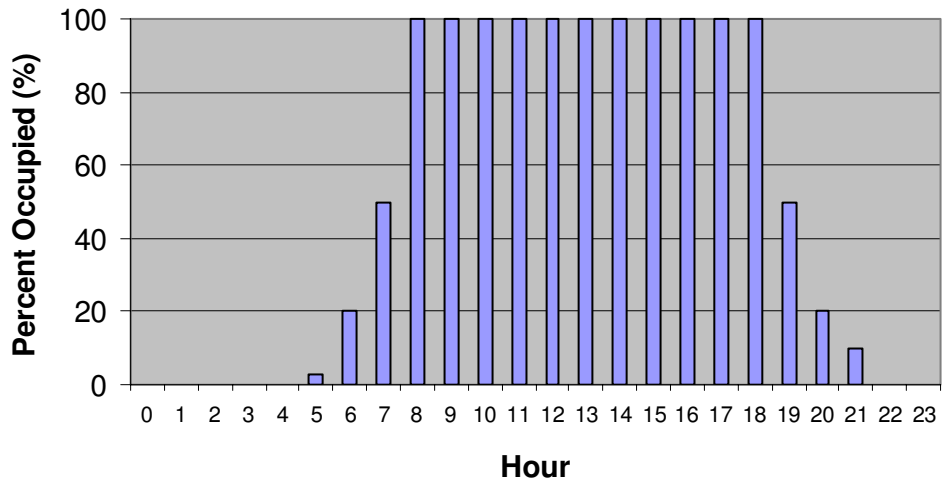




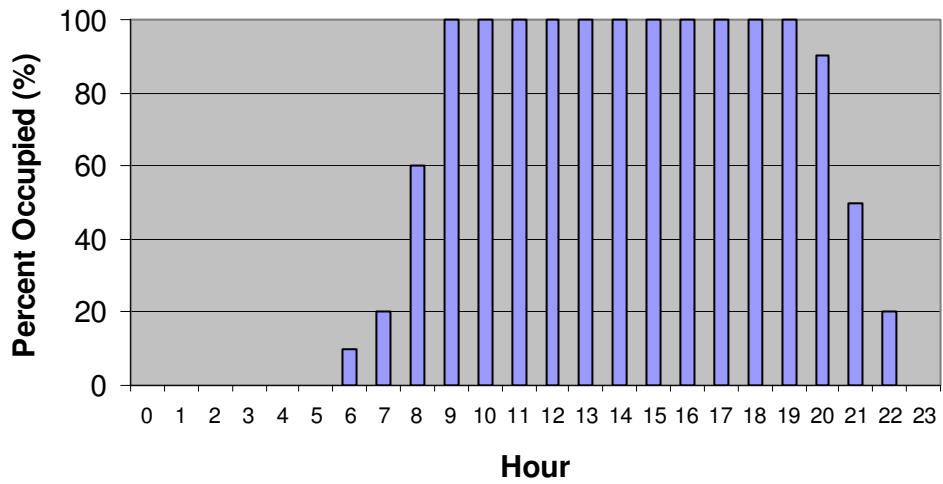
Jessica R. Baker
The Montgomery County
Conference Center and Hotel
(MCCCH), Rockville, MD

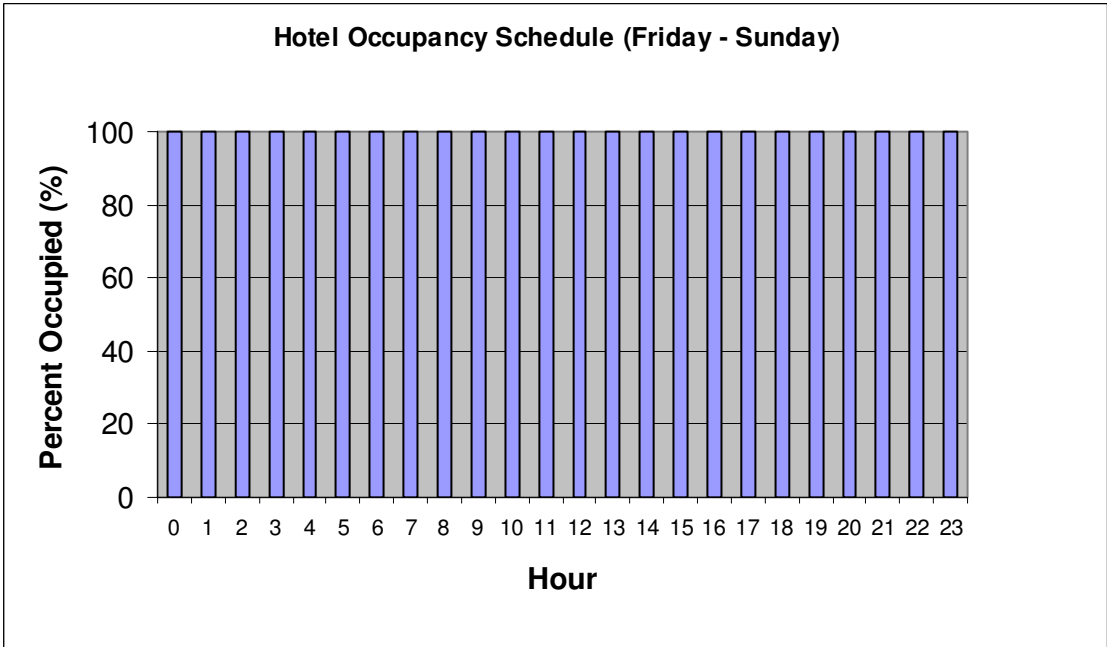
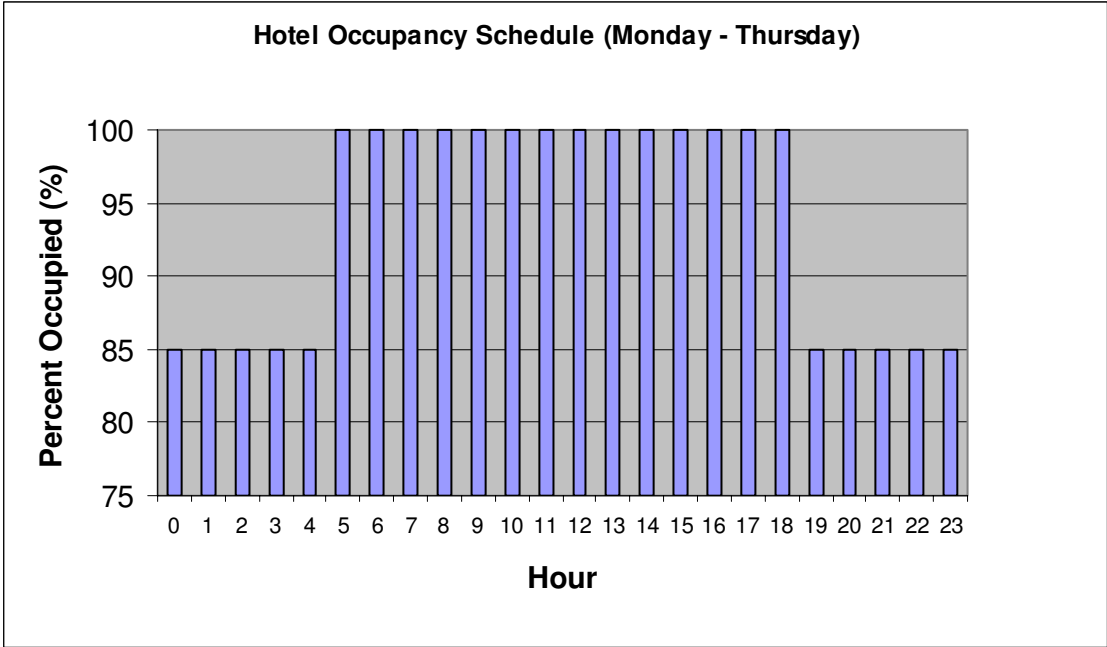
Appendix D: Ice Storage Calculations
and Drawings

Conference Center Occupancy Schedule (Monday - Thursday)

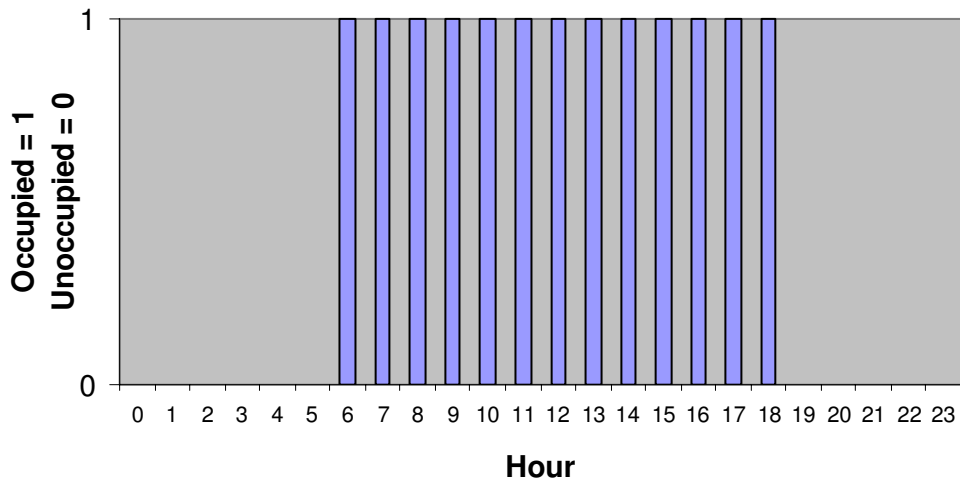


Conference Center Occupancy Schedule (Friday - Sunday)

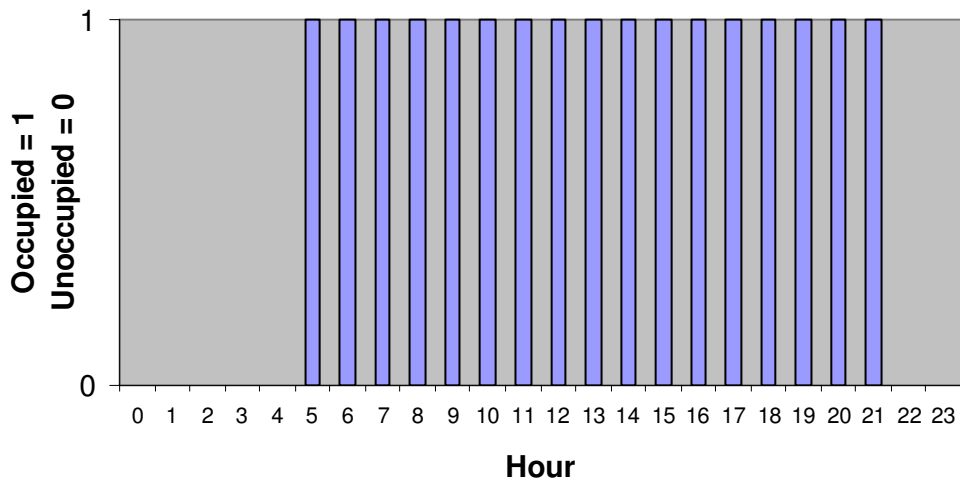




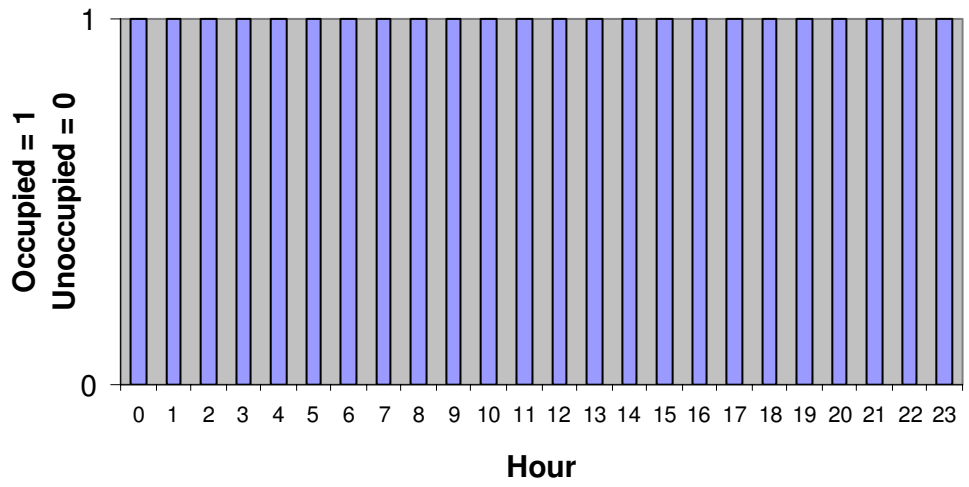
Conference Center Thermostat Schedule (Monday - Thursday)



Conference Center Thermostat Schedule (Friday - Sunday)



Hotel Thermostat Schedule (Week Days and Weekend)



Ice Storage Calculations (w/ Base Load Chiller):

On-peak hours (with base load chiller)= 17 (5am-10pm)
Off-peak hours (with base load chiller)= 7 (10pm-5am)

Daily, Full Storage

Total ton-hr = 6,258
On-peak ton-hr = 6,258
Off-peak ton-hr = 0

Nominal Chiller Size, Chilled Water = 894 tons
Storage Capacity, Chilled Water = 6,258 ton-h
Nominal Chiller Size, Glycol Ice = 1277.1 tons
Storage Capacity, Glycol Ice = 6,258 ton-h

Daily Partial Storage, Load Leveling

Nominal Chiller Size, Chilled Water = 260.75 tons
Storage Capacity, Chilled Water = 1825.3 ton-h
Nominal Chiller Size, Glycol Ice = 285.75 tons
Storage Capacity, Glycol Ice = 1400.2 ton-h

Daily Partial Storage, 50% Demand Limiting

Nominal Chiller Size, Glycol Ice = 467.01 tons
Storage Capacity, Glycol Ice = 2288.4 ton-h

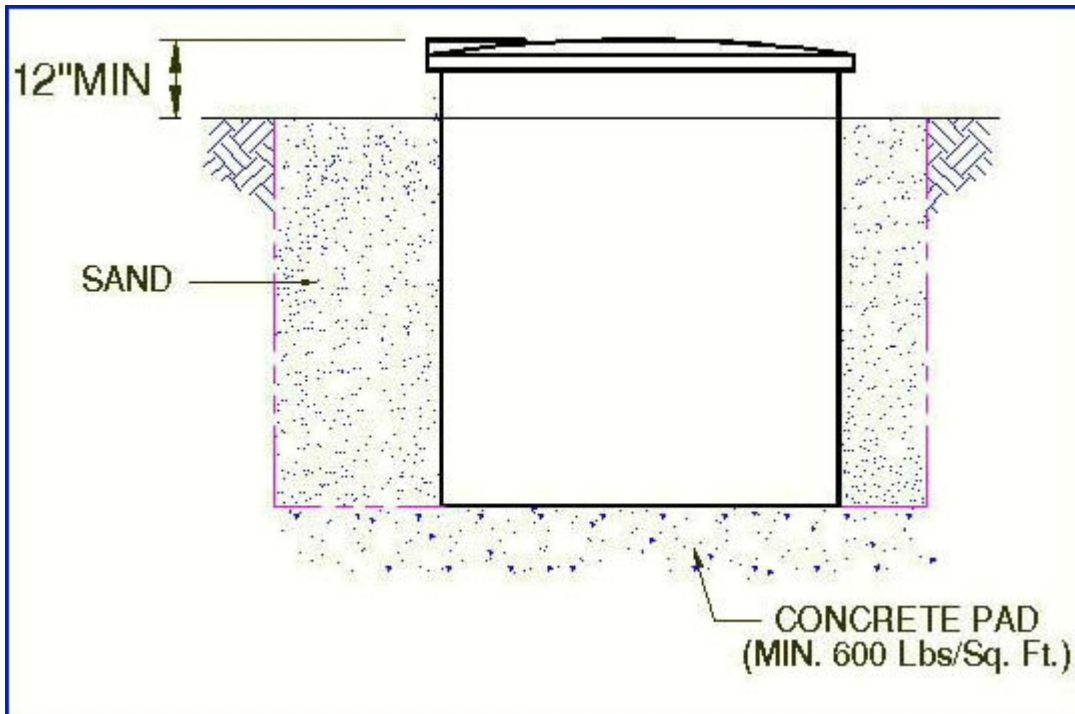
Off-Peak Cooling - ICEBANK Model C

Specifications and Drawings

TANK MODELS	1098C	1190C	1320C	1500C
Drawings	View drawings: 1098C2F 1098C3F 1098C4F	View drawings: 1190C2F 1190C3F 1190C4F	View drawings: 1320CRF 1320CSF	View drawings: 1500CRF 1500CSF
	Download CAD drawings: 1098C	Download CAD drawings: 1190C	Download CAD drawings: 1320CRF 1320CSF	Download CAD drawings: 1500CRF 1500CSF
Total Storage Capacity, Ton-Hr	115	190	380	570
With Mix Air	108	183	366	550
Latent Capacity Ton-Hr	98	162	324	486
With Mix Air	92	156	312	469
Sensible Capacity Ton-Hr	17	28	56	84
With Mix Air	16	27	54	81
Max. Operating Temp., °F	100	100	100	100
Factory Tested Pres., PSI	250	250	250	250
Max. Operating Pres., PSI	90	90	90	90
Dimensions (ODxH), in.	--	--	--	--
Dimensions (WxLxH), in.	89x91x69.5(2F) 89x93x69.5(3F) 89x93x69.5(4F)	89x91x102(2F) 89x93x102(3F) 89x93x102(4F)	89x183x102(RF) 89x181x102(SF)	89x273x102(RF) 89x271x102(SF)
Shipping Weight, lb*	1,275	2,000	4,000	6,000
Weight, Filled, lb	10,235	16,890	33,730	50,600
Floor Loading, lb/Sq Ft	237	391	391	391

Volume Of Water/Ice, Gal	980	1,655	3,310	4,965
Vol. Solution in HX, Gal	99	157	315	470
With Mix Air	85	152	304	434
Type of connection	4" Flange	4" Flange	4" Flange	4" Flange
Total Burial Drawing	Full Burial Models 1190XC (2F, 3F, 4F); 1320XC & 1500XC (RF & SF); and 1098XC (2F, 3F, 4F).			
* Shipping weight may vary slightly because of differences in volumes of residual water from hydrostatic test				

Partial Burial



Hour	Remaining Design Load-July (Ton-Hr)	Chiller During Day (Ton-Hr)	Ice-Making (Ton-Hr)	Ice Melted (Ton-Hr)	12-1098 Ice Buckets Melt Rate per Tank (Ton-hrs)	Cumulative TH Melted per Tank (Ton-hrs)	7-1190 Ice Buckets Melt Rate per Tank (Ton-hrs)	Cumulative TH Melted per Tank (Ton-hrs)
0	0	-----	210	-----	-----	-----	-----	-----
100	0	-----	210	-----	-----	-----	-----	-----
200	0	-----	210	-----	-----	-----	-----	-----
300	0	-----	210	-----	-----	-----	-----	-----
400	0	-----	210	-----	-----	-----	-----	-----
500	252.3	300	-----	0.0	0.0	0.0	0.0	0.0
600	255.6	300	-----	0.0	0.0	0.0	0.0	0.0
700	266.3	300	-----	0.0	0.0	0.0	0.0	0.0
800	291.3	300	-----	0.0	0.0	0.0	0.0	0.0
900	323.9	300	-----	23.9	2.0	2.0	3.4	3.4
1000	347.8	300	-----	47.8	4.0	6.0	6.8	10.2
1100	373.7	300	-----	73.7	6.1	12.1	10.5	20.8
1200	399.1	300	-----	99.1	8.3	20.4	14.2	34.9
1300	422.7	300	-----	122.7	10.2	30.6	17.5	52.5
1400	441.2	300	-----	141.2	11.8	42.4	20.2	72.6
1500	453.8	300	-----	153.8	12.8	55.2	22.0	94.6
1600	454.6	300	-----	154.6	12.9	68.1	22.1	116.7
1700	447.8	300	-----	147.8	12.3	80.4	21.1	137.8
1800	425.5	300	-----	125.5	10.5	90.8	17.9	155.7
1900	395.0	300	-----	95	7.9	98.8	13.6	169.3
2000	370.1	300	-----	70.1	5.8	104.6	10.0	179.3
2100	337.3	300	-----	37.3	3.1	107.7	5.3	184.6
2200	0	-----	210	-----	-----	-----	-----	-----
2300	0	-----	210	-----	-----	-----	-----	-----
Totals:	6258	5100	1470	1293	108	108	185	185

4-1320 Ice Buckets Melt Rate per Tank (Ton-hrs)	Cumulative TH Melted per Tank (Ton-hrs)	3-1500 Ice Buckets Melt Rate per Tank (Ton-hrs)	Cumulative TH Melted per Tank (Ton-hrs)
----	----	----	----
----	----	----	----
----	----	----	----
----	----	----	----
----	----	----	----
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
6.0	6.0	8.0	8.0
12.0	17.9	15.9	23.9
18.4	36.4	24.6	48.5
24.8	61.1	33.0	81.5
30.7	91.8	40.9	122.4
35.3	127.1	47.1	169.5
38.5	165.6	51.3	220.7
38.7	204.2	51.5	272.3
37.0	241.2	49.3	321.5
31.4	272.5	41.8	363.4
23.8	296.3	31.7	395.0
17.5	313.8	23.4	418.4
9.3	323.1	12.4	430.8
----	----	----	----
----	----	----	----
323	323	431	431

PROJECT NAME : MCCCH
ANALYSIS BY : Jessica R. Baker

CALMAC MANUFACTURING CORP.

101 WEST SHEFFIELD AVE.

ENGLEWOOD, NJ 07631

201 569-0420

FILE NAME : icepick_prog
COMMENTS : N/A
FILE DATE : 3/22/2005

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DESIGN DAY LOAD DATA

HOUR	LOAD	TYPE	CHILL %	HOUR	LOAD	TYPE	CHILL %
1	.00	I	70.0	13	399.10	P	100.0
2	.00	I	70.0	14	422.70	P	100.0
3	.00	I	70.0	15	441.20	P	100.0
4	.00	I	70.0	16	453.80	P	100.0
5	.00	I	70.0	17	454.60	P	100.0
6	252.30	P	100.0	18	447.80	P	100.0
7	255.60	P	100.0	19	425.50	P	100.0
8	266.30	P	100.0	20	395.00	P	100.0
9	291.30	P	100.0	21	370.10	P	100.0
10	323.90	P	100.0	22	337.30	P	100.0
11	347.80	P	100.0	23	.00	I	70.0
12	373.70	P	100.0	24	.00	I	70.0

CHILLER AND TANK SELECTION SUMMARY

ICEBANK TANK MODEL									1500
DESIGN LOAD				(TONS)					455
SYSTEM SUPPLY TEMPERATURE				(F)					40
SYSTEM RETURN TEMPERATURE				(F)					51.1
DEFAULT CHILLER COOLING CAPACITY				(% OF NOMINAL)					100
DEFAULT CHILLER ICEMAKING CAPACITY				(% OF NOMINAL)					70
NUMBER OF COOLING HOURS									17
NUMBER OF ICE-MAKING HOURS									7
TOTAL COOLING LOAD				(TONHRS)					6258
NOM CHLR TONS	COOL CAP TONS	ICE CAP TONS	STRG DIV	ESTMTD TONHRS	STRG INLET F	STRG OUT F	PEAK STRG TONS	MIN # TANKS	MAX # TANKS
290.15	290.15	203.10	0.51	447.45	44.02	40.00	164.45	3.18	3.18

FLOW ANALYSIS

290 TONS CHILLER					
4 STORAGE TANKS MODEL 1500					
30 PERCENT ETHYLENE GLYCOL					
CHG dT	CHG GPM	GPM/TANK	dP (PSI)	AVG LCWT	MIN LCWT
=====	=====	=====	=====	=====	=====
3.0	1743.6	435.9	*****	*****	*****
4.0	1307.7	326.9	27.6	25.1	21.9
5.0	1046.2	261.5	19.0	24.4	21.4
6.0	871.8	218.0	14.3	23.7	21.0
7.0	747.3	186.8	11.4	23.0	20.6
8.0	653.9	163.5	9.4	22.2	20.1
9.0	581.2	145.3	8.0	21.5	19.7
10.0	523.1	130.8	7.0	20.7	19.3
	DIS dT	DIS GPM	GPM/TANK	dP (PSI)	
	=====	=====	=====	=====	
	8.0	1463.2	365.8	*****	
	9.0	1300.7	325.2	22.7	
	10.0	1170.6	292.6	18.9	
	11.0	1064.2	266.0	16.2	
	12.0	975.5	243.9	14.1	
	13.0	900.5	225.1	12.4	
	14.0	836.1	209.0	11.1	
	15.0	780.4	195.1	10.0	

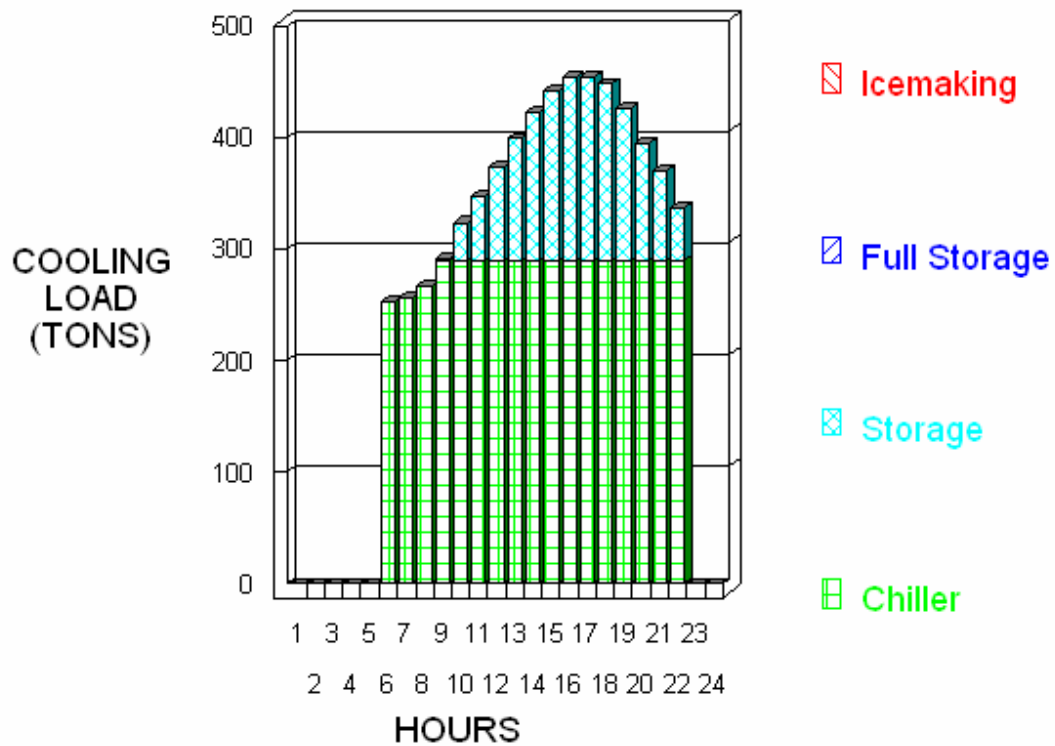
DESIGN DAY SYSTEM ANALYSIS

CHILLER UPSTREAM - SERIES FLOW										NOMINAL CHILLER SIZE = 290.2				
SYSTEM SUPPLY TEMPERATURE (F) = 40.0										NUMBER OF TANKS = 4 MODEL 1500				
SYSTEM RETURN TEMPERATURE (F) = 51.1										PERCENT ETHYLENE GLYCOL = 30.0				
FLOW (GPM) : DISCHARGE = 1055										DELTA P (PSI) : DISCHARGE = 17.3				
										CHARGE = 19.2				
										AVAILABLE UNUSED ICE (TONHRS) = 655				
HOUR					TONHRS	TONHRS			REQD	AVLB		GPM	PD	F
&	LOAD	CHLR	STRG	TANK	TOTAL	PER	%	CHLR	STRG	MIN	RTRN	PER		L
TYPE	TONS	TONS	TONS	TONS		TANK	CHRG	TEMP	TEMP	TEMP	TEMP	TANK	PSI	G
1	I	0	203.1	203.1	50.8	609	152.4	26.7	26.5	31.5	31.5	31.5	263.6	19.1
2	I	0	203.1	203.1	50.8	813	203.1	35.6	26.3	31.2	31.2	31.2	263.6	19.2
3	I	0	203.1	203.1	50.8	1016	253.9	44.5	25.9	30.8	30.8	30.8	263.6	19.2
4	I	0	203.1	203.1	50.8	1219	304.7	53.5	25.3	30.3	30.3	30.3	263.6	19.3
5	I	0	203.1	203.1	50.8	1422	355.5	62.4	24.6	29.5	29.5	29.5	263.6	19.4
6	P	252	252.3	0.0	.0	1422	355.5	62.4	40.0	40.0	32.0	46.2	.0	****
7	P	256	255.6	0.0	.0	1422	355.5	62.4	40.0	40.0	32.0	46.2	.0	****
8	P	266	266.3	0.0	.0	1422	355.5	62.4	40.0	40.0	32.0	46.5	.0	****
9	P	291	290.2	-1.1	-.3	1421	355.2	62.3	40.0	40.0	32.0	47.1	.9	.0
10	P	324	290.2	-33.7	-8.4	1387	346.8	60.8	40.8	40.0	32.0	47.9	24.7	1.0
11	P	348	290.2	-57.6	-14.4	1330	332.4	58.3	41.4	40.0	32.1	48.5	40.0	1.6
12	P	374	290.2	-83.5	-20.9	1246	311.5	54.7	42.0	40.0	32.3	49.1	55.2	2.3
13	P	399	290.2	-108.9	-27.2	1137	284.3	49.9	42.7	40.0	32.5	49.7	69.3	3.0
14	P	423	290.2	-132.5	-33.1	1005	251.2	44.1	43.2	40.0	32.9	50.3	82.7	3.7
15	P	441	290.2	-151.0	-37.8	854	213.4	37.4	43.7	40.0	33.4	50.8	94.6	4.4
16	P	454	290.2	-163.6	-40.9	690	172.5	30.3	44.0	40.0	34.1	51.1	105.9	5.0
17	P	455	290.2	-164.4	-41.1	526	131.4	23.1	44.0	40.0	34.4	51.1	110.5	5.3
18	P	448	290.2	-157.6	-39.4	368	92.0	16.1	43.8	40.0	34.6	50.9	110.0	5.3
19	P	426	290.2	-135.3	-33.8	233	58.2	10.2	43.3	40.0	34.4	50.4	97.4	4.5
20	P	395	290.2	-104.8	-26.2	128	32.0	5.6	42.6	40.0	34.5	49.6	83.3	3.8
21	P	370	290.2	-79.9	-20.0	48	12.0	2.1	42.0	40.0	35.2	49.0	75.8	3.4
22	P	337	290.2	-47.1	-11.8	1	.2	0.0	41.2	40.0	35.7	48.2	56.1	2.4
23	I	0	203.1	203.1	50.8	203	50.8	8.9	26.9	31.8	31.8	31.8	263.6	19.1
24	I	0	203.1	203.1	50.8	406	101.6	17.8	26.7	31.7	31.7	31.7	263.6	19.1

TANK DISCHARGE DATA

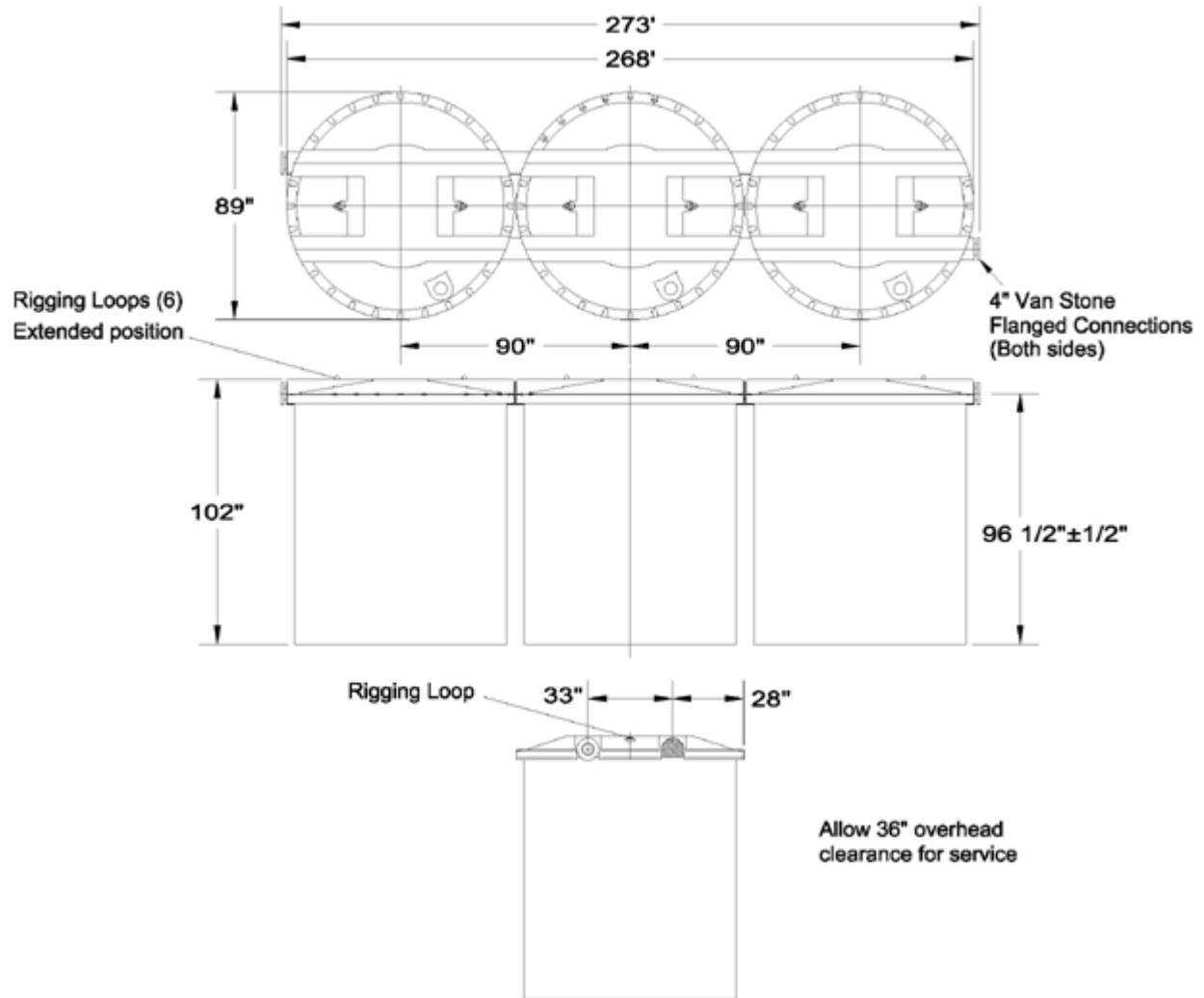
HOUR	TYPE	TONS /TANK	INLET TEMP (F)	OUTLET TEMP (F)	% TANK DISCH	TONHRS DISCH	OUT OF RANGE
10	P	8.4	40.8	40.0	1.5	8.70	
11	P	14.4	41.4	40.0	4.1	23.10	
12	P	20.9	42.0	40.0	7.7	43.97	
13	P	27.2	42.7	40.0	12.5	71.20	
14	P	33.1	43.2	40.0	18.3	104.33	
15	P	37.7	43.7	40.0	24.9	142.08	
16	P	40.9	44.0	40.0	32.1	182.98	
17	P	41.1	44.0	40.0	39.3	224.08	
18	P	39.4	43.8	40.0	46.2	263.48	
19	P	33.8	43.3	40.0	52.2	297.30	
20	P	26.2	42.6	40.0	56.8	323.50	
21	P	20.0	42.0	40.0	60.3	343.48	
22	P	11.8	41.2	40.0	62.3	355.25	

DESIGN DAY COOLING SCHEDULE





Technical Bulletin
Specifications
Model 1500CRF Dimensions
August 2000
CS-50



Calmac Manufacturing Corp. 101W. Sheffield Ave. Englewood, NJ 07631 / Ph 201.569.0420 / Fax 201.569.7593

LCC Cost Calculations (w electricity escalation factor):

$$LCC = FC + PWFe \cdot UC + PWFm \cdot MC$$

where,

$$PWFe = \frac{((1+e')^N - 1)}{(e'(1+e')^N)}$$

$$e' = (d-e)/(1+e)$$

$$PWFm = \frac{((1+m')^N - 1)}{(m'(1+m')^N)}$$

$$m' = (d-m)/(1+m)$$

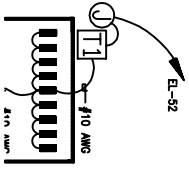
N = # years of analysis/life of building in years (30)

York with Ice Storage =	\$425,922											
MC	UC	d	e	m	e'	m'	PWFe	PWFm				
15000	160,836	0.12	0.03	0.01	0.087	0.109	11	9				
							LCC =	\$2,249,005.58				

First Cost Breakdowns

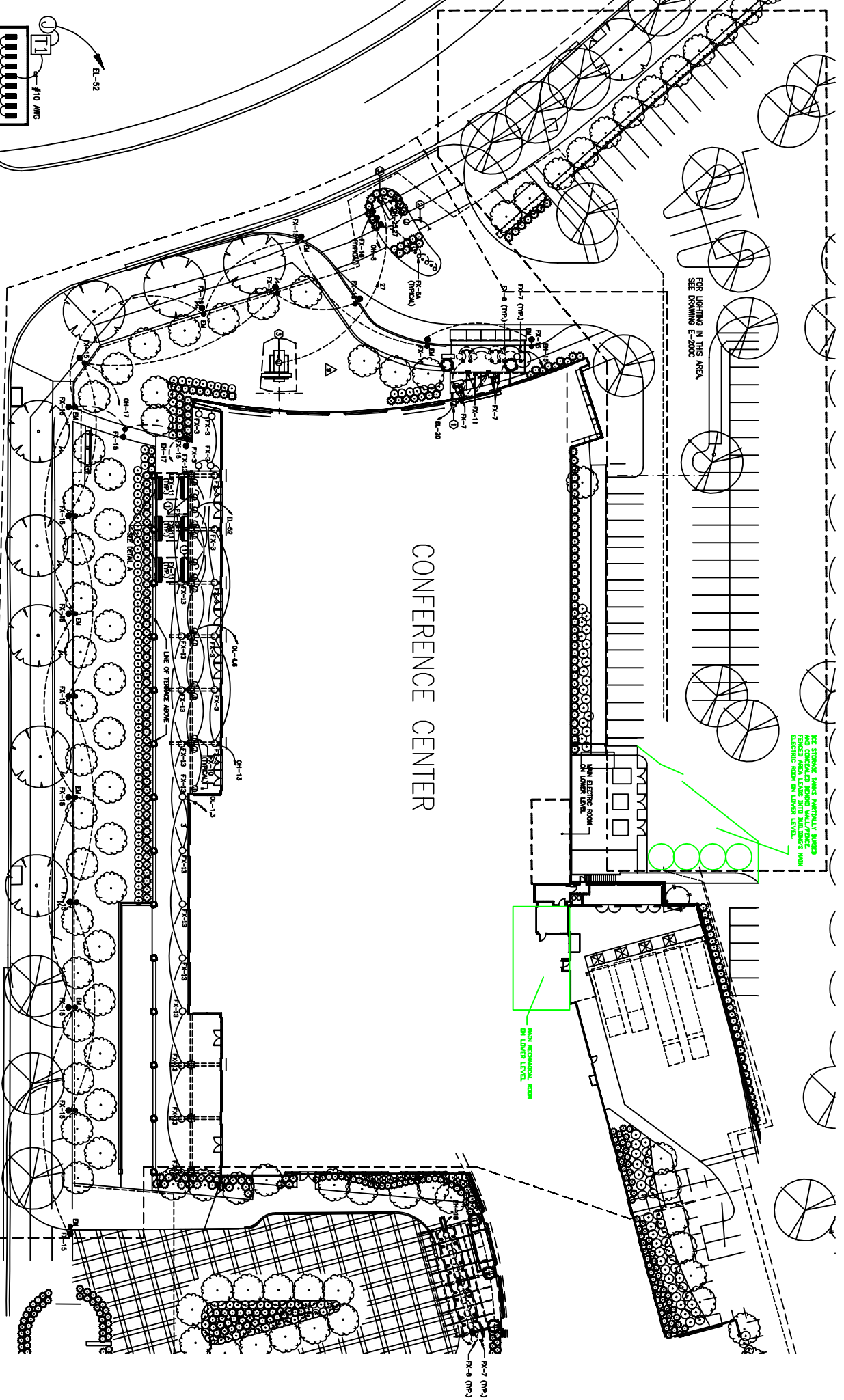
Electric Plant w/ Ice Storage (Base Load Chiller and Ice-making, etc.)		
	Equipment Cost	Installation Cost
<i>Chillers (2)</i>	\$145,000.00	\$19,800.00
<i>Cooling Towers (2)</i>	\$38,800.00	\$3,850.00
<i>Pumps (2)</i>	\$5,925.00	\$960.00
<i>Piping (200'-6" CW)</i>	\$6,500.00	\$5,900.00
<i>Boiler (2)</i>	\$50,000.00	\$7,000.00
<i>Heat Exchanger</i>	\$15,000.00	\$1,500.00
<i>Ethelyne Glycol</i>	\$792.00	\$1,815.00
<i>Added Pump Cost</i>	\$8,425.00	\$855.00
<i>Ice Storage</i>	\$86,400.00	\$15,000.00
<i>Piping (200'-6" CW)</i>	\$6,500.00	\$5,900.00
Total w/o chiller equipment cost:	\$280,922.00	
Total w/ chiller equipment cost:	\$425,922.00	

Difference in F.C. from Electric Plant	
Payback:	107682
Savings per year:	3800
# years:	28.34 (can't be justified)



DRAWING NOTES C:

GENERAL NOTES



FOR LIGHTING IN THIS AREA
SEE DRAWING E-200C

SEE STORAGE TRUNKS SPATIALLY INDEXED
FOR ELECTRICAL LEADS INTO BUILDING'S MAIN
ELECTRICAL ROOM ON LOWER LEVEL.

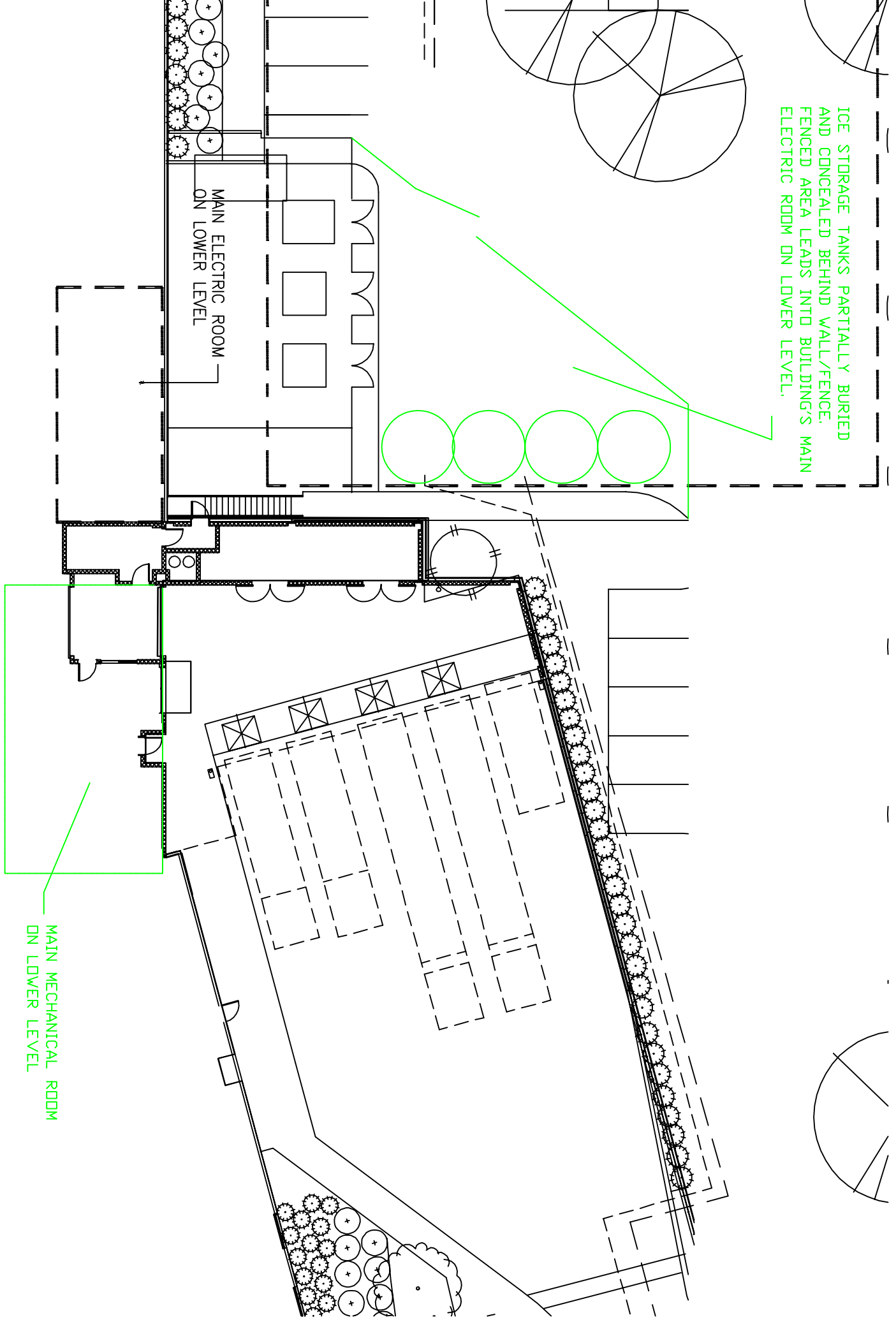
MAIN MECHANICAL ROOM
ON LOWER LEVEL.

MAIN ELECTRICAL ROOM
ON LOWER LEVEL.

CONFERENCE CENTER

R-7 (TR)
R-4 (TR)

ICE STORAGE TANKS PARTIALLY BURIED AND CONCEALED BEHIND WALL/FENCE. FENCED AREA LEADS INTO BUILDING'S MAIN ELECTRIC ROOM ON LOWER LEVEL.



MAIN MECHANICAL ROOM ON LOWER LEVEL

MAIN ELECTRIC ROOM ON LOWER LEVEL