Executive Summary

This report will summarize the electrical system of the Frederick College of Cardiology. First, an estimation of the possible building electrical loads will be performed. The actual loads will be calculated in part 2. Part 3 will further critique the design and suggest potential changes which could improve building electrical performance and cost.

The Frederick College of Cardiology

Arlington Heights, IL

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PART 1

1. **Preliminary Load Calculations**

Building Square Footage: 48,500/ft^2

Building Type: Education / Office

Estimated Building Loads

12.5W/ft^2	*Total* Estimated Connected Load
6W/ft^2	*HVAC* Connected Load
4W/ft^2	*Lighting* Connected Load
1W/ft^2	*Receptacle* Connected Load
1.5W/ft^2	*Emergency* Connected Load

Demand Factor Estimation

Total Connected Load approx 1200 Amps

Total Demand Load approx 1000 Amps

Demand Factor = 1000/1200 = .8333

2. **Identify Power Company**

Commonwealth Edison

3. **Preliminary Rate Schedule**

12KV – Primary Service Voltage

4. **Building Utilization Voltage and Load Voltages**

Building Utilization Voltage:	480 Y/277 V
Lighting:	120 V
Receptacle:	120V
Mechanical:	480 V 3 phase
Emergency ATS's:	480 Y/277 V
UPS:	208Y/120 V
Fire Alarm System:	120 V
Rescue Communication System:	120 V
Electronic Door Lock System:	120V
A/V Equipment:	120V

5. **Emergency Power Requirements**

Systems:

- Fire Pump Controller (80 Amp)
- Emergency Egress Lighting (IBC Section 1006.3 requires a minimum of *1 fc (11 lux)* on the floor surface)
- Selected HVAC Equipment
- UPS System

Generator:

- Fuel System: Natural Gas Generator
- Connected to emergency circuits ATS-1, ATS2, UPS System, and Fire Pump and
- Total Generator Estimated Load 150 Amps (+80amp fire pump)

6. **Special Occupancy Requirements Based on NEC Chapter 5 -** None

7. **Special Equipment Based on NEC Chapter 6**

- Electric Signs
- Elevators
- IT Equipment
- X Ray Equipment
- Fire Pump

8. **Priority Assessment**

Education / Office Building Type

Long-term Ownership Cost	High (Long-term Occupant)
Initial Cost	Med
Flexibility	Med
Power Quality	Med
Reliability	Med
Redundancy	Low

9. **Back Up Power**

Emergency Lighting, HVAC, Fire Alarm System, Communication System

10. **Special Communication Systems**

Telephone/Data, Fire Alarm System, Intercom, Access Control, Security

12. **Large Equipment**

Standard

Pad Mounted Utility Transformer

1-SW-BD-1 Switchgear

EDU-1-HDP-1 Education Distribution Panel

EDU-1-LDP-1 Education Lighting Distribution Panel

OFF-1-LDP-1 Office Lighting Distribution Panel

T-EDU-1LD-P1 Education Wing Transformer

T-OFF-1LD-P1 Office Wing Transformer

EDU-ATS-2 Automatic Transfer Switch

EDU-ATS-1 Automatic Transfer Switch

Back Up System

Natural Gas Generator 125kva

FPC-ATS Fire Pump Automatic Transfer Switchgear

EDU-ELDP Education Emergency Lighting Distribution Panel

T-EDU-1-ELDP-1 Back Up Power System Transformer 1

T-EDU-1-ELP-1 Back Up Power System Transformer 1

UPS Equipment

PART 2

1. **Calculate Actual Building Loads**

	Amps	Volts
Total Demand Load	989.8	480
Total HVAC Connected (EDU-1-HDP-1, AHU-1, AHU	586.6	480
Total Lighting	368.8	480
Plug Load	92.2	480
Total Emergency (EDU-ATS-1, EDU-ATS-2)	147.3	480

2. **Identify Power Company Rate Schedule**

In Progress

3. **Power System Description**

Power to the outdoor Utility Transformer arrives at 12kv and is transformed to the building utilization voltage which is 480/277Y. The utility transformer sends power to the main switchgear and fire pump controller. The main switchgear (1-SWBD-1) is rated at 1600A and connects to two step-down transformers, one HVAC distribution panels, and two automatic transfer Switches. The step down transformer for the education wing lighting and receptacle loads (T-EDU-1-LDP-1) transforms 480Y/277 to 208Y/120, is rated at 225kva, and outputs to distribution panel EDU-1-LDP-1. The step down transformer for the office wing lighting and plug loads (T-OFF-1-LDP-1) transforms 480Y/277 to 208Y/120,is rated at 150kva, and outputs to distribution panel OFF-1-LDP-1. All lighting and receptacle loads operate at 120V. The HVAC distribution panel for education wing and office wing HVAC loads (EDU-HDP-1) is powered at 480Y/277 and is rated at 400A. HVAC equipment operates at 480V. The back up power system is switched from switchgear 480Y/277 power to 480Y/277 back-up generator power in the event of a power interruption by two ATS switches (EDU-ATS-2 & EDU-ATS-1). Two step down transformers following the ATS switches convert 480Y/277 to 208Y/120. The back-up system powers emergency lighting, the UPS system, emergency communication equipment, and emergency HVAC equipment. Specialty equipment including fire alarm System, rescue communication system, electronic door lock system, ad A/V equipment all operate at 120V.

4. **Emergency Power System**

Emergency Power is provided by an outdoor pad mounted generator. The generator is fueled by natural gas and is rated at 100KW/125KVA and provides 480Y/277 3 phase electricity. The generator runs to two ATS switches which are also connected to the switchgear. In the event of a power interruption the ATS will switch to generator connection and the generator will start within a certain period of time. The ATS switches connect to two step down transformers (T-EDU-1-ELDP-1, 1-EDU-1-ELP-1) converting 480Y/277 to 208Y/120. The transformers power the emergency power systems including lighting, HVAC equipment, fire alarms and emergency communication systems.

Total Load:

Total Connected Load:	122.4kva
EDU-ATS-1	8.6kva connected load
EDU-ATS-2	113.8kva connected load

Sub Total (by system):

HVAC Loads:	68.8kva
Lighting Loads:	53.6kva

5. **Special Occupancy Requirements Based on NEC Chapter 5 - None**

6. **Special Equipment Based on NEC Chapter 6**

- Electric Signs - Drawings
- Elevators - Drawings
- IT Equipment - Drawings
- X Ray Equipment – Drawings
- Fire Pump – Drawings

7. **Components**

Main Service and Distribution Equipment - Switchgear - 480/277

Main Service Equipment – Double Ended/ Indoor 480/277

Main Service Transformer – Outdoor/Utility Owned 12kv – 480Y/277

Distribution step down transformers - indoor/dry – air cooled 480Y/277 to 208Y/120

Panelboards

Distribution Panelboards – MCB – Bolt-in – Copper

Branch Circuit Panelboards – MCB – Bolt-in - Copper

Feeders – (5) SETS OF 4#400 in 3" Conduit – wire type: XHHW

Conductors – Copper – Interior: THHN THWN Exterior: XHHW and XHHW-2

Conduit –

Metal: Rigid Steel Conduit, Aluminum Rigid Conduit, Intermediate Metal Conduit, Electrical Metallic Tubing, Flexible Metal Conduit, Liquidtight Flexible Metal Conduit.

Non Metallic: Rigid Nonmetallic Conduit, Liquidtight Flexible Nonmetallic Conduit

Receptacles – Straight Blade Receptacles: Hospital Grade, GFCI Receptacles: Hospital Grade, Twist Lock Receptacles: NEMA WD1 and NEMA WD6

Switch and Receptacle Face plates – Steel with white baked enamel suitable for field painting for finished spaces and Galvanized steel for unfinished spaces

8. **Optional Backup Power**

HVAC Loads: 68.8kva – 208Y/120 3 phase

Lighting Loads: 53.6kva – 208Y/120 single phase

Lighting loads are connected to UPS system and generator system. The HVAC loads are only connected to the generator system.

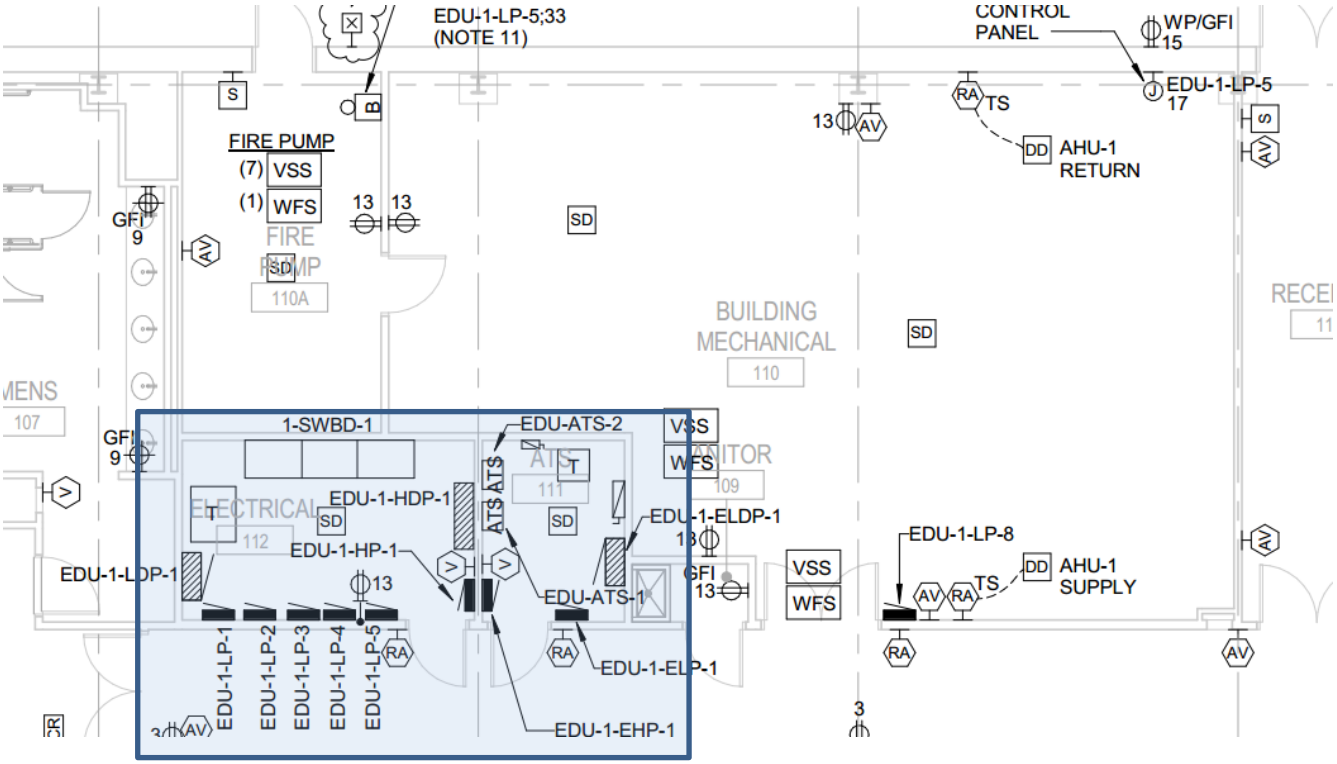
9. **System Integration**

Fire Alarm

Overhead Paging/ In

10. **Dedicated Electrical Systems**

Electrical Room 112 and ATS Room 111 house most of the electrical distribution equipment. These spaces take up about 400 sq./ft. which makes up about 1% of the buildings total area.



12. **Energy Reduction Techniques**

Building is LEED – Silver Certified

PART 3

1. In order to arrive at my estimated building loads I worked backwards from my design data, therefore my estimated loads and actual calculated loads were very close. The building does not have any systems that are extremely energy intensive and has proven to be fairly predictable.

2. I am having trouble locating the rate schedule and will update this section in the future.

3. One change that I would investigate would be using one ATS instead of two. This would eliminate a transformer and ATS from the design which would save money and space, although a larger single transformer and single ATS would be necessary to compensate which may cost much more. ATS-1 is rated at 60 amps and Transformer 1-EDU-1-ELP-1 is rated at 15kva.

4. The generator system is powered by natural gas which could be cause a discrepancy in some areas. Many generators are required to have on site fuel sources which must be stored in tanks such as diesel. A natural gas delivery system could become damaged in the event of an earthquake or other type of natural disaster which would render the buildings emergency power system completely useless.