

Army National Guard Readiness Center

Technical Report 2

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Executive Summary

The following technical report contains an analysis of all the existing electrical systems of the Army National Guard Readiness Center Addition. It building is comprised of a five story tower atop three below grade levels. The building serves as an addition to an existing building but functions as a stand-alone structure. Its main purpose is to serve as an administrative office building to accommodate for the increase in the number of employees. Open and private offices make up the majority of the square footage, with the exception of several special purpose areas including an auditorium, fitness center, library, and data center. At 254,000 ft², a large and somewhat complex distribution system is required to operate the building on a daily basis.

Included in the analysis is information about the power distribution system, service entrance, utility, voltage systems, major equipment and their loads, and any special features of the electrical system. All of this information is described in order to come up with a calculation for the service entrance size, which will then be compared to the actual service entrance used in the project.

Also included within this report is a single-line diagram which shows the electrical path from the service entrance all the way to the branch circuit panel boards. An existing single-line and riser diagram as well as a single- line diagram produced by this author are included for comparison.

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Section 1- Power Distribution Systems

Summary Description of Distribution System

The Army National Guard Readiness Center Addition receives its power from an onsite utility yard that is tapped into Dominion Power's grid. The electrical distribution system is a simple radial system that has one point of service entrance. Within the utility yard is a Dominion Power owned pad mounted transformer, fed by a medium voltage feeder, which steps down the power from 34.5 kV to 13.2 kV Y. Power is then fed into a NEMA 3R interrupter switchgear rated at 13.2kV, 3PH, 3W.

From the switchgear, power enters the building through a double ended unit substation. From there the power is stepped down from 13.2kV to 480V, 3PH, 3W, 32900A, 65KAIC. This first unit substation is also connected to a second unit substation of identical size and similar layout. Power flows from these two double ended unit substations to various distribution panels. These distribution panels include motor control centers, mechanical critical distribution, normal distribution, and ups backup systems.

Emergency power is generated by two 1500kW diesel generators that feed into a 6000A generator paralleling switchgear. The emergency power is distributed through the building with the use of three automatic bypass switches for emergency load, standby load, and elevators. These bypass switches divert power straight to the two unit substations.

Utility Company Information

The utility company that provides power to the service entrance of the Army National Guard Readiness Center Addition is Dominion Virginia Power. They are located at 120 Tredegar Street, Richmond, VA 23261. Website: www.dom.com/dominion-virginia-power.

The rate schedule that applies to this building is MS which is for military service. At the time of this report, rates and tariffs are not provided due to confidential reasons. The Army National Guard is very sensitive about certain information of their facilities, such as specific tasks and, in this case, rates.

Service Entrance

The Army National Guard Readiness Center Addition is a stand-alone building connected directly to the utility. As mentioned previously, the service entrance is located within an existing onsite utility yard. Components that make up the service entrance are a 4-way pad mounted switch, 34.5kV - 13.2kV Y pad mounted transformer, medium voltage feeders, pad mounted CTS, metering cabinet, and an

interrupter switchgear. Dominion Power owns the majority of the equipment, including the 4-way pad mounted switch, transformer, and CTS and metering cabinet. The MVS is provided by the electrical contractor. Dominion Power meters the use of electricity for the building through the pad mounted CTS and metering cabinet, also located within the utility yard. Power eventually comes into the building from the service entrance to the double ended unit substation.

Voltage Systems

Voltage starts at the service entrance at 34.5kV but is then stepped down to 13.2kV Y by a Dominion Power provided transformer. Once power enters the building through the two double ended unit substations, voltage is further stepped down to 480YV, 3PH. The two unit substations feed into the normal and mechanical distribution panels where the voltage gets further dropped from 480V to 480/277V Y. All of the distribution panels and the majority of the lighting loads operate at 480/277VY. For the emergency systems, the UPS systems operate at 480V while the backup diesel generators operate at 480/277VY. HVAC equipment operates anywhere from a range of 115V to 480V, with the majority operating at around 480V. The systems that operate solely on 208/120VY are incandescent lighting, receptacle, and IT loads.

Emergency Power Systems

Emergency power is supplied to the building by two 1500kW, 0.8PF, 480Y/277V, 3PH, 3W diesel generators located in the mechanical penthouse. Power is distributed through the building from these generators through the use of a 6000A, 480V, 3PH, 3W, 65KAIC generator paralleling switchgear. The switchgear is connected to both unit substations and three automatic transfer switches with bypass. There is an ATS for emergency load rated at 255A, 3PH, 480V; for standby load rated at 400A, 3PH, 480V; and for the elevators rated at 600A, 3PH, 480V. In the case of a power failure, the automatic transfer switches redirect power from the generators to the critical systems.

A 550kVA, 480V, 3PH, 3W UPS system is connected to each of the unit substations. Each UPS system contains a 15 minute wet cell battery. These UPS systems are connected to distribution panel boards that supply power mainly to telecommunication loads.

Locations of Switchgear

The main switchgear is located at the utility yard where the service entrance is located. All switchboards and distribution panels are located either on the second basement floor level (level 2P) or in the mechanical penthouse. The mechanical penthouse houses the motor control centers and emergency power distribution systems. All normal and mechanical, normal, and UPS distribution

panels are located on level 2P. A complete list of all distribution panel, and panelboard, locations are listed below.

Distribution Panels Schedule						
Tag	Type of Equipment	Voltage System	Main Size	Floor	Room	Room Name
DHN2PA	Normal Dist. A	480/277Y, 3P, 4 Wire	800A MCB	2P	P227	Elec-Ups
DHNC2P-A	UPS Dist. A	480, 3P, 3 WIRE	1200A MCB	2P	P227	Elec-Ups
DHN2PB	Normal Dist. B	480/277Y, 3P, 4 Wire	800A MCB	2P	P227	Elec-Ups
DHNC2P-B	UPS Dist. B	480, 3P, 3 WIRE	1200A MCB	2P	P227	Elec-Ups
MCC-A	Motor Control Center	480, 3P, 3 WIRE	600A MCB	PH	T606	Switchgear
MCC-B	Motor Control Center	480, 3P, 3 WIRE	600A MCB	PH	T606	Switchgear
DHNM2P	Mech Dist.	480, 3P, 3 WIRE	400A MCB	2P	P232	Elec. XFMR
DHNCM2P	Motor Critical Dist	480/277Y, 3P, 4 WIRE	600A MCB	2P	P232	Elec. XFMR
EDHNMMP	Elevator Distribution	480, 3P, 3 WIRE	600AMCB	PH	T606	Switchgear
SDHNMMP	Standby Distribution	480, 3P, 3 WIRE	400A MCB	PH	T606	Switchgear

Panelboards						
Tag	Voltage System	Main Size	Floor	Room #	Room Name	
LNM4T	208/120Y, 3P, 4 WIRE	100A MCB	4T	T401	N. Electric	
LSCM3P	208/120Y, 3P, 4 WIRE	100A MCB	3P	P323	Electrical	
LNM1T	208/120Y, 3P, 4 WIRE	100A MCB	1T	T115	N. Electric	
LSCM5T	208/120Y, 3P, 4 WIRE	100A MCB	5T	T512	S. IT Comm	
LNM2P	208/120Y, 3P, 4 WIRE	100A MCB	2P	P201	N. Electric	
EHS3P	480/277Y, 3P, 4 WIRE	225A MLO	3P	P323	Electrical	
EHN2P	480/277Y, 3P, 4 WIRE	225A MLO	2P	P201	N. Electric	
EHN2T	480/277Y, 3P, 4 WIRE	225A MLO	2T	T201	N. Electric	
EHN5T	480/277Y, 3P, 4 WIRE	225A MCB	5T	T501	N. Electric	
ELS3P	208/120Y, 3P, 4 WIRE	100A MCB	3P	P323	Electrical	
ELN2P	208/120Y, 3P, 4 WIRE	100A MCB	2P	P201	Electrical	
ELN2T	208/120Y, 3P, 4 WIRE	100A MCB	2T	T201	N. Electric	
ELN5T	208/120Y, 3P, 4 WIRE	100A MCB	5T	T501	N. Electric	
HN3P	480/277Y, 3P, 4 WIRE	225A MCB	3P	P301	Electrical	

Panelboards					
Tag	Voltage System	Main Size	Floor	Room #	Room Name
HN2P	480/277Y, 3P, 4 WIRE	225A MCB	2P	P201	N. Electric
H1PB	480/277Y, 3P, 4 WIRE	225A MCB	1P	P129	SE. Electric
HN1PA	480/277Y, 3P, 4 WIRE	225A MCB	1P	P101	N. Electric
HN1T	480/277Y, 3P, 4 WIRE	225A MCB	1T	T115	N. Electric
HN2T	480/277Y, 3P, 4 WIRE	225A MCB	2T	T201	N. Electric
HN3T	480/277Y, 3P, 4 WIRE	225A MCB	3T	T301	N. Electric
HN4T	480/277Y, 3P, 4 WIRE	225A MCB	4T	T401	N. Electric
HN5T	480/277Y, 3P, 4 WIRE	225A MCB	5T	T501	N. Electric
LC3PA	208/120Y, 3P, 4 WIRE	400A MCB	3P	P323	Electrical
LC3PB	208/120Y, 3P, 4 WIRE	400A MCB	3P	P323	Electrical
LSC3P	208/120Y, 3P, 4 WIRE	225A MCB	3P	P323	Electrical
HSC3P	480/277Y, 3P, 4 WIRE	225A MCB	3P	P323	Electrical
LSC1PB	208/120Y, 3P, 4 WIRE	100A MCB	1P	P129	SE. Electric
LNC1PA	208/120Y, 3P, 4 WIRE	225A MCB	1P	P101	N. Electric
LSC1PA	208/120Y, 3P, 4 WIRE	225A MCB	1P	P119	S. Electric
LSC5T	208/120Y, 3P, 4 WIRE	225A MCB	5T	T512	S. IT Comm
LNC3T	208/120Y, 3P, 4 WIRE	225A MCB	3T	T301	N. Electric
LNC5T	208/120Y, 3P, 4 WIRE	225A MCB	5T	T501	N. Electric
LSE3P	208/120Y, 3P, 4 WIRE	225A MCB	3P	P319	S. Electric
LS2P	208/120Y, 3P, 4 WIRE	225A MCB	2P	P220	S. Electric
L1PBA	208/120Y, 3P, 4 WIRE	225A MCB	1P	P129	SE. Electric
LN2P	208/120Y, 3P, 4 WIRE	225A MCB	2P	P201	Electrical
L1PBB	208/120Y, 3P, 4 WIRE	225A MCB	1P	P129	SE. Electric
LN3P	208/120Y, 3P, 4 WIRE	225A MCB	3P	P301	Electrical
LN1PA	208/120Y, 3P, 4 WIRE	225A MCB	1P	P101	N. Electric
LS1PA	208/120Y, 3P, 4 WIRE	225A MCB	1P	P119	S. Electric
LN1T	208/120Y, 3P, 4 WIRE	225A MCB	1T	T115	N. Electric
LS1T	208/120Y, 3P, 4 WIRE	225A MCB	1T	T115	S. Electric
LN2T	208/120Y, 3P, 4 WIRE	225A MCB	2T	T201	N. Electric
LS2T	208/120Y, 3P, 4 WIRE	225A MCB	2T	T215	S. Electric
LN3T	208/120Y, 3P, 4 WIRE	225A MCB	3T	T301	N. Electric
LS3T	208/120Y, 3P, 4 WIRE	225A MCB	3T	T315	S. Electric
LN5T	208/120Y, 3P, 4 WIRE	100A MCB	5T	T501	N. Electric
LN4T	208/120Y, 3P, 4 WIRE	225A MCB	4T	T401	N. Electric
LS4T	208/120Y, 3P, 4 WIRE	225A MCB	4T	T415	S. Electric
LS5T	208/120Y, 3P, 4 WIRE	225A MCB	5T	T512	S. IT Comm
LSM2P	208/120Y, 3P, 4 WIRE	100A MCB	2P	P220	S. Electric
HDIM2	480/277Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric

Panelboards					
Tag	Voltage System	Main Size	Floor	Room #	Room Name
HDIM5	480/277Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric
EHDIM3	480/277Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric
LNCM3T	208/120Y, 3P, 4 WIRE	100A MCB	3T	T301	N. Electric
LDIM1	208/120Y, 3P, 4 WIRE	40A MCB	1P	P129	SE. Electric
HDIM1	480/277Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric
EHDIM1	480/277Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric
ELDIM1	208/120Y, 3P, 4 WIRE	20A MCB	1P	P129	SE. Electric
SHS1PA	480, 3P, 3 WIRE	250A MCB	1P	P119	S. Electric
SDHSCM3P	480, 3P, 3 WIRE	200A MCB	3P	P323	Electrical
HDIM3	480/277Y, 3P, 4 WIRE	20A MCB	3P	P323	Electrical
HDIM4	480/277Y, 3P, 4 WIRE	20A MCB	3P	P323	Electrical
EHDIM2	480/277Y, 3P, 4 WIRE	20A MCB	3P	P323	Electrical

Over Current Devices

Main overcurrent device between the main service entrance and switchboard is a 600A, 3PH switch and fuse. Within the main switch gear is three more 600A, 3PH switch and fuses that protect the two unit substations and the transformer leading to the parking garage. Between the main switchgear and each of the unit substations is another set of 600A, 3PH switch and fuse. Each unit substation distributes power on 16 different feeders, which are all protected by three-pole circuit breakers ranging from 3200AT to 125AT.

Overcurrent devices between the backup generators and generator paralleling switchgear are 3200AF/3000AT draw out circuit breakers. The paralleling switchgear distributes power over nine different feeders, which are all protected by three-pole circuit breakers ranging from 3200AT to 225AT.

The majority of the panels are protected by main circuit breakers while a few are main lugs only.

Transformers

There are 43 transformers in the Army National Guard Readiness Center Headquarters. The initial transformer at the service entrance steps down voltage from 34.5kV to 13.2kV Y. Transformers within the unit substations further drop the voltage to 480YV. Distribution panels and some of the mechanical loads use 480V. For all other loads, the transformers step the voltage down from 480V to 480/277V Y or 208/120V Y. A complete schedule of transformers is listed below.

TRANSFORMER SCHEDULE							
TAG	Voltage	KVA	TYPE	Temp Rise °C	Taps	Mounting	K-RATING
T1	480V-208/120V Y	15	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T2	480V-208/120V Y	30	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T3	480V-208/120V Y	45	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T4	480V-208/120V Y	75	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T5	480V-208/120V Y	112.5	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T6	480V-208/120V Y	150	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T7	480V-208/120V Y	225	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T8	480V-208/120V Y	300	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T9	480V-208/120V Y	500	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T10	480V-208/120V Y	15	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T11	480V-208/120V Y	30	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T12	480V-208/120V Y	45	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T13	480V-208/120V Y	75	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T14	480V-208/120V Y	112.5	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T15	480V-208/120V Y	150	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T16	480V-208/120V Y	225	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T17	480V-208/120V Y	300	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T18	480V-208/120V Y	500	DRY TYPE-NEMA TP1	115	(2) @2.5%	Pad Mounted	K-4
T19	480V-208/120V Y	75	DRY TYPE-NEMA TP1	150	(2) @2.5%	Pad Mounted	-

TRANSFORMER SCHEDULE							
TAG	Voltage	KVA	TYPE	Temp Rise °C	Taps	Mounting	K-RATING
T20	480V-208/120V Y	150	DRY TYPE- NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T21	480V-208/120V Y	500	DRY TYPE- NEMA TP1	150	(2) @2.5%	Pad Mounted	-
T22	480V-208/120V Y	9	DRY TYPE- NEMA TP1	150	(2) @2.5%	Pad Mounted	-

Grounding

The extent to which grounding is shown in the building documents is a site power and grounding plan and a grounding riser diagram. Transformers that have a grounding component are also indicated on the single-line and power riser diagram.

Specialty Equipment

The Army National Guard Readiness Center Addition contains two 1500kW diesel generators located within the mechanical penthouse. They are fed into the building through a generator paralleling switchgear and three automatic transfer switches.

Two 550kVA UPS systems are both connected to each of the unit substations located on level 2P. Each UPS system is connected to its own 15 minute wet cell battery which provides the building with 100% power for 15 minutes. Each UPS system is connected to a separate distribution panel that feeds into the telecommunication systems.

Lighting Loads

The majority of the lighting in the Army National Guard Readiness Center Addition is done with either linear or compact fluorescent lighting operating at 277V. The fixtures used in the open office areas are indirect/direct pendant mounted linear fluorescent fixtures. Other office and circulation spaces use recessed downlight fixtures. There is use of incandescent lighting as well as cold cathode lighting within the auditorium for more decorative purposes. Outdoor lighting is predominantly done by either 70W or 150W metal halide lamps with some LED fixtures.

The following Luminaire Schedule lists the luminaire tag, number of lamps, type of lamp, lamp wattage, ballast type, voltage, total input watts, ballast factor, operating current, and power factor. Some luminaire information is left out, typically for incandescent and LED fixtures, and is denoted by "NA."

Luminaire Schedule									
Tag	Lamps			Ballast Type	Input Voltage	Input Wattage	Ballast Factor	Operating Current	Power Factor
	#	Type	Wattage						
KA	1	F032/835PS/ECO	38W/4'	IS	277	78	1.18	0.29	0.98
KA-1	2	F032/835PS/ECO	76W/4'	IS	277	78	1.18	0.29	0.98
KA-1D	2	F032/835PS/ECO	76W/4'	PS	277	72/70	1	0.61/0.26	0.98
KA-D	1	F032/835PS/ECO	41W/4'	PS	277	36	1	0.31/0.13	0.98
KB	1	CF26DT/E/IN/835	29W	PS	277	28	1	0.5/0.22	0.98
KB-D	1	CF26DT/E/IN/835	29W	PS	277	28	1	0.24/0.1	0.98
KC	1	F40/30BX/SPX35	41W	PS	277	40	1.17	0.15	0.95
KC-1	2	F40/30BX/SPX35	41W	PS	277	40	1.17	0.15	0.95
KC-D	1	F40/30BX/SPX35	41W	PS	277	40	1.17	0.15	0.95
KD	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97
KD-D	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97
KD-1	1	F39 T5/835/HO/ECO	41W/4'	PS	277	89	0.98	0.74	0.97
KD-2	1	F28 T5/835/ECO	33W/4'	PS	277	32	1	0.55/0.23	0.95
KE	1	F28 T5/835/ECO	33W/4'	PS	277	32	1	0.55/0.23	0.95
KF	1	CF42DT/E/IN/835	46W	PS	277	46	0.98	0.17	0.98
KH	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97
KI	1	CF26DT/E/IN/835	29W	PS	277	29	1.1	0.11	0.98
KI-D	1	CF26DT/E/IN/835	31W	PS	277	54	1.02	0.11	0.98
KJ	1	F32T8/35	33W/4'	PS	277	25	0.72	0.1	0.96
KJ-D	1	F32T8/35	33W/4'	PS	277	25	0.72	0.1	0.96
KL	1	CF32DT/E/IN 835	36W	PS	277	35	1	0.5/0.22	0.98
KL-D	1	CF32DT/E/IN 835	36W	PS	277	35	1	0.5/0.22	0.98
KM	6/1W	1W LED - Warm Light	6.2W/2'	NA	120	6.2	NA	-	1
KN	1	50W PAR 30/FL	50W	NA	120	50	NA	0.42	1
KP	2	F32T8/35	33W	PS	277	58	1.53	0.21	0.96
KQ	1	Q20MR16/IR/C/NF L25	20W	NA	277	20	NA	0.07	1
KR	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97
KR-1	1	F39 T5/835/HO/ECO	41W/3'	PS	277	89	0.98	0.74	0.97
KS	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97
KS-D	1	F54 T5/835/HO	62W/4'	PS	277	71	1.11	0.26	0.97

Luminaire Schedule									
Tag	Lamps			Ballast Type	Input Voltage	Input Wattage	Ballast Factor	Operating Current	Power Factor
	#	Type	Wattage						
KT	1	CF32DT/E/IN 835	36W	PS	277	35	1	0.5/0.22	0.98
KU	1	Cold Cathode FCLS-C-277	13.7W/FT	NA	277	13.7W/ft	NA	0.05W/ft	1
KU-D	1	Cold Cathode FCLS-C-277	13.7W/FT	NA	277	13.7W/ft	NA	0.05W/ft	1
KV			TRACK	NA	120		NA		
KV-1	1	Q 90 PAR 38/FL	90W	NA	120	90	NA	0.75	1
KW	1	Q150T4 MINI CAN-FROSTED	150W	NA	120	150	NA	1.25	1
KX	1	Q150T4 MINI CAN-FROSTED	150W	NA	120	150	NA	1.25	1
KX-1	1	Q150T4 MINI CAN-FROSTED	150W	NA	120	150	NA	1.25	1
KY	1	Q90 PAR 38/FL	90W	NA	120	90	NA	1.25	1
KZ-1D	2-3' T5 + 2 MR16	F39 T5/835/HO + 2-USHIO Q35MR16-36	194W	PS	277	89	0.98	0.74	0.97
KZ-2D	2-4' T5 + 2 MR16	F54 T5/835/HO + 2-USHIO Q35MR16-36	194W	PS	277	71	1.11	0.26	0.97
K-2	3-3W	LED SUPPLIED WITH FIXTURE	9W	NA	277	9W	NA	0.03	1
K-3	3-3W	LED SUPPLIED WITH FIXTURE	9W	NA	277	9W	NA	0.03	1
K-5	1	150W CERAMIC METAL HALIDE	185W	MAG	277	173	-	0.7/0.63	0.9
K-7	1	3W 700 MA	3W	NA	277	3W	NA	0.01	
A	2	F32T8/835	32W	PS	277	25	0.72	0.1	0.96
B	3	F32T8/835	32W	PS	277	25	0.72	0.1	0.96
C	2	F32T8/835	32W	PS	277	25	0.72	0.1	0.96
D	2	F32T8/835	32W	PS	277	25	0.72	0.1	0.96
F	2	F32T8/835	32W	PS	277	25	0.72	0.1	0.96
G	1	MXR70/U/MED	70W	NA	277	70	NA	0.25	1
H	2	F54 T5/835/HO	104W	PS	120	116	1	0.98	0.99
L	1	F40/30BX/SPX35	41W	PS	277	40	1.17	0.15	0.95
M	2	MR24	10.8W	NA	277	10.8	NA	0.04	1
L-D	1	F40/30BX/SPX35	41W	PS	277	40	1.17	0.15	0.95
L2	2	F40/30BX/SPX35	41W	PS	277	61	1	0.23	0.95
L2-D	2	F40/30BX/SPX35	41W	PS	277	61	1	0.23	0.95

Luminaire Schedule									
Tag	Lamps			Ballast Type	Input Voltage	Input Wattage	Ballast Factor	Operating Current	Power Factor
	#	Type	Wattage						
X	-	LED	-	NA	120	-	-	-	-
X2	-	LED	-	NA	120	-	-	-	-
X3	-	LED	-	NA	120	-	-	-	-
KEX-1	1	CHM70/T/U/830 /G12-300K	79W	MAG	277	118	-	0.7/0.45	0.9
KEX-2	1	CHM70/T/U/830 /G12-300K	56W	MAG	277	94	-	0.85/0.85	0.9
KEX-3	As Required	Whit LED 3200K	2.1W/ft	NA	277	2.1W/ft	NA	-	1
KEX-4	1	MXR150/c/u/ME D/O-Clear-3400k	185W	MAG	277	173	-	0.7/0.63	0.9
KEX-6	3 @ 150	MXR150/c/u/ME D/O-Clear-3400k	185W	MAG	277	173	-	0.7/0.63	0.9
KEX-7	1	35W T4-GY6.35 12V Lamp	35W	NA	120	35	NA	0.29	1
KEX-8	2	CF26DT/E/IN/835	62W	PS	277	94	0.95	0.9/0.4	0.9/0.4
KEX-9	1	F28 T5/835/ECO	33W	PS	277	28	1	0.24/0.1	0.98
KEX-10	3	3W LED Supplied With Fixture	9W	NA	120	9	NA	-	1

Lighting Control

ASHRAE 90.1 states that interior lighting in buildings larger than 5000ft² shall be controlled with an automatic control device to shut off the building lighting in all spaces. This is accomplished in this building in several ways. The first is that there is a time-of-day operated a control device which keeps lights on only during business hours in most of the larger work spaces. Another way is with the use of occupancy sensors in many of the private offices and other rooms. Each enclosed space is has at least one control device to independently control the general lighting within the space as required by section 9.4.1.2 in ASHRAE 90.1. Exterior fixtures are light sensitive and turn off automatically when sufficient daylight is available.

Programmable lighting relay systems control the lighting in the open office areas. Some of the smaller offices will be equipped with dimmable light fixtures and controls. For all other spaces, automatic controls as mentioned in the previous paragraph will be implemented.

Mechanical and Other Loads

The mechanical systems in the Army National Guard Readiness Center Addition are diverse, ranging from air-handling units to VAV terminal units to various pumps. Each floor house's air-handling units (AHUs) with individual variable air volume (VAV) terminal units and fan coil units (FCU) in a mechanical room. These AHUs range from 1500 cfm to 2450 cfm and are supplied by 100% outside air. A hydronic HVAC system consisting of a four-pipe heating and chilled water system distributes water to the AHUs and VAVs on each floor and also to the energy recovery units in the mechanical penthouse. A Building Automation System (BAS) is used to control the individual units, monitor the temperatures in each space, and controlling the FCUs throughout the building. There are also backup generators and energy recovery units located in the mechanical penthouse.

The following Mechanical Equipment Schedule lists the tag, description, size, motor amps, voltage, phase, power factor, kVA, and kW of each mechanical and plumbing load throughout the building. All motor amps are based on the assumed NEC motor amps.

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
AHU-3P-A1	Air Handleing Unit	15	HP	21	480	3	0.86	17.5	15.05
AHU-3P-B1	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-3P-B2	Air Handleing Unit	5	HP	7.6	480	3	0.84	6.33	5.32
AHU-3P-B3	Air Handleing Unit	3	HP	4.8	480	3	0.86	3.99	3.43
AHU-3P-B4	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-3P-B5	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-2P-A1	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-1P-A1	Air Handleing Unit	20	HP	27	480	3	0.86	22.44	19.30
AHU-1P-A2	Air Handleing Unit	7.5	HP	11	480	3	0.86	9.15	7.87
AHU-1P-B1	Air Handleing Unit	7.5	HP	11	480	3	0.86	9.15	7.87
AHU-1P-B2	Air Handleing Unit	7.5	HP	11	480	3	0.86	9.15	7.87
AHU-1P-B3	Air Handleing Unit	7.5	HP	11	480	3	0.86	9.15	7.87
AHU-1T-A1	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-2T-A1	Air Handleing Unit	15	HP	21	480	3	0.86	17.46	15.02

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
AHU-3T-A1	Air Handling Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-4T-A1	Air Handling Unit	15	HP	21	480	3	0.86	17.46	15.02
AHU-5T-A1	Air Handling Unit	20	HP	27	480	3	0.86	22.44	19.30
ERU-1	Emergency Recovery Unit	15	HP	21	460	3	0.86	45.7	39.30
ERU-2	Emergency Recovery Unit	10	HP	14	460	3	0.86	29.07	25.00
CH-1	Centrifugal Chiller	230	kW	302	480	3	0.91	253	230.00
CH-2	Centrifugal Chiller	230	kW	302	480	3	0.91	253	230.00
FCU-3P-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3P-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3P-A3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3P-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3P-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-3P-B1	Fan Coil Unit	1/4	HP	7.2	115	1	0.84	1.39	1.17
FCU-3P-B2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-3P-B3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-3P-B4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-3P-B5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-2P-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A6	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A7	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2P-A8	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
FCU-1P-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1P-A2	Fan Coil Unit	1/10	HP	3	115	1	0.84	0.08	0.07
FCU-1P-A3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1P-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1P-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1P-B1	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-1P-B2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1P-B3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1T-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1T-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1T-A3	Fan Coil Unit	1/2	HP	9.8	115	1	0.84	0.08	0.07
FCU-1T-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1T-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-1T-A6	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-2T-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2T-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2T-A3	Fan Coil Unit	1/2	HP	9.8	115	1	0.84	0.08	0.07
FCU-2T-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2T-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-2T-A6	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-3T-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3T-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3T-A3	Fan Coil Unit	1/2	HP	9.8	115	1	0.84	0.08	0.07

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
FCU-3T-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3T-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-3T-A6	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-4T-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-4T-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-4T-A3	Fan Coil Unit	1/2	HP	5.8	115	1	0.84	0.08	0.07
FCU-4T-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-4T-A5	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.08	0.07
FCU-4T-A6	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-5T-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.335	0.28
FCU-5T-A2	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.335	0.28
FCU-5T-A3	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.335	0.28
FCU-5T-A4	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.335	0.28
FCU-5T-A5	Fan Coil Unit	1/4	HP	5.8	115	1	0.84	1.39	1.17
FCU-P-A1	Fan Coil Unit	1/3	HP	7.2	115	1	0.84	0.075	0.06
FCU-P-A2	Fan Coil Unit	1/10	HP	3	115	1	0.84	0.075	0.06
FCU-P-A3	Fan Coil Unit	1/10	HP	3	115	1	0.84	0.075	0.06
FCU-P-A4	Fan Coil Unit	1/10	HP	3	115	1	0.84	0.075	0.06
CU-1	Split System Air Conditioning Unit	1/4	HP	5.8	208	1	0.84	2.56	2.15
CT-1	Cooling Tower	25	HP	34	480	3	0.89	16.3	14.50
CT-2	Cooling Tower	25	HP	34	480	3	0.89	16.3	14.50
CRAC-1P-A1	Computer Room Air Conditioner	5	HP	7.6	480	3	0.84	41.31	25.00
CRAC-2P-A1	Computer Room Air Conditioner	3	HP	4.8	480	3	0.84	18.99	15.00
CRAC-2P-A2	Computer Room Air Conditioner	3	HP	4.8	480	3	0.84	18.99	15.00
CRAC-3P-B1	Computer Room Air Conditioner	1.5	HP	3	480	3	0.84	17.49	15.00
B-1	Hot Water Boiler	0.96	kW	-	120	1	1	0.96	0.96

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
B-2	Hot Water Boiler	0.96	kW	-	120	1	1	0.96	0.96
B-3	Hot Water Boiler	0.96	kW	-	120	1	1	0.96	0.96
B-4	Hot Water Boiler	0.96	kW	-	120	1	1	0.96	0.96
B-5	Hot Water Boiler	0.96	kW	-	120	1	1	0.96	0.96
UH-1	Hot Water Unit Heater	1/20	HP	2	120	1	0.84	0.2	0.17
UH-2	Hot Water Unit Heater	1/20	HP	2	120	1	0.84	0.2	0.17
UH-3	Hot Water Unit Heater	1/8	HP	2.9	120	1	0.84	0.35	0.29
UH-4	Hot Water Unit Heater	1/8	HP	2.9	120	1	0.84	0.35	0.29
UH-P-A1	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A2	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A3	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A4	Hot Water Unit Heater	1/8	HP	2.9	120	1	0.84	0.41	0.34
UH-P-A5	Hot Water Unit Heater	1/8	HP	2.9	120	1	0.84	0.41	0.34
UH-P-A6	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A7	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A8	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A9	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A10	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
UH-P-A11	Hot Water Unit Heater	1/20	HP	0.3	120	1	0.84	0.19	0.16
CUH-3P-A1	Hot Water Unit Heater	1/10	HP	3	120	1	0.84	0.19	0.16
CUH-3P-B1	Hot Water Unit Heater	1/10	HP	3	120	1	0.84	0.19	0.16
CP-3P-B1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B2	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B3	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B4	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B5	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B6	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B7	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3P-B8	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-1T-A1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-2T-A1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-3T-A1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-4T-A1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15
CP-5T-A1	Condensate Pump	1/50	HP	-	120	1	0.84	0.18	0.15

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
CHWP-1	Pump	30	HP	40	460	3	0.89	18.4	16.40
CHWP-2	Pump	30	HP	40	460	3	0.89	18.4	16.40
CHWP-3	Pump	30	HP	40	460	3	0.89	18.4	16.40
CWP-1	Pump	30	HP	40	460	3	0.89	18.4	16.40
CWP-2	Pump	30	HP	40	460	3	0.89	18.4	16.40
CWP-3	Pump	30	HP	40	460	3	0.89	18.4	16.40
HWP-1	Pump	30	HP	40	460	3	0.89	9.7	8.63
HWP-2	Pump	30	HP	40	460	3	0.89	9.7	8.63
SSS-1	Solids Separation System	5	HP	7.6	480	3	0.84	3.84	3.23
FP-1P-A1	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-1P-A2	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1P-A3	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-1P-A4	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-1P-B1	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1P-B2	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-1P-B3	Fan Powered VAV Terminal Unit	(2) 1/6	HP	4.4	120	1	0.84	1.06	0.89
FP-1T-A1	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1T-A2	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1T-A3	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1T-A4	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1T-A5	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-1T-A6	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	1.18	0.99
FP-2T-A1	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-2T-A2	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-2T-A3	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-2T-A4	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
FP-2T-A5	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-2T-A6	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-2T-A7	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-3T-A1	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-3T-A2	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-3T-A3	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-3T-A4	Fan Powered VAV Terminal Unit	(2) 1/6	HP	4.4	120	1	0.84	1.06	0.89
FP-4T-A1	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-4T-A2	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-4T-A3	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.53	0.45
FP-4T-A4	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-4T-A5	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-4T-A6	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-5T-A1	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-5T-A2	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-5T-A3	Fan Powered VAV Terminal Unit	1/6	HP	4.4	120	1	0.84	0.53	0.45
FP-5T-A4	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
FP-5T-A5	Fan Powered VAV Terminal Unit	(2) 1/6	HP	4.4	120	1	0.84	1.06	0.89
FP-5T-A6	Fan Powered VAV Terminal Unit	1/4	HP	5.8	120	1	0.84	0.7	0.59
EF-3P-A1	Fan	1/4	HP	5.8	120	1	0.84	0.7	0.59
EF-3P-A2	Fan	1/4	HP	5.8	120	1	0.84	0.7	0.59
EF-3P-B1	Fan	1/4	HP	5.8	120	1	0.84	0.7	0.59
EF-2P-A1	Fan	1/3	HP	7.2	120	1	0.84	0.86	0.72
SF-2P-A1	Fan	1/3	HP	7.2	120	1	0.84	0.86	0.72
EF-1P-A1	Fan	10	HP	18	480	1	0.84	9.15	7.69
EF-1P-A2	Fan	15	HP	27	480	1	0.84	17.46	14.67

Mechanical and Plumbing Schedule									
Tag	Description	Magnitude	Unit	Motor Amps	Voltage	Phase	Assumed P.F.	kVA	kW
EF-1P-B1	Fan	0.5	HP	9.8	120	1	0.84	0.42	0.35
RF-1P-B2	Fan	2	HP	3.4	480	3	0.84	2.82	2.37
RF-1P-B3	Fan	5	HP	7.6	480	3	0.84	6.33	5.32
SF-1P-B1	Fan	5	HP	20	480	1	0.84	6.3	5.29
SF-1P-B2	Fan	3	HP	12.2	480	1	0.84	3.99	3.35
EF-P-A1	Fan	7.5	HP	13.6	480	1	0.86	5.3	4.56
EF-P-A2	Fan	5	HP	20	480	1	0.84	3.65	3.07
EF-P-A3	Fan	1	HP	4.7	480	1	0.84	1	0.84
EF-P-A4	Fan	1	HP	4.7	480	1	0.84	1	0.84
SF-P-A1	Fan	10	HP	18	480	1	0.86	11.64	10.00
SF-P-A2	Fan	7.5	HP	13.6	480	1	0.86	9.15	7.87
SF-P-A3	Fan	5	HP	20	480	1	0.84	6.3	5.30
HP-1	Mailroom Equipment	3/4	HP	4.7	480	3	0.84	8.67	7.50
CU-1	Mailroom Equipment	1/4	HP	3.2	208	1	0.84	2.22	1.87
ETWH-1	Electric Tankless Water Heater	18	kW	-	480	3	0.86	18	18.00
ETWH-2	Electric Tankless Water Heater	9	kW	-	277	1	0.86	8	9.00
ETWH-3	Electric Tankless Water Heater	8	kW	-	277	1	0.86	8	8.00
ETWH-4	Electric Tankless Water Heater	8	kW	-	277	1	0.86	8	8.00
ETWH-5	Electric Tankless Water Heater	18	kW	-	480	3	0.86	18	18.00
ETWH-6	Electric Tankless Water Heater	18	kW	-	480	3	0.86	18	18.00
ETWH-7	Electric Tankless Water Heater	18	kW	-	480	3	0.86	18	18.00
ETWH-8	Electric Tankless Water Heater	72	kW	-	480	3	0.89		72.00
SE-1	Duplex Sewag Ejector Pumps	(2) 3	HP	4.8	480	3	0.84	7.98	6.70
SE-2	Duplex Sewag Ejector Pumps	(2) 3	HP	4.8	480	3	0.84	7.98	6.70
ELEVATOR 1	Elevator	65	kW	-	480	3	0.89	57.3	65.00
ELEVATOR 2	Elevator	65	kW	-	480	3	0.89	57.3	65.00
ELEVATOR 3	Elevator	65	kW	-	480	3	0.89	57.3	65.00
ELEVATOR 4	Elevator	65	kW	-	480	3	0.89	57.3	65.00
ELEVATOR 5	Elevator	65	kW	-	480	3	0.89	57.3	65.00
ELEVATOR 6	Elevator	65	kW	-	480	3	0.89	57.3	65.00

Service Entrance Size

The following section illustrates three methods of for which the size of the service entrance is measured. The first method is the Conceptual/Schematic Design method, where total load is determined by the total square footage of the building multiplied by an estimated VA/ft². The second method is for the Design Development phase in which demand factors and assumed VA/ft² for specific load types are taken into account. The third and final method is done by adding the actual building loads and multiplying these loads with the appropriate demand factor. At the end of these calculations, the results will be compared to each other as well as the actual service entrance size.

Service Entrance Size Calculation- Conceptual/Schematic Design			
Building Type	Square Footage	VA/ft ²	Load (VA)
Office Building	251,444	12	3017328.00
Total kVA			3017.33
Total Amps (480V)			3629.28

Service Entrance Size Calculation- Design Development			
Lighting (Demand Factor 1)			
	Square Footage	VA/ft ²	Load (kVA)
	251444	3.5	880.05
Receptacles Applied Demand Factor(1 for first 10kVA, 0.5 for rest)			
	Square Footage	VA/ft ²	Load (kVA)
	251444	0.5	67.86
HVAC- air conditioned			
	Square Footage	VA/ft ²	Load (kVA)
	251444	8	2011.55
Data Center			
	Square Footage	VA/ft ² .	Load (kVA)
	138	60	8.28
Fans			
	Square Footage	VA/ft ²	Load (kVA)
	251444	2	502.888
Elevators			
	50kW/elevator	6 elevators	Load (kVA)
			333.33
Total kVA			3803.96
Load (Amps)			4575.46

Service Entrance Size: Actual Loading			
Load Type	Connected Load	Demand Factor	Demand Load(kVA)
Lighting	401.8	1	401.8
Receptacles	496	1 for first 10kVA, 0.5 for rest	253
Mech/Plumbing Equip	902.38	1	902.38
AV/ Office Equipment	1046.73	1	1046.73
Elevators	343.8	1	343.8
Total kVA			2947.71
Total Amps			3545.54
Plus 20% Spare Capacity			4254.65

Service Entrance Size			
Phase	Load-kVA	Voltage System	Load-Amps
Conceptual/Schematic Design	3017.33	480Y/277, 3PH, 4W	3629.28
Design Development	3803.96	480Y/277, 3PH, 4W	4575.46
Working Drawings	2947.71	480Y/277, 3PH, 4W	3545.54
Actual Service Entrance	2500	480Y/277, 3PH, 4W	3007

Summary-VA/ft²	9.94 VA/ft ²
----------------------------------	-------------------------

Environmental Stewardship Design

The Army National Guard Readiness Center Addition is expected to achieve a LEED Silver rating. In order to achieve this, the electrical design must pass the United States Green Build Council (USGBC) LEED electrical requirements for certification. The power densities for the open office areas are considerably lower than what's required by ASHRAE 90.1, which makes up the majority of the building space. This is mostly due to efficient use of fluorescent lighting. Other than that, no special electrical systems have been implemented.

Design Issues

Upon a visit to the job site during mid July 2010, one of the engineers described problems of their not being enough in between floors for the electrical and mechanical equipment to run through. This is due to the fact that the architect wanted such a large floor to ceiling height for each of the floors. This problem is causing a lot of conflicts during its current phase of construction where contractors are now constantly redoing conduit, plumbing, and air duct layout.

Section 2- Communication Systems

Audiovisual systems

This building has various conference rooms and an auditorium which utilize different audio visual tools to aid in presentations and meetings. Some of these systems include but are not limited to 52" LCD Direct View Displays, video teleconference microphones, video teleconferencing cameras, AV equipment rack and connection panels, video projectors, ceiling loudspeakers, wireless touch screen interfaces, and a motorized projection screen.

Telecommunication systems

All of the major communication systems equipment are located on the 3rd basement level in various telecommunication and server rooms. The main servers for the building are located in room P346. However, there are at least IT/telecommunication rooms located on each floor. Each one of these rooms has 100% access flooring as well as in the conference rooms, and offices. Telecommunication systems are distributed through the building 12" cable trays and 24" width by 4" depth under-floor cable basket tray. Most of the workstations access the telecommunication systems through either ceiling or floor mounted box telecommunication outlets. Each box outlet either contains 2 or 4 voice and data outlets.

Security Systems

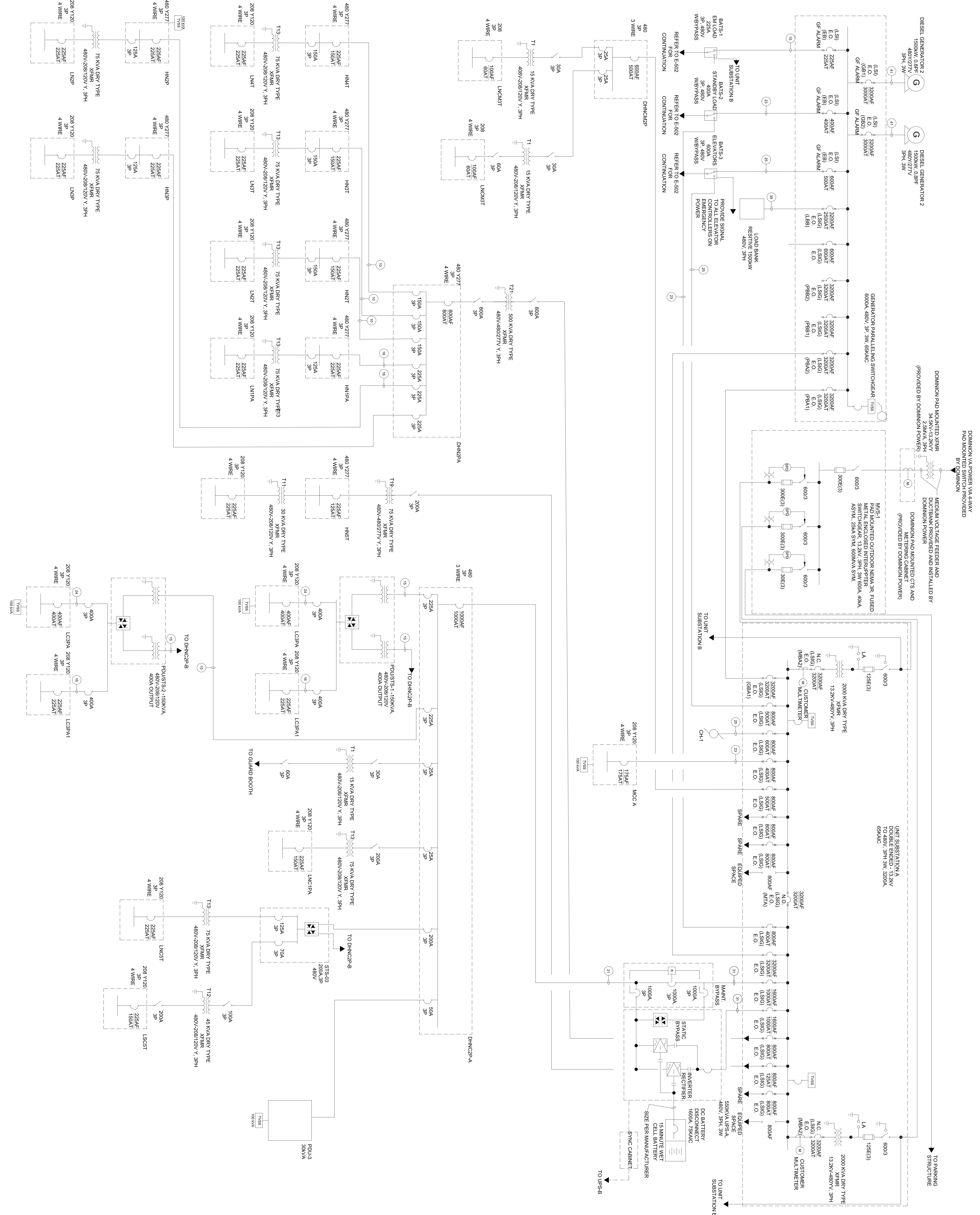
Because this building is a government building, security is of the utmost importance. Some of the security measures include card access readers (with or without keypads), security cameras with pan/tilt/zoom features, motion detectors, and glass break sensors. The majority of security is implemented in the lower below grade floors where card readers limit access to sensitive areas such as labs and server rooms. There is also a lot of security on site where many security cameras are positioned around the building.

Fire Protection

There are two existing hydrants that provide 1520 gallon per minute flow rate to the sprinkler system. The building is designed for both light hazard areas, requiring 0.10 GPM over 3,000 ft², and ordinary hazard areas which require 0.20 over 3,000 ft².

Within the main server room is a FM-200 system. FM-200 is a colorless, non-toxic gas that when released into the room extinguishes a fire within ten seconds of detection. A major advantage to this system as opposed to sprinkler systems is the minimal damage that the gas will do to the electrical equipment.

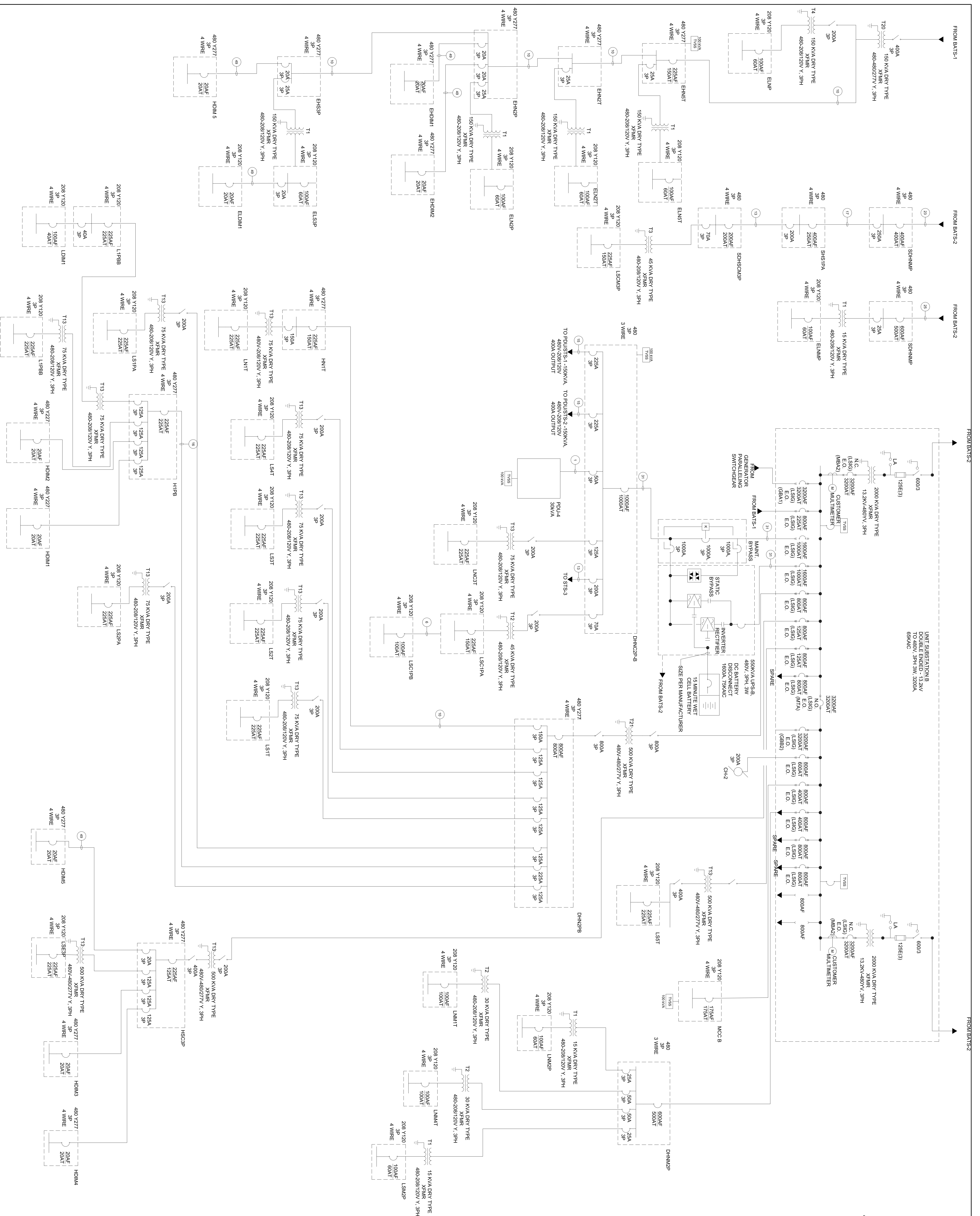
Appendix A- Single-Line and Riser Diagram



Army National Guard
 Readiness Center
 111S. Mason Dr.
 Arlington, VA

Ian Herron
 AE 481W

October 27, 2010
 E 501



UNIT SUBSTATION B
 DOUBLE ENDED - 13.2kV
 0.480V, 3PH, 3W, 3200A
 650kVA

Army National Guard
 Readiness Center

111S. Mason Dr.
 Arlington, VA

Ian Herron

AE 481W

October 27, 2010

E 502

Appendix B- Lamp and Ballast Cut Sheets



MasterColor® CDM ED17 Protected

MasterColor CDM 150W/830 Med ED17P CL ALTO+FB

Range of protected, high-efficiency long life ceramic metal halide lamps with a stable color over lifetime and a crisp, sparkling light to be used in open fixtures.

Product data

• Product Data

Product number	134635
Full product name	MasterColor CDM 150W/830 Med ED17P CL ALTO+FB
Short product name	CDM 150W/830 Med ED17P CL ALTO+FB
Pieces per Sku	1
Skus/Case	12
Bar code on pack	046677134631
Bar code on case	50046677134636
Logistics code(s)	928601132301

• General Characteristics

Base	Medium [Single Contact Medium Screw]
Base Information	Brass [Brass Base]
Bulb	ED17P [Protected]
Bulb Material	Hard Glass
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Main Application	General Lighting
RatedAvgLife(See Family Notes)	16000 hr

• Electrical Characteristics

Watts	150 W
Lamp Voltage	95 V
Lamp Current	1.8 A
Ignition Time	10 s
Ignition Supply Voltage	235 V
Re-ignition Time [min]	12 min

• Environmental Characteristics

Mercury (Hg) Content	14.2 mg
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• Light Technical Characteristics

Color Code	830 [CCT of 3000K]
Color Rendering Index	85 Ra8
Color Designation	Warm White
Color Temperature technical	3000 K
Chromaticity Coordinate X	2900 K
Chromaticity Coordinate Y	440 -
Initial Lumens	400 -
Luminous Efficacy Lamp	12900 Lm
Lumen Maintenance 2000h	86 Lm/W
Lumen Maintenance 5000h	82 %
Design Mean Lumens	73 %
	9545 Lm

• UV-related Characteristics

PET (NIOSH)	322 h.klx
Damage Factor D/fc	.257 -

• Product Dimensions

Light Center Length L	3.438 in
Max Overall Length (MOL) - C	5.438 in

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Diameter D 2.125 in

Bulb Temperature 400 C

• Luminaire Design Requirements

Cap-Base Temperature 190 C

Dimensional drawing



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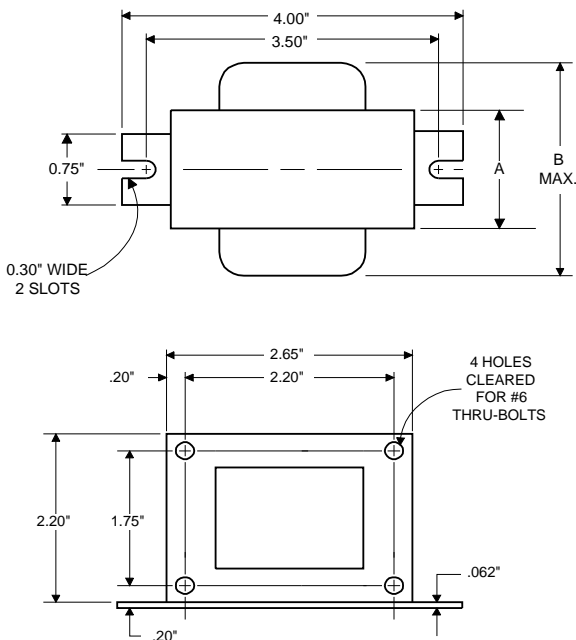
**PHILIPS
ADVANCE**

**Metal
Halide
Lamp Ballast**

**Catalog Number 71A5437BP
For 150W M102
60 Hz R-HPF
Status: Active**

DIMENSIONS AND DATA

2 5/8 X 2 3/16 CORE



INPUT VOLTS	277				
CIRCUIT TYPE	R-HPF				
POWER FACTOR (min)	90%				
REGULATION					
Line Volts	±5%				
Lamp Watts	±10%				
LINE CURRENT (Amps)					
Operating.....	0.63				
Open Circuit.....	1.50				
Starting.....	0.70				
UL TEMPERATURE RATINGS	H(180°C)				
Insulation Class	1029				
Coil Temperature Code	-20°F or -30°C	B			
MIN. AMBIENT STARTING TEMP.	277				
NOM. OPEN CIRCUIT VOLTAGE					
INPUT VOLTAGE AT LAMP DROPOUT.....	173	170			
INPUT WATTS					
RECOMMENDED FUSE (Amps).....	4				
CORE and COIL	2.50				
Dimension (A)	4.00				
Dimension (B)	4.2				
Weight (lbs.)	12"				
Lead Lengths					
CAPACITOR REQUIREMENT	14.0				
Microfarads	280				
Volts (min.)					
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)	2000				
1 minute	2500				
2 seconds	250-305				
Open Circuit Voltage Test (Volts)					
Short-Circuit Current Test (Amps)	2.00-2.50				
Secondary Current					
Input Current.....	0.50-				
	0.75	-	-	-	-

Capacitor: 7C140M30RA



Capacitance: 14
Dia/Oval Dim: 1.65
Height: 2.75
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

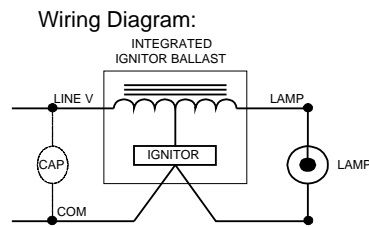


Fig. H

Typical Ordering Information

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

Order Suffix	Description

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

PHILIPS LIGHTING ELECTRONICS N.A.

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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 07/31/09



MasterColor® CDM ED17 Protected

MasterColor CDM 50W/940 Med ED17P CL ALTO+FB

Range of protected, high-efficiency long life ceramic metal halide lamps with a stable color over lifetime and a crisp, sparkling light to be used in open fixtures.

Product data

• Product Data

Product number	368936
Full product name	MasterColor CDM 50W/940 Med ED17P CL ALTO+FB
Short product name	CDM 50W/940 Med ED17P CL ALTO+FB
Pieces per Sku	1
Skus/Case	12
Bar code on pack	046677368937
Bar code on case	50046677368932
Logistics code(s)	928601137201

• General Characteristics

Base	Medium [Single Contact Medium Screw]
Base Information	Brass [Brass Base]
Bulb	ED17P [Protected]
Bulb Material	Hard Glass
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Main Application	General Lighting
RatedAvgLife(See Family Notes)	20000 hr

• Electrical Characteristics

Watts	50 W
Lamp Voltage	100 V
Lamp Current	0.59 A
Ignition Time	10 s
Ignition Supply Voltage	235 V
Re-ignition Time [min]	8 min

• Environmental Characteristics

Mercury (Hg) Content	5.8 mg
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• Light Technical Characteristics

Color Code	940 [CCT of 4000K]
Color Rendering Index	88 (min), 92 (nom) Ra8
Color Designation	Deluxe Cool White
Color Temperature technical	4000 K
Color Temperature	3800 (min), 4000 (nom), 4200 (max) K
Chromaticity Coordinate X	377 (min), 386 (nom), 395 (max) -
Chromaticity Coordinate Y	369 (min), 375 (nom), 401 (max) -
Initial Lumens	3600 Lm
Luminous Efficacy Lamp	72 Lm/W
Lumen Maintenance 2000h	78 %
Lumen Maintenance 5000h	69 %
Design Mean Lumens	2450 Lm

• UV-related Characteristics

PET (NIOSH)	172 h.klx
Damage Factor D/fc	.481 -

• Product Dimensions

Light Center Length L	3.438 in
Max Overall Length (MOL) - C	5.438 in

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Diameter D 2.125 in

Bulb Temperature 400 C

• Luminaire Design Requirements

Cap-Base Temperature 190 C

Dimensional drawing



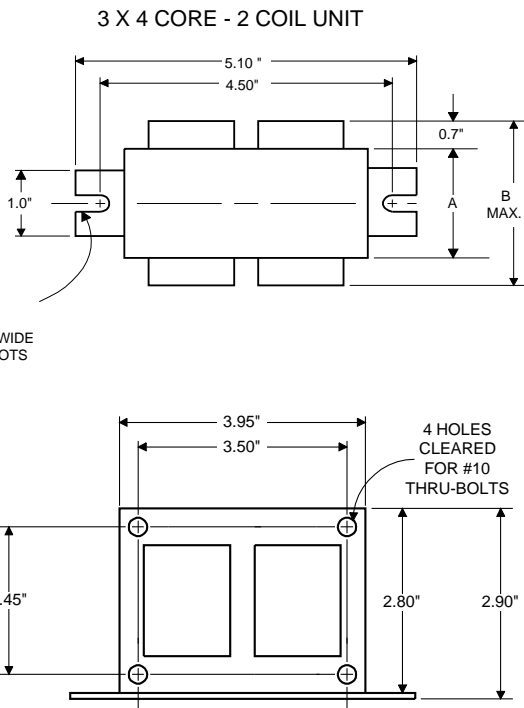
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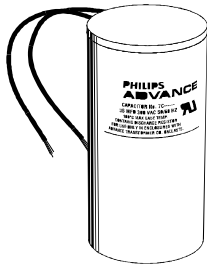
DIMENSIONS AND DATA



0.25" WIDE
2 SLOTS

INPUT VOLTS	120	277			
CIRCUIT TYPE	HX-HPF				
POWER FACTOR (min)	90%				
REGULATION					
Line Volts	±5%				
Lamp Watts	±7%				
LINE CURRENT (Amps)					
Operating.....	0.85	0.37			
Open Circuit.....	1.60	0.70			
Starting.....	0.85	0.40			
UL TEMPERATURE RATINGS					
Insulation Class	H(180°C)				
Coil Temperature Code	1029	A	A		
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C				
NOM. OPEN CIRCUIT VOLTAGE	245				
INPUT VOLTAGE AT LAMP DROPOUT.....	80	190			
INPUT WATTS	94				
RECOMMENDED FUSE (Amps).....	4	2			
CORE and COIL					
Dimension (A)	1.50				
Dimension (B)	2.70				
Weight (lbs.)	5.5				
Lead Lengths	12"				
CAPACITOR REQUIREMENT					
Microfarads	8.0				
Volts (min.)	280				
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)	220-270				
Short-Circuit Current Test (Amps)					
Secondary Current	1.10-1.40				
Input Current.....	0.70-1.10	0.30-0.50	-	-	-

Capacitor: 7C080L30RA



Capacitance: 8
Dia/Oval Dim: 1.25
Height: 2.75
Temp Rating: 105°C



Wiring Diagram:

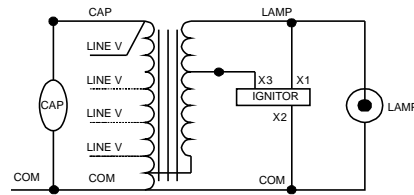


Fig. K

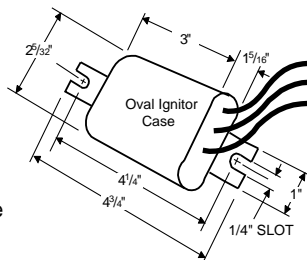
Typical Ordering Information

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

Order Suffix

Description

Ignitor: LI522-H5



Ballast to Lamp Distance
(BTL) = 20 feet
Temp Rating: 105°C

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