JAMES KLINE

LIGHTING + ELECTRICAL

SUNY CORTLAND
STUDENT LIFE CENTER
Cortland, NY

Tech Report 2

Executive Summary

Technical Report 2 incorporates the design criteria and scope of work; existing conditions; and critique of existing conditions and further research for all electrical systems in the SUNY Cortland Student Life Center.

Current design achievements identified by report:

- Lighting load is 30% below the allowable load
- PV cells to be utilized to harvest solar energy
- Extensive control system utilizes the following to lower energy usage:
    - Photocells for daylight harvesting
    - Occupancy sensors for lighting
    - Occupancy sensors for mechanical system
- Area utilized for electrical equipment less than 1% of total building area
- Spinning room designed to allow energy harvesting from bikes as occupants pedal
    - Spinning room located close to main electrical space to minimize voltage drop
- Efficient back-up generator uses natural gas rather than oil

Further research highlights the following system improvements/additions:

- Programmable accent track lighting to represent pacing
- Cost reductions that can be achieved via energy use reduction
    - Payback periods and initial system costs to be explored
- Battery system to store spinning room and PV energy
- Demand Shifting techniques to lower mechanical load, and in turn, electrical load
- MicroTrack technology to turn curtain walls into transparent solar harvesting walls
- Autonomous media façade (uses yet to be explored)

Upon the conclusion of Technical Report 2, further exploration will be completed involving the feasibility and long term effects of the topics outlined above. Coordination between the lighting and electrical alternatives must be explored in tandem in order to develop the most effective and feasible improvements.

Table of Contents

Part 1

DESIGN CRITERIA & SCOPE OF WORK

Introduction

Part 1 outlines design criteria and the general scope for the SUNY Cortland Student Life Center. It also includes item such as preliminary load calculations, preliminary research for utility companies, and a priority assessment to help determine the most important factors of design.

The report is organized in such a way to help introduce the reader to the building's general data before going more into depth within each Part. The numbers in parenthesis are meant only to expedite the grading process of this report, as they refer to the specific sections which they satisfy within a predetermined rubric.

General Building Data (2,4,10,11)

Power Company (2)

New York State Electric and Gas (NYSEG)

Building Voltages (4)

Building Utilization	480Y/277
Lighting	277V
Receptacle	120V
Mechanical	480V - 3 phase
Special	
Cardio Equipment	120V
Spa Equipment	120V
Elevator Control	120V

Primary Special/Communication Systems (10)

Telephone/Data
Fire Alarms
Access Control – in the form of turnstiles
CATV

Other Special/Communication Systems (11)

Photovoltaic Power System

Preliminary Approximated Load Calculation (1)

Lighting

Occupancy type assumed: School

3W/sf x 148,329sf = **445 kW**

Demand Factor: 100%

Receptacles

3 W/sf x 148,329sf = 445 kW

Demand Factor: 100% for first 10kVA, 50% for remainder

10 kVA + .5x435 kVA = **228 kVA**

Mechanical

4 W/sf x 148,329sf = **593 kW**

Special Equipment:

Kitchen Equipment = **124 kW**

Demand Factor used: 65%

Preliminary Rate Schedule (3)

Preliminary Rate Schedule: NYSEG

Service Classification: Large General Service Time-Of-Use Rates (SC-7-2)

***The Industrial/High Load Factor (I/HLF) rate provision is available to qualifying nonresidential customers with an annual load factor of 68.0% or higher or for industrial customers with an annual average on-peak NYSEG demand of 500 kw or more.**

■SC No. 7 SECONDARY PRIMARY

	SC 7-2 Distribution	SC 7-2 Distribution (I/HLF)
Customer Charge	$371.98	$371.98
Meter Ownership Charge	$4.91	$4.91
Bill Issuance Charge	$0.73	$0.73
Meter Service Charge	$24.85	$24.85
Meter Data Service Charge	$7.37	$7.37
Demand Charge per kw	$7.51	$5.07
Delivery Charge per kwh	$0.00	$0.00
Reactive Charge per billing reactive kilovolt-ampere hour	$0.00078	$0.00078

Note: The campus distribution system is what gets billed, so the building will not be billed directly for its energy use.

"Service" Voltage: 13.8kV

Emergency Power Requirements (5)

Classification group B

2702.2.2 Smoke control systems.
909.11 Power systems.
Secondary power shall be from an approved standby source complying with Chapter 27 of this code. The standby power source and its transfer switches shall be in a room separate from the normal power transformers and switch gears and ventilated directly to and from the exterior. The room shall be enclosed with not less than 1-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both. The transfer to full standby power shall be automatic and within 60 seconds of failure of the primary power.

2702.2.3 Exit signs
1011.6.3 Power source.
Exit signs shall be illuminated at all times. To ensure continued illumination for a duration of not less than 90 minutes in case of primary power loss, the sign illumination means shall be connected to an emergency power system provided from storage batteries, unit equipment or an on-site generator.

2702.2.4 Means of egress illumination.
In the event of power supply failure, an emergency electrical system shall automatically illuminate all of the following areas:

1. Aisles and unenclosed egress stairways in rooms and spaces that require two or more means of egress.

2. Corridors, interior exit stairways and ramps and exit passageways in buildings required to have two or more exits.

3. Exterior egress components at other than their levels of exit discharge until exit discharge is accomplished for buildings required to have two or more exits.

4. Interior exit discharge elements, as permitted in Section 1027.1, in buildings required to have two or more exits.

5. Exterior landings as required by Section 1008.1.6 for exit discharge doorways in buildings required to have two or more exits.

The emergency power system shall provide power for a duration of not less than 90 minutes and shall consist of storage batteries, unit equipment or an on-site generator.

2702.2.19 Elevators.
3008.9 Electrical power.

The following features serving each occupant evacuation elevator shall be supplied by both normal power and Type 60/Class 2/Level 1 standby power:

1. Elevator equipment.

2. Elevator machine room ventilation and cooling equipment.

3. Elevator controller cooling equipment.

Special Occupancy Requirements – From Chapter 5 NEC (6)

None Apply.

Special Equipment – From Chapter 6 NEC (7)

620 Elevators:	NEC 70-532 – 70-543
645 Information Technology Equipment	NEC 70-559
680 Swimming Pools	NEC 70-575 – 70-579
690 Solar Photovoltaic Systems	NEC 70-593 – 70-607

Priority Assessment (8)

Topic	Priority Level
Reliability	Medium
Power Quality	High
Redundancy	Medium
Initial Cost	Medium
Long Term Ownership Cost	Medium
Flexibility	High

Optional Back-up Power (9)

All back-up power should be supplied by a natural gas generator. The following systems should be provided with optional back-up power.

1. Emergency Lighting — 25 kW
2. Elevators — 5 kW
3. Pool water pumps — 23 kW x 1.25 for start-up = 28.75 kW
4. Kitchen Refrigeration — 13 kW x 1.25 for start-up = 16.25 kW
5. Office Server — 1 kW

Total Optional Back-up Power = 76 kW

Major Equipment Needed (12)

Switchboard
Generator
Transformers
Elevator Motors

Part 2

EXISTING ELECTRICAL CONDITIONS

Introduction

Part 2 identifies the existing electrical conditions for the SUNY Cortland Student Life Center as currently designed. The highlights in Part 1 are the connected load calculation, other special/communication systems, and the energy reduction techniques.

General Building Data (2,3)

Power Company (2)

This building is serviced by the campus electric distribution system.

Service Voltage: 13.8kV

Building Voltages (3)

Utilization Voltage	480Y/277
Lighting	277V
Receptacle	120V
Mechanical	480V - 3 phase
Special	
Cardio Equipment	120V
Spa Equipment	120V
Elevator Control	120V

The Student Life Center utilizes one 2000 Amp service switchboard at 480/277 Volts: three phase. The switchboard connects to multiple panelboard loads in addition to the dedicated photovoltaic system and lighting relay panels. Lighting relay panels are used in order to activate lighting throughout the building based on occupancy and daylight sensors. Mechanical systems also use these relay panels activated by occupancy sensors in specific areas of the building to conserve energy consumed by the mechanical system.

Connected Load Calculation (1)

Please refer to Appendix A for existing load calculation charts.

Emergency Power System (4)

The emergency power system relies on a 130 kW natural gas fired generator.
Details: 162 kVA, 0.80 PF, 480 V, three phase, 4 wire, 60 Hz, 1800 rpm.

The emergency power system uses two automatic transfer switches which supply power to the kitchen, emergency lighting, elevator controls, and turntiles.

Connected Emergency Power Loads	
Panelboard	Load (kVA)
LV-EM-1-1	34.33
LV-EM-1-2	16.00
LV-EM-1-3	20.33
HV-EM-1-1	41.67
HV-EM-1-2	18.67
HV-EM-1-3	39.33
HV-EM-NC-1-1	4.00
LV-EM-2-1	10.67
HV-EM-2-1	27.67
Total Load	212.67

Special Occupancy Requirements – From Chapter 5 NEC (5)

None Apply.

Special Equipment – From Chapter 6 NEC (6)

620 Elevators: **NEC 70-532 – 70-543**

Found: Drawing A603

- Elevator A
- Elevator B

645 Information Technology Equipment **NEC 70-559**

Found: Division 27 of Specifications

- Lobby — Campus visual messaging system via TV
- Main Desk (room 110C) — PA System
- Meeting/Classroom 1104 — Electronic Whiteboards, Laptop Ready Podiums, Projectors, Speakers,

	Lighting and motorized shades, Internal Signage, Cable TV
Room 1113	Control interface, signal transport, network and audio, projector
Room 2101B	Outdoor Pursuits Laptop Ready space with large flat panel, Control interface, signal transport, network and audio, projector
Servery Prep/Seating Area	LCD Displays, Cameras, Permanent PC, Speakers, Power, Data, COAX, Cable TV
Classroom/Trip Prep	Motorized screen, permanent PC, speakers, laptop connection Crestron Room-View system touch screen
Circuit Free Weights–1127	3 flat panel displays connected to campus CATV system
Cardio Expansion / Lounge -1210 and 1203	Overhead sound via ceiling speakers
Cardio - 1214	12 flat panel screens connected to campus CATV system
Combatives - 1211	Overhead speakers for background sound, Roust audio system w/ wireless microphone for instructor
Group Exercise - Room 1212	Audio system with wireless microphone for instructor
Conference Room – 1201F	Laptop Ready system, TV, Control interface, Signal transport, network and audio
Mind Body Room – 1207	Ceiling speakers with sources: CD player, radio, iPod
Game Room – 1213	4 Laptop Ready systems w/ large flat panels for individual connection of gaming systems, two separate flat panels for campus CATV system
Natatorium – 1119	Radio, CD or iPod connection, horn speakers, Microphone plug in

680 Swimming Pools **NEC 70-575 – 70-579**

Found: Division 13 of Specifications

Natatorium	GFI systems, UV system – kills pathogens in water present after sand filtering

690 Solar Photovoltaic Systems **NEC 70-593 – 70-607**

This system is still under construction, but we do know that the harvested power will only be utilized as building power during daylight hours since there is no battery available to store energy. Whether the campus will sell extra power back to the utility is undetermined.

As part of the campus initiative, both roofs of the wings will be used for the photovoltaic cell placement. The entrance lobby roof will be green roof rather than PV cells.

Two other buildings will be part of this solar initiative put in place across the campus.

Equipment (7)

Existing Equipment	
Main Service and Distribution Equipment	
Switch Board	2000A, 480/277V 3 phase, 4 Wire
Main Service Equipment	
Single ended equipment located indoor	
Main Service Transformer	
Dry Type	1500 KVA, 13.8kV/480/277V 3 Phase W Wire
Distribution step down transformers	
9 KVA 480Delta 208/120V Wye 3 Phase 4 Wire	
15 KVA 480Delta 208/120V Wye 3 Phase 4 Wire	
30 KVA 480Delta 208/120V Wye 3 Phase 4 Wire	
45 KVA 480Delta 208/120V Wye 3 Phase 4 Wire	
300 KVA 480Delta 208/120V Wye 3 Phase 4 Wire	
Panelboards	
Federal Standard W-P-115A Type II, Class 1. Bolt-in type, Enclosure shall be code gauge steel box, galvanized, provide stainless steel covers for all panelboards located in kitchens and laboratories	
LV-EM-1-1	208Y/120, 3 PHASE, 4 WIRE
LV-EM-1-2	208Y/120, 3 PHASE, 4 WIRE
LV-EM-1-3	208Y/120, 3 PHASE, 4 WIRE
HV-EM-1-1	480Y/277, 3 PHASE, 4 WIRE
HV-EM-1-2	480Y/277, 3 PHASE, 4 WIRE
HV-EM-1-3	480Y/277, 3 PHASE, 4 WIRE
HV-EM-NC-1-1	480Y/277, 3 PHASE, 4 WIRE
LV-EM-2-1	208Y/120, 3 PHASE, 4 WIRE
HV-EM-2-1	480Y/277, 3 PHASE, 4 WIRE
HV-1-1	480Y/277, 3 PHASE, 4 WIRE
HV-1-2	480Y/277, 3 PHASE, 4 WIRE
HV-1-3	480Y/277, 3 PHASE, 4 WIRE
LV-1-1-(1)	208Y/120, 3 PHASE, 4 WIRE
LV-1-1-(2)	208Y/120, 3 PHASE, 4 WIRE
LV-1-2 SECT. 1	208Y/120, 3 PHASE, 4 WIRE
LV-1-2 SECT. 2	208Y/120, 3 PHASE, 4 WIRE
LV-1-3	208Y/120, 3 PHASE, 4 WIRE
LV-2-1 (1)	208Y/120, 3 PHASE, 4 WIRE
LV-2-1 (2)	208Y/120, 3 PHASE, 4 WIRE
LV-2-2 (1)	208Y/120, 3 PHASE, 4 WIRE
LV-2-2 (2)	208Y/120, 3 PHASE, 4 WIRE
LV-PE-1-1	208Y/120, 3 PHASE, 4 WIRE

HV-2-1	480Y/277, 3 PHASE, 4 WIRE
HV-2-2	480Y/277, 3 PHASE, 4 WIRE
PP-MECH-1-1	480Y/277, 3 PHASE, 4 WIRE
PP-MECH-1-2	480Y/277, 3 PHASE, 4 WIRE
PP-MECH-2-1	480Y/277, 3 PHASE, 4 WIRE
PP-MECH-LV-2-1	208Y/120, 3 PHASE, 4 WIRE
HV-KIT-1-1	480Y/277, 3 PHASE, 4 WIRE
LV-KIT-1(A)	208Y/120, 3 PHASE, 4 WIRE
LV-KIT-1(B)	208Y/120, 3 PHASE, 4 WIRE
LV-KIT-2(A)	208Y/120, 3 PHASE, 4 WIRE
LV-KIT-2(B)	208Y/120, 3 PHASE, 4 WIRE
PP-KIT-2-1	480Y/277, 3 PHASE, 4 WIRE
PP-PE-1-1	460 3 PHASE, 4 WIRE
Main Risers and Feeders	
Copper busses, bolted feeders, MCCBs, Feeders to follow color coding as noted in Table 2.1	

120/208 Volts Code
Phase A – Black
Phase B – Red
Phase C – Blue
Neutral – White
Ground – Green
Isolated Ground - Green/Yellow Striped

277/480 Volts Code
Phase A - Brown
Phase B - Orange
Phase C - Yellow
Neutral - Gray
Equipment Ground - Green

Table 2.1: Color Coding of feeders

Conductors	
	Copper Conductors
Receptacles	
	Specification grade, with brass contacts that accept plugs with two parallel blades and one grounding blade, enclosures shall be heat-resistant plastic with and two grounding screws.
Switch and Receptacle Faceplates	
	Nylon and stainless steel faceplates: white, black, brown, beige, gray metal or custom color as selected by the Architect
Motor Starters	
	Non-reversing - two step - part winding - star connected.
	Non-reversing - full voltage - two speed separate winding
	Non-reversing - full voltage - two speed single winding.
UPS	
	None
Conduit	
	Refer to table 2.2 on next page.

Raceway Types	Application
Galvanized Rigid Steel Conduit (GRS)	All locations unless otherwise specified below.
Intermediate Metal Conduit (IMC)	All locations except wet and hazardous areas as defined by NEC
Electrical Metallic Tubing (EMT)	(1) Concealed as branch circuit conduits above suspended ceilings where conduit does not support fixtures or other equipment. (2) Concealed as branch circuit conduits in dry locations. (3) Exposed as branch conduits in dry, non-hazardous locations at elevations over 10'0" above finished floor, where conduit does not support fixtures or other equipment. May not be used in Mechanical Rooms.
Flexible Metal Conduit (FMC or Greenfield)	(1) Final connection to recessed lighting fixtures, equipment subject to vibration (dry locations), or equipment requiring flexible connection for adjustment or alignment (dry locations) (2) May be used as concealed branch circuit or feeder where conduit must be fished through inaccessible spaces
Liquid-Tight Flexible Conduit (LFMC)	Same uses as for FMC in damp and wet locations
Non-Metallic Conduit	Schedule 40 - Where raceways are in slab in below grade levels, for raceway duct banks. Duct banks must be reinforced for the entire length. Schedule 80 - For underground raceways outside of building which are direct bumed and not encased in concrete.
Wireways and Auxiliary Gutters	Where indicated on the Drawings and as otherwise specifically required.

Table 2.2: Conduit Types and Application

Optional Back-up Power (8)

Connected Back-up Power (all connected to generator)			
Load	**KVA**	**Voltage**	**Phase**
Emergency Lighting	13.81	480Y/277	3
Fire Suppression	4.5	280Y/120	3
Elevator Control, Lighting, Receptacles, Fans, Battery backup	14.33	Both	3
IT	9.6	280Y/120	3
Security Systems	30	280Y/121	3
Turntiles	7.2	280Y/121	3
Control Panels	7.2	280Y/122	3
Exit Signs	0.8	480Y/277	3
Receptacles	27.34	Both	3
Transformers	69	480Y/277	3
Mechanical	18.53	480Y/277	3
Uncategorized	9.2	280Y/120	3

Primary Special/Communication Systems (9)

Telephone/Data
All necessary information found above in Section (6) under “645 Information Technology Equipment.”

Fire Alarms
If a smoke detector is activated, the following systems will respond in the following manners:

- Speakers and strobes will activate on all floors
- Alphanumeric text message will display on LCD screens
- Signal is transmitted to campus command center via campus monitoring system
- Return Fans stop
- Recirculating air system fans stop
- Door release on all floors activate via security sytem
- Smoke control fans start

Access Control
In the form of turnstiles
Located in entry spaces when entering either the South wing or the North wing from the main lobby.

Exterior doors
Security system has ability to lock exterior doors at set times.

CATV
All necessary information found above in Section (6) under “645 Information Technology Equipment.”

Daylighting Control
Photocells are used to dim lighting in the free weight area, and dining/servery space.

HVAC Control
Occupancy sensors relay to room-specific control stations which in turn activate the mechanical system in addition to the lighting as necessary.

Other Special/Communication Systems (10)

Spinning room power harvesting
More info found below Section (12): "Energy Reductions Techniques."

Photovoltaic Power System

All necessary information found above in Section (6) under "690 Solar Photovoltaic Systems."

Dedicated Equipment Spaces (11)

Level 1	
Elev Equip A – 1194A	SF: 65
Electrical – 1194B	SF: 127
Electrical Service – 1194C	SF: 366
Generator Room – 1194D	SF: 185
ATS Room – 1194E	SF: 42
Electrical – 1194F (2)	SF: 89
Elev Equip B – 1194G	SF: 57
Electrical – 2194A	SF: 116
Level 2	
Electrical – 1294A	SF: 55
Electrical – 1294B	SF: 31
Total	*SF: 1133*

Percentage of total area: .7% (< 1%)

Energy Reduction Techniques (12)

All necessary information found above in Sections (6) and (9).

Single line/Riser Diagram (13)

Refer to Appendix A for the complete existing electrical power riser diagram.

Part 3

EXISTING ELECTRICAL CRITIQUE

Introduction

Part 3 involves the critique of the current electrical system in addition to further research and consideration of alternative solutions. Highlights of Part 3 include cost reduction techniques, additional systems integration, and additional energy reduction techniques.

Estimated vs. Actual Load Comparison (1)

Comparing Preliminary Load Calculation to Actual Load	**Estimated Load (kW)**	**Connected Load (kW)**
Lighting	445	310*
Receptacles	228	215
Mechanical	593	558
Kitchen Equipment	124	338.8

*Assuming transformer loads identified in panel boards correspond to Lighting Loads

The lighting load is lower than initially calculated. This makes sense because energy efficiency was high priority for the design of this building; therefore the connected load should be lower than the allowed load.

The kitchen load as initially calculated was very low compared to the connected load. This was due to the fact that a lot of the equipment found in the building's final design was not included in the initial calculation; it was difficult to guess what equipment and how much will be needed before the design is examined.

Power Company Rate Schedule (2)

There are very few alternatives to what the campus can choose for its electric rates. One option that would be beneficial for the campus is to utilize hourly pricing which would allow it to buy cheaper energy at night if systems are in place to take advantage of this.

The campus system can also take advantage of the "Industrial/High Load Factor" provision since they would clearly exceed the 500kW/month requirement to qualify for this provision.

Building Utilization Voltage and Fundamental Distribution Concepts (3)

As highlighted in section (9) of Part 3, I would highly suggest involving a battery storage system to serve this building as well as the other three buildings that will be part of this solar initiative. Creating a dedicated space for a highly efficient battery system will only expand the renewable energy capabilities of this building and the SUNY Cortland campus as a whole. The system would improve the flexibility of the campus as they continue energy development and can lower long term energy costs.

Emergency Power system (4)

There are no discrepancies between the emergency power requirements identified in Part 1 and the as-designed conditions. The emergency power system is designed well including a spare connection located at the emergency switchboard connected directly to the gas fired generator. Natural gas is the most efficient and cheap fossil fuel available to the area, so no suggestions on fuel changes need to be made.

Equipment Changes (5)

There are no necessary changes to be addressed at this point in the design.

Optional Back-up Power and UPS systems (6)

The only suggestion I would make is to add a small UPS to prevent any office servers from going down. It is likely that the campus has its servers and battery system off site from the Student Life Center which houses all the servers and therefore the building itself may not need to address this issue. If a UPS was added to the design, space would have to be allocated for the equipment.

Cost reduction: Ownership (7)

The equipment specified for this project is very efficient; therefore equipment changes would not significantly lower the cost of ownership. The best way to lower cost of ownership for this building is to lower the amount of energy it uses via high efficiency energy harvesting systems and batteries such as those outlined in section (9) below.

Additional systems integration (8)

Programmable Accent Lighting

One system that may be added to create a one-of-a-kind experience for a runner would be a programmable accent lighting system embedded into the running track. This system could utilize accent lighting such as small LEDs which could be programmed to chase around the track at a specific pace in a specific color. This would allow the runner to know visually whether they are on the pace they determined or not without having to count seconds each lap. Each runner could be assigned a specific color so that multiple runners could use the system at the same time. Intense coordination between electrical, control, and lighting systems would be important in order to make this a reality.

Additional Energy Reduction Techniques (9)

Some possible additional energy reduction techniques that could be added to the Student Life Center include:

1. Batteries (for solar energy storage)
   A battery system would allow the PV system, spinning room system, and demand shifting to store extra energy for later use rather than being wasted if overproduced.

2. Wind generation
   Wind energy harvesting to produce electricity can help reduce the energy needed from the campus distribution system. Since this structure already utilizes all of its space for PV cells, this is likely not a feasible system to add to the current design. In addition, the amount of energy harvested in this geographic area in comparison with the cost of a wind system will not overcome the comparable attributes of a PV system.

3. Demand Shifting
   Since this building is in an area that gets cold a large majority of the school year, it would be wise to shift as much demand as possible to off-peak times in order to lower the load on the system when energy is high. Peak times are from 7:00 Am to 10:00 PM on weekdays for the energy provider for this area. Since the building will likely be open early in the morning, heating the building to the desired conditions before 7:00 AM would cause the building to only maintain its temperature throughout the day. Also, sunlight will help lower the energy need after sunrise, which will lower the maintenance load even more.

4. Solar: MicroTrack

This revolutionary solar tracking photovoltaic is 40% efficient and can be built into the architecture of the building as a curtain wall or be placed on a roof in a similar module type construction. Each ball is filled with water and refracts sunlight from all directions onto a single solar cell. This cell uses continuous dual axis tracking to adjust for the angle of the sun thus maximizing harvesting capabilities at all times of day. The total thickness is only 60mm which allows it to be used in almost any situation architecturally.

The module is also being produced in large stand-alone spheres nearly the size of one story of a building. This technology has recently been proposed for a hybrid building consisting of 60 hotel rooms and what is being called a “vertical power plant” near the World Trade Center of Barcelona.

The system is currently available in Europe (since July) and is hitting the market now for the United States. This technology can also be bought as one large single ball rather than a module.

5. Autonomous Media Façade
   This Media façade system is identical to the MicroTrack, but utilizes 10% of the daytime captured energy to power the LEDs at night. These LEDs can be programmed as a media façade to display video in addition to custom color programming at night.

6. Spinning Bike Harvesting
   The Spinning Room has the ability to utilize spinning cycles which harvest the power produced by the runners to power the room’s lighting and receptacle loads. There is also potential to store the excess energy in a battery. According to one manufacturer’s average estimations, “a typical group cycling class with 20 bikes [will produce] 3 kW” of energy (UMass). Through calculations, we can estimate that if there are only two classes per day, five days a week, this system could reduce the building load by 120kW per month during months when school is in session. Using

school months only, and accounting for holidays, this would reduce the annual load by nearly 1000 kW.

The spinning room in this building can hold 25 bikes easily. Two examples of manufacturers of these bikes are GYRE9 and Pedal Power Generators, LLC.

Works Cited

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Appendix A

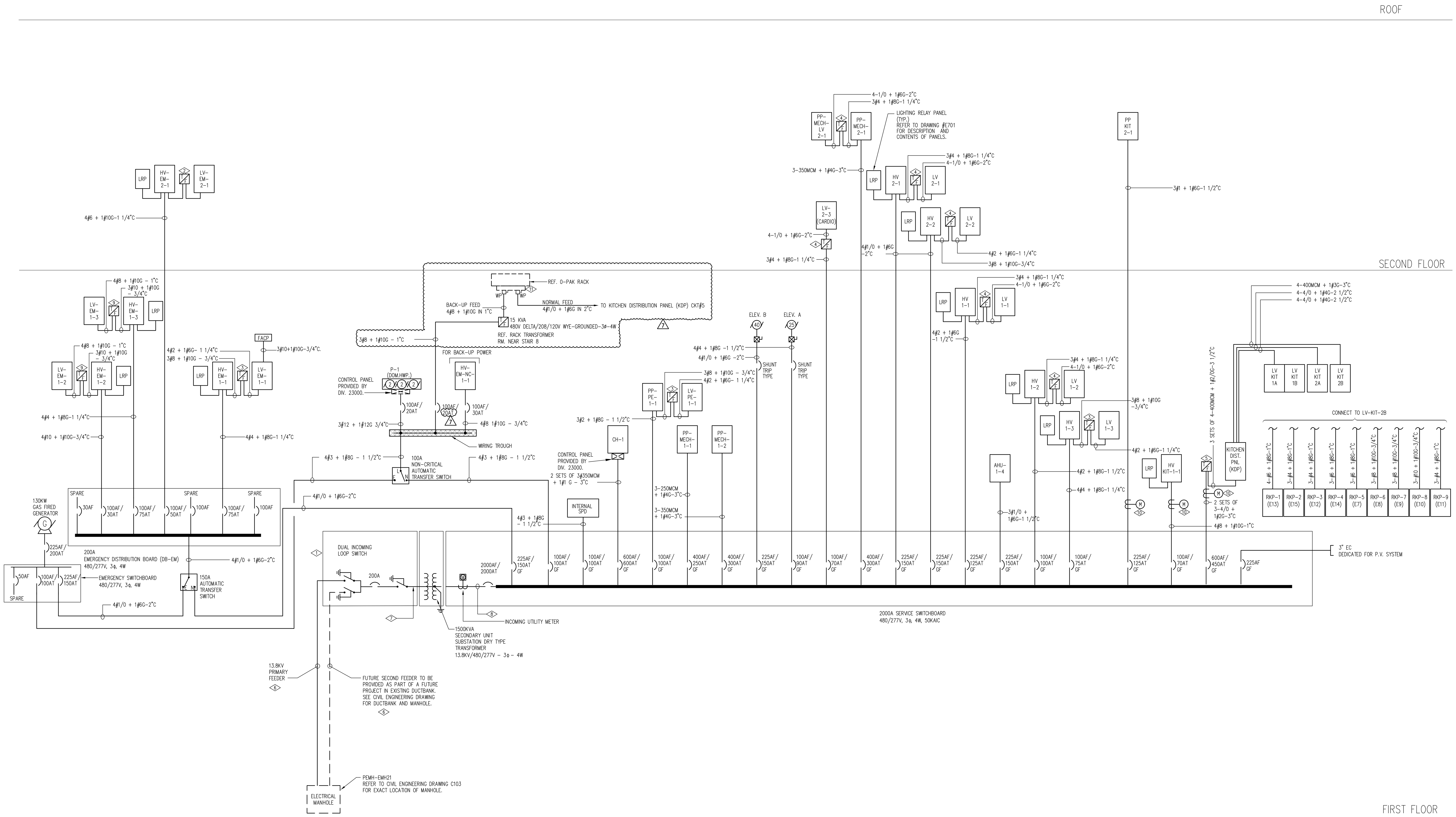
Total Connected Load	
Panelboard	Load (kVA)
HV-1-1	70.17
HV-1-2	61.29
HV-1-3	42.07
LV-1-1-(1)	36.22
LV-1-1-(2)	17.92
LV-1-2 SECT. 1	30.6
LV-1-2 SECT. 2	25.69
LV-1-3	45.9
LV-2-1 (1)	25.56
LV-2-1 (2)	37
LV-2-2 (1)	41.02
LV-2-2 (2)	6.36
LV-PE-1-1	25.43
HV-2-1	102.65
HV-2-2	67.44
PP-MECH-1-1	112.1
PP-MECH-1-2	184.1
PP-MECH-2-1	173.18
PP-MECH-LV-2-1	23.69
HV-KIT-1-1	41.33
LV-KIT-1(A)	53.67
LV-KIT-1(B)	51.69
LV-KIT-2(A)	74.49
LV-KIT-2(B)	166.86
PP-KIT-2-1	71.7
PP-PE-1-1	69.4
Total	1588.13

Total Connected Load (lighting)	
Panelboard	Load (kVA)
HV-1-1	7.08
HV-1-2	1.68
HV-1-3	2.64
LV-1-1-(1)	0
LV-1-1-(2)	1
LV-1-2 SECT. 1	0
LV-1-2 SECT. 2	1
LV-1-3	0
LV-2-1 (1)	0
LV-2-1 (2)	0
LV-2-2 (1)	0
LV-2-2 (2)	0
LV-PE-1-1	0
HV-2-1	0
HV-2-2	0
PP-MECH-1-1	0
PP-MECH-1-2	0
PP-MECH-2-1	0
PP-MECH-LV-2-1	0
HV-KIT-1-1	12.03
LV-KIT-1(A)	0
LV-KIT-1(B)	0
LV-KIT-2(A)	0
LV-KIT-2(B)	0
PP-KIT-2-1	0
PP-PE-1-1	0
Total	25.43

Total Connected Load (receptacle)	
Panelboard	Load (kVA)
HV-1-1	16.18
HV-1-2	14.61
HV-1-3	9.43
LV-1-1-(1)	15.06
LV-1-1-(2)	1.2
LV-1-2 SECT. 1	13.3
LV-1-2 SECT. 2	13.78
LV-1-3	9.86
LV-2-1 (1)	17.06
LV-2-1 (2)	2.9
LV-2-2 (1)	8.52
LV-2-2 (2)	5.28
LV-PE-1-1	0
HV-2-1	57.65
HV-2-2	22.44
PP-MECH-1-1	0
PP-MECH-1-2	0
PP-MECH-2-1	0
PP-MECH-LV-2-1	0
HV-KIT-1-1	0
LV-KIT-1(A)	2.52
LV-KIT-1(B)	0
LV-KIT-2(A)	5.36
LV-KIT-2(B)	0
PP-KIT-2-1	0
PP-PE-1-1	0
Total	215.15

Total Connected Load (mechanical)	
Panelboard	Load (kVA)
HV-1-1	0
HV-1-2	0
HV-1-3	0
LV-1-1-(1)	0
LV-1-1-(2)	11
LV-1-2 SECT. 1	0
LV-1-2 SECT. 2	7.67
LV-1-3	16.94
LV-2-1 (1)	0
LV-2-1 (2)	2.3
LV-2-2 (1)	0
LV-2-2 (2)	0.28
LV-PE-1-1	0
HV-2-1	0
HV-2-2	0
PP-MECH-1-1	112.1
PP-MECH-1-2	184.1
PP-MECH-2-1	128.18
PP-MECH-LV-2-1	23.69
HV-KIT-1-1	0
LV-KIT-1(A)	0
LV-KIT-1(B)	0
LV-KIT-2(A)	0
LV-KIT-2(B)	0
PP-KIT-2-1	71.7
PP-PE-1-1	0
Total	557.96

Total Connected Load (special eqpmt)		
Panelboard	Load (kVA)	Notes
HV-1-1	45	transformer
HV-1-2	45	transformer
HV-1-3	30	transformer
LV-1-1-(1)	21.16	TVs, golf sim., dryers, mot. screens, projector, water cooler,spin machine
LV-1-1-(2)	4.52	refrigerator, signage, ceiling fan, spin machines
LV-1-2 SECT. 1	17.3	hand dryers, signage, water cooler, electrified plbg
LV-1-2 SECT. 2	3.24	clg fan, signage
LV-1-3	19.6	projector, washer, elec. Plbg., motorized screen, water cooler, hand dryers
LV-2-1 (1)	8.5	hand dryers, water cooler, refrigerator, dishwasher, copier
LV-2-1 (2)	33.3	Cardio eqpmt
LV-2-2 (1)	32.5	Cardio eqpmt, TVs, water coolers
LV-2-2 (2)	0.8	motorized curtain
LV-PE-1-1	25.43	all pool equipment
HV-2-1	45	transformer
HV-2-2	45	transformer
PP-MECH-1-1	0	
PP-MECH-1-2	0	
PP-MECH-2-1	45	transformer
PP-MECH-LV-2-1	0	
HV-KIT-1-1	29.3	overhead doors, heat tracing
LV-KIT-1(A)	51.15	kitchen eqpmt
LV-KIT-1(B)	51.69	kitchen eqpmt
LV-KIT-2(A)	69.13	kitchen eqpmt
LV-KIT-2(B)	166.86	kitchen eqpmt
PP-KIT-2-1	0	
PP-PE-1-1	69.4	Pool eqpmt, transformer
Total	789.48	



NOTES:

<1> G & W VANTAGE VACUUM INTERRUPTER LOOP SWITCH OR S & C VISTA WITH TWO INCOMING 3-POSITION (OPEN, CLOSED, GROUNDED) SWITCHED WAYS AND ONE OUTGOING VACUUM INTERRUPTER WAY WITH IN-LINE SWITCH TO FEED TRANSFORMER.

<2> 9 KVA 480V DELTA/208V/120V WYE-GROUND – 3φ – 4W

<3> 30 KVA 480V DELTA/208V/120V WYE-GROUND – 3φ – 4W

<4> 45 KVA 480V DELTA/208V/120V WYE-GROUND – 3φ – 4W

<5> 300 KVA 480V DELTA/208V/120V WYE-GROUND – 3φ – 4W

<6> SEE CIVIL DRAWING C105 FOR DUCTBANK AND FEEDER REQUIREMENTS.

<7> 3#2/0 + 1#8G – 3 1/2" CONDUIT.

<8> 6 SETS OF 4-400MCM + 1 #250MCMG – 6-3 1/2"CONDUITS.

<9> 15 KVA 480V DELTA/208V/120V WYE-GROUND – 3φ – 4W

<10> PROVIDE E-MON CLASS 3400 SMART METER WITH DUAL PROTOCAL COMMUNICATIONS. METER TO BE 277/480V, 3 PHASE WITH 3 SPALT-CORE CURRENT SENSORS. SIZE TO MATCH OVERCURRENT DEVICE FRAME SIZE.
SUBMETER TO INCLUDE DEGITAL NETWORKED OWNER'S ELECTRIC SUBMETERS (DNOS) SERVING KITCHEN PANELS.
DIGITAL NETWORKED SUBMETERS SHALL COMMUNICATE WITH BUILDING MANAGEMENT AND CONTROL SYSTEM (BMCS) VIA BACNET COMPATIBLE MS/TP COMMUNICATIONS. PROVIDE MANUFACTURER'S BACNET COMPATIBLE BTL TESTED COMMUNICATION GATEWAY FROM DNOS TO BMCS. COORDINATE DIGITAL COMMUNICATIONS BETWEEN DNOS AND BMCS. PROVIDE END TO END COMMUNICATIONS COORDINATION BETWEEN DNOS AND BMCS TREND DATABASE. THE FOLLOWING DATA SHALL BE TRENDED: KWH CONSUMPTION, KW REAL POWER, KVAR REACTIVE POWER , KVA APPARENT POWER, POWER FACTOR, VOLTAGE LINE TO LINE, VOLTAGE LINE TO NEUTRAL, AMPS, AVERAGE CURRENT, AMPS, PHASE A, AMPS PHASE B, AMPS PHASE C.

<11> REFRIGERATION RACK CONTROL PANEL AND DISCONNECTS PROVIDED WITH EQUIPMENT. PROVIDE ONE NORMAL FEED FROM KITCHEN DISTRIBUTION PANEL AND ONE BACK-UP FEED FROM NON-CRICTICAL ATS WIRING TROUGH UPON LOSS OF UTILITY POWER, ONLY ONE COMBINATION COMPRESSOR & COOLER MAY OPERATE AT A TIME. 7

09.25.2012 - FOR CONSTRUCTION

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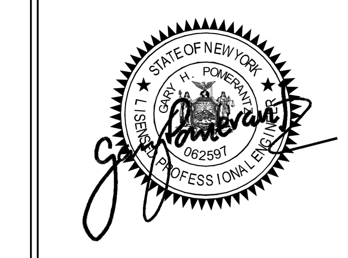

SEAL

REVISIONS

12/21/12	ASI#007
3/28/13	ASI#016
4/24/13	ASI#028
5/1/13	ASI#032
5/7/13	ASI#035
5/15/13	ASI#043
6/24/13	ASI#058 7

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PROJECT

ELECTRICAL POWER RISER DIAGRAM

SHEET TITLE

SUCF #: 04339	H2L2 #: 5669
DATE: 09.25.2012	SHEET No.
SCALE: NONE	E500
DRAWN: LS	
CHECKED: -	
PROJ. MNGR:	

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