Technical Report 2: Electrical Existing Conditions and Design Criteria

Reva and David Logan Center for the Arts, Chicago, IL

Sean Kim Lighting/Electrical option

Leslie A. Beahm

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Executive Summary

The *Reva and David Logan Center for the Arts* building is a new multidisciplinary arts center at the University of Chicago. The building provides a dynamic mix of the spaces to create a rich environment across the artistic spectrum and collaboration.

The purpose of this report is for understanding of the electrical systems required and designed in The *Reva and David Logan Center for the Arts* building. The primary service of this building has two services from the power company, ComEd. The 12.47kV primary voltage is step down into 480/277V through the service transformers which is owned by ComEd. The 480/277V is a building service for main mechanical loads, and it is step down into 120/208V with dry-type transformer for lighting, receptacle, and small loads. Two emergency services from Power Company serve the fire pump and 120/208V emergency switchboard. For additional back-up power, there is 600kW diesel-powered engine generator located at the lower level to serve the fire pump, low-voltage switchboard, and high-voltage switchboard.

There is some potential change in electrical design to reduce the cost. The switchboards sizing could be reduced by using main circuit break instead of the fuse and switch. For the safety issues, the wire should be reasonable size if it is not violated the Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago.

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Part 1 – Develop the Electrical Systems Criteria and Scope of Work

1.1 Preliminary Electrical Load Calculation

Demand factors are as follows:

Lighting: 125%

Receptacles: First 10kVA 100%, and rest 50%

HVAC/Other: 100%

Following assumptions are made from to perform a preliminary electrical load calculation:

Lighting: 1.39 W/ft^2 (ASHRAE 90.1)

Receptacles: 1.0 W/ft^2

HVAC: 5 W/ft^2

Other: 1.0 W/ft^2

The preliminary building loads are estimated as following:

Lighting: 320 kVA

Receptacles: 97 kVA

HVAC: 920 kVA

Other: 184 kVA

1.2 Power Company Information

Name: Commonwealth Edison Company

Location: 509 N Dearborn St. Chicago, IL 60654

Website: https://www.comed.com/Pages/default.aspx

Large Load Delivery Class	January - June	July - December
CC	$63.54 x $IDUF_n$	$62.13 x $IDUF_n$
SMSC	$20.26 x $IDUF_n$	$19.98 x $IDUF_n$
Secondary Voltage DFC ($/kW)	$5.20 x $IDUF_n$	$5.12 x $IDUF_n$
Primary Voltage DFC ($/kW)	$3.57 x $IDUF_n$	$3.53 x $IDUF_n$
Primary Voltage Transformer Charge ($/kW)	$0.19 x $IDUF_n$	$0.18 x $IDUF_n$

IEDT ($/kWh)	$0.00120 x $IDUF_n$	$0.00120 x $IDUF_n$

1.3 Building Utilization Voltage

Building Utilization Voltage: 277/480 volt

- Lighting: 120 volt and 277 volt
- Receptacles: 120 volt
- HVAC: 208 volt or 480 volt
- Special Equipment – Elevator: 480 volt, Other technology: 120 volt

1.4 Emergency Power Requirements

Based on IBC Section 2702-Emergency and Standby Power Systems, emergency power should be designed as listed below. Also, Installation and maintenance for the emergency power system required by International Fire Code, or NEPA 110 and 111.

- 2702.2.1 Group A occupancies.
  Emergency power shall be provided for emergency voice/alarm communication systems in Group A occupancies in accordance with Section 907.5.2.2.4.

- 2702.2.2 Smoke control systems.
  Standby power shall be provided for smoke control systems in accordance with Section 909.11.

- 2702.2.3 Exit signs.
  Emergency power shall be provided for *exit* signs in accordance with Section 1011.6.3.

- 2702.2.4 Means of egress illumination.
  Emergency power shall be provided for *means of egress* illumination in accordance with Section 1006.3.

- 2702.2.5 Accessible means of egress elevators.
  Standby power shall be provided for elevators that are part of an *accessible means of egress* in accordance with Section 1007.4.

- 2702.2.6 Accessible means of egress platform lifts.
  Standby power in accordance with this section or ASME A 18.1 shall be provided for platform lifts that are part of an *accessible means of egress* in accordance with Section 1007.5.

- 2702.2.7 Horizontal sliding doors.
  Standby power shall be provided for horizontal sliding doors in accordance with Section 1008.1.4.3.

- 2702.2.8 Semiconductor fabrication facilities.
  Emergency power shall be provided for semiconductor fabrication facilities in accordance with Section 415.10.10.

- 2702.2.9 Membrane structures.
  Standby power shall be provided for auxiliary inflation systems in accordance with Section 3102.8.2. Emergency power shall be provided for *exit* signs in temporary tents and membrane structures in accordance with the *International Fire Code*.

- 2702.2.10 Hazardous materials.
  Emergency or standby power shall be provided in occupancies with hazardous materials in accordance with Section 414.5.3.

- 2702.2.11 Highly toxic and toxic materials.
  Emergency power shall be provided for occupancies with highly *toxic* or *toxic* materials in accordance with the *International Fire Code*.

- 2702.2.12 Organic peroxides.
  Standby power shall be provided for occupancies with silane gas in accordance with the *International Fire Code*.

- 2702.2.13 Pyrophoric materials.
  Emergency power shall be provided for occupancies with silane gas in accordance with the *International Fire Code*.

- 2702.2.14 Covered and open mall buildings.
  Standby power shall be provided for voice/alarm communication systems in *covered and open mall buildings* in accordance with Section 402.7.3.

- 2702.2.15 High-rise buildings.
  Emergency and standby power shall be provided in high-rise buildings in accordance with Sections 403.4.8 and 403.4.9.

- 2702.2.16 Underground buildings.
  Emergency and standby power shall be provided in underground buildings in accordance with Sections 405.8 and 405.9.

- 2702.2.17 Group I-3 occupancies.
  Emergency power shall be provided for doors in Group I-3 occupancies in accordance with Section 408.4.2.

- 2702.2.18 Airport traffic control towers.
  Standby power shall be provided in airport traffic control towers in accordance with Section 412.3.4.

- 2702.2.19 Elevators.
  Standby power for elevators shall be provided as set forth in Sections 3003.1, 3007.9 and 3008.9.

- 2702.2.20 Smokeproof enclosures.
  Standby power shall be provided for smokeproof enclosures as required by Section 909.20.6.2.

1.5 Special Occupancy Requirements

Based on Chapter 5 of the NEC 2011, the following lists may be considered for the special occupancy requirements.

- Article 520: Theaters, Audience Areas of Motion Picture and Television Studios, Performance Area, and Similar Location
- Article 530: Motion Picture and Television Studios and Similar Location
- Article 540: Motion Picture Projection Rooms

1.6 Special Equipment

Based on Chapter 6 of the NEC 2011, the following lists may be considered for the special equipment.

- Article 620: Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts
- Article 640: Audio Signal Processing, Amplification, and Reproduction Equipment
- Article 645: Information Technology Equipment
- Article 690: Solar Photovoltaic (PV) System
- Article 695: Fire Pumps

1.7 Priority Assessment

- Reliability – Medium
- Power Quality – Low
- Redundancy – Medium
- Initial Cost (low initial cost) – Low
- Long Term Ownership Cost – Medium
- Flexibility – High

1.8 Optional Back-up Loads

Fire pump, lighting, mechanical, and elevation loads should be provided back-up power in case of emergency.

1.9 Special/Communication Systems

Following lists are the potential special/communication systems for the building:

- Fire Alarm – Automatic Sprinkler System, Fire Alarm System
- CATV – Audio Video Systems, Rescue Assistance Communication System
- Access Control
- Security – Security Management System, Video Surveillance System, Intercom Communications system,

1.10 Other Building Services

Following other building services required for special/communication systems:

- Telephone
- Data
- CATV

1.11 Major Equipment

Space will be required for the switchboard, dry-type transformer, distribution panelboards, and a generator. For the emergency system, the automatic transfer switch system is required.

Part 2 – Describe the Electrical Systems as Currently Designed

2.1 Actual Connected Building Loads

Panelboards Load				
	Lighting	**Receptacle**	**Mechanical**	**Special Equipment**
LP-LL-S	15218	44208	5880	2880
LP-LL-N	18825	56600	1056	1380
LP-LL-NA	6244	5400	7120	11200
LP-1-S	15661	22200	6000	4240
LP-1-N	46513	23300	400	3120
LP-AV-LL	0	10400	0	16800
PP-MS	0	0	0	75034
PP-SS	13284	0	0	54299
PP-TH-1	0	9800	1928	26824
LP-AV-1	0	18400	0	12800
PP-FS	0	10000	0	27000
PP-SR	2100	0	0	51048
LP-2_N	35514	35984	2047	10978
LP-2-S	16392	55176	11748	4370
TLP-2-6, PP-PS	15292	58960	31088	5916
TLP-7-11	10218	60949	20852	3308
PP-TH-2A	0	9600	250	30460
PP-TH-2B	0	0	0	41529
PP-TH-2C	0	8400	0	30660
LP-LL-DR	18828	36000	0	0
Totlal (VA)	214089	465377	88369	413846

Panelboards Load

- Lighting: 214 kVA
- Receptacle: 465 kVA
- Mechanical: 88 kVA
- Special Equipment: 414 kVA

Mechanical Load								
Units	**Description**	**Location**	**Voltage**	**Ph**	**Hz**	**HP (QTY)**	**RPM**	**Load (kVA)**
AHU-1	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	15 (2)	1750	33.5
	Return Fan	Main Mech. Room at LL	460	3	60	10 (2)	1750	22.30
AHU-2	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	15 (2)	1750	33.5
	Return Fan	Main Mech. Room at LL	460	3	60	10 (2)	1750	22.30
AHU-3	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	15 (2)	1750	33.5
	Return Fan	Main Mech. Room at LL	460	3	60	7.5 (2)	1750	17.5
AHU-4	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	15 (2)	1750	33.5
	Return Fan	Main Mech. Room at LL	460	3	60	10 (2)	1750	22.30
AHU-5	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	15 (2)	1750	33.5
	Return Fan	Main Mech. Room at LL	460	3	60	7.5 (2)	1750	17.5
AHU-6	Enthalpy Wheel	Main Mech. Room at LL	460	3	60	0.5	-	0.87
	Supply Fan	Main Mech. Room at LL	460	3	60	7.5 (2)	1750	17.5
	Return Fan	Main Mech. Room at LL	460	3	60	5 (2)	1750	12.11
AHU-7	Enthalpy Wheel	Lower Tower Mech.	-	-	-	-	-	
	Supply Fan	Lower Tower Mech.	460	3	60	3 (2)	1750	7.6
	Return Fan	Lower Tower Mech.	-	-	-	-	-	
AHU-8	Enthalpy Wheel	Lower Tower Mech.	-	-	-	-	-	
	Supply Fan	Lower Tower Mech.	460	3	60	7.5 (4)	1750	35
	Return Fan	Lower Tower Mech.	-	-	-	-	-	
AHU-9	Enthalpy Wheel	Theater Mech. Room	-	-	-	-	-	
	Supply Fan	Theater Mech. Room	460	3	60	5 (4)	1750	24.22
	Return Fan	Theater Mech. Room	-	-	-	-	-	
AHU-10	Enthalpy Wheel	Theater Mech. Room	-	-	-	-		
	Supply Fan	Theater Mech. Room	460	3	60	5 (1)	1750	6.1
	Return Fan	Theater Mech. Room	-	-	-	-	-	
AHU-11	Enthalpy Wheel	Upper Tower Mech.	460	3	60	0.5	-	0.87
	Supply Fan	Upper Tower Mech.	460	3	60	20 (2)	1750	43.02
	Return Fan	Upper Tower Mech.	460	3	60	10 (2)	1750	22.30
FVU-1	Fan	Main Mech. Room at LL	460	3	60	1	-	2.26
	Condenser	Main Mech. Room at LL	460	3	60	3	-	3.82
DX-1	Dilution Fan	Roof	480	3	60	5	1770	6.32
DX-2	Dilution Fan	Roof	480	3	60	25	1170	28.3
DX-3	Dilution Fan	Roof	480	3	60	7.5	1722	9.12
DX-4	Dilution Fan	Roof	480	3	60	3	1551	4
DX-5	Dilution Fan	Roof	480	3	60	3	1546	4
DX-6	Dilution Fan	Roof	480	3	60	3	1638	4
DX-7	Dilution Fan	Roof	480	3	60	2	2626	2.83
FCU	Fan coil	Various	Calculated in panelbaords					

CH-1	Compressor	East Court Yard	460	3	60	35 (2)	-	73.3
	Fan	East Court Yard	460	3	60	1.5 (6)	1140	14.96
HWP-1	Fan	PRV Room	480	3	60	40	1750	43.23
HWP-2	Fan	PRV Room	480	3	60	40	1750	43.23
RHWP-1	Fan	Various	480	3	60	3	1750	4
RHWP-1A	Fan	Various	480	3	60	3	1750	4
RHWP-2	Fan	Various	480	3	60	1	1750	1.7
RHWP-2A	Fan	Various	480	3	60	1	1750	1.7
RHWP-3	Fan	Room 805	Calculated in panelbaords					
CHWP-1	Fan	Chilled (Summer)	480	3	60	40	1750	43.23
CHWP-2	Fan	Chilled (Summer)	480	3	60	40	1750	43.23
CHWP-3	Fan	Chilled (Winter)	480	3	60	7.5	1750	9.15
CHWP-4	Fan	Chilled	480	3	60	10	1750	11.64
CHWP-5	Fan	Chilled	480	3	60	10	1750	11.64
CHWP-6	Fan	Chilled	480	3	60	7.5	1750	9.15
AC-1	Air Condition Unit	Room 055	460	3	60	FLA = 6.9		5.49
AC-3	Air Condition Unit	Room 053	460	3	60	FLA = 1.24		0.98
CUH	Cabinet & Unit Heater	Various	Calculated in panelbaords					
TX-2	Fan	Lower Roof	480	3	60	1.5	1403	2.49
TX-3	Fan	Lower Roof	480	3	60	1.5	1167	2.49
SX-1	Fan	Lower Roof	480	3	60	5	962	6.32
SX-2	Fan	Lower Roof	480	3	60	2	711	2.83
GX-1	Fan	Comed. Vault	480	3	60	3	743	3.99
GX-3	Fan	Various	480	3	60	1/3	1351	0.9
GX-4	Fan	Lower Roof	480	3	60	1	981	1.74
GX-5	Fan	Generator Room	480	3	60	1/2	1024	0.9
Air Curtain	Hot water	Various	460	3	60	0.5 (2)	-	1.12
							Total	851.4

Total Actual Connected Building Loads

- Lighting: 214 kVA
- Receptacle: 465 kVA
- Mechanical: 939.4 kVA
- Special Equipment: 414 kVA
- Total: 2032.4 kVA

2.2 Power Company Rate Schedule and Service Voltage

Name: Commonwealth Edison Company

Location: 509 N Dearborn St. Chicago, IL 60654

Website: https://www.comed.com/Pages/default.aspx

Large Load Delivery Class	January - June	July - December
CC	$63.54 x $IDUF_n$	$62.13 x $IDUF_n$
SMSC	$20.26 x $IDUF_n$	$19.98 x $IDUF_n$
Secondary Voltage DFC ($/kW)	$5.20 x $IDUF_n$	$5.12 x $IDUF_n$
Primary Voltage DFC ($/kW)	$3.57 x $IDUF_n$	$3.53 x $IDUF_n$
Primary Voltage Transformer Charge ($/kW)	$0.19 x $IDUF_n$	$0.18 x $IDUF_n$
IEDT ($/kWh)	$0.00120 x $IDUF_n$	$0.00120 x $IDUF_n$

2.3 Building Utilization Voltage

Primary Service: (2) 12.47kV with Bus Tie and interlock system

Service Transformer: owned by local utility (ComEd)

Building distribution: 277/480 volt, 3-phase, 4-wire

- Lighting: Incandescent 120 volt and 277 volt for fluorescent and HID sources, single phase, 2-wire
- Receptacles: 120 volt, single phase, 2-wire
- Motors (1/3 horsepower and larger): 480 volt, 3-phase, and all fan powered VAV boxes to be 277 volt, single phase, 2-wire.
- Motors (smaller than 1/3 horsepower): 120 volt, single phase.
- Special Equipment (Computer, Information Technology): 120 volt

2.4 Existing Emergency Power

A 600KW diesel-powered engine generator is located on the lower level. The generator set fully automatic on transfer and re-transfer and suitable for continuous operation for the duration of any interruption of the normal electric power source. The generator serves the emergency service switchboard *EM-GEN-DB*, fire pump with 100 horsepower, High-voltage emergency switchboard for mechanical loads, and Low-voltage emergency switchboard for lighting loads. The detail of emergency power system is described below.

1. ***EM-GEN-DB***: 277/480V, 3-phases, 4-wires, 1200A, 20K AIC
   - Fire pump,
   - LV-EM-LL
   - HV-EM-LL
2. ***Fire Pump***: 100 horsepower
3. ***LV-EM-LL***: 120/208V, 3-phases, 4-wires, 600A, 20K AIC

- EM-LP-LL
- EM-DP-PA
- EM-LP-LL-N
- EM-LP-2-N
- EM-TLP-11

4. ***HV-EM-LL***: 277/480V,3ϕ, 4-wires, 800A BUS, 75K AIC
   - AHU 1-6 and AHU 11
   - RHWP 1-2 and HWP 1-2
   - Sump pump
   - HP-PP-ELEV
   - EM-PP-LL
5. ***HP-PP-ELEV***: 277/480V, 3-phases, 4-wires, 400A BUS, 25K AIC
   - PE-1 with 60 horsepower
   - PE-2 with 40 horsepower

PANEL DESIGNATION: EM-LP-LL FUSED 1 SECTION PANEL

PANEL VOLTAGE: 120/208 VOLTS 3 PHASE 4 WIRE
WITH 100% GROUND BUS

AMPACITY: 125 AMPERE MAIN LUGS

MOUNTING: SURFACE

AIC: 22K

REMARKS: FUSES SHALL BE TYPE "CC"

CKT#	FUSE TRIP	FUSE POLES	DESCRIPTION	POLE	PHASE A	PHASE B	PHASE C	POLE	DESCRIPTION	FUSE POLES	FUSE TRIP	CKT#
1	20	1	CORR LTG FIXTURES @ 2ND	1	1408			2	LTG. FIXTURES @ LL	1	20	2
3	20	1	CORR LTG FIXTURES @ 2ND	3		1216		4	LTG. FIXTURES @ LL	1	20	4
5	20	1	CORR LTG FIXTURES @ 2ND	5			1472	6	LTG. FIXTURES @ LL	1	20	6
7	20	1	CORR LTG FIXTURES @ 3RD	7	994			8	LTG. FIXTURES @ LVL 1	1	20	8
9	20	1	CORR LTG FIXTURES @ 3RD	9		1606		10	LTG. FIXTURES @ LVL 2	1	20	10
11	20	1	STAIR S4 LTG @ LL-3	11			666	12	CORR LTG FIXTURES @ LL	1	20	12
13	20	1	STAIR S4 LTG @ LL-3	13	652			14	CORR LTG FIXTURES @ LL	1	20	14
15	20	1	STAIR S5 LTG @ LL	15		308		16	CORR LTG FIXTURES @ 1ST	1	20	16
17	20	1	STAIR S5 LTG @ LL	17			330	18	CORR LTG FIXTURES @ 1ST	1	20	18
19	20	1	STAIR S2 LTG @ LL-1	19	308			20	CORR LTG FIXTURES @ 1ST	1	20	20
21	20	1	STAIR S2 LTG @ LL-1	21		154		22	STAIR S3 LTG @ LL-2	1	20	22
23	15	3	ELEV. 'PE-3'	23			1528	24	STAIR S3 LTG @ LL-2	1	20	24
				25	2324			26	ROOM'S LTG @ LL	1	20	26
				27		2259		28	SITE LTG ('RA' & 'RB')	1	20	28
25	15	3	ELEV. 'FE-4'	29			2259	30	SITE LTG ('RA' & 'RB')	1	20	30
				31	1740			32	R-7, R-10, R-16	1	20	32
				33		3000		34	DLS	1	25	34
27	20	1	ROOM'S LTG @ LL	35			1156	36	LTG @ LL & L2 (6C, 23A, 25A, 26A)	1	20	36
29	20	1	OUTDOOR LTG (LVL 1)	37	838			38	SPARE	1	20	38
31	20	1	OUTDOOR LTG (LVL 1)	39		1050		40	SPARE	1	20	40
33	20	1	SPARE	41			0	42	SPARE	1	20	42

Figure 1 - EM-LP-LL Panel Schedule

PANEL DESIGNATION: EM-LP-LL-N FUSED 1 SECTION PANEL

PANEL VOLTAGE: 120/208 VOLTS 3 PHASE 4 WIRE
WITH 100% GROUND BUS

AMPACITY: 60 AMPERE MAIN LUGS

MOUNTING: SURFACE

AIC: 22K

REMARKS: FUSES SHALL BE TYPE "CC"

CKT#	FUSE		DESCRIPTION	POLE	PHASE A	PHASE B	PHASE C	POLE	DESCRIPTION	FUSE		CKT#
	TRIP	POLES								POLES	TRIP	
1	20	1	STAIR N2 LTG LL-2	1	940			2	LTG. FIXTURES LL	1	20	2
3	20	1	STAIR N2 LTG LL-2	3		560		4	CORR. LTG. FIXTURES @ LL	1	20	4
5	20	1	SITE LTG ('RJ' TYPE)	5			458	6	CORR. LTG. FIXTURES @ LL	1	20	6
7	20	1	SITE LTG ('RJ' TYPE)	7	396			8	CORR. LTG. FIXTURES @ 1ST	1	20	8
9	20	1	SITE LTG ('RJ' TYPE)	9		396		10	CORR. LTG. FIXTURES @ 1ST	1	20	10
11	20	1	SITE LTG ('RJ' TYPE)	11			288	12	R-8 + R-14	1	20	12
13	20	1	LTG. FIXTURES L1	13	1660			14	LTG. FIXTURES LL	1	20	14
15	20	1	SPARE	15		534		16	LTG. FIXTURES L1	1	20	16
17	20	1	SPARE	17			1257	18	OUTDOOR LTG (LVL 1)	1	20	18
19	20	1	SPARE	19	0			20	SPARE	1	20	20
21	20	1	SPARE	21		0		22	SPARE	1	20	22
23	20	1	SPARE	23			0	24	SPARE	1	20	24
25	20	1	SPARE	25	0			26	SPARE	1	20	26
27	20	1	SPARE	27		0		28	SPARE	1	20	28
29	20	1	SPARE	29			0	30	SPARE	1	20	30
31	20	1	SPARE	31	0			32	SPARE	1	20	32
33	20	1	SPARE	33		0		34	SPARE	1	20	34
35	20	1	SPARE	35			0	36	SPARE	1	20	36
37	20	1	SPARE	37	0			38	SPARE	1	20	38
39	20	1	SPARE	39		0		40	SPARE	1	20	40
41	20	1	SPARE	41			0	42	SPARE	1	20	42

Figure 2 - EM-LP-LL-N Panel Schedule

PANEL DESIGNATION: EM-LP-2-N FUSED 1 SECTION PANEL

PANEL VOLTAGE: 120/208 VOLTS 3 PHASE 4 WIRE
WITH 100% GROUND BUS

AMPACITY: 60 AMPERE MAIN LUGS

MOUNTING: SURFACE

AIC: 22K

REMARKS: FUSES SHALL BE TYPE "CC"

CKT#	FUSE		DESCRIPTION	POLE	PHASE A	PHASE B	PHASE C	POLE	DESCRIPTION	FUSE		CKT#
	TRIP	POLES								POLES	TRIP	
1	20	1	CORR. LTG. FIXTURES @ 3RD	1	962			2	SAW LTG @ LEVEL 2	1	20	2
3	20	1	CORR. LTG. FIXTURES @ 3RD	3		224		4	SCREEN. RM. 201 (ZONE 1C)	1	20	4
5	20	1	CORR. LTG. FIXT. @ 4,5,6	5			615	6	CORR. LTG. FIXTURES @ 2ND	1	20	6
7	20	1	CORR. LTG. FIXT. @ 4,5,6	7	522			8	CORR. LTG. FIXTURES @ 2ND	1	20	8
9	20	1	STAIR N2 LTG 3-6	9		696		10	STAIR N1 LTG 3-6	1	20	10
11	20	1	STAIR N2 LTG 3-6	11			608	12	STAIR N LTG 3-6	1	20	12
13	20	1	STAIR N1 LTG 1-2	13	736			14	SCREEN. RM. 201 @ LVL 3	1	20	14
15	20	1	STAIR N1 LTG 1-2	15		1112		16	SAW LTG @ LEVEL 2	1	20	16
17	20	1	LTG. FIXT. @ 4,5,6	17			1744	18	SAW LTG @ LEVEL 2	1	20	18
19	20	1	SPARE	19	640			20	SAW LTG @ LEVEL 2	1	20	20
21	20	1	SPARE	21		0		22	SPARE	1	20	22
23	20	1	SPARE	23			0	24	SPARE	1	20	24
25	20	1	SPARE	25	0			26	SPARE	1	20	26
27	20	1	SPARE	27		0		28	SPARE	1	20	28
29	20	1	SPARE	29			0	30	SPARE	1	20	30
31	20	1	SPARE	31	0			32	SPARE	1	20	32
33	20	1	SPARE	33		0		34	SPARE	1	20	34
35	20	1	SPARE	35			0	36	SPARE	1	20	36
37	20	1	SPARE	37	0			38	SPARE	1	20	38
39	20	1	PURGE DAMPERS LEVEL 2 NORTH	39		600		40	SPARE	1	20	40
41	20	1	PURGE DAMPERS LEVEL 2 SOUTH	41			600	42	SPARE	1	20	42

Figure 3 - EM-LP-2-N Panel Schedule

PANEL DESIGNATION: EM-TLP-11 **FUSED 1 SECTION PANEL**

PANEL VOLTAGE: 120/208 VOLTS 3 PHASE 4 WIRE WITH 100% GROUND BUS
AMPACITY: 200 AMPERE MAIN LUGS
MOUNTING: SURFACE
AIC: 22K
REMARKS: FUSES SHALL BE TYPE "CC"

CKT#	FUSE		DESCRIPTION	POLE	PHASE A	PHASE B	PHASE C	POLE	DESCRIPTION	FUSE		CKT #
	TRIP	POLES								POLES	TRIP	
1	20	1	CORR. LTG. FIXT. @ 7,8	1	176			2	SPARE	2	15	2
3	20	1	CORR. LTG. FIXT. @ 7,8	3		154		4				
5	20	1	STAIR N2 LTG 7-11	5			486	6	FCU-A @ 10TH	1	15	4
7	20	1	LTG. FIXTURES @ 11th	7	1040			8	FCU-C @ 4TH	1	15	6
9	20	1	STAIR N2 LTG 7-11	9		330		10	CORR. LTG. FIXT. @ 9,10	1	20	8
11	20	1	LTG. FIXT. @ 7,8	11			874	12	CORR. LTG. FIXT. @ 9,10	1	20	10
13	20	1	LTG. FIXT. @ 9,10	13	864			14	STAIR N1 LTG 7-11	1	20	12
15	80	3	EM. DIMMER RACK @ LVL 10	15		8104		16	STAIR N1 LTG 7-11	1	20	14
				17			7711	18	SPARE	1	20	16
				19	7718			20	SPARE	1	20	18
17	20	1	SPARE	21		0		22	SPARE	1	20	20
19	20	1	SPARE	23			0	24	SPARE	1	20	22
21	20	1	SPARE	25	0			26	SPARE	1	20	24
23	20	1	SPARE	27		0		28	SPARE	1	20	26
25	20	1	SPARE	29			0	30	SPARE	1	20	28
27	20	1	SPARE	31	0			32	SPARE	1	20	30
29	20	1	SPARE	33		0		34	SPARE	1	20	32
31	20	1	SPARE	35			0	36	SPARE	1	20	34
33	20	1	SPARE	37	1800			38	AC-4 @ EMR3 1101B	3	20	36
35	20	1	PURGE DAMPERS LEVELS 3-6	39		2200		40				
37	20	1	PURGE DAMPERS LEVELS 7-11	41			2300	42				

Figure 4 - EM-TLP-11 Panel Schedule

PANEL DESIGNATION:				**EM-PP-LL**		**1 SECTION PANEL**									
PANEL VOLTAGE :				**120/208 VOLTS 3 PHASE 4 WIRE WITH 100% GROUND BUS**											
AMPACITY :				**200 AMPERE MAIN CIRCUIT BREAKER**											
MOUNTING:				**SURFACE**											
AIC:				**22K**											
REMARKS:															
CKT#	**CIRCUIT BREAKER**			**DESCRIPTION**	**POLE**	**PHASE A**	**PHASE B**	**PHASE C**	**POLE**	**DESCRIPTION**	**CIRCUIT BREAKER**			**CKT#**
	FRAME	**TRIP**	**POLES**								**POLES**	**TRIP**	**FRAME**	
1	100	20	1	NETWORK CL. 009	**1**	2880			**2**	NETWORK CL. 123	1	20	100	**2**
3	100	20	1	NETWORK CL. 009	**3**		2880		**4**	NETWORK CL. 123	1	20	100	**4**
5	100	20	1	NETWORK CL. 009	**5**			2880	**6**	NETWORK CL. 123	1	20	100	**6**
7	100	20	1	NETWORK CL. 009	**7**	2880			**8**	NETWORK CL. 123	1	20	100	**8**
9	100	20	1	NETWORK CL. 009	**9**		2880		**10**	NETWORK CL. 123	1	20	100	**10**
11	100	20	1	NETWORK CL. 009	**11**			2880	**12**	NETWORK CL. 123	1	20	100	**12**
13	100	20	1	(1) QUAD @ SEC.RM 061	**13**	5544			**14**	CP-1	3	60	100	**14**
15	100	20	1	(1) QUAD @ SEC.RM 061	**15**		5544		**16**					
17	100	20	1	(1) QUAD @ SEC.RM 061	**17**			5544	**18**					
19	100	20	1	AC-A @ 009	**19**	2498			**20**	CP-2	2	15	100	**16**
21	100	20	1	AC-A @ 107A	**21**		2498		**22**					
23	100	20	1	AC-A @ 123	**23**			2640	**24**	FCU-A + FCU-E @ 1ST	1	20	100	**18**
25	100	20	1	AC-2 @ 051	**25**	1563			**26**	BMS @ 049	1	20	100	**20**
					27		1563		**28**	RESCUE ASSISTANCE SYSTEM	1	20	100	**22**
27	100	20	1	AC-7 @ 061	**29**			1413	**30**	VESDA + FM200 ANNUNCIATORS	1	20	100	**24**
					31	1663			**32**	FM200 CONTROL PANEL	1	20	100	**26**
29	100	20	1	SPARE	**33**		0		**34**	SPARE	1	20	100	**28**
31	100	20	1	SPARE	**35**			500	**36**	VESDA CONTROL PANEL	1	20	100	**30**
33	100	20	1	PURGE DAMPERS LL NORTH	**37**	1000			**38**	FIRE ALARM PANEL	3	20	100	**32**
35	100	20	1	PURGE DAMPERS LL SOUTH	**39**		1000		**40**					
37	100	20	1	PURGE DAMPERS LEVEL 1	**41**			1000	**42**					

Figure 5 - EM-PP-LL Panel Schedule

2.5 Special Occupancy Requirements

There is no special occupancy in the drawing document.

2.6 Special Equipment

Elevator

- (2) Passenger elevators are located on the north of building. Each elevator is connected to 60 HP motor and 40 HP motor that is served by switchboard HV-PP-ELEV which is 277/480V, 3-phase, and 4 wires.
- (1) Passenger elevator and (1) freight elevator are located on the south of the building. Each elevator is connected to 40 HP motor and 75 HP motor that is served by main distribution switchboard (MDSB) which is 277/480V, 3-phase, and 4 wires.

Fire Pump

- 100 HP fire pump is generally served by main fire pump service, but it has automatic transfer switch and connected to EM-GEN-DB that is served by generator for the emergency case.

Solar panel roof system is existing on the building currently, but no information is provided.

2.7 Existing Equipment

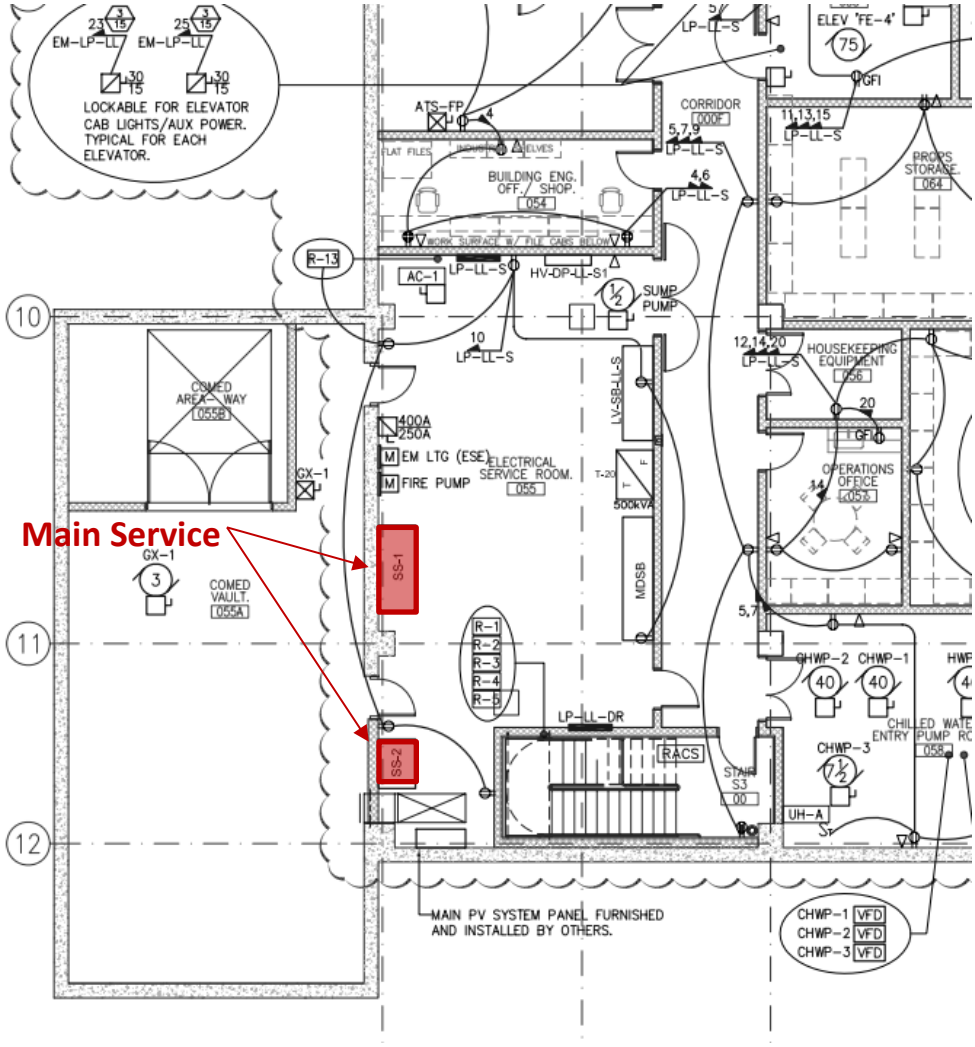


Figure 6 - Enlarged Lower Level Plan

There is (2) main service switchboards on the electrical service room at lower level. Those are completely metal enclosed with dead front type and single ended. Voltage rating is 277/480, 3-phase, and 4 wires. A separate barriered-off utility metering compartment with hinged sealable door is installed with main service switchboards. Overcurrent devices are 3-poles otherwise noted on drawings.

(2) Main service switchboards serve the (3) main distribution switchboards as follow below:

- HV-EM-LL: 277/480V, 3-phase, 4 wires, 800A BUS, 75K AIC
- HV-DP-LL-S2: 277/480V, 3-phase, 4 wires, 1200A BUS, 100K AIC
- MDSB: 277/480V, 3-phase, 4 wires, 2500A BUS, 200K AIC

Bolted pressure switches with UL listed for 100% continuous rating are used for the service switches 800 amperes and larger, and distribution switches at 1200 amperes and larger. Fusible circuit breaker with class L fuse clips is used for the switches 800 amperes and larger. A fusible switch with class L fuse clips is used for the switches 800 amperes and below. For breakers 100 ampere through 400 ampere frame, thermal-magnetic trip with inverse time current characteristics is used. As required to operate ground fault systems, the control power transformers with primary and secondary protection is provided.

(3) main distribution switchboards serve various mechanical loads and panelboards. Each panelboards are complied with latest versions of, Underwriters Laboratories Standards: UL 50 for cabinets and boxes, UL 67 for panelboards, and UL 98 for enclosed and dead front switches. They are all 120/208V, 3-phase, and 4 wires with different AIC and ampacity. Each panelboards are summarized on the table below with the following categories: voltage, ampacity, and AIC. Fused emergency lighting panelboards is consisted of Type 1 – galvanized steel box with interior mounting studs and Type 1 – dead-front trim.

Panelboard	Voltage	Ampacity	AIC
LP-LL-S	120/208V with 100% ground bus	250 ampere main lugs	42K
LP-LL-N	120/208V with 100% ground bus, and 100% Isolated	400 ampere main lugs	22K
LP-LL-NA	120/208V with 100% ground bus	100 ampere main lugs	22K
LP-1-S	120/208V with 100% ground bus	200 ampere main lugs	42K
LP-1-N	120/208V with 100% ground bus, and 100% Isolated	400 ampere main lugs	22K
LP-AV-LL	120/208V with 100% ground bus, and 100% Isolated	125 ampere MCB	22K
PP-MS	120/208V with 100% ground bus	250 ampere main lugs	22K
PP-SS	120/208V with 100% ground bus	250 ampere main lugs	22K
PP-TH-1	120/208V with 100% ground bus	175 ampere MCB	22K
LP-AV-1	120/208V with 100% ground bus, and 100% Isolated	125 ampere MCB	22K
PP-FS	120/208V with 100% ground bus	200 ampere main lugs	22K
PP-SR	120/208V with 100% ground bus	175 ampere MCB	22K
LP-2-N	120/208V with 100% ground bus	400 ampere main lugs	22K
LP-2-S	120/208V with 100% ground bus	250 ampere main lugs	42K
TLP-3-6	120/208V with 100% ground bus	400 ampere main lugs	22K
PP-PS	120/208V with 100% ground bus	100 ampere main lugs	22K
TLP-7-11	120/208V with 100% ground bus, and 100% Isolated	250 ampere MCB	22K
PP-TH-2A	120/208V with 100% ground bus	200 ampere main lugs	22K
PP-TH-2B	120/208V with 100% ground bus	200 ampere main lugs	22K
PP-TH-2C	120/208V with 100% ground bus	200 ampere main lugs	22K
LP-LL-DR	120/208V with 100% ground bus	200 ampere main lugs	42K

A dry-type transformer (up to 400KVA) is used to step down the voltage from 480C, 3-phase, and delta primary to 208/120V, 3-phase, and wye secondary to feed each panelboards.

The various size of a copper ground conductor is used based on the size of feeder and branch circuit as follows:

Size of Feeder and Branch circuit	Size of Ground Conductor

Up to #2	#8
#1 thru 1/0	#6
2/0 thru 3/0	#4
4/0 thru 350 MCM	#2
500 thru 600 MCM	1/0

For the raceway system, the galvanized and coated with a chromate coating EMT is used for the outside, and a silicone epoxy-ester lubricant EMT is used for the inside. Type THWN/THHN insulation is used for lighting, receptacles, and motor circuits and for panel, switchboard, service and equipment feeders. Type THHN or THWN/THHN is used for lighting branch circuit wiring installed and passing through the ballast channels of fluorescent fixtures, and raceway exposed to the sun. Type FEP is used for any wiring within 3 feet horizontally, or 10 feet above any furnace, boiler or similar appliance.

Duplex receptacles and local wall switches are finished with decora line ivory. The cover plate is finished with smooth white finish. The single pole, double pole, 3-way, 4-way, pilot or keyed type of the local wall switches are used based on purpose of the space. The product line of *Leviton* for the local wall switches are indicated below with their catalog number.

Device	**Decora Catalog #**
Single pole toggle switch	5621-2
Three way switch	5623-2
Four way switch	5624-2
Single pole switch and pilot light (120 V)	5628-2
Single pole switch and pilot light (270 V)	5629-2
Three way switch with pilot light (120 V)	5638-2
Three way switch with pilot light (270 V)	5639-2
Single pole locking toggle switch	NA
Single pole, momentary contact, double throw, center off	5657-2

Three-pole, National Electrical Manufactures Association (NEMA) and American National Standards Institute (ANSI) standard type, with bronze contacts which accept plug with two parallel blades and one grounding blade is used for duplex convenience receptacles with GFI-Tamper resistant. For outdoor locations and GFI receptacles, the protect exterior receptacles by a cast aluminum weatherproof metal plate with a stainless steel spring-loaded, casketed lift cover is used. The Plate is to be U.L listed for wet locations with cover open with cover closed.

There is no UPS system in the drawing documents.

2.8 Optional Back-up Loads

As mentioned on 2.4 Existing Emergency Power, (1) diesel-powered engine generator serves the emergency service switchboard, the fire pump, mechanical loads, and lighting loads. Refer to figure 1 thru 5 for detail loads. There is no UPS system in the building.

2.9 Special/Communication Systems

Fire Alarm

- Each room including corridor has installed with fire alarm system such as sound/visual unit, or sound unit.
- The mechanical/electrical room has installed with smoke detector, or duct smoke detector.
- Some special room such as cafeteria, auditorium, and exhibition hall has installed with addressable control module.
- The stairs of the each floor has installed with waterflow switch and supervisorary tamper switch. Main fire command center is located on the entry lobby.
- The addressable control module sets are located on the lower level, and connected to smoke control at BMS Panel.
- (1) Single stage horizontal split case pump and (1) jockey pump are located on the lower lever to serve the sprinkler and pressure maintenance.

Security/Access Control

- (5) Outdoor cameras are installed around the building.
- Indoor fixed cameras are installed on the entrance areas.
- (13) Card reader devices are installed to access from the outside to inside of the building with local audible alarm devices
- Indoor card reader devices are installed to access into the special rooms such as AV control rooms, network closet, Theater backstage, studio, and supply rooms.

Other

- “Lutron” lighting control system is used in the space such as corridor, studio, and classroom.
- Motorized shades and Motorized windows are used to control the daylight.
- ADA door system.

2.10 Other Building Services

Telephone/data

- (4) 4” sleeves for low voltage telecom service entrance is located on the underground at the north of the building.
- (4) 4” sleeves for low voltage telecom service entrance is located on the underground at the South of the building.

CATV cable is running from the telecommunications rack throughout the building.

2.11 Electrical/Communications Systems Spaces

There is total 11 rooms relate to electrical/communication systems in the building, and its total 2319.54 ft^2. It is 1.26% of the total building square foot (184,000 ft^2). Refer to the figure 7 thru 10 for the location of each spaces.

Lower Level

- Network Closet: 84.27 ft^2
- Panelboard Closet: 15.31 ft^2
- Electrical Room: 73.69 ft^2
- Emergency Generator Room: 384.30 ft^2
- Auto-Transfer-Switch Room: 164.62 ft^2
- Electrical Service Room: 946.83 ft^2

First Level

- Network Closet: 107.85 ft^2
- Panelboard Closet: 15.31 ft^2
- Electrical Closet for South Portion: 30.12 ft^2
- Electrical Room: 164 ft^2

Second Level

- Electrical Transformer Room: 29.23 ft^2
- Panelboard Closet: 15.31 ft^2
- Electrical Closet: 32.11 ft^2

Tower Level 3 – 10

- (8) Panelboard Closet: 15.31 ft^2

Tower Level 11

- Electrical Room: 134.11 ft^2

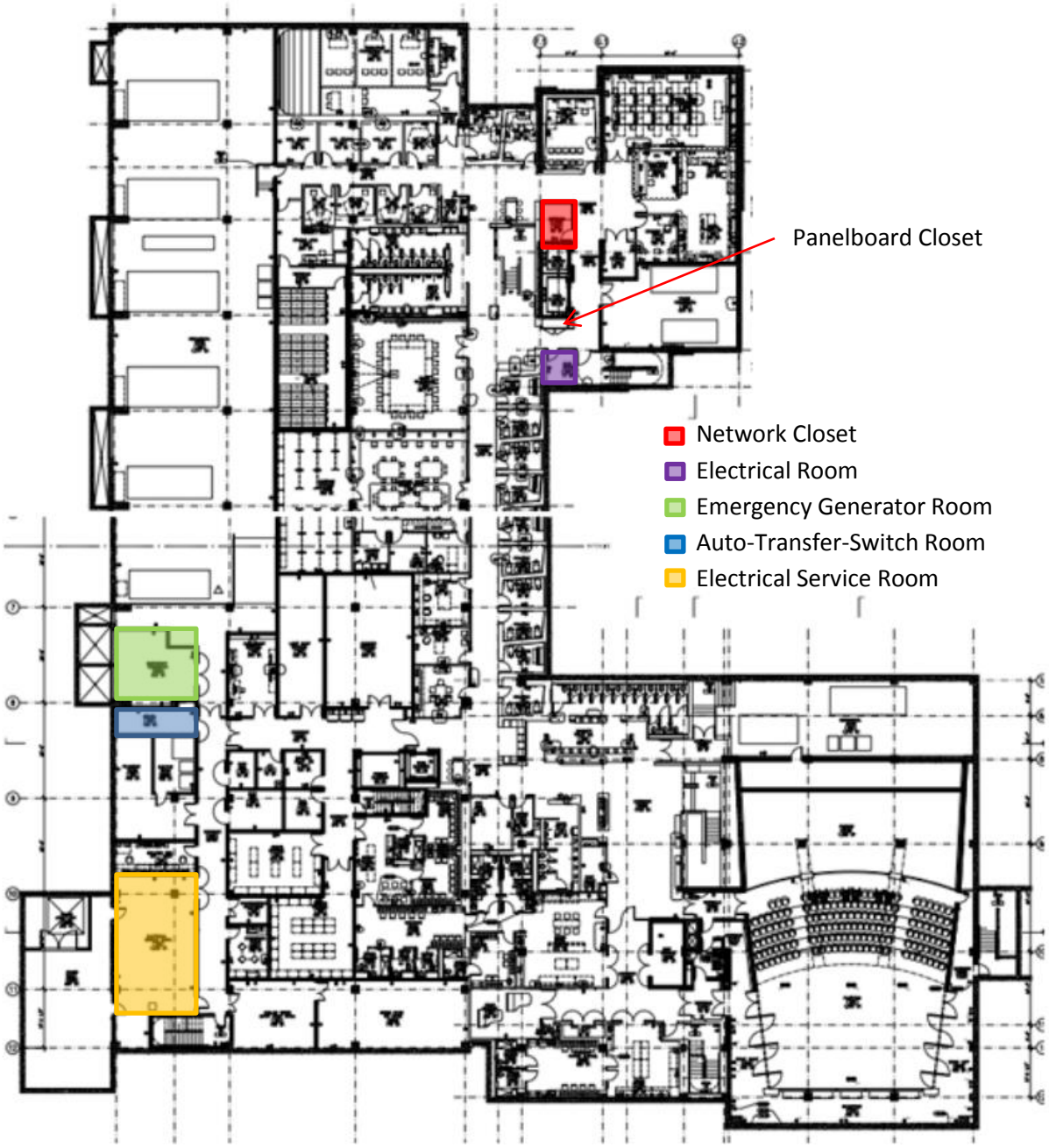


Figure 7 - Lower Level Plan

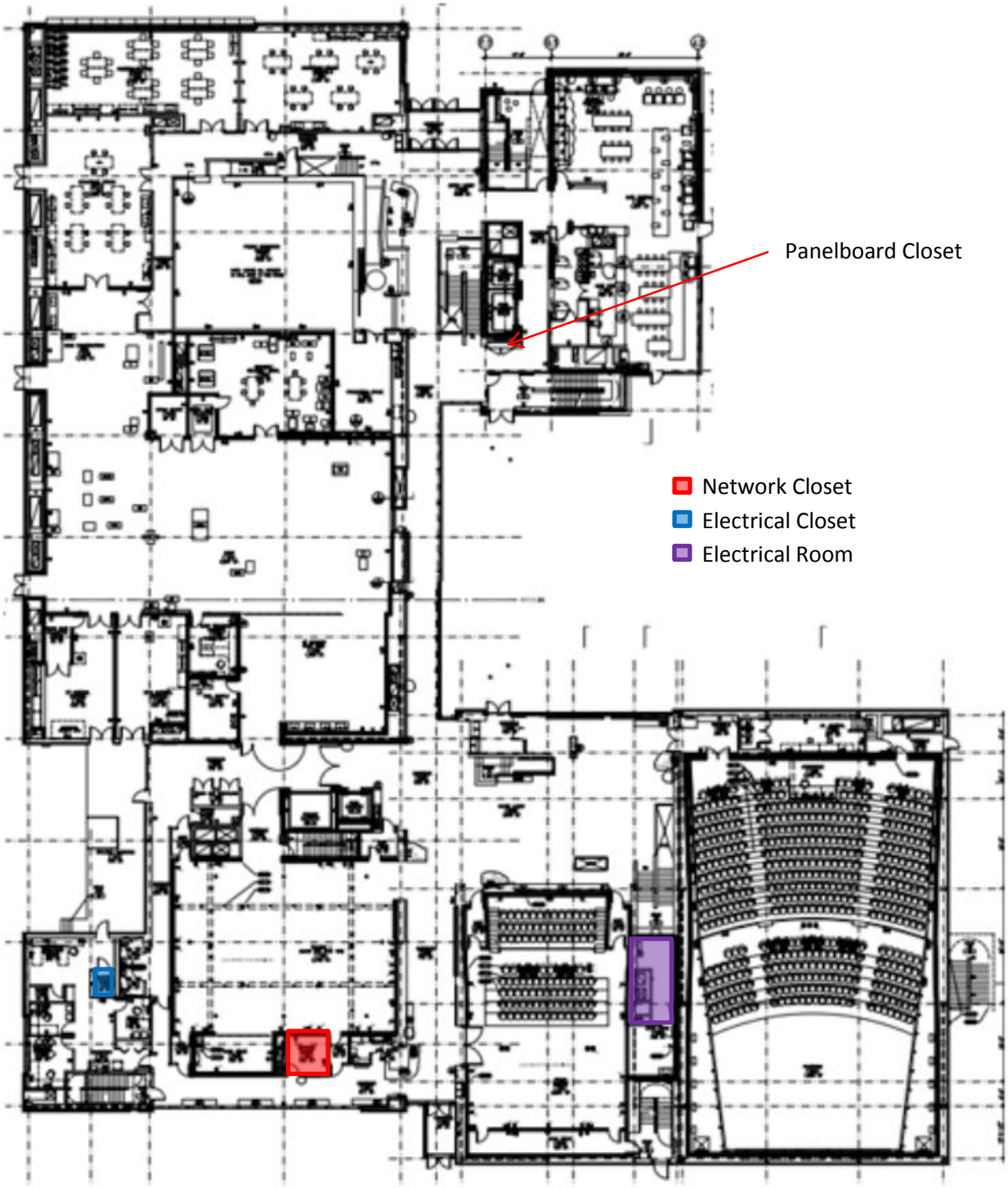


Figure 8 - First Level Plan

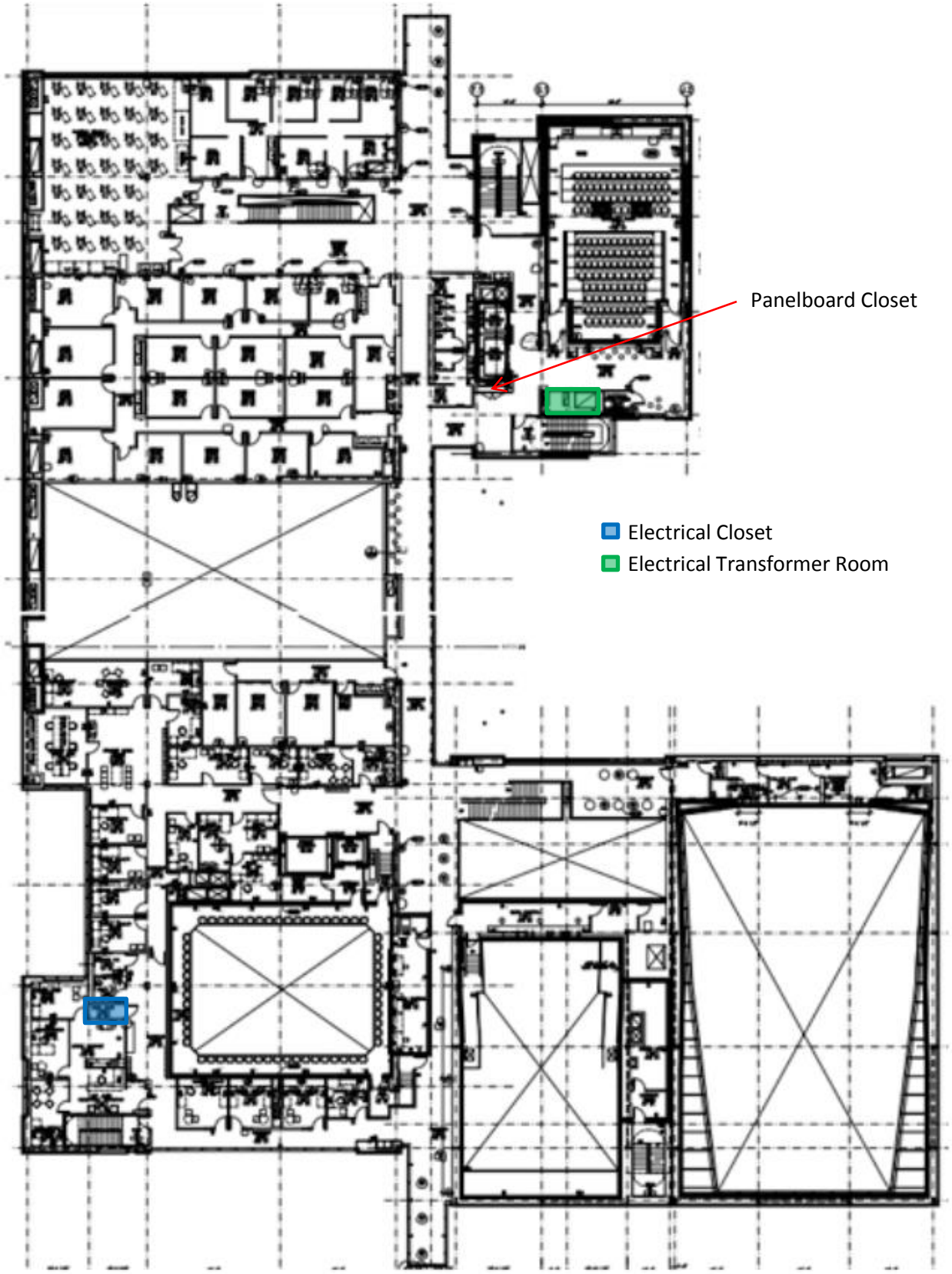


Figure 9 - Second Level Plan

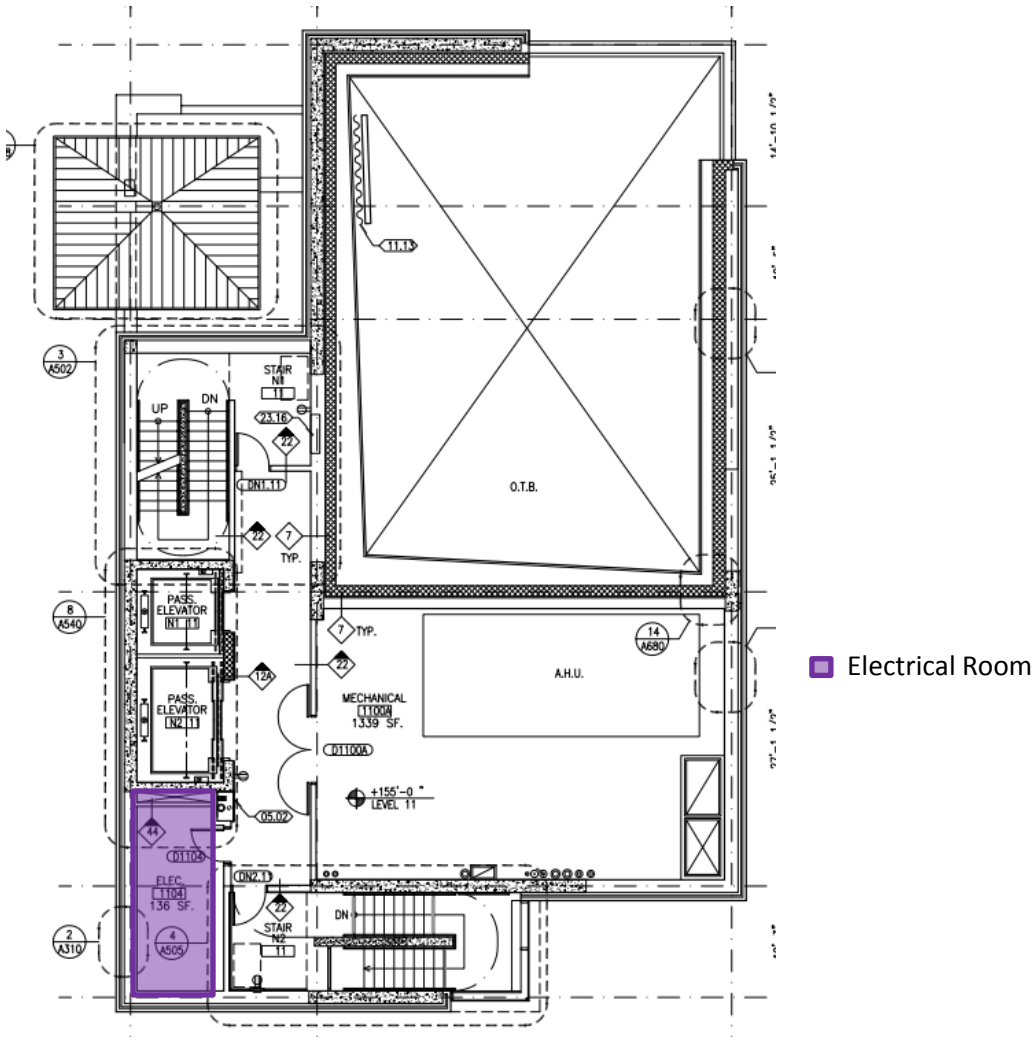


Figure 10 - Tower Level 11 Plan

2.12 Energy Reduction Techniques

The project requires the environmental performance goals to achieve LEED certification. The specific project goals that impact this area of work include: use of recycled-content materials; use of locally-manufactured materials; use of low-emitting materials; construction waste recycling; and the implementation of a construction indoor air quality management plan.

2.13 Single Line/Riser Diagram

Please see attachment on the last page.

Part 3 – Evaluation of Criteria vs. Current Design

3.1 Comparison of Estimated and Actual Connected Building Loads

	Estimated Load (kVA)	Actual Load (kVA)
Lighting	320	214
Receptacles	97	465
HVAC	920	939.4
Others	184	414
Total	1521	2032.4

As you see the table above, the total actual load is greater than the total estimated load. Since the purpose of the building is for performing art center, the many extra equipments such as table saw, air compressor, band saw, drill saw, hoist motors, and etc., are placed on the studio rooms. Also, the receptacles load is greater than expected load because it is required in the case of electricity needed in each room and studio. But as you see the comparison of lighting loads, the actual load is smaller than the estimated load because the building is focused on the energy saving from lighting by using LED technology.

3.2 Power Company Rate Schedule

Commonwealth Edison Company provides the 277/480 voltage which is necessary for the mechanical loads. And, this voltage is step down into the 120/208 voltage for the lighting/receptacles loads by dry-type transformer in the building. Therefore, I would not suggest any potential change for the alternative.

3.3 Building Utilization Voltage and Fundamental Distribution Concept

The existing lighting voltage is 120V for incandescent, and 277V for fluorescent and HID sources. It would be costly, if all lighting system runs at 120/208V. The receptacles are operated on 120V, and no option. For the mechanical loads, it runs at 120/208V or 277/408V. To reduce the cost, it needed to be determined the unnecessary mechanical loads which are run by 277/408V, and it should be reduced or changed to 120/208V if it is not violated the Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago.

3.4 Emergency Power System

The as-designed emergency power system meets the IBC emergency requirements, and the 600kW diesel-engine generator serves the fire pump, and high-voltage and low-voltage distribution switchboards. But as you see the single line diagram for the utility service entrances and emergency, the generator serves too many loads which are fire pump and LV-EM-LL even if they are served by fire pump, and emergency service from the power company. Therefore, the size of generator could be decreased if

it is not violated the Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago.

3.5 Existing Electrical Equipment

Since all electrical equipment is referred to the Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago, there is no possible change the existing electrical equipment. But, a dry-type transformer could be changed into the high efficiency type. It is more costly in the energy usage than the standard efficiency type, but it requires high initial cost for the equipment.

3.6 Optional Back-up Power

In the ordinary way, the emergency service from the power company serves the emergency loads such as exit lighting, mechanical loads, fire pump, and elevators. Since the building is large, the generator is a effective system for the back-up power. Due to the short runtime of the UPS system, it is not effective and useful system for the back-up power in the building.

3.7 Cost Reduction Techniques

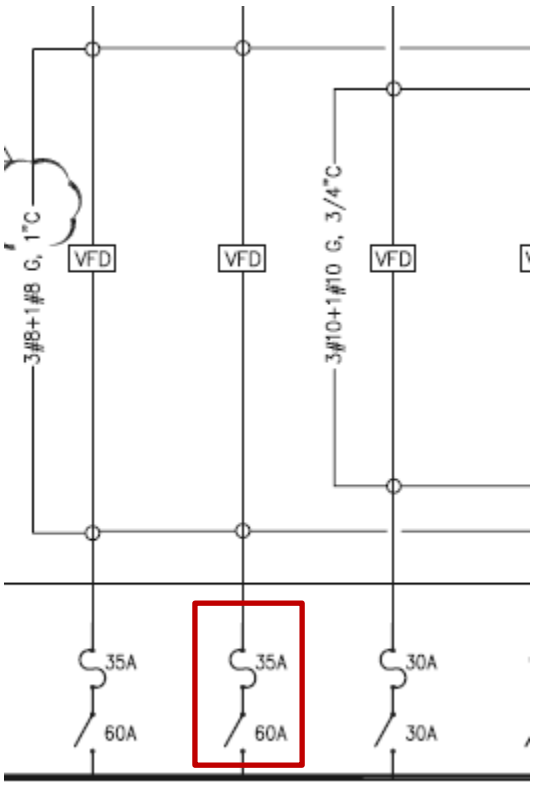


Figure 11 - Enlarged detail switchboard [HV-EM-LL]

There is potential change in the switchboards to reduce the cost. As you see the figure 11 above, the switch and fuse is used for all main distribution switchboards. It is more costs and space. The size and

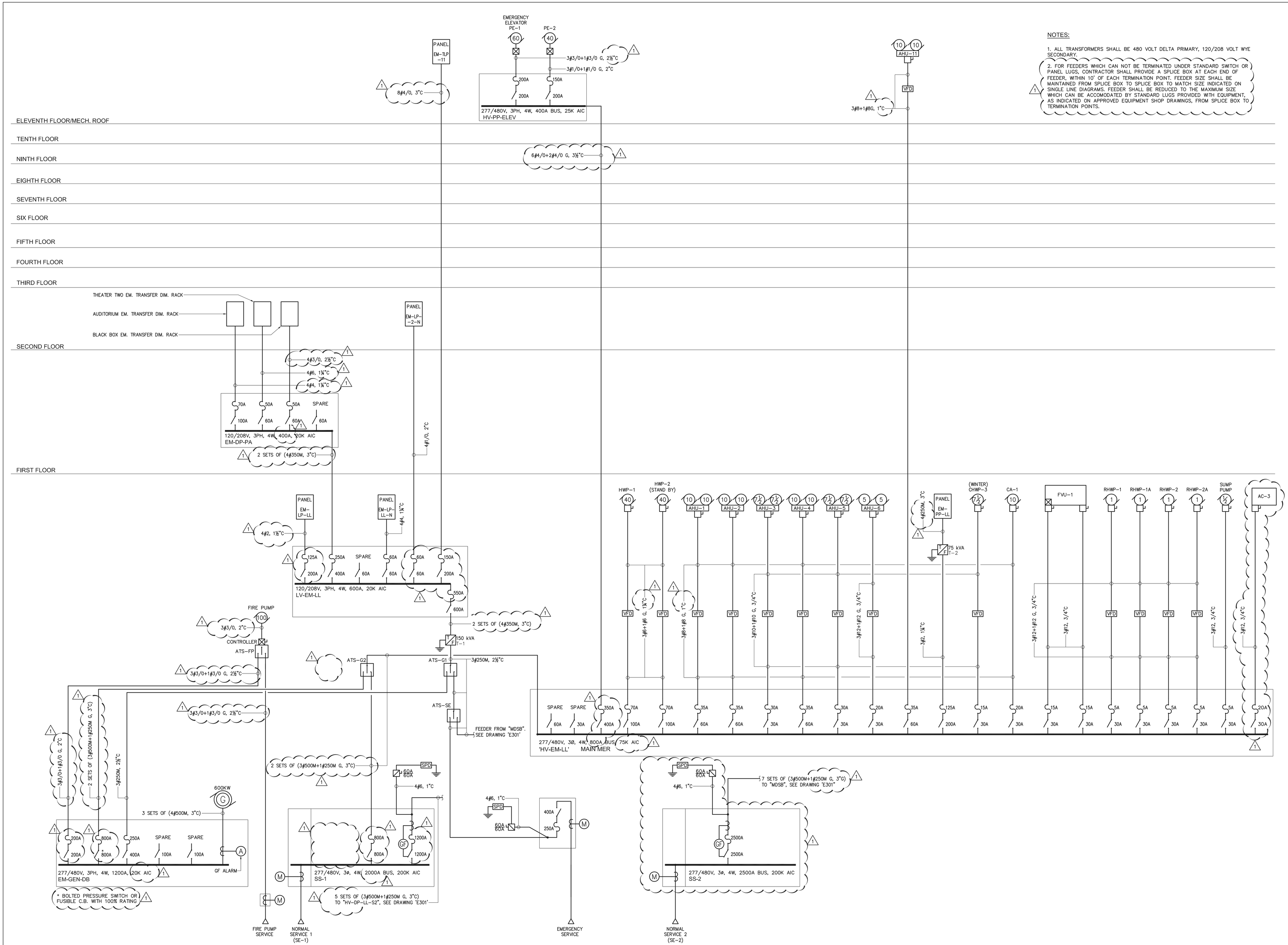
cost of switchboards could be decreased by using main circuit break if it is not violated the Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago.

3.8 Potential Systems Integration

By request of Illinois Chicago Electrical Code, and the Facilities Services Facility Standards – Electrical System from the University of Chicago, the building system is designed for integration system for BMS, and BAS. Through the entire building, they control the environmental, utilities metering, lighting, fire systems and security systems. Therefore, I would not suggest any potential change in the system integration.

3.9 Energy Reduction Techniques

This project was awarded Gold Leadership in Energy and Environmental Design (LEED) Certification with the daylighting system, solar panels roof, skylight, ground and water source heat pumps, and radiant heating and cooling system.



UTILITY SERVICE ENTRANCES AND EMERGENCY SINGLE LINE DIAGRAM

N.T.S.

222 CENTRAL PARK SOUTH
NEW YORK, NY 10019
TEL 212-245-2080
FAX 212-245-1984
MAIL@TWBTA.COM

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UTILITY SERVICE ENTRANCES AND EMERGENCY SLS

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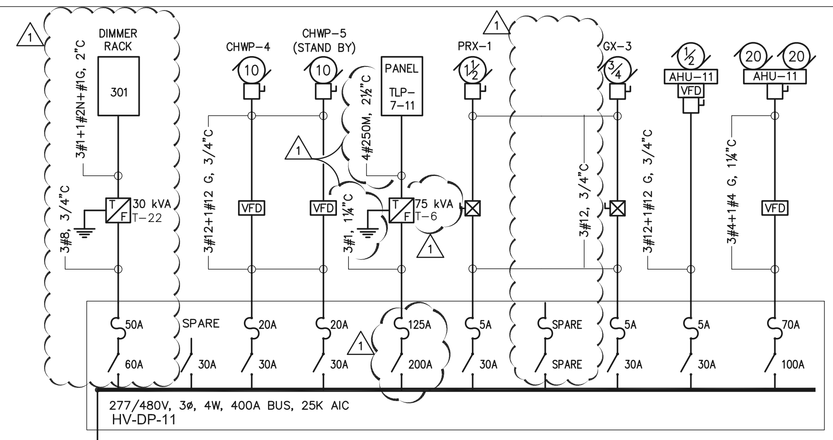
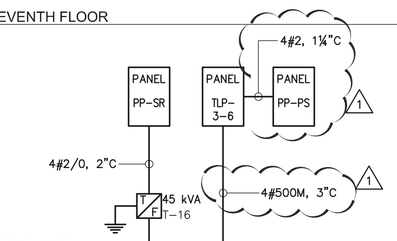


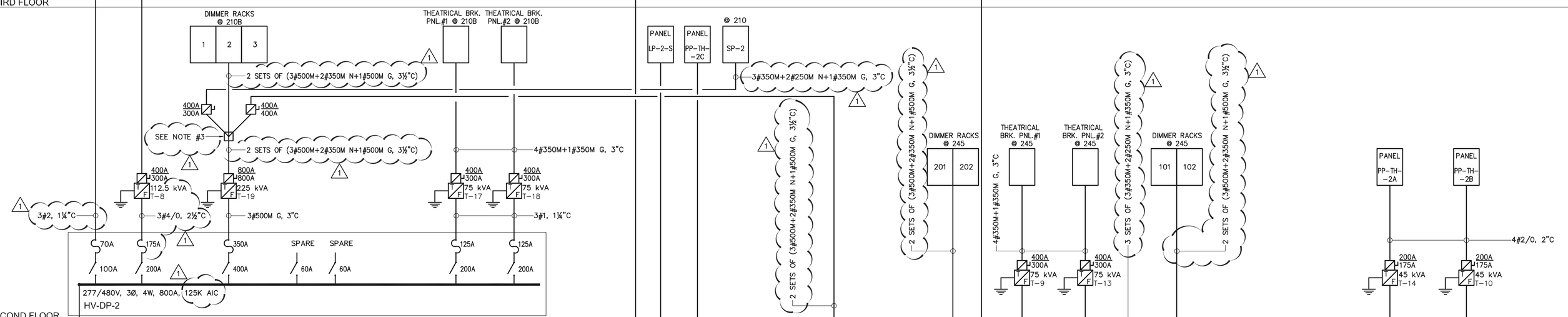
NOTES:

1. ALL TRANSFORMERS SHALL BE 480 VOLT DELTA PRIMARY, 120/208 VOLT WYE SECONDARY.
2. FOR FEEDERS WHICH CAN NOT BE TERMINATED UNDER STANDARD SWITCH OR PANEL LUGS, CONTRACTOR SHALL PROVIDE A SPLICE BOX AT EACH END OF FEEDER, WITHIN 10' OF EACH TERMINATION POINT. FEEDER SIZE SHALL BE MAINTAINED FROM SPLICE BOX TO SPLICE BOX TO MATCH SIZE INDICATED ON SINGLE LINE DIAGRAMS. FEEDER SHALL BE REDUCED TO THE MAXIMUM SIZE WHICH CAN BE ACCOMODATED BY STANDARD LUGS PROVIDED WITH EQUIPMENT, AS INDICATED ON APPROVED EQUIPMENT SHOP DRAWINGS, FROM SPLICE BOX TO TERMINATION POINTS.
3. PROVIDE SPLICE BOX WITH COPPER DETAILS TO FACILITATE INDICATED TAP.

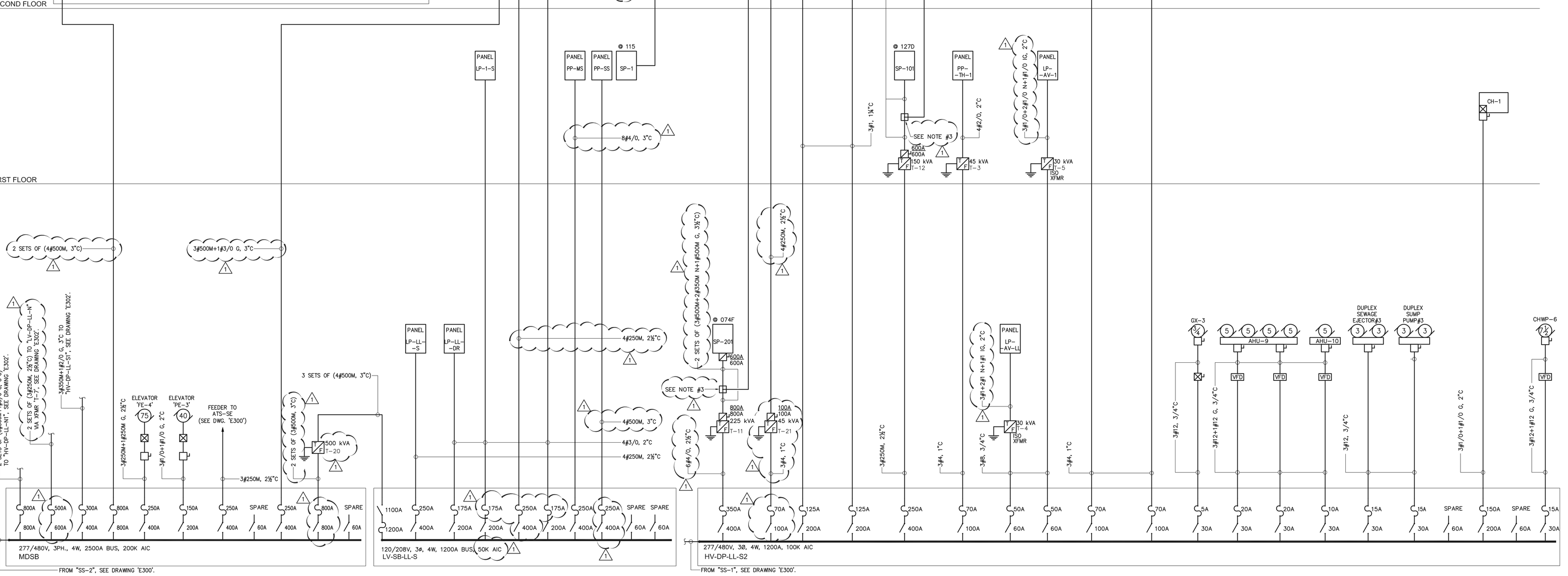
ELEVENTH FLOOR



THIRD FLOOR



SECOND FLOOR



LOWER LEVEL

ELECTRICAL SINGLE LINE DIAGRAM
N.T.S.

222 CENTRAL PARK SOUTH
NEW YORK, NY 10019
PH. 212-245-2050
FAX 212-245-1964
MAIL@TWBTA.COM

TOD WILLIAMS BILLIE TSIEN ARCHITECTS LLP

HOLABIRD & ROOT
140 SOUTH DEARBORN STREET CHICAGO IL 60603
TEL: 312-357-1777 FAX: 312-357-1999
WWW.HOLABIRD.COM

ads ENGINEERS
275 Seventh Avenue
21st Floor
New York, N.Y. 10001
Tel (212) 645-6060
Fax (212) 645-6633
www.adsce.com

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1 07.01.10- ASI 006

UNIVERSITY OF CHICAGO
REVA AND DAVID LOGAN CENTER
FOR THE CREATIVE AND PERFORMING ARTS
915 EAST 60TH STREET, CHICAGO, ILLINOIS 60637
PROJECT NUMBER: 2008012
PROJECT CERTIFICATION NUMBER: 130

DRAWN BY: NZ
DATE: 04/02/2010
SCALE: N.T.S.

ELECTRICAL SINGLE LINE DIAGRAM 1 of 2

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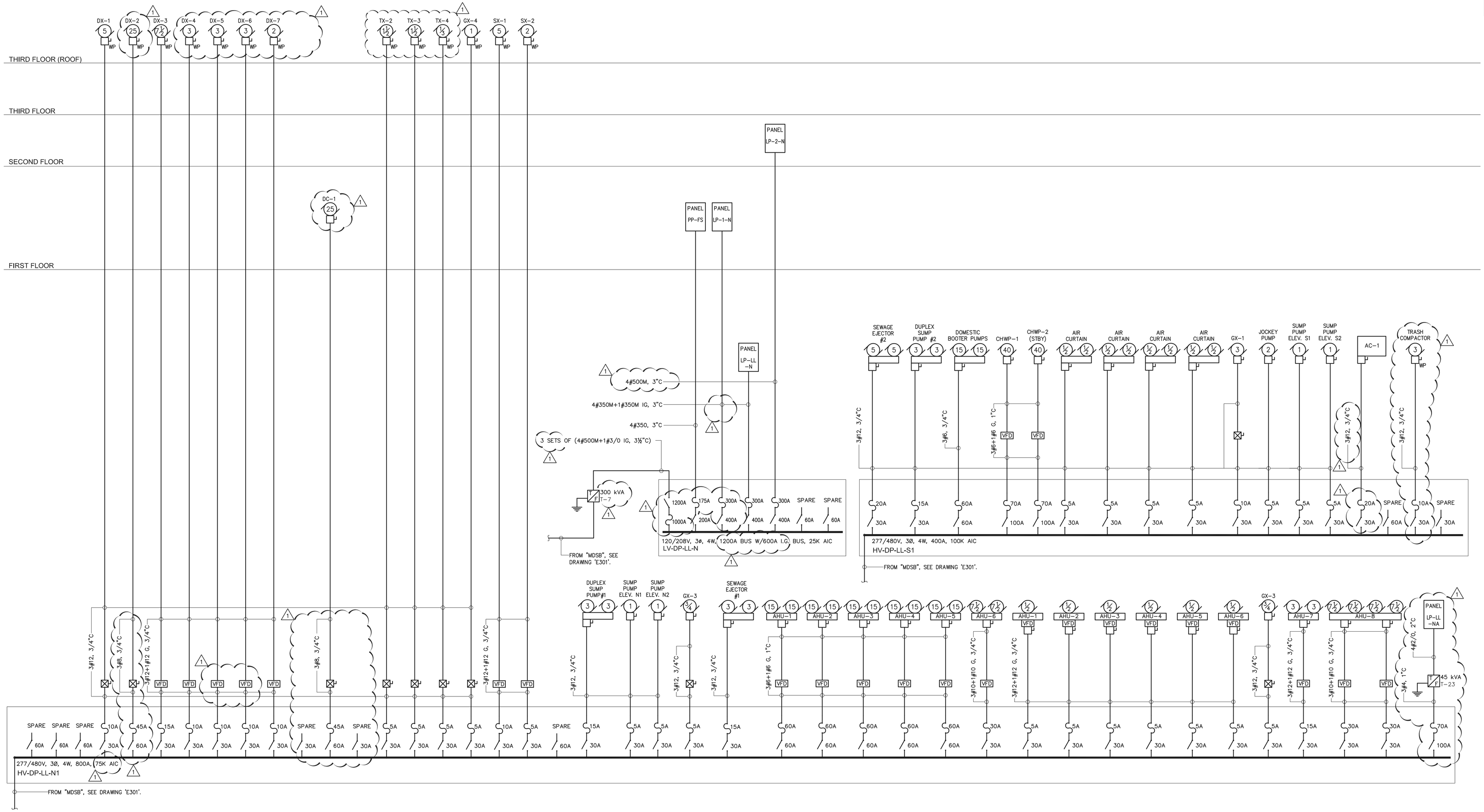
NOTES:

1. ALL TRANSFORMERS SHALL BE 480 VOLT DELTA PRIMARY, 120/208 VOLT WYE SECONDARY.
2. FOR FEEDERS WHICH CAN NOT BE TERMINATED UNDER STANDARD SWITCH OR PANEL LUGS, CONTRACTOR SHALL PROVIDE A SPLICE BOX AT EACH END OF FEEDER, WITHIN 10' OF EACH TERMINATION POINT. FEEDER SIZE SHALL BE MAINTAINED FROM SPLICE BOX TO SPLICE BOX TO MATCH SIZE INDICATED ON SINGLE LINE DIAGRAMS. FEEDER SHALL BE REDUCED TO THE MAXIMUM SIZE WHICH CAN BE ACCOMODATED BY STANDARD LUGS PROVIDED WITH EQUIPMENT, AS INDICATED ON APPROVED EQUIPMENT SHOP DRAWINGS, FROM SPLICE BOX TO TERMINATION POINTS. (2)



ELECTRICAL SINGLE LINE DIAGRAM
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TOD WILLIAMS BILLIE TSIEN ARCHITECTS LLP
222 CENTRAL PARK SOUTH
NEW YORK, NY 10019
TEL 212-265-2335
FAX 212-245-1984
MAIL@TWBTA.COM

HOLABIRD & ROOT
140 SOUTH DEARBORN STREET CHICAGO IL 60603
TEL: 312-357-1777 FAX: 312-357-1999
WWW.HOLABIRD.COM

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21st Floor
New York, N.Y. 10001
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PROPOSITION IDENTIFICATION NUMBER: 139

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DATE:	04/02/2010
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ELECTRICAL SINGLE LINE DIAGRAM 2 of 2

E 302