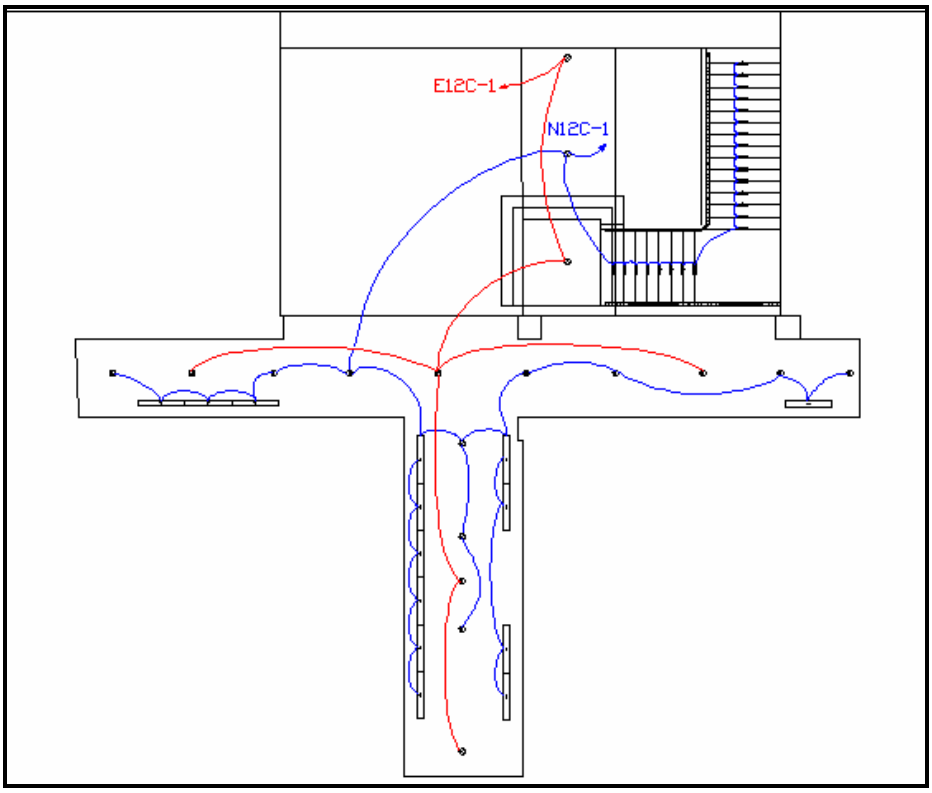
Lindsay Rekuc
Virginia Commonwealth University Life Sciences Building
Richmond, VA

Redesign of Lighting Spaces

1st Floor Lobby

LIGHTING POWER PLAN



Lindsay Rekuc
Virginia Commonwealth University Life Sciences Building
Richmond, VA

EXISTING

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: N12C
PANEL LOCATION: 1st Floor
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ELEC. RM 115	2290	20A/1P	1	*			2	20A/1P	2683	HUM. ANAT. 131	Lighting
Lighting	FR. BIO 120	2683	20A/1P	3		*		4	20A/1P	776	PREP. 132	Lighting
Lighting	RESC. CNTR. 122	1524	20A/1P	5			*	6	20A/1P	2683	HUM. ANAT. 130	Lighting
Lighting	COR. 128	1035	20A/1P	7	*			8	20A/1P	776	PREP. 123	Lighting
Lighting	OFFICE 118	1293	20A/1P	9		*		10	20A/1P	2683	ENV. SCI. 127	Lighting
Lighting	OFFICE 111	2134	20A/1P	11			*	12	20A/1P	2683	FR. BIO 123	Lighting
Lighting	OFFICE 107	1843	20A/1P	13	*			14	20A/1P	2683	FR. BIO 121	Lighting
Lighting	STOR. 104B	1940	20A/1P	15		*		16	20A/1P	2683	FR. BIO 117	Lighting
Lighting	VEST. 110	865	20A/1P	17			*	18	20A/1P	776	PREP. 119	Lighting
Lighting	SERVICE 114	768	20A/1P	19	*			20	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	15734	80A/1P	21		*		22	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	13213	70A/1P	23			*	24	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	10665	60A/1P	25	*			26	-	0		Space
Equipment	SNOW MELTING CABLE	5291	60A/1P	27		*		28	-	0		Space
Space		0	-	29			*	30	-	0		Space
Space		0	-	31	*			32	-	0		Space
Space		0	-	33		*		34	-	0		Space
Space		0	-	35			*	36	-	0		Space
Sub	45kVA XFMR N11C	7788	70A/3P	37	*			38	-	0		Space
Sub	45kVA XFMR N11C	5808	-	39		*		40	-	0		Space
Sub	45kVA XFMR N11C	4356	-	41			*	42	-	0		Space

CONNECTED LOAD (KW) - A	30.53	TOTAL DESIGN LOAD (KW)	41.76
CONNECTED LOAD (KW) - B	38.89	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	28.23	TOTAL DESIGN LOAD (AMPS)	52

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Virginia Commonwealth University Life Sciences Building
Richmond, VA

MODIFIED

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: N12C
PANEL LOCATION: 1st Floor
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ELEC. RM 115	2851	20A/1P	1	*			2	20A/1P	2683	HUM. ANAT. 131	Lighting
Lighting	FR. BIO 120	2683	20A/1P	3		*		4	20A/1P	776	PREP. 132	Lighting
Lighting	RESC. CNTR. 122	1524	20A/1P	5			*	6	20A/1P	2683	HUM. ANAT. 130	Lighting
Lighting	COR. 128	1035	20A/1P	7	*			8	20A/1P	776	PREP. 123	Lighting
Lighting	OFFICE 118	1293	20A/1P	9		*		10	20A/1P	2683	ENV. SCI. 127	Lighting
Lighting	OFFICE 111	2134	20A/1P	11			*	12	20A/1P	2683	FR. BIO 123	Lighting
Lighting	OFFICE 107	1843	20A/1P	13	*			14	20A/1P	2683	FR. BIO 121	Lighting
Lighting	STOR. 104B	1940	20A/1P	15		*		16	20A/1P	2683	FR. BIO 117	Lighting
Lighting	VEST. 110	865	20A/1P	17			*	18	20A/1P	776	PREP. 119	Lighting
Lighting	SERVICE 114	768	20A/1P	19	*			20	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	15734	80A/1P	21		*		22	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	13213	70A/1P	23			*	24	20A/1P	0		Spare
Equipment	SNOW MELTING CABLE	10665	60A/1P	25	*			26	-	0		Space
Equipment	SNOW MELTING CABLE	5291	60A/1P	27		*		28	-	0		Space
Space		0	-	29			*	30	-	0		Space
Space		0	-	31	*			32	-	0		Space
Space		0	-	33		*		34	-	0		Space
Space		0	-	35			*	36	-	0		Space
Sub	45kVA XFMR N11C	7788	70A/3P	37	*			38	-	0		Space
Sub	45kVA XFMR N11C	5808	-	39		*		40	-	0		Space
Sub	45kVA XFMR N11C	4356	-	41			*	42	-	0		Space

CONNECTED LOAD (KW) - A	31.09	TOTAL DESIGN LOAD (KW)	42.44
CONNECTED LOAD (KW) - B	38.89	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	28.23	TOTAL DESIGN LOAD (AMPS)	53

Calculation for Sizing N12C Equipment

Total Design Load (A) = 53
From NEC 240.6A --> 60A Circuit Breaker
From NEC Table 310.16 --> (3) #6- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #6- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #10 Copper Ground
From Conduit Sizer Spreadsheet --> 1" C

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EXISTING

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: E12C	MIN. C/B AIC: 14K
SIZE/TYPE BUS: 100A	PANEL LOCATION: 1st Floor	OPTIONS:
SIZE/TYPE MAIN: 50A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	CORR. C102	1609	20A/1P	1	*			2	20A/1P	0	0	Spare
Lighting	PREP. 132	647	20A/1P	3		*		4	20A/1P	614	CONF. 116	Lighting
Lighting	FR. BIO 117	905	20A/1P	5			*	6	20A/1P	388	OFFICE 111	Lighting
Spare		0	20A/1P	7	*			8	-	0		Space
Spare		0	20A/1P	9		*		10	-	0		Space
Spare		0	20A/1P	11			*	12	-	0		Space
Space		0	-	13	*			14	-	0		Space
Space		0	-	15		*		16	-	0		Space
Space		0	-	17			*	18	-	0		Space
Space		0	-	19	*			20	-	0		Space
Space		0	-	21		*		22	-	0		Space
Space		0	-	23			*	24	-	0		Space
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	1.61	TOTAL DESIGN LOAD (KW)	5.00
CONNECTED LOAD (KW) - B	1.26	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	1.29	TOTAL DESIGN LOAD (AMPS)	6

Lindsay Rekuc
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Richmond, VA

MODIFIED

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: E12C	MIN. C/B AIC: 14K
SIZE/TYPE BUS: 100A	PANEL LOCATION: 1st Floor	OPTIONS:
SIZE/TYPE MAIN: 50A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	CORR. C102	1528	20A/1P	1	*			2	20A/1P	0	0	Spare
Lighting	PREP. 132	647	20A/1P	3		*		4	20A/1P	614	CONF. 116	Lighting
Lighting	FR. BIO 117	905	20A/1P	5			*	6	20A/1P	388	OFFICE 111	Lighting
Spare		0	20A/1P	7	*			8	-	0		Space
Spare		0	20A/1P	9		*		10	-	0		Space
Spare		0	20A/1P	11			*	12	-	0		Space
Space		0	-	13	*			14	-	0		Space
Space		0	-	15		*		16	-	0		Space
Space		0	-	17			*	18	-	0		Space
Space		0	-	19	*			20	-	0		Space
Space		0	-	21		*		22	-	0		Space
Space		0	-	23			*	24	-	0		Space
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	1.53	TOTAL DESIGN LOAD (KW)	4.90
CONNECTED LOAD (KW) - B	1.26	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	1.29	TOTAL DESIGN LOAD (AMPS)	6

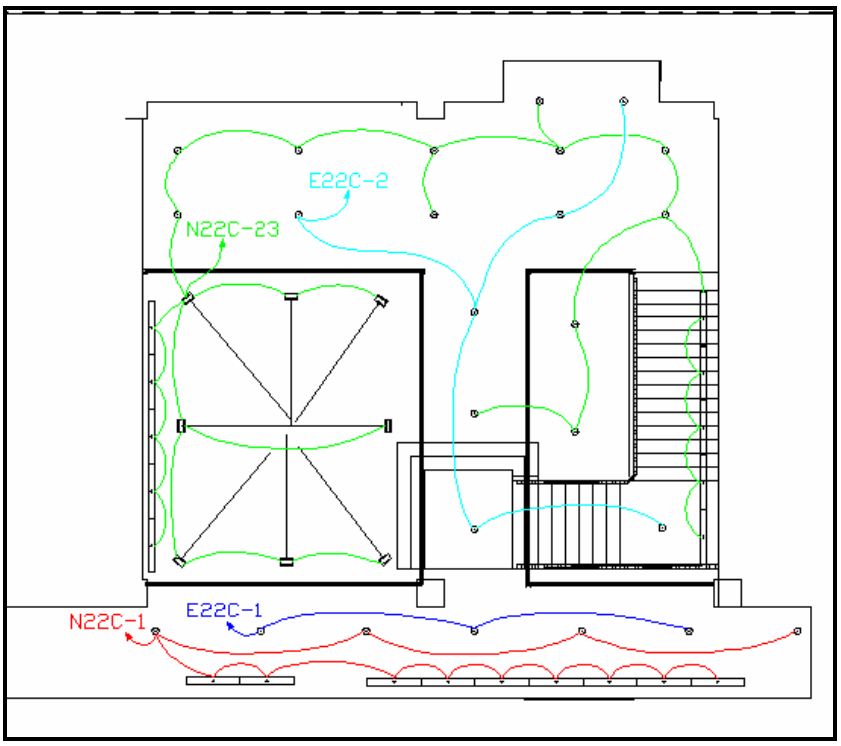
Calculation for Sizing E12C Equipment

Total Design Load (A) = 6
From NEC 240.6A --> 20A Circuit Breaker
From NEC Table 310.16 --> (3) #12- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #12- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #12 Copper Ground
From Conduit Sizer Spreadsheet --> 3/4" C

Lindsay Rekuc
Virginia Commonwealth University Life Sciences Building
Richmond, VA

2nd Floor Lobby & Genetics Laboratory

LIGHTING POWER PLAN



2nd Floor Lobby

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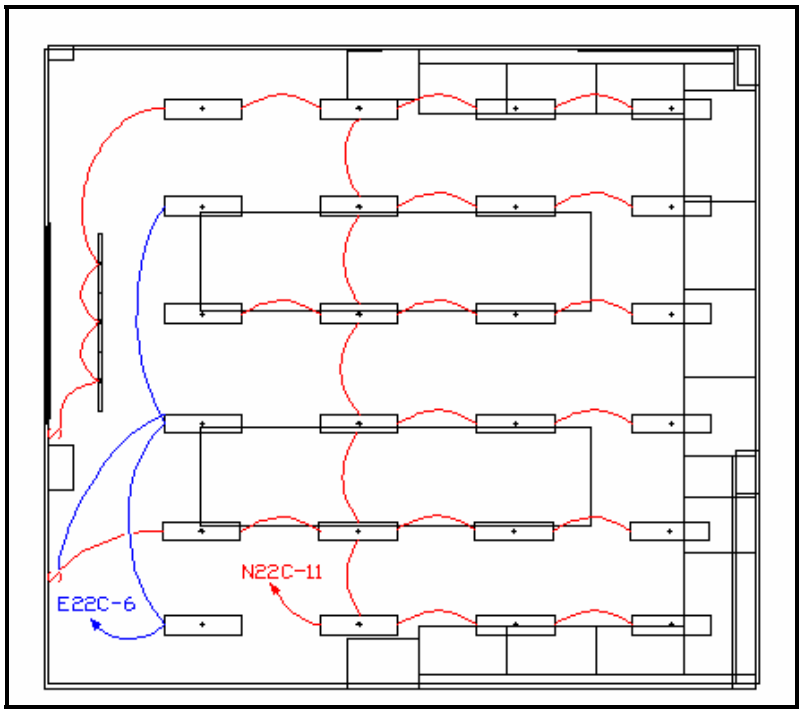
Richmond, VA



Genetics Lab

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Richmond, VA

EXISTING

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: N22C	MIN. C/B AIC: 14K
SIZE/TYPE BUS: 100A	PANEL LOCATION: 2nd Floor	OPTIONS:
SIZE/TYPE MAIN: 100A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ELEC. RM 215	2053	20A/1P	1	*			2	20A/1P	2683	QUATICS BIO. 23	Lighting
Lighting	OFFICE 223	1487	20A/1P	3		*		4	20A/1P	776	PREP. 228	Lighting
Lighting	STUDY 216	1919	20A/1P	5			*	6	20A/1P	2687	ECOLOGY 226	Lighting
Lighting	YS. & BIOMED.	2683	20A/1P	7	*			8	20A/1P	776	PREP. 229	Lighting
Lighting	OFFICE 217	1487	20A/1P	9		*		10	20A/1P	2683	PLANT BIO. 231	Lighting
Lighting	GENETICS 211	2683	20A/1P	11			*	12	20A/1P	2683	HISTOLOGY 227	Lighting
Lighting	PREP. 209	776	20A/1P	13	*			14	20A/1P	2683	COMP. ANAT. 22	Lighting
Lighting	MOLEC. BIO 207	2683	20A/1P	15		*		16	20A/1P	2683	BEHAV. 220	Lighting
Lighting	LEC. BIO PREP.	1293	20A/1P	17			*	18	20A/1P	776	AB SUPPORT 23	Lighting
Lighting	STORAGE 208E	769	20A/1P	19	*			20	20A/1P	776	BEHAV. 220	Lighting
Lighting	PREP. 220 (ALT	776	20A/1P	21		*		22	20A/1P	776	MICRO. 204	Lighting
Lighting	STAIR S203	1533	20A/1P	23			*	24	20A/1P	2683	MICRO. 204	Lighting
Spare	0	0	20A/1P	25	*			26	20A/1P	0	0	Spare
Spare	0	0	20A/1P	27		*		28	20A/1P	0	0	Spare
Spare	0	0	20A/1P	29			*	30	20A/1P	0	0	Spare
Space	0	0	-	31	*			32	-	0	0	Space
Space	0	0	-	33		*		34	-	0	0	Space
Space	0	0	-	35			*	36	-	0	0	Space
Space	0	0	-	37	*			38	-	0	0	Space
Space	0	0	-	39		*		40	-	0	0	Space
Space	0	0	-	41			*	42	-	0	0	Space

CONNECTED LOAD (KW) - A	13.20	TOTAL DESIGN LOAD (KW)	51.37
CONNECTED LOAD (KW) - B	13.35	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	16.26	TOTAL DESIGN LOAD (AMPS)	64

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Richmond, VA

MODIFIED

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 100A
SIZE/TYPE MAIN: 100A/3P C/B

PANEL TAG: N22C
PANEL LOCATION: 2nd Floor
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ELEC. RM 215	1906	20A/1P	1	*			2	20A/1P	2683	QUATICS BIO. 23	Lighting
Lighting	OFFICE 223	1487	20A/1P	3		*		4	20A/1P	776	PREP. 228	Lighting
Lighting	STUDY 216	1919	20A/1P	5			*	6	20A/1P	2687	ECOLOGY 226	Lighting
Lighting	YS. & BIOMED.	2683	20A/1P	7	*			8	20A/1P	776	PREP. 229	Lighting
Lighting	OFFICE 217	1487	20A/1P	9		*		10	20A/1P	2683	PLANT BIO. 231	Lighting
Lighting	GENETICS 211	821	20A/1P	11			*	12	20A/1P	2683	HISTOLOGY 227	Lighting
Lighting	PREP. 209	776	20A/1P	13	*			14	20A/1P	2683	COMP. ANAT. 22	Lighting
Lighting	MOLEC. BIO 20	2683	20A/1P	15		*		16	20A/1P	2683	BEHAV. 220	Lighting
Lighting	LEC. BIO PREP	1293	20A/1P	17			*	18	20A/1P	776	AB SUPPORT 23	Lighting
Lighting	STORAGE 208E	769	20A/1P	19	*			20	20A/1P	776	BEHAV. 220	Lighting
Lighting	PREP. 220 (ALT	776	20A/1P	21		*		22	20A/1P	776	MICRO. 204	Lighting
Lighting	STAIR S203	854	20A/1P	23			*	24	20A/1P	2683	MICRO. 204	Lighting
Spare	0	0	20A/1P	25	*			26	20A/1P	0	0	Spare
Spare	0	0	20A/1P	27		*		28	20A/1P	0	0	Spare
Spare	0	0	20A/1P	29			*	30	20A/1P	0	0	Spare
Space	0	0	-	31	*			32	-	0	0	Space
Space	0	0	-	33		*		34	-	0	0	Space
Space	0	0	-	35			*	36	-	0	0	Space
Space	0	0	-	37	*			38	-	0	0	Space
Space	0	0	-	39		*		40	-	0	0	Space
Space	0	0	-	41			*	42	-	0	0	Space

CONNECTED LOAD (KW) - A	13.05	TOTAL DESIGN LOAD (KW)	48.14
CONNECTED LOAD (KW) - B	13.35	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	13.72	TOTAL DESIGN LOAD (AMPS)	60

Calculation for Sizing N22C Equipment

Total Design Load (A) = 55
From NEC 240.6A --> 60A Circuit Breaker
From NEC Table 310.16 --> (3) #6- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #6- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #10 Copper Ground
From Conduit Sizer Spreadsheet --> 1” C

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Richmond, VA

EXISTING

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: E22C	MIN. C/B AIC: 14K
SIZE/TYPE BUS: 100A	PANEL LOCATION: 2nd Floor	OPTIONS:
SIZE/TYPE MAIN: 50A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	CORR. C201	1106	20A/1P	1	*			2	20A/1P	850	BB&E LAB S203	Lighting
Lighting	PREP. 220A	711	20A/1P	3		*		4	20A/1P	905	ST. LAB. 219	Lighting
Lighting	PREP. 228	453	20A/1P	5			*	6	20A/1P	841	GENETICS 211	Lighting
Spare		0	20A/1P	7	*			8	20A/1P	0		Spare
Spare		0	20A/1P	9		*		10	20A/1P	0		Spare
Spare		0	20A/1P	11			*	12	20A/1P	0		Spare
Space		0	-	13	*			14	-	0		Space
Space		0	-	15		*		16	-	0		Space
Space		0	-	17			*	18	-	0		Space
Space		0	-	19	*			20	-	0		Space
Space		0	-	21		*		22	-	0		Space
Space		0	-	23			*	24	-	0		Space
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	1.96	TOTAL DESIGN LOAD (KW)	5.84
CONNECTED LOAD (KW) - B	1.62	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	1.29	TOTAL DESIGN LOAD (AMPS)	7

Lindsay Rekuc
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Richmond, VA

MODIFIED

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: E22C	MIN. C/B AIC: 14K
SIZE/TYPE BUS: 100A	PANEL LOCATION: 2nd Floor	OPTIONS:
SIZE/TYPE MAIN: 50A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	CORR. C201	970	20A/1P	1	*			2	20A/1P	115	BB&E LAB S203	Lighting
Lighting	PREP. 220A	711	20A/1P	3		*		4	20A/1P	905	ST. LAB. 219	Lighting
Lighting	PREP. 228	453	20A/1P	5			*	6	20A/1P	91	GENETICS 211	Lighting
Spare		0	20A/1P	7	*			8	20A/1P	0		Spare
Spare		0	20A/1P	9		*		10	20A/1P	0		Spare
Spare		0	20A/1P	11			*	12	20A/1P	0		Spare
Space		0	-	13	*			14	-	0		Space
Space		0	-	15		*		16	-	0		Space
Space		0	-	17			*	18	-	0		Space
Space		0	-	19	*			20	-	0		Space
Space		0	-	21		*		22	-	0		Space
Space		0	-	23			*	24	-	0		Space
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	1.08	TOTAL DESIGN LOAD (KW)	3.89
CONNECTED LOAD (KW) - B	1.62	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	0.54	TOTAL DESIGN LOAD (AMPS)	5

Calculation for Sizing E22C Equipment

Total Design Load (A) = 5
From NEC 240.6A --> 20A Circuit Breaker
From NEC Table 310.16 --> (3) #12- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #12- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #12 Copper Ground
From Conduit Sizer Spreadsheet --> 3/4" C

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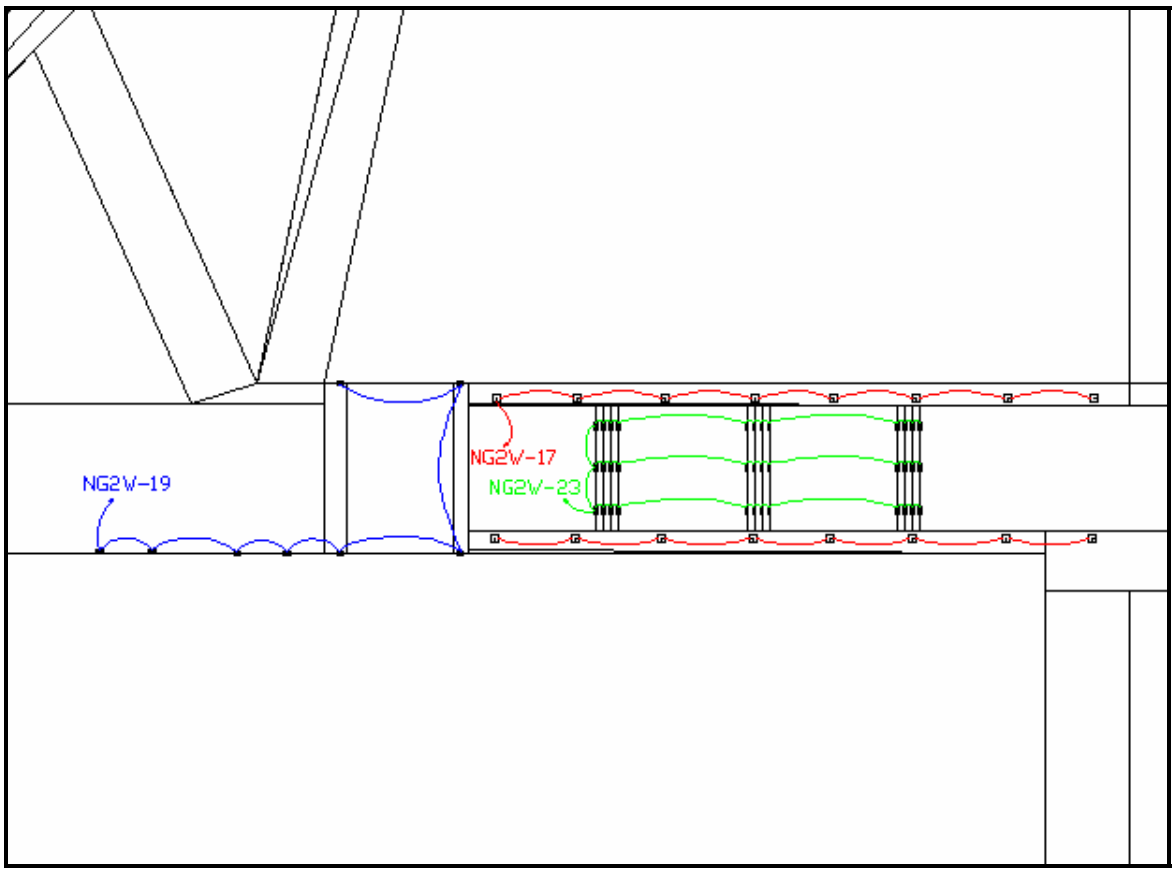
Exterior

LIGHTING POWER PLAN



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EXISTING

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W	PANEL TAG: NG2W	MIN. C/B AIC: 65K
SIZE/TYPE BUS: 400A	PANEL LOCATION: Main Elec. Rm 042	OPTIONS:
SIZE/TYPE MAIN: MLO	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	MAIN ELEC 042	2882	20A/1P	1	*			2	20A/1P	2328	WORK 041	Lighting
Lighting	AQUATICS 045	2555	20A/1P	3		*		4	20A/1P	2328	WORK 035	Lighting
Lighting	CAGE WASH 040B	1751	20A/1P	5			*	6	20A/1P	2328	WORK 029	Lighting
Lighting	HOLDING 040J	2826	20A/1P	7	*			8	20A/1P	2328	WORK 030	Lighting
Lighting	AUTO CLAVE 018	1617	20A/1P	9		*		10	20A/1P	2328	WORK 024	Lighting
Lighting	MICROSCOPY 008	2911	20A/1P	11			*	12	20A/1P	2134	WORK 020	Lighting
Lighting	VEST 012	864	20A/1P	13	*			14	20A/1P	2328	WORK 015	Lighting
Lighting	MECH RM 019	905	20A/1P	15		*		16	20A/1P	2458	OFFICE 009	Lighting
Lighting	BRIDGE	485	20A/1P	17			*	18	20A/1P	2070	OFFICE 003	Lighting
Lighting	EXTERIOR BLDG	2138	20A/1P	19	*			20	20A/1P	162	COLUMN TOP LIGHTS	Lighting
Lighting	TREE UPLIGHTS	855	20A/1P	21		*		22	20A/1P	808	FRONT STEP LIGHTS	Lighting
Lighting	REAR STEP LIGHTS	1131	20A/1P	23			*	24	20A/1P	727	FRONT STEP LIGHTS	Lighting
Lighting	COURTYARD POLES EAST	1900	20A/1P	25	*			26	20A/1P	0		Spare
Lighting	COURTYARD POLES WEST	1900	20A/1P	27		*		28	20A/1P	0		Spare
Lighting	CARY ST. LIGHTS	2351	20A/1P	29			*	30	20A/1P	0		Spare
Lighting	LINDEN ST. LIGHTS	1710	20A/1P	31	*			32	100A/3P	19188	75 KVA XFMR- NG1E	Sub
Space		0	-	33		*		34	-	19140		Sub
Space		0	-	35			*	36	-	14202		Sub
Sub	45 KVA XFMR- N11W	9336	70A/3P	37	*			38	50A/3P	8340	30 KVA XFMR- NG1W	Sub
Sub		9024	-	39		*		40	-	8304		Sub
Sub		8340	-	41			*	42	-	6652		Sub

CONNECTED LOAD (KW) - A	56.33	TOTAL DESIGN LOAD (KW)	61.33
CONNECTED LOAD (KW) - B	52.22	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	45.08	TOTAL DESIGN LOAD (AMPS)	77

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MODIFIED

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: NG2W	MIN. C/B AIC: 65K
SIZE/TYPE BUS: 400A	PANEL LOCATION: Main Elec. Rm 042	OPTIONS:
SIZE/TYPE MAIN: MLO	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	MAIN ELEC 042	2882	20A/1P	1	*			2	20A/1P	2328	WORK 041	Lighting
Lighting	AQUATICS 045	2555	20A/1P	3		*		4	20A/1P	2328	WORK 035	Lighting
Lighting	CAGE WASH 040B	1751	20A/1P	5			*	6	20A/1P	2328	WORK 029	Lighting
Lighting	HOLDING 040J	2826	20A/1P	7	*			8	20A/1P	2328	WORK 030	Lighting
Lighting	AUTO CLAVE 018	1617	20A/1P	9		*		10	20A/1P	2328	WORK 024	Lighting
Lighting	MICROSCOPY 008	2911	20A/1P	11			*	12	20A/1P	2134	WORK 020	Lighting
Lighting	VEST 012	864	20A/1P	13	*			14	20A/1P	2328	WORK 015	Lighting
Lighting	MECH RM 019	905	20A/1P	15		*		16	20A/1P	2458	OFFICE 009	Lighting
Lighting	EXTERIOR FLOOD	1503	20A/1P	17			*	18	20A/1P	2070	OFFICE 003	Lighting
Lighting	EXTERIOR SCONCES	2106	20A/1P	19	*			20	20A/1P	162	COLUMN TOP LIGHTS	Lighting
Lighting	TREE UPLIGHTS	855	20A/1P	21		*		22	20A/1P	808	FRONT STEP LIGHTS	Lighting
Lighting	REAR STEP LIGHTS	704	20A/1P	23			*	24	20A/1P	727	FRONT STEP LIGHTS	Lighting
Lighting	COURTYARD POLES EAST	1900	20A/1P	25	*			26	20A/1P	0		Spare
Lighting	COURTYARD POLES WEST	1900	20A/1P	27		*		28	20A/1P	0		Spare
Lighting	CARY ST. LIGHTS	2351	20A/1P	29			*	30	20A/1P	0		Spare
Lighting	LINDEN ST. LIGHTS	1710	20A/1P	31	*			32	100A/3P	19188	75 KVA XFMR- NG1E	Sub
Space		0	-	33		*		34	-	19140		Sub
Space		0	-	35			*	36	-	14202		Sub
Sub	45 KVA XFMR- N11W	9336	70A/3P	37	*			38	50A/3P	8340	30 KVA XFMR- NG1W	Sub
Sub		9024	-	39		*		40	-	8304		Sub
Sub		8340	-	41			*	42	-	6652		Sub

CONNECTED LOAD (KW) - A	56.30	TOTAL DESIGN LOAD (KW)	62.00
CONNECTED LOAD (KW) - B	52.22	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	45.67	TOTAL DESIGN LOAD (AMPS)	78

Calculation for Sizing NG2W Equipment

Total Design Load (A) = 78
From NEC 240.6A --> 80A Circuit Breaker
From NEC Table 310.16 --> (3) #4- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #4- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #8 Copper Ground
From Conduit Sizer Spreadsheet --> 1- 1/4" C

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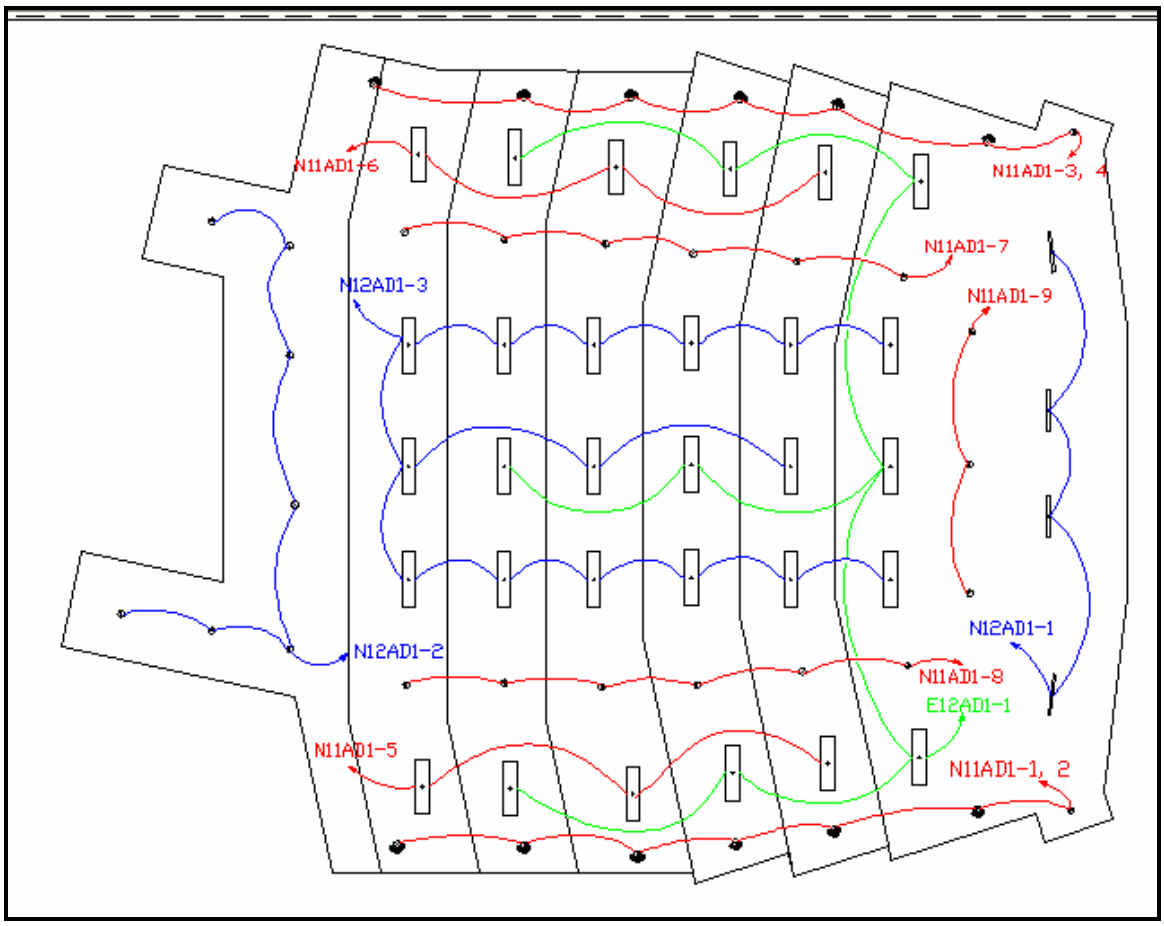
Auditorium

LIGHTING POWER PLAN



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EXISTING

DESIGNATION: N11AD1				DIMMING PANEL SCHEDULE			VOLTAGE: 480Y/277 V MAIN: MLO AIC RATING: 10K	
BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- FLUOR. WALL WASHERS-S	117.5		GFK1	4
2	1	100	20	AUD. 150- FLUOR. WALL WASHERS-S	117.5		GFK1	5
3	1	100	20	AUD. 150- FLUOR. WALL WASHERS- N	117.5		GFK1	6
4	1	100	20	AUD. 150- FLUOR. WALL WASHERS- N	117.5		GFK2	4
5	1	100	20	AUD. 150- DOWN LIGHTS- C	1050		GFK2	5
6	1	100	20	AUD. 150- DOWN LIGHTS- C	1050		GFK2	6
7	1	100	20	AUD. 150- DOWN LIGHTS- N	750		GFK3	2
8	1	100	20	AUD..150- DOWN LIGHTS- S	750		GFK3	3
9	1	100	20	AUD. 150- DOWN LIGHTS- CE	253		GFK4	2
10	1	100	20	AUD. 155- DOWN LIGHTS- S	764		GFK4	3
11	1	100	20	AUD. 155- DOWN LIGHTS- S	764		GFK5	2
12	1	100	20	AUD. 155- DOWN LIGHTS- N	764		GFK5	3
13	1	100	20	AUD. 155- DOWN LIGHTS- N	764		GFK6	2
14	1	100	20	AUD. 155- DOWN LIGHTS- C	1500		GFK6	3
15	1	100	20	AUD. 155- DOWN LIGHTS- CE	253		-	-
16	1	100	20	SPARE			-	-
TOTAL CONNECTED LOAD (KVA) 9.1								

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MODIFIED

DESIGNATION: N11AD1				DIMMING PANEL SCHEDULE			VOLTAGE: 480Y/277 V MAIN: MLO AIC RATING: 10K	
BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- FLUOR. WALL WASHERS-S	117.5		GFK1	4
2	1	100	20	AUD. 150- FLUOR. WALL WASHERS-S	117.5		GFK1	5
3	1	100	20	AUD. 150- FLUOR. WALL WASHERS- N	117.5		GFK1	6
4	1	100	20	AUD. 150- FLUOR. WALL WASHERS- N	117.5		GFK2	4
5	1	100	20	AUD. 150- DOWN LIGHTS- C	1050		GFK2	5
6	1	100	20	AUD. 150- DOWN LIGHTS- C	1050		GFK2	6
7	1	100	20	AUD. 150- DOWN LIGHTS- N	750		GFK3	2
8	1	100	20	AUD..150- DOWN LIGHTS- S	750		GFK3	3
9	1	100	20	AUD. 150- DOWN LIGHTS- CE	253		GFK4	2
10	1	100	20	AUD. 155- DOWN LIGHTS- S	764		GFK4	3
11	1	100	20	AUD. 155- DOWN LIGHTS- S	764		GFK5	2
12	1	100	20	AUD. 155- DOWN LIGHTS- N	764		GFK5	3
13	1	100	20	AUD. 155- DOWN LIGHTS- N	764		GFK6	2
14	1	100	20	AUD. 155- DOWN LIGHTS- C	1500		GFK6	3
15	1	100	20	AUD. 155- DOWN LIGHTS- CE	253		-	-
16	1	100	20	SPARE			-	-
TOTAL CONNECTED LOAD (KVA) 9.1								

Calculation for Sizing N11AD1 Equipment

Total Design Load (A) = 19.1
From NEC 240.6A --> 80A Circuit Breaker
From NEC Table 310.16 --> (3) #4- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #4- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #8 Copper Ground
From Conduit Sizer Spreadsheet --> 1- 1/4" C

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EXISTING

DESIGNATION: N12AD1				DIMMING PANEL SCHEDULE			VOLTAGE: 480Y/277 V MAIN: MLO AIC RATING: 10K	
BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- WALL WASHERS- E	490		GFK1	4
2	1	100	20	AUD. 150- WALL WASHERS- CE	490		GFK1	5
3	1	100	20	AUD. 150- TROFFERS	722		GFK1	6
4	1	100	20	AUD. 155- WALL WASHERS- E	490		GFK2	4
5	1	100	20	AUD. 155- WALL WASHERS- CE	490		GFK2	5
6	1	100	20	AUD. 155- TROFFERS	809		GFK2	6
7	1	100	20	CLASSRM. 250- TROFFERS & WW	238		GFK3	2
8	1	100	20	CLASSRM. 250- TROFFERS & WW	238		GFK3	3
9	1	100	20	CLASSRM. 251- TROFFERS & WW	238		GFK4	2
10	1	100	20	CLASSRM. 251- TROFFERS & WW	238		GFK4	3
11	1	100	20	CLASSRM. 253- TROFFERS & WW	296		GFK5	2
12	1	100	20	CLASSRM. 253- TROFFERS & WW	296		GFK5	3
13	1	100	20	CLASSRM. 254- TROFFERS & WW	224		GFK6	2
14	1	100	20	CLASSRM. 254- TROFFERS & WW	224		GFK6	3
15	1	100	20	CLASSRM. 254- WALL WASHERS	819		-	-
16	1	100	20	CLASSRM. 253- WALL WASHERS	1255		-	-
TOTAL CONNECTED LOAD (KVA)					7.6			

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DIMMING PANEL SCHEDULE

DESIGNATION: N12AD1

VOLTAGE: 480Y/277 V
MAIN: MLO
AIC RATING: 10K

BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- WALL WASHERS- E	254		GFK1	4
2	1	100	20	AUD. 150- DOWN LIGHTS- W	94		GFK1	5
3	1	100	20	AUD. 150- TROFFERS- C	474		GFK1	6
4	1	100	20	AUD. 155- WALL WASHERS- E	490		GFK2	4
5	1	100	20	AUD. 155- WALL WASHERS- CE	490		GFK2	5
6	1	100	20	AUD. 155- TROFFERS	809		GFK2	6
7	1	100	20	CLASSRM. 250- TROFFERS & WW	238		GFK3	2
8	1	100	20	CLASSRM. 250- TROFFERS & WW	238		GFK3	3
9	1	100	20	CLASSRM. 251- TROFFERS & WW	238		GFK4	2
10	1	100	20	CLASSRM. 251- TROFFERS & WW	238		GFK4	3
11	1	100	20	CLASSRM. 253- TROFFERS & WW	296		GFK5	2
12	1	100	20	CLASSRM. 253- TROFFERS & WW	296		GFK5	3
13	1	100	20	CLASSRM. 254- TROFFERS & WW	224		GFK6	2
14	1	100	20	CLASSRM. 254- TROFFERS & WW	224		GFK6	3
15	1	100	20	CLASSRM. 254- WALL WASHERS	819		-	-
16	1	100	20	CLASSRM. 253- WALL WASHERS	1255		-	-
TOTAL CONNECTED LOAD (KVA) 6.7								

Calculation for Sizing N12AD1 Equipment

Total Design Load (A) = 22.3
From NEC 240.6A --> 80A Circuit Breaker
From NEC Table 310.16 --> (3) #4- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #4- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #8 Copper Ground
From Conduit Sizer Spreadsheet --> 1- 1/4" C

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EXISTING

DESIGNATION: E12AD1				DIMMING PANEL SCHEDULE			VOLTAGE: 480Y/277 V MAIN: MLO AIC RATING: 10K	
BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- TROFFERS	345		GFK1	4
2	1	100	20	AUD. 155- TROFFERS	260		GFK1	5
3	1	100	20	CLASSRM. 250- TROFFERS	58		GFK1	6
4	1	100	20	CLASSRM. 251- TROFFERS	58		GFK2	4
5	1	100	20	CLASSRM. 253- TROFFERS	116		GFK2	5
6	1	100	20	CLASSRM. 254- TROFFERS	58		GFK2	6
7	1	100	20				GFK3	2
8	1	100	20				GFK3	3
9	1	100	20				GFK4	2
10	1	100	20				GFK4	3
11	1	100	20				GFK5	2
12	1	100	20				GFK5	3
13	1	100	20				GFK6	2
14	1	100	20				GFK6	3
15	1	100	20				-	-
16	1	100	20				-	-
TOTAL CONNECTED LOAD (KVA)					0.895			

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DIMMING PANEL SCHEDULE

DESIGNATION: E12AD1

VOLTAGE: 480Y/277 V
MAIN: MLO
AIC RATING: 10K

BREAKERS					CONN. LOAD (VA)	MINIMUM BREAKER AIC-SYM	CONTROLS	
NO.	POLE	AMP FRAME	AMP TRIP	DESCRIPTION			DEVICE	ZONE
1	1	100	20	AUD. 150- TROFFERS	285		GFK1	4
2	1	100	20	AUD. 155- TROFFERS	260		GFK1	5
3	1	100	20	CLASSRM. 250- TROFFERS	58		GFK1	6
4	1	100	20	CLASSRM. 251- TROFFERS	58		GFK2	4
5	1	100	20	CLASSRM. 253- TROFFERS	116		GFK2	5
6	1	100	20	CLASSRM. 254- TROFFERS	58		GFK2	6
7	1	100	20				GFK3	2
8	1	100	20				GFK3	3
9	1	100	20				GFK4	2
10	1	100	20				GFK4	3
11	1	100	20				GFK5	2
12	1	100	20				GFK5	3
13	1	100	20				GFK6	2
14	1	100	20				GFK6	3
15	1	100	20				-	-
16	1	100	20				-	-
TOTAL CONNECTED LOAD (KVA)					0.835			

Calculation for Sizing E12AD1 Equipment

Total Design Load (A) = 2.8
From NEC 240.6A --> 80A Circuit Breaker
From NEC Table 310.16 --> (3) #4- 75˚ C Copper THWN Phase Wire
From NEC 220.61 --> (1) #4- 75˚ C Copper THWN Neutral Wire
From NEC Table 250.122 --> (1) #8 Copper Ground
From Conduit Sizer Spreadsheet --> 1- 1/4" C

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Richmond, VA

Central Transformers versus Distributed Transformers

The Virginia Commonwealth University Life Sciences Building is broken up into two areas: the classroom building, which is two stories tall and the laboratory building, which is three stories tall. The laboratory building is very long and narrow running east to west with the classroom building running north to south off of the northeast corner of the laboratory building. With this building both central and distributed transformer systems must be considered in order to determine which system will be the most cost and energy efficient.

A central transformer system consists of having one or two main transformers located centrally on each floor of the building and then connecting to lower voltage panels throughout that floor. However, the large size of the transformers and the amount of feeders and conduit along with their sizes can incur large initial costs. On the other hand, distributed transformer systems have many smaller transformers distributed throughout each floor of the building. This can incur larger costs in having a large amount of transformers, however, smaller amounts and sizes of feeders and conduit can bring this cost down.

Currently, in The VCU Life Sciences Building, there are seven transformers for power distribution. They are located in the main electric room on the basement level and also in various electric closets on the first floor. There is a conduit system that distributes 208Y/120V to the rest of the building. A different solution to this would be the distributed system which would locate smaller transformers in each electrical closet on all of the floors to then provide lower voltage power to each section of the building on each floor.

To determine which system will provide higher cost and energy savings in The VCU Life Sciences Building, the number of transformers necessary, building configuration, the size and space restraints for the equipment, and the way the load is distributed must be considered.

Number of Transformers

Because there are only seven transformers in The VCU Life Sciences Building, a distributed system would increase this number. The physical size of each smaller transformer would be smaller than the larger rated ones. However, overall, when their dimensions are totaled, the physical space that the required amount of transformers actually increases. The Distributed Transformer Size Calculation Table shows how the current transformers could be broken down into smaller transformers distributed throughout the building. The seven large transformers break down into 22 smaller transformers. With a distributed system, the number of transformers increases, but further analysis is required to determine if this is economical.

DISTRIBUTED TRANSFORMER SIZE CALCULATION																								
Current Transformer Tag		T-500				T-225K			T-45			T-75		T-300			T-45			T-75			
Panel Serving		NG1WL	N11WL	N21WL	N31WL	N11CL	N21CL	N31CL	N11C	N21C	N31C	N11A	N21A	NG1EL	N21EL	N31EL	N11W	N21W	N31W	NG1E	N11E	N21E	N31E
Transformer	Size (kVA)	75	112.5	112.5	112.5	30	75	75	30	15	15	112.5	15	75	45	112.5	30	15	15	75	15	15	15
	Secondary Protection	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Primary Protection	110	175	175	175	45	110	110	45	20	20	175	20	110	70	175	45	20	20	110	25	20	20
Primary Design Load (A)		97.58	120.74	123.29	119.38	35.94	79.84	87.06	27.06	5.11	3.31	117.43	19.85	107.20	61.65	120.89	40.15	4.81	14.73	77.88	23.61	14.28	21.80
Wire Size	Phase	(3) #2	(3) #2/0	(3) #2/0	(3) #2/0	(3) #8	(3) #2	(3) #2	(3) #8	(3) #12	(3) #12	(3) #2/0	(3) #12	(3) #2	(3) #4	(3) #2/0	(3) #8	(3) #12	(3) #12	(3) #2	(3) #10	(3) #12	(3) #12
	Ground	(1) #6	(1) #6	(1) #6	(1) #6	(1) #10	(1) #6	(1) #6	(1) #10	(1) #12	(1) #12	(1) #6	(1) #12	(1) #6	(1) #8	(1) #6	(1) #10	(1) #12	(1) #12	(1) #6	(1) #10	(1) #12	(1) #12
Conduit Size		1- 1/4"	2"	2"	2"	3/4"	1- 1/4"	1- 1/4"	3/4"	3/4"	3/4"	2"	3/4"	1- 1/4"	1- 1/4"	2"	3/4"	3/4"	3/4"	1- 1/4"	3/4"	3/4"	3/4"
Secondary Design Load (A)		225.19	278.62	284.52	275.50	82.93	184.24	200.90	62.46	11.80	7.63	270.99	45.80	247.39	142.26	278.97	92.64	11.10	34.00	179.73	54.48	32.96	50.31
Wire Size	Phase	(4) #250	(4) #500	(4) #500	(4) #500	(4) #3	(4) #250	(4) #250	(4) #3	(4) #8	(4) #8	(4) #500	(4) #8	(4) #250	(4) #1/0	(4) #500	(4) #3	(4) #8	(4) #8	(4) #250	(4) #8	(4) #8	(4) #8
	Ground	(1) #2	(1) #2	(1) #2	(1) #2	(1) #8	(1) #2	(1) #2	(1) #8	(1) #10	(1) #10	(1) #2	(1) #10	(1) #2	(1) #6	(1) #2	(1) #8	(1) #10	(1) #10	(1) #2	(1) #10	(1) #10	(1) #10
Conduit Size		2- 1/2"	3- 1/2"	3- 1/2"	3- 1/2"	1- 1/4"	2- 1/2"	2- 1/2"	1- 1/4"	1"	1"	3- 1/2"	1"	2- 1/2"	2"	3- 1/2"	1- 1/4"	1"	1"	2- 1/2"	1"	1"	1"

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Building Configuration

Another one of the first considerations in deciding whether to use a central or distributed transformer system is the building configuration. The VCU Life Sciences building has a very large footprint, but is relatively low to the ground. In the laboratory section, the electrical rooms are all stacked one on top of the other with the exception of the main electrical closet in the basement. In the classroom section, the electrical rooms are not stacked. Because there is only one electrical room per floor and only two floors total, this part of the building will be negligible in this consideration. The electric rooms are all approximately 81 S.F. This allows minimal room for equipment.

The longest distance between distribution points is 170 feet in the central system. For a branch circuit carrying 20A, 170 feet, off of a 208Y/120V panelboard, a #6 conductor would be required to maintain a voltage drop below the NEC's requirement of three percent. Wire for 208Y/120V is larger because it is distributing a higher amount of amps a longer distance than wire that is for 480Y/277V. With a distributed system, the 480Y/277V conductor would run for part of the 170 feet, allowing for a shorter distance of 208Y/120V feeder to be used and therefore a smaller size would be okay to maintain the less than three percent voltage drop requirement. Also, because the wire is larger, larger conduit is also required. In this case, for the 208Y/120V branch circuit, 1-¼"conduit would be required.

Size and Space Restraints

When transformers are used in a central distribution method they are larger because they are required to support more of a load. Not only are the loads they carry larger, but also the size of the physical transformer is too. Physical sizes of the transformers were obtained from The Cutler-Hammer Product Catalog. The Physical Size Comparison Table shows the difference in physical sizes between the current large transformers vs. many smaller distributed transformers. In comparison to the centralized system versus the distributed system, in The VCU Life Sciences Building, the physical space that the transformers take up increases by 382" x 303-¼" x 203-¾" or 31' 10" x 25' 3-¼" x 16' 11-¾". This is a very large amount of space that will infringe on the useable space for laboratories and other facilities in the buildings.

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Physical Size Comparison				
Current		Resized		Increase in Size (H xW x D) (in.)
Transformer Tag	Physical Size (H x W x D) (in.)	Transformer Tag	Physical Size (H x W x D) (in.)	
T-500	75 x 44- 1/2 x 36	75	39/ 3/8 x 26- 1/8 x 19- 1/8	82.5 x 60 x 40.5
		112.5	39- 3/8 x 26- 1/8 x 19- 1/8	
		112.5	39- 3/8 x 26- 1/8 x 19- 1/8	
		112.5	39- 3/8 x 26- 1/8 x 19- 1/8	
T-300	62- 1/4 x 31- 1/4 x 30- 1/4	75	39/ 3/8 x 26- 1/8 x 19- 1/8	46- 5/8 x 41- 1/8 x 22- 1/8
		45	30 -1/8 x 20- 1/8 x 14- 1/8	
		112.5	39- 3/8 x 26- 1/8 x 19- 1/8	
T-225K	56 x 31- 1/4 x 24- 1/4	30	30- 1/8 x 20- 1/8 x 14- 1/8	52- 7/8 x 41- 1/8 x 28- 1/8
		75	39/ 3/8 x 26- 1/8 x 19- 1/8	
		75	39/ 3/8 x 26- 1/8 x 19- 1/8	
T-75	39- 3/8 x 26- 1/8 x 19- 1/8	112.5	39- 3/8 x 26- 1/8 x 19- 1/8	25 x 20- 1/8 x 14- 1/8
		15	25 x 20- 1/8 x 14- 1/8	
T-75	39- 3/8 x 26- 1/8 x 19- 1/8	75	39/ 3/8 x 26- 1/8 x 19- 1/8	75 x 60- 3/8 x 42- 3/8
		15	25 x 20- 1/8 x 14- 1/8	
		15	25 x 20- 1/8 x 14- 1/8	
		15	25 x 20- 1/8 x 14- 1/8	
T-45	30- 1/8 x 20- 1/8 x 14- 1/8	30	30- 1/8 x 20- 1/8 x 14- 1/8	50 x 40- 1/4 x 28- 1/4
		15	25 x 20- 1/8 x 14- 1/8	
		15	25 x 20- 1/8 x 14- 1/8	
T-45	30- 1/8 x 20- 1/8 x 14- 1/8	30	30- 1/8 x 20- 1/8 x 14- 1/8	50 x 40- 1/4 x 28- 1/4
		15	25 x 20- 1/8 x 14- 1/8	
		15	25 x 20- 1/8 x 14- 1/8	
			TOTAL INCREASE IN SIZE (in): 382 x 303- 1/4 x 203- 3/4	

Another note of consideration is that if the transformer is larger than 112.5 kVA, it requires more cooling than what is necessary for the lower rated transformers. This can lead to an increase in energy costs. With the centrally located system, this is the case with three of the transformers. However, with the distributed system, none of the transformers exceed 112.5 kVA, so no additional cooling will need to be taken into consideration.

Larger transformers have large magnetizing currents that are required to energize the coil. However, a minimal amount of that energy is actually being used when it is lightly loaded. Even if everything connected to the transformer is turned off, it is still using energy. Again, with a larger transformer, more energy will be used. Therefore, in order to maximize efficiency and minimize costs, the transformers should be heavily loaded and there should be an even distribution of continuous and non-continuous loads on each transformer.

Cost

Another consideration for a distributed versus central system in The VCU Life Sciences Building is cost. Larger transformers have a higher cost per unit. However, because there are so many smaller transformers, despite lower costs per unit, they add up to a higher total system cost. Cost data was obtained from The Cutler-Hammer Product

Catalog to compare the equipment costs of the central versus distributed systems. As shown in The Cost Comparison Table, the cost of a distributed system is actually increases by $10,380. This is a significant initial cost increase for a distributed system.

Cost Comparison				
Current		Resized		Cost Difference (U.S. $)
Transformer Tag	Cost (U.S. $)	Transformer Tag	Cost (U.S. $)	
T-500	16,000	75	2,970	-130
		112.5	4,300	
		112.5	4,300	
		112.5	4,300	
T-300	10,000	75	2,970	-630
		45	2,100	
		112.5	4,300	
T-225K	7,900	30	1,725	-235
		75	2,970	
		75	2,970	
T-75	2,970	112.5	4,300	+2,680
		15	1,350	
T-75	2,970	75	2,970	+4,050
		15	1,350	
		15	1,350	
		15	1,350	
T-45	2,100	30	1,725	+2,325
		15	1,350	
		15	1,350	
T-45	2,100	30	1,725	+2,325
		15	1,350	
		15	1,350	
			TOTAL	**+ 10,380**

Load Distribution

An offset to the cost, is how the load is distributed. Because it is such a large building, having distributed transformers allows for a shorter distance of running 208Y/120V feeders. With a centrally located system, the 208Y/120V feeders would have to be run a much longer distance therefore adding to cost in branch circuit feeders and conduit. Because the feeders are larger they bump up the size of the conduit adding to the cost of both. With distributed transformers, 480Y/277V feeder would be run for longer distances, but because of the larger voltage, a smaller feeder would be equivalent to the larger 208Y/120V feeder, also decreasing the size of the conduit and the overall cost of the distribution system.

Conclusions

When considering the many issues with centrally vs. distributed transformer systems, it is on a case by case basis in which they can be examined. In the case of The VCU Life Sciences Building, building configuration, the size and space restraints for the equipment, and the way the load is distributed were considered. Seven transformers are required for a centrally located system, whereas 22 transformers in a distributed system are required to equivalently provide power. Due to the horizontal orientation of the building, a distributed system will cut into the useable space for the

laboratories and classrooms. However, it will also cut down in the cost of branch circuit feeder wire and conduit. With a distributed system, the physical size of that the transformers increases significantly by 31’ 10” x 25’ 3- ¼” x 16’ 11- ¾”. Another major issue of concern with a distributed system is the $10,380 initial cost increase of the transformers. The distributed system would allow for 208Y/120V branch circuit feeders to run for a shorter distance, which would decrease the cost of these feeders and there conduit.

HVAC Redesign

Refer to Mechanical Breadth section for mechanical redesign and corresponding electrical redesign.

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Protective Device Coordination Study

A protective device coordination study was performed on one of the redesigned paths to the switchboard. It started with a 20A branch circuit on the modified panel N22C and went through a 60A circuit breaker onto the 100A main circuit breaker. On the following page is an overlay of the time current curves for these size circuit breakers. The curves were obtained from The Cutler-Hammer product CD. The 20A circuit breaker curve is shown in green, the 60A in red, and the 100A in blue. These curves illustrate that the 20A circuit breaker would be the first to trip, with the 60A circuit breaker being the next and finally the 100A circuit breaker.

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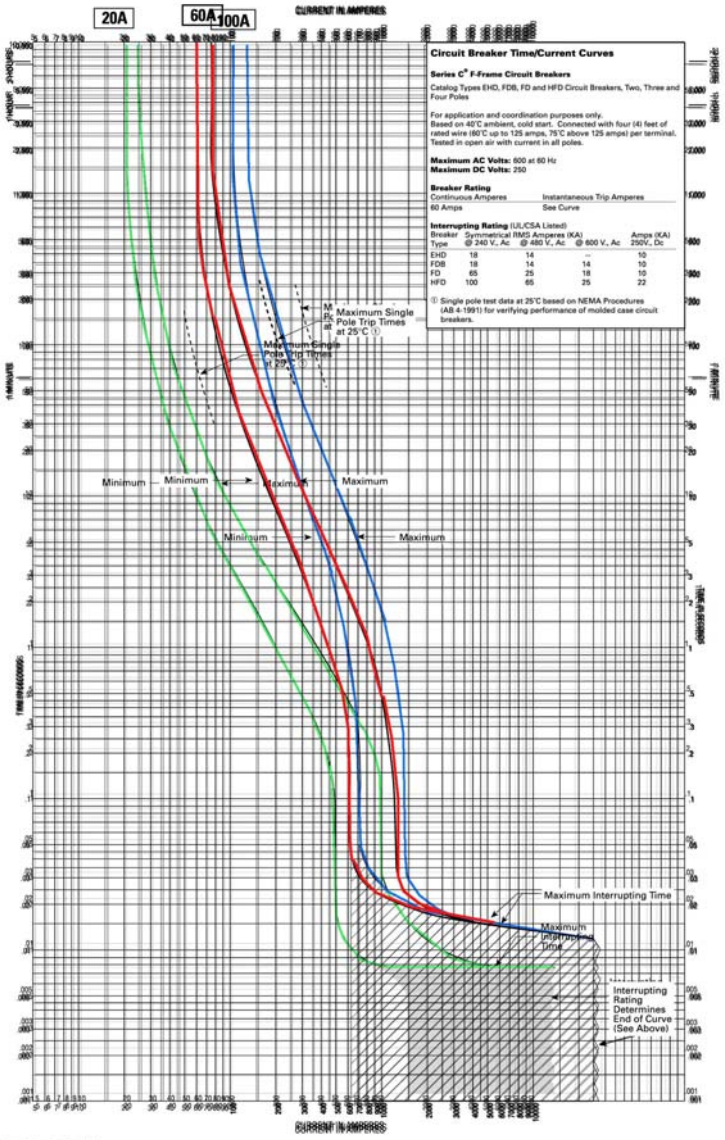
AB DE-ION Circuit Breakers

Types EHD, FDB, FD, HFD 2-Pole, 3-Pole and 4-Pole Amperes



Curve No. SC-4134-B3B

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