

Electrical Design Training Class

**Service Cabinet &
Transformer Breaker sizing**

WSDOT

Winter 2008

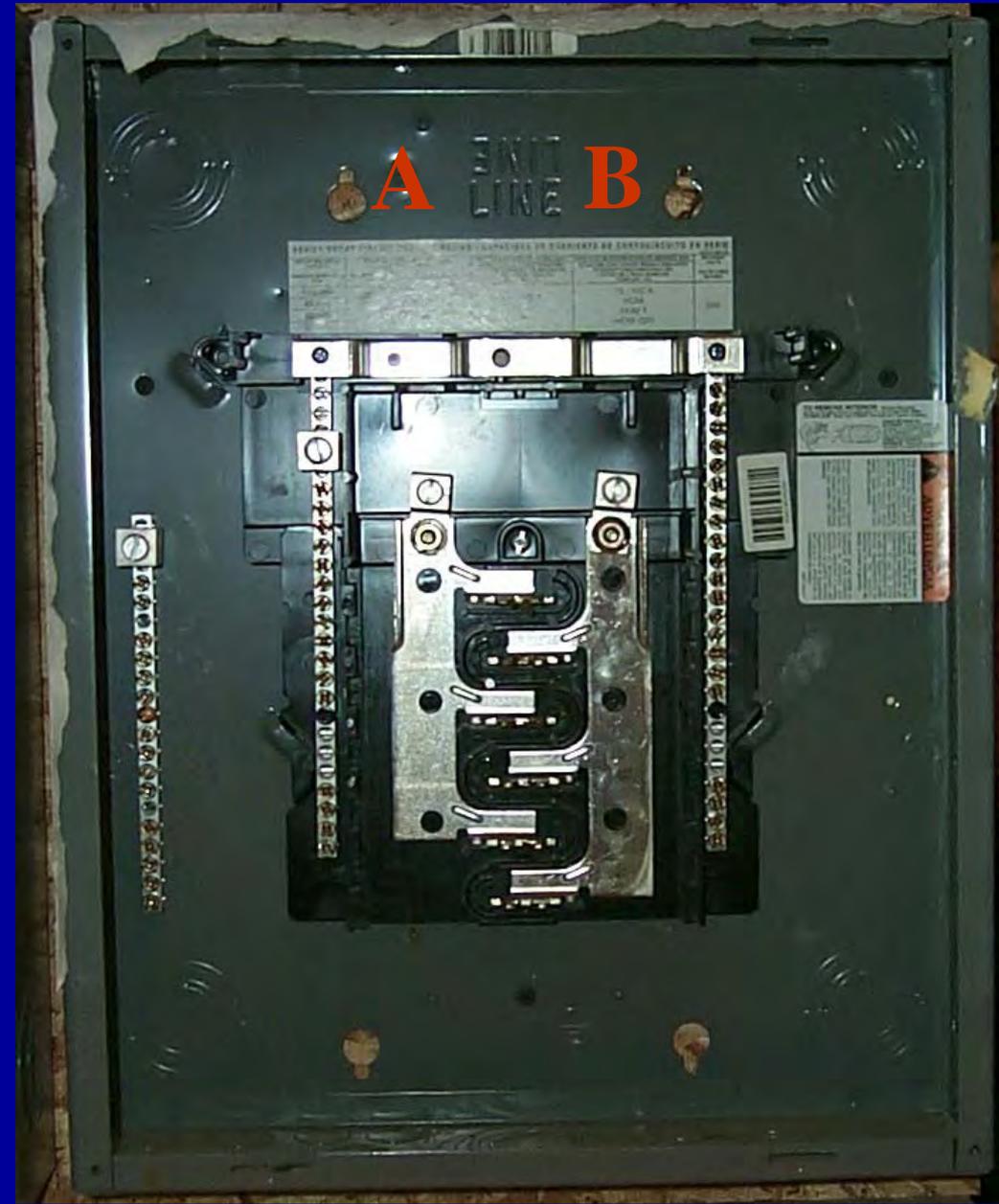
BZA

Presented by: Keith Calais

Main Breaker

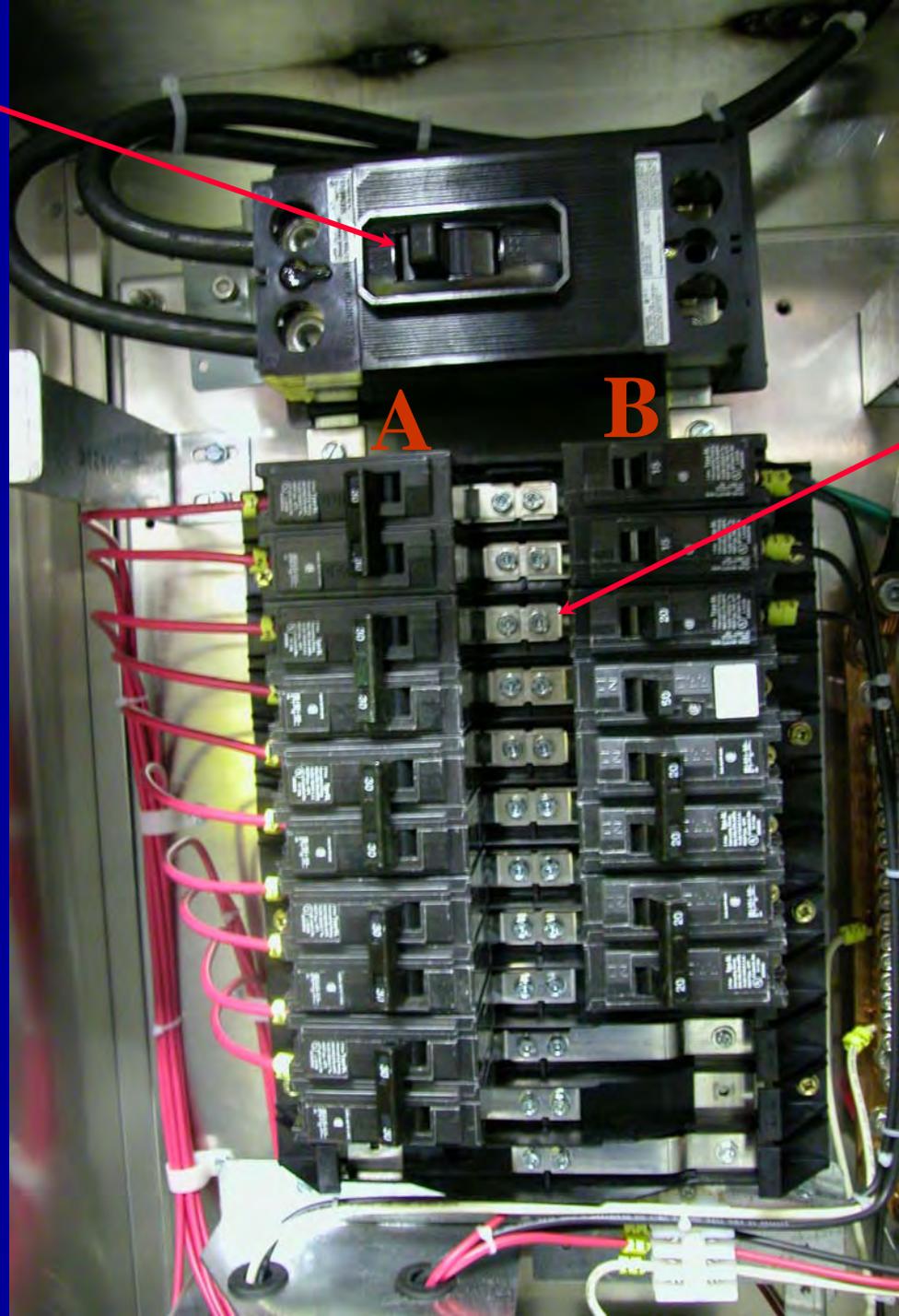


A B



A LINE B

Main Breaker



A

B

24 circuit panel board

120V / 240V Transformer Cabinet



120V / 240V
Transformer

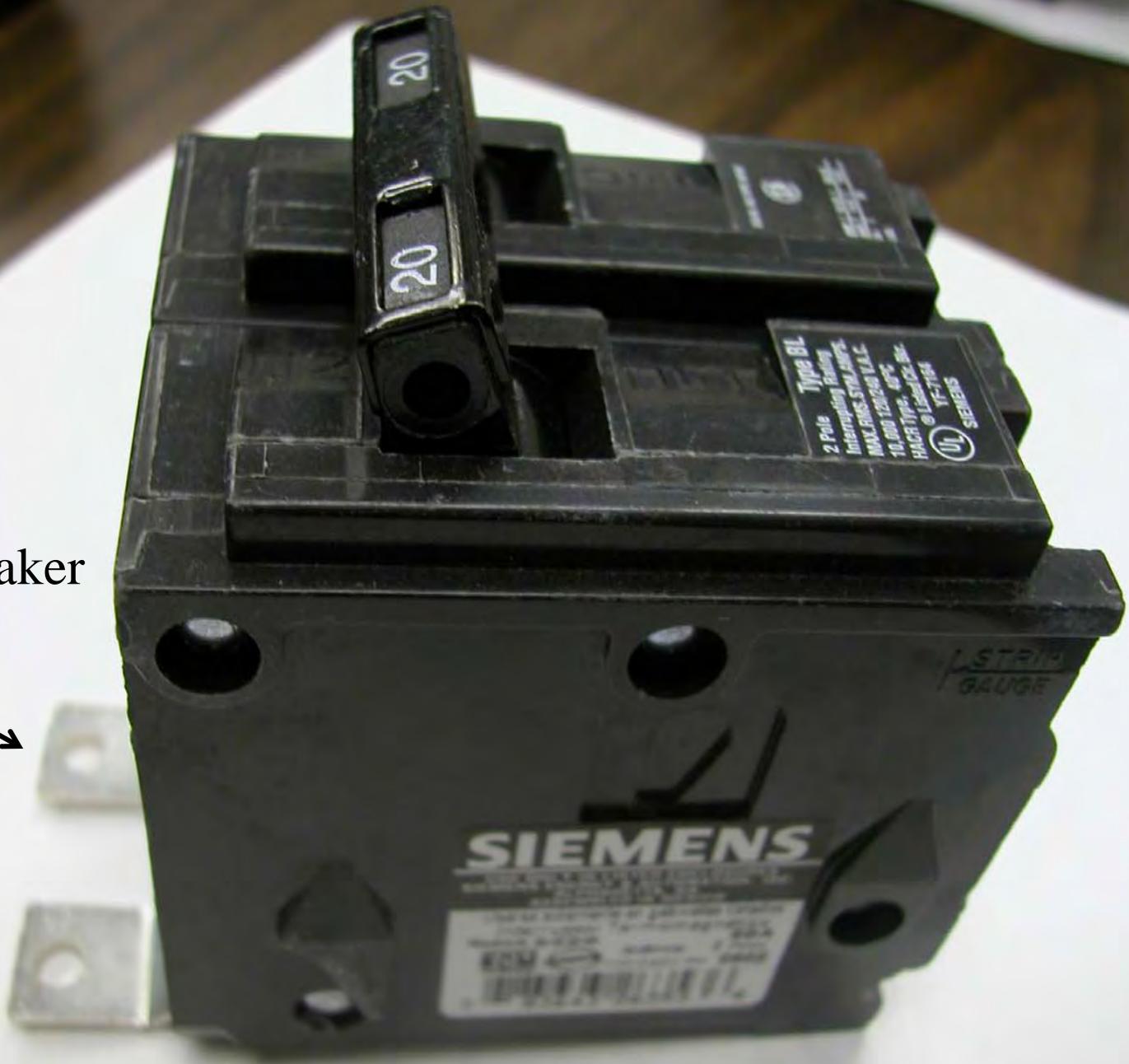




● Single pole, single throw

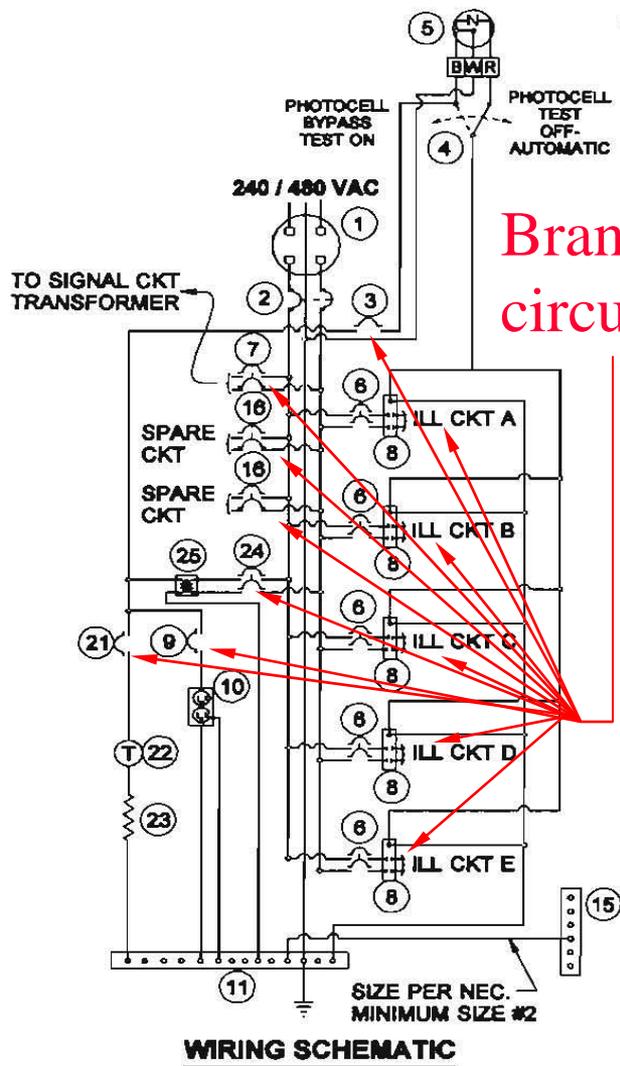
● Double pole, single throw

Bolt down breaker



Definitions

- **Circuit breaker** - A device designed to open & close by nonautomatic means & to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. (NEC 2005 - Article 100)
- **Standard ampere ratings for fuses & inverse time circuit breakers** shall be considered 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300....,.... (NEC 2005 - Article 240.6)
- **Branch Circuit** - The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s). (NEC 2005 - Article 100)
- **Continuous Load** – A load where the maximum current is expected to continue for 3 hours or more. (NEC 2005 - Article 100)



Branch
circuits

- KEY**
- ① METER BASE PER SERVING UTILITY REQUIREMENTS. AS A MINIMUM, THE METER BASE SHALL BE SAFETY SOCKET BOX WITH FACTORY INSTALLED TEST BYPASS FACILITY THAT MEETS THE REQUIREMENTS OF EUSERC DRAWING 305.
 - ② MAIN BREAKER (SEE BREAKER SCHEDULE)
 - ③ PHOTOCELL BREAKER (SPST 15 AMP - 120/240 VOLT)
 - ④ TEST SWITCH (SPDT SNAP ACTION, POSITIVE CLOSE 15 AMP - 120/277 VOLT "T" RATED)
 - ⑤ PHOTOELECTRIC CONTROL, STD. SPEC. 9 - 29.11(2)
 - ⑥ BRANCH BREAKER (SEE BREAKER SCHEDULE)
 - ⑦ SIGNAL TRANSFORMER BREAKER (SEE BREAKER SCHEDULE)
 - ⑧ CONTACTOR (SEE BREAKER SCHEDULE)
 - ⑨ RECEPTACLE BREAKER (SPST 20 AMP - 120/240 VOLT)
 - ⑩ RECEPTACLE, GROUNDED (GFCI 20 AMP - 125 VOLT)
 - ⑪ NEUTRAL BUSS, 14 LUG COPPER
 - ⑫ PHOTOCELL ENCLOSURE - ENCLOSURE TO BE FABRICATED FROM 5/8" EXPANDED STEEL MESH WITH WELDED SEAMS AND MOUNTING FLANGES. HOT DIP GALVANIZED AFTER FABRICATION. TYPE 5052 - H32 ALUMINUM WITH 5/8" x 5/8" OPENINGS EQUIVALENT TO 5/8" EXPANDED STEEL MESH MAY BE USED AS ALTERNATIVE MATERIAL. SEE PHOTOCELL ENCLOSURE MOUNTING DETAILS, STANDARD PLAN J-3b.
 - ⑬ HINGED FRONT FACING DOOR WITH 4" x 4" MIN. POLISHED WIRE GLASS WINDOW.
 - ⑭ HINGED DEAD FRONT WITH 1/4 TURN FASTENERS OR SLIDE LATCH
 - ⑮ CABINET MAIN BONDING JUMPER. BUSS SHALL BE 4 LUG TINNED COPPER. SEE CABINET MAIN BONDING JUMPER DETAIL, STANDARD PLAN J-3b.
 - ⑯ SPARE BRANCH BREAKER (DPST 20AMP- 240/480 VOLT)
 - ⑰ METAL WIRING DIAGRAM HOLDER
 - ⑱ REMOVABLE EQUIPMENT MOUNTING PAN
 - ⑲ 6" x 6" MIN. UNDERGROUND FEED - SERVICE WIREWAY (LEFT REAR CORNER)
 - ⑳ SCREENED VENTS, 2 REQUIRED, 1 EACH SIDE, LOUVERED PLATES
 - ㉑ HEATER BREAKER (SPST 15 AMP - 120/240 VOLT)
 - ㉒ THERMOSTAT, 40°F CLOSURE - 3 DIFFERENTIAL
 - ㉓ STRIP HEATER (100 WATT NOMINAL), WITH TERMINAL STRIP COVER
 - ㉔ TRANSFORMER BREAKER (DPST 15 AMP - 480 VOLT)
 - ㉕ DRY TRANSFORMER (480/120 VOLT) 3 KVA COPPER BUSSED AND COPPER WOUND
 - ㉖ RESERVED FOR METER, CURRENT TRANSFORMER AND/OR DISCONNECT SWITCH AS REQUIRED BY THE UTILITY
 - ㉗ 24 CIRCUIT PANEL BOARD - MINIMUM SIZE WITH SEPARATE MAIN BREAKER.
 - ㉘ LABEL CABINET WITH BUSSWORK RATING

Service Cabinet
wiring schematic

Sizing Branch Breakers

- Illumination Branch breakers are to be sized to carry 140 percent minimum of the total computed load.
- Non-illumination Branch breakers are to be sized to carry 125 percent continuous load plus 100% of the noncontinuous load. (NEC 2005 Article 210.20(A) Overcurrent protection - Continuous & Noncontinuous loads)
- Illumination loads should be calculated using the line-operating amps out of the supplier catalog. Use the Illumination Loads chart provided in “Line Loss” chapter, page 27. (The Traffic Manual July 1993, Page 4-15, figure 4-6 shows the older method for lamp load factor that we no longer use.)

Sizing Illumination Contactors

- Illumination Contactors must be equal to or larger than the Amperage rating for the branch breaker controlling that circuit.
- Illumination Contactors come in three sizes, 30, 60, and 100 Amps. (Per the NEC, lighting circuits can not be bigger than 50 amps) (NEC 2005 210.23(D) Branch Circuits Larger than 50 Amperes)

Sizing Lighting Branch Breaker Circuit A

Illumination Circuit **A** load

12 each - 250 watt, HPS Luminaires, 480 VAC, 0.7 Amps per luminaire

$12 \times 0.7 \text{ amps} = 8.4 \text{ Amps}$

Illumination Circuit **A** Breaker

$8.4 \text{ amps continuous load} \times 140\% \text{ factor} = 11.76 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Use 30 Amp contactor

Sizing Lighting Branch Breaker Circuit B

Illumination Circuit **B** load

13 each - 250 watt, HPS Luminaires, 480 VAC, 0.7 Amps per luminaire

$13 \times 0.7 \text{ amps} = 9.1 \text{ Amps}$

Illumination Circuit **B** Breaker

$9.1 \text{ amps continuous load} \times 140\% \text{ factor} = 12.74 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Use 30 Amp contactor

Sizing Lighting Branch Breaker Circuit C

Illumination Circuit C load

10 each - 250 watt, HPS Luminaires, 480 VAC, 0.7 Amps per luminaire

$10 \times 0.7 \text{ amps} = 7.0 \text{ Amps}$

Illumination Circuit C Breaker

$7.0 \text{ amps continuous load} \times 140\% \text{ factor} = 9.8 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Use 30 Amp contactor

Sizing Lighting Branch Breaker Circuit D

Illumination Circuit **D** load

10 each - 250 watt, HPS Luminaires, 480 VAC, 0.7 amps per luminaire

$10 \times 0.7 \text{ amps} = 7.0 \text{ amps}$

Illumination Circuit **D** Breaker

$7.0 \text{ amps continuous load} \times 140\% \text{ factor} = 9.8 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Use 30 Amp contactor.

Sizing Lighting Branch Breaker Circuit E

Illumination Circuit **E** load

10 each - 250 watt, HPS Luminaires, 480 VAC, 0.7 amps per luminaire

$10 \times 0.7 \text{ amps} = 7.0 \text{ amps}$

Illumination Circuit **E** Breaker

$7.0 \text{ amps continuous load} \times 140\% \text{ factor} = 9.8 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Use 30 Amp contactor.

Sizing Labree transformer Branch Breaker Circuit F –

Note: This is the breaker inside the service cabinet

Labree Traffic Signal Transformer Cabinet - Circuit F load
15,000 Watts, 480 VAC total load

15,000 watts continuous load/480 volts = 31.25 amps

Labree Traffic Signal Transformer Cabinet - Circuit F load
31.25 amps continuous load x 125% factor = 39.06 amps

Use 40 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

This completes the sizing of the circuit breaker for the Labree Transformer Branch Breaker Circuit F in the Service Cabinet. Go to slides 46 – 65 for continuation of sizing of branch breakers within the transformer cabinet.

Sizing L-B-M Transformer Branch Breaker Circuit G

Note: This is the breaker inside the service cabinet

L-B-M Traffic Signal Transformer Cabinet - Circuit G load

7,500 watts, 480 VAC total load

$7,500 \text{ watts continuous load} / 480 \text{ volts} = 15.625 \text{ amps}$

L-B-M Traffic Signal Transformer Cabinet - Circuit G load

$15.625 \text{ amps continuous load} \times 125\% \text{ factor} = 19.53 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a)
Overcurrent protection - Continuous & Noncontinuous
loads)

Sizing Over-height Transformer Branch Breaker Circuit H

Note: This is the breaker inside the service cabinet

Over-height Transformer Cabinet - Circuit **H** load

5,000 watts, 480 VAC total load

5,000 watts continuous load/480 volts= 10.4167 amps

Over-height Transformer Cabinet - Circuit **H** load

10.4167 amps continuous load x 125% factor=13.02 amps

Use 15 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Sizing Internal Transformer Branch Breaker Circuit K

Note: This is the breaker inside the service cabinet that provides power for the receptacle, photocell and contactors

Internal Transformer - Circuit **K** load

3,000 watts, 480 VAC total load

$3,000 \text{ watts continuous load} / 480 \text{ volts} = 6.25 \text{ amps}$

Internal Transformer - Circuit **K** load

$6.25 \text{ amps continuous load} \times 125\% \text{ factor} = 7.81 \text{ amps}$

Use 15 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Sizing Service cabinet Outlet Branch Breaker Circuit K1

Service Cabinet Outlet Circuit **K1** load

1800 watts, 120 VAC

$1800 \text{ watts continuous load} / 120 \text{ VAC} = 15.0 \text{ amps}$

Service Cabinet Outlet – Circuit **K1** Breaker

$15.0 \text{ amps continuous load} \times 125\% = 18.75 \text{ amps}$

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Sizing Service Cabinet Heat Strip Branch Breaker Circuit K2

Service Cabinet Heat strip Circuit **K2** load

100 watts per strip, 120 VAC

100 watts continuous load / 120 VAC = 0.83 amps

Service Cabinet Heat strip – Circuit **K2** Breaker

0.83 amps continuous load x 125% = 1.04 amps

Use 15 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Sizing Photocell Branch Breaker

Circuit K3

Photocell Circuit **K3** load

120 VAC, 1.1 watts

1.1 watts (photocell model SST-IES from Tyco Electronics Area Lighting)

continuous load / 120 VAC = 0.009 amps

Photocell – Circuit **K3** Breaker

0.009 amps continuous load x 125% = 0.011 amps

Use 15 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Verify Breaker protects Conductors – 1st 2” conduit

- CKT A
- #8 reduced by 30% Ampacity = $50A \times 0.7 = 35$ Amps
- Breaker Size = 20 Amps
- 35 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**
- CKT B
- #8 reduced by 30% Ampacity = $50A \times 0.7 = 35$ Amps
- Breaker size = 20 Amps
- 35 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**

Verify Breaker protects Conductors-cont. - 1st 2" conduit

- CKT C
- #8 reduced by 30% Ampacity = $50A \times 0.7 = 35$ Amps
- Breaker size = 20 Amps
- 35 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**
- CKT D
- #8 reduced by 30% Ampacity = $50A \times 0.7 = 35$ Amps
- Breaker size = 20 Amps
- 35 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**

Verify Breaker protects Conductors-cont. – 2nd 2” conduit

- CKT E
- #8 reduced by 20% Ampacity = $50A \times 0.8 = 40$ Amps
- Breaker size = 20 Amps
- 40 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**

Verify Breaker protects Conductors-cont. - 2nd 2" conduit

- CKT G
- #8 reduced by 20% Ampacity = $50\text{A} \times 0.8 = 40\text{ Amps}$
- Breaker size = 20 Amps
- 40 Amps Allowable through conductor > 20 Amp breaker
- #8 conductor protected by 20 Amp Breaker is **OK**
- CKT H
- #4 reduced by 20% Ampacity = $85\text{A} \times 0.8 = 68\text{ Amps}$
- Breaker size = 20 Amps
- 68 Amps Allowable through conductor > 20 Amp breaker
- #4 conductor protected by 20 Amp Breaker is **OK**

Verify Breaker protects Conductors-cont. – 1 1/2” conduit

- CKT F
- #8 no reduction for Ampacity = 50Amps
- Breaker size = 30 Amps
- 50 Amps Allowable through conductor > 30 Amp breaker
- #8 conductor protected by 30 Amp Breaker is **OK**

WIRING SCHEDULE

SERVICE NO.

△ NO.	CONDUIT SIZE	CONDUCTORS		CIRCUIT	COMMENTS
		EXISTING	NEW		
1	2"		8 - #8	A, B, C, D	ILLUMINATION
	2"		4 - #8	E, F	ILLUM, LABREE TRANSFORMER
			2 - #4	H	OVERHEIGHT TRANSFORMER
	2"		EMPTY	---	SPARE
2	1 1/2"		2 - #8	G	L-B-M TRANSFORMER

Service Cabinet Main Breaker Load

Circuit, Voltage	Noncont. Load	Cont. Load	Factor	A	N	B
A-Illumination A, 480 vac		8.400 Amps	x 140%	11.76		11.76
B-Illumination B, 480 vac		9.100 Amps	x 140%	12.74		12.74
C-Illumination C, 480 vac		7.000 Amps	x 140%	9.800		9.800
D-Illumination D, 480 vac		7.000 Amps	x 140%	9.800		9.800
E-Illumination E, 480 vac		7.000 Amps	x 140%	9.800		9.800
F-Labree Transformer, 480 vac		31.25 Amps	x 125%	39.06		39.06
G-L-B-M Transformer, 480 vac		15.62 Amps	x 125%	19.53		19.53
H-Over-height transformer, 480 vac		10.42 Amps	x 125%	13.02		13.02
I-Spare				-----		-----
J-Spare				-----		-----
K-Internal transformer, 480 vac		6.250 Amps	x 125%	<u>7.812</u>		<u>7.812</u>
TOTAL SIZED LOAD:				133.32*		133.32

* Size the main breaker for the buss with the largest load.

Sizing Main Breaker and Busswork

Size the main breaker for the buss with the largest load.

$$133.32 \text{ Amps} \times 133\% \text{ (future capacity)} = 177.76 \text{ Amps}$$

Use 200 amp Main Breaker as minimum size to provide for future loads.

The Busswork in this example should be 200 Amp minimum. With the new Service Cabinets, specify 250 Amp Busswork in every cabinet. If the main breaker is larger than 200 Amps, the standard service cabinet details must be modified.

Size the feeder wires, the wires between the serving utility transformer and the main breaker, to handle the maximum busswork capacity.

For 240/480 volt service feeders use this chart

Allowable Ampacity of Insulated Conductors Rated 0 through 2000 volts: Not more than 3 current carrying conductors in a raceway, cable or earth (direct buried) based on ambient temperature of 86F. (2005 NEC 310.16) (Used 75C (167F) column from table)

Wire Size	Allowable Ampacity	Wire Size	Allowable Ampacity
Copper		Aluminum	
14	20	14	n/a
12	25	12	20
10	35	10	30
8	50	8	40
6	65	6	50
4	85	4	65
3	100	3	75
2	115	2	90
1	130	1	100
1/0	150	1/0	120
2/0	175	2/0	135
3/0	200	3/0	155
4/0	230	4/0	180
250	255	250	205
300	285	300	230
350	310	350	250
400	335	400	270
32 500	380	500	310

Sizing Feeder wires

- Per the previous chart, this service has a 200 Amp main breaker with 250 amp busswork. The feeder conductors should be 3 each – 250 Kcmil.

Conductor Types and Sizes for 120/240V, 3-Wire, Single-Phase Dwelling Services and Feeders.

<u>Copper</u>	<u>Aluminum or Copper-Clad Aluminum</u>	<u>Feeder Rating (Amperes)</u>
4	2	100
3	1	110
2	1/0	125
1	2/0	150
1/0	3/0	175
2/0	4/0	200
3/0	250	225
4/0	300	250
250	350	300
350	500	350
400	600	400

NEC 2005 - Table 310.15(b)(6)

BREAKER SCHEDULE		SERVICE NO. 001			
TYPE E SERVICE		240/480V			
CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	X	X	480	X
B	ILLUMINATION B	X	X	480	X
C	ILLUMINATION C	X	X	480	X
D	ILLUMINATION D	X	X	480	X
E	ILLUMINATION E	X	X	480	X
F	SIGNAL XFRMR	X	N/A	480	X
G	SPARE	20 AMP	N/A	480	X
H	SPARE	20 AMP	N/A	480	X
I	INTERNAL TRANSFORMER	15 AMP	N/A	480	X
II	TRANSFORMER SECONDARY	35 AMP	N/A	120	---
I-1	GFCI	20 AMP	N/A	120	1.8
I-2	HEAT STRIP	15 AMP	N/A	120	0.1
I-3	PHOTOCELL	15 AMP	N/A	120	0.001
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

BREAKER SCHEDULE FOR TYPE E SERVICE PER STANDARD PLAN J-3D

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	X	---	---	---
A	ILLUMINATION A	X	X	X	X
B	ILLUMINATION B	X	X	X	X
C	ILLUMINATION C	X	X	X	X
D	ILLUMINATION D	X	X	X	X
E	ILLUMINATION E	X	X	X	X
F	LABREE TRANSFORMER	X	X	X	X
G	L-B-M TRANSFORMER	X	X	X	X
H	OVERHEIGHT TRANSFORMER	X	X	X	X
I	SPARE	X	X	X	X
J	SPARE	X	X	X	X
K	INTERNAL TRANSFORMER	X	X	X	X
KK	TRANSFORMER SECONDARY	X	X	X	X
K-1	GFCI	X	X	X	X
K-2	HEAT STRIP	X	X	X	X
K-3	PHOTOCELL	X	X	X	X
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

JOB SPECIFIC BREAKER SCHEDULE FOR TYPE E SERVICE

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	X	X	X
B	ILLUMINATION B	20 AMP	X	X	X
C	ILLUMINATION C	20 AMP	X	X	X
D	ILLUMINATION D	20 AMP	X	X	X
E	ILLUMINATION E	20 AMP	X	X	X
F	LABREE TRANSFORMER	40 AMP	X	X	X
G	L-B-M TRANSFORMER	20 AMP	X	X	X
H	OVERHEIGHT TRANSFORMER	20 AMP	X	X	X
I	SPARE	20 AMP	X	X	X
J	SPARE	20 AMP	X	X	X
K	INTERNAL TRANSFORMER	15 AMP	X	X	X
KK	TRANSFORMER SECONDARY	35 AMP	X	X	X
K-1	GFCI	20 AMP	X	X	X
K-2	HEAT STRIP	15 AMP	X	X	X
K-3	PHOTOCELL	15 AMP	X	X	X
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	X	X
B	ILLUMINATION B	20 AMP	30 AMP	X	X
C	ILLUMINATION C	20 AMP	30 AMP	X	X
D	ILLUMINATION D	20 AMP	30 AMP	X	X
E	ILLUMINATION E	20 AMP	30 AMP	X	X
F	LABREE TRANSFORMER	40 AMP	N/A	X	X
G	L-B-M TRANSFORMER	20 AMP	N/A	X	X
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	X	X
I	SPARE	20 AMP	N/A	X	X
J	SPARE	20 AMP	N/A	X	X
K	INTERNAL TRANSFORMER	15 AMP	N/A	X	X
KK	TRANSFORMER SECONDARY	35 AMP	N/A	X	X
K-1	GFCI	20 AMP	N/A	X	X
K-2	HEAT STRIP	15 AMP	N/A	X	X
K-3	PHOTOCELL	15 AMP	N/A	X	X
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

FILL-IN CONTACTOR SIZES USING EARLIER BREAKER CALCULATIONS

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	480	X
B	ILLUMINATION B	20 AMP	30 AMP	480	X
C	ILLUMINATION C	20 AMP	30 AMP	480	X
D	ILLUMINATION D	20 AMP	30 AMP	480	X
E	ILLUMINATION E	20 AMP	30 AMP	480	X
F	LABREE TRANSFORMER	40 AMP	N/A	480	X
G	L-B-M TRANSFORMER	20 AMP	N/A	480	X
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	480	X
I	SPARE	20 AMP	N/A	480	X
J	SPARE	20 AMP	N/A	480	X
K	INTERNAL TRANSFORMER	15 AMP	N/A	480	X
KK	TRANSFORMER SECONDARY	35 AMP	N/A	120	X
K-1	GFCI	20 AMP	N/A	120	X
K-2	HEAT STRIP	15 AMP	N/A	120	X
K-3	PHOTOCELL	15 AMP	N/A	120	X
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

FILL-IN VOLTAGES

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	480	X
B	ILLUMINATION B	20 AMP	30 AMP	480	X
C	ILLUMINATION C	20 AMP	30 AMP	480	X
D	ILLUMINATION D	20 AMP	30 AMP	480	X
E	ILLUMINATION E	20 AMP	30 AMP	480	X
F	LABREE TRANSFORMER	40 AMP	N/A	480	X
G	L-B-M TRANSFORMER	20 AMP	N/A	480	X
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	480	X
I	SPARE	20 AMP	N/A	480	X
J	SPARE	20 AMP	N/A	480	X
K	INTERNAL TRANSFORMER	15 AMP	N/A	480	X
KK	TRANSFORMER SECONDARY	35 AMP	N/A	120	X
K-1	GFCI	20 AMP	N/A	120	X
K-2	HEAT STRIP	15 AMP	N/A	120	X
K-3	PHOTOCELL	15 AMP	N/A	120	X
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

FILL-IN KVA TOTALS

kVA Calculations

- CKT A – $8.4 \text{ Amps} \times 480 \text{ volts} = 4,032 \text{ w}/1000 = 4.032 \text{ kVA}$
- CKT B – $9.1 \text{ Amps} \times 480 \text{ volts} = 4,368 \text{ w}/1000 = 4.368 \text{ kVA}$
- CKT C – $7.0 \text{ Amps} \times 480 \text{ volts} = 3,360 \text{ w}/1000 = 3.360 \text{ kVA}$
- CKT D – $7.0 \text{ Amps} \times 480 \text{ volts} = 3,360 \text{ w}/1000 = 3.360 \text{ kVA}$
- CKT E – $7.0 \text{ Amps} \times 480 \text{ volts} = 3,360 \text{ w}/1000 = 3.360 \text{ kVA}$
- CKT F – $15,000 \text{ watts} / 1000 = 15.00 \text{ kVA}$
- CKT G – $7,500 \text{ watts} / 1000 = 7.500 \text{ kVA}$
- CKT H – $5,000 \text{ watts} / 1000 = 5.000 \text{ kVA}$
- Ckt K – $3,000 \text{ watts} / 1000 = 3.000 \text{ kVA}$

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	480	4.032
B	ILLUMINATION B	20 AMP	30 AMP	480	4.368
C	ILLUMINATION C	20 AMP	30 AMP	480	3.360
D	ILLUMINATION D	20 AMP	30 AMP	480	3.360
E	ILLUMINATION E	20 AMP	30 AMP	480	3.360
F	LABREE TRANSFORMER	40 AMP	N/A	480	15.0
G	L-B-M TRANSFORMER	20 AMP	N/A	480	7.5
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	480	5.0
I	SPARE	20 AMP	N/A	480	0.0
J	SPARE	20 AMP	N/A	480	0.0
K	INTERNAL TRANSFORMER	15 AMP	N/A	480	3.0
KK	TRANSFORMER SECONDARY	35 AMP	N/A	120	---
K-1	GFCI	20 AMP	N/A	120	1.8
K-2	HEAT STRIP	15 AMP	N/A	120	0.1
K-3	PHOTOCELL	15 AMP	N/A	120	0.001
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

FILL-IN KVA TOTALS

BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	480	4.032
B	ILLUMINATION B	20 AMP	30 AMP	480	4.368
C	ILLUMINATION C	20 AMP	30 AMP	480	3.360
D	ILLUMINATION D	20 AMP	30 AMP	480	3.360
E	ILLUMINATION E	20 AMP	30 AMP	480	3.360
F	LABREE TRANSFORMER	40 AMP	N/A	480	15.0
G	L-B-M TRANSFORMER	20 AMP	N/A	480	7.5
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	480	5.0
I	SPARE	20 AMP	N/A	480	0.0
J	SPARE	20 AMP	N/A	480	0.0
K	INTERNAL TRANSFORMER	15 AMP	N/A	480	3.0
KK	TRANSFORMER SECONDARY	35 AMP	N/A	120	---
K-1	GFCI	20 AMP	N/A	120	1.8
K-2	HEAT STRIP	15 AMP	N/A	120	0.1
K-3	PHOTOCELL	15 AMP	N/A	120	0.001
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		X
			CONTINUOUS		X

Peak* / Continuous** load calculations

*Peak load is the sum of all loads (current) that can be drawn at any one time.

**Continuous load is the sum of all loads (current) that run for 3 hours or more continuously.

(normally you just subtract ALL gfci's and unused transformer capacity)

<u>Peak</u>		<u>Continuous</u>	
• Ckt A=	4.032	• Ckt A=	4.032
• Ckt B=	4.368	• Ckt B=	4.368
• Ckt C=	3.360	• Ckt C=	3.360
• Ckt D=	3.360	• Ckt D=	3.360
• Ckt E=	3.360	• Ckt E=	3.360
• Ckt F=	15.000	• Ckt F=	1.566 = 0.324(CC)+0.252(ES)+0.990(SIG)
• Ckt G=	7.500	• Ckt G=	0.740 = (L-B-M signal)
• Ckt H=	5.000	• Ckt H=	1.000
• Ckt K=	<u>3.000</u>	• Ckt K=	<u>0.101</u>
	48.98 kVA		21.887 kVA

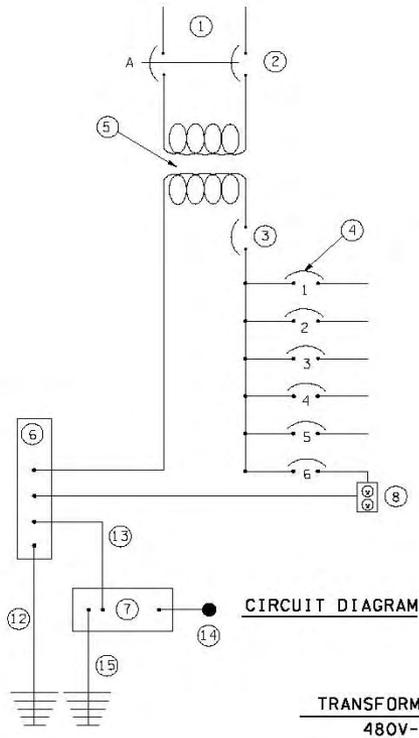
BREAKER SCHEDULE
TYPE E SERVICE

SERVICE NO. 001
240/480V

CIRCUIT	DESCRIPTION	BREAKER RATING	CONTACTOR RATING	VOLTAGE	LOAD (KVA)
---	MAIN	200 AMP	---	---	---
A	ILLUMINATION A	20 AMP	30 AMP	480	4.032
B	ILLUMINATION B	20 AMP	30 AMP	480	4.368
C	ILLUMINATION C	20 AMP	30 AMP	480	3.360
D	ILLUMINATION D	20 AMP	30 AMP	480	3.360
E	ILLUMINATION E	20 AMP	30 AMP	480	3.360
F	LABREE TRANSFORMER	40 AMP	N/A	480	15.0
G	L-B-M TRANSFORMER	20 AMP	N/A	480	7.5
H	OVERHEIGHT TRANSFORMER	20 AMP	N/A	480	5.0
I	SPARE	20 AMP	N/A	480	0.0
J	SPARE	20 AMP	N/A	480	0.0
K	INTERNAL TRANSFORMER	15 AMP	N/A	480	3.0
KK	TRANSFORMER SECONDARY	35 AMP	N/A	120	---
K-1	GFCI	20 AMP	N/A	120	1.8
K-2	HEAT STRIP	15 AMP	N/A	120	0.1
K-3	PHOTOCELL	15 AMP	N/A	120	0.001
BUSSWORK SHALL BE RATED AT 250 AMP MINIMUM			PEAK		48.980
			CONTINUOUS		21.887

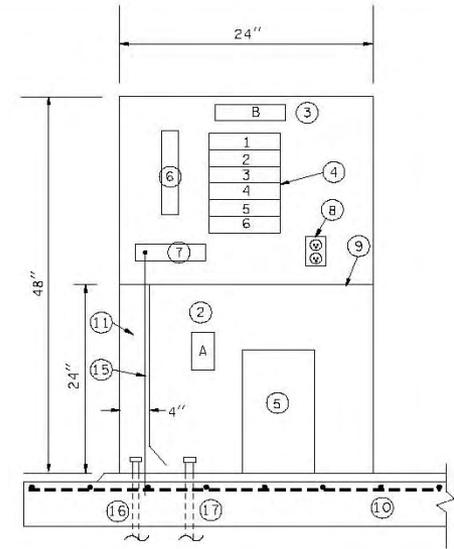
ITS Transformer Detail sheet

MASTER DETAIL REVISED 03/28/05



CIRCUIT DIAGRAM

**TRANSFORMER DETAIL
480V-120V**



**INTERIOR DETAILS
(WITH DEAD FRONTS REMOVED)**

KEY

- ① PRIMARY POWER.
- ② MAIN BREAKER.
- ③ SECONDARY MAIN BREAKER.
- ④ SECONDARY BRANCH BREAKERS, 6 CIRCUIT PANEL.
- ⑤ TRANSFORMER.
- ⑥ NEUTRAL BUSS.
- ⑦ GROUND BUSS.
- ⑧ RECEPTACLE GROUNDED (GFCI 20 AMP, 120 VOLTS).
- ⑨ PERMANENTLY AFFIXED COMPARTMENT SEPARATOR.
- ⑩ SEE FOUNDATION DETAILS, SHEET ITDXX AND ITDXX.
- ⑪ ENCLOSED WIREWAY FOR 120V CIRCUITS.
- ⑫ GROUNDING ELECTRODE.
- ⑬ MAIN BONDING JUMPER.
- ⑭ CABINET BONDING JUMPER.
- ⑮ SUPPLEMENT GROUND (FROM REBAR TO GROUND BUSS).
- ⑯ 120V/240V POWER CONDUIT(S) AND GROUND CONDUIT.
- ⑰ 480V POWER CONDUIT(S).

GENERAL NOTES

1. CABINET SIZE FOR 3 KVA - 12.5 KVA TRANSFORMERS SHALL BE 48" HIGH X 24" WIDE X 20" DEEP. CABINET SIZE FOR TRANSFORMER LARGER THAN 12.5 KVA SHALL BE PER SECTION 9.29.25. CABINET SHALL BE FABRICATED OF MILL FINISHED ALUMINUM. PAINTING OR ANODIZED ALUMINUM IS NOT ALLOWED.
2. THE SECONDARY BRANCH BREAKERS SHALL BE BOLT IN TYPE, MOUNTED ON COPPER BUSSWORK RATED AT 200 AMPS.
3. ALL CIRCUIT BREAKERS INSTALLED SHALL BE PERMANENTLY MARKED WITH APPLICABLE CIRCUIT NAME.
4. THE DEAD FRONT SHALL BE FABRICATED IN TWO PARTS, ONE FOR EACH COMPARTMENT.
5. CABINET DOOR SHALL BE THREE HINGED. THE DOOR HINGE SHALL BE MOUNTED ON THE LEFT SIDE. CONSTRUCTION CORES SHALL BE GREEN WITH TWO MASTER KEY AND ONE COKE KEY PER LOCK.
6. BOLT PATTERN IS PROVIDED BY CABINET MANUFACTURER. ALL ANCHOR BOLTS SHALL BE HOT DIPPED GALVANIZED. ALTERNATE; STAINLESS STEEL CINCH BOLTS PER MANUFACTURER'S RECOMMENDATION. BOLT SHALL EXTEND A MINIMUM 1.5 INCHES ABOVE THE CONCRETE PAD.
7. SEE SECTION 9-29.24 OF THE STANDARD SPECIFICATIONS FOR ADDITIONAL REQUIREMENT.
8. TRANSFORMER TYPE, VOLTAGE AND KVA REQUIREMENTS ARE AS SHOWN IN THE PLANS AND PER SECTION 9.29.9. TRANSFORMERS 7.5KVA AND LARGER SHALL BE SUPPLIED WITH TWO FULL CAPACITY TAPS ONE AT 5% AND ONE AT 10% BELOW NORMAL CAPACITY.
9. SEE ITS BREAKER SCHEDULE FOR SIZE AND QUANTITY OF BREAKERS.

LABEL TRANSFORMER BREAKER SCHEDULE						
15 KVA 480V-120V SQA 001 CIRCUIT F						
CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	---	---
FF	SECNDARY	175 AMP	SPST	120V	---	---
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	2.124
F-2	DATA STATION	20 AMP	SPST	120V	17.1	2.052
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	2.790
F-4	GFCI	20 AMP	SPST	120V	15.0	1.8
F-5	SPARE	20 AMP	SPST	120V	0.0	0.0
F-6	SPARE	20 AMP	SPST	120V	0.0	0.0
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM				TRANSFORMER RATED LOAD	15.0	
				TRANSFORMER ACTUAL LOAD	8.766	

LEGEND-ABBREVIATION

DPST	DOUBLE POLE SINGLE THROW
SPST	SINGLE POLE SINGLE THROW
DS/RM	DATA STATION/RAMP METER
CCTV	CLOSED CIRCUIT TELEVISION
VMS	VARIABLE MESSAGE SIGN
HAR	HIGHWAY ADVISORY RADID
PTR	PERMANENT TRAFFIC RECORDER
GFCI	GROUND FAULT CIRCUIT INTERRUPTER

FILE NAME D:\cagalsk\Class Stuff\Power Supply Class 08\Transformer.dgn	DATE 3/20/05 PM	DESIGNED BY Cagalsk	ENTERED BY	CHECKED BY	PROJ. ENGR.	REGIONAL ADM.	REVISION	DATE	BY	CONTRACT NO.	LOCATION NO.	FED. AID PROJ. NO.	DATE	P.E. STAMP BOX	DATE	P.E. STAMP BOX	PL012	SHEET OF SHEETS
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Sizing Labree transformer Branch Breaker Circuit F –

Note: This is the main breaker inside the transformer cabinet

Circuit **F** load

15,000 Watts, 480 VAC total load

15,000 watts continuous load/480 volts = 31.25 amps

Transformer Main Breaker - Circuit **F** load

31.25 amps continuous load x 125% factor = 39.06 amps

Use 40 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Secondary Main Breaker Load -Transformer panel

- Size the secondary main breaker inside the transformer for total load that can be drawn from the transformer. (these are provided already – use provided breaker schedule later in session)
- 15.0 kVA -120 volt transformer is $15,000\text{watts}/120\text{volts}=125.0$ amps.
- 125.0 amps x 125% = 156 amps
- Use a **175 amp** secondary main breaker to protect the secondary windings in the transformer. (NEC 2005 Article-450.3 Table 450.3(B), note 1)

Circuit F1

Camera Cabinet

- Camera Cabinet Circuit **F1** Total Load
- Camera Cabinet (CC) $324\text{W} + 1800\text{W}(\text{GFCI's}) = 2124\text{W}$.
- Controller-120 VAC, 324 watts continuous load.
- Camera Cabinet Outlet – Outlet 120 VAC, 1800watts non-continuous load.
- $324 \text{ watts continuous load} / 120 \text{ VAC} = 2.70 \text{ amps}$
- $1800\text{watts non-continuous load} / 120 \text{ VAC} = 15.0 \text{ amps}$
- Transformer data Station Circuit **F1** Breaker
- Continuous load – $2.70 \text{ amps} \times 125\% = 3.375 \text{ amps}$
- Non-continuous loads – 15.0 amps
- $3.375 \text{ amps Continuous} + 15.0 \text{ amps Non-continuous} = 18.375 \text{ amps}$
- Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Circuit F2

ITS Data Station Cabinet

- Data Station Circuit **F2** Total Load
- Data Station (CC) 252W+1800W(GFCI's) = 2052W.
- Controller-120 VAC, 252 watts continuous load.
- Data Station Outlet – Outlet 120 VAC, 1800watts non-continuous load.
- $252 \text{ watts continuous load} / 120 \text{ VAC} = 2.1 \text{ amps}$
- $1800 \text{ watts non-continuous load} / 120 \text{ VAC} = 15.0 \text{ amps}$
- Transformer data Station Circuit **F2** Breaker
- Continuous load – $2.1 \text{ amps} \times 125\% = 2.625 \text{ amps}$
- Non-continuous loads – 15.0 amps
- $2.625 \text{ amps Continuous} + 15.0 \text{ amps Non-continuous} = 17.625 \text{ amps}$
- Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Circuit F3

Signal Controller Cabinet

- Signal Circuit **F3** Total Load
- Controller Cabinet - $300W + 1800W(\text{GFCI's}) + 24(25) + 6(15) = 2790W$.
- Controller -120 VAC, 300 watts continuous load.
- Vehicle Signal Heads -120 VAC, 600 watts continuous load.
- Pedestrian Signal Heads -120 VAC, 90 watts continuous load.
- Controller Outlet – Outlet 120 VAC, 1800watts non-continuous load.
- $300w + 600w + 990 \text{ watts continuous load} / 120 \text{ VAC} = 8.25 \text{ amps}$
- $1800\text{watts non-continuous load} / 120 \text{ VAC} = 15.0 \text{ amps}$

- Transformer Signal Controller Cabinet Circuit **F3** Breaker
- Continuous load – $8.25 \text{ amps} \times 125\% = 10.312 \text{ amps}$
- Non-continuous loads – 15.0 amps
- $10.312 \text{ amps Continuous} + 15.0 \text{ amps Non-continuous} = 25.312 \text{ amps}$
- Use 30 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

Circuit F4

Transformer Outlet

Transformer Outlet Circuit **F4** load

120 VAC, 1800 watts

1800 watts continuous load / 120 VAC = 15.0 amps

Transformer Outlet – Circuit **F4** Breaker

15.0 amps continuous load x 125% = 18.75 amps

Use 20 amp circuit breaker. (NEC 2005 Article 210-20 (a) Overcurrent protection - Continuous & Noncontinuous loads)

- Remember that this is the main breaker and branch breaker panel within a 15 KVA / 480-120 volt transformer. Therefore, 15 KVA is 15,000 watts at 480 volts which equals 31.25 amps. The calculated load on the breaker is 31.25 amps continuous load x 125% for a total of 39.06 amps load. The minimum sized branch breaker in the main service cabinet is 40 amps.
- The secondary main breaker for the 15 kVA transformer is calculated as follows: $15,000 \text{ watts} / 120 \text{ volts} = 125 \text{ amps}$
- $125 \text{ amps} \times 1.25 = 156.25 \text{ amps}$. Round up to a **175** amp breaker.
- When sizing your buss work for the transformer, take your secondary breaker size and round up to the next available size.
- If the secondary branch breaker is 175 amps, then the next larger buss work is 200 amps.
- Specify the busswork in the transformer cabinet as 200 amps minimum. In this example, call for a 6 circuit panel board with a separate main breaker.

LABREE TRANSFORMER BREAKER SCHEDULE
 15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	X	X	X	X	X
FF	SECONDARY	X	X	X	X	X
F-1	CAMERA CABINET	X	X	X	X	X
F-2	DATA STATION	X	X	X	X	X
F-3	SIGNAL CONTROLLER	X	X	X	X	X
F-4	GFCI	X	X	X	X	X
F-5	SPARE	X	X	X	X	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN DESCRIPTION

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	X	X	X	X
FF	SECONDARY	175 AMP	X	X	X	X
F-1	CAMERA CABINET	20 AMP	X	X	X	X
F-2	DATA STATION	20 AMP	X	X	X	X
F-3	SIGNAL CONTROLLER	30 AMP	X	X	X	X
F-4	GFCI	20 AMP	X	X	X	X
F-5	SPARE	20 AMP	X	X	X	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN BREAKERS FROM EARLIER CALCULATIONS

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	X	X	X
FF	SECONDARY	175 AMP	SPST	X	X	X
F-1	CAMERA CABINET	20 AMP	SPST	X	X	X
F-2	DATA STATION	20 AMP	SPST	X	X	X
F-3	SIGNAL CONTROLLER	30 AMP	SPST	X	X	X
F-4	GFCI	20 AMP	SPST	X	X	X
F-5	SPARE	20 AMP	SPST	X	X	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN BREAKER TYPE

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	X	X
FF	SECONDARY	175 AMP	SPST	120V	X	X
F-1	CAMERA CABINET	20 AMP	SPST	120V	X	X
F-2	DATA STATION	20 AMP	SPST	120V	X	X
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	X	X
F-4	GFCI	20 AMP	SPST	120V	X	X
F-5	SPARE	20 AMP	SPST	120V	X	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN VOLTAGE

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	X	X
FF	SECONDARY	175 AMP	SPST	120V	X	X
F-1	CAMERA CABINET	20 AMP	SPST	120V	X	X
F-2	DATA STATION	20 AMP	SPST	120V	X	X
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	X	X
F-4	GFCI	20 AMP	SPST	120V	X	X
F-5	SPARE	20 AMP	SPST	120V	X	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN AMP LOAD

Circuit F Transformer – Amp Load Calculations

- CKT F1 – 2,124 watts / 120 volts = 17.70 Amps
 - CKT F2 – 2,052 watts / 120 volts = 17.10 Amps
 - CKT F3 – 2,790 watts / 120 volts = 23.25 Amps
 - CKT F4 – 1,800 watts / 120 volts = 15.00 Amps
- 73.05 Amps

LABREE TRANSFORMER BREAKER SCHEDULE
 15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	---	X
FF	SECONDARY	175 AMP	SPST	120V	---	X
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	X
F-2	DATA STATION	20 AMP	SPST	120V	17.1	X
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	X
F-4	GFCI	20 AMP	SPST	120V	15.0	X
F-5	SPARE	20 AMP	SPST	120V	0.0	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN AMP LOAD

LABREE TRANSFORMER BREAKER SCHEDULE
 15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	---	X
FF	SECONDARY	175 AMP	SPST	120V	---	X
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	X
F-2	DATA STATION	20 AMP	SPST	120V	17.1	X
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	X
F-4	GFCI	20 AMP	SPST	120V	15.0	X
F-5	SPARE	20 AMP	SPST	120V	0.0	X
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			X

FILL-IN KVA TOTALS

Circuit F Transformer - kVA Calculations

- CKT F1 – 2,124 watts / 1000 = 2.124 kVA
 - CKT F2 – 2,052 watts / 1000 = 2.052 kVA
 - CKT F3 – 2,790 watts / 1000 = 2.790 kVA
 - CKT F4 – 1,800 watts / 1000 = 1.800 kVA
- 8.766 kVA

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD	
F	PRIMARY	40 AMP	DPST	480V	---	---	
FF	SECONDARY	175 AMP	SPST	120V	---	---	
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	2.124	
F-2	DATA STATION	20 AMP	SPST	120V	17.1	2.052	
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	2.790	
F-4	GFCI	20 AMP	SPST	120V	15.0	1.8	
F-5	SPARE	20 AMP	SPST	120V	0.0	0.0	
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD				X
			TRANSFORMER ACTUAL LOAD				X

FILL-IN KVA TOTALS

LABREE TRANSFORMER BREAKER SCHEDULE
15 KVA 480V-120V SUA 001 CIRCUIT F

CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	40 AMP	DPST	480V	---	---
FF	SECONDARY	175 AMP	SPST	120V	---	---
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	2.124
F-2	DATA STATION	20 AMP	SPST	120V	17.1	2.052
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	2.790
F-4	GFCI	20 AMP	SPST	120V	15.0	1.8
F-5	SPARE	20 AMP	SPST	120V	0.0	0.0
BUSSWORK SHALL BE RATED AT 200 AMP MINIMUM			TRANSFORMER RATED LOAD			15.0
			TRANSFORMER ACTUAL LOAD			8.766

FILL-IN KVA TOTALS FOR RATED AND ACTUAL LOADS

SIZING YOUR TRANSFORMER

LABREE TRANSFORMER BREAKER SCHEDULE						
??? KVA 480V-120V SUA 001 CIRCUIT F						
CIRCUIT NUMBER	DESCRIPTION	BREAKER RATING	BREAKER TYPE	VOLTAGE	AMP LOAD	KVA LOAD
F	PRIMARY	X	DPST	480V	---	---
FF	SECONDARY	X	SPST	120V	---	---
F-1	CAMERA CABINET	20 AMP	SPST	120V	17.7	2.124
F-2	DATA STATION	20 AMP	SPST	120V	17.1	2.052
F-3	SIGNAL CONTROLLER	30 AMP	SPST	120V	23.25	2.790
F-4	GFCI	20 AMP	SPST	120V	15.0	1.8
F-5	SPARE	20 AMP	SPST	120V	0.0	0.0
BUSWORK SHALL BE RATED AT ??? AMP MINIMUM			TRANSFORMER RATED LOAD			X
			TRANSFORMER ACTUAL LOAD			8.766

TAKE YOUR ACTUAL LOAD ON THE TRANSFORMER AND MULTIPLY BY 133% TO PROVIDE FUTURE CAPACITY.

$$8.766 \times 1.33 = 11.65878$$

ROUND UP TO THE NEXT AVAILABLE SIZE TRANSFORMER.

STANDARD TRANSFORMER SIZES FOR WSDOT APPLICATIONS ARE 1, 3, 5, 7.5, 10, 15, 25 AND 50KVA.

THIS SITUATION WOULD USE A 15 KVA TRANSFORMER.

Design concepts to keep in mind

- There is not a WSDOT standard size for a transformer cabinet main breaker.
- WAC 296-46B-230 Wiring and protection–Services, subsection 042 Service conductor–size and rating, requires that “if the service conductors have a lesser ampacity than the overcurrent protection or the equipment rating that they terminate in or on, an identification plate showing the ampacity of the conductors must be installed on the service equipment.” If the feeder conductors are smaller than the rated busswork, the cabinet must be labeled with the ampacity of the feeder conductors feeding the busswork and also labeled with the busswork capacity. For WSDOT practices, this applies only to transformer cabinets (a separately derived service and a sub-panel from our “main” service). Downsizing of feeder conductors between the serving utility and WSDOT’s main service cabinet **is not allowed** .

Design concepts to keep in mind -continued

- To complicate matters further – there will be times when:

A given utility company wants to provide and install “their” conductors between the utility company transformer and the meter.

you have sized the conductors properly between the utility company transformer and the meter. (you used the table in this workbook)

yet when you receive the service agreement back from the utility company request the utility company will state that they are going to install a smaller gage conductor than you requested, and the conductor will be aluminum.

The utility company will present their own “logic” i.e.: “we are not covered by the NEC”, or “we use a different conductor ampacity table to calculate ampacity”, or, we use that size wire for all services”, or ????

In this case you are required to calculate the ampacity of the utility conductor, using the NEC table provided herein, and add a construction note to your contract requiring the addition label that states the ampacity of the serving utility’s conductors, per your calculation.

**Any
Questions?**