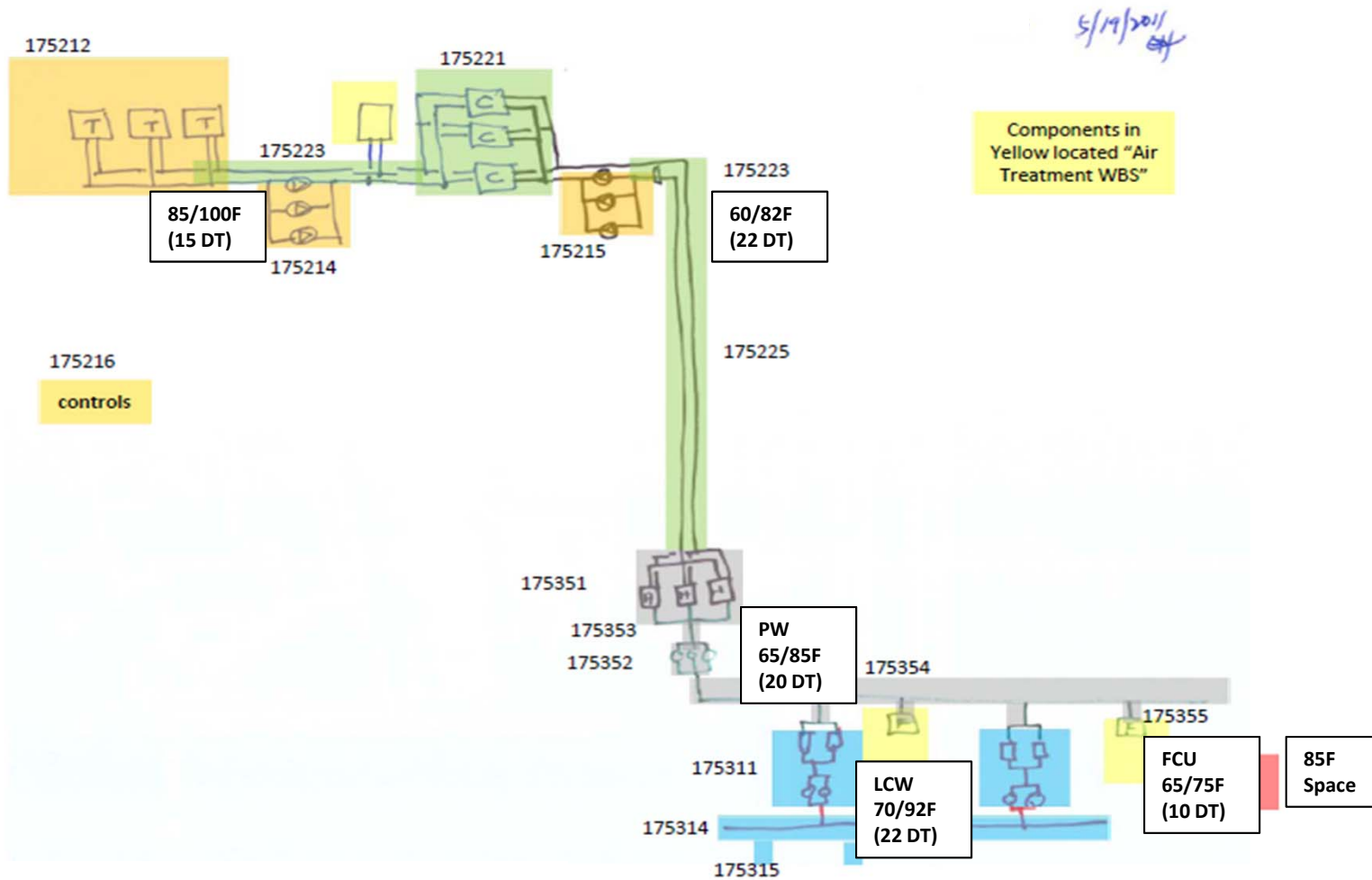
SCALE:	
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ILC GLOBAL DESIGN EFFORT

FERMILAB LINEAR COLLIDER
COOLING WATER FLOW DIAGRAM
CENTRAL REGION SHAFTS PM±7

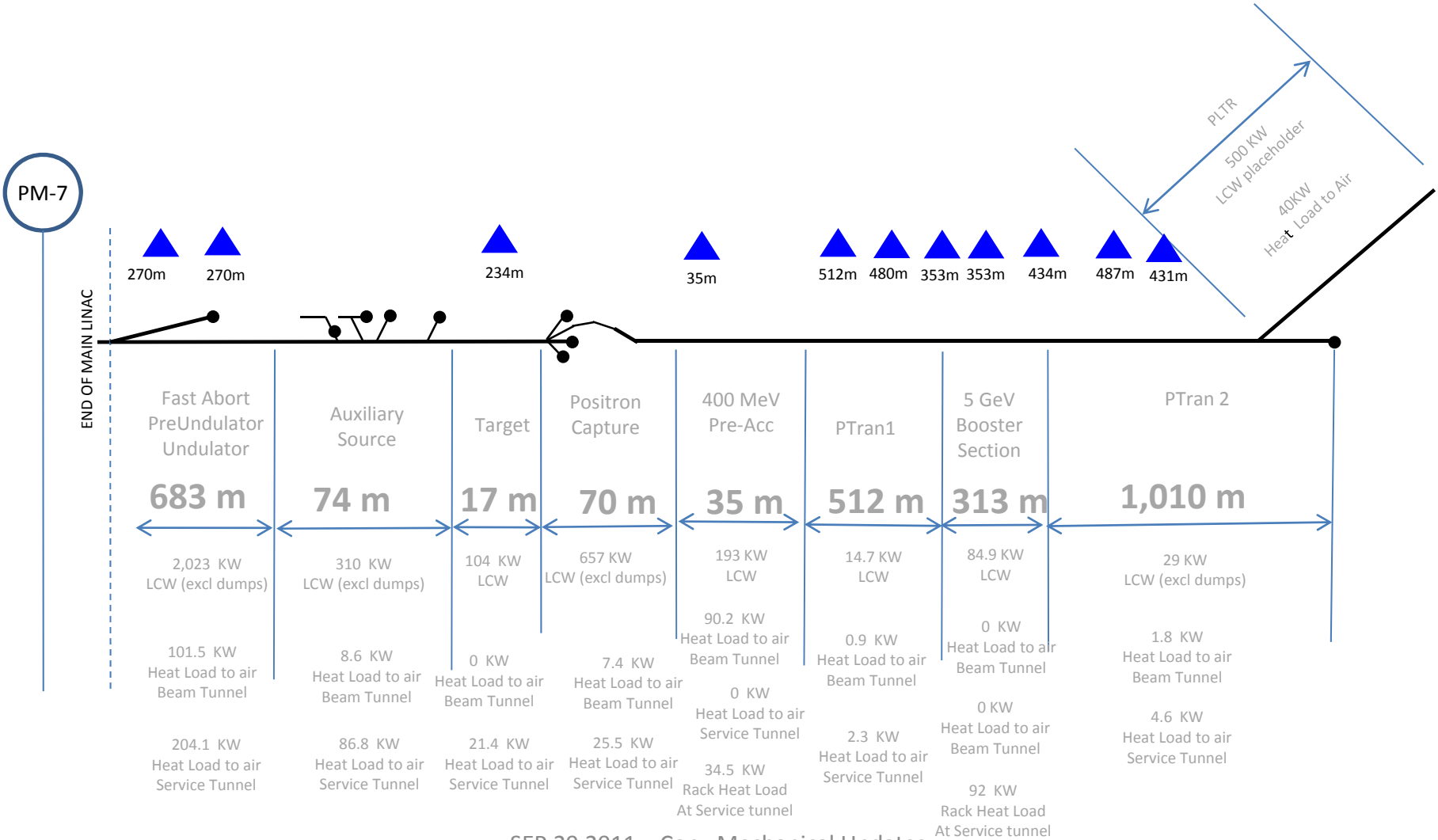
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Central Region Process water System (simplified)

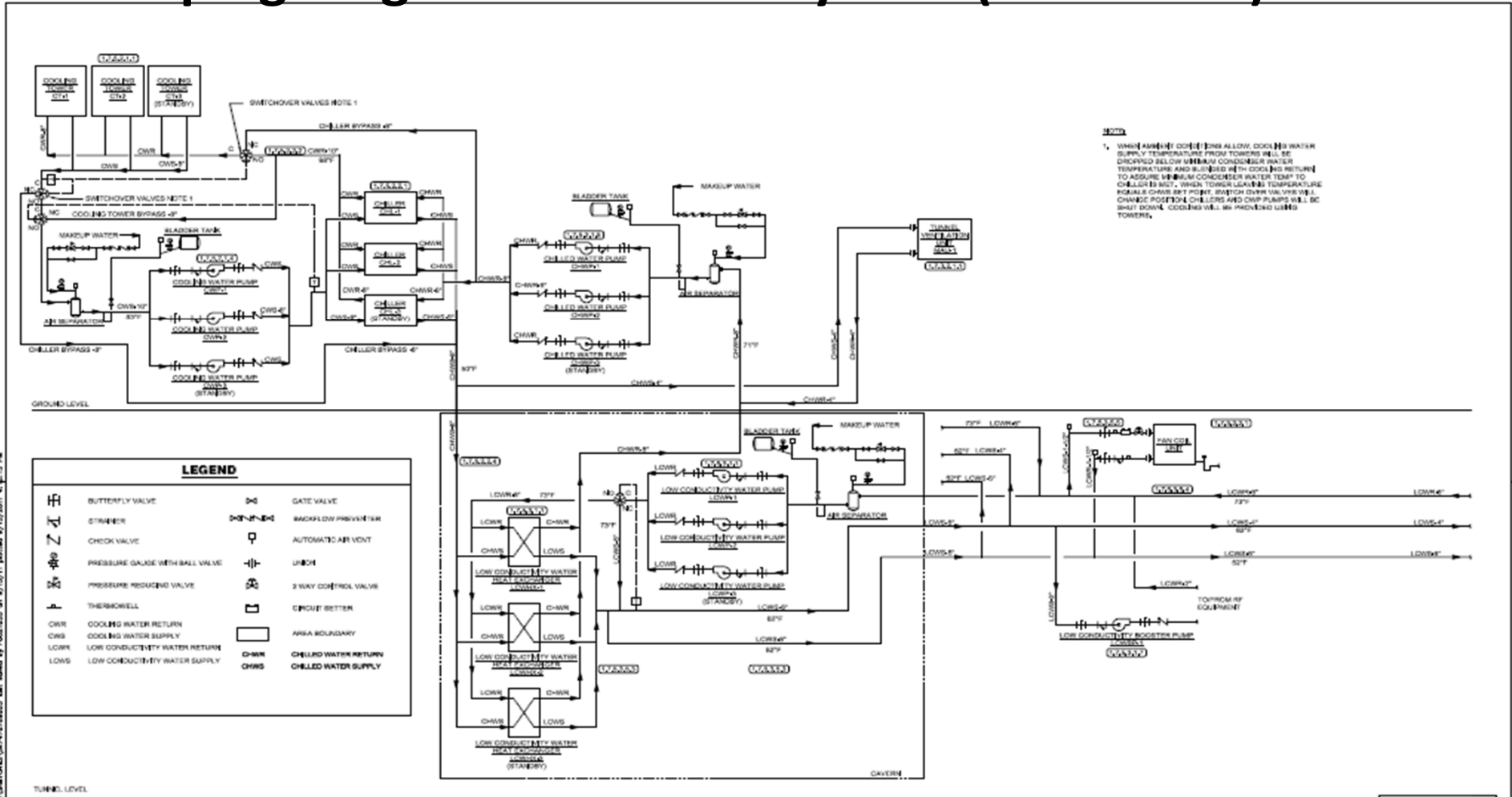


▲ Central Region LCW SKID LOCATIONS & FEED

Length shown are approximate for process water distribution purposes only & doesn't reflect the actual beamlength



Damping Ring Process water System (PMB shaft)



LEGEND	
	BUTTERFLY VALVE
	STRAINER
	CHECK VALVE
	PRESSURE GAUGE WITH BALL VALVE
	PRESSURE REDUCING VALVE
	THERMOWELL
	COOLING WATER RETURN
	COOLING WATER SUPPLY
	LOW CONDUCTIVITY WATER RETURN
	LOW CONDUCTIVITY WATER SUPPLY
	CHILLED WATER RETURN
	CHILLED WATER SUPPLY
	GATE VALVE
	BACKFLOW PREVENTER
	AUTOMATIC AIR VENT
	UNION
	2 WAY CONTROL VALVE
	CIRCUIT BREAKER
	AREA BOUNDARY

COOLING WATER FLOW DIAGRAM - DAMPING RING SHAFTS PMB-0
SCALE: N/A

NOT FOR CONSTRUCTION

NO.	REV.	DATE	BY	CHKD.	APP'D.
1	A	09/29/2011	W.HAMMOND	T.SHEEHAN	T.SHEEHAN

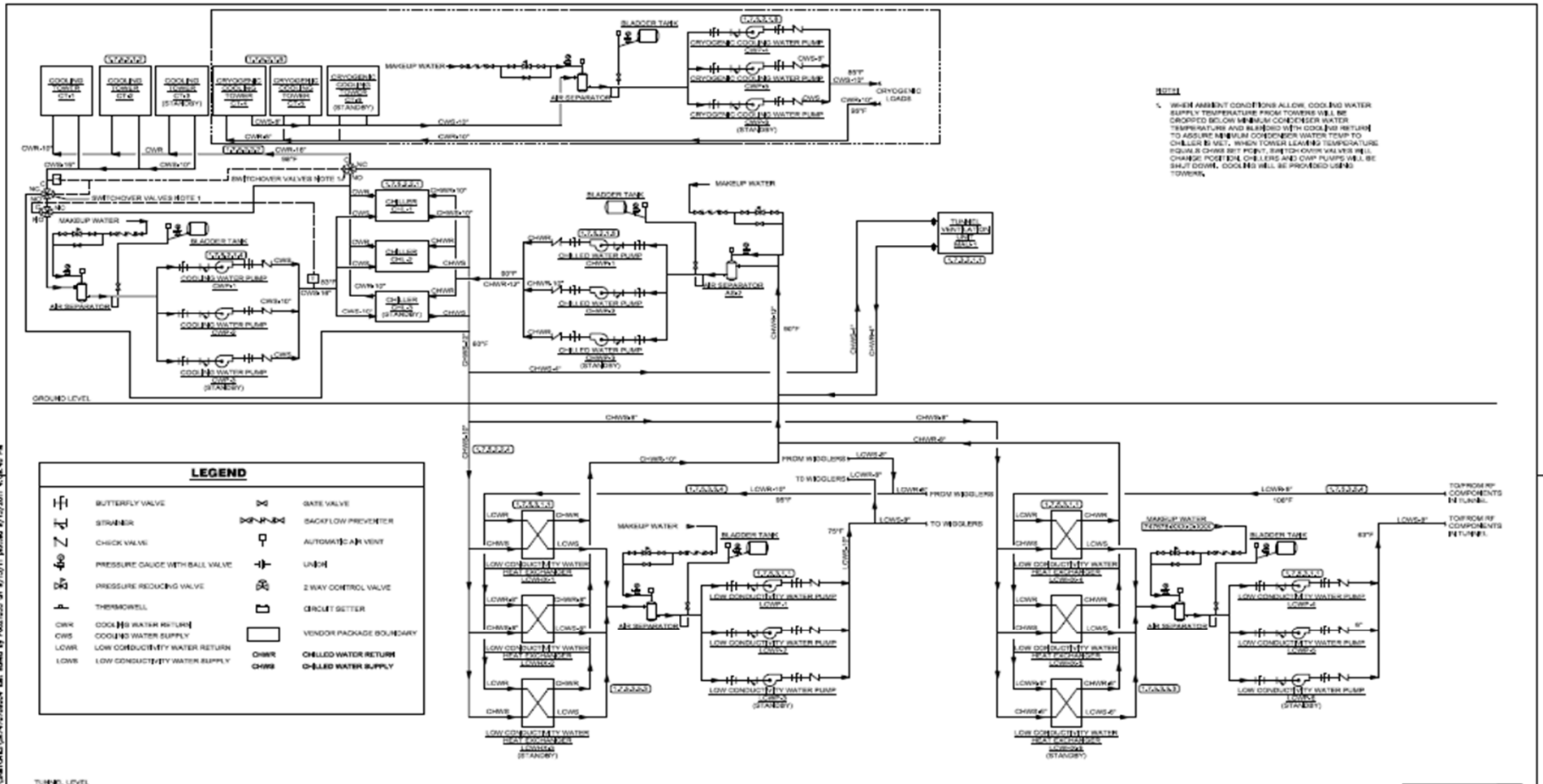
PARSONS
10 SOUTH RIVERSIDE PLAZA, SUITE 400
CHICAGO, ILLINOIS 60606
OFFICE: 312.930.5100
FAX: 312.930.0918
WWW.PARSONS.COM

NO.	REV.	DATE
1	A	09/29/2011

NO.	REV.	DATE
1	A	09/29/2011

ILC GLOBAL DESIGN EFFORT
FERMILAB LINEAR COLLIDER
COOLING WATER FLOW DIAGRAM
DAMPING RING SHAFT PMB-0
DRAWN BY: X-X-X XX M-603 REV. A

Damping Ring Process water System (PMC shaft)



LEGEND

	BUTTERFLY VALVE		GATE VALVE
	STRAINER		BACKFLOW PREVENTER
	CHECK VALVE		AUTOMATIC AIR VENT
	PRESSURE GAUGE WITH BALL VALVE		UNION
	PRESSURE REDUCING VALVE		2 WAY CONTROL VALVE
	THRESHOLD		CIRCUIT BREAKER
CWK	COOLING WATER RETURN		VENDOR PACKAGE BOUNDARY
CWS	COOLING WATER SUPPLY		CHILLED WATER RETURN
LCWR	LOW CONDUCTIVITY WATER RETURN		CHILLED WATER SUPPLY
LCWS	LOW CONDUCTIVITY WATER SUPPLY		

COOLING WATER FLOW DIAGRAM - DAMPING RING SHAFTS PMC-0
SOLID HTS

NOT FOR CONSTRUCTION

NO.	REV.	DATE	DESCRIPTION

PARSONS
10 SOUTH RIVERSIDE PLAZA, SUITE 400
CHICAGO, ILLINOIS 60606
OFFICE: 312.939.5100
FAX: 312.939.0518
WWW.PARSONS.COM

DATE	BY	CHKD
26-04-2011	A. SURIC	
26-04-2011	M. PASTER	
26-04-2011	T. MEDINA	
26-04-2011	T. MEDINA	

SCALE:

ILC GLOBAL DESIGN EFFORT
CORPORATIONAL WATER SYSTEMS DESIGN

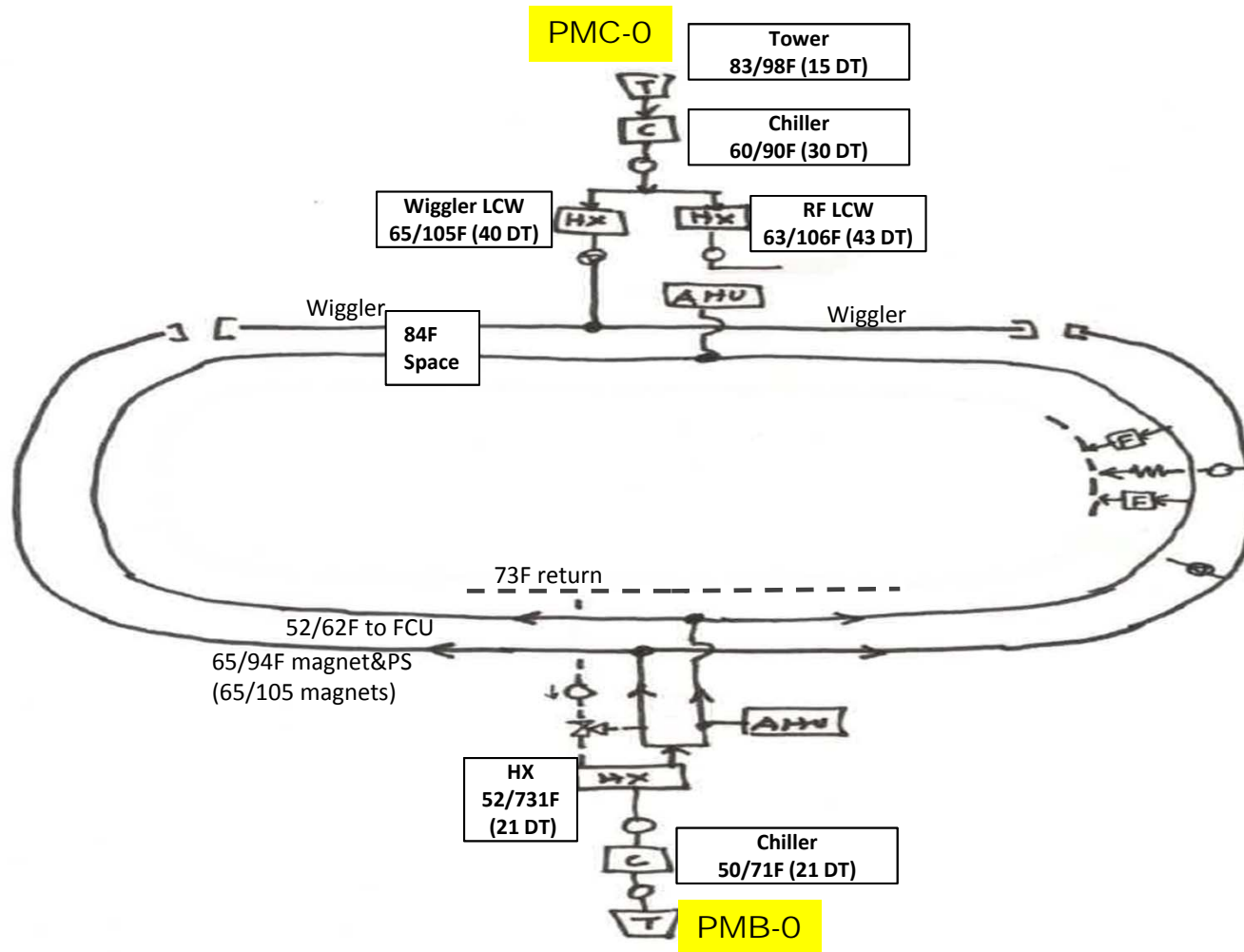
FERMILAB LINEAR COLLIDER
COOLING WATER FLOW DIAGRAM
DAMPING RING SHAFT PMC-0

DATE: **X-X-X** XX **M-604** REV. **A**

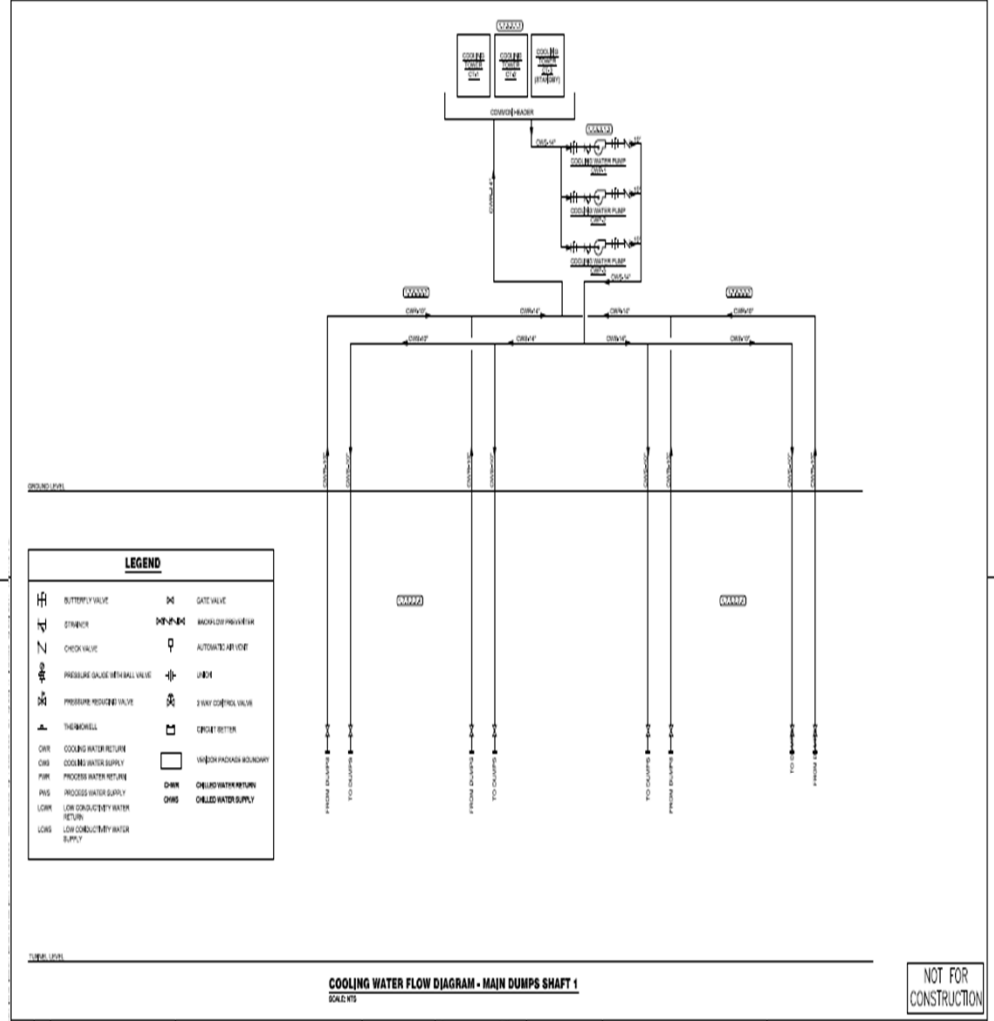
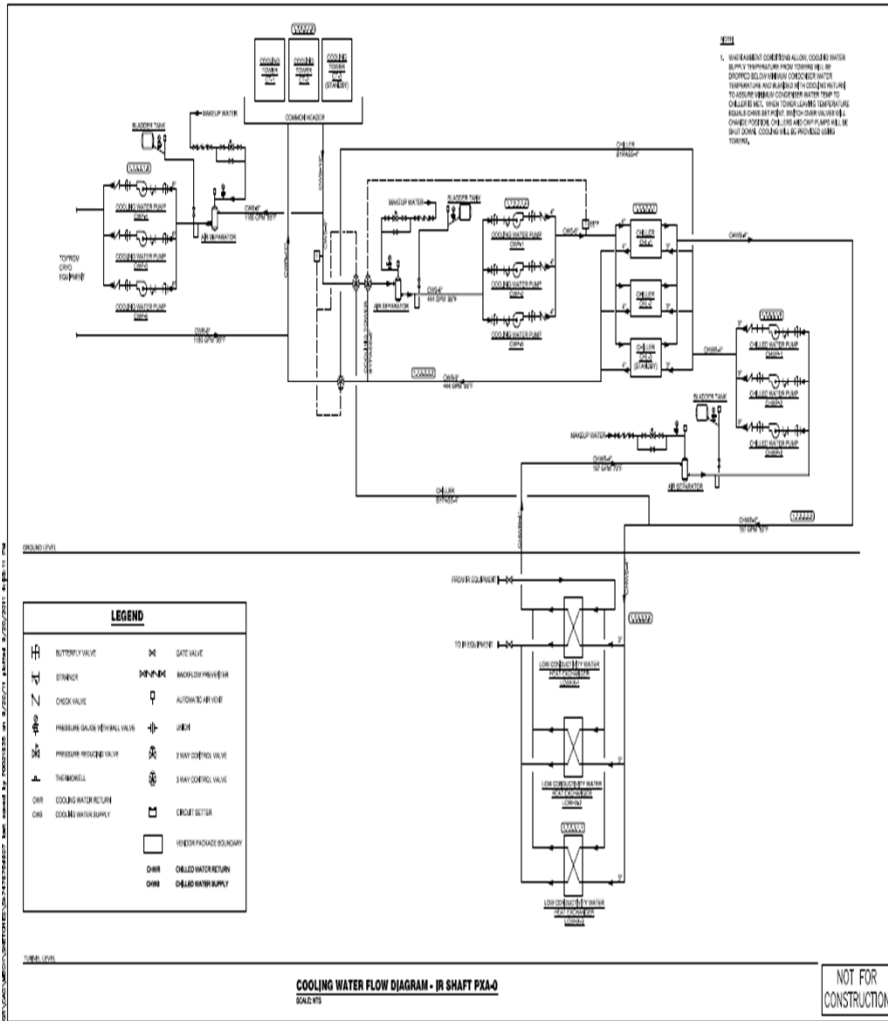
XX-04-2011

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Damping Ring Process water System (Simplified)



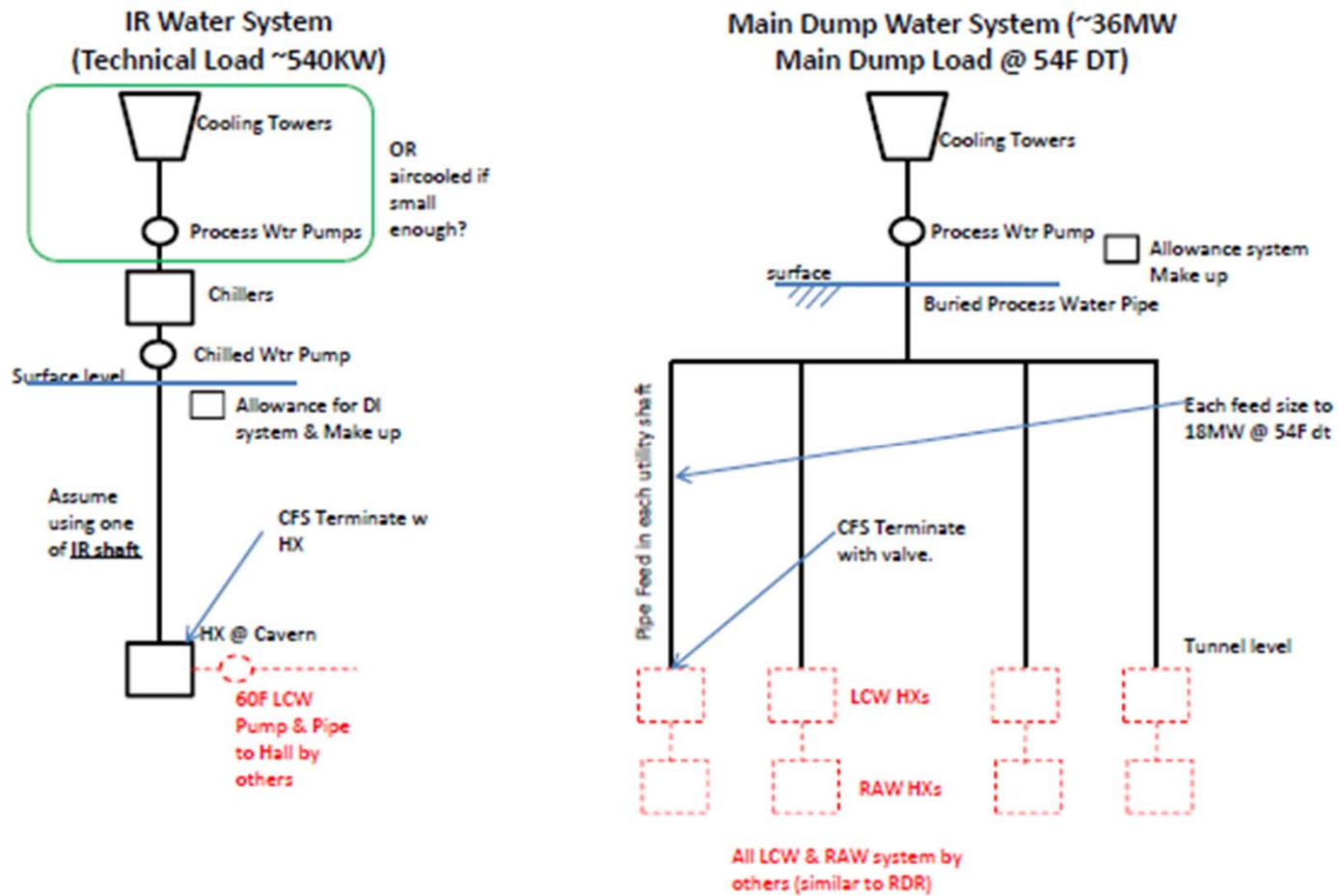
IR & Main Dump Process water System



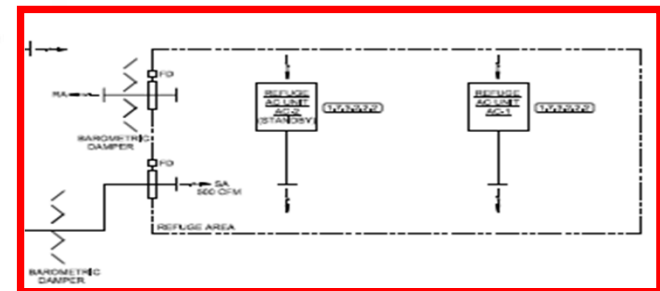
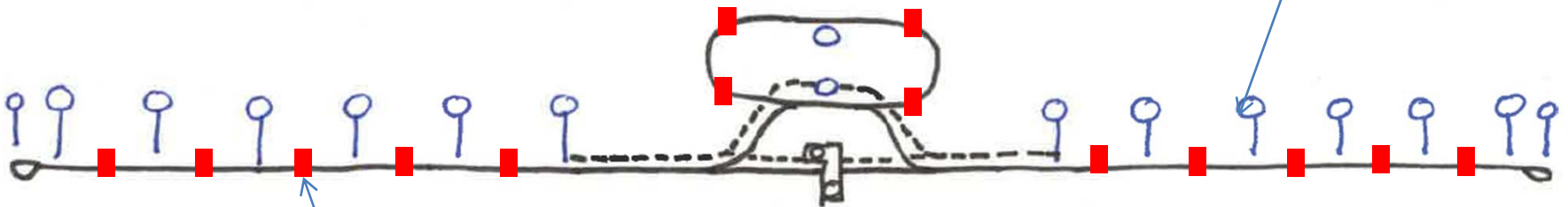
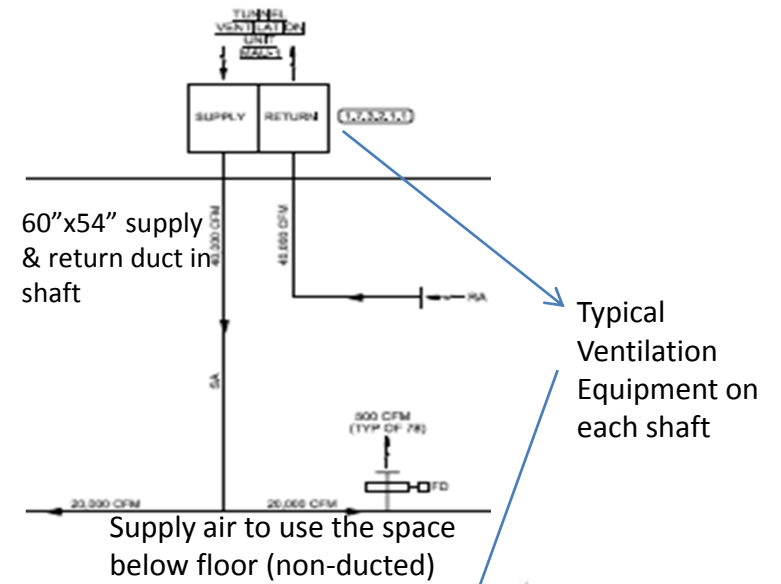
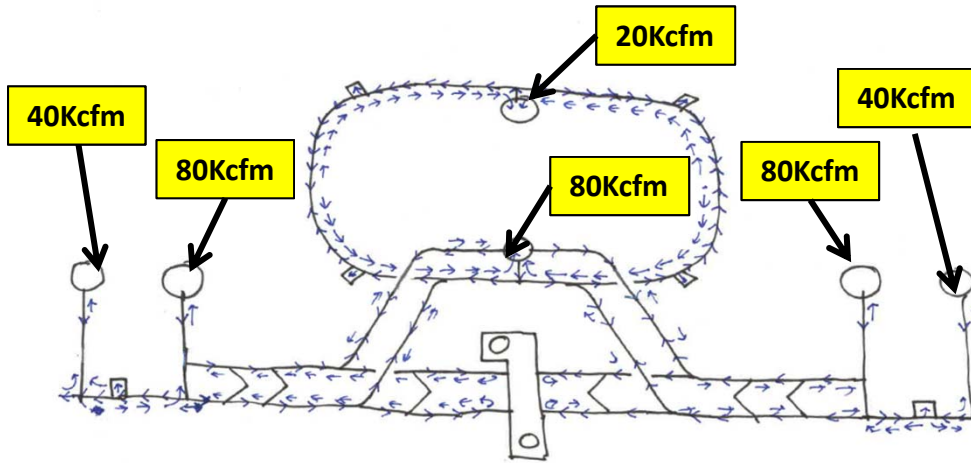
DATE	BY	CHKD	APPD	SCALE	PROJECT
<p>PARSONS 10 SOUTH RIVERSIDE PLAZA, SUITE 400 CHICAGO, ILLINOIS 60606 OFFICE: 312.230.0100 FAX: 312.230.0118 WWW.PARSONS.COM</p>					
<p>ILC GLOBAL DESIGN EFFORT FERMILAB LINEAR COLLIDER COOLING WATER FLOW DIAGRAM IR SHAFT PXA-0 DRAWING: X-XX XX M-607 REV. A</p>					

DATE	BY	CHKD	APPD	SCALE	PROJECT
<p>PARSONS 10 SOUTH RIVERSIDE PLAZA, SUITE 400 CHICAGO, ILLINOIS 60606 OFFICE: 312.230.0100 FAX: 312.230.0118 WWW.PARSONS.COM</p>					
<p>ILC GLOBAL DESIGN EFFORT FERMILAB LINEAR COLLIDER COOLING WATER FLOW DIAGRAM MAIN DUMP SHAFT 1 DRAWING: X-XX XX M-606 REV. A</p>					

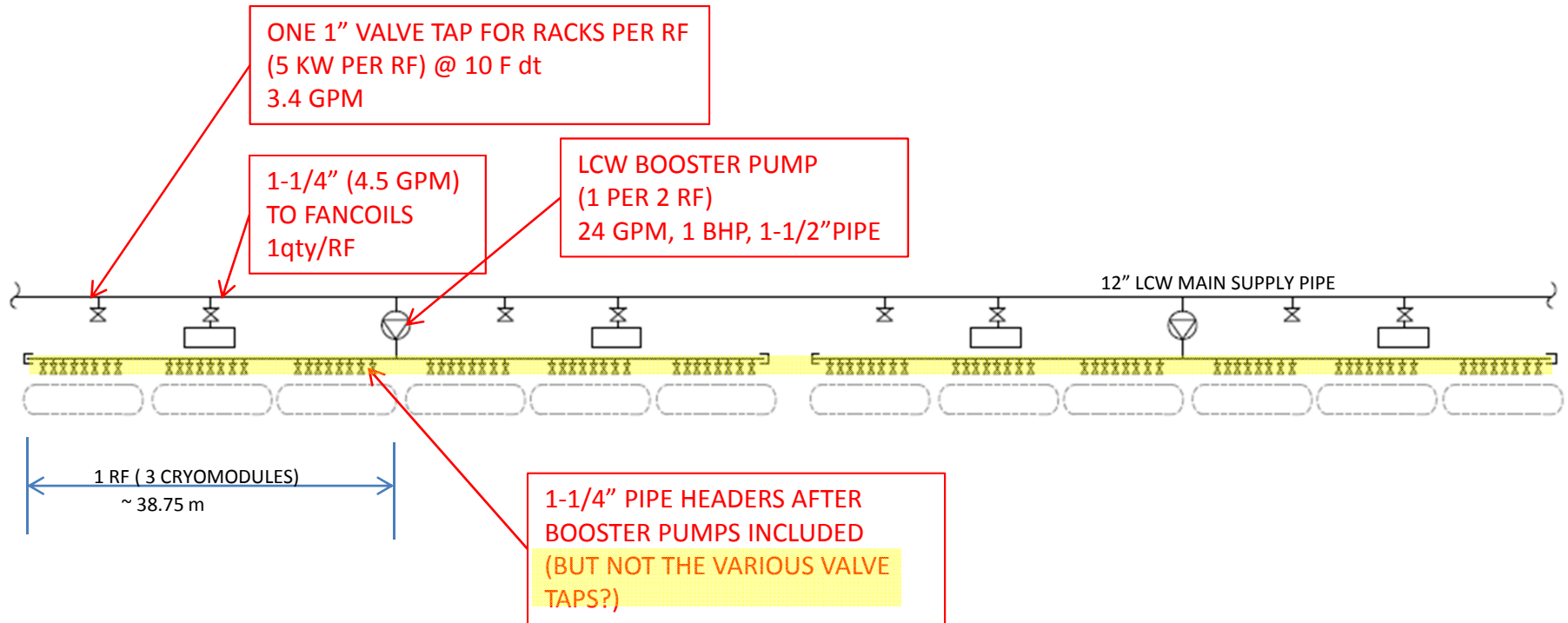
IR & Main Dump Process water System (simplified)



AIR TREATMENT SCHEME



INTERFACE (KCS) (ONLY THE SUPPLY PIPE ARE SHOWN FOR CLARITY)

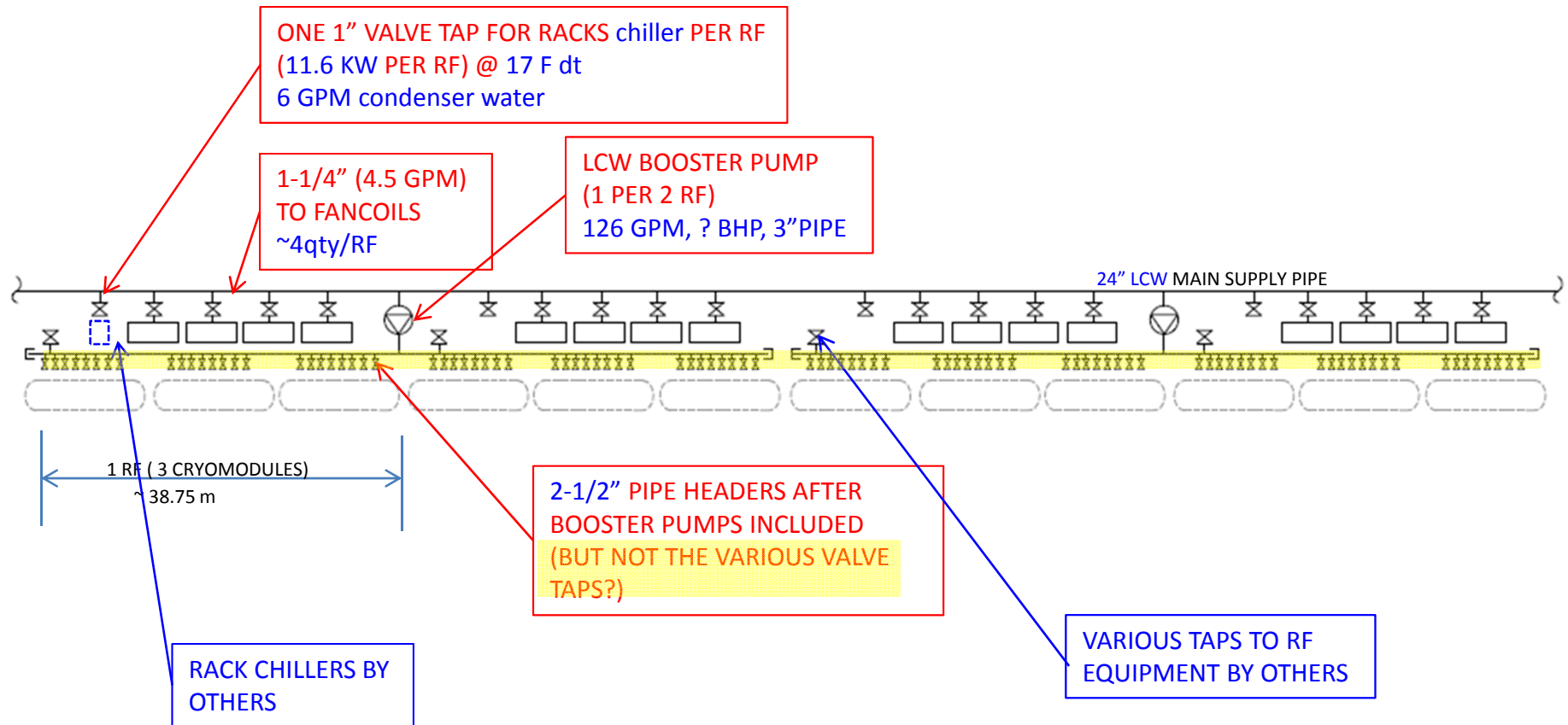


SEP 23 2011

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INTERFACE (DRFS) (ONLY THE SUPPLY PIPE ARE SHOWN FOR CLARITY)

Option 1 (for comparison)

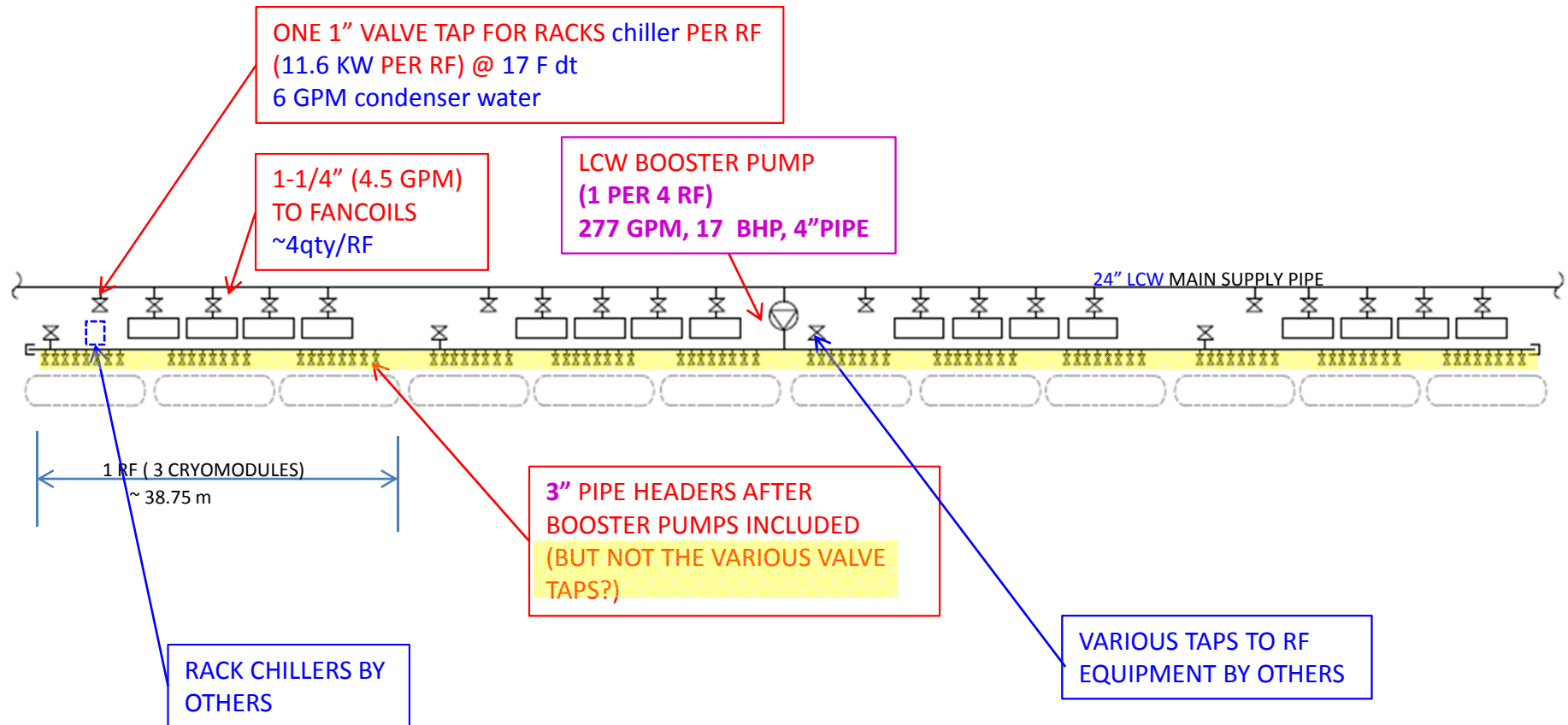


SEP 23 2011

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INTERFACE (DRFS) (ONLY THE SUPPLY PIPE ARE SHOWN FOR CLARITY)

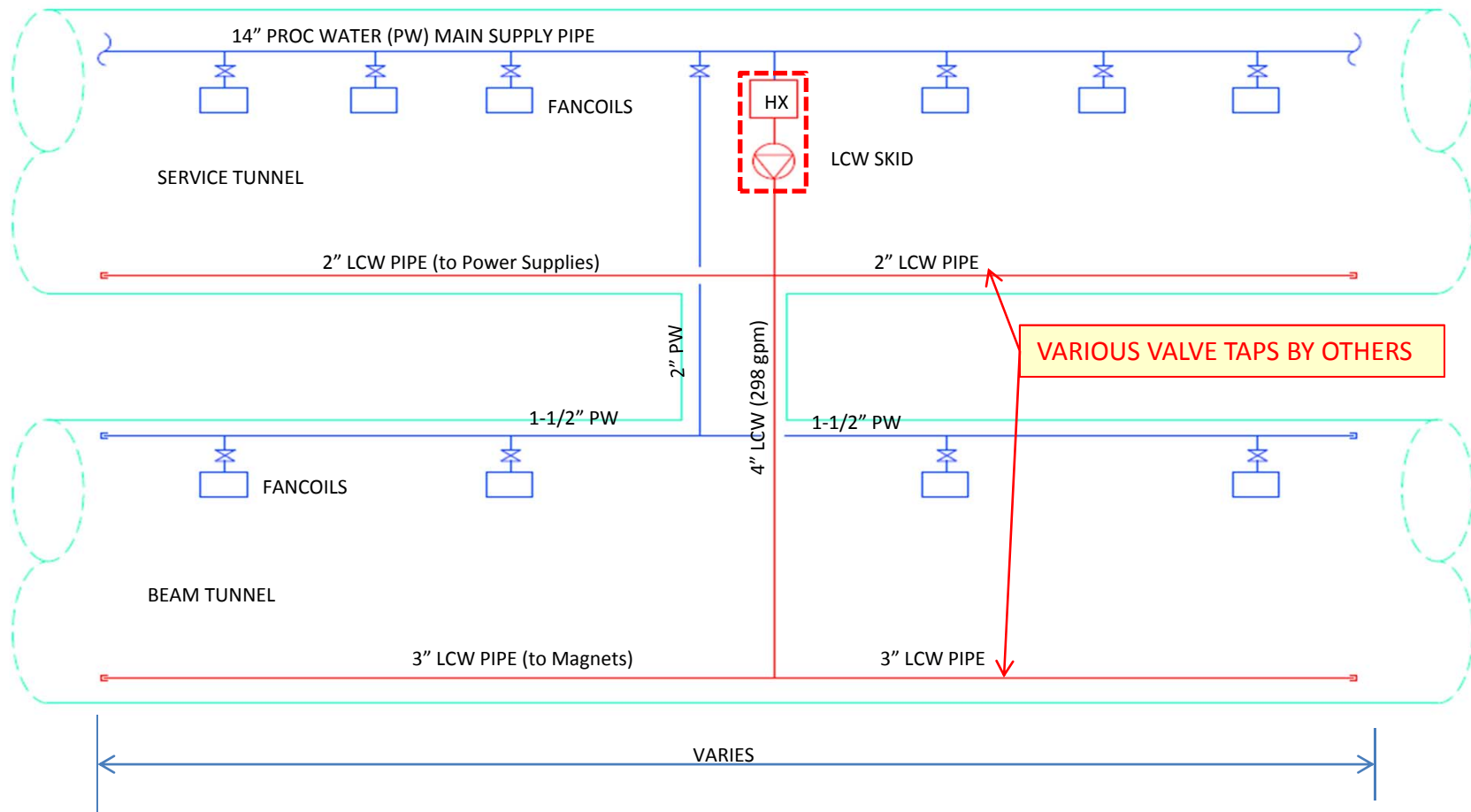
Option 2 (used)



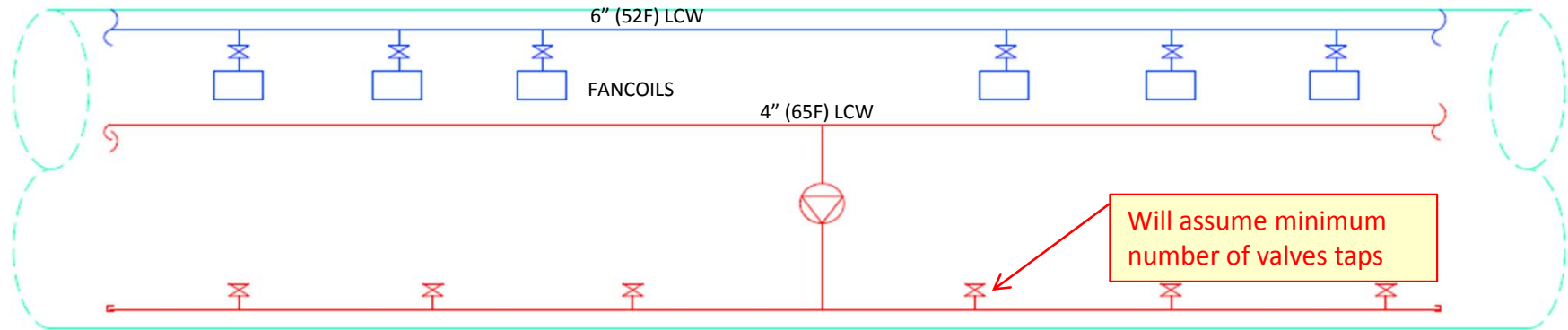
SEP 23 2011

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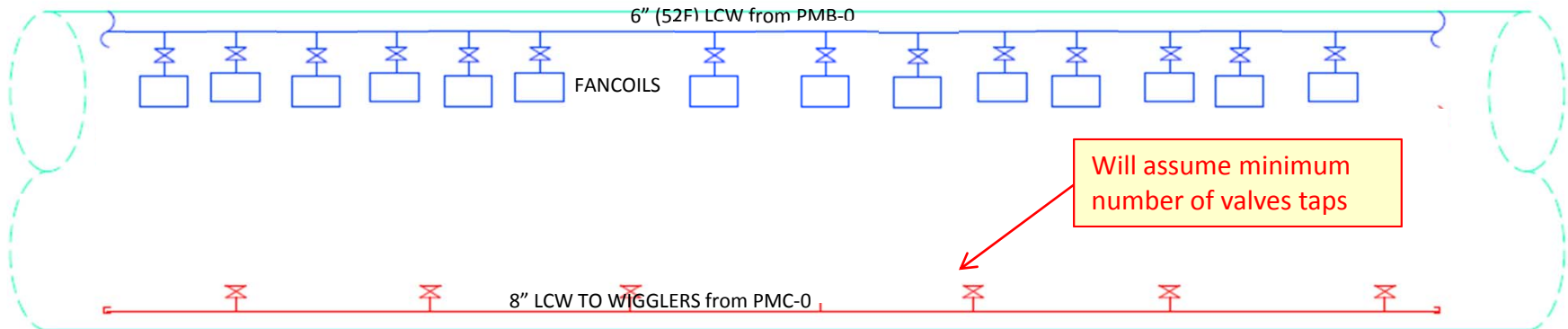
INTERFACE (Central Region) (ONLY THE SUPPLY PIPE ARE SHOWN FOR CLARITY)



INTERFACE (Damping Ring) (ONLY THE SUPPLY PIPE ARE SHOWN FOR CLARITY)



Feed from PMB-0 to beam tunnel (approx 1.3 Km)



Feed from PMC-0 to wiggler area (approx 204m x 2)

BACKUP SLIDES

LOAD TABLES

MAIN LINAC KCS

Mar 23 2011		Quantity	Average Heat Load (KW)	To Low Conductivity Water										to CHW?	To AIR	Max Space Temp (C)
				Heat Load to LCW Water (KW)	Max Allowable Temperature (c)	Supply Temp (C)	Delta Temperature (C delta)	Water Flow (l/min)	gpm	Delta Temperature (F delta)	Maximum Allowable Pressure (Bar)	Typical (water) pressure drop Bar	Acceptable Temp Variation delta C			
RF Components x (692)																
RF Charging Supply	Power Supplies	692/ML	3.03	2.1		40	10.7	2.84	0.75	19.3	18	5	10	NA	0.9	104 F (a)
Switching power supply		692/ML	7.0	4.2		35	7.94	7.6	2.008	14.28	13	5	10	NA	2.8	
Pulse Transformer		692/ML	1.0	0.7	60	35	0.50	20	5.283	0.905		1	n/a	NA	0.3	
Modulator	692/ML	6.3	3.8		35	2.73	20	5.283	4.916	10	5	n/a	NA	2.5		
Klystron Scket Tank / Gun	Klystron Wvgud	692/ML	1.0	0.8	60	35	1.15	10	2.642	2.068	15	1	n/a	NA	0.2	
Focusing Coil (Solenoid)		692/ML	1.7	1.6	80	55	2	10	2.642	4.182	15	1	n/a	NA	0.1	
Klystron Collector	692/ML	42.13	37.5	87	38 (inlet temp 25 to 63)	15	37	9.774	26.19	15	0.3	n/a	NA	1.3		
Klystron Body & Windows	692/ML		3.4	40	25 to 40C	5	10	2.642	8.711	15	4.5	+ - 2.5 C	NA			
CTOs & combining Loads/circulator	2/Klystron		10.50	8.4			6.04	19.99	5.28	10.86		(80 psid)	?		2.1	
Relay Racks (Instrument Racks)	TBD		3.0	0	N/A	N/A	N/A		0	N/A	N/A	N/A	None	3	0.0	
SUBTOTAL				62.51			Total surface RF (excluding Racks) =				72.74			3.0	10.2	
COMPONENTS IN THE TUNNEL (listed as per RF)																
RF Components x (584)																
RF Pipe in Shaft (shaft & bends)		584/ML	1.31	1.18			10	1.693	0.447	18		(80 psid)	?		0.1	
Relay Racks (Instrument Racks)		TBD	5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	None	5	0.0	
Main tunnel Wvgde & local wvgd		584/ML	8.47	8.05			12	9.628	2.544	21.6		(80 psid)			0.4	??
Distribution Edn Loads & Cavity Reflection loads		TBD	30.21	27			20	19.52	5.157	36		(80 psid)	+ - 2.5 C	0	3	
Subtotal Tunnel RF& NonRF unit Only (for 1 RF)				36.41			Total tunnel RF (excluding Racks) =				39.99			5.0	3.6	
Power to Beam =37KW per RF		Total (for 1 RF)		98.9			total RF heat loss less racks =						112.73	KW/RF	8	13.8

POSITRON SOURCE (1 of 3)

Positron (e+)Source Heat and Power load

DRAFT AUG 27 2010

	Total kW	Rough location	Quantity	Distribution Assumption	Load to Water - LCW				Load to Air	Chilled Wtr	Beam Tunnel Temperature	Notes			
					kW heat load	LCW supply temperature (F)	Delta T (F)	Flow (gpm)							
1) Pre-Undulator															
Magnets	785.6	Beam Tunnel	52	individual	785.6	Depends on tunnel space temperature. Initial basis is 95F	18	298		?	Follows BDS reqmnt	25 Mattison Magnets omitted - no info (Norbert 8-27-2010)			
Cables	85.5	Beam Tunnel		individual					85.5					Includes Rack figures (Norbert 8-27-2010)	
Power Supplies	122.9	Cavern	20	Cavern Cluster	87.6		18	33.2	35.4						
Racks	0	Cavern	10	Cavern Cluster											7 Freestanding Racks + 13 Rackmounted PSUs (Norbert 8-27-2010)
Collimator	30	Beam Tunnel	3	individual	30		54	3.8							1 gpm per collimator - 30°C delta T (Norbert 8-27-2010)
2) Fast Abort Dump															
Magnets	633.2	Beam Tunnel	38	individual	633.2	Depends on tunnel space temperature. Initial basis is 95F	18	240.2			Follows BDS reqmnt				
Cables	15	Beam Tunnel		individual					15					Includes Rack figures (Norbert 8-27-2010)	
Power Supplies	97.2	Cavern	10	Cavern Cluster	23.1		18	8.8	74.2						
Dumps	240	Beam Tunnel	1	individual	240		54	30.3							
3) Undulator Section															
Magnets	8.4	Beam Tunnel	22		8.4	Depends on tunnel space temperature. Initial basis is 95F	18	3.2			Follows BDS reqmnt				
Cables	1	Beam Tunnel	1	String					1					Includes Rack figures (Norbert 8-27-2010)	
Power Supplies	108.7	Service Tunnel	64	individual	14.2				94.5					Includes 63 PSU for 21 Undulator Strings in service tunnel (Norbert 8-27-2010)	
Cryocooler	441	Service Tunnel	63	individual	441		45	66.9						Cryocooler can be in Service tunnel. Yellow boxes require info (Norbert 8-27-2010)	
4) AUX Source															
Magnets	1	Beam Tunnel	33	individual	1		18	0.4							
Cables	7.4	Beam Tunnel		individual					7.4					Info for Bunchers from e- Source (Norbert 8-27-2010)	
Power Supplies	11	Service Tunnel	24						11					SW Accel info included in RF (Norbert 8-27-2010)	

SEP 29 2011 Conv Mechanical Updates

POSITRON SOURCE (2 of 3)

Positron (e+)Source Heat and Power load DRAFT AUG 27 2010

	Positron (e+)Source Heat and Power load				Load to Water - LCW				Load to Air	Chilled Wtr	Beam Tunnel Temperature	Notes
	Total kW	Rough location	Quantity	Distribution Assumption	kW heat load	LCW supply temperature (F)	Delta T (F)	Flow (gpm)	kW Heat load			
RF	249.8	Service Tunnel	2	30% in Beam Tunnel	207	Depends on tunnel space temperature. Initial basis is 95F	45	31.4	42.8		Follows BDS reqmnt	2 Superconducting Cryomodules + 2 Standing Wave Accelerators (ML info used)- (Norbert 8-27-2010, Emil use MLRF high delta T data)
Bunchers	135	Service Tunnel	3	30% in Beam Tunnel	102		32.4	21.5	33			PSU, Solenoid and RF included (Norbert 8-27-2010)
Dumps	78.5	Beam Tunnel	4	individual	78.5		54	9.9				
Thermionic Gun	1.2	Beam Tunnel	1	individual					1.2			incl. 150kV PSU with 0.2kW heatload into Service Tunnel (Norbert 8-27-2010)
5) Target Area												
RF	124.9	Service Tunnel	1	30% in Beam Tunnel	103.5	Depends on tunnel space temperature. Initial	45	15.7	21.4		Follows BDS reqmnt	3 Travelling Wave Accelerators (Norbert 8-27-2010, Emil use MLRF high delta T data)
Target Stations	0	Beam Tunnel	0									
6) Capture Area												
Magnets	657	Beam Tunnel	62	String	657	Depends on tunnel space temperature. Initial basis is 95F	18	249			Follows BDS reqmnt	
Cables	7.4	Beam Tunnel							7.4			
Power Supplies	25.5	Service Tunnel	7	String					25.5			
Dumps	327	Beam Tunnel	3	individual	327		54	41.3				Assumed 301kW for Photon Dump and 13kW for Electron Dump (x2)-(Norbert 8-27-2010)
7) 400 MeV Pre-Accelerator												
Magnets	166.5	Beam Tunnel	8	individual	166.5	Depends on tunnel space temperature. Initial basis is 95F	64.4	17.7			Follows BDS reqmnt	Estimate (Norbert 8-27-2010)
Cables	90.15	Beam Tunnel		individual					90.15			Estimate (Norbert 8-27-2010)
Power Supplies (HV)	26.4	Service Tunnel	3		26.4		45	4.0				Estimate (Norbert 8-27-2010)
Racks	34.5	Service Tunnel	3		0					34.5		Estimate (Norbert 8-27-2010)
8) Positron Transport Line 1												

POSITRON SOURCE (3 of 3)

Positron (e+)Source Heat and Power load

DRAFT AUG 27 2010

	Total kW	Rough location	Quantity	Distribution Assumption	Load to Water - LCW				Load to Air	Chilled Wtr	Beam Tunnel Temperature	Notes
					kW heat load	LCW supply temperature (F)	Delta T (F)	Flow (gpm)	kW Heat load			
Magnets	14.7	Beam Tunnel	62	String	14.7	Depends on tunnel space temperature. Initial basis is 95F	18	5.6			Follows BDS reqmnt	Estimate (Norbert 8-27-2010)
Cables	0.9	Beam Tunnel							0.9			
Power Supplies	2.3	Service Tunnel	1						2.3			
9) 5 GeV Booster Section												
Magnets	2.1	Beam Tunnel	8	individual	2.1	Depends on tunnel space temperature. Initial basis is 95F	18	0.8			Follows BDS reqmnt	No info for Coldbox available - not included (Norbert 8-27-2010)
RF	828	Service Tunnel	8	30% in Beam Tunnel	828		45	125.6				Info from ML 9-8-9 RDR Water and Air Heat Load 31/10/2007 spread sheet
Racks	92	Service Tunnel	8		0					92		
10) Positron Transport Line 2												
Magnets	29	Beam Tunnel	122	String	29	Depends on tunnel space temperature. Initial basis is 95F	18	11.0			Follows BDS reqmnt	
Cables	1.8	Beam Tunnel							1.8			
Power Supplies	4.6	Service Tunnel	2	String					4.6			
Dumps	226	Beam Tunnel	1	individual	226		54	29				
11) Positron Line Transfer to Damping Ring (PLTR)												
PLACEHOLDER	540	Beam Tunnel	???	uniformly	500	Depends on tunnel	18	189.7	40		Follows BDS reqmnt	PLACEHOLDER (Norbert / Emil 8-27-2010)
	6253				5532				595	127		
Misc components												
AC Power Transformers		??										
Emergency Transformer		cavern										
Fancoils		beam										
Dehumidifier		beam										
Water Pumps		cavern										
Lighting		beam										
	0				0				0			

**Updates recently Added
~200KW
New totals = 6460**

	Total KW	rough location	Qty	Distribution Assumption	Load to water-LCW				Load to Air	Space Temperature (F)		Notes
					KW heat load	LCW supply temperature (F)	Delta T (F)	or Flow (gpm)	KW heat load	Beam Tunnel	Service Tunnel	
BDS components (excluding Major DUMPS)												
Magnets	129.9	Post Undulator Dogleg	92	equally distributed	129.9	depend on space temperature discussion	20	44	0	80-85	~85	Norbert Email Sep 27 2010
	2746	e-e+ common - beam tunnel		equally distributed	2746		20	937	0			Total KW From Paul Bellomo List May 9 2007
	5604	e-e+ 14 mr - beam tunnel		equally distributed	5604		20	1913	0			Total KW From Paul Bellomo List May 9 2007
Cables	3.9	Post Undulator Dogleg		assume at beam tunnel	0		N/A	N/A	3.9			Norbert Email Sep 27 2010
	186	e-e+ common - beam tunnel		equally distributed (assume 50% to beam tunnel and 50% to svc tunnel)	0		N/A	N/A	186			Total KW From Paul Bellomo List May 9 2007
	398	e-e+ 14 mr - beam tunnel		equally distributed (assume 50% to beam tunnel and 50% to svc tunnel)	0		N/A	N/A	398			Total KW From Paul Bellomo List May 9 2007
Power supplies	20.1	Post Undulator Dogleg	58	assume at service tunnel	0		N/A	N/A	20			Norbert Email Sep 27 2010
	440	e-e+ common - service tunnel	27	equally distributed	168		12	96	272			Quantity from Paul Bellomo List May 9 2007
	900	e-e+ 14 mr - service tunnel	179	equally distributed?	552		12	314	348			Quantity from Paul Bellomo List May 9 2007
RF	0	beam	0	N/A	0		N/A	N/A	0			
Racks	0	beam	0	N/A	0	N/A	N/A	0				
Dumps	0	beam	0	N/A	0	N/A	N/A	0	There are (4) 18MW major dumps served by dedicated water plant			
	10427.9	KW (Total)			9200	KW (water)			1228	KW (air)		

Misc components (LATER)												
AC Power Transformers												
Emergency Transformer												
Fancoils		beam									104	
Dehumidifer												
Water Pumps												
Lighting												
	0				0			0				

RTML (Ring-To-Main-Linac)

RTML Heat and Power Load (Totals RTML shown)

draft SEP 7 2010

CFS

for total (2) RTML

	Total KW	rough location	Qty	Distribution Assumption	Load to water-LCW				Load to Air	Beam tunnel Temperature	Notes
					KW heat load	LCW supply temperature (F)	Delta T (F)	or Flow (gpm)	KW heat load		
RTML components											
Magnets	2931	beam	4000	equally distributed in RTML area? & negligible in ML from DR area	2931	95	20	1001	0	104F (40C)	Qty and KW from P.Bellomo 5/9/2007. [SEP 3 2010, scale qty by ratio of 4000/4334]
Cables	942	beam		equally distributed?	0	95	N/A	N/A	942		KW from P.Bellomo 5/9/2007
Power supplies	618	??	3832	equally distributed?	8	95	N/A	N/A	610		P.Bellomo 5/9/2007
RF	3570	svc			3570	95	45	542	0		Jul 14 2009 Nikolai & Marc (50% from RDR)
Racks	550	beam			0	95	N/A	N/A	550		Old Table Oct 2006
Dumps	* 0	beam		one location (in each rtml) = (2)	0	95	56	0	0		{RDR showed 250 KW each AL ball dump with 30 gpm } Jul 14 2009 Nikolai & Marc (50% from RDR)
	* 0	beam		one location each (near DT-LTR) = (2)	0	95	56	0	0	from dump list 2009 - not used?	
	8611			* (4) 220 KW dump are not used all the time	6509				2102		
Misc components											
AC Power Transformers		??								104F (40C)	
Emergency Transformer		cavern									
Fancoils		beam									
Dehumidifer		beam									
Water Pumps		cavern									
Lighting		beam									
	0				0				0		

RTML (Ring-To-Main-Linac)

RTML Heat and Power Load (Totals RTML shown)

draft SEP 13 2011

UPDATED just recently

CFS

for total (2) RTML

	Total KW	rough location	Qty	Load to water-LCW				Load to Air	Beam tunnel Temperature	Notes
				KW heat load	LCW supply temperature (F)	Delta T (F)	or Flow (gpm)	KW heat load		
RTML components										
Magnets	765	beam	4248	694	95	20	237	71	104F (40C)	Qty and KW from P.Bellomo 5/9/2007. [SEP 3 2010, scale qty by ratio of 4000/4334). File/Email N. Solyak Aug 2011 P.Bellomo 5/9/2007. Aug 2011 CFS & NSolyak P.Bellomo 5/9/2007. Aug 2011 CFS & NSolyak Jul 14 2009 Nikolai & Marc (50% from RDR). Aug 2011 CFS&NSolyak + assume % to air + used RDR Old Table Oct 2006 (assume included w RF) {RDR showed 250 KW each AL ball dump with 30 gpm } Jul 14 2009 Nikolai & Marc (50% from RDR) from dump list 2009 - not used?
Cables	84	beam		56	95	N/A	N/A	28		
Power supplies	123	caverns, Alcoves & Svc Tnl	TBD	114	95	N/A	N/A	9		
RF	640	Alcove		576	95	45	87	64		
Racks	0	alcove		0	95	N/A	N/A	0		
Dumps *	0	beam		0	95	56	0	0		
	0	beam		0	95	56	0	0		
	1612	* (4) 220		1440				172		

Misc components										
AC Power Transformers		??							104F (40C)	
Emergency Transformer		cavern								
Fancoils		beam								
Dehumidifer		beam								
Water Pumps		cavern								
Lighting		beam								
	0			0				0		

DR (DAMPING RING)

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
	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		
DR components (surface)											
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

DR components (tunnels and caverns)

	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	Beam tunnel Temperature (F)	Notes
DR components (tunnels and caverns)											
Magnets	1628	tunnel		equally distributed	1553	65 F if using chiller, 95F if using just towers	20	530	75	77F to 87 F	<p>30 w/m</p> <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(wag), Reduce the wiggler (radiation) heat load 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	?	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)	4432		45	672	1108		
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			
Totals for tunnel/cavern DR components											
	14812				13116				1697		

Misc components

AC Power /Emerg Transformers										
Fancoils		beam								
Water Pumps										
Lighting										
Totals for Misc components										
	0				0				0	

DRFS

July 21 2011

WATER AND AIR HEAT LOAD for Revised DRFS Full Version

MAIN LINAC - ELECTRON & POSITRON								
	Group A	Group B	Group C	Group D	Group E	Average		
Cavity Medium Gradient (MV/m)	36.8	34.1	31.5	28.9	26.3	31.52		
Pulse Width(ms)	1.8	1.76	1.71	1.66	1.61	1.708		
AV. Power Increase Factor	1.3445	1.2181	1.0933	0.9737	0.8594	1.0978		
Beam power(kW)	43.339	40.159	37.097	34.035	30.973	37.121		
HLRF related loss	204.11	184.10	164.25	145.36	135.32	166.92		
Fixed Loss in HLRF	12.69	12.69	12.69	12.69	12.69	12.73		
Other Than HLRF	11.65	11.65	11.65	11.65	11.65	13.85		
Waveguides in beam tunnel	0.80	0.80	0.80	0.80	0.80	0.80		
Subtotal RF unit Only	229.25	209.23	189.38	170.49	160.45	194.30		
Total RF								

TOTAL RF POWER less Racks (from Shigeki's Jul 21 2011 slide)

Total Heat Load per RF (use average)	194.30	KW
Total Rack Power per RF (use peak)	11.65	KW
Total Heat Load (Less Racks) per RF	182.66	KW
Beam Power per RF (use average)	37.12	KW
Total Plug POWER per RF	219.78	KW
No of Main Linac RF	584	
Total Plug POWER- Main Linac RF	128.35	MW

Total RACK Power-Main Linac	6.8	MW
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TOTAL HEAT LOAD

TOTAL HEAT LOAD per RF	194.3	KW
No fo Main Linac RF	584	
TOTAL HEAT LOAD -Main Linac	113.5	MW
% to LCW (current placeholder 90%)	102.1	MW
% to Air (current placeholder 10%)	11.35	MW

Understanding DRFS
Power/Heat Loads
JUL 22, 2011