SUSQUEHANNA CENTER

HARFORD COMMUNITY COLLEGE 401 THOMAS RUN ROAD BEL AIR, MD

MARCUS NG LIGHTING & ELECTRICAL OPTION

http://engr.psu.edu/ae/thesis/portfolios/2013/nyn5021/index.html

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EXECUTIVE SUMMARY

The following report provides a detailed analysis and narrative describing the scope of the electrical requirements and systems in the Susquehanna Center. The Susquehanna Center is a 106,955 SF two story athletic facility located in 401 Thomas Run Road, Bel Air, Maryland. The expansion of the project produces an 18,270 SF arena which can house up to 2,552 occupants. The multi-purpose space can also be used for various academic activities, such as, concerts and exhibitions. The building also includes a gymnasium, fitness center, dance and exercise studios, a swimming pool, and offices for faculty and staff. Due to the variety of tasks performed, the electrical distribution system was specifically designed to accommodate such requirements.

This report will consist of three sections. SECTION I will focus on the development of the electrical systems criteria and scope of work. SECTION II provides an in-depth description and understanding of the electrical systems as currently designed. Lastly, SECTION III will include a comparison of the differences and similarities discussed in the first two sections, with additional potential suggestions to any changes made in the design.

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SECTION I

PRELIMINARY LOAD CALCULATION

In order to develop the electrical systems criteria, it is important to first perform a preliminary load calculation on the building. A preliminary load calculation is important in determining the service entrance size, as well as all other electrical systems that are connected.

The first method of conducting a preliminary load calculation is based on the building type. Different building types have specific load and VA/SF requirements.

Area: 106,955 SF
Schools – 13 VA/SF

106,955 SF x 13 VA/SF = 1,390,415 VA or 1390.415 kVA, 480Y/277V 3PH 4W

(1390.415 kVA x 1000) / [√(3) x 480V] = 1672 A

The second method of conducting a preliminary load calculation requires an analysis of the different electrical systems and equipment in the building, separated into lighting, receptacle, HVAC, and special equipment.

General lighting: schools – 3 VA/SF
Receptacle – 1 VA/SF
HVAC: Exhaust fans – 2 VA/SF
Fossil fuel heating – 4 VA/SF
Cooling – 8 VA/SF

Special equipment and other: Elevator – 50 kVA

Demand factor: 1.25

Total VA/SF – 3 +1+2+4+8 = 18 VA/SF

18 VA/SF x 106,955 SF = 1,925,190 VA + 50 KVA = 1975 kVA

1975 kVA x 1.25 = 2468.75 kVA

(2468.75 kVA x 1000) / [√(3) x 480V] = 2969 A

POWER UTILITY COMPANY

The power utility company serving the building location of the Susquehanna Center is Baltimore Gas and Electric (BGE). BGE is a subsidiary of Exelon Corporation, and serves more than 1.2 million electric customers and more than 650,000 gas customers in all or part of 10 Central Maryland counties. For more information, please visit: http://www.bge.com

PRELIMINARY RATE SCHEDULE / SERVICE VOLTAGE

BGE provides a wide selection of electric rate schedules and is separated into residential rates and commercial, industrial, and lighting rates. Each rate schedule is utilized for different purposes, and is determined according to the power consumption, measured in kW. The most appropriate electrical rate schedule to be utilized by the Susquehanna Center is Rate Schedule GL (see attached Rate Schedule GL). In general, Rate Schedule GL is normally used for a large electric service assuming a monthly demand of 60kW or more.

Service voltage provided by the utility company will be at 480Y/277V, 3PH, 4W, and will be fed to a pad-mounted transformer that will adjust the service voltage to the required voltage most appropriate to the connected electrical systems in the building.

PRELIMINARY BUILDING UTILIZATION VOLTAGE

Lighting, receptacle, mechanical and other equipment in the building generally require different utilization voltages. It is important to select the most appropriate utilization voltage serving such electrical systems. In some cases, it is quite easy to select a utilization voltage, which can be determined by what the equipment is rated at. The following provides a preliminary building utilization voltage for each the following electrical systems.

LIGHTING – according to the lighting fixture schedule in drawing E0.01, all lighting equipment will be served at 277V.

RECEPTACLE – there will be selection options for the utilization voltage for receptacle loads. All receptacle loads will be served at 120V.

MECHANICAL – depending on the size and type of the mechanical equipment, mechanical loads may be served with either 208V 3PH or 480V 3PH.

SPECIAL EQUIPMENT – the only special equipment installed in the Susquehanna Center is the photovoltaic array located on the roof of the building. The installation aims to be help cut down electric power consumption by generating power through solar energy. The photovoltaic array will be served at 208V 3PH.

EMERGENCY POWER REQUIREMENTS

Emergency power requirements are governed by the *2006 International Building Code (IBC),* and are based on the building use and occupancy type of the facility. The Susquehanna Center is classified into the A-3, A-4 category of occupancy type. The description of the respective occupancy type is as follows:

A-3: assembly uses intended for the worship, recreation or amusement: gymnasiums, indoor swimming pools and lecture halls.

A-4: assembly uses intended for viewing of indoor sports events and activities with spectator seating: arenas, swimming pools, and tennis courts.

Additionally, the Susquehanna Center is also classified as a covered mall building. *Section 402.13 Standby Power* states that covered mall buildings exceeding 50,000 square feet shall be provided with standby power systems that are capable of operating the emergency voice/alarm communication system, and shall be accessible to the fire department.

Standby power fuel source can be found from the electrical riser diagram in drawing E5.01 of the project. The emergency generator will be a 60 kW, 75 kVA, 480/277V, 3PH, 4W, diesel fueled generator.

POTENTIAL SPECIAL OCCUPANCY REQUIREMENTS

In consideration of the various activities and tasks performed in the Susquehanna Center, it is important to address any special occupancy requirements that can affect the design of the electrical distribution system. The following requirements are based on *Chapter 5* of the *2011 National Electric Code (2011 NEC)*.

HEALTH CARE FACILITIES: X-RAY INSTALLATIONS – X-ray equipment may be installed to provide injured basketball and volleyball players a preliminary X-ray examination before further treatment is conducted.

ASSEMBLY OCCUPANCIES – according to *ARTICLE 518* in *Chapter 5* of the *2011 NEC,* assembly occupancies are 'buildings or portions of building or structures designed or intended for the gathering together of 100 or more persons for such purposes as deliberation, worship, **entertainment**, eating, drinking, amusement, awaiting transportation, or similar purposes'. The Susquehanna Center can be considered an assembly occupancy building due to the various activities performed going on in the building.

POTENTIAL SPECIAL EQUIPMENT

Although the photovoltaic array system is the only identified special equipment in the building, there may be other potential special equipment that needs to be considered. The following requirements are based on *Chapter 6* of the *2011 National Electric Code (2011 NEC)*.

ELEVATORS & STAIRWAY CHAIRLIFTS – elevators and stairway chairlifts are important circulation equipment that can help people, especially the disabled to get from one level of the building to another.

SWIMMING POOLS – the indoor swimming pool located the main level of the building can be considered a potential special equipment.

PRIORITY ASSESSMENT

An evaluation of a building's functionality and performance is usually determined by several important factors that are specific to the occupancy and usage of a building. Since the Susquehanna Center is primarily used for entertainment, sports and recreation, certain characteristics may be more important than others.

RELIABILITY (HIGH) – the reliability of the electrical system is crucial in providing a high quality environment that meets the demands of the spaces in the building as well as the thermal comfort of the occupants. The electrical system should be reliable in terms of its efficiency and should not break down frequently, which can lead to long term ownership cost due to maintenance.

POWER QUALITY (HIGH) – although providing electrical equipment with efficient power is deemed necessary, power quality also plays a major role in making sure that that the entire electrical system is operating at its optimum level. Therefore, power quality and reliability will need to be analyzed carefully so that they are well balanced.

REDUNDANCY (HIGH) – in situations where power outages occur, most if not all buildings will generally have some sort of emergency back-up generator and/or UPS system that will provide the necessary loads to make sure the operation of the building and its occupants are not affected. Therefore, it is critical to include redundancy equipment that will prevent any damages or losses, such as, corruption of data systems from happening.

INITIAL COST (LOW) – most owners would prefer their project to have a low initial cost as possible. However, it is also important to consider all the costs that go into buying and installing electrical equipment. As mentioned before, reliability and power quality are critical for this project, the owner must carefully consider and balance the importance between a low initial cost while also providing a relatively reliable and high quality electrical distribution system.

LONG TERM OWNERSHIP COST (MEDIUM) – long term ownership costs mainly come from the costs of maintaining a building. If something breaks down, it is important to act on it and have the issue fixed as soon as possible before any further damage is done. An overall high quality system will prevent the need for frequent maintenance which can increase costs in the long run.

FLEXIBILITY (MEDIUM) – a multipurpose space like the Susquehanna Center requires that the electrical distribution system be fairly flexible and adjustable to serve different activities and occasions. For instance, power consumption on a basketball game day would be higher than a regular day when occupancy is medium to low.

OPTIONAL BACK-UP POWER

Emergency power can be provided by two options. The first option utilizes an emergency back-up generator which is ideal for long term power outages, where the equipment does not necessarily require the need for instant back-up power. The second option implements an uninterrupted power supply (UPS) system which serves equipment that can be affected by short term power outages. In general, a building will usually incorporate both options to provide redundancy and mainly because it will have equipment that will need a back-up generator and UPS systems. It is important to note that date storage systems and computers will usually be served with UPS systems to prevent any corruption or loss of data.

Lighting, elevator, pumps and fire alarm loads should incorporate a back-up generator, and can utilize a UPS system as well, but it is usually not necessary. These equipment generally not severely affected by power outages and may need to operate for longer hours during power outages for circulation, guidance and safety purposes.

Telecommunication systems should be served with a UPS system as potentially important communications should not be interrupted.

POTENTIAL COMMUNICATIONS SYSTEMS

TELEPHONE / DATA – telephone systems may be installed in the building to provide regular and emergency communication activities. Data systems such as data storage equipment and computers are used for the communication, transfer and processing of information and data.

FIRE ALARM – according to the *Section 907 FIRE ALARM AND DETECTION SYSTEMS of the 2006 IBC,* an approved manual, automatic or manual and automatic fire alarm system should be installed.

- A manual fire alarm system shall be installed in Group A occupancies with an occupant load of 300 or more.
- If the occupant load is 1,000 or more, an activation of the fire alarm shall initiate a signal using emergency voice/alarm communications systems in accordance with NFPA72.
- Audible alarm notification shall be installed and produce a distinctive sound that is not to be used for any purpose other than that of a fire alarm. The system shall provide a sound pressure level of 15 decibels

above the average ambient sound level or 5 decibels above the maximum sound level having a duration of at least 60 seconds.
- Automatic fire detectors shall be connected to the building's fire alarm control panel where a fire alarm system is required. Detectors shall, upon activation, perform the intended function and activate the alarm notification appliances or a visible and audible supervisory signal at a constantly attended location.
- Duct smoke detectors shall be connected to the building's fire alarm control panel when a fire alarm system is provided.
- Automatic fire-extinguishing systems shall be connected to the building fire alarm system where a fire alarm system is required.

CATV – cable television service equipment may be installed to provide occupants with a wide variety of television channels for up to date news on the general public such as politics and weather forecasts.

OVERHEAD PAGING / INTERCOM – public announcements throughout the campus and inside the Susquehanna Center can be made via overhead paging or intercom systems.

ACCESS CONTROL SYSTEM – card access into the building is appropriate to provide safety to occupants, faculty and staff. Access control systems can be made adjustable so that it only operates during certain times of the day. For instance, when the building is closed to the public at night, card access control can be used by faculty and staff.

SECURITY – intrusion detection and video surveillance cameras should be installed throughout the building and operated 24 hours a day for maximum security measures.

MAJOR EQUIPMENT

There is no major equipment in the building that will require additional space in the building.

SECTION II

ACTUAL CONNECTED BUILDING LOADS

Building connected loads are categorically separated and distributed amongst the various electrical, lighting, and mechanical systems in the building. The following provides the calculated connected building loads.

TOTAL CONNECTED LOAD

VOLTAGE: 480Y/277V 3PH 4W

		CIRCUIT BREAKER			WIRING					
CKT NO	SERVES	P	FRAME	TRIP	SETS	NO.	SIZE	GW	C	LOAD (KVA)
1A	INCOMING CT/BGE METER	-	-	-						
2A	MAIN CB - SUSQUEHANNA	3	2400A	2400A						
2B	MAIN CB - CHESAPEAKE	3	1200A	1200A	3	4	600 MCM	#3/0	3 1/2"	500
3A	AUX - METERING	3	-	-						
4A	AIR COOLED CHILLER	3	800A	600A						354
4B	RTU #5	3	225A	200A						142
4C	RTU #6	3	225A	200A						142
4D	RTU #7	3	225A	200A						142
4E	RTU #8	3	225A	200A						142
4F	DHU #1	3	100A	100A						60
4G	PANEL 'MLP'	3	600A	600A	2	4	350 MCM	#1	3"	402
4H	PANEL 'LPA'	3	225A	225A	1	4	#4/0	#4	2 1/2"	155
4I	PANEL 'LPB'	3	225A	225A	1	4	#4/0	#4	2 1/2"	115
4J	PANEL 'ARP' XFMR	3	400A	400A	1	3	600 MCM	#3	3 1/2"	237
4K	SPACE	3	400A	-						
4L	PANEL 'SLP'	3	100A	100A	1	4	#3	#8	1 1/4"	55
4M	PANEL 'SITE'	3	225A	225A	1	4	#4/0	#4	2 1/2"	99
4N	PANEL 'ELP'	3	225A	125A	1	4	#1	#6	1 1/2"	80
4O	SPACE	3	225A	-						
4P	SPACE	3	225A	-						
										2624KVA
							TOTAL CONNECTED LOAD:			3160A

FIGURE 1. BUILDING TOTAL CONNECTED LOAD

PANEL ARP VOLTAGE: 208Y/120V 3PH 4W

		CIRCUIT BREAKER			WIRING					
CKT NO	SERVES	P	FRAME	TRIP	SETS	NO.	SIZE	GW	C	LOAD (KVA)
1	STAGE DISCONNECT	3	225A	225A	1	4	#4/0	#4	2 1/2"	48
2	STAGE DISCONNECT	3	225A	225A	1	4	#4/0	#4	2 1/2"	48
3	STAGE DISCONNECT	3	225A	225A	1	4	#4/0	#4	2 1/2"	48
4	STAGE DISCONNECT	3	400A	400A	1	4	600 MCM	#3	3 1/2"	86
5	STAGE DISCONNECT	3	100A	100A	1	4	#3	#8	1 1/4'	-
6	SCOREBOARD LOAD CENTER	2	100A	20A	1	3	#3	#8	1 1/4"	3
7	SOCCER LOAD CENTER	2	100A	30A	1	3	#2/0	#6	2"	4
										237KVA
							TOTAL CONNECTED LOAD			659A

FIGURE 2. DISTRIBUTION PANEL BOARD CONNECTED LOAD

LIGHTING CONNECTED LOADS

PANEL ELP VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	L: MAIN EMERG WEST	1.5			1	20	1	20	1.6			L: LOWER EMERG	2
3	L: MAIN EMERG		1.5		1	20	1	20		0.3		ELEVATOR PIT: 003	4
5	L: EMERG 124, 142, 146 & 147			2.4	1	20	1	20			2	L: TYPE 'Y'	6
7	L: EMERG MAIN	2.4			1	20							
9	L: EXTERIOR		0.6		1	20							
		3.9	2.1	2.4	SUBTOTAL				1.6	0.3	2		

CONNECTED LOAD:	
A:	5.5KVA = 20A
B:	2.4KVA = 9A
C:	4.4KVA = 16A

FIGURE 3. PANEL ELP LIGHTING CONNECTED LOAD

PANEL LPA VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	L: 137, 38, 57-59 N TOILETS	2.3			1	20	1	20	1.7			L: FITNESS	2
3	L: CORRI 150		2.1		1	20	1	20		2.8		L: FITNESS & OFFICES	4
5	L: CORRI 152			1.7	1	20	1	20			1.3	L: FITNESS DL	6
7	L: CORRI 152 & 56	2.7			1	20	1	20		2.8		L: MULTI # 1&2	10
9	L: 148		1.5		1	20	1	20	0.4			L: EXT. BY SAIL	14
11	L: AUX GYM			3.6	1	20	1	20		3.2		L: NE OFFICES	16
13	L: AUX GYM	3.6			1	20	1	20			2.8	L: 109, 112 & 113	18
15	L: 114		0.8		1	20							
		8.6	4.4	5.3	SUBTOTAL				2.1	8.8	4.1		

CONNECTED LOAD:	
A:	10.7KVA = 39A
B:	13.2KVA = 48A
C:	9.4KVA = 34A

FIGURE 4. PANEL LPA LIGHTING CONNECTED LOAD

PANEL LPB VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	L: ARENA COURT	2.7			1	20	1	20	2.4			L: ARENA / THEATER	2
3	L: ARENA COURT		2.7		1	20	1	20		1.2		L: ARENA SEAT	4
5	L: ARENA COURT			2.7	1	20	1	20			1.5	L: ARENA SEAT	6
7	L: ARENA COURT	2.7			1	20	1	20	1			L: ARENA SEAT	8
9	L: ARENA COURT		2.7		1	20	1	20		0.8		L: ARENA SEAT	10
11	L: ARENA COURT			2.7	1	20	1	20			1	L: ARENA SEAT	12
13	L: ARENA COURT	2.7			1	20	1	20	0.8			L: ARENA SEAT	14
15	L: ARENA COURT		2.7		1	20	1	20		1		L: ARENA SEAT	16
17	L: ARENA COURT			2.7	1	20	1	20			0.8	L: ARENA SEAT	18
19	L: ARENA COURT	2.7			1	20	1	20	1			L: ARENA SEAT	20
21	L: ARENA DOWNLIGHT		0.4		1	20	1	20		0.8		L: ARENA SEAT	22
23	L: LOWER ENTRANCES			1.2	1	20	1	20			0.7	L: ARENA SEAT	24
25	L: TOILETS UPPER LEVEL	1.8			1	20	1	20	0.7			L: ARENA SEAT	26
27	L: TOILETS LOWER LEVEL		1.8		1	20	1	20		1.7		L: ARENA SEAT	28
29	L: 010 & 011			1.2	1	20	1	20			1.7	L: ARENA SEAT	30
31	L: TOILETS LOWER LEVEL	2			1	20	1	20	1.1			L: ARENA SEAT	32
33	L: CORRIDOR 116		2		1	20	1	20		1		L: ARENA SEAT	34
							1	20			1.3	L: CONCESSION	36
							1	20	0.6			L: UPPER ENTRANCES	38
							1	20		2.6		L: WALL LIGHTING	40
							1	20			0.6	L: STAIRS NW & SW	42
		14.6	12.3	10.5	SUBTOTAL				7.6	9.1	7.6		

CONNECTED LOAD:	
A:	22.2KVA = 80A
B:	21.4KVA = 77A
C:	18.1KVA = 65A

FIGURE 5. PANEL LPB LIGHTING CONNECTED LOAD

PANEL LPC VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
							1	20	1.7			L: 115 - 118	16
							1	20		3.1		L: POOL LOCKERS & OFFICES	18
					SUBTOTAL				1.7	3.1	-		

CONNECTED LOAD:	
A:	1.7KVA = 6A
B:	3.1KVA = 11A
C:	-

FIGURE 6. PANEL LPC LIGHTING CONNECTED LOAD

PANEL RPA VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
							1	20		1.2		EXTERIOR SAIL LTG	58
							1	20			1.2	EXTERIOR SAIL LTG	60
					SUBTOTAL				-	1.2	1.2		

CONNECTED LOAD:	
A:	-
B:	1.2KVA = 10A
C:	1.2KVA = 10A

FIGURE 7. PANEL RPA LIGHTING CONNECTED LOAD

PANEL SLP VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
							1	20	2.9			L: POOL AREA	20
							1	20		2.9		L: POOL AREA	22
							1	20	2.1			L: W. TOILETS & 012	26
							1	20		-		L: 004	28
							1	20			-	L: 001, 002, 012	30
					SUBTOTAL				5	2.9	-		

CONNECTED LOAD:	
A:	5KVA = 18A
B:	2.9KVA = 10A
C:	-

FIGURE 8. PANEL SLP LIGHTING CONNECTED LOAD

PANEL SRP VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
9	POOL LIGHTING		1		1	20							
11	POOL LIGHTING			1	1	20							
13	POOL LIGHTING	1			1	20							
15	POOL LIGHTING		1		1	20							
		1	2	1	SUBTOTAL								

CONNECTED LOAD:	
A:	1KVA = 8A
B:	2KVA = 17A
C:	1KVA = 8A

FIGURE 9. PANEL SRP LIGHTING CONNECTED LOAD

PANEL SITE VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
							1	20	1.8			SITE LIGHTING	2
							1	20		1.8		SITE LIGHTING	4
							1	20			1.8	SITE LIGHTING	6
							1	20	2			SITE LIGHTING	8
							1	20		2		SITE LIGHTING	10
							1	20			2.7	SITE LIGHTING	12
							1	20	2.4			SITE LIGHTING	14
							1	20		0.5		SITE LIGHTING	16
							1	20	1.2			'SAIL' LIGHTING	38
							1	20		1.2		'SAIL' LIGHTING	40
							1	20			0.4	CANOPY LIGHTING	42
							1	20	1.8			SOFFIT LIGHTING	44
							1	20		1.5		SOFFIT LIGHTING	46
							1	20			0.4	ENTRANCE (2)	48
					SUBTOTAL				9.2	7	5.3		

CONNECTED LOAD:	
A:	9.2KVA = 33A
B:	7KVA = 25A
C:	5.3KVA = 19A

FIGURE 10. PANEL SITE LIGHTING CONNECTED LOAD

RECEPTACLE CONNECTED LOADS

PANEL ERP VOLTAGE: 280Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	R: EXTERIOR & 138	0.4			1	20	1	20		0.4		R: TELECOM	4
3	R: TELECOM UPS		1.5		2	30	1	20			0.4	R: SECURITY	6
5	------			1.5	-	-	1	20	0.4			R: SECURITY	8
11	GEN. BATT CHARGER			0.5	1	20							
17	GEN. JACKET HEATER			1.5	2	20							
19	------	1.5			-	-							
		1.9	1.5	3.5	SUBTOTAL				0.4	0.4	0.4		

CONNECTED LOAD:	
A:	2.3KVA = 19A
B:	1.9KVA = 16A
C:	3.9KVA = 33A

FIGURE 11. PANEL ERP RECEPTACLE CONNECTED LOAD

PANEL ERPA VOLTAGE: 280Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
9	R: TELECOM UPS		1.5		2	30	1	20		0.4		R: TELECOM	10
11	------			1.5	-	-	1	20			0.4	R: TELECOM	12
13	R: TELECOM UPS	1.5			2	30	1	20	0.4			R: TELECOM	14
15	------		1.5		-	-							
		1.5	3	1.5	SUBTOTAL				0.4	0.4	0.4		

CONNECTED LOAD:	
A:	1.9KVA = 16A
B:	3.4KVA = 28A
C:	1.9KVA = 16A

FIGURE 12. PANEL ERPA RECEPTACLE CONNECTED LOAD

PANEL LPC VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	WASHER	1.7			3	20	3	20	1.8			DRYER	2
3	-----		1.7		-	-	-	-		1.8		-----	4
5	-----			1.7	-	-	-	-			1.8	-----	6
7	WASHER	1.7			3	20	3	20	1.8			DRYER	8
9	-----		1.7		-	-	-	-		1.8		-----	10
11	-----			1.7	-	-	-	-			1.8	-----	12
		3.4	3.4	3.4	SUBTOTAL				3.6	3.6	3.6		

CONNECTED LOAD:	
A:	7KVA = 25A
B:	7KVA = 25A
C:	7KVA = 25A

FIGURE 13. PANEL LPC RECEPTACLE CONNECTED LOAD

PANEL MRP VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
11	R: EXTERIOR			0.6	1	20	3	20			0.6	R: MECH ROOM	6
							-	-	0.6			R: MECH ROOM	8
							-	20		0.4		R: MECH ROOM	10
							1	20			0.8	R: ROOF	12
							1	20	0.8			R: ROOF	14
		-	-	0.6	SUBTOTAL				1.4	0.4	1.4		

CONNECTED LOAD:	
A:	1.4KVA = 12A
B:	0.4KVA = 3A
C:	2KVA = 17A

FIGURE 14. PANEL MRP RECEPTACLE CONNECTED LOAD

PANEL MRPA VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
11	UNIT HEATERS (3)			0.1	1	20							
27	R: ROOF		0.4		1	20							
		-	0.4	0.1	SUBTOTAL								

CONNECTED LOAD:	
A:	-
B:	0.4KVA = 3A
C:	0.1KVA = 1A

FIGURE 15. PANEL MRPA RECEPTACLE CONNECTED LOAD

PANEL RPA VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	R: 138, 157, & 159	1			1	20	1	20	0.6			R: 150	2
3	R: 146		0.6		1	20	1	20		0.4		R: 150	4
5	R: 146			0.6	1	20	1	20			0.8	R: 147	6
7	SOUND RACK: 146	0.5			1	20	1	20	0.8			R: 147	8
9	R: 148		0.6		1	20	1	20		0.5		SOUND RACK: 148	10
11	R: 148			0.6	1	20	1	20			1.5	BACKBOARD: 142	12
13	SOUND RACK: 148	0.5			1	20	1	20	1.5			BACKBOARD: 143	14
15	BATTING CAGE: 142		1.2		1	20	1	20		1.5		BACKBOARD: 144	16
17	DIVIDER: 142			1.5	1	20	1	20			1.5	BACKBOARD: 145	18
19	SOUND RACK: 148	0.5			1	20	1	20	1.5			BACKBOARD: 146	20
21	R: 142		0.6		1	20	1	20		1.5		BACKBOARD: 147	22
23	R: 142			0.8	1	20	1	20			0.6	SCOREDBOARD (2): 142	24
25	R: 142	0.6			1	20	1	20	0.5			PROJECTOR/SCREEN: 148	26
27	R: 143-145, & 148		1		1	20	1	20		0.4		R: 152	28
29	EWC: 152			0.7	1	20	1	20			0.6	R: 139 & 141	30
31	R: 101 & 102	1.2			1	20	1	20	0.6			R: 140	32
33	R: 104 &111		0.6		1	20	1	20		1.2		R: 103	34
35	R: 105 & 111B			1.2	1	20	1	20			1.2	R: 111A & 111C	36
37	R: 106 & 107	1.2			1	20	1	20	0.7			R: 108 (RE)	38
39	PROJECTOR/SCREEN: 110		0.5		1	20	1	20		1		R: 108	40
41	R: 110			1.2	1	20	1	20			1	R: 108 (MW)	42
43	R: 154	0.6			1	20	1	20	1.2			R: 109	44
45	R: 156		0.4		1	20	1	20		1.2		R: 109	46
47	R: 112A			0.2	1	20	1	20			1.4	R: 109	48
49	R: 112A	0.2			1	20	1	20	1.2			R: 112	50
51	R: 112A		0.2		1	20	1	20		1.2		R: 113	52
53	R: 112A			0.2	1	20	1	20			0.7	PROJECTOR/SCREEN: 112	54
55	R: 113A	0.2			1	20	1	20	0.7			PROJECTOR/SCREEN: 113	56
57	R: 113A		0.2		1	20	1	20	1			R: 143 & 144	62
59	R: 113A			0.2	1	20	1	20		0.8		R: 151	64
61	R: 113A	0.2			1	20							
63	R: 128		0.8		1	20							
		6.7	6.7	7.2	SUBTOTAL				10.3	9.7	9.3		

CONNECTED LOAD:	
A:	17KVA = 142A
B:	16.4KVA = 137A
C:	16.5KVA = 138A

FIGURE 16. PANEL RPA RECEPTACLE CONNECTED LOAD

PANEL RPB VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	R: 134	0.6			1	20	1	20	0.6			R: 166 & 166A	2
3	R: EXTERIOR		0.8		1	20	1	20		0.4		R: 166	4
5	R: 162			0.8	1	20	1	20			0.5	EWC: 162	6
7	R: 164	0.6			1	20	1	20	1.2			R: 177 (FOLLOW SPOT)	8
9	R: 163		0.7		1	20	1	20		1.2		R: 177 (FOLLOW SPOT)	10
11	SCOREBOARD: 024			0.2	1	20	1	20			1.2	R: 177 (FOLLOW SPOT)	12
13	PROJECTION: 024	1.5			1	20	1	20	1.2			R: 177 (FOLLOW SPOT)	14
41	R: 024			0.4	1	20	1	20		0.9		PROJECTION SCREEN: 024	16
43	R: 024	0.4			1	20	1	20			0.6	R: 175	18
45	R: 024		0.4		1	20	1	20	0.8			R: 174	20
47	R: 024			0.4	1	20	1	20		0.6		R: 177	22
49	R: 015	0.9			1	20	1	20			0.4	R: 174	24
51	R: 016		0.7		1	20	1	20		0.2		R: 024	28
53	R: 007 (WHIRPOOL)			1.2	1	20	1	20			0.2	R: 024	30
55	R: 007 (WHIRPOOL)	1.2			1	20	1	20	0.2			R: 024	32
57	R: 007		0.4		1	20	1	20		0.2		R: 024	34
59	R: 007 (DW)			1	1	20	1	20			0.6	R: 020	36
61	R: 007A & 007B	1			1	20	1	20	0.4			R: 017	38
63	R: 008		0.8		1	20	1	20		0.6		R: 021	40
65	R: 016			0.6	1	20	1	20			0.8	R: 022 & 023	42
67	R: 016 (EWC)	0.5			1	20	1	20	0.2			R: EXTERIOR	44
69	R: 003		0.3		1	20	1	20		0.2		R: EXTERIOR	46
71	R: 024			0.8	1	20	1	20			0.2	R: EXTERIOR	48
							1	20	0.5			R: 013	50
							1	20		0.5		R: 014	52
							1	20			0.6	R: 009	54
							1	20	0.7			R: 007 (ICE MACHINE)	56
							1	20		0.7		R: 007 (RE)	58
							1	20			1	R: 007	60
							1	20	0.7			R: 005	62
							1	20		0.8		R: 006	64
									0.4			R: 004	68
										0.4		R: 016	70
											1	R: 010 & 011	72
		6.7	4.1	5.4	SUBTOTAL				6.9	6.7	7.1		

CONNECTED LOAD:	
A:	13.6KVA = 113A
B:	10.8KVA = 90A
C:	12.5KVA = 104A

FIGURE 17. PANEL RPB RECEPTACLE CONNECTED LOAD

PANEL RPC VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	R: 128	0.8			1	20	1	20	0.6			R: 124 & 125	2
9	R: 118		0.5		1	20	1	20		1		R: 127 & 129	4
11	R: 114 (VENDING)			1	1	20	1	20			0.6	R: 116	6
13	R: 114 (VENDING)	1			1	20	1	20	0.6			R: 116	8
15	EWC: 114		0.7		1	20	1	20		0.7		R: 117	10
17	R: 114 (VENDING)			1	1	20	1	20			0.6	R: 114 & 115	12
19	R: 114 (VENDING)	1			1	20	1	20	0.4			R: 115	14
21	R: 155		0.6		1	20	1	20		0.4		R: 114	16
23	R: 130			0.3	1	20	1	20			0.6	R: 114	18
25	R: 130	0.5			1	20	1	20	0.8			R: 120	20
27	SOUND RACK: 129		0.5		1	20	1	20		0.8		R: 121	22
29	EXHAUST FAN			0.5	1	20	1	20			0.4	R: 123	24
							1	20	0.2			R: 123	26
							1	20		0.2		R: 123	28
							1	20			0.4	R: 123	30
		3.3	1.7	2.8	SUBTOTAL				2.6	3.1	2.6		

CONNECTED LOAD:	
A:	5.9KVA = 49A
B:	4.8KVA = 40A
C:	5.4KVA = 45A

FIGURE 18. PANEL RPC RECEPTACLE CONNECTED LOAD

PANEL FRP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	R: UNDER FLOOR DUCT	1.2			1	20	1	20	1.2			R: TELEVISION	2
3	R: UNDER FLOOR DUCT		1.2		1	20	1	20		1.2		R: TELEVISION	4
5	R: UNDER FLOOR DUCT			1.2	1	20	1	20			0.7	R: EWC	6
7	R: UNDER FLOOR DUCT	1.2			1	20	1	20	0.7			R: EWC	8
9	R: UNDER FLOOR DUCT		1.2		1	20	1	20		0.6		R: COUNTER	10
11	R: UNDER FLOOR DUCT			1.2	1	20	1	20			0.6	R: FITNESS	12
13	R: UNDER FLOOR DUCT	1.2			1	20	1	20	1			R: OFFICE 136	14
15	R: UNDER FLOOR DUCT		1.2		1	20	1	20		0.4		R: RECEPTION DESK	16
17	R: UNDER FLOOR DUCT			1.2	1	20	1	20			0.4	R: SOUND SYSTEM	18
							1	20	1.2			R: OFFICE 131 & 132	20
							1	20		1		R: EVALUATION 133	22
							1	20			0.6	R: FITNESS	24
							1	20	0.6			R: FITNESS	26
							1	20		0.6		R: FITNESS	28
							1	20			0.6	R: FITNESS	30
							1	20	0.6			R: FITNESS	32
							1	20		0.6		R: FITNESS	34
		3.6	3.6	3.6	SUBTOTAL				5.3	4.4	2.9		

CONNECTED LOAD:	
A:	8.9KVA = 74A
B:	8KVA = 67A
C:	6.5KVA = 54A

FIGURE 19. PANEL FRP RECEPTACLE CONNECTED LOAD

PANEL CRP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	REACH IN REFRIGERATOR	0.8			1	20	1	20		1.5		COFFEE BREWER	4
3	BEVERAGE MERCHANDISER		1.2		1	20	1	20			1.5	COFFEE BREWER	6
5	WARMER			1.2	1	20	1	20	0.8			PCS REGISTER (2)	8
7	WARMER	1.2			1	20	1	20		1.9		MICROWAVE	10
9	ICE MACHINE		0.7		1	20	1	20			0.4	RECEPTACLES	12
11	PRETZLE			1.5	1	20	1	20	0.8			RECEPTACLES	14
13	POPCORN	1.2			1	20	1	20		0.9		LIGHTING	16
15	NACHO CHEESE WARMER		0.3		1	20							
		3.2	2.2	2.7	SUBTOTAL				1.6	4.3	1.9		

CONNECTED LOAD:	
A:	4.8KVA = 40A
B:	6.5KVA = 54A
C:	4.6KVA = 38A

FIGURE 20. PANEL CRP RECEPTACLE CONNECTED LOAD

PANEL SRP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
17	EWC: 124			0.7	1	20	1	20		0.6		R: EQUIPMENT RM 012	10
19	R: 124	0.6			1	20	1	20			0.6	R: EQUIPMENT RM 012	12
21	R: TENNIS COURT		0.6		1	20	1	20	0.5			R: 001	14
23	R: TENNIS COURT			0.6	1	20	1	20		0.5		R: 002	16
25	R: TENNIS COURT	0.4			1	20	1	20			0.6	R: 124	18
27	R: VENDING		0.5		1	20							
29	R: VENDING			0.5	1	20							
		1	1.1	1.8	SUBTOTAL				0.5	1.1	1.2		

CONNECTED LOAD:	
A:	1.5KVA = 13A
B:	2.2KVA = 18A
C:	3KVA = 25A

FIGURE 21. PANEL SRP RECEPTACLE CONNECTED LOAD

MECHANICAL AND OTHER CONNECTED LOADS

PANEL ELP VOLTAGE: 480Y/277V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
31	LIFT STATION	1.9			3	20	3	30	3			WELL PUMP (ETR)	8
33	------		1.9		-	-	-	-		3		------	10
35	------			1.9	-	-	-	-			3	------	12
37	LIFT STATION (ETR)	2.1			3	20	3	30	3			WELL PUMP (ETR)	14
39	------		2.1		-	-	-	-		3		------	16
41	------			2.1	-	-	-	-			3	------	18
							3	20	-			WELL PHASE MONITOR	20
							3	80	13.6			PANEL 'ERP' XFMR	38
							-	-		12.9		------	40
							-	-			10.7	------	42
		4	4	4	SUBTOTAL				19.6	18.9	16.7		

CONNECTED LOAD:	
A:	23.6KVA = 85A
B:	22.9KVA = 83A
C:	20.7KVA = 75A

FIGURE 22. PANEL ELP MECHANICAL AND OTHER CONNECTED LOAD

PANEL ERP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
7	AUTO DOOR	0.6			1	20	1	20	1			FIRE ALARM	2
9	PUMP HCFP #1-4		1.2		1	20	1	20		0.5		ACCESS CONTROL SYSTEM	10
							1	20			0.3	PUMP HCFP #9	12
							-	-	9.7			SPACE	26
							-	-		9.3		SPACE	28
							-	-			6.5	SPACE	30
		0.6	1.2	-	SUBTOTAL				10.7	9.8	6.8		

CONNECTED LOAD:	
A:	11.3KVA = 94A
B:	11KVA = 92A
C:	6.8KVA = 57A

FIGURE 23. PANEL ERP MECHANICAL AND OTHER CONNECTED LOAD

PANEL ERPA VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	ACCCU/ACU #2	2.1			2	30	1	20	1.2			AUTODOOR (2)	2
3	------		2.1		-	-	1	20		1.2		AUTODOOR (2)	4
5	ELEV. CAB			1.5	1	20	1	20			1.2	AUTODOOR (2)	6
7	SUMP PLUMP	1.2			1	20	1	20	1.2			AUTODOOR (2)	8
17	FIRE ALARM BOOSTER			0.7	1	20	1	20		0.5		ACCESS CONTROL SYSTEM	16
19	ACCCU/ACU #6	2.1			2	30	1	20			1.2	PUMPS HCFP #5-8	18
21	SPARE		2.1		-	-							
		5.4	4.2	2.2	SUBTOTAL				2.4	1.7	2.4		

CONNECTED LOAD:	
A:	7.8KVA = 65KVA
B:	5.9KVA = 49A
C:	4.6KVA = 38A

FIGURE 24. PANEL ERPA MECHANICAL AND OTHER CONNECTED LOAD

PANEL LPA VOLTAGE: 480Y/277V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
37	PANEL 'RPA' TRANSFORMER	25.9			3	150	3	100	15.9			PANEL 'LPC'	38
39	------		25.6		-	-	-	-		16.2		------	40
41	------			24.2	-	-	-	-			13.7	------	42
		25.9	25.6	24.2	SUBTOTAL				15.9	16.2	13.7		

CONNECTED LOAD:	
A:	41.8KVA = 151A
B:	41.8KVA = 151A
C:	37.9KVA = 137A

FIGURE 25. PANEL LPA MECHANICAL AND OTHER CONNECTED LOAD

PANEL LPB VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
55	PANEL 'RPB' TRANSFORMER	18.4			3	80							
57	------		17.3		-	-							
59	------			17.1	-	-							
		18.4	17.3	17.1	SUBTOTAL								

CONNECTED LOAD:	
A:	18.4KVA = 66A
B:	17.3KVA = 62A
C:	17.1KVA = 62A

FIGURE 26. PANEL LPB MECHANICAL AND OTHER CONNECTED LOAD

PANEL LPC VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
13	FAN VF #1	1.3			3	20							
15	------		1.3		-	-							
17	------			1.3	-	-							
37	PANEL 'RPC' TRANSFORMER	5.9			3	60							
39	------		4.8		-	-							
41	------			5.4	-	-							
		7.2	6.1	6.7	SUBTOTAL								

CONNECTED LOAD:	
A:	7.2KVA = 26A
B:	6.1KVA = 22A
C:	6.7KVA = 24A

FIGURE 27. PANEL LPC MECHANICAL AND OTHER CONNECTED LOAD

PANEL MLP VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	RTU #1 SUPPLY	5.8			3	40	3	20	2.1			RTU-1 RETURN	2
3	------		5.8		-	-	-	-		2.1		------	4
5	------			5.8	-	-	-	-			2.1	------	6
7	RTU #2 SUPPLY	7.5			3	50	3	40	5.8			RTU-2 RETURN	8
9	------		7.5		-	-	-	-		5.8		------	10
11	------			7.5	-	-	-	-			5.8	------	12
13	RTU #3 SUPPLY	11.1			3	60	3	40	5.8			RTU-3 RETURN	14
15	------		11.1		-	-	-	-		5.8		------	16
17	------			11.1	-	-	-	-			5.8	------	18
19	RTU #4	13			3	70	3	60	7.5			ELEVATOR	20
21	------		13		-	-	-	-		7.5		------	22
23	------			13	-	-	-	-			7.5	------	24
25	HEATING PUMP - SUSQUE	11.1			3	70	3	20	1.3			BOILER #1	50
27	------		11.1		-	-	-	-		1.3		------	52
29	------			11.1	-	-	-	-			1.3	------	54
31	HEATING PUMP - CHESA	3			3	20	3	20	1.3			BOILER #2	56
33	------		3		-	-	-	-		1.3		------	58
35	------			3	-	-	-	-			1.3	------	60
37	CHD WTR PUMP - SUSQUE	11.1			3	70	3	20	1.3			BOILER #3	62
39	------		11.1		-	-	-	-		1.3		------	64
41	------			11.1	-	-	-	-			1.3	------	66
43	CHD WTR PUMP - CHESA	14.4			3	90	3	20	3			DCU #1	68
45	------		14.4		-	-	-	-		3		------	70
47	------			14.4	-	-	-	-			3	------	72
49	POOL PUMP - SUSQUE	3			3	20	3	80	11.1			PANEL 'MRPA' TRANSFORMER	80
51	------		3		-	-	-	-		11.5		------	82
53	------			3	-	-	-	-			6.9	------	84
55	PUMP DWP #1	3			3	20							
57	------		3		-	-							
59	------			3	-	-							
61	PUMP DWP #2	3			3	20							
63	------		3		-	-							
65	------			3	-	-							
67	ATC COMPRESSOR	2.1			3	20							
69	------		2.1		-	-							
71	------			2.1	-	-							
79	PANEL 'MRP' TRANSFORMER	9.7			3	80							
81	------		6.5		-	-							
83	------			7.4	-	-							
		97.8	94.6	95.5	SUBTOTAL				39.2	39.6	35		

CONNECTED LOAD:	
A:	137KVA = 495A
B:	134.2KVA = 484A
C:	130.5KVA = 471A

FIGURE 28. PANEL MLP MECHANICAL AND OTHER CONNECTED LOAD

PANEL MRP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	DWH #1	0.9			1	20	1	20	0.9			DHW #2	2
3	DOM RECIR. PUMP		0.5		1	20	1	20		0.5		DOM RECIR. PUMP	4
5	BOILER			1.2	1	20	1	20		0.7		BOILER BLEND PUMP	16
7	ATC PANEL	0.7			2	20	1	20			0.2	CHEMICAL MIXER	18
9	ATC PANEL		0.7		-	-	1	20	0.7			EXH FAN EF #4	20
13	BOILER BLEND PUMP	1.2			1	20	1	20		1.2		EXH FAN 138	22
15	BOILER BLEND PUMP		1.2		1	20	2	25			1.4	ACCU/ACC #5	24
17	BOILER BLEND PUMP			1.2	1	20	-	-	1.4			------	26
19	FCU (2): 152	1.1			1	20							
21	FCU (2): 152		1.1		1	20							
23	ACCU/ACU #4			1.4	2	25							
25	-------	1.4			-	-							
27	BOILER CONTROL PANEL		0.2		1	20							
		5.3	3.7	3.8	SUBTOTAL				3	2.4	1.6		

CONNECTED LOAD:	
A:	8.3KVA = 69A
B:	6.1KVA = 51A
C:	5.4KVA = 45A

FIGURE 29. PANEL MRP MECHANICAL AND OTHER CONNECTED LOAD

PANEL MRPA VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	BLEACHERS	1.3			3	20	1	20	1.6			FCU (2) 166 & 166A	2
3	------		1.3		-	-	1	20		1.1		FCU (2) 166 & 166A	4
5	------			1.3	-	-	1	20			1.6	FCU (2) 160	6
7	FAN EF #6	0.5			2	20	1	20	1.1			FCU (2) 022	8
9	RAIN WATER CTRL		0.8		-	-	1	20		1.1		FCU (2) 173	10
13	WINCH 024	1.5			1	20	1	20			1.1	FCU (2) 023	12
15	WINCH 024		1.5		1	20	1	20	1.1			FCU (2) 016	14
25	FAN EF #5	1.2			1	20	1	20		1.1		FCU 170	16
							1	20			0.7	ATC	18
							1	20	0.7			ATC	20
							2	30		2.1		ACCU/ACU #3	22
							-	-			2.1	------	24
							2	30	2.1			ACCU/ACU #1	26
							-	-		2.1		------	28
		4.5	3.6	1.3	SUBTOTAL				6.6	7.5	5.5		

CONNECTED LOAD:	
A:	11.1KVA = 93A
B:	11.1KVA = 93A
C:	6.8KVA = 57A

FIGURE 30. PANEL MRPA MECHANICAL AND OTHER CONNECTED LOAD

PANEL RPA VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
							3	100	8.9			PANEL 'FRP'	80
							-	-		8		------	82
							-	-			6.5	------	84
					SUBTOTAL				8.9	8	6.5		

CONNECTED LOAD:	
A:	8.9KVA = 74A
B:	8KVA = 67A
C:	6.5KVA = 54A

FIGURE 31. PANEL RPA MECHANICAL AND OTHER CONNECTED LOAD

PANEL RPB VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
							3	100	4.8			PANEL 'CRP'	80
							-	-		6.5		------	82
							-	-			4.6	------	84
					SUBTOTAL				4.8	6.5	4.6		

CONNECTED LOAD:	
A:	4.8KVA = 40A
B:	6.5KVA = 54A
C:	4.6KVA = 38A

FIGURE 32. PANEL RPB MECHANICAL AND OTHER CONNECTED LOAD

PANEL SLP VOLTAGE: 480Y/277V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	POOL PUMP (P1)	5.8			3	40	3	60	8.2			PANEL 'SRP' TRANSFORMER	2
3	------		5.8		-	-	-	-		6.9		------	4
5	------			5.8	-	-	-	-			4.6	------	6
7	PUMP (PHWP #2)	0.9			3	20	3	20	0.9			PUMP (PHWP #3)	8
9	------		0.9		-	-	-	-		0.9		------	10
11	------			0.9	-	-	-	-			0.9	------	12
13	PUMP (PHWP #5)	0.4			3	20	3	20	0.6			PUMP (PHWP #6)	14
15	------		0.4		-	-	-	-		0.6		------	16
17	------			0.4	-	-	-	-			0.6	------	18
19	CHEM EXH FAN (P8)(EF #2)	0.6			3	20							
21	------		0.6		-	-							
23	------			0.6	-	-							
		7.7	7.7	7.7	SUBTOTAL				9.7	8.4	6.1		

CONNECTED LOAD:	
A:	17.4KVA = 63A
B:	16.1KVA = 58A
C:	13.8KVA = 50A

FIGURE 33. PANEL SLP MECHANICAL AND OTHER CONNECTED LOAD

PANEL SRP VOLTAGE: 208Y/120V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	FILTER CONT. COMPRESSOR	1.6			1	20	1	30	1.9			FILTER CTRL PANEL	2
3	CHEM FEED PUMP (P4)		0.5		1	20	1	25		1.5		ULTRAVIOLET CONT. PNL (P5)	4
5	WTR CHEM CONTROLLER (P6)			0.5	1	20	1	20			0.1	UON LEVEL COMPRESSOR (P7)	6
7	WTR CHEM CONTROLLER (P6)	0.5			1	20	1	20	1.2			PUMP (PHWP #4)	8
							1	20	0.5			ATC PANEL	20
							1	20		0.7		ROOF: EF #2	22
		2.1	0.5	0.5	SUBTOTAL				3.6	2.2	0.1		

CONNECTED LOAD:	
A:	5.7KVA = 48A
B:	2.7KVA = 23A
C:	0.6KVA = 5A

FIGURE 34. PANEL SRP MECHANICAL AND OTHER CONNECTED LOAD

PANEL SITE VOLTAGE: 480Y/277V 3PH 4W

		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	TENNIS COURT	1.8			2	20	3	20	1.3			DOCK LEVELER	20
3	------		1.8		-	-	-	-		1.3		------	22
5	TENNIS COURT			1.8	2	20	-	-			1.3	------	24
7	------	1.8			-	-	3	20	1.2			RAIN WATER	26
9	TENNIS COURT		1.8		2	20	-	-		1.2		------	28
11	------			1.8	-	-	-	-			1.2	------	30
13	TENNIS COURT	1.8			2	20	3	25	4.2			PUMP RWHB #1 & 2	32
15	------		1.8		-	-	-	-		4.2		------	34
17	TENNIS COURT			1.8	2	20	-	-			4.2	------	36
19	------	1.8			-	-							
21	TENNIS COURT		1.8		2	20							
23	------			1.8	-	-							
25	TENNIS COURT	1.8			2	20							
27	------		1.8		-	-							
29	TENNIS COURT			1.8	2	20							
31	------	1.8			-	-							
33	TENNIS COURT		1.8		2	20							
35	------			1.8	-	-							
37	TENNIS COURT	1.8			2	20							
39	------		1.8		-	-							
41	TENNIS COURT			1.8	2	20							
43	------	1.8			-	-							
45	TENNIS COURT		1.8		2	20							
47	------			1.8	-	-							
49	TENNIS COURT	1.8			2	20							
51	------		1.8		-	-							
53	TENNIS COURT			1.8	2	20							
55	------	1.8			-	-							
57	TENNIS COURT		1.8		2	20							
59	------			1.8	-	-							
61	TENNIS COURT	1.8			2	20							
63	------		1.8		-	-							
		19.8	19.8	18	SUBTOTAL				6.7	6.7	6.7		

CONNECTED LOAD:	
A:	26.5KVA = 96A
B:	26.5KVA = 96A
C:	24.7KVA = 89A

FIGURE 35. PANEL SITE MECHANICAL AND OTHER CONNECTED LOAD

SPECIAL EQUIPMENT CONNECTED LOADS

PANEL RPB VOLTAGE: 208Y/120V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
79	PV SYSTEM				3	100							
81	------				-	-							
83	------				-	-							
					SUBTOTAL								

CONNECTED LOAD:	
A:	-
B:	-
C:	-

FIGURE 36. PANEL RPB SPECIAL EQUIPMENT CONNECTED LOAD

RATE SCHEDULE / SERVICE VOLTAGE

The actual power company electrical rate schedule utilized by the Susquehanna Center is the same as the preliminary rate schedule described in SECTION I of this report. Rate Schedule GL is used which assumes a monthly demand of 60KW or more. The building location pays a fee of $0.0725/KW. The amount paid per month is calculated to be $190.24 per month.

The service voltage is also the same as it is described in SECTION I. The utility company will provide a service voltage of 480Y/277V, 3PH, 4W.

BUILDING UTILIZATION VOLTAGE

LIGHTING – all lighting equipment will be served at 277V, 1PH, as identified in drawing E0.01. The drawing provides a luminaire fixture schedule with three different types of lamps: linear fluorescent, compact fluorescent and LEDs. The design concept of using 277V, 1PH instead of 120V is that longer runs of wiring can be made and more fixtures can be attached per circuit breaker. 277V, 1PH also has less of a voltage drop and use less current compared to 120V which produces a cheaper, more efficient system.

RECEPTACLE – all receptacle loads are rated at 120V in North America. In other countries it may be different.

MECHANICAL – different mechanical equipment requires a different building utilization voltage. This depends on the size and type of the mechanical equipment. The mechanical loads in the building are served using three types of utilization voltage, 480V 3PH, 208 3PH, and 120V 1PH. 208V equipment are slightly smaller and safer to use but the power consumption compared to 480V is basically the same, as 480V runs on half the amperage but twice the voltage. 480V equipment allow for longer wire runs and smaller wire sizes.

SPECIAL EQUIPMENT – the photovoltaic array will be served with a building utilization voltage of 208V, 3PH, 4W, determined by the rating on the equipment.

EMERGENCY POWER SYSTEM

The emergency power system of the Susquehanna Center is supplied by a 60KW, 75KVA, 480/277V, 3PH, 4W diesel fueled emergency back-up generator. The generator is pad-mounted on grade outside in the North end of the building and feeds one 150A, 3PH Automatic Transfer Switch, one step-down transformer from 480/277V to 208/120V, and three panels (Panels ELP, ERP, ERPA). Each panel requires a different voltage system for the different electrical and mechanical equipment in the building.

The following provides the total connected loads to the emergency power system:

PANEL ELP MAIN: 125A MCB VOLTAGE: 480Y/277V 3PH 4W

CKT	EQUIPMENT SERVED	LOAD (KVA) A	B	C	BREAKER P	AMPS	BREAKER P	AMPS	LOAD (KVA) A	B	C	EQUIPMENT SERVED	CKT
1	L: MAIN EMERG WEST	1.5			1	20	1	20	1.6			L: LOWER EMERG	2
3	L: MAIN EMERG WEST		1.5		1	20	1	20		0.3		ELEVATOR PIT: 003	4
5	L: EMERG 124, 142, 146 & 147			2.4	1	20	1	20			2	L: TYPE 'Y'	6
7	L: EMERG MAIN	2.4			1	20	3	30	3			WELL PUMP (ETR)	8
9	L: EXTERIOR		0.6		1	20	-	-		3		-------	10
11	SPARE				1	20	-	-			3	-------	12
13	SPARE				1	20	3	30	3			WELL PUMP (ETR)	14
15	SPACE				-	-	-	-		3		-------	16
17	SPACE				-	-	-	-			3	-------	18
19	SPACE				-	-	3	20	-			WELL PHASE MONITOR (ETR)	20
21	SPACE				-	-	-	-		-		-------	22
23	SPACE				-	-	-	-			-	-------	24
25	SPACE				-	-	-	-				SPACE	26
27	SPACE				-	-	-	-				SPACE	28
29	SPACE				-	-	-	-				SPACE	30
31	LIFT STATION	1.9			3	20	-	-				SPACE	32
33	-------		1.9		-	-	-	-				SPACE	34
35	-------			1.9	-	-	-	-				SPACE	36
37	LIFT STATION (ETR)	2.1			3	20	3	80	14			PANEL 'ERP' XFMR	38
39	-------		2.1		-	-	-	-		12.9		-------	40
41	-------			2.1	-	-	-	-			11	-------	42
		7.9	6.1	6.4	SUBTOTALS				21	19	19		

CONNECTED LOAD:
A: 29.1 KVA = 105A
B: 25.3 KVA = 91A
C: 25.1 KVA = 91A

FIGURE 37. PANEL ELP CONNECTED LOADS

PANEL ERP MAIN: 150A MCB VOLTAGE: 208Y/120V 3PH 4W													
		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	R: EXTERIOR & 138	0.4			1	20	1	20	1			FIRE ALARM	2
3	R: TELECOM UPS		1.5		2	30	1	20		0.4		R: TELECOM	4
5	------			1.5	-	-	1	20			0.4	R: SECURITY	6
7	AUTO DOOR	0.6			1	20	1	20	0.4			R: SECURITY	8
9	PUMP HCFP #1-4		1.2		1	20	1	20		0.5		ACCESS CONTROL SYSTEM	10
11	GEN. BATT CHARGER			0.5	1	20	1	20			0.3	PUMP HCFP #9	12
13	SPARE				1	20	1	20				SPARE	14
15	SPARE				1	20	1	20				SPARE	16
17	GEN. JACKET HEATER			1.5	2	20	1	20				SPARE	18
19	------	1.5			-	-	-	-				SPACE	20
21	SPACE				-	-	-	-				SPACE	22
23	SPACE				-	-	-	-				SPACE	24
25	SPACE				-	-	-	-	9.7			SPACE	26
27	SPACE				-	-	-	-		9.3		SPACE	28
29	SPACE				-	-	-	-			6.5	SPACE	30
		2.5	2.7	3.5	SUBTOTALS				11.1	10.2	7.2		

CONNECTED LOAD:	
A:	13.6 KVA = 113A
B:	12.9 KVA = 108A
C:	10.7 KVA = 89A

FIGURE 38. PANEL ERP CONNECTED LOADS

PANEL ERPA MAIN: 225A MLO VOLTAGE: 208Y/120V 3PH 4W													
		LOAD (KVA)			BREAKER		BREAKER		LOAD (KVA)				
CKT	EQUIPMENT SERVED	A	B	C	P	AMPS	P	AMPS	A	B	C	EQUIPMENT SERVED	CKT
1	ACCCU/ACU #2	2.1			2	30	1	20	1.2			AUTODOOR (2)	2
3	------		2.1		-	-	1	20		1.2		AUTODOOR (2)	4
5	ELEV. CAB			1.5	1	20	1	20			1.2	AUTODOOR (2)	6
7	SUMP PUMP	1.2			1	20	1	20	1.2			AUTODOOR (2)	8
9	R: TELECOM UPS		1.5		2	30	1	20		0.4		R: TELECOM	10
11	------			1.5	-	-	1	20			0.4	R: TELECOM	12
13	R: TELECOM UPS	1.5			2	30	1	20	0.4			R: TELECOM	14
15	------		1.5		-	-	1	20		0.5		ACCESS CONTROL SYSTEM	16
17	FIRE ALARM BOOSTER			0.7	1	20	1	20			1.2	PUMPS HCFP #5 & 8	18
19	ACCCU/ACU #6	2.1			2	30	1	20				SPARE	20
21	SPARE		2.1		-	-	1	20				SPARE	22
23	SPARE				1	20	-	-				SPACE	24
25	SPARE				1	20	-	-				SPACE	26
27	SPARE				1	20	-	-				SPACE	28
29	SPARE				1	20	-	-				SPACE	30
		6.9	7.2	3.7	SUBTOTALS				2.8	2.1	2.8		

CONNECTED LOAD:	
A:	9.7 KVA = 81A
B:	9.3 KVA = 78A
C:	6.5 KVA = 54A

FIGURE 39. PANEL ERPA CONNECTED LOADS

SPECIAL OCCUPANCY REQUIREMENTS

There are no actual special occupancy requirements identified in the Susquehanna Center.

SPECIAL EQUIPMENT

The only identified special equipment in the Susquehanna Center is the solar photovoltaic array system, described in *ARTICLE 690 Chapter 6* of the *2011 National Electrical Code (2011 NEC)*. The solar photovoltaic system includes solar panels, a net meter, and three types of fused switches located along the system to provide overcurrent protection. The system can be found in the electrical drawing number E5.01.

ELECTRICAL SYSTEM DOCUMENTATION

The following subsection provides the documentation and description of the entire electrical distribution system of the Susquehanna Center.

MAIN SERVICE AND DISTRIBUTION EQUIPMENT

MAIN SWITCHGEAR – the single ended, indoor 3200A 3PH 4W main switchgear is comprised of 5 sections. The first section serves to receive the service voltage from the utility transformer. The second section is a 2400A circuit breaker for the expansion portion of the building. The third section is also a circuit breaker but this 1200A section is for the existing portion of the building. The fourth section is an auxiliary meter while the fifth section is the main distribution switchboard MDS. The distribution switchboard should be dead-front, freestanding front accessible, with a NEMA 1 indoor construction.

PANELBOARDS – there are 18 panelboards located throughout the main and lower level of the building. Each distribution panel distributes the required voltage and loads to the respective equipment. All panelboards shall be bolt-on type with ambient compensated and thermal magnetic functions which will provide inverse time delay overload and instantaneous short circuit protection. All buses connected to panelboards shall be copper.

SWITCHBOARD SCHEDULE						
DESIGNATION	VOLTAGE	MOUNTING	FLOOR LEVEL	ROOM #	ROOM NAME	DRAWING #
MDS	480y/277V 3PH 4W	FLOOR	MAIN	138	ELECTRICAL ROOM 2	E4.01

FIGURE 40. SWITCHBOARD SCHEDULE

PANELBOARD SCHEDULE							
DESIGNATION	MAIN SIZE	VOLTAGE	MOUNTING	FLOOR LEVEL	ROOM #	ROOM NAME	DRAWING #
ELP	125A MCB	480Y/277V 3PH 4W	FLOOR	MAIN	138	ELECTRICAL ROOM 2	E4.01
ERP	150A MCB	208Y/120V 3PH 4W	SURFACE	MAIN	138	ELECTRICAL ROOM 2	E4.01
ERPA	225A MLO	208Y/120V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05
LPA	225A MCB	480Y/277V 3PH 4W	SURFACE	MAIN	157	ELECTRICAL ROOM 1	E4.01
LPB	225A MCB	480Y/277V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05
LPC	100A MLO	480Y/277V 3PH 4W	SURFACE	MAIN	116	UNIFORM STORAGE & WASHER/DRYER	E2.02
MLP	500A MLO	480Y/277V 3PH 4W	SURFACE	MAIN	157	ELECTRICAL ROOM 1	E4.01
MRP	150A MCB	208Y/120V 3PH 4W	SURFACE	MAIN	157	ELECTRICAL ROOM 1	E4.01
MRPA	150A MCB	208Y/120V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05
RPA	225A MCB	208Y/120V 3PH 4W	SURFACE	MAIN	157	ELECTRICAL ROOM 1	E4.01
RPB	150A MCB	208Y/120V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05
RPC	100A MCB	208Y/120V 3PH 4W	SURFACE	MAIN	116	UNIFORM STORAGE & WASHER/DRYER	E2.02
FRP	100A MCB	208Y/120V 3PH 4W	RECESSED	MAIN	135	FITNESS AND WEIGHT ROOM	E2.01
CRP	100A MLO	208Y/120V 3PH 4W	SURFACE	MAIN	165A	STORAGE CLOSET	E4.02
SLP	100A MLO	480Y/277V 3PH 4W	SURFACE	LOWER	012	POOL MECHANICAL	E2.05
SRP	100A MCB	208Y/120V 3PH 4W	SURFACE	LOWER	012	POOL MECHANICAL	E2.05
ARP	800A MCB	208Y/120V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05
SITE	225A MCB	480Y/277V 3PH 4W	SURFACE	LOWER	010	ELECTRICAL ROOM 3	E2.05

FIGURE 41. PANELBOARD SCHEDULE

TRANSFORMERS – the main service transformer is a utility owned dry type pad mounted on-grade transformer located on the outside of the building. There are 8 distribution step-down transformers that are located throughout the building on both the main and lower level of the building.

MAIN SERVICE TRANSFORMER SCHEDULE											
DESIGNATION	SIZE	PRIMARY VOLTAGE	SECONDARY VOLTAGE	TYPE	TEMPERATURE RISE	TAPS	MOUNTING	FLOOR LEVEL	ROOM #	ROOM NAME	DRAWING #
BGE XFMR	2000 KVA	-	480Y/277V 3PH 4W	-	-	-	PAD ON GRADE	EXTERIOR ON GRADE	-	-	E4.01
DISTRIBUTION STEP DOWN TRANSFORMER SCHEDULE											
DESIGNATION	SIZE	PRIMARY VOLTAGE	SECONDARY VOLTAGE	TYPE	TEMPERATURE RISE	TAPS	MOUNTING	FLOOR LEVEL	ROOM #	ROOM NAME	DRAWING #
XFMR	45 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	MAIN	138	ELECTRICAL ROOM 2	E4.01
XFMR	75 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	MAIN	157	ELECTRICAL ROOM 1	E4.01
XFMR	45 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	MAIN	157	ELECTRICAL ROOM 1	E4.01
XFMR	30 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	MAIN	116	UNIFORM STORAGE & WASHER/DRYER	E2.02
XFMR	30KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	LOWER	012	POOL MECHANICAL	E2.05
XFMR	225 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	LOWER	010	ELECTRICAL ROOM 3	E2.05
XFMR	45 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	LOWER	010	ELECTRICAL ROOM 3	E2.05
XFMR	45 KVA	480Y/277V 3PH 4W	208Y/120V 3PH 4W	DRY	150 °C	(6) 2.5%	PAD ON FLOOR	LOWER	010	ELECTRICAL ROOM 3	E2.05

FIGURE 42. TRANSFORMER SCHEDULE

MAIN RISERS AND FEEDERS – the main feeder to the Susquehanna Center comprises of a 12 way 4" PVC conduit concrete encased duct bank. This construction method was designed to provide protection to the incoming wires to the building, and can be installed underground. The type of wire contained in the main feeder could not be identified from the specifications and drawings provided.

CONDUCTORS – all conductors in the building should be made of soft drawn copper. There are certain requirements for the installation of wires and cables listed in the specifications for this project. Firstly, all wiring #14 or larger should have 98 percent conductivity, 600 insulation with type THHN wires. All wiring #8

or larger for feeders and branch circuits should be stranded. And the minimum wire sizes should be #12 for power and lighting circuits and #14 for control circuits.

CONDUIT – there are a total of 6 conduit types selected for this project. Each type of conduit has different characteristics, which is determined by wall thickness, mechanical stiffness and conduit material. Each type is chosen to be stalled in specific locations. For instance, hazardous areas will require a different conduit installation than a regular classroom.

RIGID METAL CONDUIT (RMC)

Rigid metal conduits are usually made from coated steel, stainless steel or aluminum. In this project, this type of conduit are required to be full weight, heavy wall steel, galvanized with threaded connections conforming to the latest editions and revisions of ANSI standard C-80.1 and Federal Specification WW-C-581E. Rigid metal conduits shall be used in exterior locations above grade, in damp or wet locations, within concrete floor slabs and below slabs on grade,

INTERMEDIATE METAL CONDUIT (IMC)

Intermediate metal conduits are similar to rigid metal conduits but have a slightly thinner wall and are about one third of the weight. IMCs for this project are required to be steel, galvanized with threaded connections conforming to the latest editions and revisions of the Federal Specification WW-C-581E and Underwriter's Laboratories Standard 1242. IMCs are used for crawl spaces, exposed locations up to 10' AFF and within concrete and masonry exterior walls.

ELECTRICAL METAL TUBING (EMT)

Electrical metal tubing are thin walled conduits that cannot be threaded but may possibly be connected to threaded fittings with clamps. For this project, they are required to be galvanized and conforming to the latest editions and revision of ANSI Standard C80.3, Federal Specification WW-563, and Underwriter's Laboratories Standard 797. Additionally, expansion fitting with bonding jumpers should be used when the conduit passes through a building's expansion joint. Steel concrete tight compression type box connections and couplings with nylon insulating throats

are required. Applications for EMTs include exposed locations above 10' AFF and dry concealed locations that are either accessible or non-accessible.

FLEXIBLE METAL CONDUIT (FMC)

Flexible metal conduits are made from helix shaped coils of aluminum or steel that is self-interlocking. They are primarily used in dry areas where the installation of EMTs or other types of conduits are not applicable. The required FMC conduit for this project shall be steel, metal strip self-interlocked construction with a zinc coating. FMCs should conform to the latest editions and revisions of Federal Specification WW-C566B and Underwriter's Laboratories Standard for Flexible Steel Conduit, UL1. Applications include connections to motor terminal boxes, control panels mounted on equipment, dry type transformers, vibration producing equipment in dry locations, recessed lighting fixtures, and between fixture and its respective outlet box. Another type of FMCs are liquidtight flexible metal conduits (LMFC) which should be type UL with a PVC cover conforming to UL360. Applications include connections to motor terminal boxes, control panels mounted on equipment, dry type transformers, and vibration producing equipment in damp and wet locations.

RIGID NONMETALLIC CONDUIT (RNMC)

Rigid nonmetallic conduits are usually made of some sort of plastic material. PVC material is used for this project and requires either heavy wall Schedule 40 or Schedule 80 conforming to the latest editions and revisions of Federal Specification WC-1094, Underwriter's Laboratories Standard UL651, and NEMA Standard TC-2. RNMCs are applicable within concrete floor slabs, below slabs on grade, direct buried, exterior, feeders and branch circuits and ducts encased in a minimum of 2 inch thick concrete.

RIGID ALUMINUM CONDUIT (RAC)

Rigid aluminum conduits are similar to rigid metal conduits but the only difference is that they are made from aluminum. RACs are usually used instead of RMCs in areas that require a higher resistance to corrosion. RACs are not used in this project.

RECEPTACLES – all receptacles used for this project shall be Specification Grade and white in color unless it is specified to be different. Specification grade receptacles are receptacles that comply with US Federal Specification W-C-596 'General Electrical Power Connectors'. The compliance means that Spec. grade receptacles are built for the required demand of durability and life in mind. There are two varieties of receptacles that are installed in the facility. The first type is convenience receptacles and they should be duplex, grounding type, 20A, 2P, 3W, 125V, NEMA 5-20R, straight blade, made from nylon or high strength thermoplastic material. The second type are safety receptacles which shall be tamper resistant and incorporate a dual shutter system to prevent the insertion of foreign objects. Characteristics of the safety receptacles are the same as convenience receptacles.

SWITCH AND RECEPTACLE FACEPLATES – as noted in the specifications, all switch and receptacle faceplates shall be Lutron Nova T Style, which are standard plastic faceplates.

MOTOR STARTERS

FRACTIONAL HORSEPOWER STARTERS
A fractional horsepower starter is any electric motor starter with a rated output of 746 watts or less. They should be used for single phase motors except where indicated.

COMBINATION STARTERS
Combination starters provide overcurrent protection in the form of fuses and circuit breakers contained in the equipment. Combination starters for this project should integrate a motor circuit protector that should have a minimum short circuit rating of 42,000A at 480V.

VARIABLE FREQUENCY DRIVES (VFD)
Variable frequency drives is a type of motor that drives an electric motor by adjusting the input frequency and voltage. Load requirements can be matched by varying the speed of the motor driven equipment. As a result, VFD driven equipment will not have to run at full speed, which can significantly reduce costs and power consumption. VFDs for this project shall be pulse width modulated with an input power factor greater than 0.95 at all operating speeds and loads, and an efficiency of 96% or greater at rated output.

UNINTERRUPTED POWER SUPPLY (UPS) - UPS systems in the Susquehanna Center are only connected to telecommunication systems to provide short term uninterrupted power supply. The specific type of UPS system installed is unknown

through the drawings and specifications provided, but can be identified as a 30A, 208V rack mounted UPS.

OPTIONAL BACK-UP POWER

The 60KW, 75KVA, 480/277V, 3PH, 4W diesel fueled emergency back-up generator serves three panels (panels ELP, ERP, ERPA) during power outages to distribute power to critical equipment throughout the building, such as emergency lighting, lift stations, well pumps, well phase monitors, auto doors, fire alarms, access control systems, and air conditioning units. Telecommunication systems are the only loads served with a UPS system. (Please see FIGURE. 37, FIGURE 38, & FIGURE 39 for loads, voltage and phase).

COMMUNICATION SYSTEMS

TELEPHONE / DATA – all telephone, voice/data and video systems information are found in SECTION 16720 of the specifications of this project. Located throughout the building, telecommunications and data systems provide an important means of information processing and transferring.

FIRE ALARM – the fire alarm system integrated in the Susquehanna Center will be a microprocessor based, power limited, supervised, 24 VDC, non-coded system. The system is capable of providing an integral clock and calendar, alarm verification, and user defined automatic voice evacuation message functions. Since the fire alarm is connected to several electrical systems, the activation of the system will cause a shutdown in the HVAC system, automatic release of auto doors, elevator recall, and close smoke dampers in the building. Additionally, attention signals will be broadcasted throughout the building through the overhead paging and intercom system.

OVERHEAD PAGING / INTERCOM – overhead paging and intercom serve to provide announcements through loudspeakers and microphones in the building. Such systems are specified in SECTION 11130 of the specifications of this project.

ACCESS CONTROL – the access control system provides controlled access, security and safety of building occupancy and is identified in SECTION 08720 of project specifications. The system utilizes the Best Access Systems Integrated Solutions (B.A.S.I.S) which provides manual and automatic alarm capabilities and access validation control functions.

SECURITY – CCTVs located throughout the building, specifically in building entrances and corridors are installed to provide intrusion detection and maximum security and safety to the occupants and the building.

ELECTRICAL AND COMMUNICATION SYSTEMS OCCUPIED SPACE

The total area occupied by electrical and communication systems in the Susquehanna Center are relatively small, with a total calculated occupied area of 13,050 SF, distributed amongst 7 spaces, and only occupy 12% of the total area of the entire facility. A tabulation of the breakdown of the square footages of each space is provided below.

ROOM #	NAME	AREA
010	ELECTRICAL ROOM 3	360 SF
012	POOL MECHANICAL	6110 SF
116	UNIFORM STORAGE & WASHER/DRYER	590 SF
135	FITNESS AND WEIGHT ROOM	5560 SF
138	ELECTRICAL ROOM 2	240 SF
157	ELECTRICAL ROOM 1	120 SF
165A	STORAGE CLOSET	70 SF
	TOTAL OCCUPIED SPACE	**13050 SF**

FIGURE 43. OCCUPIED SPACE BREAKDOWN AND TOTAL OCCUPIED SPACE

The total occupied space by electrical and communication systems can be calculated as follows:

Total occupied area / Total building area = 13,050 SF / 106,955 SF = 0.12 = 12%

ENERGY COST SAVINGS TECHNIQUES

The balance between providing efficiency, reliability, quality, and energy costs are carefully considered in every architectural project through the collaboration, discussion between owners, architects, engineers, contractors, and many other various people behind the scenes. As much as we like to create the 'perfect' building, the truth is, it is actually very difficult due to design issues from the various fields in architectural engineering. However, techniques can be introduced to provide the best possible solution to the problem. Energy consumption has always been a highly talked about subject, as most owner's

would prefer to have a building that requires little maintenance and low energy consumption. Energy consumption depends on factors, such as, equipment size, rating, and also the size and type of building. One of the energy cost savings technique implemented by the Susquehanna Center is the installation of a solar photovoltaic array system, which generates power that can either be used instantly or stored for future use.

Furthermore, the project aims to achieve a LEED silver rating by following USGBC's practices and procedures by using high efficient HVAC systems, low flow plumbing fixtures, an indoor air quality management plan, use of recycled materials, low cut off-site lighting fixtures, and occupancy sensors integrated into energy efficient lighting fixtures.

SECTION III

ESTIMATE VS. ACTUAL CONNECTED BUILDING LOADS

An estimation of the total connected building loads was done in SECTION I of this report, and was conducted using two methods. The first method provides a basic preliminary load calculation based on the building type, while the second method uses a more in-depth analysis of the individual equipment connected building loads and demand factors. In SECTION II of this report, the actual connected building load was calculated with the provided information based on documentations in the electrical drawings of the project. Comparisons between the preliminary load calculation and the actual building connected load suggest minor differences in power consumption.

The first method based on building type was calculated to be 1390.415 kVA. This method provides the most basic load calculation and seems to ignore many of the important elements such as the variations in equipment loads in VA/SF and demand factors. Therefore, a difference between the estimated and actual connected load is apparent.

The second method uses a more detailed approach in which different equipment loads were analyzed with their respective VA/SF values. Demand factors were also included to provide the most accurate load estimation. The calculated connected load using this method was 2469 kVA, in comparison to the actual building connected load of 2624 kVA. This method provides a relatively accurate approximation because VA/SF values for specific equipment loads were taken into account, as well as an appropriate demand factor application.

A possibly better estimation of the total connected building load would be to analyze every single piece of equipment and total their loads with appropriate demand and power factors, instead of using the total building area.

POWER COMPANY RATE SCHEDULE

There are a number of rate schedules provided by BGE. However, the most appropriate electrical rate schedule is still the one utilized currently by the Susquehanna Center, which is Schedule GL. Schedule GL is used when the general service is considered large; an established monthly demand of 60 kW or more. Other commercial, industrial and lighting rates provided by BGE seem to be inappropriate due to the building type, service type, and power usage.

There are potential riders in Schedule GL that could be used to provide cost savings. Rider 1 is a Standard Offer Service (SOS) which includes generation and transmission demand and energy charges. An advantage of SOS service is that customers are allowed to choose an alternative electricity supplier that may offer lower rates than BGE's SOS service. BGE remains the primary energy delivery company even if this does occur and will continue to respond to power outages and emergency situations.

BUILDING UTILIZATION VOLTAGE

After analyzing the actual building utilization voltages in the Susquehanna Center, many of the as-designed electrical and mechanical equipment utilize an appropriate and energy efficient design concept. Lighting loads served at 277V 1PH allows for more attached lighting fixtures per circuit breaker and longer wire runs. Additionally, it allows for a cheaper and more efficient system because there is less of a voltage drop and uses less current than a 120V system. Lighting fixtures in classrooms and other related spaces are also equipped with occupancy and vacancy sensors, which would help reduce power consumption and cost while greatly improving reliability and flexibility. Additionally, mechanical equipment is usually served according to the specified rated utilization voltage and power. By possibly selecting a smaller equipment size or a better alternative to the current installed equipment, cost savings can be improved. Sub-metering can be used to help allocate costs appropriately and encourages conservation of energy by assisting the decision making process about energy upgrades and conservation investments.

EMERGENCY POWER SYSTEM

There are three types of generators that the project can possibly use. The as-designed emergency back-up generator is a diesel fuel pad mounted generator. This type of generator is usually very reliable and most appropriate for continuous duty. Additionally, it is considered to be relatively safer than gasoline generators due to its lower fire and explosion hazard. Gasoline generators also produce less power compared to diesel fueled generators. Another type is the gas turbine generator, which is compact and lightweight. Because of this, gas turbine generators can be installed in relatively inaccessible and restricted locations. However, due to the time delay which can take up to 2 minutes to start, gas turbine generators are generally not appropriate for emergency back-up generators. Therefore, the as-designed emergency power system is the best possible design solution out of the three alternatives mentioned.

MAIN SERVICE DISTRIBUTION EQUIPMENT AND OTHERS

The only change that would possibly improve the reliability and flexibility of the electrical system is to use a double-ended substation instead of a single-ended substation. Double-ended substations are typically more reliable for critical loads due to the design of the equipment. Two transformers are usually connected symmetrically in two areas to connected independent sources on the primary side and to a common switchgear with a main-tie-main breaker on the secondary side. Furthermore, loads can be independently powered from both transformers in an open-tie operation or powered by one transformer in a closed-tie operation when the other transformer is under maintenance.

OPTIONAL BACK-UP POWER / UPS SYSTEMS

As discussed in SECTION I, two options of optional back-up power can be utilized. Although UPS systems are only used for telecommunication purposes in the facility, redundancy can be improved by connecting UPS systems to other critical loads in the building.

COST OF OWNERSHIP

There are many costs related to the construction and maintenance of the building. As discussed in SECTION I – PRIORITY ASSESSMENT, initial and long term ownership costs are determined by careful selection of equipment and maintenance of the facility. Therefore, the costs that go into the building and the performance of the building must be carefully evaluated. Ownership costs can be improved by selecting higher efficiency and quality systems, which might result in higher initial costs but will significantly reduce the maintenance required for equipment to perform optimally. For instance, by installing higher efficiency transformers, less power will be lost during the step-down process, while more clean power can be converted.

There are three types of UPS systems that can be used: offline / standby, line-interactive, and online / double conversion. Each type of UPS system has different characteristics which are suitable for different applications and has its own advantages and disadvantages. The line-interactive UPS system seems to be the most efficient system because it includes a tap changing transformer which regulates voltage based on the input voltage. Although this can cause premature battery failure, this system can be designed so that a failure will still

allow power flow. Such design apparently allows for a very efficient and highly reliable system.

There are three types of motor starters installed in the Susquehanna Center. Each type of motor starter is installed to specific motors to provide the most appropriate start-up. Therefore, all three types of motor starters should be used to maximize performance. Fractional Horsepower Starters are small and should be used for single phase motors. Combination Starters provide overcurrent protection in the form of fuses and circuit breakers which are already built into the equipment. Variable Frequency Drives have the ability to vary input frequency and voltage to match load requirements, which prevents equipment from running at full load all the time, decreasing power consumption.

ENERGY COST SAVINGS TECHNIQUES

As mentioned in SECTION II – ENERGY COST SAVINGS TECHNIQUES, the Susquehanna Center already incorporates many cost saving techniques. The solar photovoltaic array system installed in the roof can dramatically reduce costs by generating power through the sun, a natural and highly efficient energy source. Occupancy and vacancy sensors are integrated and calibrated with highly efficient lighting fixtures so that loads can be adjusted and reduced. Additionally, by obtaining a LEED silver certification also means that the facility designed will have to follow strict practices and procedures enforced by the USGBC. LEED certification has a large impact on the electrical systems design of the Susquehanna Center, since electrical systems will have to be designed to provide healthy indoor environments for occupants while maintaining a high performance without effecting the environment.

CONCLUSION

The analysis of the Susquehanna Center provided a very detailed understanding of the electrical systems design of the facility. Conclusion of the overall performance, functionality, and efficiency of the building suggests that the Susquehanna Center is a high quality facility that takes into account the environmental impact as well as the occupants' physical and psychological well-being. Nevertheless, potential changes on the electrical system can be made to achieving the 'perfect' facility. A LEED silver certification further guarantees that the Susquehanna Center is designed to provide the best for the public.

G E N E R A L S E R V I C E L A R G E – E L E C T R I C

SCHEDULE GL

Availability: For use for all purposes, where the Customer has established a monthly demand of 60 kW or more. The applicable Market-Priced Standard Offer Service Type is determined as follows.

Type II- Market-Priced Service: For non-residential customers not eligible for Type 1 SOS whose PJM capacity peak load contribution is less than 600kW, unless excluded by the Phase I Settlement Agreement in Case No.8908.

Delivery Voltage: Service at Secondary Distribution Systems voltages, or at Primary Systems voltages where the Customer does not qualify for Schedule P.

Monthly Net Rates:

Delivery Service Customer Charge: $ 110.00 per month,

Less: Competitive Billing (where applicable) $ 0.47 per month, plus,
(see Section 7.7 for details)

Secondary Service Customers:

Demand Charges:

Transmission Market-Priced Service Charge can be found on www.bge.com and Rider 1 – Standard Offer Service.

Delivery Service: $ 2.76/kW

Energy Charges:

Generation Market-Priced Service Charges can be found on www.bge.com and Rider 1 – Standard Offer Service.

Delivery Service Charge: 0.01468 $/kWh

(Excludes Rider 10 – Administrative Cost Adjustment)

Minimum Charge: Net Delivery Service Customer Charge.

Billing Seasons: Summer rates are billed for usage from June 1 through September 30.
Non-Summer rates are billed for usage from October 1 through May 31.

Rating Periods:

Summer

Peak-Between the hours of 10am and 8pm on weekdays, excluding the National holidays listed below.

Intermediate - Between the hours of 7 am and 10 am, and the hours of 8 pm and 11 pm on weekdays, excluding the National holidays listed below.

Off-Peak - All times other than those defined for the On-Peak and Intermediate-Peak rating periods.

Non-Summer

Peak - Between the hours of 7 am and 11 am, and the hours of 5 pm and 9 pm on weekdays, excluding the National holidays listed below.

Intermediate - Between the hours of 11 am and 5 pm on weekdays, excluding the National holidays listed below.

Off-Peak - All times other than those defined for the On-Peak and Intermediate-Peak rating periods.

The Non-Summer time periods shown above will begin and end one hour later for the period between the second Sunday in March and the first Sunday in April, and for the period between the last Sunday in October and the first Sunday in November.

Holidays:

All hours on Saturdays and Sundays and the following National holidays are Off-Peak: New Year's Day, President's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving, Christmas, and the Monday following such of these as fall on Sunday.

Billing Demand: The maximum 30-minute measured demand, adjusted to the nearest whole kW, in each applicable rating period for the month. Measured demand is the Customer's rate of use of electric energy as shown by or computed from readings of the Company's demand meter. Generation and Transmission Demand are billed for each kW of billing demand occurring during the Peak rating period. Delivery Service Demand is for each kW of Billing Demand recorded during any rating period.

Primary Service Customers: For Customers taking service at Primary Systems voltages, Type II Secondary Service rates apply for Generation and Transmission Services. The Delivery Service Demand and Energy Charge rates are as follows.

Delivery Service Demand Charge: $ 2.65/kW

Delivery Service Energy Charge: 0.01409 $/kWh

(Excludes Rider 10 – Administrative Cost Adjustment)

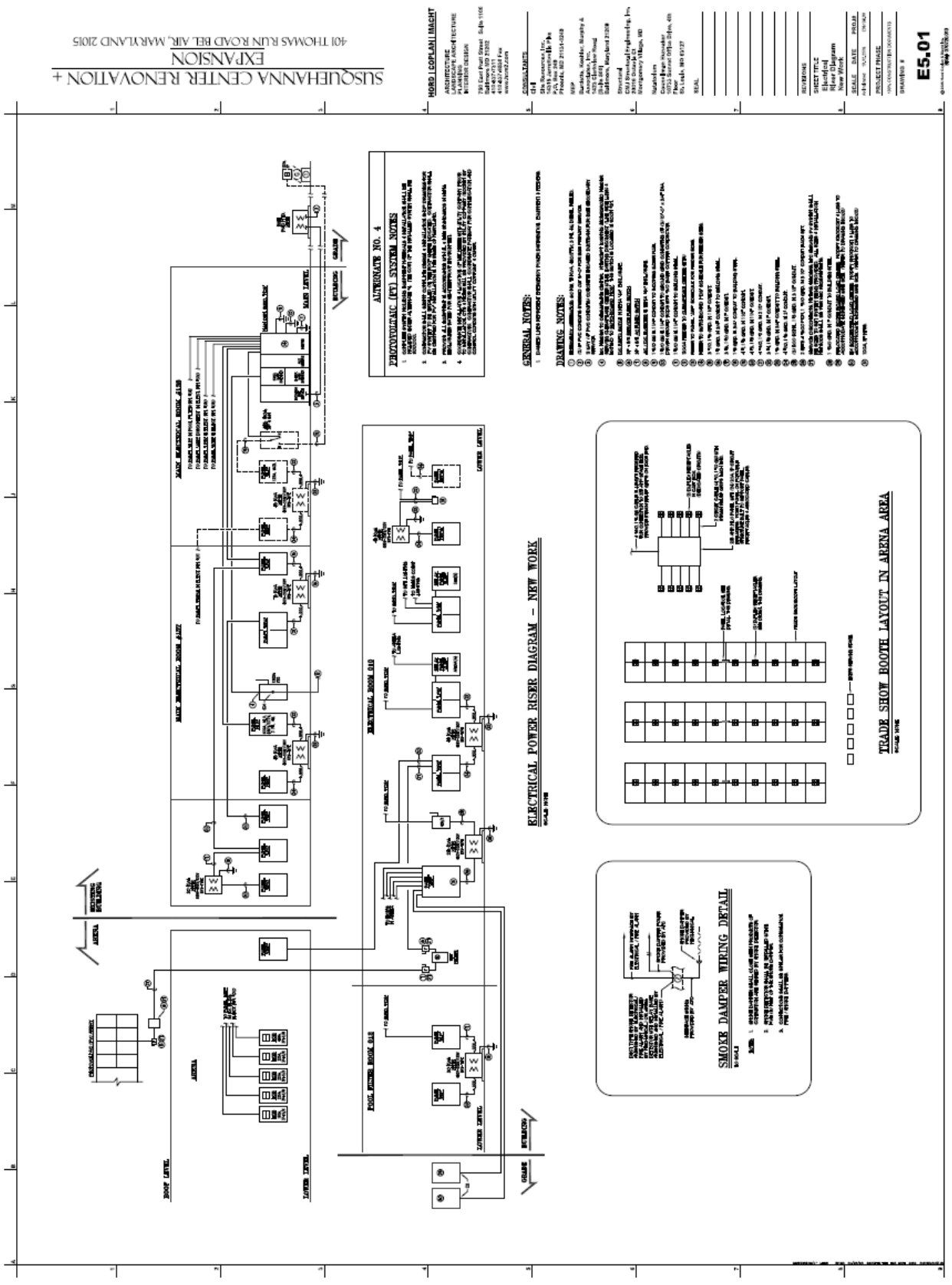
Late Payment Charge: Standard. (Sec. 7.4)

Payment Terms: Standard. (Sec. 7)

Term of Contract: The initial term of contract is 2 years where additional main facilities are required for supply. Otherwise, the term of contract is one year. After the initial term of contract, the contract may be terminated by at least 30 days' notice from the Customer.

Subject to Riders applicable as listed below:

1. Standard Offer Service
2. Electric Efficiency Charge
3. Miscellaneous Taxes and Surcharges
7. Economic Development
8. Energy Cost Adjustment
9. Customer Billing and Consumption Data Requests
10. Administrative Cost Adjustment
11. Measured Demand
13. Change of Schedule
17. Best Efforts Service
18. Net Energy Metering
19. Demonstration and Trial Installations
21. Billing in Event of Service Interruption
22. Minimum Charge for Short-Term Uses
23. Advanced Meter Services
24. Load Response Program
25. Monthly Rate Adjustment
28. Small Generator Interconnection Standards
28. Small Generator Interconnection Standards
29. Rate Mitigation and Recovery Charge Adjustment
30. Demand Resource Surcharge


SUSQUEHANNA CENTER RENOVATION + EXPANSION
401 THOMAS RUN ROAD BEL AIR, MARYLAND 21015
HORD | COPLAN | MACHT
ALTERNATE NO. 4
PHOTOVOLTAIC (PV) SYSTEM NOTES
GENERAL NOTES:
DRAWING NOTES:
ELECTRICAL POWER RISER DIAGRAM - NEW WORK
TRADE SHOW BOOTH LAYOUT IN ARENA AREA
SMOKE DAMPER WIRING DETAIL
E5.01