

Technical Assignment 2
Electrical System Existing Conditions and Building Load Summary Report



Villanova University: School of Law
Villanova, PA

Jason Greer
Lighting/Electrical Option

November 2, 2007

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Villanova, PA

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Executive Summary

The following Electrical System Existing Conditions and Building Load Summary Report analyzes the current conditions regarding the electrical system of the Villanova University: School of Law. This report analyzes all components of the electrical system as well as studies the sizing of the service entrance equipment. The systems that were analyzed are, but are not limited to the service entrance, equipment size, the fire alarm system, the security system, the lighting systems, the mechanical equipment sizes and the telecommunication system. A single line diagram was produced to help better understand the power distribution system of the law school.

Upon completion of the report, it was shown that the switchgear was sized correctly for this particular building. The 3000A switchboard will protect the load that was calculated in all three of the sizing methods. The transformer is undersized but as was discussed in class, this is a practice that is often used. A transformer can withstand short term overloads as the heat in the transformer is the issue unlike tripping in most other equipment. Further downstream, it was also discovered that all busses and over-current devices were sized correctly as well.

Any relevant information that is not located in the body of this report can be found in the appendices that follow. The information located in the appendices include the switchgear detail and schedule, the motor control center and schedule, the luminaire schedule, the mechanical equipment schedule, all service entrance calculations and the single line diagram.

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Summary Description of Distribution System

The power distribution system for the Villanova University: School of Law is a simple radial system. The electric service is connected to the university's 13.2kV underground primary distribution system with a 15kV primary loop switch.

The service is provided by a 2000kVA, 13.2kV primary voltage to 480Y/277V secondary voltage, 3 phase, 4 wire transformer located outside the building. A 3000A, 480Y/277V, 3 phase, 4 wire switchboard is located in the sub-basement and will distribute power to the building. The switchboard provides power to elevators, the chiller plant, AHUs, and the lighting and receptacle panels. The receptacle panels are supplied through a 480V to 208V transformer.

Service Entrance

The service for the law school is connected to the university's 13.2kV underground primary distribution system. A 2000kVA, 13.2kV, 3 phase, 3 wire to 480V, 3 phase, 4wire transformer steps to power down before it enters the building in the sub-basement. In the sub-basement there is a 3000A, 480Y/277V, 3P, 4W switchboard that distributes the power to the rest of the building. The switchboard is of circuit breaker type. It is metal enclosed and is front accessible. The internal bus bars are tinned copper with 100% neutral and ground bus.

Since this is a university building that is connected to the university's primary distribution system, the university has supplied all equipment and is responsible for the maintenance.

Voltage Systems

The voltage systems for this building are 480Y/277V, 3P, 4W and 208Y/120V, 3P, 4W. The 480V system provides power to mechanical loads, elevators, motors, other large equipment and non-incandescent lighting loads. The 208V system provides power to smaller equipment, receptacles and incandescent lighting loads.

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Transformers

| INDIVIDUAL TRANSFORMER SCHEDULE | | | | | | | | |
|---------------------------------|-------------------|-------------------|----------|----------------------------------|------------|----------------------------------|---------------------------------|---------|
| TAG | PRIMARY VOLTAGE | SECONDARY VOLTAGE | SIZE | TYPE | TEMP. RISE | TAPS | MOUNTING | REMARKS |
| X-1 | 13.2kV, 3P, 3W | 480Y/277V, 3P, 4W | 1500kVA | Silicone-based dielectric filled | 55°C | (4) 2.5% Taps (2) Up & (2) Dn | Concrete Pad Mount (outside) | |
| XS-1 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 75kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| XS-2 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 75kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| XS-3 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 45kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| XS-4 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 45kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| XB-1 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 30kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X1-1 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 75kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X1-2 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 112.5kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X2-1 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 45kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X2-2 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 112.5kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X3-1 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 45kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |
| X3-2 | 480Y/277V, 3P, 4W | 208Y/120V, 3P, 4W | 112.5kVA | Dry Type | 115°C | (6) 2.5% Taps (2) Up & (4) Dn | Pad mounted, vibration isolated | |

Emergency Power System

The emergency power for the law school is provided by a 300kW, 480Y/277V, 3P, 4W diesel generator. There is a 300 gallon tank that will hold the diesel fuel. 300 gallons of fuel will allow this generator to provide 13 hours of operation when the primary power is down. The generator and tank are located by the loading dock.

The emergency system consists of a life safety branch and a non-life safety branch. The life safety branch is provided with an automatic transfer switch which will serve all life safety loads which includes all emergency lighting, fire alarm system, and fire pump.

The non-life safety branch is provided with an ATS also and will serve all receptacles for the telecommunication equipment room.

ATS's are completed with all relays, timers and associated control circuitry to automatically start the engine, transfer the load upon primary power failure. Upon restoration of primary power, the ATS will transfer load back and stop the engine

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Over-current Devices

Service Generator

15kV primary fuse assembly. Current-limiting fuses are 50kA RMS at specified voltage.

Switchgear

See Appendix A for over-current specs for switchgear

Motor Control Center

See Appendix B for over-current specs for MCC

Panel Boards

Typical circuit breakers

Locations of Switchgear

| Major Equipment Locations | | | | | | |
|----------------------------------|--|--------------------|------------------|--------------------|------------------------|-----------------------|
| Equipment Tag | Type | Floor Level | Room Name | Room Number | 1/8th Scale Dwg | Detail Drawing |
| X-1 | Service Transformer | Outside | Outside | Outside | E5.1 | N/A |
| XS-1 | Stepdown Transformer | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| XS-2 | Stepdown Transformer | Sub-basement | Electrical Room | B02 | E2.0 | N/A |
| XS-3 | Stepdown Transformer | Sub-basement | Electrical Room | B02 | E2.0 | N/A |
| XS-4 | Stepdown Transformer | Sub-basement | Electrical Room | B02 | E2.0 | N/A |
| XB-1 | Stepdown Transformer | Basement | Electrical Room | L29 | E2.0 | N/A |
| X1-1 | Stepdown Transformer | First | Electrical Room | 188 | E2.1 | N/A |
| X1-2 | Stepdown Transformer | First | Electrical Room | 119A | E2.1 | N/A |
| X2-1 | Stepdown Transformer | Second | Electrical Room | 266 | E2.2 | N/A |
| X2-2 | Stepdown Transformer | Second | Electrical Room | 219A | E2.2 | N/A |
| X3-1 | Stepdown Transformer | Third | Electrical Room | 366 | E2.3 | N/A |
| X3-2 | Stepdown Transformer | Third | Electrical Room | 319A | E2.3 | N/A |
| MDB | Switch Board | Sub-basement | Electrical Room | B02 | E2.0 | E6.1 |
| EDP-BS | Emergency Dist. Panel | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| MCC | Motor Control Center | Basement | Mechanical Room | L34 | E2.0 | E6.1 |
| G-1 | Emergency Generator | Outside | Outside | Outside | E5.1 | N/A |
| ATS-NLS | Auto. Trans. Switch Non-Life Safety | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| ATS-LS | Auto. Trans. Switch Life Safety | Sub-basement | Electrical Room | B02A | E2.0 | N/A |

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| Panel Board Locations | | | | | | | | |
|-----------------------|------------------------------|---------|-----------|--------------|---------------------|-------------|---------|----------------|
| Equipment Tag | Type | Voltage | Main Size | Floor Level | Room Name | Room Number | Dwg No. | Detail Drawing |
| ENP-MDF | Non-Life Safety Emerg. Panel | 208V | 100 | Sub-basement | MDF | B01 | E2.0 | N/A |
| LP-BS | Lighting Panel | 480V | 225 | Sub-basement | Electrical Room | B02 | E2.0 | N/A |
| ENDPH-BS | Non-Life Safety Emerg. Panel | 480V | 225 | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| ENDPL-BS | Non-Life Safety Emerg. Panel | 208V | 400 | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| ENP-BS | Non-Life Safety Emerg. Panel | 480V | 100 | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| ELP-BS | Life Safety Emerg. Panel | 480V | 100 | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| ERP-BS | Emergency Receptacle Panel | 208V | 100 | Sub-basement | Electrical Room | B02A | E2.0 | N/A |
| LP-BN | Lighting Panel | 480V | 225 | Basement | Electrical Room | L29 | E2.0 | N/A |
| RP-BN | Receptacle Panel | 208V | 100 | Basement | Electrical Room | L29 | E2.0 | N/A |
| ELEV-BN | Elevator Panel | 480V | 400 | Basement | Elev. Mach. Room | L19 | E2.0 | N/A |
| RP-K(sec.1) | Receptacle Panel (kitchen) | 208V | 225 | Basement | Kitchen | L15 | E2.0 | E2.5 |
| RP-K(sec.2) | Receptacle Panel (kitchen) | 208V | 225 | Basement | Kitchen | L15 | E2.0 | E2.5 |
| RP-BSA | Receptacle Panel | 208V | 100 | Basement | Electrical Closet | N/A | E2.0 | N/A |
| RP-BS | Receptacle Panel | 208V | 450 | Basement | Electrical Closet | N/A | E2.0 | N/A |
| LP-1N | Lighting Panel | 480V | 400 | First | Electrical Room | 188 | E2.1 | N/A |
| RP-1NA | Receptacle Panel | 208V | 400 | First | Electrical Room | 188 | E2.1 | N/A |
| ELP-1N | Emergency Lighting Panel | 480V | 100 | First | Electrical Room | 188 | E2.1 | N/A |
| RP-1NB | Receptacle Panel | 208V | 100 | First | Electrical Closet | N/A | E2.1 | N/A |
| LP-1S | Lighting Panel | 480V | 400 | First | Electrical Room | 119A | E2.1 | N/A |
| RP-1SA-1 | Receptacle Panel | 208V | 225 | First | Electrical Room | 119A | E2.1 | N/A |
| RP-1SA-2 | Receptacle Panel | 208V | 225 | First | Electrical Room | 119A | E2.1 | N/A |
| RP-1SA-3 | Receptacle Panel | 208V | 225 | First | Electrical Room | 119A | E2.1 | N/A |
| ENP-1S | Non-Life Safety Emerg. Panel | 208V | 100 | First | Electrical Room | 119A | E2.1 | N/A |
| ELP-1S | Life Safety Emerg. Panel | 480V | 100 | First | Electrical Room | 119A | E2.1 | N/A |
| ERP-1S | Emerg. Receptacle Panel | 208V | 100 | First | Electrical Room | 119A | E2.1 | N/A |
| RP-1SB | Receptacle Panel | 208V | 100 | First | Electrical Closet | N/A | E2.1 | N/A |
| ENP-MDF2 | Non-Life Safety Emerg. Panel | 208V | 100 | First | Network Server Room | 146 | E2.1 | N/A |
| LP-2N | Lighting Panel | 480V | 225 | Second | Electrical Room | 266 | E2.2 | N/A |
| RP-2NA | Receptacle Panel | 208V | 225 | Second | Electrical Room | 266 | E2.2 | N/A |
| RP-2NB | Receptacle Panel | 208V | 100 | Second | Electrical Closet | N/A | E2.2 | N/A |
| LP-2S | Lighting Panel | 480V | 225 | Second | Electrical Room | 219A | E2.2 | N/A |
| RP-2SA-1 | Receptacle Panel | 208V | 225 | Second | Electrical Room | 219A | E2.2 | N/A |
| RP-2SA-2 | Receptacle Panel | 208V | 225 | Second | Electrical Room | 219A | E2.2 | N/A |
| RP-2SA-3 | Receptacle Panel | 208V | 225 | Second | Electrical Room | 219A | E2.2 | N/A |
| RP-2SB | Receptacle Panel | 208V | 100 | Second | Electrical Closet | N/A | E2.2 | N/A |
| LP-3N | Lighting Panel | 480V | 225 | Third | Electrical Room | 366 | E2.3 | N/A |
| RP-3NA | Receptacle Panel | 208V | 225 | Third | Electrical Room | 366 | E2.3 | N/A |
| ELP-3N | Life Safety Emerg. Panel | 480V | 100 | Third | Electrical Room | 366 | E2.3 | N/A |
| RP-3NB | Receptacle Panel | 208V | 225 | Third | Electrical Closet | N/A | E2.3 | N/A |
| LP-3S | Lighting Panel | 480V | 100 | Third | Electrical Room | 319A | E2.3 | N/A |
| RP-3SA-1 | Receptacle Panel | 208V | 225 | Third | Electrical Room | 319A | E2.3 | N/A |
| RP-3SA-2 | Receptacle Panel | 208V | 225 | Third | Electrical Room | 319A | E2.3 | N/A |
| RP-3SA-3 | Receptacle Panel | 208V | 225 | Third | Electrical Room | 319A | E2.3 | N/A |
| ENP-3S | Non-Life Safety Emerg. Panel | 208V | 100 | Third | Electrical Room | 319A | E2.3 | N/A |
| ELP-3S | Life Safety Emerg. Panel | 480V | 100 | Third | Electrical Room | 319A | E2.3 | N/A |
| ERP-3S | Emergency Receptacle Panel | 208V | 100 | Third | Electrical Room | 319A | E2.3 | N/A |
| RP-3SB | Receptacle Panel | 208V | 100 | Third | Electrical Closet | N/A | E2.3 | N/A |

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Power Factor Correction

This project has no capacitors for power factor correction.

Design Issues

This issue is more of a communication issue than a design issue but I will address it here nonetheless. During the completion of the construction documents, the owner added additional receptacle multiple times. This resulted in panels that are lacking in spares and spaces. This issue could have been avoided if during DD the proper amount of receptacles were discussed.

Lighting Loads

The lighting system in this building is mostly fluorescent lighting. There is some accent lighting that is incandescent. Appendix C lists all the existing lighting equipment in the law school.

The spaces in the Villanova University: School of Law utilize occupancy sensors, photocells, time switches to meet ASHRAE 90.1 automatic shutoff requirements. The main spaces are controlled using centralized lighting control panels that turn the lights on at a set time and off at another.

Mechanical and Other Loads

See Appendix D

Service Entrance Size

| Service Entrance Summary | | J. Greer |
|--------------------------|------------------|-------------------|
| Phase | Total Load (kVA) | Total Current (A) |
| Concept | 1541 | 1854 |
| Design Development | 2504 | 3012 |
| Construction | 2376 | 2858 |
| Design Equipment | Transformer | Switchboard |
| | 1500kVA | 3000A |

See Appendix E for more detailed calculations.

Utility Company Information

The following rate structure was obtained from PECO's website, <http://www.exeloncorp.com/ourcompanies/peco>. This structure applies to customers that require untransformed power service from the primary supply lines of PECO's

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distribution system. The customer installs, owns and maintains any transforming, switching and other receiving equipment required.

MONTHLY RATE TABLE

FIXED DISTRIBUTION SERVICE CHARGE: \$279.67

METERING AND BILLING CREDITS: A customer receiving Advanced Meter Services from a AMSP other than the Company will receive a credit on the Fixed Distribution Service Charge equal to the Total Metering Credit set forth for this Base Rate in Appendix B to the Joint Petition for Full Settlement. A customer receiving Consolidated EGS Billing will receive a credit on the Fixed Distribution Service Charge equal to the Billing and Collection Credit set forth for this Base Rate in Appendix B to the Joint Petition for Full Settlement.

VARIABLE DISTRIBUTION SERVICE CHARGE:

\$1.82 per kW of billing demand

1.62¢ per kWh of the first 150 hours' use of billing demand

0.96¢ per kWh of the first next 150 hours' use of billing demand

0.31¢ per kWh for additional use.

COMPETITIVE TRANSITION CHARGE:

\$3.17 per kW of billing demand

2.81¢ per kWh of the first 150 hours' use of billing demand

1.67¢ per kWh for the next 150 hours' use of billing demand

0.54¢ per kWh for additional use.

ENERGY AND CAPACITY CHARGE: The following Energy and Capacity Charges will apply to the customer if the customer receives Default PLR Service. These charges are not applicable to the customer if it obtains Competitive Energy Supply.

\$4.85 per kW of billing demand

6.07¢ per kWh of the first 150 hours' use of billing demand

4.32¢ per kWh for the next 150 hours' use of billing demand

2.59¢ per kWh for additional use.

Telecommunications/Security Systems

A duct bank for telecommunication service to the law school is provided from Villanova University's campus telecommunication network. A main telecom demarcation room is located in the basement. Two telecom rooms are located on each floor also. A complete telecom raceway system consisting of back boxes, conduits, and ladder trays are run throughout the building on each floor.

All voice and data cables are provided by others as part of a separate contract. Card access system equipment is also provided as part of a separate contract.

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Finally, a complete security raceway system is provided throughout the building where needed.

Fire Alarm System

The fire alarm system is a solid state, multiplex, addressable fire alarm system that consists of graphic annunciation panels at the entrance lobby. Manual pull stations, audio/visual devices, flow switches, tamper switches and smoke and heat detectors are located throughout the building.

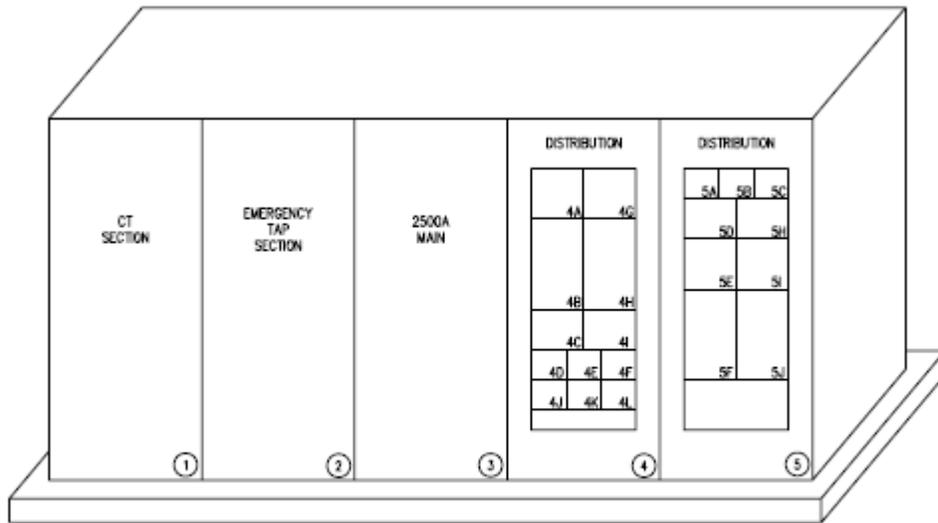
The fire alarm system is connected between the building security system and the campus central security console. The fire alarm system can be monitored through any computer and a printer can output all fire alarm activity. The smoke and heat detectors for the elevator system are interfaced with the elevator controllers for elevator recall and shut down requirements.

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Appendix A



2 SWITCHBOARD MDB ELEVATION
SCALE: 1/2" = 1'

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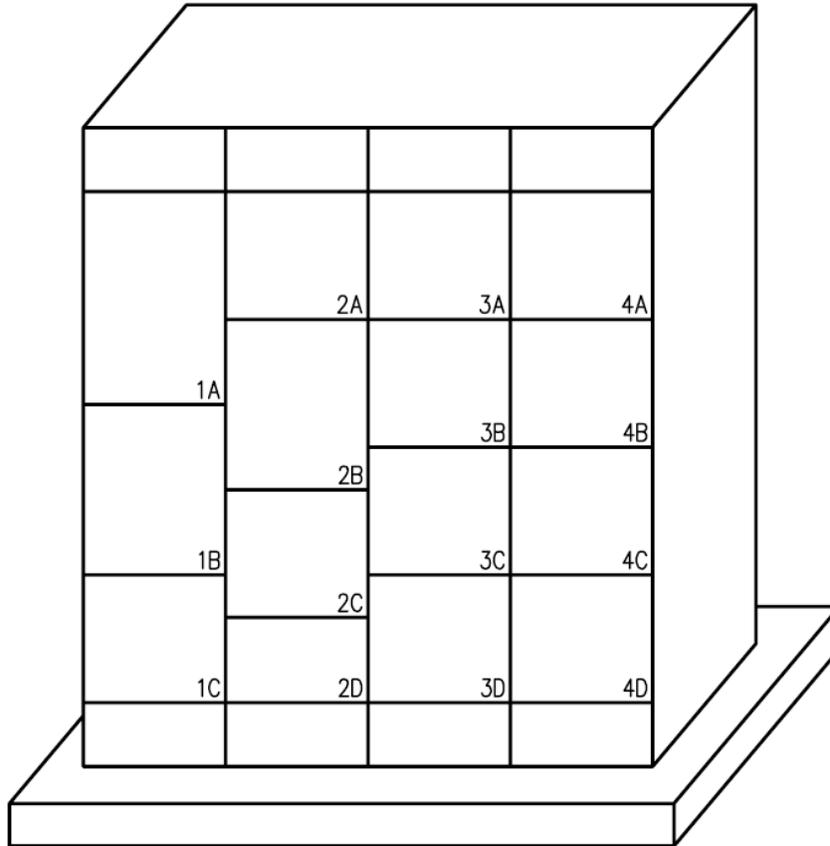
| SWITCHBOARD SCHEDULE | | | | | | | | | | | | | | | | | | | |
|----------------------|---------------------------|---------|-------|---------------------------------|-------|-------|--|---------|--|------|--|-------|--|------|--|---------|--|------------|--|
| 480/277 | | VOLTAGE | | 3 | | PHASE | | 4 | | WIRE | | 3,000 | | AMPS | | 100,000 | | AIC RATING | |
| SECTION NUMBER | BRANCH DEVICES (BREAKERS) | | | BRANCH DEVICES (FUSED SWITCHES) | | | NAMEPLATE DESIGNATION/ ITEMS SERVED | REMARKS | | | | | | | | | | | |
| | FRAME | TRIP | POLES | SWITCH | FUSES | POLES | | | | | | | | | | | | | |
| ① | - | - | - | - | - | - | CT CABINET | - | | | | | | | | | | | |
| ② | - | - | - | - | - | - | EMERGENCY TAP SECTION | - | | | | | | | | | | | |
| ③ | 2500 | 2500 | 3 | - | - | - | MAIN CIRCUIT BREAKER | - | | | | | | | | | | | |
| ④A | 400 | 400 | 3 | - | - | - | PANEL LP-1N | - | | | | | | | | | | | |
| ④B | 400 | 350 | 3 | - | - | - | PANEL LP-1S | - | | | | | | | | | | | |
| ④C | 225 | 225 | 3 | - | - | - | PANEL RP-K | - | | | | | | | | | | | |
| ④D | 225 | 225 | 3 | - | - | - | PANEL LP-BN | - | | | | | | | | | | | |
| ④E | 100 | 100 | 3 | - | - | - | ELEVATOR | - | | | | | | | | | | | |
| ④F | 225 | 225 | 3 | - | - | - | PANEL LP-BS | - | | | | | | | | | | | |
| ④G | 400 | 400 | 3 | - | - | - | PANEL ELEV-BN | - | | | | | | | | | | | |
| ④H | 800 | 600 | 3 | - | - | - | MCC | - | | | | | | | | | | | |
| ④I | 225 | 225 | 3 | - | - | - | 75 KVA XFMR FOR KITCHEN | - | | | | | | | | | | | |
| ④J | 225 | 225 | 3 | - | - | - | PANEL LP-25 | - | | | | | | | | | | | |
| ④K | 400 | 400 | 3 | - | - | - | PANEL LP-35 | - | | | | | | | | | | | |
| ④L | 100 | 100 | 3 | - | - | - | SPARE | - | | | | | | | | | | | |
| ⑤A | 100 | 100 | 3 | - | - | - | SPARE | - | | | | | | | | | | | |
| ⑤B | 100 | 100 | 3 | - | - | - | SNOW MELT 2 | - | | | | | | | | | | | |
| ⑤C | 100 | 100 | 3 | - | - | - | SPARE | - | | | | | | | | | | | |
| ⑤D | 225 | 225 | 3 | - | - | - | PANEL EDP-BS | - | | | | | | | | | | | |
| ⑤E | 800 | 750 | 3 | - | - | - | MCC | - | | | | | | | | | | | |
| ⑤F | 225 | 225 | 3 | - | - | - | PANEL DP-PH | - | | | | | | | | | | | |
| ⑤H | 100 | 75 | 3 | - | - | - | PHASE ENDPH-BS | - | | | | | | | | | | | |
| ⑤I | - | - | - | - | - | - | SPACE | - | | | | | | | | | | | |
| ⑤J | - | - | - | - | - | - | SPACE | - | | | | | | | | | | | |

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Appendix B



1 **MOTOR CONTROL CENTER ELEVATION**
SCALE: 1/2" = 1'

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| MOTOR CONTROL CENTER SCHEDULE (MCC) | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|-----------------------------|---------|-----|---------|--------------------------|------|-------|--------------|--------|--------|---------|------|--|-----|--|------|--|--------|--|------------|--|
| | | 480/277 | | VOLTAGE | | 3 | | PHASE | | 4 | | WIRE | | 600 | | AMPS | | 42,000 | | AIC RATING | |
| ITEM NO. | NAMEPLATE DESIGNATION | LOAD | | | BRANCH DEVICE (BREAKERS) | | | STARTER SIZE | PB | LTS | REMARKS | | | | | | | | | | |
| | | HP | FLA | KW/KVA | FRAME | TRIP | POLES | | | | | | | | | | | | | | |
| 1A | CH-1: ABSORPTION CHILLER | - | 9.4 | 7.8 | 30 | 15 | 3 | - | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 1B | CH-2: CENTRIFUGAL CHILLER | - | 267 | 181 | 400 | 350 | 3 | - | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 1C | CP-1: CONDENSATE PUMP | 2 | 3.4 | 2.7 | 100 | 15 | 3 | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 2A | EF-L-1: EXHAUST FAN | 2 | 3.4 | 2.7 | 100 | 15 | 3 | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 2B | CWP-1: CONDENSOR WATER PUMP | 30 | 40 | 31.8 | 100 | 90 | 3 | 3 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 2C | CWP-2: CONDENSOR WATER PUMP | 25 | 34 | 27.1 | 100 | 70 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 2D | SNOW MELT 1 | - | - | - | 225 | 225 | 3 | - | | (3)(4) | (5) | - | | | | | | | | | |
| 3A | HHWP-2: HOT WATER PUMP | 15 | 21 | 16.7 | 100 | 40 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 3B | DBP-1: BOOSTER PUMP | 10 | 14 | 3.7 | 100 | 30 | 3 | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 3C | SCHWP-1: WATER PUMP | 25 | 34 | 27.1 | 100 | 70 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 3D | SCHWP-2: WATER PUMP | 25 | 34 | 27.1 | 100 | 70 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 3E | SPARE | - | - | - | 100 | 100 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 4A | PCHWP-1: WATER PUMP | 7.5 | 11 | 8.8 | 100 | 30 | 3 | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 4B | PCHWP-2: WATER PUMP | 10 | 14 | 11.1 | 100 | 30 | 3 | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 4C | HHWP-1: HOT WATER PUMP | 15 | 21 | 16.7 | 100 | 40 | 3 | 2 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| 4D | SPACE | - | - | - | - | - | - | 1 | (1)(2) | (3)(4) | (5) | - | | | | | | | | | |
| - | - | - | - | - | - | - | - | - | | | | - | | | | | | | | | |

(1) "START" PUSHBUTTON (2) "STOP" PUSHBUTTON (3) RED "RUNNING" LIGHT (4) GREEN "STOPPED" LIGHT (5) H-O-A SWITCH