Jessica R. Baker

The Montgomery County Conference Center and Hotel (MCCCH), Rockville, MD

6.0 Electrical Breadth

PENNSTATE

6.0 Electrical Breadth:

Electrical System Redesign:

MCCCH's original electrical system was greatly affected by the redesign of the building's mechanical system. A lot of the electrical loads generated by the building's mechanical equipment were altered throughout the selected optimization of the central chilling plant (electric driven chilling w/o thermal ice storage). Most of the electrical load modifications involved downsizing the building's electrical equipment; however, there were a couple of new electrical loads that had to be added into the overall system.

All of this resulted in the need to check the sizing of electrical feeders, panel boards, and over current protection devices serving the adjusted building mechanical equipment. From there, MCCCH's electrical equipment was resized and/or redesigned accordingly. (All building electrical system resizing and redesigning was done according to the National Fire Protection Association's *2002 National Electric Code (NEC)).*

The first electrical system check dealt with changing out the building's chillers. Since the optimum central chilling plant was changed from two natural gas driven chillers to two electric driven chillers (without ice storage), major electrical system changes has to be made.

The panel that originally served the building's two chillers (panel ML1) was too small to handle the new chiller load. The motor control center (MCC1) through which panel ML1 was fed was also too small for the new chiller electrical load. Therefore, two options resulted. Both MCC1 and panel ML1 could be resized to handle the new electrical load or, panel ML1 could be reduced in size by removing the chiller electrical load from it and adding the two new chillers to their own, new motor control center (MCC2).

With the ease of chiller control and possible future expansion in mind, it was decided that panel ML1 should be reduced in size and a new motor control center (MCC2) added to control the new chiller plant electrical load. This resulted in panel ML1 going from a 225A panel to a 100A panel. The feeder that serves this panel was then downsized from 4-# 4/0, 1-# 4GRD in 2 ½" conduit to 4-# 2, 1-# 6GRD in 1 ½" conduit. Finally, a new motor control center (MCC2) was added to the electrical system via a new 800A circuit breaker from the main switchboard (feeder for MCC2 = 2-sets, 4-# 3/0, # 3GRD in 2" conduit). The new chillers were placed on MCC2 and were fed from it by 3-500 KCMIL, 1-# 3GRD in 2" conduit. They each received a 400A switch and fuse.

Figure 6 (below) shows the original 225A panel ML1 along with the new 100A panel ML1. Figure 7 (also below) shows the new motor control center (MCC2) with its respective feeder schedule. The location of this new motor control center, MCC2, can be seen in Appendix H. (All new electrical equipment is highlighted in the color green.)

LOCATION: LOWER LEVEL
SERVICE: 460/265V, 3 PHASE, 4 WIRE, FULL NEUTRAL
MAINS: 225 A MAIN LUGS ONLY
MTD SURFACE
AIC 42K

PANEL ML1-ORIGINAL

FED FROM "MCC1"

C	WIRE SIZE	LOAD DESCRIPTION	LOAD KVA	CKT NO	CKT PH	BKR AMP	PHASE KVA A	PHASE KVA B	PHASE KVA C	BKR AMP	CKT PH	CKT NO	LOAD KVA	LOAD DESCRIPTION	WIRE SIZE	C
3/4"	3#12+#12G	UNIT HEATER	2.33	1	3P	20A	4.66			20A	3P	2	2.33	UNIT HEATER	3#12+#12G	3/4"
			2.33	3				4.66				4	2.33			
			2.33	5					4.66			6	2.33			
3/4"	3#12+#12G	SF-4	0.25	7	3P	15A	3.95			30A	3P	8	3.7	CH - 1	3#10+#10G	3/4"
			0.25	9				3.95				10	3.7	(GAS)		
			0.25	11					3.95			12	3.7			
3/4"	2#12+#12G	SF-3	0.4	13	1P	20A	4.1			30A	3P	14	3.7	CH - 2	3#10+#10G	3/4"
3/4"	2#12+#12G	EF-14	0.4	15	1P	20A		4.1				16	3.7	(GAS)		
3/4"	2#12+#12G	WATER TREATMENT	0.5	17	1P	20A			4.2			18	3.7			
3/4"	2#12+#12G	J.B. FOR CHILLER	0.5	19	1P	20A	0.5			20A	1P	20		SPARE		
		SPARE		21	1P	20A		0		20A	1P	22		SPARE		
		SPARE		23	1P	20A			0	20A	1P	24		SPARE		
		SPARE		25	1P	20A	0			20A	1P	26		SPARE		
		SPARE		27	1P	20A		0		20A	1P	28		SPARE		
		SPARE		29	1P	20A			0	20A	1P	30		SPARE		
		BUSSED SPACE		31	1P		0				1P	32		BUSSED SPACE		
		BUSSED SPACE		33	1P			0			1P	34		BUSSED SPACE		
		BUSSED SPACE		35	1P				0		1P	36		BUSSED SPACE		
		BUSSED SPACE		37	1P		0				1P	38		BUSSED SPACE		
		BUSSED SPACE		39	1P			0			1P	40		BUSSED SPACE		
		BUSSED SPACE		41	1P				0		1P	42		BUSSED SPACE		
			PANEL TOTALS:				13.21	12.71	12.81	KVA						
			KVA TOTALS:						38.7 KVA							
									49 AMPS							

LOCATION: LOWER LEVEL
SERVICE: 460/265V, 3 PHASE, 4 WIRE, FULL NEUTRAL
MAINS: 100 A MAIN LUGS ONLY
MTD SURFACE
AIC 42K

PANEL ML1-NEW

FED FROM "MCC1"

C	WIRE SIZE	LOAD DESCRIPTION	LOAD KVA	CKT NO	CKT PH	BKR AMP	PHASE KVA A	PHASE KVA B	PHASE KVA C	BKR AMP	CKT PH	CKT NO	LOAD KVA	LOAD DESCRIPTION	WIRE SIZE	C
3/4"	3#12+#12G	UNIT HEATER	2.33	1	3P	20A	4.66			20A	3P	2	2.33	UNIT HEATER	3#12+#12G	3/4"
			2.33	3				4.66				4	2.33			
			2.33	5					4.66			6	2.33			
3/4"	3#12+#12G	SF-4	0.25	7	3P	15A	0.25			20A	1P	8		SPARE		
			0.25	9				0.25		20A	1P	10		SPARE		
			0.25	11					0.25	20A	1P	12		SPARE		
3/4"	2#12+#12G	SF-3	0.4	13	1P	20A	0.4			20A	1P	14		SPARE		
3/4"	2#12+#12G	EF-14	0.4	15	1P	20A		0.4		20A	1P	16		SPARE		
3/4"	2#12+#12G	WATER TREATMENT	0.5	17	1P	20A			0.5	20A	1P	18		SPARE		
3/4"	2#12+#12G	J.B. FOR CHILLER	0.5	19	1P	20A	0.5			20A	1P	20		SPARE		
		SPARE		21	1P	20A		0		20A	1P	22		SPARE		
		SPARE		23	1P	20A			0	20A	1P	24		SPARE		
		SPARE		25	1P	20A	0			20A	1P	26		SPARE		
		SPARE		27	1P	20A		0		20A	1P	28		SPARE		
		SPARE		29	1P	20A			0	20A	1P	30		SPARE		
		BUSSED SPACE		31	1P		0				1P	32		BUSSED SPACE		
		BUSSED SPACE		33	1P			0			1P	34		BUSSED SPACE		
		BUSSED SPACE		35	1P				0		1P	36		BUSSED SPACE		
		BUSSED SPACE		37	1P		0				1P	38		BUSSED SPACE		
		BUSSED SPACE		39	1P			0			1P	40		BUSSED SPACE		
		BUSSED SPACE		41	1P				0		1P	42		BUSSED SPACE		
			PANEL TOTALS:				5.81	5.31	5.41	KVA						
			KVA TOTALS:						16.5 KVA							
									21 AMPS							

Figure 6: Resizing of Panel ML1

MOTOR CONTROL CENTER 'MCC2' - NEW (FOR CHILLERS) 800A, 3 PHASE, 4W, 50% NEUTRAL, 460/265V, 65K A.I.C.								AMPS	KVA
CUBICLE	POLES	HP	STARTER	SWITCH	FUSE	FEEDER**	NAMEPLATE		
1	3			400A	400A	380	CH - 1	323	294
2	3			30A			SPARE	0	0
3	3			30A			SPARE	0	0
4	3			30A			SPARE	0	0
5	3			30A			SPARE	0	0
6	3			30A			SPARE	0	0
7	3			30A			SPARE	0	0
8	3			30A			SPARE	0	0
9	3			30A			SPARE	0	0
10	3			30A			SPARE	0	0
11	3			30A			SPARE	0	0
12	3			30A			SPARE	0	0
13	3			30A			SPARE	0	0
14	3			400A	400A	380	CH - 2	323	294
15	3			30A			SPARE	0	0
16	3			30A			SPARE	0	0
17	3			30A			SPARE	0	0
18	3			30A			SPARE	0	0
19	3			30A			SPARE	0	0
20	3			30A			SPARE	0	0
21	3			30A			SPARE	0	0
22	3			30A			SPARE	0	0
23	3			30A			SPARE	0	0
24	3			30A			SPARE	0	0
25	3			30A			SPARE	0	0
	3			30A			SPARE	0	0
PROVIDE TYPE "R" FUSES UNLESS OTHERWISE NOTED.							TOTAL	646	588

** REFER TO FEEDER SCHEDULES ON DRAWING E6.01 UNLESS OTHERWISE NOTED.

FEEDER SCHEDULE

FEEDER DESIGNATION	3PH + G PHASE + GROUND CONDUCTORS AND CONDUIT SIZE	FEEDER DESIGNATION	3PH + N + G PHASE + N + GROUND CONDUCTORS AND CONDUIT SIZE
15	3#12+#12 GROUND IN 3/4"C	15N	4#12+#12 GROUND IN 3/4"C
20	3#12+#12 GROUND IN 3/4"C	20N	4#12+#12 GROUND IN 3/4"C
30	3#10+#10 GROUND IN 3/4"C	30N	4#10+#10 GROUND IN 3/4"C
50	3#8+#10 GROUND IN 1"C	50N	4#8+#10 GROUND IN 1-1/4"C
60	3#6+# 8 GROUND IN 1"C	60N	4#6+# 8 GROUND IN 1-1/4"C
85	3#4+#8 GROUND IN 1-1/4"C	85N	4#4+#8 GROUND IN 1-1/4"C
100	3# 2+# 8 GROUND IN 1-1/4"C	100N	4#2+#8 GROUND IN 1 1/4"C
115	3#2+# 6 GROUND IN 1-1/4"C	115N	4#2+# 6 GROUND IN 1 1/4"C
130	3#1+#6 GROUND IN 1-1/2"C	130N	4#1+#6 GROUND IN 1 1/2"C
150	3#1/0+#6 GROUND IN 1-1/2"C	150N	4#1/0+#6 GROUND IN 2"C
175	3#2/0+#6 GROUND IN 2"C	175N	4#2/0+#6 GROUND IN 2"C
200	3#3/0+#6 GROUND IN 2"C	200N	4#3/0+#6 GROUND IN 2"C
230	3#4/0+#4 GROUND IN 2"C	230N	4#4/0+#4 GROUND IN 2-1/2"C
250	3-250KCMIL+#4 GROUND IN 2-1/2"C	250N	4-250KCMIL+#4 GROUND IN 3"C
300	3-350KCMIL+#4 GROUND IN 3"C	300N	4-350KCMIL+#4 GROUND IN 3"C
380	3-500KCMIL+#3 GROUND IN 3"C	380N	4-500KCMIL+#3 GROUND IN 3-1/2"C
400	2 SETS (3#3/0+#3 GROUND IN 2"C)	400N	2 SETS (4#3/0+#3 GROUND IN 2"C)
460	2 SETS (3#4/0+#2 GROUND IN 2"C)	460N	2 SETS (4#4/0+#2 GROUND IN 2-1/2"C)
500	2 SETS (3-250KCMIL+#2 GROUND IN 2-1/2"C)	500N	2 SETS (4-250KCMIL+#2 GROUND IN 3"C)
600	2 SETS (3-350KCMIL+#1 GROUND IN 3"C)	600N	2 SETS (4-350KCMIL+#1 GROUND IN 3"C)
700	2 SETS (3-500KCMIL+#1/0 GROUND IN 3"C)	700N	2 SETS (4-500KCMIL+#1/0 GROUND IN 3-1/2"C)
800	3 SETS (3-300KCMIL+#1/0 GROUND IN 2-1/2"C)	800N	3 SETS (4-300KCMIL+#1/0 GROUND IN 3"C)
1000	3 SETS (3-400KCMIL+#2/0 GROUND IN 3"C)	1000N	3 SETS (4-400KCMIL+#2/0 GROUND IN 3"C)
1200	4 SETS (3-350KCMIL+#3/0 GROUND IN 3"C)	1200N	4 SETS (4-350KCMIL+#3/0 GROUND IN 3"C)
1600	5 SETS (3-400KCMIL+#4/0 GROUND IN 3"C)	1600N	5 SETS (4-400KCMIL+#4/0 GROUND IN 3"C)
2000	6 SETS (3-400KCMIL+-250KCMIL GROUND IN 3"C)	2000N	6 SETS (4-400KCMIL+-250KCMIL GROUND IN 3"C)
2500	7 SETS (3-500KCMIL+-350KCMIL GROUND IN 3"C)	2500N	7 SETS (4-500KCMIL+-350KCMIL GROUND IN 3-1/2"C)
3000	8 SETS (3-500KCMIL+-400KCMIL GROUND IN 3"C)	3000N	8 SETS (4-500KCMIL+-400KCMIL GROUND IN 3-1/2"C)
4000	11 SETS (3-500KCMIL+-500KCMIL GROUND IN 3"C)	4000N	11 SETS (4-500KCMIL+-500KCMIL GROUND IN 3-1/2"C)

Figure 7: New Motor Control Center, MCC2

However, changing the chillers wasn't the only the only thing that affected MCCCH's electrical system. Other pieces of major mechanical equipment were altered throughout the chilling plant optimization as well.

Because the chillers were changed, both the building's cooling towers and condenser water pumps had to be redesigned and resized. Therefore, they too affected the building electrical system and, the sizing of electrical feeders, panel boards, and over current protection devices had to be checked.

The building's two cooling towers were originally placed on a 400A panel board called MP. They were sized at 20 hp (motor) per cell (with two cells) and contained two 8 kW heaters each. Also, each was originally fed by 3-# 2, 1-# 8GRD in 1 1/4" conduit and protected by a 100A circuit breaker.

By redesigning the building's central chilling plant, these two cooling towers were downsized. The new cooling towers were sized at 7.5 hp (motor) per cell (with one cell) and contained one 8 kW heater each. Therefore, the wire and circuit breaker sizes were able to be downsized as well. The new cooling towers were each fed by 3-# 10, 1-# 10GRD in 3/4" conduit and protected by a 30A circuit breaker. The panel board MP remained at its original size (400A) in case of any future expansion.

All changes made to panel board MP can be seen below in Figure 8. (Again, all new electrical equipment is highlighted in the color green.)

LOCATION: ROOF / PENTHOUSE
SERVICE: 460/265V, 3 PHASE, 4 WIRE, FULL NEUTRAL
MAINS: 400 A MAIN CIRCUIT BREAKER
MTD SURFACE
AIC 42K

PANEL MP-ORIGINAL

FED FROM "MCC1"

C	WIRE SIZE	LOAD DESCRIPTION	LOAD KVA	CKT NO	CKT PH	BKR AMP	PHASE KVA A	PHASE KVA B	PHASE KVA C	BKR AMP	CKT PH	CKT NO	LOAD KVA	LOAD DESCRIPTION	WIRE SIZE	C
1 1/4"	3#2+#8G	CT-1	14.5	1	3P*	100A	29			100A	3P*	2	14.5	CT-2	3#2+#8G	1 1/4"
			14.5	3				29				4	14.5			
			14.5	5					29			6	14.5			
3/4"	3#12+#12G	AHU-CS2	3.1	7	3P*	20A	3.7			20A	1P	8	0.6	LIGHTS	2#12+#12G	3/4"
			3.1	9				3.7		20A	1P	10	0.6	LIGHTS	2#12+#12G	3/4"
			3.1	11					3.1	20A	1P	12		SPARE		
3/4"	2#12+#12G	AHU-CS1	3.1	13	3P*	20A	3.1			20A	3P	14		SPARE		
			3.1	15				3.1				16				
			3.1	17					3.1			18				
3/4"	2#10+#10G	HEAT TAPE	2	19	1P	20A	3			20A	2P	20	1	SIGN - MARRIOT	3#10+#10G	3/4"
		HEAT TAPE	2	21	1P	20A		3				22	1			
		BUSSED SPACE		23	1P	20A			1	20A	2P	24	1	SIGN - MARRIOT	3#10+#10G	3/4"
		BUSSED SPACE		25	1P	20A	1					26	1			
		BUSSED SPACE		27	1P	20A		0			1P	28		BUSSED SPACE		
		BUSSED SPACE		29	1P	20A			0		1P	30		BUSSED SPACE		
		BUSSED SPACE		31	1P		0				1P	32		BUSSED SPACE		
		BUSSED SPACE		33	1P			0			1P	34		BUSSED SPACE		
		BUSSED SPACE		35	1P				0		1P	36		BUSSED SPACE		
		BUSSED SPACE		37	1P		0				1P	38		BUSSED SPACE		
		BUSSED SPACE		39	1P			0			1P	40		BUSSED SPACE		
		BUSSED SPACE		41	1P				0		1P	42		BUSSED SPACE		
* HACR BKR.			PANEL TOTALS:				39.8	38.8	36.2	KVA						
			KVA TOTALS:						114.8 KVA							
									144 AMPS							

LOCATION: ROOF / PENTHOUSE
SERVICE: 460/265V, 3 PHASE, 4 WIRE, FULL NEUTRAL
MAINS: 400 A MAIN CIRCUIT BREAKER
MTD SURFACE
AIC 42K

PANEL MP-NEW

FED FROM "MCC1"

C	WIRE SIZE	LOAD DESCRIPTION	LOAD KVA	CKT NO	CKT PH	BKR AMP	PHASE KVA A	PHASE KVA B	PHASE KVA C	BKR AMP	CKT PH	CKT NO	LOAD KVA	LOAD DESCRIPTION	WIRE SIZE	C
3/4"	3#10+#10G	CT-1	7.2	1	3P*	30A	14.4			30A	3P*	2	7.2	CT-2	3#10+#10G	3/4"
			7.2	3				14.4				4	7.2			
			7.2	5					14.4			6	7.2			
3/4"	3#12+#12G	AHU-CS2	3.1	7	3P*	20A	3.7			20A	1P	8	0.6	LIGHTS	2#12+#12G	3/4"
			3.1	9				3.7		20A	1P	10	0.6	LIGHTS	2#12+#12G	3/4"
			3.1	11					3.1	20A	1P	12		SPARE		
3/4"	2#12+#12G	AHU-CS1	3.1	13	3P*	20A	3.1			20A	3P	14		SPARE		
			3.1	15				3.1				16				
			3.1	17					3.1			18				
3/4"	2#10+#10G	HEAT TAPE	2	19	1P	20A	3			20A	2P	20	1	SIGN - MARRIOT	3#10+#10G	3/4"
		HEAT TAPE	2	21	1P	20A		3				22	1			
		BUSSED SPACE		23	1P	20A			1	20A	2P	24	1	SIGN - MARRIOT	3#10+#10G	3/4"
		BUSSED SPACE		25	1P	20A	1					26	1			
		BUSSED SPACE		27	1P	20A		0			1P	28		BUSSED SPACE		
		BUSSED SPACE		29	1P	20A			0		1P	30		BUSSED SPACE		
		BUSSED SPACE		31	1P		0				1P	32		BUSSED SPACE		
		BUSSED SPACE		33	1P			0			1P	34		BUSSED SPACE		
		BUSSED SPACE		35	1P				0		1P	36		BUSSED SPACE		
		BUSSED SPACE		37	1P		0				1P	38		BUSSED SPACE		
		BUSSED SPACE		39	1P			0			1P	40		BUSSED SPACE		
		BUSSED SPACE		41	1P				0		1P	42		BUSSED SPACE		
* HACR BKR.			PANEL TOTALS:				25.2	24.2	21.6	KVA						
			KVA TOTALS:						71 KVA							
									89.3 AMPS							

Figure 8: Cooling Towers' Panel MP

The building's two condenser water pumps were originally placed on an 800A motor control center called MCC1. They were each sized at 50 hp and originally fed by 3-# 4, 1-# 8GRD in 1 1/4" conduit and protected by a 100A switch/circuit breaker.

By redesigning the building's central chilling plant, these two pumps were downsized. The new pumps were sized at 15 hp. Therefore, the wire and circuit breaker sizes were able to be downsized as well. The new pumps were each fed by 3-# 10, 1-# 10GRD in 3/4" conduit and protected by a 30A switch/circuit breaker. MCC1 remained at its original size (800A) as it could not be downsized.

All changes made to MCC1 can be seen below in Figure 9. See Figure 7 (above) for the feeder schedule. (Again, all new electrical equipment is highlighted in the color green.)

MOTOR CONTROL CENTER 'MCC1' - ORIGINAL 800A, 3 PHASE, 4W, 50% NEUTRAL, 460/265V, 65K A.I.C.								AMPS	KVA
CUBICLE	POLES	HP	STARTER	SWITCH	FUSE	FEEDER**	NAMEPLATE		
1	3			400A	400A	400N	PANEL MP	144	115
2	3			200A	200A	200N	PANEL ML1	49	39
3	3			200A	200A	200N	PANEL MB1	38	30
4	3	(2) 7.5		30A	30A	30	ESCALATORS	22	18
5	3	40	3	100A	80A	85	PUMP P-1	52	41
6	3	40	3	100A	80A	85	PUMP P-2 (STANDBY)	0	0
7	3	40	VFD*	100A	80A	85	PUMP P-3	52	41
8	3	40	VFD*	100A	80A	85	PUMP P-4 (STANDBY)	0	0
9	3			30A			SPACE		
10	3	15	2	30A	30A	30	PUMP P-6	21	17
11	3	50	3	100A	90A	85	PUMP P-7	65	54
12	3	50	3	100A	90A	85	PUMP P-8	65	54
13	3			30A			SPARE	0	0
14	3			30A			SPARE	0	0
15	3			30A			SPARE	0	0
16	3			30A			SPARE	0	0
17	3	1	1	30A	15A	20	HWC-1	2	1
18	3	3	1	30A	15A	20	HWC-2	5	4
19	3	3	1	30A	15A	20	HWC-3	5	4
20	3	3	1	30A	15A	20	HWC-4	5	4
21	3			30A			SPARE		
22	3			60A			SPARE		
23	3			30A			SPARE		
24	3			30A			BUSSED SPACE		
25	3			30A			BUSSED SPACE		
							TOTAL	524	436

PROVIDE TYPE "R" FUSES UNLESS OTHERWISE NOTED.
* COORDINATE LOCATION OF RTEMOTE VFD WITH DIVISION 15
** REFER TO FEEDER SCHEDULES ON DRAWING E6.01 UNLESS OTHERWISE NOTED.

MOTOR CONTROL CENTER 'MCC1' - NEW 800A, 3 PHASE, 4W, 50% NEUTRAL, 460/265V, 65K A.I.C.								AMPS	KVA
CUBICLE	POLES	HP	STARTER	SWITCH	FUSE	FEEDER**	NAMEPLATE		
1	3			400A	400A	400N	PANEL MP	144	115
2	3			200A	200A	200N	PANEL ML1	49	39
3	3			200A	200A	200N	PANEL MB1	38	30
4	3	(2) 7.5		30A	30A	30	ESCALATORS	22	18
5	3	40	3	100A	80A	85	PUMP P-1	52	41
6	3	40	3	100A	80A	85	PUMP P-2 (STANDBY)	0	0
7	3	40	VFD*	100A	80A	85	PUMP P-3	52	41
8	3	40	VFD*	100A	80A	85	PUMP P-4 (STANDBY)	0	0
9	3			30A			SPACE		
10	3	15	2	30A	30A	30	PUMP P-6	21	17
11	3	15	3	30A	30A	30	PUMP P-7	21	17
12	3	15	3	30A	30A	30	PUMP P-8	21	17
13	3			30A			SPARE	0	0
14	3			30A			SPARE	0	0
15	3			30A			SPARE	0	0
16	3			30A			SPARE	0	0
17	3	1	1	30A	15A	20	HWC-1	2	1
18	3	3	1	30A	15A	20	HWC-2	5	4
19	3	3	1	30A	15A	20	HWC-3	5	4
20	3	3	1	30A	15A	20	HWC-4	5	4
21	3			30A			SPARE		
22	3			60A			SPARE		
23	3			30A			SPARE		
24	3			30A			BUSSED SPACE		
25	3			30A			BUSSED SPACE		
							TOTAL	437	348

PROVIDE TYPE "R" FUSES UNLESS OTHERWISE NOTED.
* COORDINATE LOCATION OF RTEMOTE VFD WITH DIVISION 15
** REFER TO FEEDER SCHEDULES ON DRAWING E6.01 UNLESS OTHERWISE NOTED.

Figure 9: Condenser Water Pumps' Motor Control Center, MCC1

Economic Impacts/First Cost Analysis:

All changes made to MCCCH's electrical system would directly impact the system's first costs. Therefore, a first cost economic study was performed to see what added costs might be incurred throughout the redesign efforts. A lot of the electrical equipment was downsized with the new building mechanical design but, one motor control center was added along with two very large chillers with extremely large electrical loads (compared to the original natural gas-fired absorption chillers). Both the original and new electrical system first cost calculations can be viewed below in Table 13. All cost information was taken from the *2005 R.S. Means Electrical Cost Data*.

Original Electrical System First Costs:					
	Size	Unit	# Units	Cost ($)/Unit	First Cost ($)
Panel Board ML1	225A	Each	1	2500.00	2500.00
Feeder for ML1	4-#4/0	C.L.F.	4	217.00	868.00
Ground for ML1	1-#4G	C.L.F.	1	48.50	48.50
Conduit for ML1	2 1/2"	L.F.	100	5.40	540.00
CT Wire	3-#2	C.L.F.	6	75.50	453.00
CT Ground	1-#8	C.L.F.	2	19.30	38.60
CT Conduit	1 1/4"	L.F.	200	2.22	444.00
CT Circuit Breaker	100A	Each	2	495.00	990.00
CW Pump Wire	3-#4	C.L.F.	6	48.50	291.00
CW Pump Ground	1-#8	C.L.F.	2	19.30	38.60
CW Pump Conduit	1 1/4"	L.F.	200	2.22	444.00
CW Pump Circuit Breaker	100A	Each	2	495.00	990.00
Chiller Wire	3-#10	C.L.F.	6	12.55	75.30
Chiller Ground	1-#10	C.L.F.	2	12.55	25.10
Chiller Conduit	3/4"	L.F.	200	1.04	208.00
Chiller Circuit Breaker	30A	Each	2	400.00	800.00
				Total:	**$8,754.10**

New Electrical System First Costs (w/ Mechanical Redesign):					
	Size	Unit	# Units	Cost ($)/Unit	First Cost ($)
Panel Board ML1	100A	Each	1	1800.00	1800.00
Feeder for ML1	4-#2	C.L.F.	4	75.50	302.00
Ground for ML1	1-#6G	C.L.F.	1	54.50	54.50
Conduit for ML1	1 1/2"	L.F.	100	2.54	254.00
MCC2	800A	Each	1	5275.00	5275.00
Feeder for MCC2	2 sets, 4-#3/0	C.L.F.	8	175.00	1400.00
Ground for MCC2	2 sets, 1-#3G	C.L.F.	2	60.00	60.00
Conduit for MCC2	2"	L.F.	100	3.20	320.00
CT Wire	3-#10	C.L.F.	6	12.55	75.30
CT Ground	1-#10	C.L.F.	2	12.55	25.10
CT Conduit	3/4"	L.F.	200	1.04	208.00
CT Circuit Breaker	30A	Each	2	400.00	800.00
CW Pump Wire	3-#10	C.L.F.	6	12.55	75.30
CW Pump Ground	1-#10	C.L.F.	2	12.55	25.10
CW Pump Conduit	3/4"	L.F.	200	1.04	208.00
CW Pump Circuit Breaker	30A	Each	2	400.00	800.00
Chiller Wire	3-500KCMIL	C.L.F.	6	505.00	3030.00
Chiller Ground	1-#3	C.L.F.	2	60.00	120.00
Chiller Conduit	2"	L.F.	200	3.20	640.00
Chiller Circuit Breaker	400A	Each	2	1950.00	3900.00
				Total:	**$19,372.30**

Increase in First Cost of Electrical System with Mechanical Redesign:	**$10,618.20**

Table 13: MCCCH's Electrical System First Cost Analysis

As one can see, the electrical system redesign has much greater first costs than the original building design. However, this added first cost did allow for more room for future expansion and will be offset by the mechanical system redesign savings. This fact will be displayed in section 9.0 of this book.