Fermilab U.S. DEPARTMENT OF ENERGY Office of Science

MS2LCW upgrade project

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June 2020

MS2LCW Overview

- The MS2LCW system uses a combination water and glycol fluid to cool magnets and power supplies in the Meson beamlines.
- The LCW heat-exchanges with air towers on the roof of the MS2 service building
- Very wide coverage area (circled in blue) covers enclosures F2, F3, M01, M02, M03, M05, and MC6.

MS2LCW issues

- The system is historically leaky and spans a wide range of areas. Because the system currently contains a mix of Ethylene glycol, Propylene glycol, and water, these leaks have ES&H implications.
- Due to the increased viscosity of the cooling fluid from the presence of glycol, the system requires high-viscosity pumps designed to pump oil. The pumps and associated bearing blocks are very expensive and difficult to obtain.
- The cooling towers are very old and contain moving parts exposed to outside weather. Spare parts are difficult to find, and are often just as old as the parts in service. Furthermore, the cooling towers lose cooling capacity in hot and humid weather.

MS2LCW upgrades

To alleviate these issues, the upgrades proposed include:

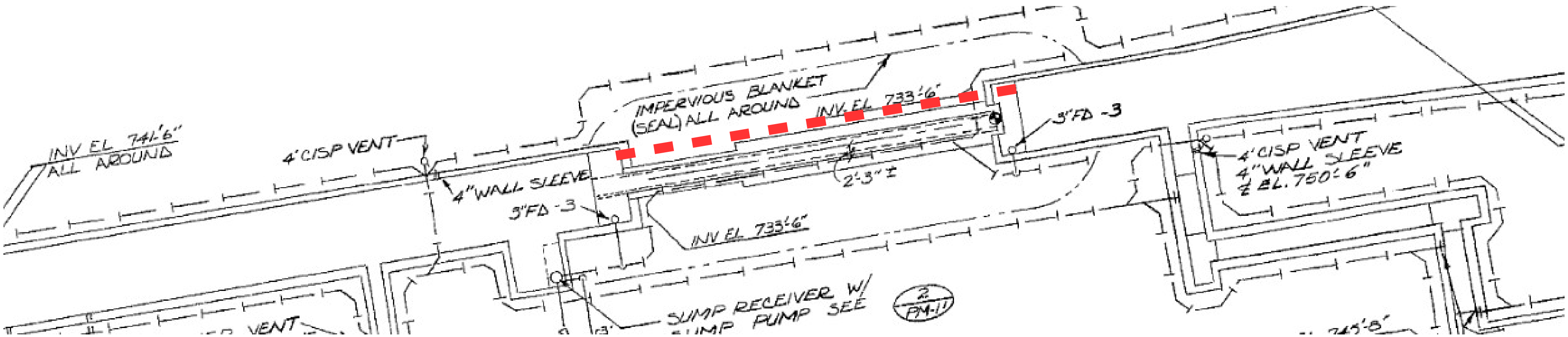
- Removal of cooling towers on MS2 roof, replacing them with a chiller system that uses a small glycol loop with plate-and-frame heat exchanger in the service building.
- Conversion of LCW to pure water. Necessitates moving all outdoor paths underground to prevent freezing in the winter

Outside LCW paths

- These 2” LCW supply and return pipes between MS1 and MS2 go outside along the radiation fence between service buildings. It will need to be re-located so they doesn’t freeze in the winter.
- One option is to trench and bury the pipes between service buildings.

Outside LCW paths

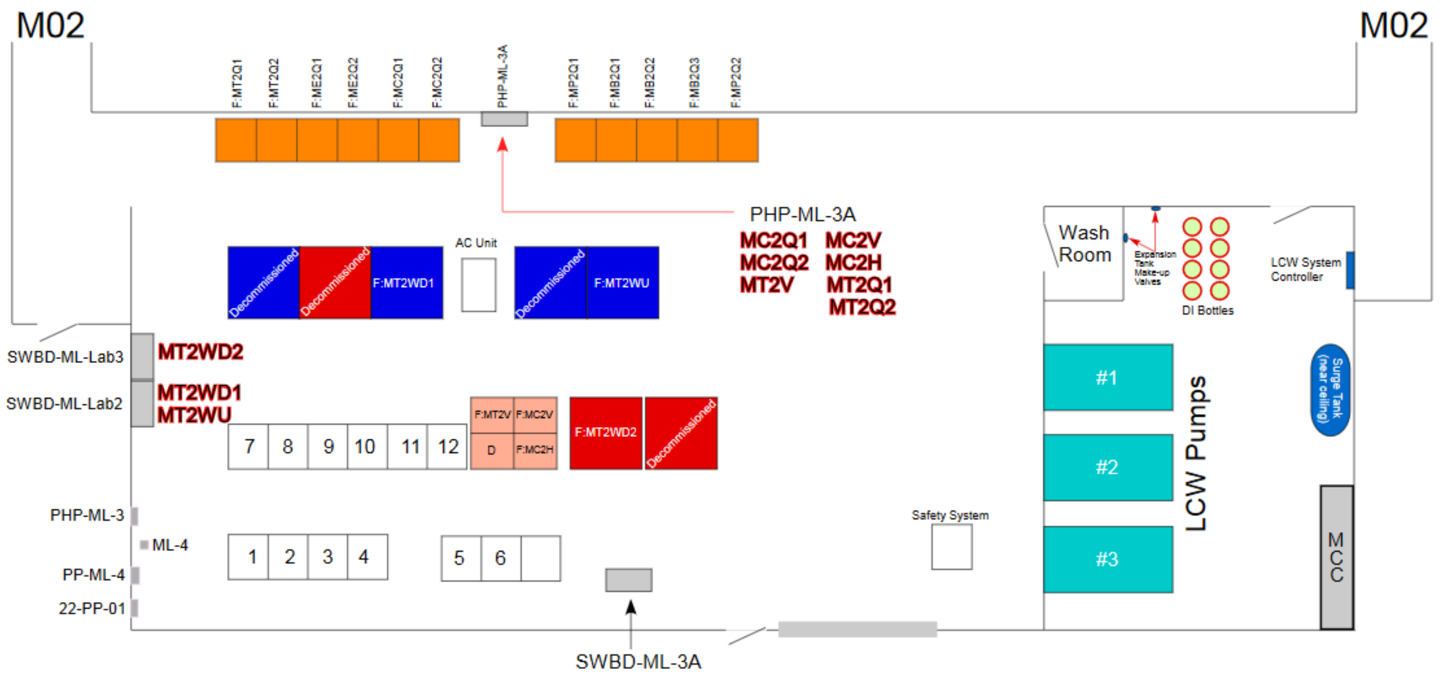
Another option is to directional-bore through the downstream MS1 enclosure wall and run pipes through the shielding berm to MS2.



Source: FESS drawing 7-2-1 PM-9

Service buildings: MS2

MS2 - Service Building



1 - 1/2 Height crate
- Meson Crate $15
2 - AC Motor Controller Chassis
3 - CATV
4 - 1/2 Height crate
- Meson Crate $14
5 - 8 Port Active ARCNET Hub
- (3)SWIC Controllers
- NIM Crate (Droeges)
6 - Meson Crate $17

7 - Meson Crate $18
- Console CLX115
8 - Empty
9 - CIA Crate (No 186 card)
10 - Empty
11 - Magnet Interlock Chassis

Source: AD/Ops, Steve Baginski

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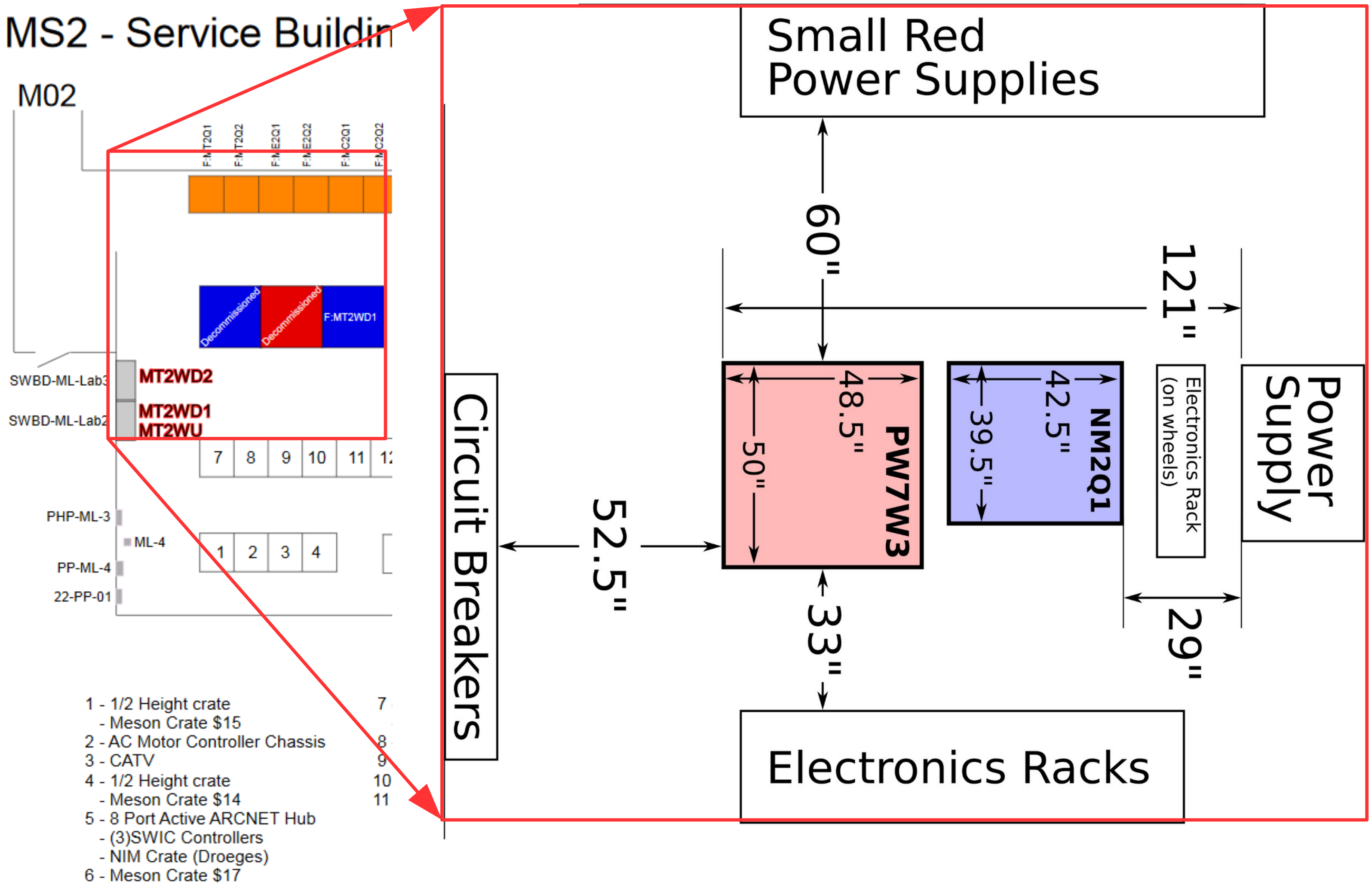
Service buildings: MS2, heat exchanger location



Source: AD/Ops, Steve Baginski, Jakob Schaeffer

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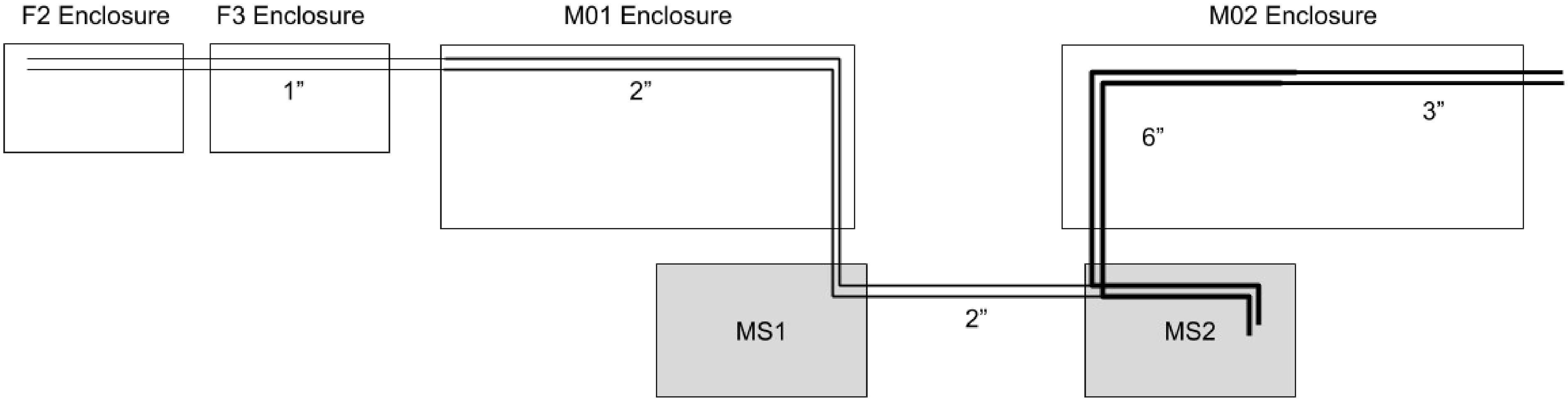
MS2LCW pipe line drawing



MS2LCW heat load estimate

This is Adam's estimate based on power supplies and magnets. Dez did his own from water params. Based on these estimates, and accounting for future beamline plans, we put the total system heat load needs at **about 1 MW**.

Service Building	BeamLine	Power Supply	Max Current [A]	# of magnets	Magnet type	Ramp?	Magnet resistance (Ohm)	Flat-top voltage [V]	Peak power (Watts)	RMS power (Watts)
	Meson Primary	F:M00U	128.00	3	CRD	N	0.075	12.5	1600	1600
	Meson Primary	F:M01D	117.80	7	Modified B1	N	0.01	16.0	1884.8	1884.8
	M Test	F:MW1W	137.40	6	3-way LAM	N		16.00	2198.4	2198.4
MS1	M Center	F:MC1D	140.00	1	Modified B1	Y	0.0015	9.50	1330	594.79
	Meson Primary	F:M00H	4.00	1	4-4-30				0	
	Meson Primary	F:M00V	2.00	1	SYB				0	
	Meson Primary	F:Q230	32.00	2	3Q120	N	4.5		0	0
	M Test	F:MT2WD2	405.00	3	6-3-120	N	0.15	60.00	24300	24300
	M Center	F:MC2V	1.50	1					0	
	M Center	F:MC2H	5.50	1					0	
	M Test	F:MT2V	35.00	1	4-4-30				0	
MS2	M Test	F:MT2WD1	975.00	2	EPB	N	0.03	38.00	37050	37050
	M Test	F:MT2WU	708.00	5	EPB	N	0.09	14.00	9912	9912
	M Center	F:MC2Q2	80.00	1	3Q120	Y	2.25		14400.0	6439.9
	M Center	F:MC2Q1	80.00	1	3Q120	Y	2.25		14400.0	6439.9
	M Test	F:MT2Q2	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT2Q1	80.00	1	3Q120	Y	2.25		14400.0	6439.9
	M Test	F:MT3U	80.00	2	3D120	N			0.0	0.0
	M Test	F:MT3Q1	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT3Q2	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT3Q3	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT3Q4	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT4Q1	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT4Q2	80.00	1	3Q120	N	2.25		14400.0	14400.0
MS3	M Test	F:MT4Q3	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT4Q4	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT4Q5	80.00	1	3Q120	N	2.25		14400.0	14400.0
	M Test	F:MT4HT		1	4-4-30				0	
	M Test	F:MT3V	12.00	1	4-4-30	Y	0.28	22.00	264	118.06
	M Test	F:MT4VT		1	4-4-30				0	0
	M Test	F:MT3W	765.00	1	EPB	Y	0.02		0	0
	M Test	F:MT4W	1,007.00	2	EPB	Y	0.03	46.00	46322	20715.8
	M Test	F:MT4Q6	80.00	1	3Q120	N	2.25		0	0
	M Test	F:MT5Q1	80.00	1	3Q120	Y	2.25	52.00	4160	1860.4
	M Center	F:MC6Q1	19.53	2	3Q120	Y	4.5	26.00	507.78	227.1
	M Center	F:MC6Q4	29.62	1	4Q120	Y	0.04	30.00	888.6	397.4
	M Center	F:MC6Q3	37.33	1	3Q120	Y	2.25	52.00	1941.16	868.1
	M Center	F:MC6Q6	20.20	1	4Q120	Y	0.04	40.00	808	361.3
	M Center	F:MC5Q1	80.00	1	3Q120	Y	2.25	65.00	5200	2325.5
	M Center	F:MC5Q2	93.20	1	3Q120	Y	2.25	65.00	6058	2709.2
	M Center	F:MC5H1	2.00						0	
	M Center	F:MC5V1	1.00						0	
	M Test	F:MT5Q2	80.00	1	3Q120	Y	2.25	75.00	6000	2683.3
MS4	M Center	F:MC5U	965.00	3	EPB?	Y	0.05	60.00	57900	25893.7
	M Center	F:MC6H2	40.00	1	4-4-30	Y	0.28		0	0.0
	M Center	F:MC6V1	0.00	1	4-4-30	Y	0.28		0	0.0
	M Test	F:MT5VT1							0	0.0
	M Center	F:MC6V2	30.00	1	4-4-30	Y	0.28		0	0.0
	M Center	F:MC6H1	0.00	1	4-4-30	Y	0.28		0	0.0
	M Test	F:MT5E	1,126.00	5	EPB	Y	0.09	106.00	119356	53377.6
	M Test	F:MT5VT2							0	
	M Test	F:MT5HT2							0	
	M Center	F:MC6D	472.90	4	EPB	Y	0.07	34.00	16078.6	7190.6
	M Center	F:MC6Q2	650.80	1	4Q120	Y	0.04	21.00	13666.8	6112.0
	M Center	F:MC6Q5	435.40	1	4Q120	Y	0.04	16.00	6966.4	3115.5

MCM500 cable resistance per foot	0.021
Cable length	0
Minimum ramp duty cycle	0.20

Magnet type	Resistance (Ohm)
Modified B1	2.96E-03
4-4-30	0.28
3Q120	2.25
EPB	0.02
4Q120	0.04
CRD	0.025
3-way LAM	0.0192
3D120	
6-3-120	0.05

Total (kW) 368.8