



College Station Utilities

Reliable, Affordable, Community Owned

Design and Operating Spreadsheets

Timothy R. Crabb, P.E.
Assistant Director

Spreadsheet for Dispatch Control of Power Factor

CHART FOR DETERMINING WHEN TO SWITCH ON CAPACITOR BANK WHEN THERE IS A LAGGING SYSTEM POWER FACTOR (>5000 KVAR) AND WHEN SYSTEM LOAD IS INCREASING

TRC/121508

KW	KVAR	P.F.	LEADING OR LAGGING	CAPACITOR KVAR TO TURN ON	NEW KVAR	NEW POWER FACTOR	LEADING OR LAGGING	KW	KVAR	P.F.	LEADING OR LAGGING	CAPACITOR KVAR TO TURN ON	NEW KVAR	NEW POWER FACTOR	LEADING OR LAGGING
1000	997	0.7082	LAGGING	1200	-203	0.9800	LEADING	1000	488	0.9093	LAGGING	600	-142	0.9900	LEADING
1500	895	0.8586	LAGGING	1200	-305	0.9800	LEADING	1500	386	0.9684	LAGGING	600	-214	0.9900	LEADING
2000	915	0.9033	LAGGING	1200	-285	0.9900	LEADING	2000	399	0.9807	LAGGING	600	-201	0.9950	LEADING
2500	949	0.9349	LAGGING	1200	-251	0.9950	LEADING	2500	349	0.9904	LAGGING	600	-251	0.9950	LEADING
3000	899	0.9579	LAGGING	1200	-301	0.9950	LEADING	3000	299	0.9951	LAGGING	600	-301	0.9950	LEADING
3500	849	0.9718	LAGGING	1200	-351	0.9950	LEADING	3500	328	0.9956	LAGGING	600	-272	0.9970	LEADING
4000	798	0.9807	LAGGING	1200	-402	0.9950	LEADING	4000	347	0.9963	LAGGING	600	-253	0.9980	LEADING
4500	748	0.9865	LAGGING	1200	-452	0.9950	LEADING	4500	315	0.9976	LAGGING	600	-285	0.9980	LEADING
5000	698	0.9904	LAGGING	1200	-502	0.9950	LEADING	5000	376	0.9972	LAGGING	600	-224	0.9990	LEADING
5500	648	0.9931	LAGGING	1200	-552	0.9950	LEADING	5500	354	0.9979	LAGGING	600	-246	0.9990	LEADING
6000	734	0.9926	LAGGING	1200	-466	0.9970	LEADING	6000	331	0.9985	LAGGING	600	-269	0.9990	LEADING
6500	695	0.9943	LAGGING	1200	-505	0.9970	LEADING	6500	309	0.9989	LAGGING	600	-291	0.9990	LEADING
7000	657	0.9956	LAGGING	1200	-543	0.9970	LEADING	7000	287	0.9992	LAGGING	600	-313	0.9990	LEADING
7500	618	0.9966	LAGGING	1200	-582	0.9970	LEADING	7500	264	0.9994	LAGGING	600	-336	0.9990	LEADING
8000	579	0.9974	LAGGING	1200	-621	0.9970	LEADING	8000	242	0.9995	LAGGING	600	-358	0.9990	LEADING
8500	540	0.9980	LAGGING	1200	-660	0.9970	LEADING	8500	331	0.9992	LAGGING	600	-269	0.9995	LEADING
9000	501	0.9985	LAGGING	1200	-699	0.9970	LEADING	9000	315	0.9994	LAGGING	600	-285	0.9995	LEADING
9500	462	0.9988	LAGGING	1200	-738	0.9970	LEADING	9500	299	0.9995	LAGGING	600	-301	0.9995	LEADING
10000	424	0.9991	LAGGING	1200	-776	0.9970	LEADING	10000	284	0.9996	LAGGING	600	-316	0.9995	LEADING

OPERATING GUIDELINES:

1. DURING THE SUMMER, TURN ON 1200 KVAR SWITCHED BANKS BEFORE UTILIZING 600 KVAR SWITCHED BANKS.
2. DURING THE WINTER, UTILIZE 1200 AND 600 KVAR SWITCHED BANKS AS NEEDED TO CONTROL POWER FACTOR.
3. DOCUMENT ANY FEEDER THAT NEEDS ADDITIONAL CAPACITORS OR SWITCHED BANKS AND FORWARD THESE RECOMMENDATIONS TO ENGINEERING ALONG WITH SCREEN PRINTS FROM THE CAPACITOR SCREEN.

CHART FOR DETERMINING WHEN TO SWITCH OFF CAPACITOR BANK WHEN SYSTEM LOAD IS DECREASING

KW	KVAR	P.F.	LEADING OR LAGGING	CAPACITOR KVAR TO TURN OFF	NEW KVAR	NEW POWER FACTOR	LEADING OR LAGGING	KW	KVAR	P.F.	LEADING OR LAGGING	CAPACITOR KVAR TO TURN OFF	NEW KVAR	NEW POWER FACTOR	LEADING OR LAGGING
1000	-251	0.9700	LEADING	1200	949	0.7252	LAGGING	1000	-251	0.9700	LEADING	600	349	0.9440	LAGGING
1500	-376	0.9700	LEADING	1200	824	0.8764	LAGGING	1500	-305	0.9800	LEADING	600	295	0.9812	LAGGING
2000	-350	0.9850	LEADING	1200	850	0.9204	LAGGING	2000	-246	0.9925	LEADING	600	354	0.9847	LAGGING
2500	-438	0.9850	LEADING	1200	762	0.9565	LAGGING	2500	-308	0.9925	LEADING	600	292	0.9932	LAGGING
3000	-526	0.9850	LEADING	1200	674	0.9756	LAGGING	3000	-301	0.9950	LEADING	600	299	0.9951	LAGGING
3500	-613	0.9850	LEADING	1200	587	0.9862	LAGGING	3500	-351	0.9950	LEADING	600	249	0.9975	LAGGING
4000	-570	0.9900	LEADING	1200	630	0.9878	LAGGING	4000	-283	0.9975	LEADING	600	317	0.9969	LAGGING
4500	-641	0.9900	LEADING	1200	559	0.9924	LAGGING	4500	-319	0.9975	LEADING	600	281	0.9981	LAGGING
5000	-712	0.9900	LEADING	1200	498	0.9953	LAGGING	5000	-224	0.9990	LEADING	600	376	0.9972	LAGGING
5500	-784	0.9900	LEADING	1200	416	0.9971	LAGGING	5500	-246	0.9990	LEADING	600	354	0.9979	LAGGING
6000	-865	0.9900	LEADING	1200	345	0.9984	LAGGING	6000	-269	0.9990	LEADING	600	331	0.9985	LAGGING
6500	-801	0.9925	LEADING	1200	399	0.9981	LAGGING	6500	-291	0.9990	LEADING	600	309	0.9989	LAGGING
7000	-862	0.9925	LEADING	1200	338	0.9988	LAGGING	7000	-221	0.9995	LEADING	600	379	0.9985	LAGGING
7500	-924	0.9925	LEADING	1200	276	0.9993	LAGGING	7500	-237	0.9995	LEADING	600	363	0.9988	LAGGING
8000	-985	0.9925	LEADING	1200	215	0.9996	LAGGING	8000	-253	0.9995	LEADING	600	347	0.9991	LAGGING
8500	-935	0.9940	LEADING	1200	265	0.9995	LAGGING	8500	-269	0.9995	LEADING	600	331	0.9992	LAGGING
9000	-990	0.9940	LEADING	1200	210	0.9997	LAGGING	9000	-180	0.9998	LEADING	600	420	0.9989	LAGGING
9500	-1045	0.9940	LEADING	1200	155	0.9999	LAGGING	9500	-180	0.9998	LEADING	600	410	0.9991	LAGGING
10000	-1100	0.9940	LEADING	1200	100	1.0000	LAGGING	10000	-200	0.9998	LEADING	600	400	0.9992	LAGGING

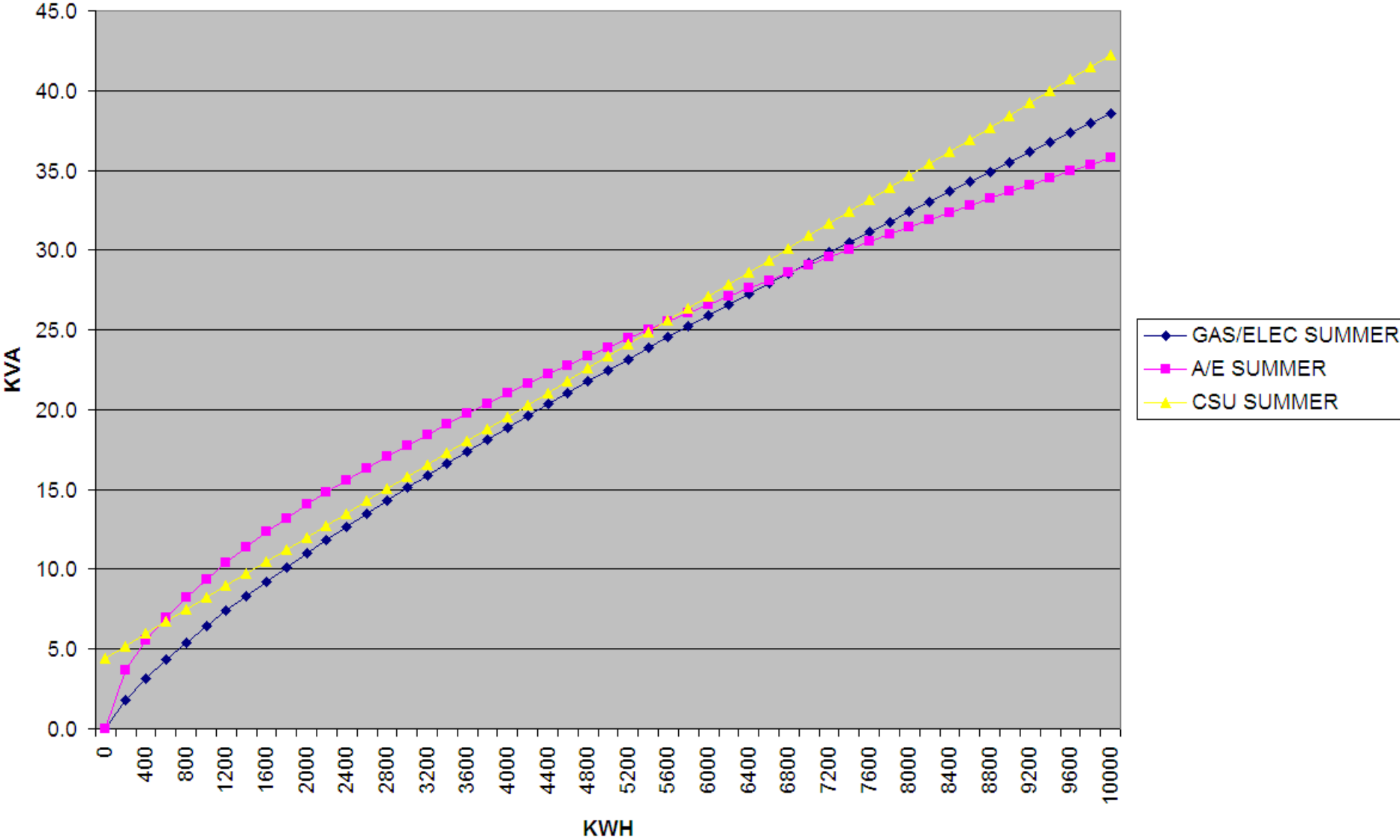
OPERATING GUIDELINES:

1. IF REQUIRED TO MAINTAIN A LAGGING SYSTEM POWER FACTOR, CAPACITORS CAN BE TURNED OFF OUTSIDE THE GUIDELINES DESIGNATED IN THIS CHART.
2. WHEN LOADS ARE DECREASING IN THE SUMMER, TURN OFF 600 KVAR CAPACITOR BANKS FIRST.
3. WHEN LOADS ARE DECREASING IN THE WINTER, MONITOR WHETHER TO TURN OFF THE 1200 KVAR BANKS FIRST TO ADJUST THE POWER FACTOR AT MINIMUM LOAD FOR THE FEEDER.
4. DOCUMENT ANY FEEDER THAT NEEDS CAPACITOR CHANGES AT MINIMUM LOADING AND FORWARD THESE RECOMMENDATIONS TO ENGINEERING ALONG WITH SCREEN PRINTS FROM THE CAPACITOR SCREEN.

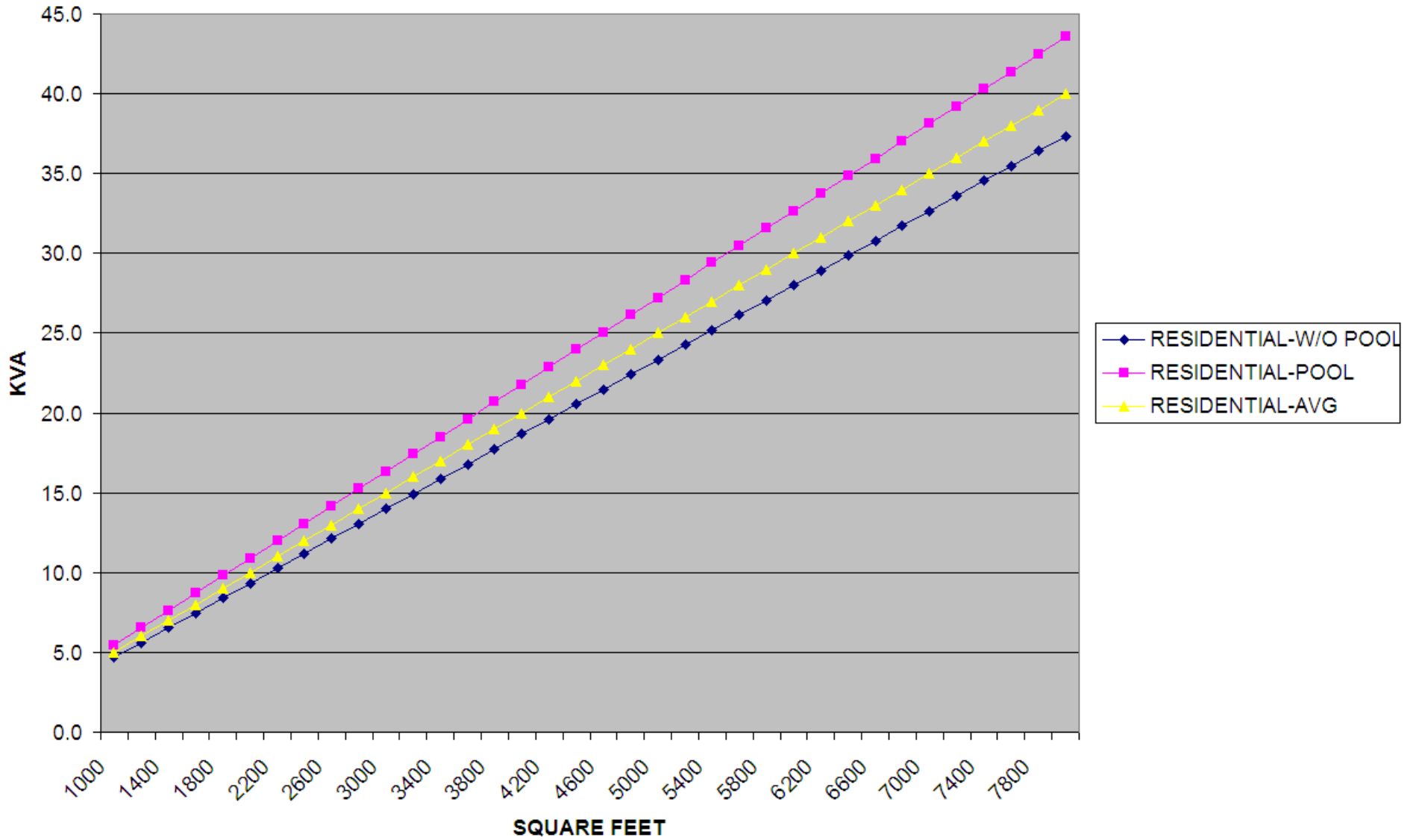
Infinite Bus Fault Current Calculation

	A	B	C	D	E	F	G	
1	<u>INFINITE BUS FAULT CURRENT CALCULATION</u>							
2							TRC/020509	
3	PROJECT NAME:							
4	DATE:	9/25/2009						
5	PROJECT COORDINATOR:							
6								
7	REQUIRED DATA:							
8	THREE PHASE TRANSFORMER KVA:		(IN KVA)					
9	TRANSFORMER PERCENT IMPEDANCE:							
10	SECONDARY LINE-TO-LINE VOLTAGE (ELL):		(IN VOLTS)					
11								
12	CALCULATIONS:							
13	I (FULL LOAD AMPS)	$I(FLA) = (KVA * 1000) / (ELL * 1.73)$						
14	SCA(SECONDARY) OR SHORT CIRCUIT AMPS AT SECONDARY BUS	$SCA(SECONDARY) = I(FLA) * 100 / PERCENT IMPEDANCE$						
15								
16	RESULTS:							
17	I (FULL LOAD AMPS)	#DIV/0!						
18	INFINITE BUS FAULT CURRENT	#DIV/0!						
19								

RESIDENTIAL KWH TO KVA COMPARISON



RESIDENTIAL: SUMMER KVA BASED ON SQUARE FOOTAGE OF HOUSE



Subdivision Design (gas/electric subdivision)

CLEAR FORM

SUMMER RESIDENTIAL LOOP LOAD CALCULATION

9/25/2009

NOTE: THIS CALCULATION IS ONLY FOR CONVENTIONAL (GAS/ELECTRIC) SUBDIVISIONS
POWER FACTOR FOR SINGLE PHASE SUMMER LOADS IS 0.90

SUBDIVISION NAME:

TOTAL NUMBER OF LOTS ON LOOP:

DESIGNER NAME:

SPECIFIC DESIGN NOTES OR COMMENTS:

LOAD CALCULATION METHOD:

AVERAGE SQUARE FOOTAGE:

NUMBER OF LOTS (SMALL SIDE)

NUMBER OF LOTS (LARGE SIDE)

CALCULATED KVA PER LOT:

SMALL SIDE OF LOOP WILL BE DIVERSIFIED:

KVA DEMAND:

N (NUMBER OF LOTS):

DIVERSITY FACTOR:

TOTAL KVA:

LARGE SIDE OF LOOP WILL BE COLD LOAD PICKUP:

KVA DEMAND:

N (NUMBER OF LOTS):

DIVERSITY FACTOR:

COLD LOAD PICKUP FACTOR:

TOTAL KVA:

TOTAL LOOP EMERGENCY KVA:

SUMMER EMERGENCY AMPS:

KEARNEY TYPE 200(N)
RECOMMENDED MINIMUM FUSE SIZE
(CONSERVATIVE FACTOR OF 125%
OVERLOAD USED FOR CALCULATION.
200(N) WILL HANDLE 150% WITHOUT
DAMAGE ACCORDING TO COOPER):

RECOMMENDED TRANSFORMER SIZES:

LOTS	RECOMMENDED MINIMUM TRANSFORMER SIZE (IN KVA)
1	25
2	25
3	25
4	25
5	25
6	25
7	25
8	25
9	25
10	25
11	25
12	25

Apartment Complex Design (3 sheets)

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
2	RESET														
3			DATE:	9/25/2009 16:02											
4	APARTMENT COMPLEX NAME:														
5	DESIGNER NAME:														
6	SPECIFIC DESIGN NOTES OR COMMENTS:														
7															
8	A/E APARTMENT UNIT LOAD														
9		TOTAL APARTMENT LOAD WITH HEAT PUMP		TOTAL APARTMENT LOAD WITH RESISTANCE HEAT											
10	TONNAGE (13 SEER)	SUMMER KW	WINTER KW	SUMMER KW	WINTER KW										
11	1.0	2.5	3.8	2.5	4.8										
12	1.5	3.2	5.0	3.2	6.6										
13	2.0	3.9	6.2	3.9	8.2										
14	2.5	4.6	7.4	4.6	10.0										
15	3.0	5.2	8.7	5.2	11.7										
16	3.5	5.9	9.9	5.9	13.5										
17															
18															
19															
20	SELECT:														
21															
22															
23	TONNAGE (13 SEER)	SUMMER KW	WINTER KW												
24	1.0	0.0	0.0												
25	1.5	0.0	0.0												
26	2.0	0.0	0.0												
27	2.5	0.0	0.0												
28	3.0	0.0	0.0												
29	3.5	0.0	0.0												
30															
31															
32															
33	BUILDING NUMBER	10 TON	15 TON	2.0 TON	2.5 TON	3.0 TON	3.5 TON	TOTAL NO. OF UNITS	TOTAL SUMMER UNDIVERSIFIED APT KW	TOTAL WINTER UNDIVERSIFIED APT KW	HOUSE METER KW	SUMMER COMMERCIAL KW	WINTER COMMERCIAL KW	TOTAL SUMMER UNDIVERSIFIED COMMERCIAL KW	TOTAL WINTER UNDIVERSIFIED COMMERCIAL KW
34	1							0	0	0				0	0
35	2							0	0	0				0	0
36	3							0	0	0				0	0
37	4							0	0	0				0	0
38	5							0	0	0				0	0
39	6							0	0	0				0	0
40	7							0	0	0				0	0
41	8							0	0	0				0	0
42	9							0	0	0				0	0
43	10							0	0	0				0	0
44	11							0	0	0				0	0
45	12							0	0	0				0	0
46	13							0	0	0				0	0
47	14							0	0	0				0	0
48	15							0	0	0				0	0
49	16							0	0	0				0	0
50	17							0	0	0				0	0
51	18							0	0	0				0	0
52	19							0	0	0				0	0
53	20							0	0	0				0	0
54															
55															
56															
57															
58															
59															
60															
61															

Apartment Complex
(continued)

	A	B	C	D	E	F	G	H	
1									
2		RESET							
3									
4									
5			DATE:	9/25/2009 16:02					
6			APARTMENT COMPLEX NAME:						0
7			DESIGNER NAME:						0
8									
9	TRANSFORMER SIZE IN KVA	SUMMER OVERLOAD FACTOR	MAX. KVA SUMMER LOAD	WINTER OVERLOAD FACTOR	MAX. KVA WINTER LOAD				
10	25	130%	32.5	160%	40.0				
11	37.5	130%	48.8	160%	60.0				
12	50	130%	65.0	160%	80.0				
13	75	130%	97.5	160%	120.0				
14	100	130%	130.0	160%	160.0				
15	167	100%	167.0	130%	217.1				
16	250	100%	250.0	130%	325.0				
17									
18									
19									
20		TRANSFORMER NO:							
21									
22	BUILDING NUMBER	TOTAL NO. OF UNITS	TOTAL SUMMER UNDIVERSIFIED APT KW	TOTAL WINTER UNDIVERSIFIED APT KW	TOTAL SUMMER UNDIVERSIFIED COMMERCIAL KW	UNDIVERSIFIED COMMERCIAL KW			
23		0	0	0	0	0			
24		0	0	0	0	0			
25		0	0	0	0	0			
26		0	0	0	0	0			
27		0	0	0	0	0			
28		0	0	0	0	0			
29		TOTAL:	0	0	0	0			
30									
31			SUMMER	WINTER					
32		CALCULATED DIVERSIFIED KVA LOAD:	0	0					
33		MINIMUM TRANSFORMER SIZE:	0	0					
34		RECOMMENDED TRANSFORMER:	0						
35									
36									
37									
38									
39									
40									
41									
45									
68									
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									

RESET SHEET

APARTMENT COMPLEX NAME: 0
 DESIGNER NAME: 0

Apartment Complex (continued)

LOOP NUMBER:

31	SIDE 1: BUILDING NUMBER	TOTAL NO. OF UNITS	TOTAL SUMMER UNDIVERSIFIED APT KW	TOTAL WINTER UNDIVERSIFIED APT KW	TOTAL SUMMER UNDIVERSIFIED COMMERCIAL KW	TOTAL WINTER UNDIVERSIFIED COMMERCIAL KW
32		0	0	0	0	0
33		0	0	0	0	0
34		0	0	0	0	0
35		0	0	0	0	0
36		0	0	0	0	0
37		0	0	0	0	0
38		0	0	0	0	0
39		0	0	0	0	0
40		0	0	0	0	0
41		0	0	0	0	0
42	TOTAL:	0	0	0	0	0

44	CALCULATED DIVERSIFIED UNIT KVA LOAD:	APARTMENT UNITS		COMMERCIAL		TOTAL	
		SUMMER	WINTER	SUMMER	WINTER	SUMMER	WINTER
46	DIVERSIFIED AMPS	0.0	0.0	0.0	0.0	0.0	0.0
48	COLD LOAD AMPS	0.0	0.0	0.0	0.0	0.0	0.0

WINTER: MULT BY 1.7 FOR COLD LOAD PICKUP
 SUMMER: LEAVE COMMERCIAL AT 100% FOR COLD LOAD

51	SIDE 2: BUILDING NUMBER	TOTAL NO. OF UNITS	TOTAL SUMMER UNDIVERSIFIED APT KW	TOTAL WINTER UNDIVERSIFIED APT KW	TOTAL SUMMER UNDIVERSIFIED COMMERCIAL KW	TOTAL WINTER UNDIVERSIFIED COMMERCIAL KW
52		0	0	0	0	0
53		0	0	0	0	0
54		0	0	0	0	0
55		0	0	0	0	0
56		0	0	0	0	0
57		0	0	0	0	0
58		0	0	0	0	0
59		0	0	0	0	0
60		0	0	0	0	0
61		0	0	0	0	0
62	TOTAL:	0	0	0	0	0

64	CALCULATED DIVERSIFIED UNIT KVA LOAD:	APARTMENT UNITS		COMMERCIAL		TOTAL	
		SUMMER	WINTER	SUMMER	WINTER	SUMMER	WINTER
66	DIVERSIFIED AMPS	0.0	0.0	0.0	0.0	0.0	0.0
68	COLD LOAD AMPS	0.0	0.0	0.0	0.0	0.0	0.0

70	SCENARIO 1:	0.0	0.0
71	SCENARIO 2:	0.0	0.0
73		SUMMER	WINTER
74	COLD LOAD AMPS:	0.0	0.0
75	CALCULATED SUMMER AND WINTER FUSE SIZE	0	0
76	RECOMMENDED FUSE SIZE:	0	

Questions?

