AE 481W
Senior Thesis

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Lighting/Electrical Option
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100% Submission

TECHNICAL REPORT 2

ELECTRICAL SYSTEMS EXISTING CONDITIONS AND BUILDING LOAD SUMMARY

SMC Campus Center

Baltimore, MD

Submitted: 10/27/2010

Executive Summary

The following report presents detailed documentation and analysis of the existing electrical systems design for the Southern Management Corporation Campus Center at the University of Maryland, Baltimore campus located in Baltimore, MD. The 110,000 square foot Campus Center is a multi-function facility containing educational and recreation spaces, dining facilities, and open and public offices for students and faculty members. As the new central hub for the campus, the lighting, electrical, and communications systems were designed to support the multiple uses within the building.

The documentation and analysis includes an overall summary of the electrical systems, detailed characteristics including power distribution, utility information, voltage systems, major equipment and loads, service entrance size, and special equipment. Brief descriptions of the main communications systems used in the building are also provided.

A single-line diagram is presented to show the electrical path through the building starting from the service entrance and ending at major branch circuit panelboards. The service entrance size was calculated three ways to represent different phases of the design process.

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Building Information and Statistics

Located on the site of the previous Student Union Building, the SMC Campus Center is a modern student-centered facility that significantly improves student life at UMB through expanded programming and enhancement of the urban campus environment. The fundamental goals of the Campus Center are to increase interaction between students and faculty from the various UMB schools and to develop an interactive campus community. The exterior of the Campus Center is respectful to the materials and aesthetics of the adjacent buildings, while maintaining a unique, easily recognizable identity. The Campus Center provides openness to Lombard Street and adjoins the surrounding courtyard and plaza areas. The interior is designed to encourage health and wellness, house student organizations and services, provide recreation and relaxation, and offer exceptional food and dining venues.

Building Name: Southern Management Corporation (SMC) Campus Center

Location and Site: Baltimore, MD

Occupancy Type: Academic

Size: 110,000 SF

Stories Above Grade: 5 + penthouse

Primary Project Team:

Owner: University of Maryland, Baltimore
CM/PC: The Whiting-Turner Contracting Co. | Baltimore, MD
Architect: WTW Architects, Inc. | Pittsburgh, PA
Landscape Architect: Fluora-Teeter Landscape Architects, Inc. | Baltimore, MD
MEP Engineer: Henry Adams, LLC | Towson, MD
Structural Engineer: Whitney, Bailey, Cox and Mangini, LLP | Towson, MD
AV/IT/Security: Allen & Shariff Corporation | Columbia, MD
Interior Designer: Portnoy Levine Design Associates | Baltimore, MD
Aquatics Designer: Counsilman/Hunsaker & Associates | St. Louis, MO
Elevator Consultant: Lerch, Bates & Associates, Inc. | Bowie, MD

Dates of Construction: May 2006 - May 2009

Overall Project Cost: $43,400,000

Project Delivery Method: CM at Risk

Section 1: Power Distribution Systems

Summary Description of Distribution System

The SMC Campus Center electrical distribution system is a primary selective system with one point of service entrance at the southwest corner of the building on the Garden Level. The building ties into the University of Maryland, Baltimore, medium voltage, campus system in which primary service is provided by BGE. The transformer section of Substation No. 1 steps down the voltage from 13.2 kV to a 480Y/277V, 3PH, 4W utilization voltage. Emergency power is provided by an existing area generator in an adjacent campus building.

The 3000A switchboard section of Substation No. 1 provides power to all building equipment loads. Power at 480Y/277V is distributed to each floor through a vertical busway in stacked electrical closets. Transformers are provided in each electrical closet to step down power to 208Y/120V, 3PH, 4W for receptacles and other small equipment. All remaining loads are connected to the 480Y/277V voltage system.

Utility Company Information

The SMC Campus Center is connected to the University of Maryland, Baltimore campus system. The UMB campus is served by the Baltimore Gas and Electric Company (BGE). The company's address and website are as follows:

100 Constellation Way
Baltimore, MD 21202-6302
http://www.bge.com
410-470-2800

Speaking with numerous members from the Office of Facilities Management at the University of Maryland, Baltimore campus, general rate schedule information was acquired for the SMC Campus Center. 40-50% of the expected volume of power is bought through derivatives from the futures market. For the remainder, the real-time/spot market is utilized. Therefore, the rate each period is a mixture of the average derivative price, spot market price, and about 1.5 cents/kWh from BGE for distribution costs. There is a difference between on-peak and off-peak hours but access to this detailed information was unavailable. The overall average values are as follows:

Summer months:	10 cents/kWh	(11 cents/kWh on-peak, 8 cents/kWh off-peak)
Winter months:	8.5 cents/kWh	

Service Entrance

Electric service to the site will be extended from the BGE campus 13.2kV, 3PH, 3W primary selective distribution system. Medium voltage feeders are located in a manhole in the alley behind the Campus Center. Two new sets of 15kV service conductors will be spliced from the manhole and routed in new concrete encased duct banks to a 54"x24"x33" pullbox located in the main mechanical room in the southwest corner of the Garden Level. From here, the service conductors are routed to the centrally located main electrical room on the Garden Level to two medium voltage fused air-break switches in the building serving one 3000A indoor single-ended substation. Square-D Powerlogic meters are used to meter the electricity use for the building.

Voltage Systems

Secondary distribution in the Campus Center provides a 480Y/277V, 3PH, 4W system serving the major mechanical equipment, the three building elevators, and most lighting loads. There is a transformer on each level in an electrical closet to step down the voltage to a 208Y/120V system that serves all receptacle loads, communication loads, fire alarm components, and ballroom lighting loads.

Emergency Power System

A single 625kVA, diesel powered engine-generator is located south of the building in a weatherproof, sound-attenuated walk-in enclosure. The generator provides power to Panel GENDP461, which feeds Emergency Panel LS461 and Standby Panel EQDP461. The emergency transfer switch, ATS-LS, and standby transfer switch, ATS-EQ, are fed alternatively from Substation No.1 or Panel GENDP461.

The emergency and standby system consists of a life safety and a standby branch. Emergency loads include those identified in NFPA and NEC Article 700. Life safety loads are energized within 10 seconds following an outage and include items such as emergency egress lighting, fire alarm system, stairway pressurization system, and automatic doors required for egress. Standby loads include security equipment, telecommunications equipment, elevators, and miscellaneous electrical outlets and lighting.

Locations of Switchgear

The main distribution substation, Substation No. 1, is in the centrally located Garden Level electrical room, E012. From here, conduits are routed from the secondary distribution section of the substation to an electrical closet located along the east wall of the building. Conduits are connected to a 1600A, 480Y/277V, 3PH, 4W busway and rise vertically through stacked electrical closets on each floor. Electrical closets contain a transformer for 208Y/120V loads and lighting, receptacle, equipment, and communication panels that serve each individual floor.

The emergency distribution panel, GENDP461, is located in room E601B of the mechanical penthouse along with equipment distribution panels EQDP261 and EQDP461. The following tables summarize all major electrical equipment and panelboards.

MAJOR EQUIPMENT SCHEDULE						
TAG	TYPE	FLOOR LEVEL	ROOM NO.	ROOM NAME	1/8 SCALE DWG.	ENLARGED DWG.
SUBSTATION NO. 1	SUBSTATION	GARDEN LEVEL	E012	ELEC ROOM	E1.0	E1.0
GENDP461	EM SWITCHBOARD	PENTHOUSE	E601B	ELEC EQUIP	E1.6	NA
LDP461	DISTRIBUTION PANEL	GARDEN LEVEL	M009	MECH ROOM	E1.0	NA
RDP2B1	DISTRIBUTION PANEL	GARDEN LEVEL	E012	ELEC ROOM	E1.0	E1.0
EQDP461	DISTRIBUTION PANEL	PENTHOUSE	E601B	ELEC EQUIP	E1.6	E1.6
EQDP261	DISTRIBUTION PANEL	PENTHOUSE	E601B	ELEC EQUIP	E1.6	E1.6
LS461	DISTRIBUTION PANEL	PENTHOUSE	E601A	ELEC EQUIP	E1.6	E1.6
LS261	DISTRIBUTION PANEL	PENTHOUSE	E601A	ELEC EQUIP	E1.6	E1.6
T1	TRANSFORMER	GARDEN LEVEL	E012	ELEC ROOM	E1.0	E1.0
T2A	TRANSFORMER	GARDEN LEVEL	E021	ELEC CLOSET	E1.0	E1.0
T2B	TRANSFORMER	GARDEN LEVEL	E021	ELEC CLOSET	E1.0	E1.0
T2C	TRANSFORMER	FIRST LEVEL	E121	ELEC CLOSET	E1.1	E1.1
T2D	TRANSFORMER	SECOND LEVEL	E217	ELEC CLOSET	E1.2	E1.2
T2E	TRANSFORMER	THIRD LEVEL	E357	ELEC CLOSET	E1.3	E1.3
T2F	TRANSFORMER	THIRD LEVEL	E357	ELEC CLOSET	E1.3	E1.3
T2G	TRANSFORMER	FOURTH LEVEL	E421	ELEC CLOSET	E1.4	E1.4
T2H	TRANSFORMER	FIFTH LEVEL	E517	ELEC CLOSET	E1.5	E1.5
T2I	TRANSFORMER	PENTHOUSE	E601A	ELEC EQUIP	E1.6	E1.6
T3	TRANSFORMER	PENTHOUSE	E601A	ELEC EQUIP	E1.6	E1.6
T4	TRANSFORMER	GARDEN LEVEL	E012	ELEC ROOM	E1.0	E1.0
T5	TRANSFORMER	PENTHOUSE	E601B	ELEC EQUIP	E1.6	E1.6
GENERATOR	GENERATOR	NA	NA	ADJAC. BLDG	E1.8	NA
ATS-LS	EMERGENCY TRANSFER SWITCH	PENTHOUSE	E601B	ELEC EQUIP	E1.6	E1.6
ATS-EQ	STANDBY TRANSFER SWITCH	PENTHOUSE	E601B	ELEC EQUIP	E1.6	E1.6

PANELBOARD SCHEDULE							
PANELBOARD TAG	VOLTAGE SYSTEM	MAIN SIZE	MLO	FLOOR LEVEL	ROOM NO.	ROOM NAME	DWG. NO.
LP4B2	480Y/277V,3PH,4W	400A		GARDEN LEVEL	M009	MECH ROOM	E1.0
LP4B1	480Y/277V,3PH,4W	200A		GARDEN LEVEL	E021	ELEC CLOSET	E1.0
LP411	480Y/277V,3PH,4W	200A	X	FIRST LEVEL	E121	ELEC CLOSET	E1.1
LP421	480Y/277V,3PH,4W	200A	X	SECOND LEVEL	E217	ELEC CLOSET	E1.2
LP431	480Y/277V,3PH,4W	200A		THIRD LEVEL	E357	ELEC CLOSET	E1.3
LP441	480Y/277V,3PH,4W	200A	X	FOURTH LEVEL	E421	ELEC CLOSET	E1.4
LP442	480Y/277V,3PH,4W	200A	X	FOURTH LEVEL	425	POOL STORAGE	E1.4
LP443	480Y/277V,3PH,4W	125A		FOURTH LEVEL	419	LAUNDRY	E1.4
LP451	480Y/277V,3PH,4W	200A		FIFTH LEVEL	E517	ELEC CLOSET	E1.5
LP461	480Y/277V,3PH,4W	200A	X	PENTHOUSE	E601A	ELEC EQUIP	E1.6
RP2B1	208Y/120V,3PH,4W	250A		GARDEN LEVEL	E021	ELEC CLOSET	E1.0
RP211	208Y/120V,3PH,4W	250A		FIRST LEVEL	E121	ELEC CLOSET	E1.1
RP221	208Y/120V,3PH,4W	250A		SECOND LEVEL	E217	ELEC CLOSET	E1.2
RP231	208Y/120V,3PH,4W	250A		THIRD LEVEL	E357	ELEC CLOSET	E1.3
RP232	208Y/120V,3PH,4W	250A		THIRD LEVEL	E357	ELEC CLOSET	E1.3
RP241	208Y/120V,3PH,4W	300A		FOURTH LEVEL	E421	ELEC CLOSET	E1.4
RP251	208Y/120V,3PH,4W	250A		FIFTH LEVEL	E517	ELEC CLOSET	E1.5
RP261	208Y/120V,3PH,4W	250A		PENTHOUSE	E601A	ELEC EQUIP	E1.6
RP2B2	208Y/120V,3PH,4W	250A		GARDEN LEVEL	E021	ELEC CLOSET	E1.0
LS461	480Y/277V,3PH,4W	225A		PENTHOUSE	E601A	ELEC EQUIP	E1.6
LS411	480Y/277V,3PH,4W	100A		FIRST LEVEL	E121	ELEC CLOSET	E1.1
LS441	480Y/277V,3PH,4W	100A		FOURTH LEVEL	E421	ELEC CLOSET	E1.4
LS261	208Y/120V,3PH,4W	200A		PENTHOUSE	E601A	ELEC EQUIP	E1.6
LS211	208Y/120V,3PH,4W	100A		FIRST LEVEL	E121	ELEC CLOSET	E1.1
LS241	208Y/120V,3PH,4W	100A		FOURTH LEVEL	E421	ELEC CLOSET	E1.4
EQDP2B1	208Y/120V,3PH,4W	100A		GARDEN LEVEL	E021	ELEC CLOSET	E1.0
EQDP231	208Y/120V,3PH,4W	100A		THIRD LEVEL	E357	ELEC CLOSET	E1.3
EAV2B1	208Y/120V,3PH,4W	100A		GARDEN LEVEL	AV019	AV CONTROL	E1.0
ECOM2B1	208Y/120V,3PH,4W	150A		GARDEN LEVEL	T023	TELE ROOM	E1.0
ECOM231	208Y/120V,3PH,4W	150A		THIRD LEVEL	T359	TELE ROOM	E1.3
ECOM251	208Y/120V,3PH,4W	100A		FIFTH LEVEL	T519	TELE ROOM	E1.5
DIM221	208Y/120V,3PH,4W	100A		SECOND LEVEL	2C4	CORRIDOR	E1.2
EDIM221	208Y/120V,3PH,4W	60A		SECOND LEVEL	2C4	CORRIDOR	E1.2

Over-current Devices

The Substation No. 1 main over-current device is a 3P-3000A, individually mounted insulated case, drawout circuit breaker. The distribution section of the substation uses eight (8) individually mounted drawout circuit breakers. All drawout circuit breakers are 3-pole and range from 225A to 1,600A with one spare.

All distribution panelboards use molded case, bolt-on type circuit breakers as the main over-current device with varying AIC ratings from 10,000 to 65,000.

Some branch circuit panelboards are main lugs only, but most are molded case, bolt-on type circuit breakers.

Transformers

The SMC Campus Center utilizes a total of thirteen (13) transformers. Each transformer is pad-mounted and located in electrical closets on each floor. All transformers except the main substation transformer step down 480Y/277V, 3PH, 4W power to 208Y/120V, 3PH, 4W power. The following table summarizes all transformers.

INDIVIDUAL TRANSFORMER SCHEDULE								
TAG	PRIMARY VOLTAGE	SECONARY VOLTAGE	SIZE	TYPE	TEMP. RISE	TAPS	MOUNTING	REMARKS
T1	13.2kV, 3PH, 4W	480Y/277V, 3PH, 4W	1000	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2A	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2B	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2C	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2D	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2E	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2F	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2G	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2H	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T2I	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T3	480V, 3PH, 4W	208Y/120V, 3PH, 4W	45	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T4	480V, 3PH, 4W	208Y/120V, 3PH, 4W	225	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	
T5	480V, 3PH, 4W	208Y/120V, 3PH, 4W	75	DRY TYPE	115˚C	(6) 2.5%	PAD MOUNTED	

Grounding

Grounding is designed in accordance with the National Electrical Code. Service ground is established at the point of building entry using a ground grid as shown on drawing E0.2. The main ground bar detail is also shown on drawing E0.2. Each feeder includes an individual ground conductor. Branch circuits have a green ground wire pulled with all circuits.

A telecommunications grounding riser diagram is shown on drawing T3.0. A grounding busbar detail for telecommunication equipment is shown on drawing T0.2.

Special Equipment

A Transient Voltage Surge Suppressor (TVSS) device is located in Substation No. 1 to eliminate or reduce damage by limiting transient voltages and currents on the electrical circuits. Drive isolation transformers are used for some of the large variable frequency drives. Two UPS systems are located in the 3rd floor telecommunications room, T359.

The campus distribution system uses two, automatic capacitor banks to address the issue of power factor correction on the medium voltage side (see drawing E4.0).

Lighting Loads

The typical lighting systems within the SMC Campus Center are recessed, linear fluorescent parabolic and small aperture, compact fluorescent downlights. These provide most of the general ambient lighting for the educational spaces, including classrooms and offices. Pendants provide decorative elements in the lobby, ballroom, and student work lounges. Metal halide sources are used to illuminate some of the recreational spaces such as the natatorium and racquetball courts. Nearly all the lighting equipment in the building is operated at 480Y/277V with the exception of the ballroom, which operates at 208Y/120V. More specific information for HID lamps and ballasts used in the Campus Center can be found in Appendix B of this report.

All spaces were designed to meet lighting power density requirements based on the ASHRAE 90.1-2004 space-by-space method with tradeoffs permitted between spaces where allowed. Illuminance levels in each space were based on IESNA Lighting Handbook recommendations found in chapter 10.

The following table provides a listing of each luminaire found in the Campus Center with specific characteristics provided for each type. This table does not include the custom pendants and wall sconces (W series), as their specifications were not provided by Winona Lighting and are not clearly defined in the construction documents.

LUMINAIRE SCHEDULE

TAG	LIGHT SOURCE	LAMP TYPE	WATTS	NO. OF LAMPS	BALLAST TYPE	VOLTAGE	INPUT WATTS	BALLAST FACTOR	CURRENT START/ OPERATE	POWER FACTOR START/ OPERATE
A2	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
A3	FLUOR	F32T8	32	3	ELECT, DIM	277V	93.5	1.00	0.37	>0.95
A32	FLUOR	F32T8	32	1 2	ELECT, PRS ELECT, PRS	277V	25 46	0.72 0.71	0.20 0.40	0.99 0.99
B3	FLUOR	F17T8	17	3	ELECT, PRS	277V	37	0.72	0.14	0.97
B32	FLUOR	F17T8	17	1 2	ELECT, PRS ELECT, PRS	277V	16 24	0.79 0.71	0.06 0.09	0.94 0.97
B4	FLUOR	F17T8	17	4	ELECT, PRS	277V	48	0.72	0.18	0.96
C	TRT CFL	F32TBX	32	1	ELECT, PRS	277V	36	0.98	0.13	0.98
CL	TRT CFL	F32TBX	32	1	ELECT, PRS	277V	36	0.98	0.13	0.98
CW	TRT CFL	F32TBX	32	1	ELECT, PRS	277V	36	0.98	0.13	0.98
C4	TRT CFL	F42TBX	42	1	ELECT, PRS	277V	46	0.98	0.17	0.98
C4D	TRT CFL	F42TBX	42	1	ELECT, DIM	120V	37.2	0.95	0.31	>0.95
C4DW	TRT CFL	F42TBX	42	1	ELECT, DIM	120V	37.2	0.95	0.31	>0.95
D	TRT CFL	F13TWIN	13	1	ELECT, PRS	120V	16	1.00	0.11	0.99
F	FLUOR	F32T8	32	1	ELECT, PRS	277V	25	0.72	0.20	0.99
G	TRT CFL	F32TBX	32	1	ELECT, PRS	277V	36	0.98	0.13	0.98
H2	FLUOR	F17T8	17	2	ELECT, PRS	277V	24	0.71	0.09	0.97
H4	FLUOR	F32T8	32	2	ELECT, PRS	277V	70	0.71	0.26	0.98
J	FLUOR	F32T8	32	1	ELECT, PRS	277V	25	0.72	0.20	0.99
J2	FLUOR	F32T8	32	1	ELECT, PRS	277V	25	0.72	0.20	0.99
K2	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
K3	FLUOR	F32T8	32	3	ELECT, PRS	277V	70	0.71	0.26	0.98
L	TRT CFL	F32TBX	32	1	ELECT, PRS	277V	36	0.98	0.13	0.98
L4	TRT CFL	F42TBX	42	1	ELECT, PRS	277V	46	0.98	0.17	0.98
M	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
N	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
P	FLUOR	F32T8	32	3 3	ELECT, PRS ELECT, PRS	277V 277V	70 70	0.71 0.71	0.26 0.26	0.98 0.98
Q	HIR	100PAR	100	2	--	120V	100	--	0.83	1.00
R1	FLUOR	F32T8	32	3	ELECT, PRS	277V	70	0.71	0.26	0.98
R2	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
R3	QUAD CFL	F28QBX	28	2	ELECT, PRS	120V	60	0.95	0.50	0.99
R4	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
S	MH	CMH400	400	1	ELECT	277V	425	1.00	2.10/1.70	0.90
S1	TRT CFL	F42TBX	42	2	ELECT, PRS	277V	93	0.97	0.78	0.99
T1	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
T2	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
T3	FLUOR	F32T8	32	3	ELECT, PRS	277V	70	0.71	0.26	0.98

LUMINAIRE SCHEDULE (CONTINUED)										
TAG	LIGHT SOURCE	LAMP TYPE	WATTS	NO. OF LAMPS	BALLAST TYPE	VOLTAGE	INPUT WATTS	BALLAST FACTOR	CURRENT START/ OPERATE	POWER FACTOR START/ OPERATE
CC	FLUOR	F32T8	32	2	ELECT, PRS	277V	46	0.71	0.40	0.99
XA	TRT CFL	F32TBX	32	2	ELECT, PRS	277V	68	0.98	0.57	0.98
XB	MH	PMH175	175	1	ELECT, PS	277V	198	1.00	0.37/0.71	0.90
XC	TRT CFL	F42TBX	42	2	ELECT, PRS	277V	93	0.97	0.78	0.99
XD	MH	PMH175	175	1	ELECTR, PS	277V	198	1.00	0.37/0.71	0.90
XF	TRT CFL	F42TBX	42	1	ELECT, PRS	277V	46	0.98	0.17	0.98
EXIT A	LED	GREEN LEDS	2.20	1	--	277V	2.20	--	0.03	1.00

Lighting Control

The SMC Campus Center fulfills ASHRAE 90.1 requirements for Automatic Lighting Shutoff by the use of occupancy sensors throughout the building lobbies, lounges, dining facilities, corridors, offices, multipurpose spaces, and fitness center. The occupancy sensing controls are a mixture of ultrasonic and dual technology sensors. Small spaces use switch-mounted occupancy sensors with manual override. Large spaces utilize ceiling-mounted occupancy sensors in combination with lighting contactors.

Where rooms are separable, such as the ballroom, the controls include partition switches to allow the room to operate from one controller, or when divided, separately from two controllers. Exterior lighting is controlled by contactors and the building automation system (BAS). A more specialized Lutron Grafik Eye lighting control system with preset scene options and manual control is provided in the ballroom and large conference and multipurpose rooms.

Mechanical and Other Loads

The building includes a variety of electrically powered mechanical and plumbing equipment. A VAV system is used in most spaces with air distribution through ceiling or wall-mounted diffusers. Power is required to run one cooling tower, one centrifugal chiller, five air handling units with energy recovery wheels, and various exhaust fans, air conditioning units, return fans, exhaust fans, unit heaters, and pumps. Most equipment is located in the main mechanical room on the Garden Level or the mechanical penthouse.

Other loads in the SMC Campus Center come from architectural and laundry equipment which need power, including vending machines, elevators, motor operated fire doors, washers, and dryers. The following schedules contain equipment descriptions and calculated load for each piece of equipment with the total load being summed in kilowatts.

MECHANICAL/PLUMBING EQUIPMENT SCHEDULE									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD	LOAD UNIT	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED PF	LOAD IN kVA	LOAD IN kW
AHU-1	AIR HANDLING UNIT	50	HP	65.0	480V	3	0.95	54.04	51.34
AHU-3	AIR HANDLING UNIT	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
AHU-4	AIR HANDLING UNIT	15	HP	21.0	480V	3	0.95	17.46	16.59
AHU-5	AIR HANDLING UNIT	10	HP	14.0	480V	3	0.95	11.64	11.06
AHU-6	AIR HANDLING UNIT	30	HP	40.0	480V	3	0.95	33.26	31.60
DHU-1	DEHUMID. UNIT	116	kVA	--	480V	3	0.85	116.0	98.6
AC-1	AIR COND. UNIT	(2) 3	HP	37.9	480V	3	0.85	31.51	26.78
AC-1S	AIR COND. UNIT	(2) 3	HP	37.9	480V	3	0.85	31.51	26.78
AC-2	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-3	AIR COND. UNIT	1-1/2	HP	32.3	480V	3	0.85	26.85	22.82
AC-4	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-5	AIR COND. UNIT	0.27	HP	23.0	480V	3	0.75	19.12	14.34
AC-6	AIR COND. UNIT	0.27	HP	23.0	480V	3	0.75	19.12	14.34
AC-7	AIR COND. UNIT	1/5	HP	10.7	208V	1	0.75	2.23	1.67
AC-8	AIR COND. UNIT	1/2	HP	14.2	208V	1	0.85	2.95	2.51
AC-9	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-10	AIR COND. UNIT	1/5	HP	10.7	208V	1	0.75	2.23	1.67
AC-11	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-12	AIR COND. UNIT	1/5	HP	10.7	208V	1	0.75	2.23	1.67
AC-13	AIR COND. UNIT	1/2	HP	14.2	208V	1	0.85	2.95	2.51
AC-14	AIR COND. UNIT	1/5	HP	10.7	208V	1	0.75	2.23	1.67
AC-15	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-16	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-17	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-18	AIR COND. UNIT	1/5	HP	6.6	208V	1	0.75	1.37	1.03
AC-19	AIR COND. UNIT	1/2	HP	26.3	480V	3	0.85	21.87	18.59
RAC-2	ROOFTOP AC UNIT	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
RAC-3	ROOFTOP AC UNIT	1	HP	2.1	480V	3	0.85	1.75	1.49
RAC-4	ROOFTOP AC UNIT	1	HP	2.1	480V	3	0.85	1.75	1.49
CU-1	CONDENSING UNIT	1.5	HP	22.0	480V	3	0.95	18.29	17.38
RF-1	AHU-1 RETURN	25	HP	34.0	480V	3	0.95	28.27	26.86
RF-3	AHU-3 RETURN	10	HP	14.0	480V	3	0.95	11.64	11.06
RF-4	AHU-4 RETURN	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
RF-5	AHU-5 RETURN	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
RF-6	AHU-6 RETURN	15	HP	21.0	480V	3	0.95	17.46	16.59
RF-7	DHU-1 RETURN	20	HP	27.0	480V	3	0.95	22.45	21.33
EF-1	EXHAUST FAN	3	HP	4.8	480V	3	0.85	3.00	2.55
EF-2	EXHAUST FAN	2	HP	3.4	480V	3	0.85	2.83	2.41
EF-3	EXHAUST FAN	5	HP	7.6	480V	3	0.95	6.32	6.00
EF-4	EXHAUST FAN	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69

MECHANICAL/PLUMBING EQUIPMENT SCHEDULE (CONTINUED)									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD	LOAD UNIT	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED PF	LOAD IN kVA	LOAD IN kW
EF-5	EXHAUST FAN	3	HP	4.8	480V	3	0.85	3.99	3.39
EF-6	EXHAUST FAN	1/4	HP	5.8	120V	1	0.75	0.70	0.53
EF-7	EXHAUST FAN	3/4	HP	1.6	480V	3	0.85	1.33	1.13
EF-8	EXHAUST FAN	3	HP	4.8	480V	3	0.85	3.99	3.39
EF-10	FIREPLACE FLUE	--	--	1.4	120V	1	0.85	0.17	0.15
EF-11	EXHAUST FAN	1	HP	2.1	480V	3	0.85	1.75	1.49
EF-12	EXHAUST FAN	1/3	HP	7.2	120V	1	0.85	0.86	0.73
EF-13	EXHAUST FAN	3/4	HP	1.6	480V	3	0.85	1.33	1.13
EF-14	EXHAUST FAN	3/4	HP	1.6	480V	3	0.85	1.33	1.13
CUH-1	CABINET UNIT HTR	60	W	--	120V	1	0.75	0.08	0.06
CUH-2	CABINET UNIT HTR	85	W	--	120V	1	0.75	0.11	0.085
CUH-3	CABINET UNIT HTR	85	W	--	120V	1	0.75	0.11	0.085
CUH-4	CABINET UNIT HTR	320	W	--	120V	1	0.75	0.43	0.32
UH-1	UNIT HEATER	1/60	HP	--	120V	1	0.75	0.23	0.017
UH-2	UNIT HEATER	1/25	HP	--	120V	1	0.75	0.053	0.04
C-1	AIR CURTAIN	(2) 1/5	HP	--	120V	1	0.75	0.20	0.15
CH-1	CHILLER	278.0	kVA	--	480V	3	0.95	278.0	264.1
CT-1 FAN	COOLING TOWER FAN	30	HP	40.0	480V	3	0.95	33.26	31.60
CT-1 HTR	COOLING TOWER HTR	(2) 10	kW	--	480V	3	0.85	23.53	20.0
CT-1F	COOLING TOWER FILL	5	HP	7.6	480V	3	0.95	6.32	6.00
CAC-1	CTRL AIR COMPRESS.	5	HP	7.6	480V	3	0.95	6.32	6.00
DWH-1	WATER HEATER	1/12	HP	--	120V	1	0.75	0.083	0.063
DWH-2	WATER HEATER	1/12	HP	--	120V	1	0.75	0.083	0.063
GB-1	GAS BOOSTER 1	1/2	HP	1.1	480V	3	0.85	0.91	0.77
GB-2	GAS BOOSTER 2	1/2	HP	1.1	480V	3	0.85	0.91	0.77
P-1	PUMP	30	HP	40.0	480V	3	0.95	33.26	31.60
P-2	PUMP	30	HP	40.0	480V	3	0.95	33.26	31.60
P-3	PUMP	3/4	HP	13.8	120V	1	0.85	1.66	1.41
P-4	PUMP	1-1/2	HP	3.0	480V	3	0.85	2.49	2.12
P-5	PUMP	1	HP	2.1	480V	3	0.85	1.75	1.49
P-6	PUMP	3	HP	4.8	480V	3	0.85	3.99	3.39
P-7	PUMP	3/4	HP	1.6	480V	3	0.85	1.33	1.13
P-8	PUMP	1/8	HP	3.0	120V	1	0.75	0.36	0.27
P-9	PUMP	3/4	HP	1.6	480V	3	0.85	1.33	1.13
P-10	PUMP	1	HP	1.6	480V	3	0.85	1.33	1.13
P-11	PUMP	10	HP	14.0	480V	3	0.95	11.64	11.06
P-12	PUMP	10	HP	14.0	480V	3	0.95	11.64	11.06
P-15	PUMP	20	HP	27.0	480V	3	0.95	22.45	21.33
P-16	PUMP	20	HP	27.0	480V	3	0.95	22.45	21.33
P-17	PUMP	20	HP	27.0	480V	3	0.95	22.45	21.33

MECHANICAL/PLUMBING EQUIPMENT SCHEDULE (CONTINUED)									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD	LOAD UNIT	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED PF	LOAD IN kVA	LOAD IN kW
P-18	PUMP	20	HP	27.0	480V	3	0.95	22.45	21.33
P-21	PUMP	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
P-22	PUMP	7-1/2	HP	11.0	480V	3	0.95	9.15	8.69
P-23	PUMP	(2) 3	HP	9.6	208V	3	0.85	3.46	2.94
P-24	PUMP	(2) 2	HP	6.8	480V	3	0.85	5.65	4.80
P-25	PUMP	(2) 10	HP	28.0	480V	3	0.95	23.28	22.12
P-27	PUMP	1/2	HP	9.8	120V	1	0.85	1.18	1.00
P-28	PUMP	1/2	HP	9.8	120V	1	0.85	1.18	1.00
P-30	PUMP	1/8	HP	3.0	120V	1	0.75	0.36	0.27
P-31	PUMP	1/8	HP	3.0	120V	1	0.75	0.36	0.27
P-32	PUMP	40	HP	52.0	480V	3	0.95	43.23	41.07
P-33	PUMP	1	HP	2.1	480V	3	0.85	1.75	1.49
P-34	PUMP	(2) 1/3	HP	14.4	208V	1	0.85	3.00	2.55
P-35	PUMP	(2) 1/3	HP	14.4	208V	1	0.85	3.00	2.55
OHC-1	COOLING GRILLE	2	HP	7.5	208V	3	0.85	2.70	2.30
OHC-2	COOLING GRILLE	2	HP	7.5	208V	3	0.85	2.70	2.30
SH-1	SAUNA HEATER	8	kW	--	208V	3	0.85	9.41	8.00
SH-2	SAUNA HEATER	8	kW	--	208V	3	0.85	9.41	8.00
							TOTAL	1147.4 kW	

LAUNDRY EQUIPMENT SCHEDULE									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD	LOAD UNIT	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED PF	LOAD IN kVA	LOAD IN kW
WMH-1	WASHING MACH. HTR	27.42	kVA	33.0	480V	3	0.95	27.42	26.05
WMH-2	WASHING MACH. HTR	27.42	kVA	33.0	480V	3	0.95	27.42	26.05
WM-1	WASHING MACHINE	4.98	kVA	6.0	480V	3	0.85	4.98	4.23
WM-2	WASHING MACHINE	4.98	kVA	6.0	480V	3	0.85	4.98	4.23
DR-1	DRYER	0.75	kVA	3.3	208V	1	0.75	0.75	0.56
DR-2	DRYER	0.75	kVA	3.3	208V	1	0.75	0.75	0.56
							TOTAL	61.68 kW	

ARCHITECTURAL EQUIPMENT SCHEDULE									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD	LOAD UNIT	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED PF	LOAD IN kVA	LOAD IN kW
V-1	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-2	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-3	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-4	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-5	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-6	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-7	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-8	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-9	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-10	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
V-11	VENDING MACHINE	1.25	kVA	--	120V	1	0.95	1.25	1.19
ELEV 1	ELEVATOR	40	HP	52.0	480V	3	0.95	43.23	41.07
ELEV 2	ELEVATOR	40	HP	52.0	480V	3	0.95	43.23	41.07
ELEV 3	ELEVATOR	50	HP	65.0	480V	3	0.95	54.04	51.34
FD-1	FIRE DOOR 1	2	HP	3.4	480V	3	0.85	2.83	2.41
FD-2	FIRE DOOR 2	2	HP	3.4	480V	3	0.85	2.83	2.41
FD-3	FIRE DOOR 3	2	HP	3.4	480V	3	0.85	2.83	2.41
FD-4	FIRE DOOR 4	2	HP	3.4	480V	3	0.85	2.83	2.41
							TOTAL	156.21 kW	

Service Entrance Size

The following tables present a summary of three different methods used to size the service entrance. The Square Foot Method is generally used during the conceptual and schematic design phase to provide a general estimate of the service entrance based on a particular building type and the square footage of the building. The second calculation involves using the NEC loading tables during the design development phase to calculate the service entrance size based on specific load categories and associated VA/SF for a particular building type. The Actual Loading Method is completed using the actual building loads from the working drawings and related demand factors from the NEC. The breakdown of each service entrance calculation method is detailed below.

SERVICE ENTRANCE SIZE CALCULATION – CONCEPTUAL/SCHEMATIC DESIGN			
BUILDING TYPE	BUILDING AREA	VA/SF	VA
COLLEGE BUILDINGS – STUDENT UNION	110000	13	1430000
		TOTAL kVA	1430
		TOTAL CURRENT AT 480V	1720A
		RECOMMENDED SWITCHBOARD SIZE	2000A

SERVICE ENTRANCE SIZE CALCULATION – DESIGN DEVELOPMENT			
LOAD TYPE	BUILDING AREA	VA/SF	VA
LIGHTING (DF = 1.0)	110000	3.0	330000
RECEPTACLES (DF = 0.5 FOR >10 KVA)	110000	1.0	60000
HVAC - COOLING	110000	8	880000
HVAC – EXHAUST FANS	110000	2	220000
KITCHEN – FULL SERVICE	3450	20	69000
KITCHEN - WARMING	407	10	4070
ELEVATORS (QUANTITY = 3)	--	--	150000
		TOTAL kVA	1713.07
		TOTAL CURRENT AT 480V	2060A
		RECOMMENDED SWITCHBOARD SIZE	2500A

SERVICE ENTRANCE SIZE CALCULATION – WORKING DRAWINGS			
LOAD TYPE	CONNECTED LOAD (VA)	DEMAND FACTOR	DEMAND LOAD (VA)
LIGHTING	117960	1.0	117960
RECEPTACLES	241800	1.0 (<10000), 0.5 (REST)	125900
MECHANICAL COOLING	475060	1.0	475060
PUMPS	337000	0.8	269600
FANS	250370	0.8	200296
KITCHEN EQUIPMENT	27660	0.9	24894
LAUNDRY EQUIPMENT	63580	1.0	63580
FITNESS EQUIPMENT	52580	1.0	52580
AV EQUIPMENT	86300	1.0	86300
ELEVATORS	140500	1.0	140500
NATATORIUM	141580	0.9	127422
		TOTAL kVA	1684
		TOTAL kVA (ADD 25% SPARE CAPACITY)	2105
		TOTAL CURRENT AT 480V	2532A
		RECOMMENDED SWITCHBOARD SIZE	3000A

SERVICE ENTRANCE SIZE CALCULATION – TABLE 1			
PHASE	LOAD - kVA	VOLTAGE SYSTEM	LOAD - AMPS
CONCEPTUAL/SCHEMATIC PHASE	1430	480Y/277V, 3PH, 4W	1720
DESIGN DEVELOPMENT	1713.07	480Y/277V, 3PH, 4W	2060
WORKING DRAWINGS	2105	480Y/277V, 3PH, 4W	2532

SERVICE ENTRANCE SIZE CALCULATION – TABLE 2			
SERVICE ENTRANCE	SIZE - AMPS	VOLTAGE SYSTEM	CAPACITY - kVA
ACTUAL CONDITIONS - SERVICE ENTRANCE 1	3000A	480Y/277V, 3PH, 4W	2494.2
SUMMARY - VA/SF (110,000 SF TOTAL)	22.67		

In comparing the three service entrance size methods, the initial schematic method was severely underestimated. This is due to the fact that the VA/SF for a student union building type more than likely does not take into consideration additional design elements such as a natatorium, fitness areas, and kitchen equipment. The design development method produced more accurate results but underestimated some of the major load types, while at the same time overestimated others. The working drawings load calculations most closely resemble the actual service entrance size for the building. There is room for expansion, which was a design concept from the beginning of the project, and many of the panelboards contain spare circuits for the possibility of adding loads in the future.

Environmental Stewardship Design

The Campus Center uses dual technology or ultrasonic technology occupancy sensors and photocells in individual rooms and public spaces for daylighting. High efficiency motors and lighting equipment were used although the building was not required to meet any LEED certification standards. However, the architect and the rest of the project team incorporated several sustainable features into the design within the limits of the project budget. UMB's focus is more on keeping the maintenance manageable.

Design Issues

Voltage drop on the electrical service side was not an issue. There was no site lighting requirements, which is usually where voltage drop may become an issue. Looking through the panelboard schedules, some circuits have a #10 wire on a 20A circuit breaker, which is where the electrical engineer felt there might be a voltage drop concern on that particular circuit. This issue, however, was not very common.

The project was originally planned to have a standby generator. Instead, UMB had the system tap off an existing generator on a neighboring building against the recommendation of the design team.

The campus distribution system is very reliable on the service side. An outage on the building's individual loop, however, needs to be manually addressed by throwing a switch on Substation No. 1.

Single-Line Diagram

The single-line diagram is included in Appendix A.

Section 2: Communication Systems

Fire Alarm System

A complete analog addressable fire alarm system by Pyrotronics was designed for the Campus Center with a fire pump room, M007, located on the Garden Level. The fire alarm control panel interfaces with the University Central Station Fire Alarm System located in Howard Hall. A graphic annunciator panel will also be located in the fire pump room, and the system will utilize NAC panels located in electrical closets on each floor for audible and visual alarms where the system cannot economically be served from the main panel. Alarm initiating devices include manual pull stations, smoke detectors, heat detectors, duct-mounted smoke detectors, tamper switches, and alarm verification to reduce false alarms. Alarm indicating devices include speakers for voice evacuation and visual devices (strobes) in accordance with NFPA.

Telecommunication System

Vertically stacked telecom rooms located adjacent to the electrical closets service each floor with ladder trays to carry cables vertically and cable trays to carry cables horizontally through the building. Rack-mounted equipment serve each floor's outlets for communications, wall phones, data, televisions, and AV.

Audiovisual System

Because of the academic nature of the building, floor and ceiling-mounted outlet types are utilized in various spaces such as dining areas, multipurpose spaces, and the natatorium to service computers, projectors, phones, televisions, speakers, and other A/V equipment. LCD televisions are located throughout the lobby, lounges, and ballroom for general announcements, schedules, news, and weather updates. The main AV Control Room, AV019, is located on the Garden Level and serves all floors.

Security System

The security system includes card readers, fixed and PTZ video surveillance cameras (exterior and exit corridors) CCTV, door contacts, intercoms, and duress alarms. Data gathering panels are located on each floor in the electrical closets. Monitoring screens are located at security desks on the first and second floors. All cameras and data gathering panels are integrated with the telecommunication equipment racks.

Appendix A

Single-Line Diagram and Existing Drawings

E4.1: Campus Center One-Line Diagram	Henry Adams, LLC
E4.1: Single-Line Diagram	Josh Winemiller

FEEDER SCHEDULE (COPPER)

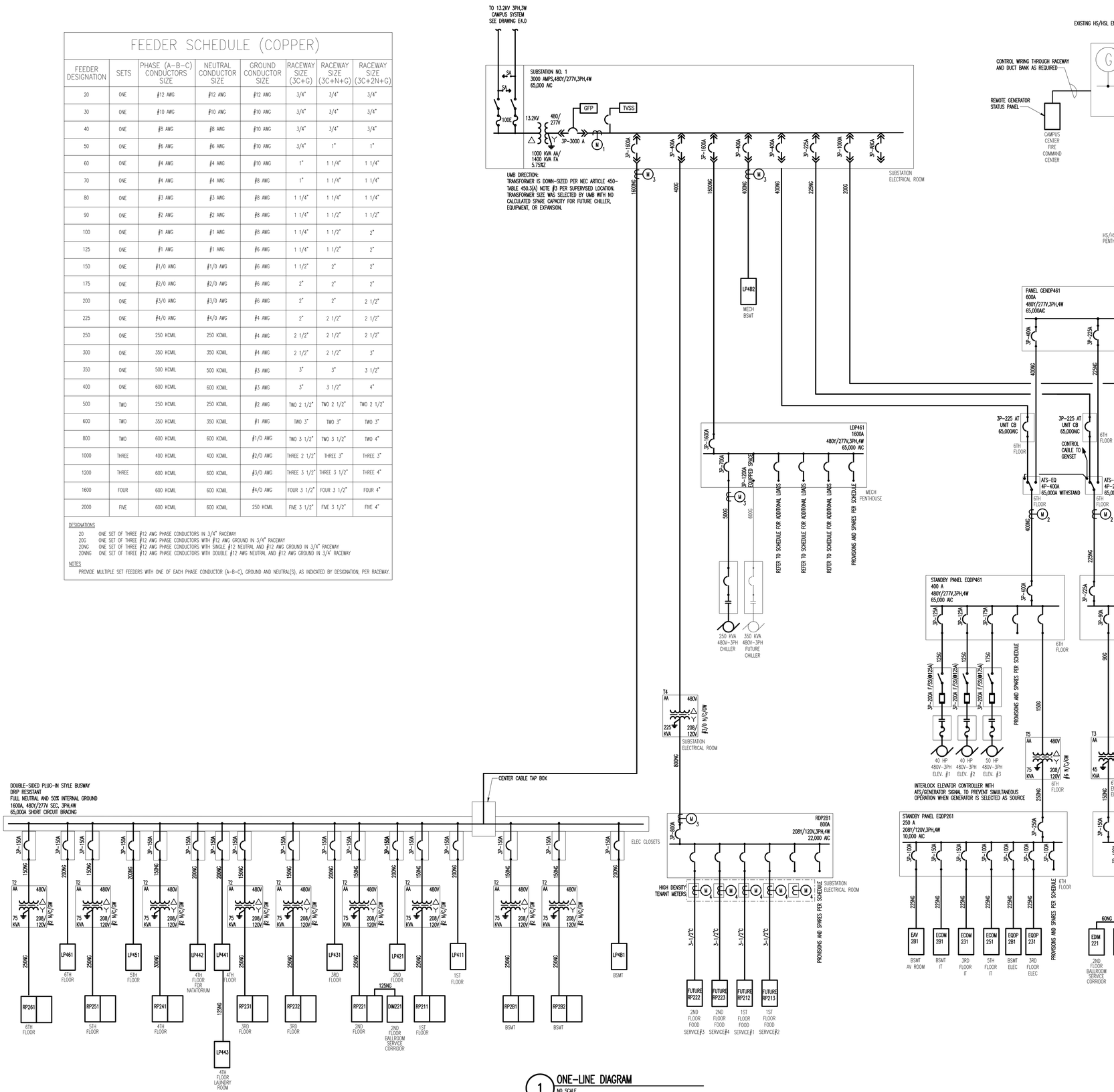
FEEDER DESIGNATION	SETS	PHASE (A-B-C) CONDUCTORS SIZE	NEUTRAL CONDUCTOR SIZE	GROUND CONDUCTOR SIZE	RACEWAY SIZE (3C+G)	RACEWAY SIZE (3C+N+G)	RACEWAY SIZE (3C+2N+G)
20	ONE	#12 AWG	#12 AWG	#12 AWG	3/4"	3/4"	3/4"
30	ONE	#10 AWG	#10 AWG	#10 AWG	3/4"	3/4"	3/4"
40	ONE	#8 AWG	#8 AWG	#10 AWG	3/4"	3/4"	3/4"
50	ONE	#6 AWG	#6 AWG	#10 AWG	3/4"	1"	1"
60	ONE	#4 AWG	#4 AWG	#10 AWG	1"	1 1/4"	1 1/4"
70	ONE	#4 AWG	#4 AWG	#8 AWG	1"	1 1/4"	1 1/4"
80	ONE	#3 AWG	#3 AWG	#8 AWG	1 1/4"	1 1/4"	1 1/4"
90	ONE	#2 AWG	#2 AWG	#8 AWG	1 1/4"	1 1/2"	1 1/2"
100	ONE	#1 AWG	#1 AWG	#8 AWG	1 1/4"	1 1/2"	2"
125	ONE	#1 AWG	#1 AWG	#6 AWG	1 1/4"	1 1/2"	2"
150	ONE	#1/0 AWG	#1/0 AWG	#6 AWG	1 1/2"	2"	2"
175	ONE	#2/0 AWG	#2/0 AWG	#6 AWG	2"	2"	2"
200	ONE	#3/0 AWG	#3/0 AWG	#6 AWG	2"	2"	2 1/2"
225	ONE	#4/0 AWG	#4/0 AWG	#4 AWG	2"	2 1/2"	2 1/2"
250	ONE	250 KCMIL	250 KCMIL	#4 AWG	2 1/2"	2 1/2"	2 1/2"
300	ONE	350 KCMIL	350 KCMIL	#4 AWG	2 1/2"	2 1/2"	3"
350	ONE	500 KCMIL	500 KCMIL	#3 AWG	3"	3"	3 1/2"
400	ONE	600 KCMIL	600 KCMIL	#3 AWG	3"	3 1/2"	4"
500	TWO	250 KCMIL	250 KCMIL	#2 AWG	TWO 2 1/2"	TWO 2 1/2"	TWO 2 1/2"
600	TWO	350 KCMIL	350 KCMIL	#1 AWG	TWO 3"	TWO 3"	TWO 3"
800	TWO	600 KCMIL	600 KCMIL	#1/0 AWG	TWO 3 1/2"	TWO 3 1/2"	TWO 4"
1000	THREE	400 KCMIL	400 KCMIL	#2/0 AWG	THREE 2 1/2"	THREE 3"	THREE 3"
1200	THREE	600 KCMIL	600 KCMIL	#3/0 AWG	THREE 3 1/2"	THREE 3 1/2"	THREE 4"
1600	FOUR	600 KCMIL	600 KCMIL	#4/0 AWG	FOUR 3 1/2"	FOUR 3 1/2"	FOUR 4"
2000	FIVE	600 KCMIL	600 KCMIL	250 KCMIL	FIVE 3 1/2"	FIVE 3 1/2"	FIVE 4"

DESIGNATIONS

20 ONE SET OF THREE #12 AWG PHASE CONDUCTORS IN 3/4" RACEWAY
20G ONE SET OF THREE #12 AWG PHASE CONDUCTORS WITH #12 AWG GROUND IN 3/4" RACEWAY
20NG ONE SET OF THREE #12 AWG PHASE CONDUCTORS WITH SINGLE #12 NEUTRAL AND #12 AWG GROUND IN 3/4" RACEWAY
20NNG ONE SET OF THREE #12 AWG PHASE CONDUCTORS WITH DOUBLE #12 AWG NEUTRAL AND #12 AWG GROUND IN 3/4" RACEWAY

NOTES

PROVIDE MULTIPLE SET FEEDERS WITH ONE OF EACH PHASE CONDUCTOR (A-B-C), GROUND AND NEUTRAL(S), AS INDICATED BY DESIGNATION, PER RACEWAY.



1 ONE-LINE DIAGRAM
NO SCALE

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Rev.	Date:	Comment:
4	01/29/10	Record Drawing
3	05/09/08	Bulletin 31
2	03/10/08	Bulletin #27
1	XXX	XXX
0	05/02/07	For Construction

Issued: May 2, 2007

Campus Center One-Line Diagram

Campus Center
621 West Lombard Street
University of Maryland, Baltimore
Baltimore, MD

UMB PROJECT NO. 99-311
WTW PROJECT NO. 70-4091

E4.1

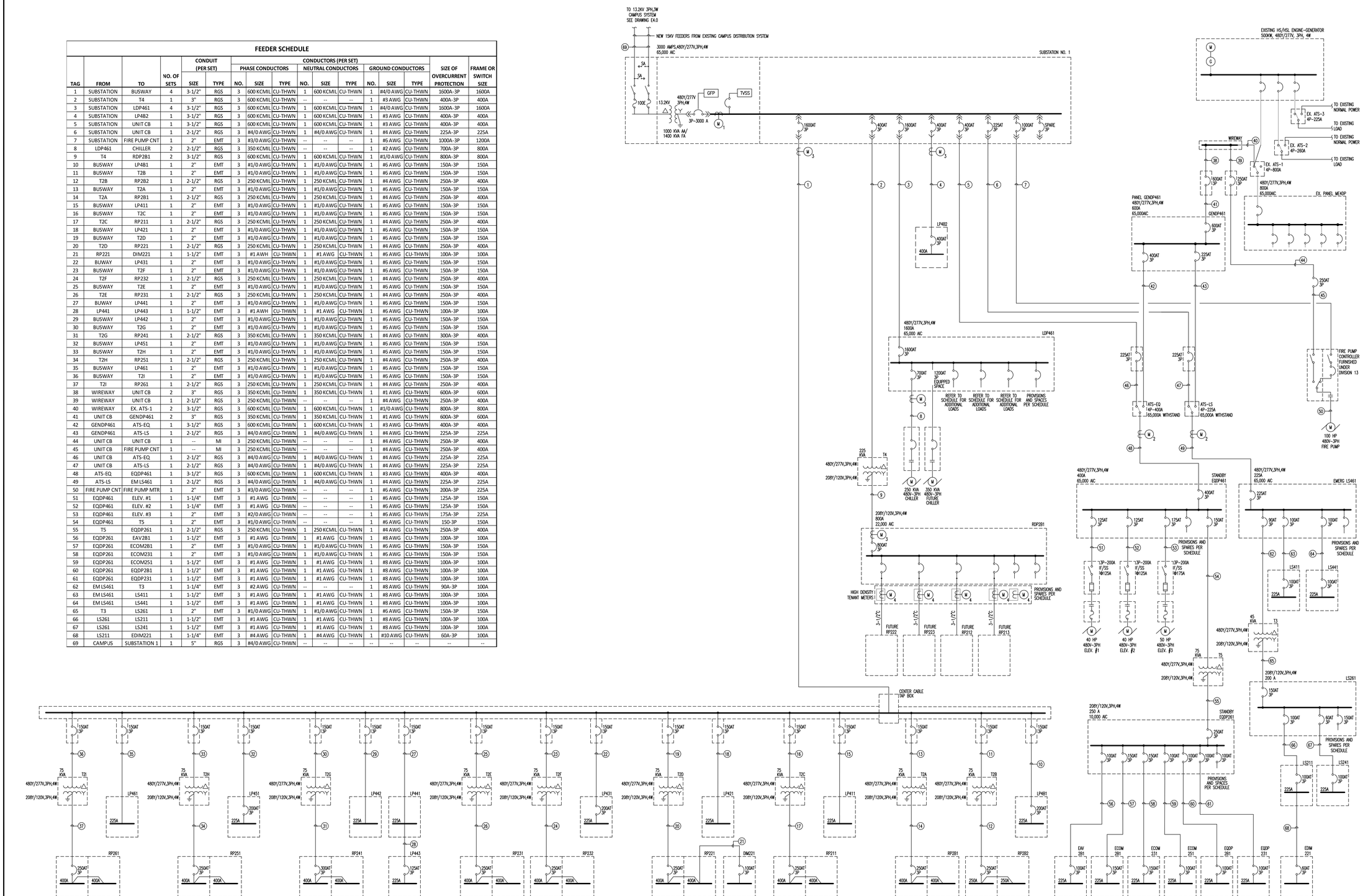
HALLC JOB NO.: U0472A0

RECORD DRAWING: This record drawing has been prepared based upon information provided by others. While this information is believed to be reliable, the Design Professional has not verified its accuracy, and thus is not responsible for the accuracy or completeness of this record drawing or for any errors or omissions which may have been incorporated into it as a result of erroneous information provided by others. Those relying on this record document are advised to obtain independent verification of its accuracy before applying it for any purpose.

IF THIS DRAWING DOES NOT MEASURE EXACTLY 30" X 42", IT HAS BEEN REDUCED OR ENLARGED. PLEASE DO NOT SCALE THIS DRAWING.

FEEDER SCHEDULE

TAG	FROM	TO	NO. OF SETS	CONDUIT (PER SET)		CONDUCTORS (PER SET)									SIZE OF OVERCURRENT PROTECTION	FRAME OR SWITCH SIZE
						PHASE CONDUCTORS			NEUTRAL CONDUCTORS			GROUND CONDUCTORS				
				SIZE	TYPE	NO.	SIZE	TYPE	NO.	SIZE	TYPE	NO.	SIZE	TYPE		
1	SUBSTATION	BUSWAY	4	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#4/0 AWG	CU-THWN	1600A-3P	1600A
2	SUBSTATION	T4	1	3"	RGS	3	600 KCMIL	CU-THWN	--	--	--	1	#3 AWG	CU-THWN	400A-3P	400A
3	SUBSTATION	LDP461	4	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#4/0 AWG	CU-THWN	1600A-3P	1600A
4	SUBSTATION	LP4B2	1	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#3 AWG	CU-THWN	400A-3P	400A
5	SUBSTATION	UNIT CB	1	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#3 AWG	CU-THWN	400A-3P	400A
6	SUBSTATION	UNIT CB	1	2-1/2"	RGS	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN	1	#4 AWG	CU-THWN	225A-3P	225A
7	SUBSTATION	FIRE PUMP CNT	1	2"	EMT	3	#3/0 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	1000A-3P	1200A
8	LDP461	CHILLER	2	2-1/2"	RGS	3	350 KCMIL	CU-THWN	--	--	--	1	#2 AWG	CU-THWN	700A-3P	800A
9	T4	RDP2B1	2	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#1/0 AWG	CU-THWN	800A-3P	800A
10	BUSWAY	LP4B1	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
11	BUSWAY	T2B	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
12	T2B	RP2B2	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
13	BUSWAY	T2A	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
14	T2A	RP2B1	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
15	BUSWAY	LP411	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
16	BUSWAY	T2C	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
17	T2C	RP211	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
18	BUSWAY	LP421	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
19	BUSWAY	T2D	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
20	T2D	RP221	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
21	RP221	DIM221	1	1-1/2"	EMT	3	#1 AWH	CU-THWN	1	#1 AWG	CU-THWN	1	#5 AWG	CU-THWN	100A-3P	100A
22	BUWAY	LP431	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
23	BUSWAY	T2F	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
24	T2F	RP232	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
25	BUSWAY	T2E	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
26	T2E	RP231	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
27	BUWAY	LP441	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
28	LP441	LP443	1	1-1/2"	EMT	3	#1 AWH	CU-THWN	1	#1 AWG	CU-THWN	1	#6 AWG	CU-THWN	100A-3P	100A
29	BUSWAY	LP442	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
30	BUSWAY	T2G	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
31	T2G	RP241	1	2-1/2"	RGS	3	350 KCMIL	CU-THWN	1	350 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	300A-3P	400A
32	BUSWAY	LP451	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
33	BUSWAY	T2H	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
34	T2H	RP251	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
35	BUSWAY	LP461	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
36	BUSWAY	T2I	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
37	T2I	RP261	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
38	WIREWAY	UNIT CB	2	3"	RGS	3	350 KCMIL	CU-THWN	1	350 KCMIL	CU-THWN	1	#1 AWG	CU-THWN	600A-3P	600A
39	WIREWAY	UNIT CB	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	--	--	--	1	#4 AWG	CU-THWN	250A-3P	400A
40	WIREWAY	EX. ATS-1	2	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#1/0 AWG	CU-THWN	800A-3P	800A
41	UNIT CB	GENDP461	2	3"	RGS	3	350 KCMIL	CU-THWN	1	350 KCMIL	CU-THWN	1	#1 AWG	CU-THWN	600A-3P	600A
42	GENDP461	ATS-EQ	1	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	600 KCMIL	CU-THWN	1	#3 AWG	CU-THWN	400A-3P	400A
43	GENDP461	ATS-LS	1	2-1/2"	RGS	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN	1	#4 AWG	CU-THWN	225A-3P	225A
44	UNIT CB	UNIT CB	1	--	MI	3	250 KCMIL	CU-THWN	--	--	--	1	#4 AWG	CU-THWN	250A-3P	400A
45	UNIT CB	FIRE PUMP CNT	1	--	MI	3	250 KCMIL	CU-THWN	--	--	--	1	#4 AWG	CU-THWN	250A-3P	400A
46	UNIT CB	ATS-EQ	1	2-1/2"	RGS	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN	1	#4 AWG	CU-THWN	225A-3P	225A
47	UNIT CB	ATS-LS	1	2-1/2"	RGS	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN	1	#4 AWG	CU-THWN	225A-3P	225A
48	ATS-EQ	EQDP461	1	3-1/2"	RGS	3	600 KCMIL	CU-THWN	1	#4/0 AWG	CU-THWN	1	#3 AWG	CU-THWN	400A-3P	400A
49	ATS-LS	EM LS461	1	2-1/2"	RGS	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN	1	#4 AWG	CU-THWN	225A-3P	225A
50	FIRE PUMP CNT	FIRE PUMP MTR	1	2"	EMT	3	#3/0 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	200A-3P	225A
51	EQDP461	ELEV. #1	1	1-1/4"	EMT	3	#1 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	125A-3P	150A
52	EQDP461	ELEV. #2	1	1-1/4"	EMT	3	#1 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	125A-3P	150A
53	EQDP461	ELEV. #3	1	2"	EMT	3	#2/0 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	175A-3P	225A
54	EQDP461	T5	1	2"	EMT	3	#1/0 AWG	CU-THWN	--	--	--	1	#6 AWG	CU-THWN	150-3P	150A
55	T5	EQDP261	1	2-1/2"	RGS	3	250 KCMIL	CU-THWN	1	250 KCMIL	CU-THWN	1	#4 AWG	CU-THWN	250A-3P	400A
56	EQDP261	EAV2B1	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
57	EQDP261	ECOM2B1	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
58	EQDP261	ECOM231	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
59	EQDP261	ECOM251	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
60	EQDP261	EQDP2B1	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
61	EQDP261	EQDP231	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
62	EM LS461	T3	1	1-1/4"	EMT	3	#2 AWG	CU-THWN	--	--	--	1	#8 AWG	CU-THWN	90A-3P	100A
63	EM LS461	LS411	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
64	EM LS461	LS441	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
65	T3	LS261	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	150A-3P	150A
66	LS261	LS211	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
67	LS261	LS241	1	1-1/2"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#8 AWG	CU-THWN	100A-3P	100A
68	LS211	EDIM221	1	1-1/4"	EMT	3	#4 AWG	CU-THWN	1	#4 AWG	CU-THWN	1	#10 AWG	CU-THWN	60A-3P	100A
69	CAMPUS	SUBSTATION 1	1	5"	RGS	3	#4/0 AWG	CU-THWN	--	--	--	--	--	--	--	--



1 SINGLE-LINE DIAGRAM
NO SCALE

SMC CAMPUS CENTER
UNIVERSITY OF MARYLAND, BALTIMORE
BALTIMORE, MD
MAY 2, 2007

JOSH WINEMILLER

AE 481W
SENIOR THESIS

10/27/2010

100% TECH 2

DRAWING TITLE:

ELECTRICAL SINGLE-LINE DIAGRAM

E4.1

Appendix B

H.I.D. Lamp/Ballast Combinations

Type S	Lamp: [1] 400W Pulse Start MH Ballast Type: Magnetic
Type XB/XD	Lamp: [1] 175W Pulse Start MH Ballast Type: Magnetic

Pulse Start Metal Halide Standard

Pulse Start MH Std 400W/640 CW Mog ED28 1SL

Philips Pulse Start Metal Halide Lamps offer an optimized metal halide system for greater efficiency and lumen maintenance.

Product data

- Product Data

Product number	232520
Full product name	Pulse Start MH Std 400W/640 CW Mog ED28 1SL
Short product name	PS MH Std 400W/640 CW Mog ED28 1SL
Pieces per Sku	1
Skus/Case	12
Bar code on pack	046677232528
Bar code on case	50046677232523
Logistics code(s)	928601165501

- General Characteristics

System Description	Pulse Start
Base	Mogul [Mogul]
Base Information	Nic/Brass [Nickel/Brass Base]
Bulb	ED28
Bulb Material	Hard Glass
Bulb Finish	Clear
Operating Position	Base Up +/-15D [Hanging +/-15D or Base Up (BU)]
Main Application	General Lighting
RatedAvgLife(See Family Notes)	20000 hr

- Electrical Characteristics

Watts	400 W
Lamp Voltage	135 V
Lamp Current	3.2 A
Re-ignition Time [min]	6 min

- Environmental Characteristics

- Light Technical Characteristics

Color Code	640 [CCT of 4000K]
Color Rendering Index	68 Ra8
Color Designation	Cool White
Color Temperature	4000 K
Color Temperature technical	4000 K
Chromaticity Coordinate X	385 -
Chromaticity Coordinate Y	390 -
Initial Lumens	44000 Lm
Luminous Efficacy	110 Lm/W
Lamp	

- UV-related Characteristics

- Product Dimensions

Light Center Length L	5 in
Max Overall Length (MOL) - C	8.3 in
Diameter D	3.5 in

- Luminaire Design Requirements

Cap-Base Temperature	230 C
Bulb Temperature	450 C

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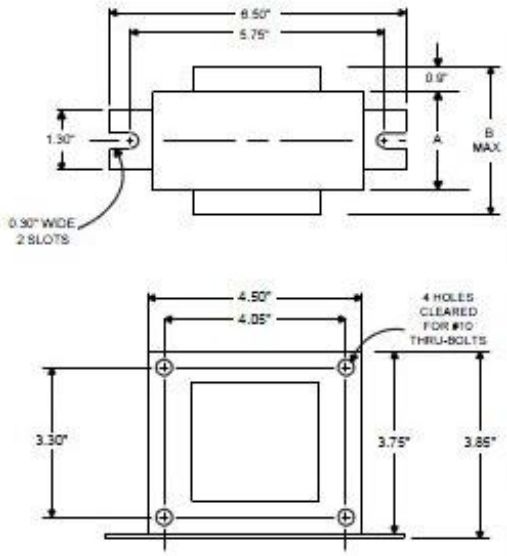
PHILIPS ADVANCE

Metal Halide Lamp Ballast

Catalog Number 71A6037BEE
For 400W M59
60 Hz R-HPF
Status: Active

DIMENSIONS AND DATA

3 3/4 X 4 1/2 CORE



INPUT VOLTS		277				
CIRCUIT TYPE	R-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±9%					
LINE CURRENT (Amps)						
Operating		1.70				
Open Circuit		2.10				
Starting		2.10				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-5°F or -20°C					
NOM. OPEN CIRCUIT VOLTAGE	277					
INPUT VOLTAGE AT LAMP DROPOUT		200				
INPUT WATTS	425					
RECOMMENDED FUSE (Amps)		5				
CORE and COIL						
Dimension (A)	1.60					
Dimension (B)	3.80					
Weight (lbs.)	9					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	20.0					
Volts (min.)	300					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	250-305					
Short-Circuit Current Test (Amps)						
Secondary Current	3.80-4.60					
Input Current		1.70-2.60	-	-	-	-

Capacitor: 7C200P30RA

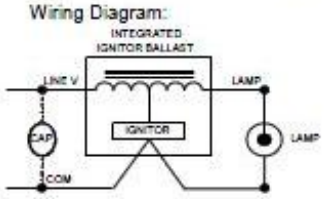
Capacitance: 20
Dia/Oval Dim: 1.58
Height: 3.62
Temp Rating: 105°C

Ignitor: INTEGRAL

An ignitor integral to the core and coil assembly is used to start the lamp.

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 125°C

Wiring Diagram:



UL RECOGNIZED

Fig. H

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description
EE	EISA COMPLIANT - 88% EFFICIENT BALLAST

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

PHILIPS LIGHTING ELECTRONICS N.A.

10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 10/26/09

Pulse Start Metal Halide Standard

Pulse Start MH Std 175W/640 CW PS Medium ED17 1SL

Philips Pulse Start Metal Halide Lamps offer an optimized metal halide system for greater efficiency and lumen maintenance.

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Pulse Start Metal Halide Standard

Product data

- **Product Data**

Product number	232496
Full product name	Pulse Start MH Std 175W/640 CW PS Medium ED17 1SL
Short product name	PS MH Std 175W/640 CW PS Medium ED17 1SL
Pieces per Sku	1
Skus/Case	12
Bar code on pack	046677232498
Bar code on case	50046677232493
Logistics code(s)	928601165201

- **General Characteristics**

System Description	Pulse Start
Base	Medium [Single Contact Medium Screw]
Base Information	Nic/Brass [Nickel/Brass Base]
Bulb	ED17
Bulb Material	Hard Glass
Bulb Finish	Clear
Operating Position	Base Up +/-15D [Hanging +/-15D or Base Up (BU)]
Main Application	General Lighting
RatedAvgLife(See Family Notes)	15000 hr

- **Electrical Characteristics**

Watts	175 W
Lamp Voltage	132 V
Lamp Current	1.5 A
Re-ignition Time [min]	4 min

- **Environmental Characteristics**

- **Light Technical Characteristics**

Color Code	640 [CCT of 4000K]
Color Rendering Index	68 Ra8
Color Designation	Cool White
Color Temperature	4000 K
Color Temperature technical	4000 K
Chromaticity Coordinate X	385 -
Chromaticity Coordinate Y	390 -
Initial Lumens	17500 Lm
Luminous Efficacy	100 Lm/W
Lamp	

- **UV-related Characteristics**

PET (NIOSH)	8 h500lx

- **Product Dimensions**

Light Center Length L	3.4 in
Max Overall Length (MOL) - C	5.4 in
Diameter D	2.125 in

- **Luminaire Design Requirements**

Cap-Base Temperature	210 C
Bulb Temperature	450 C

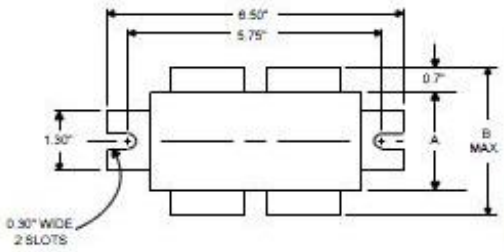
PHILIPS ADVANCE

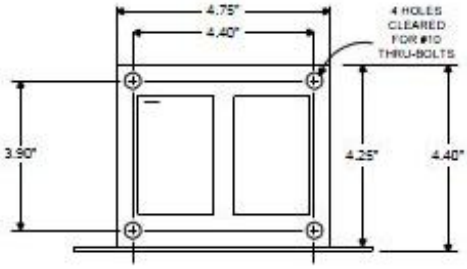
Metal Halide Lamp Ballast

Catalog Number 71A5591EE
For 175W M137/M152 (P.S.)
60 Hz SUPER-CWA
Status: Active

DIMENSIONS AND DATA

4 1/4 X 4 3/4 CORE - 2 COIL UNIT





INPUT VOLTS		120	208	240	277	
CIRCUIT TYPE	SUPER-CWA					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±10%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		1.66	0.95	0.83	0.71	
Open Circuit		1.30	0.72	0.65	0.57	
Starting		0.83	0.51	0.44	0.37	
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A	A	A	A	
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	285					
INPUT VOLTAGE AT LAMP DROPOUT		60	104	120	138	
INPUT WATTS	198					
RECOMMENDED FUSE (Amps)		5	3	3	3	
CORE and COIL						
Dimension (A)	1.65					
Dimension (B)	3.30					
Weight (lbs.)	10.5					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	11.0					
Volts (min.)	370					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	254-310					
Short-Circuit Current Test (Amps)						
Secondary Current	1.56-1.91					
Input Current		0.66-1.00	0.41-0.61	0.35-0.53	0.30-0.44	-

Capacitor: 7C110M40

Capacitance: 11
Dia/Oval Dim: 1.65
Height: 3.75
Temp Rating: 105°C

Wiring Diagram:

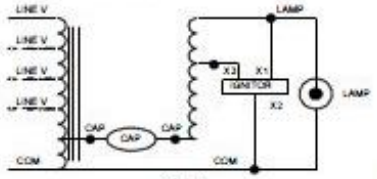


Fig. M

U.L. RECOGNIZED

Ignitor: LI533-H4

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 105°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description
EE	EISA COMPLIANT - 88% EFFICIENT BALLAST

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

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