



Cryogenic Systems Layout Status

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ILC cryogenics meeting via Webex

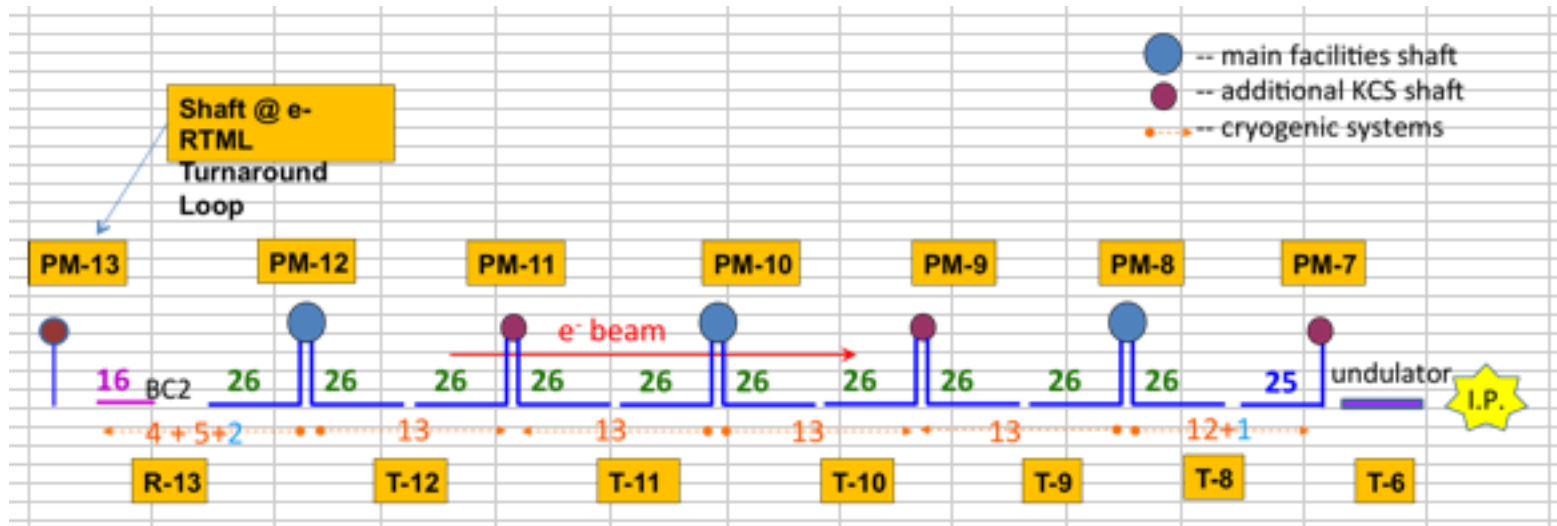
31 May 2012

A horizontal dotted line in a light green color runs across the bottom of the slide.



ILC cryogenics layout status

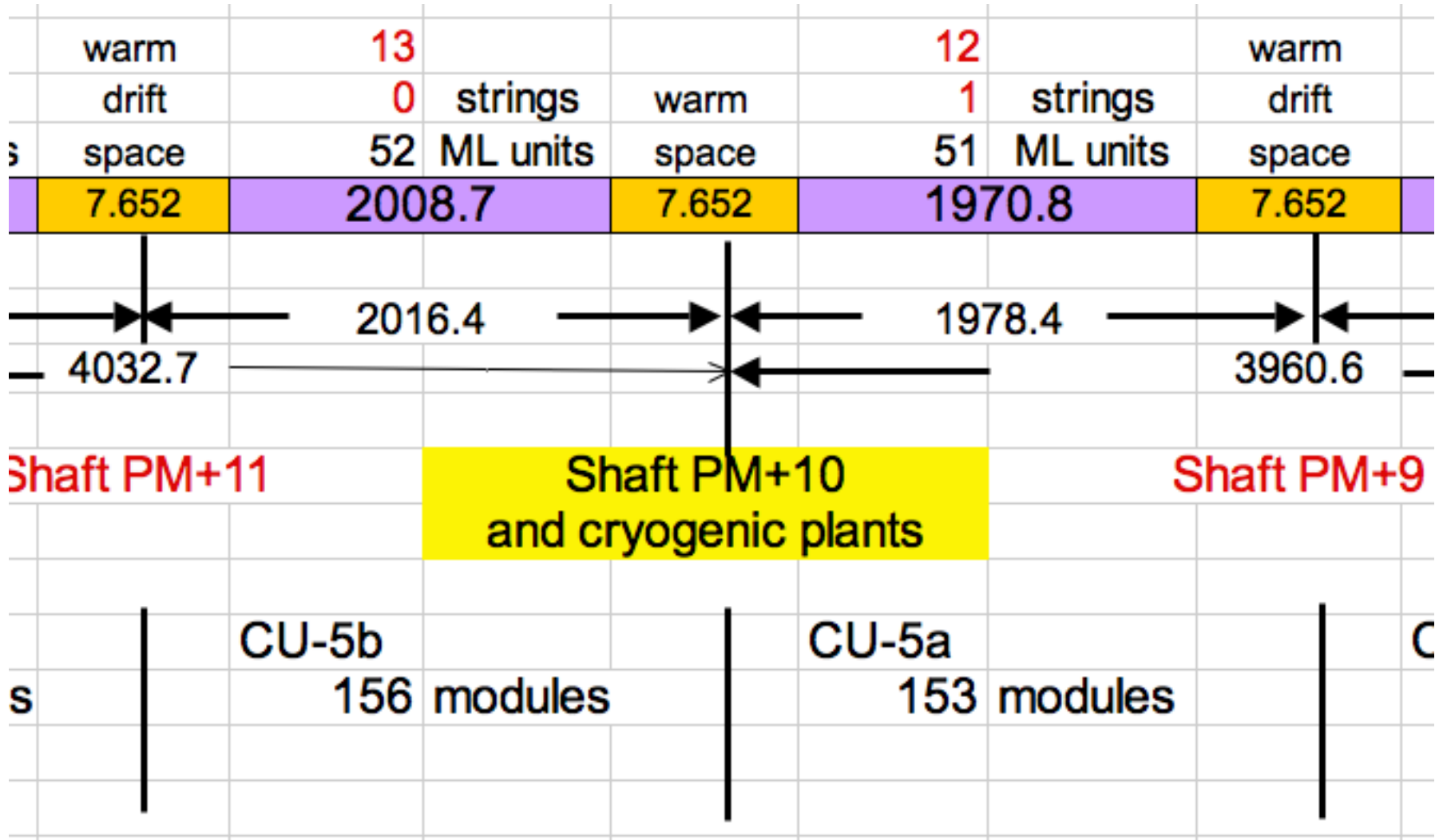
- RDR cryogenic layout, for reference
- KCS cryogenic layout
- 5 GeV booster linac locations
- Helium pipe sizes for remote compressor locations
- Installed cryogenic plant power
- Conclusions
- References



- 52 ML units per longest cryogenic unit
- KCS cryogenic string is 4 ML units = 12 cryomodules
- Cryogenic unit has 156 cryomodules
- 3 locations each with 2 cryogenic plants, 6 total per linac
- Drift spaces either 2.5 m or a cryomodule slot length

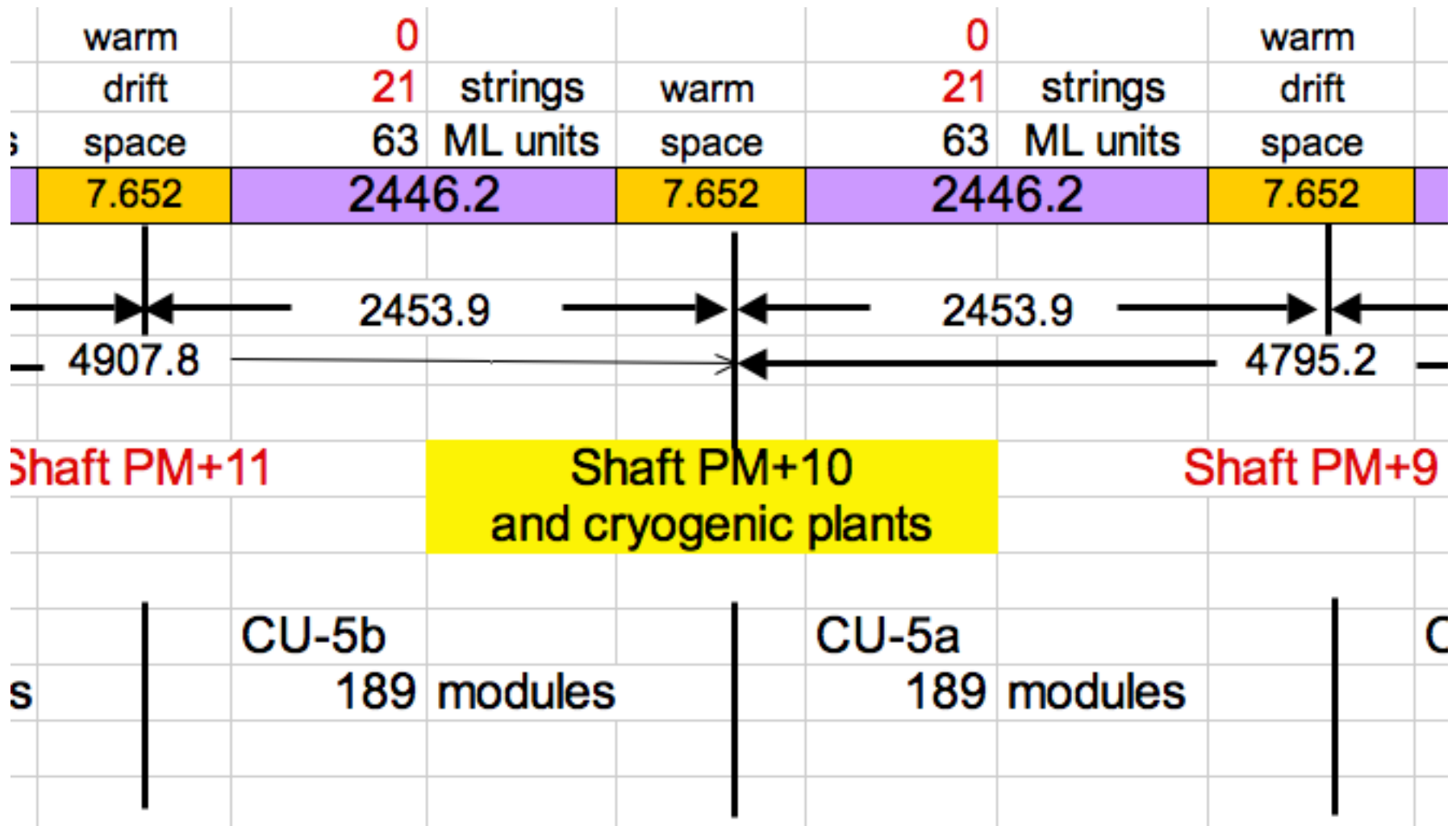


KCS cryogenic strings





DKS cryogenic strings



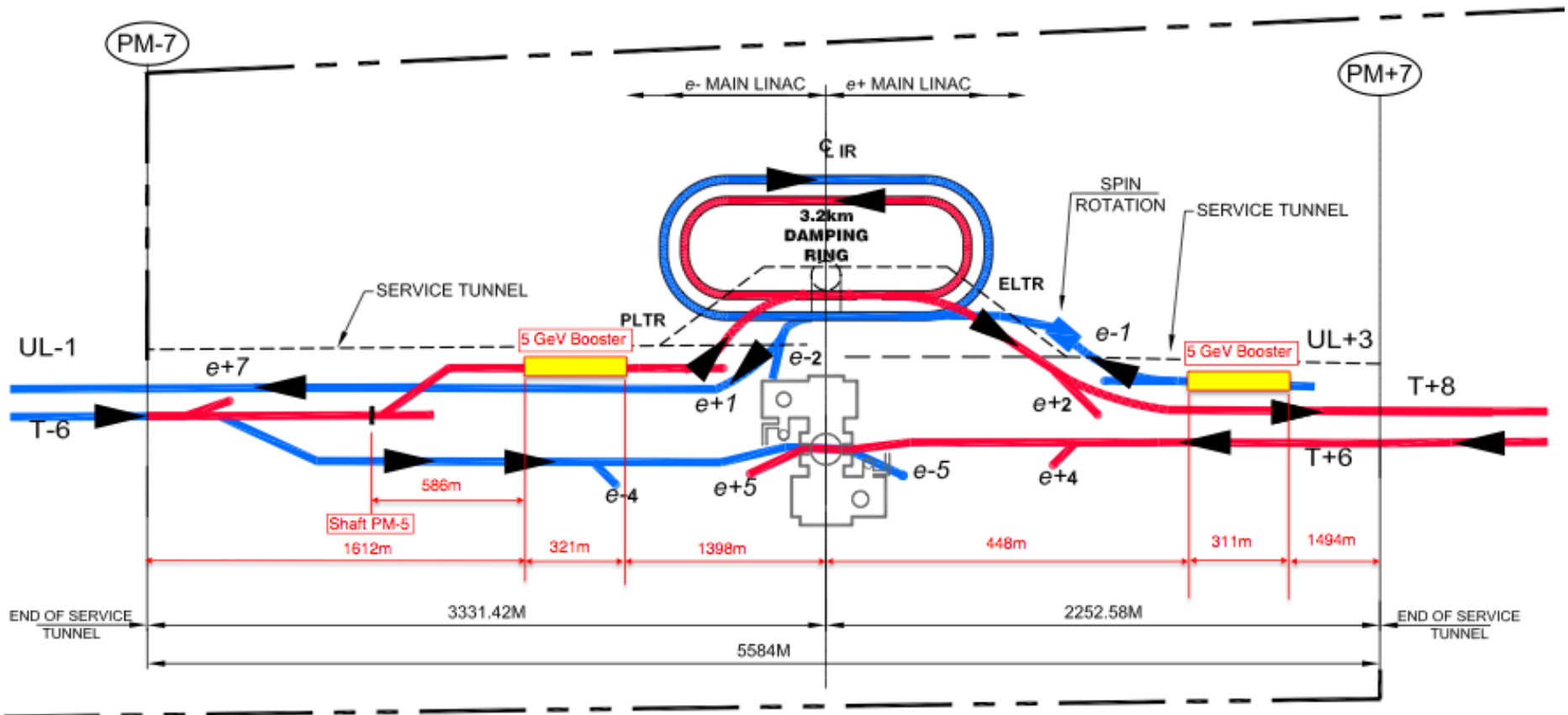


Installed cryogenic plant power

Area	Number of plants	Installed plant size (each) (MW)	Installed total power (MW)	Operating power (each) (MW)	Operating total power (MW)	
Main Linac + RTML KCS	12	3.37	40.44	2.63	31.56	
Main Linac + RTML DKS	10	4.16	41.60	3.24	32.40	
e+ 5 GeV linac	1	0.49	0.49	0.35	0.35	
e- 5 GeV linac	1	0.65	0.65	0.48	0.48	
Damping Rings	1	1.45	1.45	1.13	1.13	
BDS	1	0.41	0.41	0.33	0.33	<i>still just the old RDR number</i>
Experiments	1	1.00	1.00	0.70	0.70	<i>1 kW at 4.5 K from Tom Markiewicz</i>
TOTAL with KCS			45.60		35.39	
TOTAL with DKS			44.44		34.55	
Total central campus compr power		3.59		2.66		assume BDS+DR+Sources

- KCS and DKS have essentially the same total cryogenic plant power
 - **DKS slightly higher due to shorter cryogenic strings, more end boxes. Difference insignificant.**
- Undulators and some other odd devices not in this yet

5 GeV booster linac locations





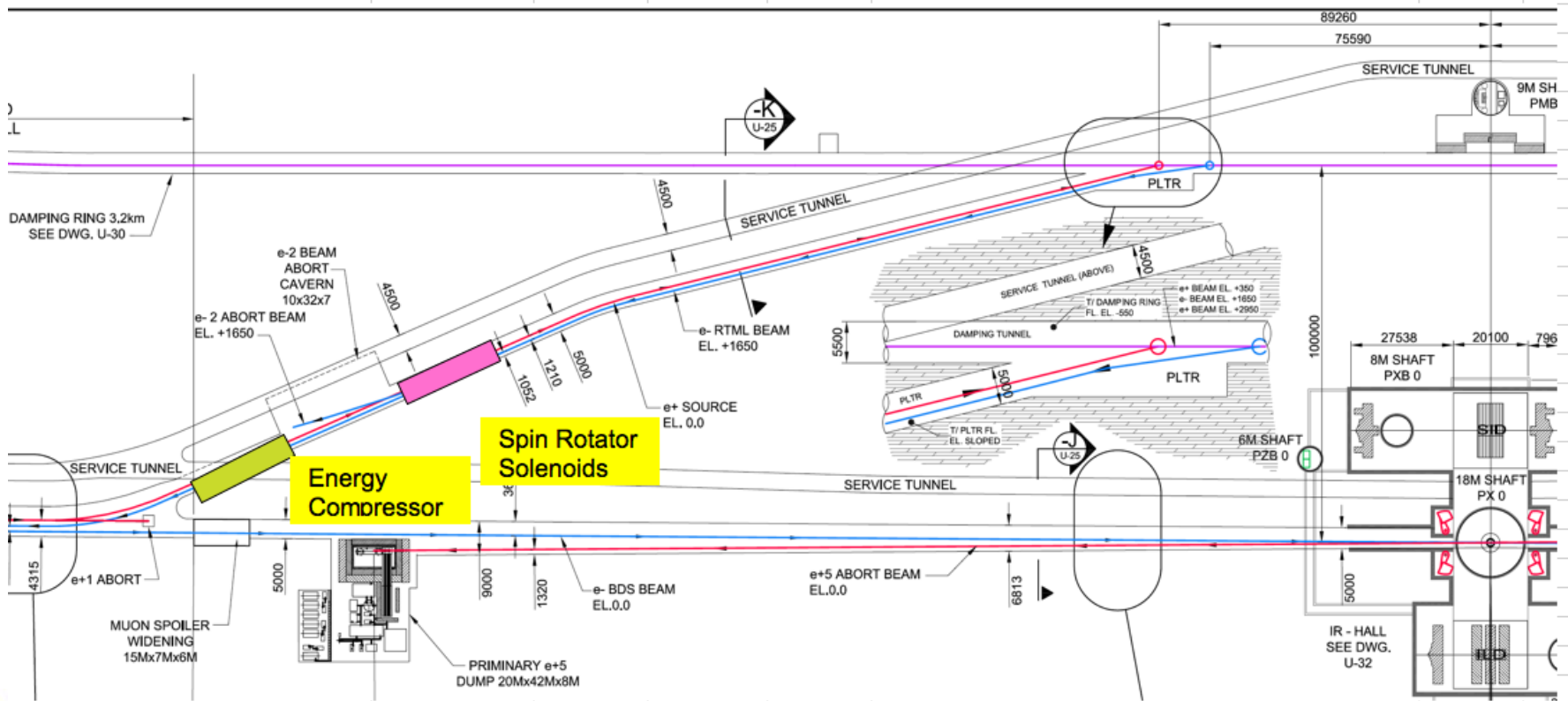
Helium pipe sizes for remote compressor locations

system	compr power (MW)	distance (m)	low pressure pipe ID (inches)	intermediate pipe ID (inches)	high pressure pipe ID (inches)
KCS ML	3.37	2000	14.21	8.71	7.63
e- 5 GeV	0.65	600	6.03	3.69	3.52
e+ 5 GeV	0.49	1600	6.68	4.09	3.88

- Piping from the central campus to relatively small cryogenic plants such as boosters is not a problem
 - **3 1/2 inch (100 mm) pipe installed cost est in 2006 is \$148/meter**
 - **6 inch (150 mm) pipe installed cost in 2006 is \$275/meter**
 - **12 inch (300 mm) pipe installed cost est in 2006 is \$716/meter**
- Main Linac compressors may be located away from cold boxes with room temperature piping
 - **Need to check cost tradeoffs for large pipes versus locations of compressors**

A few other cryogenic devices

Parts	Beamline	z [m], start	z [m], end	Temp.	Explanation	Beam	
42 helical undulators	EUND	-3035.4	-2717.36	4.2K	Helical undulator	e-	See
6xC4Q4 + 8xC8Q2 + 12xC8Q1	PBSTR	-1719.09	-1398.28	2K	Cryomodules, 5GeV booster, see Graphics sheet	e+	
C9 cryomodule	PLTR			2K	Cryomodule, Energy compressor, see sketch	e+	
4 solenoids, 2.6m long	PLTR				Spin rotator solenoids	e+	Assu
					Auxilliary source: Not specified		



- Piping to 5 GeV booster linacs and other central region cryogenics from one central compressor location looks practical
- Next step is detailing cryogenic supply to undulators and some of the small isolated devices in the central region
 - **Energy compressor, spin rotator solenoids**
 - **Add those cryogenic cooling powers to total**
- Document helium warm pipe lengths and cold transfer line lengths
 - **Refine total heat load estimates**
 - **Include in cost estimates**

- Cryogenics_parameters_DKS1.xlsx (ILC Document 991555,A,1,2)
- Cryogenics_parameters_KCS1.xlsx (ILC Document 975575,B,1,5)
- ILCcryoTDP25May2012.xls (Tom Peterson)
- cryopowertotal31May2012.xls (Tom Peterson)
- CompressorFlow&Pipes.xls (Tom Peterson)
- DampingRingCryo-17May2012.xls (Tom Peterson)
- Cryogenic-parts-overview.xlsx (ILC Document 991345,A,1,1)