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Lighting/Electrical . option
Dr. Mistrick . advisor
TCES . building
Incline Village, NV . location
10/22/05 . date
Technical Report 2 . title



This report, along with supplemental information, can be found at "P:\ae 481\tech2"
Full report available for download from the web at "<http://www.arche.psu.edu/thesis/eportfolio/current/portfolios/jdm341/>"

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Executive Summary:

This report is an examination of the electrical system as it is currently designed. The main service as well as emergency service systems were examined, including all lighting, mechanical, and other miscellaneous equipment. In order to analyze the building, data obtained from the drawings, specs and panelboard schedules were used in order to determine appropriate sizing for equipment. NEC requirements for sizing of circuit breakers, wiring and conduit were observed during the analysis. Also analyzed were the rate structure and limitations on electricity rate due to the photovoltaics and cogeneration unit.

After the analysis, it was determined that (as expected) the building was designed appropriately to meet the NEC design requirements. The switchboard was found to be about 250A larger (1600A designed vs ~1350A required) than required, but since 1600A is a common size for switchboards, its is likely not cost effective to change this with a switchboard closer to the actual design amperage.



Narrative:

System Type:

The building's electrical system is a radial type system. The service entrance contains only a single transformer and a primary feeder which then serves secondary panels and feeders.

Building Utilization Voltage:

The main service into the building is 208Y/120V. One possible point of investigation may be to try and redesign the system to utilize 480Y/277V.

Transformer Configuration:

Aside from the transformer at the service entrance, the only other transformer in the building is to connect the Cogen unit. It is a 30kVA, 480V to 208V step down transformer since the Cogen unit supplies 480V but the rest of the building is run on 208. In the redesign, it may be possible to change the main service from 208V to 480V, and since the only thing that would have to remain at 208Y/120V would be receptacle loads (since most mechanical and lighting equipment can be run at 480Y/277V) the transformer placed at the Cogen unit can be resized and moved to feed the receptacle loads, which would most likely lead to a minimal increase in cost.

Emergency Power Systems:

Lighting: Emergency ballasts are placed in specific light fixtures to maintain emergency lighting for up to 1 ½ hours.

Generator: 55kW, 208Y/120, Kohler model 50RZGB with a 4P8W alternator. It is capable of starting motor loads of 183kVA inrush with maximum voltage dip of 35%. Factory set startup time of 3 seconds. The generator feeds emergency panels "BC" and "3C" which contain fume hood loads. U.C. Davis required that fume hoods be back up and running within 30 seconds of a power outage, so the generator ensures that this is the case. No code required emergency loads are required to be on the generator branch since lighting is taken care of via battery packs.

ATS: 3 pole, 4 wire, 3 phase Kohler model KCT-ACTA-0200S with a 200A current rating a 208V-60hz rating and a solid neutral. Factory set delay of 1 second for transfer to standby power and factory set delay of 15 minutes for transfer back to normal power.



Narrative (cont'd):

Overcurrent Devices:

Circuit breakers are used on all panels and to protect all feeders.

Motors are protected by fused disconnects at the motor as well as circuit breakers when connecting to panelboards.

Locations:

Switchboard: 6000A SquareD SWBD "B" located in basement electrical room.

Panels: Each floor contains panels serving that floor, with additional distribution panels located in the basement.

Lighting Systems:

Fluorescent and Metal Halide lighting can be found throughout the building operating at 120V. A more efficient (from a distribution point of view) 277V lighting system may be investigated during redesign.

ASHRAE 90.1:

The main switchboard is protected by a 1600A circuit breaker. Each subsequent panel is protected by an appropriately sized circuit breaker corresponding to the size of the panel (see single line diagram).

Power Factor Correction:

None.

Special Design Requirements:

UC Davis placed a restriction on the design team as far as how fast the fume hoods in each lab space would be able to come back online. They wanted them to be back up within 30 seconds to avoid any harmful gases from being inhaled by the occupants. For this reason, the fume hoods were placed on panels fed by the emergency generator. Emergency lighting loads are taken care of via battery packs in emergency ballasts, so there are no loads required by code to be on the emergency generator.



Lamp Info:

Lamp Info:

Lamp	Osram Sylvania F032/835	Osram Sylvania CF32DT/E/IN/835	Osram Sylvania CF26DT/E/IN/835	Philips Master Color CDM70PAR38/3K	Philips Master Color CDM35PAR30L/3K
Ballast	Advance Transformer RCN-132-MC	Advance Transformer RCF-2S26-H1-LD-QS	Advance Transformer RCF-2S26-H1-LD-QS	Advance Transformer	Advance Transformer
Input Watts	35	36	29	94	41
Voltage	120	120	120	120	120
Current	.3	.31	.24	.85	.38
Power Factor	.98	.98	.98	.9	.9

Lamp	Osram Sylvania FT24DL/835	Osram Sylvania CF18DT/E/IN/835	Osram Sylvania CF18DD/E/IN/835	Osram Sylvania F032/830	Philips Master Color CDM150/T6/830
Ballast	Advance Transformer	Advance Transformer	Advance Transformer	Advance Transformer	Advance Transformer
Input Watts	29	20	20	35	185
Voltage	120	120	120	120	120
Current	.23	.17	.17	.3	1.95
Power Factor	.98	.98	.98	.98	.9

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Load Information:

Single Line Diagram:

See Attached or "P:\ae 481\tech2\single line.pdf"

Major Mech Equip:

See Attached or "P:\ae 481\tech2\mech.pdf"

Electrical Equipment:

See Attached or "P:\ae 481\tech2\elec.pdf"

Total Load:

Load Type	w/o Demand	Demand Factor	w/ Demand
Lighting	44.00	1.25	55.00
Motor	122.20	1.00	122.20
Receptacles	218.61	10k @1, >10k @.5	114.31
Largest Motor	30.00	0.25	7.50
Other Mech.	89.88	1.00	89.88
TOTAL kVA	504.69		388.89
TOTAL Amps	1400.88		1079.44

Main incoming service Feeder Sizing:

Allow for expansion: $1.25 \times 1079.44A = 1349.3A$

75 °C Copper wire used

From tables 310.16 and of the NEC: (5) sets of (4) 300MCM in 3" conduit, rated at 1425A

Analysis of existing switchboard:

Existing switchboard rated at 1600A

Design Amps = 1349.3A

Design Amps < switchboard rating, therefore **OK**



Utility Information:

Utility Rate Info:

TCES and the Cogen unit fall under the Qualifying Facility (QF) rate structure, as they are a small generating facility, The PVs are taken care of under a net metering agreement in which any surplus generated by the PVs rolls the meter backwards, with limits added stating that the meter may not be negative at the end of the month (i.e. any electricity generated beyond what is consumed from the grid is then “donated” back to the grid).

Additional Restriction/Considerations:

PVs alone

To qualify as a Net Metering customer and to possibly qualify for incentives, the PV system can not be larger than 30 kWac.

Installing a system larger than 30kWac allows for application to the Renewable RFP process by submitting an unsolicited bid for the sale of Renewable Energy Credits (RECs).

If the application is short-listed a power purchase agreement for the RECs, an interconnection agreement and a standby agreement must be agreed to. These agreements would be for 10-20 years and would include performance penalty provisions.

PVs and Cogen

Both installations will be required to have generation meters so the output of each can be determined.

The PV installation would be treated as if it were a Net Meter application, so a Net Metering Agreement must be agreed to.

The cogen installation falls under the CSPP tariff as a FERC Qualifying Facility and an interconnection agreement and a standby agreement would have to be agreed to.

Any excess energy generated from the combination of these systems will be treated as if it came from the cogen system and thus would fall under the CSPP tariff.

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Supplemental Information:

Single Line Diagram

See Attached or "P:\ae 481\tech2\single line.pdf"

Electrical Load Calculations

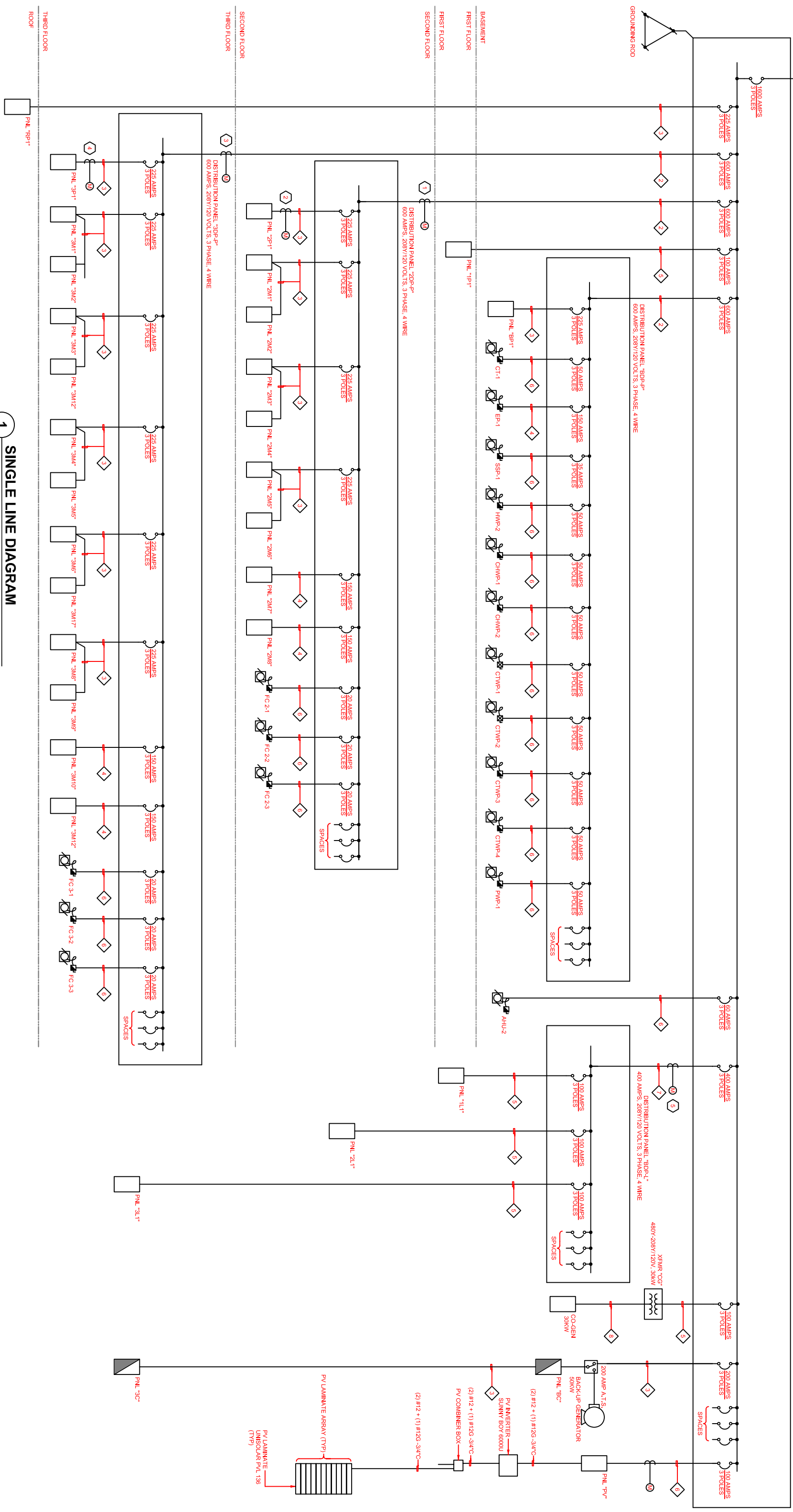
See Attached or "P:\ae 481\tech2\elec.pdf"

Mechanical Load Calculations

See Attached or "P:\ae 481\tech2\mech.pdf"

FEEDER SCHEDULE				
TAG	SETS	CONDUCTOR	GROUND CONDUIT (IN)	REMARKS
1	(6)	-	-	
2	(2)	(4) 300KCMIL	4"	
3	(1)	(4) #4/0	2 1/2"	
4	(1)	(4) #10	1 1/2"	
5	(1)	(4) #2	1 1/4"	
6	-	-	-	REFER TO EQUIPMENT SCHEDULE FOR REQUIRED CONDUCTORS AND CONDUIT
7	(1)	(4) 500KCMIL	(1) #2G	
8	(1)	(3) #8	(1) #10G	
9	(5)	(4) 400KCMIL	(1) #4/0G	

- ### SHEET NOTES
- PROVIDE SQUARE D MODEL EM83083 POWER METER WITH MODEL EMCA COMMUNICATION BOARD TO MONITOR POWER CONSUMPTION OF DISTRIBUTION PANEL "2P-P".
 - PROVIDE SQUARE D MODEL EM83032 POWER METER WITH MODEL EMCB COMMUNICATION BOARD TO MONITOR POWER CONSUMPTION OF PANEL "2P1".
 - PROVIDE SQUARE D MODEL EM83083 POWER METER WITH MODEL EMCA COMMUNICATION BOARD TO MONITOR POWER CONSUMPTION OF DISTRIBUTION PANEL "3P-P".
 - PROVIDE SQUARE D MODEL EM83032 POWER METER WITH MODEL EMCB COMMUNICATION BOARD TO MONITOR POWER CONSUMPTION OF PANEL "3P1".
 - PROVIDE SQUARE D MODEL EM83043 POWER METER WITH MODEL EMCA COMMUNICATION BOARD TO MONITOR LIGHTING DISTRIBUTION PANEL "BP-P1".



1 SINGLE LINE DIAGRAM
NOT TO SCALE

Load Name	Type	kVA	CB	Wire	Conduit
UV-1, UV-2		0.14	20A-2P	(3) #12 + (1) #12G	3/4"
		0.14			
HRP-3		0.60	20A-2P	(3) #12 + (1) #12G	3/4"
		0.60			
GWP-1, 2		0.20	20A-1P	(2) #12 + (1) #12G	3/4"
HRP-5		0.70	20A-1P	(2) #12 + (1) #12G	3/4"
HWRP-1, 2		0.10	20A-1P	(2) #12 + (1) #12G	3/4"
SS-1		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
1 RR CONTROLLER		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
MDF	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
MDF	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
MDF	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
PHONE SWITCH	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 003	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 001	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
CNG FUELING STATION		3.10	40A-2P	(3) #8 + (1) #10G	3/4"
		3.10			
RP-1		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RP-2		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RP-3		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RP-4		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
HWH-1		2.00	20A-1P	(2) #12 + (1) #12G	3/4"
HWH-2		2.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 004	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RWT-1		1.30	20A-3P	(4) #12 + (1) #12G	3/4"
		1.30			
		1.30			
SP-1		1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 004	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
SP-2		1.00	20A-1P	(2) #12 + (1) #12G	3/4"
SP-3		1.00	20A-1P	(2) #12 + (1) #12G	3/4"
ECH-1		1.30	20A-3P	(4) #12 + (1) #12G	3/4"
		1.30			
		1.30			
ELEVATOR LGTS	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
SS-2		0.80	20A-3P	(4) #12 + (1) #12G	3/4"
		0.80			
		0.80			
BACK FLOW PREVENTER		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
SITE LIGHTING	LTG	0.20	20A-2P	(3) #12 + (1) #12G	3/4"
		0.20			

AH-1	MTR	7.50	100A-3P	(4) #2 + (1) #8G	1 1/4"
		7.50			
		7.50			
HWP-1	MTR	3.00	50A-3P	(4) #6 + (1) #10G	1"
		3.00			
		3.00			
HWP-2	MTR	3.00	50A-3P	(4) #6 + (1) #10G	1"
		3.00			
		3.00			
HRP-1	MTR	0.80	20A-3P	(4) #12 + (1) #12G	3/4"
		0.80			
		0.80			
HRP-2	MTR	0.80	20A-3P	(4) #12 + (1) #12G	3/4"
		0.80			
		0.80			
EMS CONTROLS		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
FACP		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
VENDING	REC	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
VENDING	REC	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
VENDING	REC	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
VENDING	REC	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
VENDING	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 115	REC	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 148	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 148	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 148	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 111, 113, 116	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
IDF "1"	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 112	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 107	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 106	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
RP-1 & 2		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RP-3 & 4		1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 124, 125	REC	1.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 128, 131	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 126, 134, 136	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 123, 121	REC	1.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 119	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 118	REC	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 149, 152	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 108	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 108	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 108	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"

RECEPTACLES RM 108	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
EXTERIOR RECEPTACLES	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
EXTERIOR RECEPTACLES	REC	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
DOOR ACTUATOR PAD	MTR	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
MOTORIZED WINDOWS	MTR	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
MOTORIZED SKYLIGHTS	MTR	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
SMOKE DAMPERS		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
DOOR HOLD		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
RNPS "1"		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 124, 125, 132, 131, 129, 136	LTG	1.40	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 121, 119, 123	LTG	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 118, 151, 152	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 115, 116	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 111, 112	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
STAIRWELL LIGHTS	LTG	1.80	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTS - MAIN	LTG	0.90	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - SCONCE	LTG	0.50	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - TRACK	LTG	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - CORRIDOR	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - CORRIDOR	LTG	0.30	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - RECEPTION	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
LOBBY LTG - WORK SPACE	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
VESTIBULE LTG	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
LGT RM 141	LTG	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 139	LTG	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 105	LTG	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 108	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
BASEMENT LTG	LTG	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
BASEMENT LTG	LTG	0.90	20A-1P	(2) #12 + (1) #12G	3/4"
BASEMENT LTG	LTG	0.50	20A-1P	(2) #12 + (1) #12G	3/4"
EXTERIOR LTG	LTG	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
EXTERIOR LTG	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
GREEN HOUSE		1.00	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 126	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
GREEN HOUSE RECEPTACLE	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 215	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 215	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 215	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 215	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 215	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 216, 217	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 226, 219, 243	REC	1.40	20A-1P	(2) #12 + (1) #12G	3/4"
IDF "2"	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"

RECEPTACLES RM 211	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 218, 209	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
LAB CONTROLLERS		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
FUME HOOD CONTROLLERS		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 228	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 228	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
REFRIGERATOR	REC	2.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 226	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 225, 224	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 222, 223	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 219	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 219	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 244	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 2146, 247	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 218	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 237	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
VAV BOXES		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
VAV BOXES		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
SMOKE DAMPERS		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
RNPS "2"		0.00	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 216, 217, 222, 225	LTG	0.30	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 226, 228	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 226, 219	LTG	0.70	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 218, 219	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 215	LTG	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 208, 209, 211, 214	LTG	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 201, 239, 237	LTG	0.70	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 202	LTG	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 203, 246, 244	LTG	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 204	LTG	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 205	LTG	1.50	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 206	LTG	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 316	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 316	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 316	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 318	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 318	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 322	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 322	REC	8.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 317, 321, 348	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
LAB CONTROLLER		0.50	20A-1P	(2) #12 + (1) #12G	3/4"
FUME HOOD CONTROLLER	MTR	0.50	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 135	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"

RECEPTACLES RM 323, 326	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 324, 325	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 319, 338, 337, 341	REC	1.40	20A-1P	(2) #12 + (1) #12G	3/4"
IDF "3"	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 313	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 311, 312	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 323-327, 347	LTG	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 318, 322	LTG	0.30	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 316	LTG	1.30	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 317, 321, 348	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 311, 312, 313, 305, 306	LTG	0.90	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 241-243	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 338, 339, 341	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 332, 335,, 337	LTG	0.90	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 301	LTG	1.40	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 302, 303	LTG	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 304, 308	LTG	1.10	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 241-243, 246, 247	LTG	1.60	20A-1P	(2) #12 + (1) #12G	3/4"
LTG RM 338, 339, 341	LTG	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
EXHIBIT LTG	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
EXHIBIT LTG	LTG	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
EXHIBIT LTG	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
EXHIBIT LTG	LTG	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
LIGHT WELL UPLIGHTS	LTG	0.50	20A-1P	(2) #12 + (1) #12G	3/4"
EF-1	MTR	2.10	35A-3P	(4) #8 + (1) #10G	3/4"
		2.10			
		2.10			
EF-2	MTR	2.10	35A-3P	(4) #8 + (1) #10G	3/4"
		2.10			
		2.10			
S.B. RECEPTACLE RM 239	REC	1.30	20A-2P	(3) #12 + (1) #12G	3/4"
		1.30			
S.B. RECEPTACLE RM 239	REC	0.60	20A-1P	(2) #12 + (1) #12G	3/4"
S.B. RECEPTACLE RM 201	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
EF-3	MTR	2.10	35A-3P	(4) #8 + (1) #10G	3/4"
		2.10			
		2.10			
EF-4	MTR	1.70	30A-1P	(2) #10 + (1) #10G	3/4"
EF-5	MTR	1.70	30A-1P	(2) #10 + (1) #10G	3/4"
S.B. RECEPTACLE RM 301, 302, 304, 3	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
S.B. RECEPTACLE RM 301	REC	1.00	20A-3P	(4) #12 + (1) #12G	3/4"
		1.00			
		1.00			

RECEPTACLES RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
PROJECTOR	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
FLOOR BOX RM 206	REC	1.00	20A-1P	(2) #12 + (1) #12G	3/4"
FLOOR BOX RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
FLOOR BOX RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
FLOOR BOX RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
FLOOR BOX RM 206	REC	0.80	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 206	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 214	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	2.80	30A-3P	(4) #10 + (1) #10G	3/4"
		2.80			
		2.80			
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 335	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 337	REC	1.90	20A-3P	(4) #12 + (1) #12G	3/4"
		1.90			
		1.90			
		1.90			

RECEPTACLES RM 307	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 307	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 307	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 307	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 307	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 307	REC	1.90	20A-3P	(4) #12 + (1) #12G	3/4"
		1.90			
		1.90			
RECEPTACLE RM 305	REC	1.90	20A-3P	(4) #12 + (1) #12G	3/4"
		1.90			
		1.90			
RECEPTACLE RM 305	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 305	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 305	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLE RM 305	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
CONTROL PNL RM 344		2.90	30A-3P	(4) #10 + (1) #10G	3/4"
		2.90			
		2.90			
COMPRESSOR RM 344	MTR	2.90	30A-3P	(4) #10 + (1) #10G	3/4"
		2.90			
		2.90			
CONTROL PNL RM 343		2.90	30A-3P	(4) #10 + (1) #10G	3/4"
		2.90			
		2.90			
COMPRESSOR RM 343	MTR	2.90	30A-3P	(4) #10 + (1) #10G	3/4"
		2.90			
		2.90			
HUMIDIFIER RM 343	MTR	1.90	20A-2P	(3) #12 + (1) #12G	3/4"
		1.90			
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
FH 3-6	MTR	0.00	30A-1P	(2) #10 + (1) #10G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES RM 345	REC	0.20	20A-1P	(2) #12 + (1) #12G	3/4"
PV TILES		1.80	20A-2P	(3) #12 + (1) #12G	3/4"
		1.80			
PV TILES		1.80	20A-2P	(3) #12 + (1) #12G	3/4"
		2.00			
PV TILES		2.50	20A-2P	(3) #12 + (1) #12G	3/4"
		2.50			

PV TILES		1.60	20A-2P	(3) #12 + (1) #12G	3/4"
		1.60			
PV TILES		1.60	20A-2P	(3) #12 + (1) #12G	3/4"
		1.60			
PV TILES		1.60	20A-2P	(3) #12 + (1) #12G	3/4"
		1.60			
PV TILES		1.80	20A-2P	(3) #12 + (1) #12G	3/4"
		1.80			
PV TILES		1.80	20A-2P	(3) #12 + (1) #12G	3/4"
		2.50			
PV TILES		2.50	20A-2P	(3) #12 + (1) #12G	3/4"
		2.50			
EF-4	MTR	1.70	30A-1P	(2) #10 + (1) #10G	3/4"
EF-5	MTR	1.70	30A-1P	(2) #10 + (1) #10G	3/4"
RECEPTACLES ROOF	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
RECEPTACLES ROOF	REC	0.40	20A-1P	(2) #12 + (1) #12G	3/4"
EF-6	MTR	0.90	20A-3P	(4) #12 + (1) #12G	3/4"
		0.90			
		0.90			
EF-7	MTR	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
EF-8	MTR	1.20	20A-1P	(2) #12 + (1) #12G	3/4"
AH-2	MTR	3.80	60A-3P	(3) #6 + (1) #10	1"
		3.80			
		3.80			
CG-1	MTRLG	10.00	100A-3P	(3) #8 + (1) #10G	3/4"
		10.00			
		10.00			

EQUIPMENT SCHEDULE

EQUIPMENT DESIGNATION	LOCATION	HORSEPOWER	KVA	VOLTAGE AND PHASE	INTERLOCK WITH	FUSED DISCONNECT SWITCH (AT LOCKOUT)	TOGGLE SWITCH (AT)	MOTOR STARTERS		POWER PANEL OR MCC NAME AND CIRCUIT NO.	CONDUIT (IN)	POWER WIRING	REMARKS
								TYPE	AUXILIARY DEVICES IN STARTERS				
EF-1	ROOF	5		208/3		E,WP				3C - 1/3/5	3/4	(3) #8 + (1) #10G	EXHAUST FAN.
EF-2	ROOF	5		208/3		E,WP				3C - 7/9/11	3/4	(3) #8 + (1) #10G	EXHAUST FAN.
EF-3	ROOF	5		208/3		E,WP				3C - 2/4/6	3/4	(3) #8 + (1) #10G	EXHAUST FAN.
EF-4	ROOF	3/4		120/1			E,WP			3C - 8	3/4	(2) #12 + (1) #12G	EXHAUST FAN.
EF-5	ROOF	3/4		120/1			E,WP			3C - 10	3/4	(2) #12 + (1) #12G	EXHAUST FAN.
EF-6	ROOF	5		208/3		E,WP				RP1 - 8/10/12	3/4	(3) #8 + (1) #10G	EXHAUST FAN.
AH-1	BASEMENT	20		208/3	DUCT DETECTORS	E				BC - 1/3/5	1 1/4	(3) #2 + (1) #8G	AIR HANDLING UNIT.
AH-2	BASEMENT	10		208/3	DUCT DETECTORS	E				SWBD - "B"	1	(3) #6 + (1) #10G	AIR HANDLING UNIT.
CT-1	OUTDOOR	7 1/2		208/3		E,WP				BDP - P	3/4	(3) #8 + (1) #10G	COOLING TOWER FAN.
HWP-1	BASEMENT	7 1/2		208/3		E				BC - 7/9/11	3/4	(3) #8 + (1) #10G	HOT WATER PUMP.
HWP-2	BASEMENT	7 1/2		208/3		E				BC - 13/15/17	3/4	(3) #8 + (1) #10G	HOT WATER PUMP.
CHWP-1	BASEMENT	7 1/2		208/3		E				BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
CHWP-2	BASEMENT	7 1/2		208/3		E				BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
CTWP-1	BASEMENT	5		208/3		E		CMFS	AC, SS	BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
CTWP-2	BASEMENT	5		208/3		E		CMFS	AC, SS	BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
CTWP-3	BASEMENT	2		208/3		E				BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
CTWP-4	BASEMENT	2		208/3		E				BDP - P	3/4	(3) #8 + (1) #10G	WATER PUMP.
HRP-1	BASEMENT	1 1/2		208/3		E				BC - 2/4/6	3/4	(3) #12 + (1) #12G	HOT WATER CIRCULATING PUMP.
HRP-2	BASEMENT	1 1/2		208/3		E				BC - 8/10/12	3/4	(3) #12 + (1) #12G	HOT WATER CIRCULATING PUMP.
HRP-3	BASEMENT	1		208/1		E				BP1 - 5/7	3/4	(2) #12 + (1) #12G	CO-GEN HEAT RECOVERY PUMP
HRP-5	BASEMENT	1/4		120/1			E			BP1 - 11	3/4	(2) #12 + (1) #12G	SOLAR HOT WATER HEAT RECOVERY PUMP
PWP-1	BASEMENT	5		208/3		E				BDP-P	3/4	(3) #8 + (1) #10G	POTABLE WATER PUMP.
SP-1	BASEMENT	1/3		120/1			E			BP1 - 14	3/4	(2) #12 + (1) #12G	SUMP PUMP.
SP-2	BASEMENT	1/3		120/1			E			BP1 - 18	3/4	(2) #12 + (1) #12G	SUMP PUMP.
SP-3	BASEMENT	1/3		120/1			E			BP1 - 20	3/4	(2) #12 + (1) #12G	SUMP PUMP.
FC-239	RM 239	1 1/2		208/3			E			2DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
FC-201	RM 201	1 1/2		208/3			E			2DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
FC-203	RM 203	1 1/2		208/3			E			2DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
FC-335	RM 355	1 1/2		208/3			E			3DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
FC-305	RM 305	3/4		208/3			E	CMFS	AC,SS	3DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
FC-303	RM 303	1 1/2		208/3			E			3DP-P	3/4	(3) #12 + (1) #12G	FAN COIL
ECH-1	BASEMENT	3		208/3		E				BP1 - 22/24/26	3/4	(3) #12 + (1) #12G	EVAPORATIVE HUMIDIFIER PUMP
RP-1	BASEMENT	1/5		120/1			E			1P1-39	3/4	(3) #12 + (1) #12G	RADIANT FLOOR PUMP
RP-2	BASEMENT	1/5		120/1			E			1P1-39	3/4	(3) #12 + (1) #12G	RADIANT FLOOR PUMP
RP-3	BASEMENT	1/5		120/1			E			1P1-41	3/4	(3) #12 + (1) #12G	RADIANT FLOOR PUMP
RP-4	BASEMENT	1/5		120/1			E			1P-41	3/4	(3) #12 + (1) #12G	RADIANT FLOOR PUMP
FH2-1	RM 202	1		120/1			E			2M3 - 27	3/4	(2) #10 + (1) #10G	FUME HOOD
FH2-2	RM 202	1		120/1			E			2M3 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD
FH2-3	RM 203	1		120/1			E			2M4 - 27	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 2-4	RM 203	1		120/1			E			2M4 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 2-5	RM 204	1		120/1			E			2M5 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD

FH 3-1	RM 301	1		120/1			E			3M4 - 41	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 3-2	RM 302	1		120/1			E			3M4 - 27	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 3-3	RM 302	1		120/1			E			3M4 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 3-4	RM 304	1		120/1			E			3M6 - 27	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 3-5	RM 304	1		120/1			E			3M6 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD
FH 3-6	RM 345	1		120/1			E			3M12 - 29	3/4	(2) #10 + (1) #10G	FUME HOOD
CG-1	BASEMENT		30.0	480/3			E			SWBD - "B"	-	-	PROVIDE CAPSTONE 30-R-FG4-BU00 COGEN UNIT WITH MODEM MODEL 514715-100, SURGE SUPPRESSOR MODEL 510694-001 AND EXTERNAL FUEL KIT MODEL 507849-201. SEE RISER DIAGRAM FOR CONNECTION TO SWBD "B".
GWB-1	BASEMENT		0.5	120/1			E			BP1 - 9	3/4	(2) #12 + (1) #12G	GAS HOT WATER HEATER
GWB-2	BASEMENT		0.5	120/1			E			BP1 - 9	3/4	(2) #12 + (1) #12G	GAS HOT WATER HEATER
SS-1	BASEMENT		0.3	120/1			E			BP1 - 15	3/4	(2) #12 + (1) #12G	COOLING TOWER FILTRATION UNITS
SS-2	BASEMENT	1 1/2		208/3			E			BP1 - 32/34/36	3/4	(3) #12 + (1) #12g	COOLING TOWER FILTRATION UNITS
UV-1	BASEMENT		0.1	208/1			E			BP1 - 1/3	3/4	(2) #12 + (1) #12G	RAIN WATER UV TREATMENT
UV-2	BASEMENT		0.1	208/1			E			BP1 - 1/3	3/4	(2) #12 + (1) #12G	RAIN WATER UV TREATMENT
HWRP-1	BASEMENT	1/25		120/1			E			BP1 - 13	3/4	(2) #12 + (1) #12G	HOT WATER RECIRC. PUMP
HWRP-2	BASEMENT	1/25		120/1			E			BP1 - 13	3/4	(2) #12 + (1) #12G	HOT WATER RECIRC. PUMP
RWT-1	BASEMENT	3		208/3			M			BP1 - 8/10/12	3/4	(3) #12 + (1) #12G	RAIN WATER TREATMENT PANEL
MW-1	ROOF		0.2	120/1			E,WP			1P1-32	3/4	(2) #12 + (1) #12G	MOTORIZED WINDOW (SKYLIGHT). COORDINATE CONTROL LOCATION WITH ARCHITECT.
MW-2	ROOF		0.2	120/1			E,WP			1P1-32	3/4	(2) #12 + (1) #12G	MOTORIZED WINDOW (SKYLIGHT). COORDINATE CONTROL LOCATION WITH ARCHITECT.
MW-3	ROOF		0.2	120/1			E,WP			1P1-32	3/4	(2) #12 + (1) #12G	MOTORIZED WINDOW (SKYLIGHT). COORDINATE CONTROL LOCATION WITH ARCHITECT.
MW-4	ROOF		0.2	120/1			E,WP			1P1-32	3/4	(2) #12 + (1) #12G	MOTORIZED WINDOW (SKYLIGHT). COORDINATE CONTROL LOCATION WITH ARCHITECT.
MW-5	GREEN ROOM		0.2	120/1			E			1P1-30	3/4	(2) #12 + (1) #12G	MOTORIZED WINDOW . COORDINATE CONTROL
EP-1	ELEVATOR	50		208/3			E			BDP - P	2	(3) #3/0 + (1) #6G	ELEVATOR PUMP
SSP-1	EXTERIOR	5		208/3			E, WP			BDP - P	3/4	(3) #12 + (1) #12G	SITE SUMP PUMP