PENN STATE BALLPARK

University Park, Pennsylvania

Electrical Distribution Analysis for Retail Building

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Construction Management

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Sponsored by Barton Malow Company, The Pennsylvania State University, and L. Robert Kimball & Associates.

BREADTH TOPIC #2

ELECTRICAL DISTRIBUTION ANALYSIS FOR THE RETAIL STORE AND TICKET BUILDING

The electrical system design for *Penn State Ballpark* was documented rather quickly and sent out for bid without complete design documents. When the electrical package was awarded to the responsible low bidder, a new set of electrical construction documents was released. Not only did this require the electrical contractor to submit appropriate pricing for the changes, but the construction manager also had to make the necessary planning changes for the revised electrical work. Because the electrical package was assembled quickly, there is one item that I have found to give the owner, The Pennsylvania State University, a more worthwhile facility.

As depicted below, the retail store and ticket building is separate from the rest of the structure and will be used during non-operating game times.

Ballpark rendering with the area highlighted which will be analyzed.

Within the 2000 square foot structure, there is a ticket booth area, a retail store, an office, a small mechanical room, and a storage area. The spaces contain standard electrical equipment devices including light fixtures, wall receptacles, and data outlets. All of the electrical wiring for this area is designed to be run overhead through the canopy structure and into the building. Because there is no underground raceway conduits designed for this area, there is an added labor cost for running all wires through the canopy along with extra material cost for running the wires to the required panel board. Furthermore, by not

designing an electrical panel within the building, electrical maintenance could become an issue. If an electrical problem arises, the maintenance crew must find an electrical panel that is not near the retail store and ticket building.

Because of the issues named above, I have decided to design an electrical panel located within the building. The current panel which is not located within the building is 300A, 3 phase, 4 wire panel at 208V/120V for panel while the lighting is on a 225A, 3 phase, 4 wire panel at 480V/277V. In order to design a new panel, I will determine all of the connected loads with the appropriate electrical design factors for lighting, receptacles, and mechanical equipment. I will also provide underground raceways to the help minimize the wires that travel through the canopy area. Lastly, I understand before beginning the electrical calculations that two electrical panels will be required and a step-down transformer will be needed for the electrical receptacles and track lighting in the area. Furthermore, I will provide a cost-benefit analysis between the designed system and the proposed re-design to help determine the value of using an alternative system.

2.0 ELECTRICAL SUPPLY AT RETAIL BUILDING

2.0.1 EXECUTIVE SUMMARY

The retail store and ticket building is separate from the rest of the structure and will be used during non-operating game times. Within the 2000 square foot structure, there is a ticket booth area, a retail store, an office, a small mechanical room, and a storage area. The spaces contain standard electrical equipment devices including light fixtures, wall receptacles, and data outlets.

The current design includes portions of two (2) panels which are not located within the building. One panel is 300A, 3 phase, 4 wire panel at 208V/120V for panel while the lighting is on a 225A, 3 phase, 4 wire panel at 480V/277V; both are located approximately 275' from the retail building.

The proposed alternative design adds two (2) panels and a transformer. Panel RB-1 is a 480Y/277V panel fed from the main electrical room. Most of the loads associated with this panel are lighting loads; however, there are two (2) types of mechanical equipment and a step-down transformer powered from this panel as well. Panel RB-2 is a 208Y/120V panel fed from the adjacent RB-1 panel and through a 15kVA transformer. Most of the loads associated with this panel are receptacles loads in the retail building.

The alternative system is a positive value engineering suggestion for the project. It provides a cost savings of $8,771.38 in labor and material but most importantly the alternative system will provide the owner better electrical maintenance means during the building lifetime. Furthermore, the ease of expansion within the retail building will be much easier with the alternative system because wires and conduit do not need to be installed 275' away from the source of expansion.

2.0.2 OVERVIEW

As depicted below, the retail store and ticket building is separate from the rest of the structure and will be used during non-operating game times.

Ballpark rendering with the area highlighted which will be analyzed.

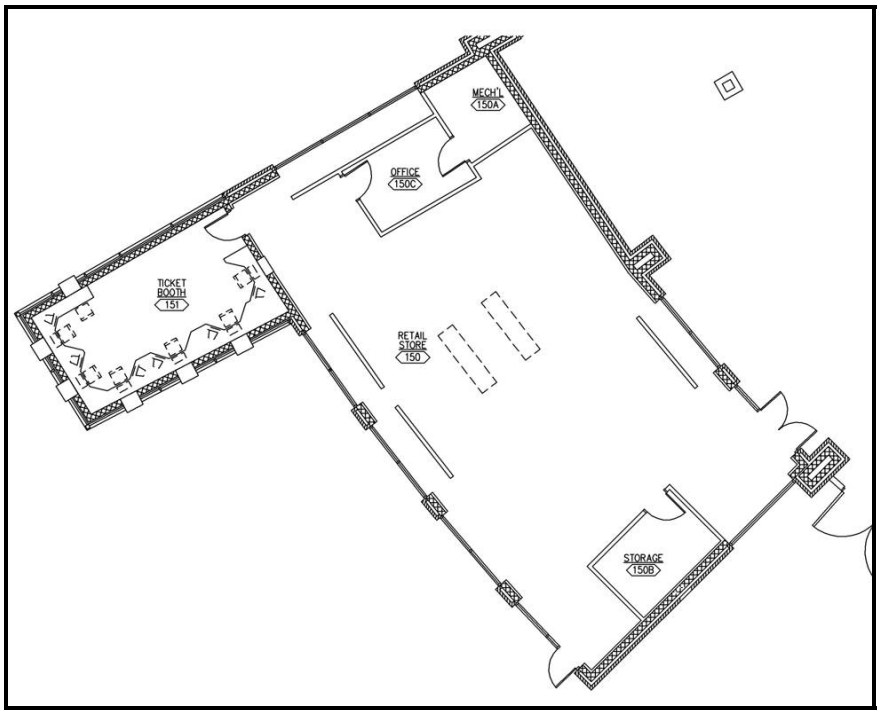
Within the 2000 square foot structure, there is a ticket booth area, a retail store, an office, a small mechanical room, and a storage area. The spaces contain standard electrical equipment devices including light fixtures, wall receptacles, and data outlets. All of the electrical wiring for this area is designed to be run overhead through the canopy structure and into the building. Because there is no underground raceway conduits designed for this area, there is an added labor cost for running all wires through the canopy along with extra material cost for running the wires to the required panel board. Furthermore, by not designing an electrical panel within the building, electrical maintenance could become an issue. If an electrical problem arises, the maintenance crew must find an electrical panel that is not near the retail store and ticket building.

Because of the issues named above, an electrical panel located within the building will be designed. The current panel which is not located within the building is 300A, 3 phase, 4 wire panel at 208V/120V for panel while the lighting is on a 225A, 3 phase, 4 wire panel at 480V/277V. In order to design a new panel, all of the connected loads with the appropriate electrical design factors for lighting,

receptacles, and mechanical equipment will be determined. Underground raceways will be provided to the help minimize the wires that travel through the canopy area. Lastly, before beginning the electrical calculations it is understood that two electrical panels will be required and a step- down transformer will be needed for the electrical receptacles in the area. Furthermore, a cost-benefit analysis between the designed system and the proposed re-design to help determine the value of using an alternative system.

2.0.3 DESIGN CONDITIONS

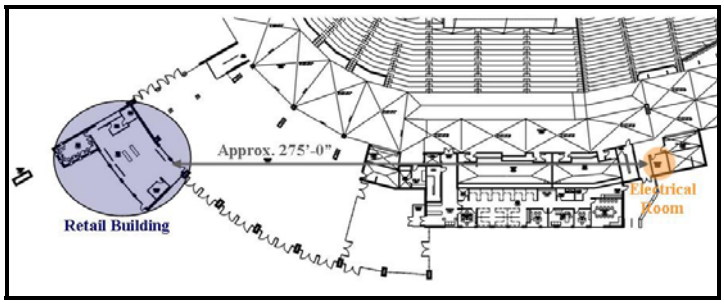
The retail store and ticket building will be operational year round which is much different than the rest of the facility. The main operating times of the stadium will be between March and September which will encompass both the college and minor league baseball seasons. During non-operational times, the stadium will be shutdown except for the retail store / ticket building, the Penn State baseball team offices, and the State College Spikes administration offices which will remain operational year round. Within the retail store and ticket building, there will be standard electrical equipment devices, determined by the client, which will require both 480Y/277V and 208Y/120V power supply.



Plan View of Retail Building (N.T.S.)

2.0.4 DESIGNED SYSTEM

The actual design at the time of the bid had all the electrical devices in the retail building connected to a panel in room 126 approximately 275 feet away. It is important to note that for this analysis fixtures connected to the normal / emergency power were not analyzed during re-design.



Partial Plan View of Concourse Level

In room 126, there is a 480Y/277V panel along with a 208Y/120V panel with the feeders for those panels coming directly from the main electrical room. Per the design, the conduit and wires supplying the retail building would need to be run through the webs of the steel joists in the canopy because underground feeders are not documented for this area on the drawings.

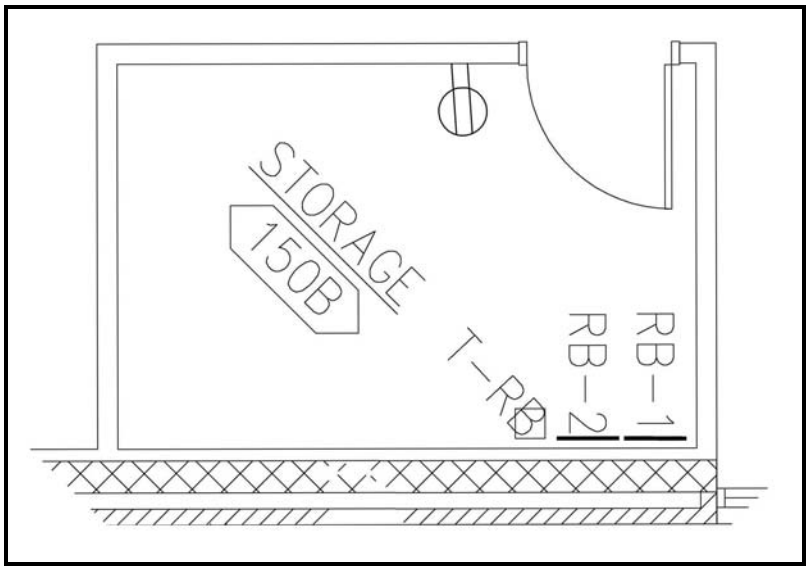
Designed System Components

	Feeder						Circuit Breaker			
Equipment Type	Name	Size	Rating (A)	Ground	Conduit Size	Length (ft)	Feeding	Size (A)	Phase	Voltage
BRANCH CIRCUITS	RB - Power (8)	(3) #12	25	#12	3/4"	275				
BRANCH CIRCUITS	RB - Lighting (3)	(3) #12	25	#12	3/4"	275				
BRANCH CIRCUITS	RB - AHU-3	(3) #12	25	#12	3/4"	275				
BRANCH CIRCUITS	RB - ACCU-3	(3) #8	50	#8	3/4"	275				
CIRCUIT BREAKER							RC1 - Ckt. 17	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 18	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 19	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 20	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 21	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 22	20	1	208Y/120
CIRCUIT BREAKER							RC1 - Ckt. 23	20	1	208Y/120
CIRCUIT BREAKER							MP1 - Ckt. 7,9,11	20	3	480Y/277
CIRCUIT BREAKER							MP2 - Ckt. 56,58,60	30	3	480Y/277
CIRCUIT BREAKER							LP2 - Ckt. 10	20	1	480Y/277
CIRCUIT BREAKER							LP2 - Ckt. 12	20	1	480Y/277

2.0.5 PROPOSED ALTERNATIVE DESIGN

The design of the electrical system with regards to the retail store building is not very accommodating for future maintenance issues the owner may develop. It is important to realize that if there is ever an electrical problem in the retail building that there is not an electrical panel within close proximity to the structure. Furthermore, from an electrical design perspective, the retail building should be viewed as its own structure and should only receive main power from the rest of the facility. Therefore, the proposed re-design adds (2) electrical panels, a 480Y/277 volt and a 208Y/120 volt panel, along with a step-down transformer in the storage room in the retail building (Figure 1). Both of these panels will supply the power necessary to operate the retail building.

Figure 1



Plan View of Storage/Electrical Room 150B with Proposed Electrical Equipment (N.T.S.)

The following tables depict the components associated with the re-designed system. These components included panelboards, feeders, a transformer, and circuit breakers.

Proposed System Components													
	Panelboard							Feeder					
Equipment Type	Name	Load Connected (A)	Rating (A)	# Poles	Spaces	Voltage	Protection (A)	Name	Size	Rating (A)	Ground	Conduit Size	Length (ft)
PANEL	RB-1	50	100	3	24	480Y/120	60						
PANEL	RB-2	19	50	3	24	208Y/120	30						
FEEDER								#3RB1	(4) #4	85	#8	1-1/4"	275
FEEDER								FD - T-RB	(4) #10	35	#8	3/4"	5
FEEDER								FD - RB2	(4) #10	35	#8	3/4"	5

Proposed System Components (Panelboards and Feeders only)

Proposed System Components									
Transformer						Circuit Breaker			
Equipment Type	Name	kVA	Primary Voltage	Secondary Voltage	Type	Feeding	Size (A)	Phase	Voltage
TRANSFORMER	T-RB	15	480Δ	208Y/120	DRY				
CIRCUIT BREAKER						PANEL RB-1	100	3	480Y/277
CIRCUIT BREAKER						T-RB Primary	50	3	480Y/277
CIRCUIT BREAKER						PANEL RB-2	30	3	208Y/120
CIRCUIT BREAKER						RB1 - Ckts. 2,4,6,7,9	20	1	480Y/277
CIRCUIT BREAKER						RB1 - Ckts. 11,13,15	20	3	480Y/277
CIRCUIT BREAKER						RB1- Ckts. 1,3,5,8,10,12	30	3	480Y/277
CIRCUIT BREAKER						RB2 - Ckts. 1,2,3,4,5,6,8,9,12	20	1	208Y/120
CIRCUIT BREAKER						PANEL RC-1	100	3	480Y/277

Proposed System Components (Transformer and Circuit Breakers only)

Below are the designed panels associated with the proposed alternative system. Please consult the *Appendix – Retail Building Electrical Analysis* for larger panel schedules.

Panel RB-1 is a 480Y/277V panel fed from the main electrical room. Most of the loads associated with this panel are lighting loads; however, there are two (2) types of mechanical equipment and a step-down transformer powered from this panel as well.

Panel Schedule

Panel: RB-1

Voltage: 480Y/277			Mains: MLO		Loads (VA)								Loc: STORAGE 150B (Area C)			AIC: 18K	
Amps: 100A	Wires: 4		Phase: 3										Mounting: SURFACE				
Branch Circuit	Amp	P	Description	Ckt	Lig		Recept		Motor		Lg Motor		Equip		Ckt	Description	P	Amp	Branch Circuit
----	----	----	----	1		342	720						1910		2	Lighting Canopy (West)	1	20	3/4"C / 3#12+1#12GRD
3/4"C / 3#10+1#8GRD	30	3	Transformer RB-2	3		216	2520								4	Lighting Ticket Booth	1	20	3/4"C / 3#12+1#12GRD
----	-	-	----	5		363	2700		250						6	Lighting Mech., Office, Stor.	1	20	3/4"C / 3#12+1#12GRD
3/4"C / 3#12+1#12GRD	20	1	Lighting Canopy (East)	7	456						6033				8	----	----	----	----
3/4"C / 3#12+1#12GRD	20	1	Lighting Retail Store	9	810						6033				10	ACCU-3	3	30	3/4"C / 3#8+1#8GRD
----	----	----	----	11					497		6033				12	----	----	----	----
3/4"C / 3#12+1#12GRD	20	3	AHU-3	13					497						14	-	-	-	-
----	----	----	----	15					497						16	-	-	-	-
-	-	-	-	17											18	-	-	-	-
-	-	-	-	19											20	-	-	-	-
-	-	-	-	21											22	-	-	-	-
-	-	-	-	23											24	-	-	-	-
Connected Load Phase A: (A)			36.0			798		720		497		6033.3		1910		Demand Load Phase A: (A)		42.1	
Connected Load Phase B: (A)			36.4			1026		2520		497		6033.3		0		Demand Load Phase B: (A)		42.7	
Connected Load Phase C: (A)			35.5			363		2700		747		6033.3		0		Demand Load Phase C: (A)		41.3	
Total VA:		34950																	
Load: (A)		42.1																	
25% Growth: (A)		52.6																	

Proposed 480Y/277V Panel in Retail Building Storage Room

Panel RB-2 is a 208Y/120V panel fed from the adjacent RB-1 panel and through a 15kVA transformer. Most of the loads associated with this panel are receptacles loads in the retail building.

Panel Schedule

Panel: RB-2

Voltage: 208Y/120			Mains: MCB		Loads (VA)								Loc: STORAGE 150B (Area C)			AIC:	18K
Amps: 50A	Wires: 4		Phase: 3										Mounting: SURFACE				
Branch Circuit	Amp	P	Description	Ckt	Ltg		Recept		Motor		Lg Motor		Equip		Ckt	Description	P	Amp	Branch Circuit
3/4"C / 2#12+1#12GRD	20	1	DP-2	1				720					250		2	Rm. 151 Receptacles	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Rm. 150A/C Receptacles	3			1080	720							4	Rm. 151 Receptacles	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Pressure Switch & Pump	5				360			250				6	Rm. 150 Televisions	1	20	3/4"C / 2#12+1#12GRD
-	20	1	SPARE	7										1680	8	Ticket Window	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Rm. 150 Quad Receptacles	9			720								10	SPARE	1	20	-
-	-	-	-	11				1080							12	Rm. 150 Receptacles	1	20	3/4"C / 2#12+1#12GRD
-	-	-	-	13											14	-	-	-	-
-	-	-	-	15											16	-	-	-	-
-	-	-	-	17											18	-	-	-	-
-	-	-	-	19											20	-	-	-	-
-	-	-	-	21											22	-	-	-	-
-	-	-	-	23											24	-	-	-	-
Connected Load Phase A: (A)			21.9			0		720		0		0		1910	Demand Load Phase A: (A)		21.9		
Connected Load Phase B: (A)			21.0			0		2520		0		0		0	Demand Load Phase B: (A)		21.0		
Connected Load Phase C: (A)			14.1			0		1440		0		250		0	Demand Load Phase C: (A)		14.8		
Total VA:			6903																
Load: (A)			19.2																
25% Growth: (A)			24.0																

Proposed 208Y/120V Panel in Retail Building Storage Room

The following demand factors were used when sizing the panel loads:

Lighting: 1.25
Receptacle (<10kVA): 1.0
Receptacle (>10kVA): 0.5
Motor: 1.0
Large Motor: 1.25
Equipment: 1.0

Electrical Design Assumptions:

- Conduit and conductors were sized at a 75°C THHW temperature rating.
- Junction boxes in ticket booth are connected to final equipment with a sizing of 2A per box.

Voltage Drop Calculations

Feeder	Size	V_{L-N}	Amperage	Length	Factor	V_{drop}	% Vd_{rop}
#3RB1	(4) #4	277	53	275	0.3	4.340	1.57
Branch	#12	120	28	55	1.749	2.722	2.27

Voltage Drop Calculation

Assumptions:

- No voltage drop between 480Y/277V panel and 208Y/120V panel.
- Voltage at in transformer, T-RB, is regulated to 208Y/120V meaning no voltage drop occurs through transformer.
- Original design suffices for ¾" conduit and #12 wire for branch circuits back to panel in P126. Therefore, no voltage drop experienced on designed branch circuits.

Per NEC 2002 Article 215.2.A.4, the wire size of (4) #4 and the branch circuit suffice for a voltage drop required of less than 5% total.

It is important to note that a new main panel is not needed because the overall load on that panel has not changed.

2.0.6 COST ANALYSIS BETWEEN SYSTEMS

Designed System Component Pricing								
Equipment Type	Product Number	Quantity	Material Cost	Total Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
FEEDER (3 #12)	Electrical Supplier	5775	0.30	1732.50	115.5	29.58	3416.49	5148.99
EMT (3/4")	Electrical Supplier	1925	0.90	1732.50	154.0	29.58	4555.32	6287.82
FEEDER (5 #8)	Electrical Supplier	1375	0.20	275.00	16.5	29.58	488.07	763.07
EMT (3/4")	Electrical Supplier	275	0.90	247.50	22.0	29.58	650.76	898.26
FEEDER (5 #12)	Electrical Supplier	1375	0.30	412.50	16.5	29.58	488.07	900.57
EMT (3/4")	Electrical Supplier	275	0.90	247.50	22.0	29.58	650.76	898.26
FEEDER (5 #12)	Electrical Supplier	4125	0.30	1237.50	49.5	29.58	1464.21	2701.71
EMT (3/4")	Electrical Supplier	825	0.90	742.50	66.0	29.58	1952.28	2694.78
CIRCUIT BREAKER (20A - PNL RC1)	QOB120	8	26.50	212.00	1.0	29.58	29.58	241.58
CIRCUIT BREAKER (20A - PNL MP1)	EDB34020	1	754.00	754.00	1.0	29.58	29.58	783.58
CIRCUIT BREAKER (30A - PNL MP2)	EDB34030	1	754.00	754.00	1.0	29.58	29.58	783.58
CIRCUIT BREAKER (20A - PNL LP2)	EDB14020	3	170.00	510.00	1.0	29.58	29.58	539.58
							Total Cost:	$22,641.78

Designed System Component Pricing

Proposed System Component Pricing								
Equipment Type	Product Number	Quantity	Material Cost	Total Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
PANEL RB-1	NQOD424L100CU	1	708.00	708.00	1.0	29.58	29.58	737.58
PANEL RB-1 BOX	MH23	1	75.00	75.00	1.0	29.58	29.58	104.58
PANEL RB-1 COVER	MHC23	1	293.00	293.00	1.0	29.58	29.58	322.58
PANEL RB-1 (60A BREAKER)	FCL34060	1	1206.00	1206.00	1.0	29.58	29.58	1235.58
FEEDER (4 #4)	Electrical Supplier	1200	0.64	768.00	18.0	29.58	532.44	1300.44
FEEDER GROUND (#8)	Electrical Supplier	300	0.20	60.00	0.0	0.0	0.00	60.00
PVC (1 1/4")	Electrical Supplier	300	1.35	405.00	24.0	29.58	709.92	1114.92
CIRCUIT BREAKER (20A - PNL RB1)	EGB14020	5	170.00	850.00	1.0	29.58	29.58	879.58
CIRCUIT BREAKER (30A - PNL RB1)	EGB34030	2	754.00	1508.00	1.0	29.58	29.58	1537.58
CIRCUIT BREAKER (20A - PNL RB1)	EGB34020	1	754.00	754.00	1.0	29.58	29.58	783.58
TRANSFORMER T-RB	15T2F	1	2322.00	2322.00	24.0	29.58	709.92	3031.92
FEEDER (3 #10)	Electrical Supplier	15	0.25	3.75	0.3	29.58	8.87	12.62
FEEDER GROUND (#8)	Electrical Supplier	20	0.20	4.00	0.0	0.0	0.00	4.00
EMT (3/4")	Electrical Supplier	5	0.90	4.50	0.4	29.58	11.83	16.33
PANEL RB-2	NQOD424L50CU	1	708.00	708.00	1.0	29.58	29.58	737.58
PANEL RB-2 BOX	MH23	1	75.00	75.00	1.0	29.58	29.58	104.58
PANEL RB-2 COVER	MHC23	1	293.00	293.00	1.0	29.58	29.58	322.58
PANEL RB-2 (30A BREAKER)	FCL34030	1	1206.00	1206.00	1.0	29.58	29.58	1235.58
FEEDER (4 #10)	Electrical Supplier	20	0.25	5.00	0.3	29.58	8.87	13.87
FEEDER GROUND (#8)	Electrical Supplier	20	0.20	4.00	0.0	0.0	0.00	4.00
EMT (3/4")	Electrical Supplier	5	0.90	4.50	0.4	29.58	11.83	16.33
CIRCUIT BREAKER (20A - PNL RB2)	QOB120	10	26.50	265.00	1.0	29.58	29.58	294.58
							Total Cost:	$13,870.40

Proposed System Component Pricing

Please consult the *Appendix – Retail Building Electrical Analysis* for larger component pricing information.

Pricing Clarifications:

- Material pricing with product numbers were calculated using the SquareD Digest supplied by Schneider Electric.
- Material pricing for wire and conduit was given by a State College area electrical supplier.
- Material quantity for feeders is noted as number of wires and then wire type and multiplied accordingly. Example is FEEDER (4 #4) translates to four, number 4 wires.
- Main feeder is run underground through 1-1/4" PVC conduit. All other braches use EMT conduit.
- Feeder (wire) labor quantity assumes 100 feet of wire will take 2 men, 3 hours to pull and terminate. (data from electrical contractor)

- All wires are pulled at the same time when calculating the labor rate for feeders.
- Conduit labor quantity assumes 100 feet of conduit will take 1 man, 8 hours to install. (data from electrical contractor)
- Labor rate per hour was determined by using the 2006 PA prevailing wage labor rate for an Electrician Class 1 without fringe benefits.
- Conduit labor quantity assumes 100 feet of conduit will take 1 man, 8 hours to install. (data from electrical contractor)
- Transformer labor quantity assumes 2 men, 1 day to lug and set into place, and a second day to make all connections to panels.
- Grounding wire labor quantity include with feeder labor quantity per previous assumption.

The alternative system provides a cost savings of $8,771.38 in labor and material. The material savings is easily noted with the decrease in the amount of wire and conduit used with the proposed system.

2.0.7 PROJECT IMPACTS

As discussed in the cost analysis section, the alternative system provides a cost savings of $8,771.38 and also provides a true worthwhile value engineering suggestion to the owner. Electrical systems often need to be shutdown and it only makes sense to have an electrical panel located in close proximity to the structure. Furthermore, the retail building is one of the few areas in the facility that will be operational year round. If an electrical problem is found in the retail building with the designed system, the maintenance staff would have to enter the stadium and locate the electrical room, P126, a distance of 275' away. By implementing the alternative system, the owner will have all power and lighting loads fed within the retail building. Most importantly, any electrical maintenance occurring within the retail building will not require entrance into the stadium unless the main feeder needs to be shutdown.

The construction of the retail building is the last sequence on the project to be completed and is not on the critical path for final completion. However, the alternative system requires less labor to run multiple feeders to electrical room, P126. An underground raceway will still be required to feed from the main electrical room to storage, 150B, within the retail building; but, there is a significant labor savings by keeping the branch circuits within the retail building. Additionally, there a decrease in coordination with other trades for electrical branch conduits installed through main concourse per original design.

There are no disadvantages found with implementing the alternative system.

Proposed Alternative System	
Advantages	Disadvantages
Cost savings of $8,771.38.	
Ease of electrical system maintenance during owner operation.	
Decrease in amount of conduit and wire needed (labor savings).	
Decrease in coordination with other trades for electrical branch conduits installed through main concourse per original design.	
Ease of expansion.	
Less voltage drop experienced on branch circuits.	

2.0.8 CONCLUSION

The alternative system is a positive value engineering suggestion for the project. It provides a cost savings of $8,771.38 in labor and material but most importantly the alternative system will provide the owner better electrical maintenance means during the building lifetime. Furthermore, the ease of expansion within the retail building will be much easier with the alternative system because wires and conduit do not need to be installed 275' away from the source of expansion.

This analysis is a valuable tool for a construction manager to be able to utilize when providing value engineering suggestion to an owner. An understanding of the cost and benefits to modifying an electrical system can help identify alterations of future projects.

Overall, the alternative system is a very positive electrical value engineering suggestion for the owner and will provide positive effects during the building operation.

Electrical Distribution Analysis for the Retail Store/Ticket Building

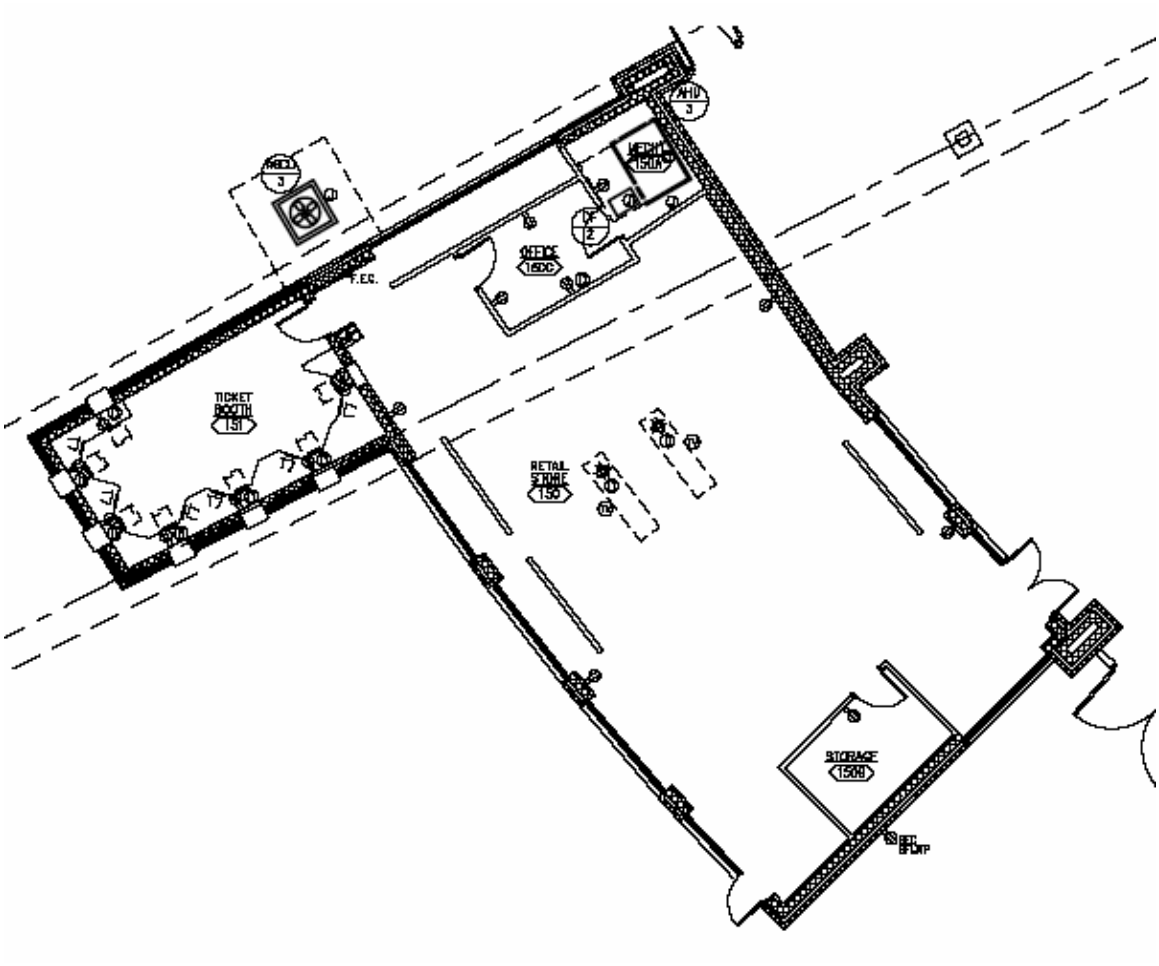
Bettwy, Tim. Personal interview. 24 Jan 2006.

National Electric Code 2005 (2005).

Schneider Electric. “SquareD Digest.” (2003).

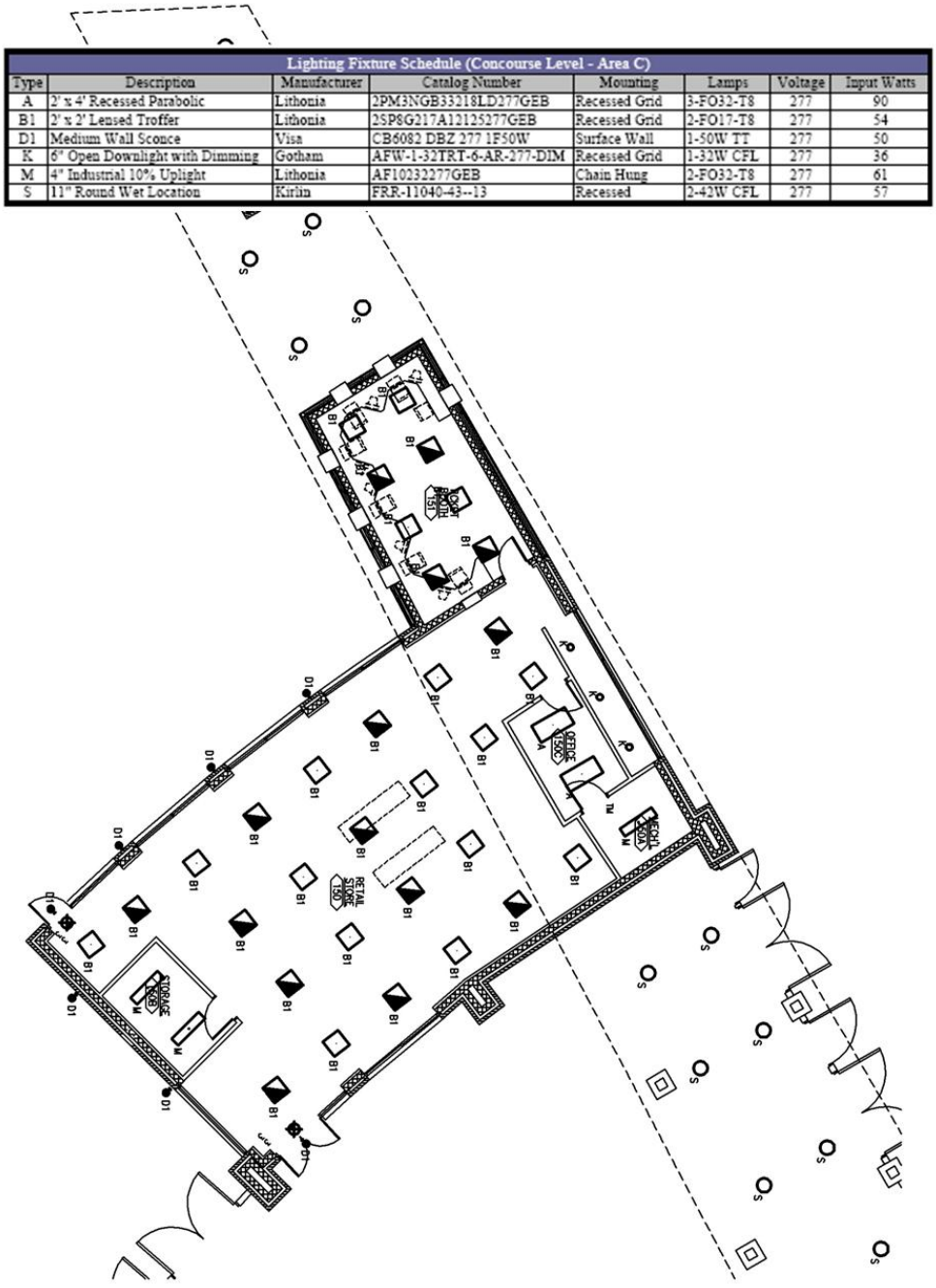
APPENDIX

ELECTRCIAL SUPPLY AT RETAIL BUILDING



Power Plan for Retail Building (Area C)

Lighting Fixture Schedule (Concourse Level - Area C)							
Type	Description	Manufacturer	Catalog Number	Mounting	Lamps	Voltage	Input Watts
A	2' x 4' Recessed Parabolic	Lithonia	2PM3NGB33218LD277GEB	Recessed Grid	3-FO32-T8	277	90
B1	2' x 2' Lensed Troffer	Lithonia	2SP8G217A12125277GEB	Recessed Grid	2-FO17-T8	277	54
D1	Medium Wall Sconce	Visa	CB6082 DBZ 277 1F50W	Surface Wall	1-50W TT	277	50
K	6" Open Downlight with Dimming	Gotham	AFW-1-32TRT-6-AR-277-DIM	Recessed Grid	1-32W CFL	277	36
M	4" Industrial 10% Uplight	Lithonia	AF10232277GEB	Chain Hung	2-FO32-T8	277	61
S	11" Round Wet Location	Kirlin	FRR-11040-43--13	Recessed	2-42W CFL	277	57



Lighting Plan for Retail Building (Area C)

Panel Schedule

Panel: RB-1

Voltage: 480Y/277			Mains: MLO			Loads (VA)					Loc: STORAGE 150B (Area C)			AIC: 18K		
Amps: 100A	Wires: 4		Phase: 3								Mounting: SURFACE					
Branch Circuit	Amp	P	Description	Ckt	Lig	Recept	Motor	Lg Motor	Equip	Ckt	Description	P	Amp	Branch Circuit
----	----	----	---	1	342	720			1910	2	Lighting Canopy (West)	1	20	3/4"C / 3#12+1#12GRD
3/4"C / 3#10+1#8GRD	30	3	Transformer RB-2	3	216	2520				4	Lighting Ticket Booth	1	20	3/4"C / 3#12+1#12GRD
----	-	-	---	5	363	2700	250			6	Lighting Mech., Office, Stor.	1	20	3/4"C / 3#12+1#12GRD
3/4"C / 3#12+1#12GRD	20	1	Lighting Canopy (East)	7	456			6033		8	---	---	---	---
3/4"C / 3#12+1#12GRD	20	1	Lighting Retail Store	9	810			6033		10	ACCU-3	3	30	3/4"C / 3#8+1#8GRD
----	----	----	---	11			497	6033		12	---	---	---	---
3/4"C / 3#12+1#12GRD	20	3	AHU-3	13			497			14	-	-	-	-
----	----	----	---	15			497			16	-	-	-	-
-	-	-	-	17						18	-	-	-	-
-	-	-	-	19						20	-	-	-	-
-	-	-	-	21						22	-	-	-	-
-	-	-	-	23						24	-	-	-	-
Connected Load Phase A: (A)			38.0		798	720	497	6033.3	1910		Demand Load Phase A: (A)		42.1	
Connected Load Phase B: (A)			38.4		1026	2520	497	6033.3	0		Demand Load Phase B: (A)		42.7	
Connected Load Phase C: (A)			35.5		363	2700	747	6033.3	0		Demand Load Phase C: (A)		41.3	
Total VA:			34850											
Load: (A)			42.1											
25% Growth: (A)			52.6											

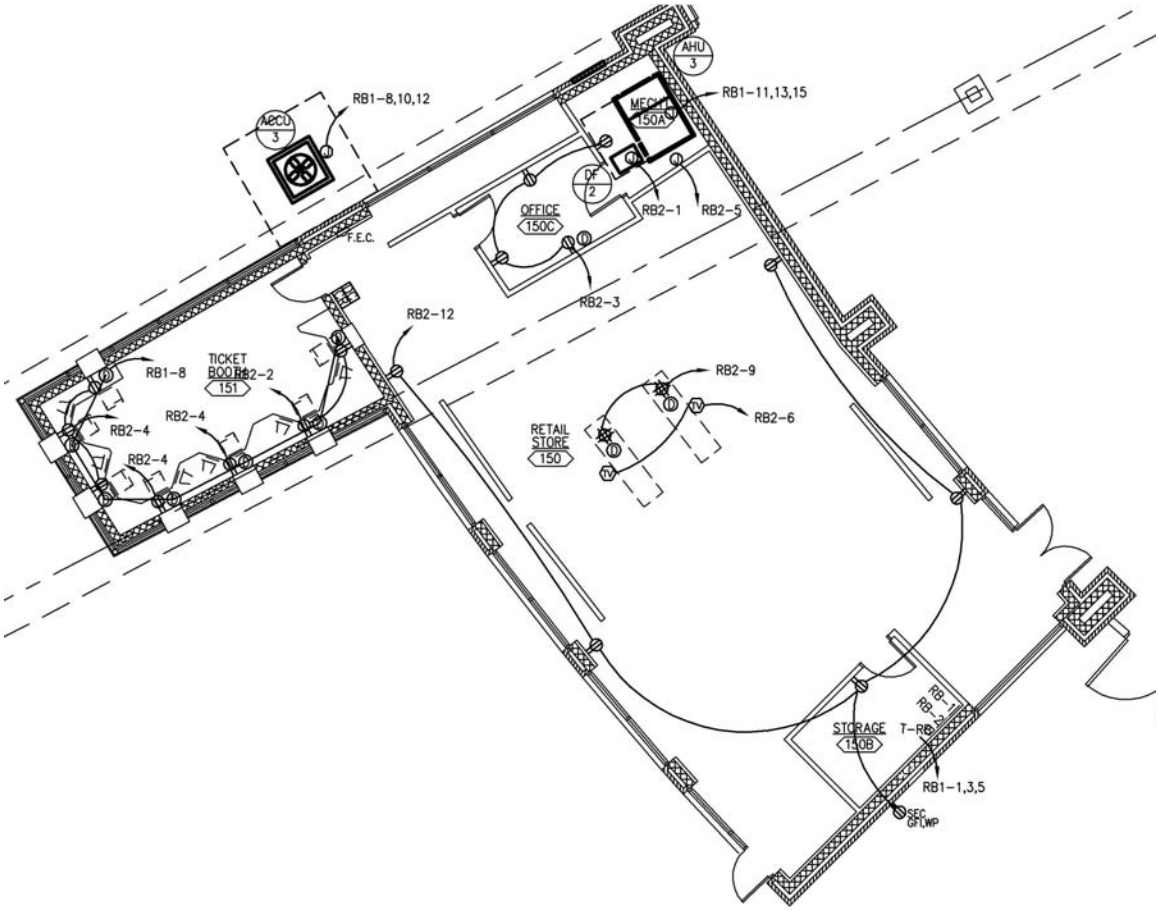
Proposed 480Y/277V Panel in Retail Building Storage Room

Panel Schedule

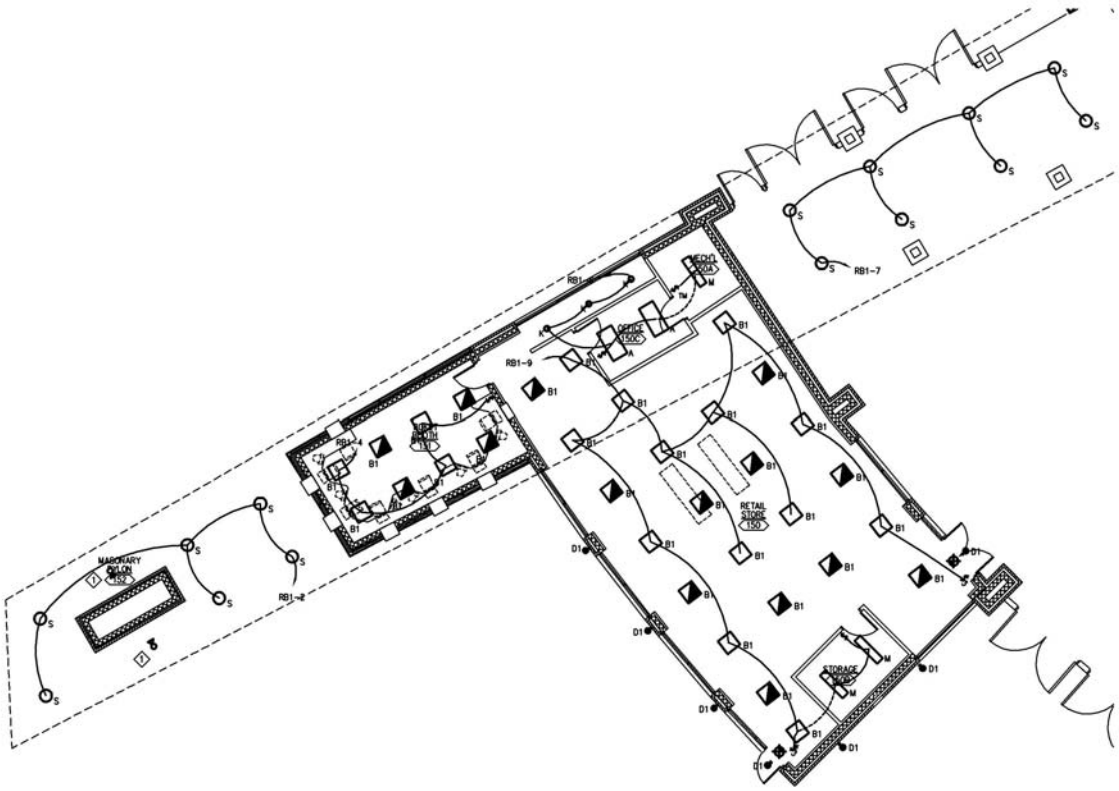
Panel: RB-2

Voltage: 208Y/120			Mains: MCB			Loads (VA)						Loc: STORAGE 150B (Area C)			AIC:	18K	
Amps: 50A	Wires: 4		Phase: 3									Mounting: SURFACE					
Branch Circuit	Amp	P	Description	Cir	Ltg	Recept	Motor	Lg Motor	Equip	Cir	Description	P	Amp	Branch Circuit
3/4"C / 2#12+1#12GRD	20	1	DF-2	1		720			230	2	Rm. 161 Receptacles	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Rm. 150A/C Receptacles	3		720				4	Rm. 161 Receptacles	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Pressure Switch & Pump	5		360		250		6	Rm. 160 Televisions	1	20	3/4"C / 2#12+1#12GRD
-	20	1	SPARE	7					1680	8	Ticket Window	1	20	3/4"C / 2#12+1#12GRD
3/4"C / 2#12+1#12GRD	20	1	Rm. 150 Quad Receptacles	9		720				10	SPARE	1	20	-
-	-	-	-	11		1080				12	Rm. 160 Receptacles	1	20	3/4"C / 2#12+1#12GRD
-	-	-	-	13						14	-	-	-	-
-	-	-	-	15						16	-	-	-	-
-	-	-	-	17						18	-	-	-	-
-	-	-	-	19						20	-	-	-	-
-	-	-	-	21						22	-	-	-	-
-	-	-	-	23						24	-	-	-	-
Connected Load Phase A: (A)		21.9			0	720	0	0	1910	Demand Load Phase A: (A)		21.9		
Connected Load Phase B: (A)		21.0			0	2520	0	0	0	Demand Load Phase B: (A)		21.0		
Connected Load Phase C: (A)		14.1			0	1440	0	250	0	Demand Load Phase C: (A)		14.6		
Total VA:		6903												
Load: (A)		19.2												
25% Growth: (A)		24.0												

Proposed 208Y/120V Panel in Retail Building Storage Room



Proposed Power Circuiting Plan for Retail Building (Area C)



Proposed Lighting Circuiting Plan for Retail Building (Area C)

Designed System Component Pricing								
Equipment Type	Product Number	Quantity	Material Cost	Total Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
FEEDER (3 #12)	Electrical Supplier	5775	0.30	1732.50	115.5	29.58	3416.49	5148.99
EMT (3/4")	Electrical Supplier	1925	0.90	1732.50	154.0	29.58	4555.32	6287.82
FEEDER (5 #8)	Electrical Supplier	1375	0.20	275.00	16.5	29.58	488.07	763.07
EMT (3/4")	Electrical Supplier	275	0.90	247.50	22.0	29.58	650.76	898.26
FEEDER (5 #12)	Electrical Supplier	1375	0.30	412.50	16.5	29.58	488.07	900.57
EMT (3/4")	Electrical Supplier	275	0.90	247.50	22.0	29.58	650.76	898.26
FEEDER (5 #12)	Electrical Supplier	4125	0.30	1237.50	49.5	29.58	1464.21	2701.71
EMT (3/4")	Electrical Supplier	825	0.90	742.50	66.0	29.58	1952.28	2694.78
CIRCUIT BREAKER (20A - PNL RC1)	QOB120	8	26.50	212.00	1.0	29.58	29.58	241.58
CIRCUIT BREAKER (20A - PNL MP1)	EDB34020	1	754.00	754.00	1.0	29.58	29.58	783.58
CIRCUIT BREAKER (30A - PNL MP2)	EDB34030	1	754.00	754.00	1.0	29.58	29.58	783.58
CIRCUIT BREAKER (20A - PNL LP2)	EDB14020	3	170.00	510.00	1.0	29.58	29.58	539.58
							Total Cost:	$22,641.78

Designed System Component Pricing

Proposed System Component Pricing								
Equipment Type	**Product Number**	**Quantity**	**Material Cost**	**Total Material Cost**	**Labor Quantity**	**Labor Cost ($/hr)**	**Total Labor Cost**	**Total Cost**
PANEL RB-1	NQOD424L100CU	1	708.00	708.00	1.0	29.58	29.58	737.58
PANEL RB-1 BOX	MH23	1	75.00	75.00	1.0	29.58	29.58	104.58
PANEL RB-1 COVER	MHC23	1	293.00	293.00	1.0	29.58	29.58	322.58
PANEL RB-1 (60A BREAKER)	FCL34060	1	1206.00	1206.00	1.0	29.58	29.58	1235.58
FEEDER (4 #4)	Electrical Supplier	1200	0.64	768.00	18.0	29.58	532.44	1300.44
FEEDER GROUND (#8)	Electrical Supplier	300	0.20	60.00	0.0	0.0	0.00	60.00
PVC (1 1/4")	Electrical Supplier	300	1.35	405.00	24.0	29.58	709.92	1114.92
CIRCUIT BREAKER (20A - PNL RB1)	EGB14020	5	170.00	850.00	1.0	29.58	29.58	879.58
CIRCUIT BREAKER (30A - PNL RB1)	EGB34030	2	754.00	1508.00	1.0	29.58	29.58	1537.58
CIRCUIT BREAKER (20A - PNL RB1)	EGB34020	1	754.00	754.00	1.0	29.58	29.58	783.58
TRANSFORMER T-RB	15T2F	1	2322.00	2322.00	24.0	29.58	709.92	3031.92
FEEDER (3 #10)	Electrical Supplier	15	0.25	3.75	0.3	29.58	8.87	12.62
FEEDER GROUND (#8)	Electrical Supplier	20	0.20	4.00	0.0	0.0	0.00	4.00
EMT (3/4")	Electrical Supplier	5	0.90	4.50	0.4	29.58	11.83	16.33
PANEL RB-2	NQOD424L50CU	1	708.00	708.00	1.0	29.58	29.58	737.58
PANEL RB-2 BOX	MH23	1	75.00	75.00	1.0	29.58	29.58	104.58
PANEL RB-2 COVER	MHC23	1	293.00	293.00	1.0	29.58	29.58	322.58
PANEL RB-2 (30A BREAKER)	FCL34030	1	1206.00	1206.00	1.0	29.58	29.58	1235.58
FEEDER (4 #10)	Electrical Supplier	20	0.25	5.00	0.3	29.58	8.87	13.87
FEEDER GROUND (#8)	Electrical Supplier	20	0.20	4.00	0.0	0.0	0.00	4.00
EMT (3/4")	Electrical Supplier	5	0.90	4.50	0.4	29.58	11.83	16.33
CIRCUIT BREAKER (20A - PNL RB2)	QOB120	10	26.50	265.00	1.0	29.58	29.58	294.58
							Total Cost:	**$13,870.40**

Proposed System Component Pricing