Appendix-B

Results of System Intact Analysis

1. *Base Case*

Table 1-1 Transformers Overloading in the Base Case

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rate B MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.20
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.00
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	126.00
5	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
6	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.30	113.80
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.60	113.00
8	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	70.00	112.00
9	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.50
10	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
11	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.60
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.60	109.10
13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	609.40	107.70
14	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.00	107.00
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	630.40	106.80
16	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	105.40	105.40
17	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	105.40	105.40
18	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	105.40	105.40
19	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
20	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	259.10	103.70
21	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	259.10	103.70
22	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	103.50	103.50
23	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.60	103.40
24	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.20	103.20
25	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.10	103.10
26	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	102.90	102.90
27	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.80
28	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.70
29	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.00	102.50
30	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	482.10	102.30
31	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.20	102.20
32	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	434.10	101.40
33	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	101.10	101.10

Table 1-2 Bus Voltage Violations in the Base Case

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.942	108.34		31	68609	KENNEDY4	230	672	1.067	245.51
2	67508	PONTON 4	230	667	1.050	241.50		32	63287	ORTQUAR7	115	626	1.069	122.91
3	63265	DEVILSE7	115	626	1.050	120.78		33	68608	FLEETST4	230	672	1.069	245.97
4	63266	RAMSEY 7	115	626	1.051	120.81		34	63216	ORTONVL7	115	626	1.070	123.03
5	65039	OGLALA Y	230	640	1.051	241.66		35	67940	NOTIGI 6	138	667	1.071	147.75
6	61696	TAC HBR6	138	608	1.051	145.01		36	65338	S3456T4T	345	645	1.074	370.64

7	66440	FARGOM14	230	652	1.052	241.84		37	68607	REGINA 4	230	672	1.075	247.15
8	60141	NORDIC 7	115	626	1.053	121.05		38	68666	LLOYDMI4	230	672	1.075	247.25
9	65025	E.COL. Y	230	640	1.054	242.42		39	68612	CONDIE 4	230	672	1.078	247.90
10	65036	MOORE Y	345	640	1.054	363.72		40	60116	PRASWCP7	115	626	1.078	123.96
11	66712	PRAIRIE7	115	626	1.055	121.29		41	68630	EBCAMPB4	230	672	1.078	247.94
12	64605	CB MID5	161	635	1.055	169.85		42	68616	PEEBLES4	230	672	1.080	248.37
13	65024	COOPER Y	345	640	1.056	364.23		43	68686	ASSINIB4	230	672	1.082	248.95
14	66705	DRAYTON7	115	626	1.056	121.44		44	67941	RUTTNTP6	138	667	1.083	149.45
15	64787	COOPER 5	161	640	1.056	170.03		45	68649	CODETTE4	230	672	1.084	249.24
16	65043	TEKAMA Y	161	640	1.057	170.23		46	67944	LEAFRPD6	138	667	1.084	149.63
17	65044	TWINCH Y	230	640	1.057	243.18		47	67943	RUTTNLK6	138	667	1.085	149.67
18	66788	DRAYTO2T	230	626	1.058	243.29		48	68650	NIPAWIN4	230	672	1.087	250.01
19	67170	STEGALDC	230	652	1.058	243.36		49	68601	BD 4	230	672	1.088	250.24
20	67939	NELHOUS6	138	667	1.060	146.23		50	65031	HOSKIN Y	230	640	1.090	250.62
21	67171	MBPP-1	230	652	1.060	243.84		51	68621	SHAND 4	230	672	1.091	251.00
22	63217	APPLETN7	115	626	1.062	122.11		52	68610	POPLAR 4	230	672	1.091	251.00
23	68638	BEATTY 4	230	672	1.062	244.24		53	67942	LAURRIV6	138	667	1.091	150.61
24	68670	COTEAU 4	230	672	1.062	244.34		54	60172	SHYSWCP7	115	626	1.092	125.59
25	63289	CORRELL7	115	626	1.064	122.33		55	68683	MCNEILL4	230	672	1.093	251.29
26	62000	MARSHLK7	115	626	1.064	122.40		56	67553	POINTDB7	121	667	1.094	132.38
27	63214	BIGSTON7	115	626	1.065	122.42		57	67556	WHTSL1 4	220	667	1.095	240.84
28	63215	HIWY12 7	115	626	1.066	122.57		58	67589	WHTSL2 4	220	667	1.095	240.83
29	63288	ODESSA 7	115	626	1.067	122.71		59	67554	SLAVEFL7	121	667	1.096	132.65
30	68685	SWIFTCU4	230	672	1.067	245.46		60	67648	POINTD27	121	667	1.100	133.11

Table 1-3 Area and Network Losses in the Base Case

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-81	292	-28
XEL-NSP	453	1830	-3030	727	2168	357	2736	
608	1818	1788	0	0	0	-89	120	-105
MP	388	599	-1247	0	551	46	1540	
613	91	288	0	0	0	-198	1	-198
SMMPA	47	72	-26	0	8	5	4	
618	1717	1365	0	0	0	222	130	159
GRE	683	75	-1285	0	312	195	2010	
626	1454	2312	0	0	0	-1011	154	-914
OTP	309	272	-675	26	599	25	1262	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	11	
635	4382	4240	0	0	0	26	117	43
MEC	612	891	-404	51	1285	-39	1399	
640	2815	2436	0	0	0	260	143	-58
NPPD	376	483	-468	263	1161	-33	1299	
645	1982	2028	0	0	0	-69	23	-68
OPPD	485	607	-73	14	345	-112	394	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-93	0	87	-14	98	
652	4779	3009	0	0	0	1412	333	766
WAPA	347	561	-646	721	3107	-150	2961	
667	3559	3910	0	0	0	-496	146	833
MH	359	650	-2310	348	1342	-56	3068	
672	3511	3548	0	0	0	-151	114	0

SPC	406	597	-387	63	1092	97	1127	
680	1209	978	0	0	0	146	75	140
DPC	136	168	-144	0	189	-107	403	
Network MW	**513220**						**10859**	
MVAR	**84633**						**151195**	

2. ***Case10: 500 MW Interconnection at Garrison 230 kV***

Table 2-1 Transformers overloading in Case 1-500 MW at Garrison 230 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rate B MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.20
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.00
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.60	113.00
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
9	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	110.70	110.70
10	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	110.60	110.60
11	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	110.60	110.60
12	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
13	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.70
14	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
15	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	109.20	109.20
16	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.00	108.80
17	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	107.80	107.80
18	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	107.70	107.70
19	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	106.40	106.40
20	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	106.10	106.10
21	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	105.80	105.80
22	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
23	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.60	103.30
24	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
25	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.80
26	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.70	102.70
27	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
28	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	580.10	102.50
29	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	438.70	102.50
30	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	482.70	102.40
31	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	602.10	102.10
32	66749	CENTER1G	22	626	66751	CENTER 4	230	626	1	256	259.20	101.20
33	63002	STANT41G	18	618	63049	STANTON4	230	618	1	210	210.00	100.00
34	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	709.90	100.00

Table 2-2 Bus Voltage Violations in Case 1-500 MW at Garrison 230 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.906	104.14		42	68670	COTEAU 4	230	672	1.062	244.34
2	63306	ESMOND Y	115	626	0.924	106.26		43	66788	DRAYTO2T	230	626	1.063	244.46
3	63198	BUFFALOY	345	626	0.936	322.77		44	63289	CORRELL7	115	626	1.064	122.34

4	63358	BUFFALO3	345	626	0.936	322.89		45	62000	MARSHLK7	115	626	1.064	122.41
5	66455	BOTTNO 7	115	652	0.937	107.72		46	63214	BIGSTON7	115	626	1.065	122.44
6	66792	MAPLE R3	345	626	0.938	323.54		47	63215	HIWY12 7	115	626	1.066	122.58
7	63369	JAMESTN3	345	626	0.941	324.51		48	63288	ODESSA 7	115	626	1.067	122.72
8	63188	PICKERTY	230	626	0.941	216.43		49	68685	SWIFTCU4	230	672	1.067	245.46
9	63199	JAMSTN1Y	345	626	0.942	325.02		50	68609	KENNEDY4	230	672	1.067	245.49
10	63200	JAMSTN2Y	345	626	0.942	325.02		51	63287	ORTQUAR7	115	626	1.069	122.93
11	63307	HARVEY Y	230	626	0.943	216.86		52	68608	FLEETST4	230	672	1.069	245.96
12	63193	FORMAN Y	230	626	0.944	217.08		53	63216	ORTONVL7	115	626	1.070	123.04
13	67166	DUNNING7	115	652	0.945	108.69		54	67940	NOTIGI 6	138	667	1.071	147.75
14	63185	RUGBY Y	230	626	0.945	217.45		55	68607	REGINA 4	230	672	1.075	247.14
15	63279	RUGBOTP7	115	626	0.946	108.84		56	65338	S3456T4T	345	645	1.075	370.74
16	67179	RUGBYNP7	115	652	0.949	109.11		57	68666	LLOYDMI4	230	672	1.075	247.25
17	67264	RUGBCPC7	115	626	0.949	109.11		58	68612	CONDIE 4	230	672	1.078	247.89
18	66452	RUGBY 7	115	652	0.949	109.12		59	68630	EBCAMPB4	230	672	1.078	247.94
19	63260	ENDERLN7	115	626	0.949	109.14		60	68616	PEEBLES4	230	672	1.080	248.35
20	67178	BALTA 7	115	652	0.949	109.15		61	60141	NORDIC 7	115	626	1.080	124.23
21	63293	ESMOND 7	115	626	0.949	109.15		62	66712	PRAIRIE7	115	626	1.082	124.46
22	63278	ESMDOTP7	115	626	0.949	109.17		63	68686	ASSINIB4	230	672	1.082	248.95
23	63292	CPESMON7	115	626	0.949	109.18		64	67941	RUTTNTP6	138	667	1.083	149.45
24	62982	HUTCHMN7	115	618	0.95	109.19		65	68649	CODETTE4	230	672	1.084	249.24
25	63277	SELZ 7	115	626	0.95	109.19		66	67944	LEAFRPD6	138	667	1.084	149.63
26	61578	MUDLKJCT	115	608	1.050	120.78		67	67943	RUTTNLK6	138	667	1.085	149.67
27	61696	TAC HBR6	138	608	1.051	144.97		68	60172	SHYSWCP7	115	626	1.085	124.79
28	66440	FARGOM14	230	652	1.052	241.91		69	68650	NIPAWIN4	230	672	1.087	250.01
29	65036	MOORE Y	345	640	1.054	363.72		70	68601	BD 4	230	672	1.088	250.24
30	64605	CB MID5	161	635	1.055	169.83		71	65031	HOSKIN Y	230	640	1.090	250.68
31	65025	E.COL. Y	230	640	1.055	242.71		72	68610	POPLAR 4	230	672	1.091	251.00
32	65024	COOPER Y	345	640	1.056	364.39		73	68621	SHAND 4	230	672	1.091	251.00
33	64787	COOPER 5	161	640	1.057	170.10		74	67942	LAURRIV6	138	667	1.091	150.61
34	65043	TEKAMA Y	161	640	1.058	170.30		75	68683	MCNEILL4	230	672	1.093	251.29
35	65044	TWINCH Y	230	640	1.058	243.27		76	67553	POINTDB7	121	667	1.094	132.38
36	67170	STEGALDC	230	652	1.058	243.36		77	67589	WHTSL2 4	220	667	1.096	241.04
37	67939	NELHOUS6	138	667	1.060	146.23		78	67556	WHTSL1 4	220	667	1.096	241.05
38	67171	MBPP-1	230	652	1.060	243.84		79	67554	SLAVEFL7	121	667	1.096	132.65
39	66705	DRAYTON7	115	626	1.061	122.03		80	67648	POINTD27	121	667	1.100	133.11
40	63217	APPLETN7	115	626	1.062	122.12		81	60116	PRASWCP7	115	626	1.116	128.34
41	68638	BEATTY 4	230	672	1.062	244.24								

Table 2-3 Area and Network Losses in Case 1-500 MW at Garrison 230 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-69	279	-28
XEL-NSP	393	1830	-3030	728	2170	390	2643	
608	1818	1788	0	0	0	-93	123	-105
MP	404	599	-1237	0	547	26	1563	
613	91	288	0	0	0	-198	1	-198
SMMPA	41	72	-27	0	8	-1	5	
618	1717	1365	0	0	0	217	135	159
GRE	535	75	-1437	0	310	203	2004	
626	1454	2312	0	0	0	-1028	171	-914
OTP	376	272	-827	25	590	69	1428	

633	159	159	0	0	0	-1	0	-1
MPW	51	40	0	0	9	11	10	
635	4382	4240	0	0	0	28	114	43
MEC	572	891	-404	51	1286	-48	1370	
640	2815	2436	0	0	0	262	141	-58
NPPD	385	483	-469	263	1161	-26	1303	
645	1982	2028	0	0	0	-66	21	-68
OPPD	480	607	-73	14	346	-96	373	
650	21	591	0	0	0	-575	6	-575
LES	2	97	-93	0	87	-13	97	
652	5280	3009	0	0	0	1870	376	766
WAPA	587	561	-636	720	3098	-315	3346	
667	3559	3910	0	0	0	-495	145	833
MH	363	650	-2309	348	1340	-44	3058	
672	3511	3548	0	0	0	-151	114	0
SPC	414	597	-387	63	1091	105	1128	
680	1209	978	0	0	0	148	72	140
DPC	128	168	-144	0	190	-103	392	
Network MW	**513224**						**10863**	
MVAR	**84417**						**151259**	

3. ***Case 20: 500 MW Interconnection at Pickert 230 kV***

Table 3-1 Transformers overloading in Case 2-500 MW at Pickert 230 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.30
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.00
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
6	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.60	113.00
7	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	67.40	112.40
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.50
9	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
10	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.70
11	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	109.00	109.00
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	90.70	108.00
13	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	67.30	107.60
14	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	607.60	107.30
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	628.60	106.50
16	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
17	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.50
18	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	103.00	103.00
19	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
20	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.70
21	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	102.60	102.60
22	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	102.60	102.60
23	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	102.60	102.60
24	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.10	102.10
25	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	480.00	101.80
26	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	432.30	101.00

27	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	80.70	100.80
28	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	709.80	100.00

Table 3-2 Bus Voltage Violations in Case 2-500 MW at Pickert 230 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.941	108.15		30	63287	ORTQUAR7	115	626	1.071	123.12
2	67508	PONTON 4	230	667	1.050	241.50		31	67940	NOTIGI 6	138	667	1.071	147.75
3	61652	BRAINRD7	115	608	1.050	120.76		32	63216	ORTONVL7	115	626	1.072	123.24
4	63070	PL VLLY5	161	618	1.050	169.11		33	60116	PRASWCP7	115	626	1.073	123.35
5	60330	CRYSTAL7	115	600	1.051	120.81		34	68607	REGINA 4	230	672	1.075	247.14
6	61696	TAC HBR6	138	608	1.051	145.00		35	65338	S3456T4T	345	645	1.075	370.77
7	66440	FARGOM14	230	652	1.051	241.82		36	68666	LLOYDMI4	230	672	1.075	247.25
8	61578	MUDLKJCT	115	608	1.052	121.03		37	68612	CONDIE 4	230	672	1.078	247.89
9	65036	MOORE Y	345	640	1.055	363.86		38	68630	EBCAMPB4	230	672	1.078	247.94
10	64605	CB MID5	161	635	1.055	169.83		39	68616	PEEBLES4	230	672	1.080	248.36
11	65025	E.COL. Y	230	640	1.056	242.90		40	68686	ASSINIB4	230	672	1.082	248.95
12	65024	COOPER Y	345	640	1.056	364.45		41	67941	RUTTNTP6	138	667	1.083	149.45
13	64787	COOPER 5	161	640	1.057	170.13		42	68649	CODETTE4	230	672	1.084	249.24
14	65043	TEKAMA Y	161	640	1.058	170.33		43	67944	LEAFRPD6	138	667	1.084	149.63
15	67170	STEGALDC	230	652	1.058	243.36		44	67943	RUTTNLK6	138	667	1.085	149.67
16	65044	TWINCH Y	230	640	1.058	243.36		45	68650	NIPAWIN4	230	672	1.087	250.01
17	67939	NELHOUS6	138	667	1.060	146.23		46	68601	BD 4	230	672	1.088	250.24
18	67171	MBPP-1	230	652	1.060	243.84		47	65031	HOSKIN Y	230	640	1.090	250.75
19	68638	BEATTY 4	230	672	1.062	244.24		48	68610	POPLAR 4	230	672	1.091	251.00
20	68670	COTEAU 4	230	672	1.062	244.34		49	68621	SHAND 4	230	672	1.091	251.00
21	63217	APPLETN7	115	626	1.064	122.32		50	67942	LAURRIV6	138	667	1.091	150.61
22	63214	BIGSTON7	115	626	1.066	122.54		51	68683	MCNEILL4	230	672	1.093	251.29
23	63289	CORRELL7	115	626	1.066	122.53		52	67589	WHTSL2 4	220	667	1.094	240.70
24	62000	MARSHLK7	115	626	1.066	122.60		53	67553	POINTDB7	121	667	1.094	132.38
25	63215	HIWY12 7	115	626	1.067	122.71		54	67556	WHTSL1 4	220	667	1.094	240.71
26	68685	SWIFTCU4	230	672	1.067	245.46		55	67554	SLAVEFL7	121	667	1.096	132.65
27	68609	KENNEDY4	230	672	1.067	245.50		56	60172	SHYSWCP7	115	626	1.097	126.11
28	63288	ODESSA 7	115	626	1.069	122.91		57	67648	POINTD27	121	667	1.100	133.11
29	68608	FLEETST4	230	672	1.069	245.96								

Table 3-3 Area and Network Losses in Case 2-500 MW at Pickert 230 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-56	267	-28
XEL-NSP	279	1830	-3026	729	2172	365	2551	
608	1818	1788	0	0	0	-95	125	-105
MP	390	599	-1257	0	548	-11	1606	
613	91	288	0	0	0	-198	1	-198
SMMPA	38	72	-27	0	8	-4	5	
618	1717	1365	0	0	0	227	125	159
GRE	663	75	-1254	0	312	179	1975	
626	1955	2312	0	0	0	-509	153	-914
OTP	348	272	-679	26	603	29	1305	
633	159	159	0	0	0	-1	0	-1
MPW	51	40	0	0	9	10	10	
635	4382	4240	0	0	0	30	112	43

MEC	549	891	-405	51	1287	-55	1354	
640	2815	2436	0	0	0	263	140	-58
NPPD	380	483	-469	263	1162	-25	1298	
645	1982	2028	0	0	0	-66	20	-68
OPPD	478	607	-73	14	346	-95	371	
650	21	591	0	0	0	-575	6	-575
LES	2	97	-93	0	87	-12	97	
652	4779	3009	0	0	0	1438	307	766
WAPA	184	561	-601	722	3125	-205	2824	
667	3559	3910	0	0	0	-494	143	833
MH	345	650	-2309	348	1341	-45	3041	
672	3511	3548	0	0	0	-151	114	0
SPC	406	597	-387	63	1091	97	1127	
680	1209	978	0	0	0	150	70	140
DPC	123	168	-144	0	190	-102	386	
Network MW	**513100**						**10739**	
MVAR	**83872**						**150408**	

4. ***Case 30: 500 MW Interconnection at Ellendale 345 kV (Tap on Leland Olds-Groton Line)***

Table 4-1 Transformers overloading in Case 3-500 MW for Ellendale 345 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.50
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.00
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	301.40	120.60
6	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	301.40	120.50
7	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
8	67105	LELANDO3	345	652	67202	LELND2TY	345	652	1	500	571.70	114.30
9	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
10	67106	LELANDO4	230	652	67202	LELND2TY	345	652	1	500	570.50	114.10
11	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.50	112.90
12	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
13	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	63.90	110.20
14	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.70
15	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
16	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	617.30	109.10
17	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.10	108.90
18	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	108.80	108.80
19	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	108.80	108.80
20	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	108.80	108.80
21	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	638.00	108.10
22	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	106.60	106.60
23	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	106.10	106.10
24	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	105.30	105.30
25	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	105.30	105.30
26	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
27	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	105.00	105.00

28	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.90	104.90
29	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.50
30	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
31	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.80
32	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	484.20	102.70
33	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
34	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.30	102.30
35	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	436.50	102.00
36	66749	CENTER1G	22	626	66751	CENTER 4	230	626	1	256	255.90	100.00
37	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	709.80	100.00

Table 4-2 Bus Voltage Violations in Case 3-500 MW for Ellendale 345 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.918	105.61		36	62000	MARSHLK7	115	626	1.064	122.31
2	63306	ESMOND Y	115	626	0.936	107.65		37	63214	BIGSTON7	115	626	1.064	122.38
3	63198	BUFFALOY	345	626	0.941	324.63		38	63215	HIWY12 7	115	626	1.065	122.51
4	63193	FORMAN Y	230	626	0.941	216.51		39	63288	ODESSA 7	115	626	1.066	122.62
5	63358	BUFFALO3	345	626	0.941	324.74		40	68685	SWIFTCU4	230	672	1.067	245.46
6	66792	MAPLE R3	345	626	0.942	324.86		41	68609	KENNEDY4	230	672	1.067	245.49
7	63188	PICKERTY	230	626	0.944	217.02		42	63287	ORTQUAR7	115	626	1.068	122.83
8	63260	ENDERLN7	115	626	0.947	108.86		43	63216	ORTONVL7	115	626	1.069	122.95
9	66432	EDGELEY7	115	652	0.947	108.88		44	68608	FLEETST4	230	672	1.069	245.96
10	63369	JAMESTN3	345	626	0.947	326.77		45	67940	NOTIGI 6	138	667	1.071	147.75
11	62982	HUTCHMN7	115	618	0.948	109.02		46	68607	REGINA 4	230	672	1.075	247.14
12	63199	JAMSTN1Y	345	626	0.949	327.31		47	65338	S3456T4T	345	645	1.075	370.75
13	63200	JAMSTN2Y	345	626	0.949	327.31		48	68666	LLOYDMI4	230	672	1.075	247.25
14	62983	HUTCH3M7	115	618	0.950	109.20		49	68612	CONDIE 4	230	672	1.078	247.89
15	63307	HARVEY Y	230	626	0.950	218.42		50	68630	EBCAMPB4	230	672	1.078	247.94
16	61696	TAC HBR6	138	608	1.051	144.97		51	68616	PEEBLES4	230	672	1.080	248.35
17	66440	FARGOM14	230	652	1.052	241.90		52	68686	ASSINIB4	230	672	1.082	248.95
18	66705	DRAYTON7	115	626	1.054	121.17		53	67941	RUTTNTP6	138	667	1.083	149.45
19	65036	MOORE Y	345	640	1.055	363.79		54	68649	CODETTE4	230	672	1.084	249.24
20	64605	CB MID5	161	635	1.055	169.83		55	67944	LEAFRPD6	138	667	1.084	149.63
21	66788	DRAYTO2T	230	626	1.055	242.72		56	67943	RUTTNLK6	138	667	1.085	149.67
22	65025	E.COL. Y	230	640	1.056	242.81		57	68650	NIPAWIN4	230	672	1.087	250.01
23	65024	COOPER Y	345	640	1.056	364.40		58	68601	BD 4	230	672	1.088	250.24
24	64787	COOPER 5	161	640	1.057	170.11		59	60172	SHYSWCP7	115	626	1.088	125.17
25	65043	TEKAMA Y	161	640	1.058	170.31		60	60116	PRASWCP7	115	626	1.089	125.28
26	65044	TWINCH Y	230	640	1.058	243.31		61	65031	HOSKIN Y	230	640	1.090	250.71
27	67170	STEGALDC	230	652	1.058	243.36		62	68621	SHAND 4	230	672	1.091	251.00
28	60141	NORDIC 7	115	626	1.059	121.80		63	68610	POPLAR 4	230	672	1.091	251.00
29	67939	NELHOUS6	138	667	1.060	146.23		64	67942	LAURRIV6	138	667	1.091	150.61
30	67171	MBPP-1	230	652	1.060	243.84		65	68683	MCNEILL4	230	672	1.093	251.29
31	63217	APPLETN7	115	626	1.061	122.02		66	67553	POINTDB7	121	667	1.094	132.38
32	66712	PRAIRIE7	115	626	1.061	122.04		67	67556	WHTSL1 4	220	667	1.095	240.82
33	68638	BEATTY 4	230	672	1.062	244.24		68	67589	WHTSL2 4	220	667	1.095	240.81
34	68670	COTEAU 4	230	672	1.062	244.34		69	67554	SLAVEFL7	121	667	1.096	132.65
35	63289	CORRELL7	115	626	1.063	122.24		70	67648	POINTD27	121	667	1.100	133.11

Table 4-3 Area and Network Losses in Case 3-500 MW for Ellendale 345 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-74	284	-28
XEL-NSP	427	1830	-3032	728	2169	395	2675	
608	1818	1788	0	0	0	-93	123	-105
MP	406	599	-1237	0	547	14	1576	
613	91	288	0	0	0	-198	1	-198
SMMPA	41	72	-27	0	8	-1	5	
618	1717	1365	0	0	0	219	133	159
GRE	730	75	-1275	0	310	204	2036	
626	1454	2312	0	0	0	-1026	169	-914
OTP	370	272	-763	25	591	39	1387	
633	159	159	0	0	0	-1	0	-1
MPW	51	40	0	0	9	11	10	
635	4382	4240	0	0	0	28	114	43
MEC	573	891	-404	51	1286	-49	1370	
640	2815	2436	0	0	0	262	140	-58
NPPD	382	483	-469	263	1162	-25	1299	
645	1982	2028	0	0	0	-66	20	-68
OPPD	479	607	-73	14	346	-96	372	
650	21	591	0	0	0	-575	6	-575
LES	2	97	-93	0	87	-13	97	
652	5280	3009	0	0	0	1880	366	766
WAPA	570	561	-655	719	3103	-275	3316	
667	3559	3910	0	0	0	-495	145	833
MH	369	650	-2309	348	1340	-40	3060	
672	3511	3548	0	0	0	-151	114	0
SPC	409	597	-387	63	1091	100	1127	
680	1209	978	0	0	0	148	72	140
DPC	129	168	-144	0	190	-104	393	
Network MW	**513217**						**10855**	
MVAR	**84635**						**151275**	

5. ***Case 40: 500 MW Interconnection at New Underwood 230 kV***

Table 5-1 Transformers overloading in Case 4-500 MW at New Underwood 230 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.80
2	66266	NUNDRWDT	230	652	66484	NUNDRWD4	230	652	1	100	158.60	158.60
3	66266	NUNDRWDT	230	652	66485	NUNDRWD7	115	652	1	100	157.40	157.40
4	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.80	152.30
5	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.40	126.10
6	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
7	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
8	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
9	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.50	113.00
10	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
11	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	63.90	110.20
12	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.60	109.80
13	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.60	109.70

14	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
15	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	615.10	108.70
16	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	635.90	107.80
17	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.70	107.70
18	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	107.40	107.40
19	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	107.40	107.40
20	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	107.30	107.30
21	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	107.30	107.30
22	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	106.00	106.00
23	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	263.20	105.30
24	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	263.20	105.30
25	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
26	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.90	104.90
27	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.80	104.10
28	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.80	103.80
29	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.10	103.10
30	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
31	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.80
32	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
33	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	483.50	102.50
34	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.30	102.30
35	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	436.70	102.00
36	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	719.50	101.30
37	66749	CENTER1G	22	626	66751	CENTER 4	230	626	1	256	256.10	100.00

Table 5-2 Bus Voltage Violations in Case 4-500 MW at New Underwood 230 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.925	106.35		32	68685	SWIFTCU4	230	672	1.067	245.46
2	63188	PICKERTY	230	626	0.936	215.26		33	68609	KENNEDY4	230	672	1.067	245.49
3	66792	MAPLE R3	345	626	0.940	324.17		34	63287	ORTQUAR7	115	626	1.068	122.84
4	63198	BUFFALOY	345	626	0.940	324.30		35	63216	ORTONVL7	115	626	1.069	122.96
5	63358	BUFFALO3	345	626	0.940	324.42		36	68608	FLEETST4	230	672	1.069	245.96
6	63306	ESMOND Y	115	626	0.942	108.34		37	67940	NOTIGI 6	138	667	1.071	147.75
7	63193	FORMAN Y	230	626	0.947	217.69		38	65338	S3456T4T	345	645	1.074	370.53
8	67152	SHAN-SD7	115	652	0.947	108.94		39	68607	REGINA 4	230	672	1.075	247.14
9	63369	JAMESTN3	345	626	0.948	326.88		40	68666	LLOYDMI4	230	672	1.075	247.25
10	62982	HUTCHMN7	115	618	0.949	109.11		41	68612	CONDIE 4	230	672	1.078	247.89
11	63200	JAMSTN2Y	345	626	0.949	327.42		42	68630	EBCAMPB4	230	672	1.078	247.94
12	63199	JAMSTN1Y	345	626	0.949	327.42		43	68616	PEEBLES4	230	672	1.080	248.35
13	67508	PONTON 4	230	667	1.050	241.50		44	60172	SHYSWCP7	115	626	1.082	124.40
14	61696	TAC HBR6	138	608	1.051	144.98		45	68686	ASSINIB4	230	672	1.082	248.95
15	64605	CB MID5	161	635	1.055	169.85		46	67941	RUTTNTP6	138	667	1.083	149.45
16	65024	COOPER Y	345	640	1.055	364.00		47	68649	CODETTE4	230	672	1.084	249.24
17	64787	COOPER 5	161	640	1.055	169.92		48	67944	LEAFRPD6	138	667	1.084	149.63
18	65044	TWINCH Y	230	640	1.056	242.84		49	67943	RUTTNLK6	138	667	1.085	149.67
19	65043	TEKAMA Y	161	640	1.057	170.15		50	68650	NIPAWIN4	230	672	1.087	250.01
20	60116	PRASWCP7	115	626	1.058	121.64		51	65031	HOSKIN Y	230	640	1.088	250.17
21	67170	STEGALDC	230	652	1.058	243.36		52	68601	BD 4	230	672	1.088	250.24
22	67939	NELHOUS6	138	667	1.060	146.23		53	68621	SHAND 4	230	672	1.091	251.00
23	67171	MBPP-1	230	652	1.060	243.84		54	68610	POPLAR 4	230	672	1.091	251.00

24	63217	APPLETN7	115	626	1.061	122.03		55	67942	LAURRIV6	138	667	1.091	150.61
25	68638	BEATTY 4	230	672	1.062	244.24		56	68683	MCNEILL4	230	672	1.093	251.29
26	68670	COTEAU 4	230	672	1.062	244.34		57	67553	POINTDB7	121	667	1.094	132.38
27	63289	CORRELL7	115	626	1.063	122.25		58	67556	WHTSL1 4	220	667	1.095	240.79
28	62000	MARSHLK7	115	626	1.064	122.32		59	67589	WHTSL2 4	220	667	1.095	240.78
29	63214	BIGSTON7	115	626	1.064	122.38		60	67554	SLAVEFL7	121	667	1.096	132.64
30	63215	HIWY12 7	115	626	1.065	122.52		61	67648	POINTD27	121	667	1.100	133.10
31	63288	ODESSA 7	115	626	1.066	122.63								

Table 5-3 Area and Network Losses in Case 4-500 MW at New Underwood 230 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-78	288	-28
XEL-NSP	456	1830	-3033	728	2168	388	2711	
608	1818	1788	0	0	0	-92	122	-105
MP	400	599	-1243	0	548	26	1565	
613	91	288	0	0	0	-198	1	-198
SMMPA	43	72	-27	0	8	1	5	
618	1717	1365	0	0	0	220	132	159
GRE	715	75	-1275	0	310	202	2025	
626	1454	2312	0	0	0	-1021	164	-914
OTP	375	272	-670	26	588	-3	1339	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	11	
635	4382	4240	0	0	0	25	117	43
MEC	617	891	-404	51	1285	-28	1393	
640	2815	2436	0	0	0	244	159	-58
NPPD	507	483	-478	259	1146	-35	1432	
645	1982	2028	0	0	0	-67	21	-68
OPPD	490	607	-73	14	345	-91	377	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-92	0	86	-16	99	
652	5280	3009	0	0	0	1835	412	766
WAPA	780	561	-746	718	3087	-249	3575	
667	3559	3910	0	0	0	-496	145	833
MH	379	650	-2309	348	1340	-33	3063	
672	3511	3548	0	0	0	-151	114	0
SPC	408	597	-387	63	1091	99	1128	
680	1209	978	0	0	0	147	73	140
DPC	132	168	-144	0	189	-105	397	
Network MW	**513291**						**10930**	
MVAR	**85131**						**151745**	

6. *Case 50: 500 MW Interconnection at Mission 115 kV*

Table 6-1 Lines overloading in Case 5-500 MW at Mission 115 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	64967	ST.FRANC	115	640	66482	MISSION7	115	652	1	105	159.80	152.20
2	64844	HARMONY7	115	640	64967	ST.FRANC	115	640	1	105	151.10	143.90
3	64844	HARMONY7	115	640	64998	VALENTN7	115	640	1	105	146.80	139.90
4	64723	AINSWRT7	115	640	64998	VALENTN7	115	640	1	92	124.50	135.30
5	66482	MISSION7	115	652	66495	WITTEN 7	115	652	1	167	204.60	122.50

6	66494	WINNER 7	115	652	66495	WITTEN 7	115	652	1	167	202.70	121.40
7	66478	GREGORY7	115	652	66494	WINNER 7	115	652	1	167	179.00	107.20
8	66482	MISSION7	115	652	67153	VETALTP7	115	652	1	167	173.40	103.80
9	66479	MARTIN 7	115	652	67153	VETALTP7	115	652	1	167	172.20	103.10

Table 6-2 Transformers overloading in Case 5-500 MW at Mission 115 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.80
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.90
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.10
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	126.00
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.50	113.00
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
9	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	69.10	110.50
10	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
11	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.60	109.70
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	612.10	108.10
14	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.40	107.40
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	633.00	107.30
16	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	106.30	106.30
17	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	106.30	106.30
18	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	106.30	106.30
19	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	105.50	105.50
20	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
21	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	262.80	105.10
22	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	262.80	105.10
23	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	104.00	104.00
24	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.00	104.00
25	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.90	103.90
26	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.80
27	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.80	103.80
28	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
29	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.50	102.80
30	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
31	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	483.00	102.40
32	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.20	102.20
33	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	435.10	101.70
34	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	717.20	101.00

Table 6-3 Bus Voltage Violations in Case 5-500 MW at Mission 115 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	66494	WINNER 7	115	652	0.721	82.87		44	67170	STEGALDC	230	652	1.058	243.36
2	66478	GREGORY7	115	652	0.733	84.25		45	67939	NELHOUS6	138	667	1.060	146.23
3	64998	VALENTN7	115	640	0.735	84.51		46	67171	MBPP-1	230	652	1.060	243.84
4	64777	CODY 7	115	640	0.736	84.62		47	63217	APPLETN7	115	626	1.061	122.04

5	64844	HARMONY7	115	640	0.746	85.77		48	68638	BEATTY 4	230	672	1.062	244.24
6	66495	WITTEN 7	115	652	0.759	87.30		49	68670	COTEAU 4	230	672	1.062	244.34
7	64723	AINSWRT7	115	640	0.766	88.10		50	63289	CORRELL7	115	626	1.063	122.26
8	64760	CALAMS 7	115	640	0.820	94.32		51	62000	MARSHLK7	115	626	1.064	122.33
9	67153	VETALTP7	115	652	0.829	95.28		52	63214	BIGSTON7	115	626	1.064	122.39
10	66479	MARTIN 7	115	652	0.833	95.78		53	63215	HIWY12 7	115	626	1.065	122.52
11	64977	STUART 7	115	640	0.834	95.95		54	63288	ODESSA 7	115	626	1.066	122.64
12	64967	ST.FRANC	115	640	0.838	96.33		55	68685	SWIFTCU4	230	672	1.067	245.46
13	66475	BONESTL7	115	652	0.856	98.38		56	68609	KENNEDY4	230	672	1.067	245.50
14	64730	ATKINSN7	115	640	0.859	98.75		57	63287	ORTQUAR7	115	626	1.068	122.84
15	64812	EMMET 7	115	640	0.882	101.45		58	60116	PRASWCP7	115	626	1.069	122.90
16	67152	SHAN-SD7	115	652	0.888	102.10		59	63216	ORTONVL7	115	626	1.069	122.96
17	64990	THEDFRD7	115	640	0.898	103.21		60	68608	FLEETST4	230	672	1.069	245.96
18	64926	ONEILL 7	115	640	0.921	105.87		61	67940	NOTIGI 6	138	667	1.071	147.75
19	64833	GORDON 7	115	640	0.931	107.00		62	65338	S3456T4T	345	645	1.074	370.53
20	63297	ROLETTE7	115	626	0.933	107.32		63	68607	REGINA 4	230	672	1.075	247.14
21	66487	PHILIP 7	115	652	0.939	107.97		64	68666	LLOYDMI4	230	672	1.075	247.25
22	66496	RUSHMRE7	115	652	0.940	108.07		65	68612	CONDIE 4	230	672	1.078	247.89
23	66490	RAPIDCY7	115	652	0.941	108.21		66	68630	EBCAMPB4	230	672	1.078	247.94
24	66477	ELSWRTH7	115	652	0.943	108.47		67	68616	PEEBLES4	230	672	1.080	248.36
25	66792	MAPLE R3	345	626	0.945	326.10		68	65031	HOSKIN Y	230	640	1.082	248.93
26	66492	WALL 7	115	652	0.945	108.70		69	68686	ASSINIB4	230	672	1.082	248.95
27	63188	PICKERTY	230	626	0.946	217.61		70	67941	RUTTNTP6	138	667	1.083	149.45
28	63198	BUFFALOY	345	626	0.946	326.45		71	68649	CODETTE4	230	672	1.084	249.24
29	63358	BUFFALO3	345	626	0.947	326.55		72	67944	LEAFRPD6	138	667	1.084	149.63
30	66482	MISSION7	115	652	0.947	108.88		73	67943	RUTTNLK6	138	667	1.085	149.67
31	67262	ELKCRK 7	115	652	0.948	109.01		74	68650	NIPAWIN4	230	672	1.087	250.01
32	65046	WAYSID Y	230	640	0.949	218.15		75	60172	SHYSWCP7	115	626	1.087	125.05
33	62982	HUTCHMN7	115	618	0.949	109.16		76	68601	BD 4	230	672	1.088	250.24
34	63306	ESMOND Y	115	626	0.950	109.23		77	68610	POPLAR 4	230	672	1.091	251.00
35	66493	WICKSVL7	115	652	0.950	109.24		78	68621	SHAND 4	230	672	1.091	251.00
36	66788	DRAYTO2T	230	626	1.051	241.62		79	67942	LAURRIV6	138	667	1.091	150.61
37	61696	TAC HBR6	138	608	1.051	144.99		80	68683	MCNEILL4	230	672	1.093	251.29
38	66440	FARGOM14	230	652	1.051	241.81		81	67553	POINTDB7	121	667	1.094	132.38
39	65044	TWINCH Y	230	640	1.054	242.42		82	67589	WHTSL2 4	220	667	1.095	240.86
40	64605	CB MID5	161	635	1.055	169.85		83	67556	WHTSL1 4	220	667	1.095	240.87
41	65024	COOPER Y	345	640	1.055	363.98		84	67554	SLAVEFL7	121	667	1.096	132.65
42	64787	COOPER 5	161	640	1.055	169.91		85	67648	POINTD27	121	667	1.100	133.11
43	65043	TEKAMA Y	161	640	1.056	170.00								

Table 6-4 Area and Network Losses in Case 5-500 MW at Mission 115 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-80	290	-28
XEL-NSP	466	1830	-3032	727	2168	382	2726	
608	1818	1788	0	0	0	-91	121	-105
MP	397	599	-1244	0	549	34	1556	
613	91	288	0	0	0	-198	1	-198
SMMPA	45	72	-27	0	8	2	4	
618	1717	1365	0	0	0	221	131	159
GRE	698	75	-1280	0	311	197	2017	
626	1454	2312	0	0	0	-1016	159	-914

OTP	342	272	-668	26	594	6	1301	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	11	
635	4382	4240	0	0	0	25	117	43
MEC	634	891	-404	51	1285	-15	1397	
640	2815	2436	0	0	0	195	208	-58
NPPD	492	483	-464	260	1137	-152	1510	
645	1982	2028	0	0	0	-67	21	-68
OPPD	491	607	-73	14	345	-94	381	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-92	0	86	-16	99	
652	5280	3009	0	0	0	1777	469	766
WAPA	950	561	-719	718	3085	-120	3587	
667	3559	3910	0	0	0	-496	145	833
MH	368	650	-2309	348	1341	-45	3065	
672	3511	3548	0	0	0	-151	114	0
SPC	405	597	-387	63	1091	96	1128	
680	1209	978	0	0	0	147	74	140
DPC	134	168	-144	0	189	-106	399	
Network MW	**513402**						**11041**	
MVAR	**85291**						**151863**	

7. *Case 51: 375 MW Interconnection at Mission 115 kV*

Table 7-1 Lines overloading in Case 51-375 MW at Mission 115 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	64967	ST.FRANC	115	640	66482	MISSION7	115	652	1	105	112.90	107.60

Table 7-2 Transformers overloading in Case51-375MW at Mission 115kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.80
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.80
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.10
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.60	113.00
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
9	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	69.10	110.60
10	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
11	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.60	109.70
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	611.90	108.10
14	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.40	107.40
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	632.80	107.20
16	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	106.20	106.20
17	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	106.20	106.20
18	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	106.20	106.20
19	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	105.30	105.30
20	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10

21	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	262.70	105.10
22	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	262.70	105.10
23	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.90	103.90
24	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.90	103.90
25	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	103.90	103.90
26	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	103.80	103.80
27	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.70
28	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
29	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.50	102.80
30	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
31	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	483.00	102.40
32	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.20	102.20
33	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	435.00	101.60
34	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	714.00	100.60

Table 7-3 Bus Voltage Violations in Case 51-375 MW at Mission 115 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	66478	GREGORY7	115	652	0.917	105.45		36	63214	BIGSTON7	115	626	1.064	122.39
2	66494	WINNER 7	115	652	0.918	105.62		37	63215	HIWY12 7	115	626	1.065	122.52
3	64998	VALENTN7	115	640	0.931	107.03		38	63288	ODESSA 7	115	626	1.066	122.64
4	64723	AINSWRT7	115	640	0.932	107.16		39	68685	SWIFTCU4	230	672	1.067	245.46
5	64777	CODY 7	115	640	0.933	107.28		40	68609	KENNEDY4	230	672	1.067	245.50
6	63297	ROLETTE7	115	626	0.934	107.40		41	63287	ORTQUAR7	115	626	1.068	122.85
7	66495	WITTEN 7	115	652	0.935	107.48		42	63216	ORTONVL7	115	626	1.069	122.97
8	64844	HARMONY7	115	640	0.935	107.50		43	60116	PRASWCP7	115	626	1.069	122.98
9	66792	MAPLE R3	345	626	0.946	326.24		44	68608	FLEETST4	230	672	1.069	245.96
10	66496	RUSHMRE7	115	652	0.946	108.84		45	67940	NOTIGI 6	138	667	1.071	147.75
11	63198	BUFFALOY	345	626	0.947	326.59		46	65338	S3456T4T	345	645	1.074	370.59
12	63188	PICKERTY	230	626	0.947	217.77		47	68607	REGINA 4	230	672	1.075	247.14
13	63358	BUFFALO3	345	626	0.947	326.70		48	68666	LLOYDMI4	230	672	1.075	247.25
14	66490	RAPIDCY7	115	652	0.947	108.92		49	68612	CONDIE 4	230	672	1.078	247.89
15	62982	HUTCHMN7	115	618	0.949	109.17		50	68630	EBCAMPB4	230	672	1.078	247.94
16	64977	STUART 7	115	640	0.950	109.23		51	68616	PEEBLES4	230	672	1.080	248.36
17	67508	PONTON 4	230	667	1.050	241.50		52	68686	ASSINIB4	230	672	1.082	248.95
18	68570	COTEAU 6	138	672	1.050	144.90		53	67941	RUTTNTP6	138	667	1.083	149.45
19	61696	TAC HBR6	138	608	1.051	144.99		54	68649	CODETTE4	230	672	1.084	249.24
20	65036	MOORE Y	345	640	1.051	362.58		55	67944	LEAFRPD6	138	667	1.084	149.63
21	66788	DRAYTO2T	230	626	1.051	241.75		56	67943	RUTTNLK6	138	667	1.085	149.67
22	66440	FARGOM14	230	652	1.051	241.81		57	65031	HOSKIN Y	230	640	1.086	249.67
23	64605	CB MID5	161	635	1.055	169.85		58	68650	NIPAWIN4	230	672	1.087	250.01
24	65044	TWINCH Y	230	640	1.055	242.68		59	60172	SHYSWCP7	115	626	1.088	125.09
25	65024	COOPER Y	345	640	1.055	364.09		60	68601	BD 4	230	672	1.088	250.24
26	64787	COOPER 5	161	640	1.056	169.96		61	68621	SHAND 4	230	672	1.091	251.00
27	65043	TEKAMA Y	161	640	1.057	170.11		62	68610	POPLAR 4	230	672	1.091	251.00
28	67170	STEGALDC	230	652	1.058	243.36		63	67942	LAURRIV6	138	667	1.091	150.61
29	67939	NELHOUS6	138	667	1.060	146.23		64	68683	MCNEILL4	230	672	1.093	251.29
30	67171	MBPP-1	230	652	1.060	243.84		65	67553	POINTDB7	121	667	1.094	132.38
31	63217	APPLETN7	115	626	1.061	122.04		66	67589	WHTSL2 4	220	667	1.096	241.08
32	68638	BEATTY 4	230	672	1.062	244.24		67	67556	WHTSL1 4	220	667	1.096	241.09
33	68670	COTEAU 4	230	672	1.062	244.34		68	67554	SLAVEFL7	121	667	1.096	132.65
34	63289	CORRELL7	115	626	1.063	122.26		69	67648	POINTD27	121	667	1.100	133.11

35	62000	MARSHLK7	115	626	1.064	122.33								

Table 7-4 Area and Network Losses in Case 51-375 MW at Mission 115 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-80	291	-28
XEL-NSP	465	1830	-3032	727	2168	379	2728	
608	1818	1788	0	0	0	-91	121	-105
MP	395	599	-1244	0	549	34	1555	
613	91	288	0	0	0	-198	1	-198
SMMPA	45	72	-27	0	8	3	4	
618	1717	1365	0	0	0	221	131	159
GRE	696	75	-1281	0	311	197	2017	
626	1454	2312	0	0	0	-1016	159	-914
OTP	339	272	-668	26	594	7	1298	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	11	
635	4382	4240	0	0	0	25	117	43
MEC	622	891	-404	51	1285	-27	1396	
640	2815	2436	0	0	0	233	170	-58
NPPD	442	483	-468	261	1149	-75	1398	
645	1982	2028	0	0	0	-67	21	-68
OPPD	487	607	-73	14	345	-97	381	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-92	0	86	-15	98	
652	5154	3009	0	0	0	1723	398	766
WAPA	648	561	-662	719	3094	-177	3294	
667	3559	3910	0	0	0	-496	145	833
MH	365	650	-2309	348	1341	-48	3065	
672	3511	3548	0	0	0	-151	114	0
SPC	405	597	-387	63	1091	96	1128	
680	1209	978	0	0	0	146	74	140
DPC	134	168	-144	0	189	-106	400	
Network MW	**513293**						**10932**	
MVAR	**84914**						**151460**	

8. ***Case 52: 250 MW Interconnection at Mission 115 kV***

Table 8-1 Transformers overloading in Case 52-250 MW at Mission 115 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.80
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.70	151.70
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.00
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.80
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.50	113.00
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
9	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	69.30	110.90
10	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.30
11	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.70
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30

13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	611.20	108.00
14	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.30	107.30
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	632.10	107.10
16	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	106.00	106.00
17	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	106.00	106.00
18	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	106.00	106.00
19	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
20	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	261.70	104.70
21	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	261.70	104.70
22	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	104.60	104.60
23	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	104.00	104.00
24	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.90	103.90
25	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	103.80	103.80
26	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.70
27	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	103.10	103.10
28	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
29	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.50	102.80
30	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
31	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	482.70	102.40
32	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.20	102.20
33	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	434.70	101.60
34	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	711.50	100.20

Table 8-2 Bus Voltage Violations in Case 52-250 MW at Mission 115 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.936	107.66		31	63287	ORTQUAR7	115	626	1.068	122.87
2	66792	MAPLE R3	345	626	0.947	326.65		32	63216	ORTONVL7	115	626	1.069	122.99
3	63198	BUFFALOY	345	626	0.948	327.04		33	68608	FLEETST4	230	672	1.069	245.96
4	63358	BUFFALO3	345	626	0.948	327.14		34	67940	NOTIGI 6	138	667	1.071	147.75
5	63188	PICKERTY	230	626	0.949	218.29		35	60116	PRASWCP7	115	626	1.072	123.24
6	62982	HUTCHMN7	115	618	0.950	109.21		36	65338	S3456T4T	345	645	1.074	370.63
7	67508	PONTON 4	230	667	1.050	241.50		37	68607	REGINA 4	230	672	1.075	247.14
8	61696	TAC HBR6	138	608	1.051	144.99		38	68666	LLOYDMI4	230	672	1.075	247.25
9	66705	DRAYTON7	115	626	1.051	120.89		39	68612	CONDIE 4	230	672	1.078	247.89
10	66440	FARGOM14	230	652	1.051	241.82		40	68630	EBCAMPB4	230	672	1.078	247.94
11	65036	MOORE Y	345	640	1.053	363.12		41	68616	PEEBLES4	230	672	1.080	248.36
12	66788	DRAYTO2T	230	626	1.053	242.16		42	68686	ASSINIB4	230	672	1.082	248.95
13	64605	CB MID5	161	635	1.055	169.85		43	67941	RUTTNTP6	138	667	1.083	149.45
14	65024	COOPER Y	345	640	1.056	364.18		44	68649	CODETTE4	230	672	1.084	249.24
15	64787	COOPER 5	161	640	1.056	170.00		45	67944	LEAFRPD6	138	667	1.084	149.63
16	65044	TWINCH Y	230	640	1.056	242.92		46	67943	RUTTNLK6	138	667	1.085	149.67
17	65043	TEKAMA Y	161	640	1.057	170.16		47	68650	NIPAWIN4	230	672	1.087	250.01
18	67170	STEGALDC	230	652	1.058	243.36		48	65031	HOSKIN Y	230	640	1.088	250.12
19	67939	NELHOUS6	138	667	1.060	146.23		49	68601	BD 4	230	672	1.088	250.24
20	67171	MBPP-1	230	652	1.060	243.84		50	60172	SHYSWCP7	115	626	1.089	125.22
21	63217	APPLETN7	115	626	1.061	122.06		51	68621	SHAND 4	230	672	1.091	251.00
22	68638	BEATTY 4	230	672	1.062	244.24		52	68610	POPLAR 4	230	672	1.091	251.00
23	68670	COTEAU 4	230	672	1.062	244.34		53	67942	LAURRIV6	138	667	1.091	150.61
24	63289	CORRELL7	115	626	1.063	122.28		54	68683	MCNEILL4	230	672	1.093	251.29
25	62000	MARSHLK7	115	626	1.064	122.35		55	67553	POINTDB7	121	667	1.094	132.38

26	63214	BIGSTON7	115	626	1.064	122.40		56	67556	WHTSL1 4	220	667	1.095	241.00
27	63215	HIWY12 7	115	626	1.066	122.54		57	67589	WHTSL2 4	220	667	1.095	240.99
28	63288	ODESSA 7	115	626	1.067	122.66		58	67554	SLAVEFL7	121	667	1.096	132.65
29	68685	SWIFTCU4	230	672	1.067	245.46		59	67648	POINTD27	121	667	1.100	133.11
30	68609	KENNEDY4	230	672	1.067	245.50								

Table 8-3 Area and Network Losses in Case 52-250 MW at Mission 115 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-81	291	-28
XEL-NSP	461	1830	-3032	727	2168	373	2729	
608	1818	1788	0	0	0	-91	121	-105
MP	394	599	-1245	0	549	37	1552	
613	91	288	0	0	0	-198	1	-198
SMMPA	45	72	-27	0	8	3	4	
618	1717	1365	0	0	0	221	131	159
GRE	693	75	-1282	0	311	196	2015	
626	1454	2312	0	0	0	-1015	158	-914
OTP	331	272	-670	26	596	11	1289	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	11	
635	4382	4240	0	0	0	25	117	43
MEC	614	891	-404	51	1285	-34	1396	
640	2815	2436	0	0	0	250	153	-58
NPPD	410	483	-467	262	1156	-44	1340	
645	1982	2028	0	0	0	-67	22	-68
OPPD	486	607	-73	14	345	-101	384	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-92	0	86	-14	98	
652	5030	3009	0	0	0	1634	362	766
WAPA	489	561	-647	720	3104	-184	3135	
667	3559	3910	0	0	0	-496	146	833
MH	364	650	-2309	348	1342	-49	3066	
672	3511	3548	0	0	0	-151	114	0
SPC	404	597	-387	63	1091	95	1127	
680	1209	978	0	0	0	146	74	140
DPC	134	168	-144	0	189	-106	400	
Network MW	**513244**						**10883**	
MVAR	**84726**						**151274**	

9. *Case 60: 500 MW Interconnection at Ft. Thompson 345 kV*

Table 9-1 Transformers overloading in Case 6-500 MW at Ft. Thompson 345 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.80	152.50
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.40	126.10
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	66.20	114.10
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60

9	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.60	111.40
10	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.60	109.70
11	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.40	109.40
12	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
13	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	273.10	109.20
14	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	273.10	109.20
15	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	615.30	108.70
16	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	636.00	107.80
17	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.70	107.70
18	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	107.60	107.60
19	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	107.60	107.60
20	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	107.60	107.60
21	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	107.40	107.40
22	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	105.90	105.90
23	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
24	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.50	104.50
25	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.80	104.30
26	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.80	103.80
27	67105	LELANDO3	345	652	67202	LELND2TY	345	652	1	500	518.00	103.60
28	67106	LELANDO4	230	652	67202	LELND2TY	345	652	1	500	517.30	103.50
29	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.00	103.00
30	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
31	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.80
32	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	484.20	102.70
33	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
34	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.30	102.30
35	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	436.10	101.90
36	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	710.20	100.00

Table 9-2 Bus Voltage Violations in Case 6-500 MW at Ft. Thompson 345 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang	Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.924	106.23	34	63215	HIWY12 7	115	626	1.065	122.49
2	63188	PICKERTY	230	626	0.935	215.08	35	63288	ODESSA 7	115	626	1.066	122.59
3	66792	MAPLE R3	345	626	0.939	323.91	36	68685	SWIFTCU4	230	672	1.067	245.46
4	63198	BUFFALOY	345	626	0.940	324.17	37	68609	KENNEDY4	230	672	1.067	245.49
5	63358	BUFFALO3	345	626	0.940	324.29	38	63287	ORTQUAR7	115	626	1.068	122.79
6	63306	ESMOND Y	115	626	0.941	108.22	39	63216	ORTONVL7	115	626	1.069	122.91
7	63193	FORMAN Y	230	626	0.945	217.39	40	68608	FLEETST4	230	672	1.069	245.96
8	63369	JAMESTN3	345	626	0.948	326.91	41	67940	NOTIGI 6	138	667	1.071	147.75
9	62982	HUTCHMN7	115	618	0.948	109.02	42	68607	REGINA 4	230	672	1.075	247.14
10	63199	JAMSTN1Y	345	626	0.949	327.45	43	65338	S3456T4T	345	645	1.075	370.71
11	63200	JAMSTN2Y	345	626	0.949	327.45	44	68666	LLOYDMI4	230	672	1.075	247.25
12	62983	HUTCH3M7	115	618	0.950	109.20	45	68612	CONDIE 4	230	672	1.078	247.89
13	67508	PONTON 4	230	667	1.050	241.50	46	68630	EBCAMPB4	230	672	1.078	247.94
14	68570	COTEAU 6	138	672	1.050	144.90	47	68616	PEEBLES4	230	672	1.080	248.35
15	61696	TAC HBR6	138	608	1.051	145.00	48	60172	SHYSWCP7	115	626	1.081	124.26
16	65036	MOORE Y	345	640	1.053	363.43	49	68686	ASSINIB4	230	672	1.082	248.95
17	65025	E.COL. Y	230	640	1.054	242.34	50	67941	RUTTNTP6	138	667	1.083	149.45
18	64605	CB MID5	161	635	1.055	169.84	51	68649	CODETTE4	230	672	1.084	249.24
19	60167	RUNSWCP4	230	608	1.055	242.73	52	67944	LEAFRPD6	138	667	1.084	149.63
20	65024	COOPER Y	345	640	1.056	364.29	53	67943	RUTTNLK6	138	667	1.085	149.67
21	64787	COOPER 5	161	640	1.056	170.06	54	68650	NIPAWIN4	230	672	1.087	250.01
22	65044	TWINCH Y	230	640	1.057	243.05	55	68601	BD 4	230	672	1.088	250.24

23	60116	PRASWCP7	115	626	1.057	121.56		56	65031	HOSKIN Y	230	640	1.089	250.52
24	65043	TEKAMA Y	161	640	1.057	170.23		57	68621	SHAND 4	230	672	1.091	251.00
25	67170	STEGALDC	230	652	1.058	243.36		58	68610	POPLAR 4	230	672	1.091	251.00
26	67939	NELHOUS6	138	667	1.060	146.23		59	67942	LAURRIV6	138	667	1.091	150.61
27	67171	MBPP-1	230	652	1.060	243.84		60	68683	MCNEILL4	230	672	1.093	251.29
28	63217	APPLETN7	115	626	1.061	121.99		61	67553	POINTDB7	121	667	1.094	132.39
29	68638	BEATTY 4	230	672	1.062	244.24		62	67554	SLAVEFL7	121	667	1.096	132.65
30	68670	COTEAU 4	230	672	1.062	244.34		63	67648	POINTD27	121	667	1.100	133.11
31	63289	CORRELL7	115	626	1.063	122.21		64	67589	WHTSL2 4	220	667	1.108	243.66
32	62000	MARSHLK7	115	626	1.063	122.28		65	67556	WHTSL1 4	220	667	1.108	243.67
33	63214	BIGSTON7	115	626	1.064	122.36								

Table 9-3 Area and Network Losses in Case 6-500 MW at Ft. Thompson 345 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-78	289	-28
XEL-NSP	467	1830	-3034	728	2169	401	2711	
608	1818	1788	0	0	0	-92	122	-105
MP	418	599	-1227	0	550	29	1567	
613	91	288	0	0	0	-198	1	-198
SMMPA	43	72	-27	0	8	1	5	
618	1717	1365	0	0	0	220	132	159
GRE	716	75	-1275	0	310	201	2025	
626	1454	2312	0	0	0	-1022	165	-914
OTP	373	272	-669	26	588	-8	1341	
633	159	159	0	0	0	-1	1	-1
MPW	52	40	0	0	9	11	10	
635	4382	4240	0	0	0	26	116	43
MEC	597	891	-404	51	1286	-44	1389	
640	2815	2436	0	0	0	261	142	-58
NPPD	392	483	-468	263	1160	-29	1311	
645	1982	2028	0	0	0	-66	21	-68
OPPD	482	607	-73	14	346	-94	373	
650	21	591	0	0	0	-576	6	-575
LES	2	97	-93	0	86	-14	98	
652	5280	3009	0	0	0	1872	374	766
WAPA	590	561	-688	721	3100	-241	3329	
667	3559	3910	0	0	0	-496	145	833
MH	364	650	-2309	348	1341	-47	3062	
672	3511	3548	0	0	0	-151	114	0
SPC	408	597	-387	63	1091	98	1128	
680	1209	978	0	0	0	147	73	140
DPC	131	168	-144	0	190	-105	397	
Network MW	**513231**						**10869**	
MVAR	**84745**						**151320**	

10. ***Case 70: 500 MW Interconnection at White 345 kV***

Table 10-1 Lines overloading in Case 7-500 MW at White 345 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63219	GRANTCO7	115	626	66555	MORRIS 7	115	652	1	96	98.00	102.10

Table 10-2 Transformers overloading in Case 7-500 MW at White 345 kV

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.80	152.00
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	126.10
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.90
5	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.70	114.50
6	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.50	112.90
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.60
9	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	63.90	110.20
10	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.60	109.70
11	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.80	109.30
12	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.10	109.00
13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	613.00	108.30
14	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.60	107.60
15	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	633.80	107.40
16	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	106.80	106.80
17	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	265.90	106.40
18	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	265.90	106.40
19	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	106.30	106.30
20	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	106.30	106.30
21	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	106.30	106.30
22	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	105.40	105.40
23	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
24	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.20	104.20
25	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	104.10	104.10
26	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.70	103.90
27	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.70	103.70
28	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	485.40	103.00
29	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.80
30	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.50	102.80
31	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
32	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.30	102.30
33	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	434.90	101.60
34	67105	LELANDO3	345	652	67202	LELND2TY	345	652	1	500	504.50	100.90
35	67106	LELANDO4	230	652	67202	LELND2TY	345	652	1	500	503.90	100.80

Table 10-3 Bus Voltage Violations in Case 7-500 MW at White 345 kV

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.930	106.94		32	60116	PRASWCP7	115	626	1.065	122.50
2	63188	PICKERTY	230	626	0.943	216.90		33	63287	ORTQUAR7	115	626	1.067	122.71
3	66792	MAPLE R3	345	626	0.944	325.54		34	68685	SWIFTCU4	230	672	1.067	245.46
4	63198	BUFFALOY	345	626	0.945	326.03		35	68609	KENNEDY4	230	672	1.067	245.50
5	63358	BUFFALO3	345	626	0.945	326.14		36	63216	ORTONVL7	115	626	1.068	122.83
6	63193	FORMAN Y	230	626	0.946	217.53		37	68608	FLEETST4	230	672	1.069	245.96
7	62982	HUTCHMN7	115	618	0.946	108.82		38	67940	NOTIGI 6	138	667	1.071	147.75

8	63306	ESMOND Y	115	626	0.947	108.88		39	68607	REGINA 4	230	672	1.075	247.14
9	62983	HUTCH3M7	115	618	0.948	109.00		40	65338	S3456T4T	345	645	1.075	370.79
10	68570	COTEAU 6	138	672	1.050	144.90		41	68666	LLOYDMI4	230	672	1.075	247.25
11	65039	OGLALA Y	230	640	1.050	241.54		42	68612	CONDIE 4	230	672	1.078	247.89
12	61696	TAC HBR6	138	608	1.051	144.97		43	68630	EBCAMPB4	230	672	1.078	247.94
13	66440	FARGOM14	230	652	1.051	241.79		44	68616	PEEBLES4	230	672	1.080	248.36
14	64605	CB MID5	161	635	1.055	169.83		45	68686	ASSINIB4	230	672	1.082	248.95
15	65036	MOORE Y	345	640	1.055	364.03		46	67941	RUTTNTP6	138	667	1.083	149.45
16	65024	COOPER Y	345	640	1.056	364.47		47	68649	CODETTE4	230	672	1.084	249.24
17	64787	COOPER 5	161	640	1.057	170.14		48	67944	LEAFRPD6	138	667	1.084	149.63
18	65025	E.COL. Y	230	640	1.057	243.15		49	67943	RUTTNLK6	138	667	1.085	149.67
19	67170	STEGALDC	230	652	1.058	243.36		50	60172	SHYSWCP7	115	626	1.085	124.81
20	65043	TEKAMA Y	161	640	1.058	170.37		51	68650	NIPAWIN4	230	672	1.087	250.01
21	65044	TWINCH Y	230	640	1.059	243.52		52	68601	BD 4	230	672	1.088	250.24
22	67939	NELHOUS6	138	667	1.060	146.23		53	65031	HOSKIN Y	230	640	1.091	250.87
23	63217	APPLETN7	115	626	1.060	121.90		54	68621	SHAND 4	230	672	1.091	251.00
24	67171	MBPP-1	230	652	1.060	243.84		55	68610	POPLAR 4	230	672	1.091	251.00
25	68638	BEATTY 4	230	672	1.062	244.24		56	67942	LAURRIV6	138	667	1.091	150.61
26	63289	CORRELL7	115	626	1.062	122.12		57	68683	MCNEILL4	230	672	1.093	251.29
27	68670	COTEAU 4	230	672	1.062	244.34		58	67553	POINTDB7	121	667	1.094	132.38
28	62000	MARSHLK7	115	626	1.063	122.19		59	67589	WHTSL2 4	220	667	1.095	240.86
29	63214	BIGSTON7	115	626	1.064	122.31		60	67556	WHTSL1 4	220	667	1.095	240.87
30	63215	HIWY12 7	115	626	1.065	122.42		61	67554	SLAVEFL7	121	667	1.096	132.64
31	63288	ODESSA 7	115	626	1.065	122.50		62	67648	POINTD27	121	667	1.100	133.11

Table 10-4 Area and Network Losses in Case 7-500 MW at White 345 kV

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-84	294	-28
XEL-NSP	442	1830	-3042	727	2168	358	2735	
608	1818	1788	0	0	0	-93	123	-105
MP	405	599	-1241	0	547	19	1575	
613	91	288	0	0	0	-198	1	-198
SMMPA	42	72	-27	0	8	-1	5	
618	1717	1365	0	0	0	220	132	159
GRE	701	75	-1279	0	311	194	2021	
626	1454	2312	0	0	0	-1022	165	-914
OTP	356	272	-675	26	592	-1	1327	
633	159	159	0	0	0	-1	0	-1
MPW	51	40	0	0	9	11	10	
635	4382	4240	0	0	0	28	114	43
MEC	563	891	-404	51	1286	-55	1367	
640	2815	2436	0	0	0	264	139	-58
NPPD	372	483	-470	263	1163	-22	1287	
645	1982	2028	0	0	0	-66	20	-68
OPPD	477	607	-73	14	346	-95	370	
650	21	591	0	0	0	-575	6	-575
LES	2	97	-93	0	87	-12	96	
652	5280	3009	0	0	0	1900	347	766
WAPA	451	561	-640	723	3108	-182	3090	
667	3559	3910	0	0	0	-496	145	833
MH	371	650	-2309	348	1341	-41	3064	
672	3511	3548	0	0	0	-151	114	0

SPC	408	597	-387	63	1091	99	1128	
680	1209	978	0	0	0	148	73	140
DPC	130	168	-144	0	190	-105	395	
Network MW	**513200**						**10839**	
MVAR	**84470**						**151032**	

11. ***Case 80: 100 MW & 50 MW Interconnections at All Sites***

Table 11-1 Transformers overloading in Case 8-100 MW & 50 MW at All Sites

Sl. No.	From Bus ID	From Bus Name	From Bus kV	From Bus Area	To Bus ID	To Bus Name	To Bus kV	To Bus Area	Ckt ID	Rating MVA	Loading MVA	Loading %
1	63192	HENSEL Y	115	626	66796	HENSELU8	69	626	1	40	63.50	158.70
2	63197	CASS LKY	115	626	63347	CASS LK8	69	626	1	13	19.60	150.60
3	63192	HENSEL Y	115	626	63257	HENSEL 7	115	626	1	55	69.30	125.90
4	64792	CRAWFRD7	115	640	64793	CRAWFRD9	34.5	640	1	6.3	7.90	125.80
5	67343	HESKETT7	115	652	67344	HESKET1G	13.8	652	1	28	32.00	114.30
6	63223	HOOT LK7	115	626	63323	HOOTLK2G	13.8	626	1	60	68.20	113.70
7	66719	MORANVI7	115	626	66794	MORANV3T	115	626	1	58	65.60	113.10
8	63221	BRANDN 7	115	626	67455	BRANDN 9	41.6	626	1	12	13.40	111.50
9	66794	MORANV3T	115	626	66999	MORANVI8	69	626	1	58	64.00	110.40
10	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	1	16	17.50	109.60
11	63223	HOOT LK7	115	626	63324	HOOTLK3G	13.8	626	1	84	91.60	109.00
12	60315	T-CRNRS7	115	600	60666	T CORNE8	69	600	1	62.5	68.00	108.90
13	63000	COAL 41G	22	618	63041	COAL CR4	230	618	1	566	612.90	108.30
14	63001	COAL 42G	22	618	63041	COAL CR4	230	618	1	590	633.80	107.40
15	66203	FARGO 8	69	652	66436	FARGO 7	115	652	2	100	107.40	107.40
16	66441	GARRISN4	230	652	66457	GARISN1G	13.8	652	1	100	105.80	105.80
17	66441	GARRISN4	230	652	66458	GARISN2G	13.8	652	1	100	105.70	105.70
18	66441	GARRISN4	230	652	66459	GARISN3G	13.8	652	1	100	105.70	105.70
19	61601	CENTRDC4	230	608	66748	CENTER2G	20	608	1	465	488.60	105.10
20	66442	GARRISN7	115	652	66461	GARISN5G	13.8	652	1	100	104.30	104.30
21	66435	FARGO 4	230	652	66446	FARGOM24	230	652	1	100	103.90	103.90
22	66436	FARGO 7	115	652	66446	FARGOM24	230	652	1	100	103.70	103.70
23	66436	FARGO 7	115	652	66440	FARGOM14	230	652	1	100	103.50	103.50
24	63197	CASS LKY	115	626	63247	CASS LK7	115	626	1	19	19.60	103.00
25	61641	HUBBARD7	115	608	61841	HUBBARD9	34.5	608	2	24	24.70	102.70
26	61647	LONG PR7	115	608	61847	LONG PR9	34.5	608	3	16	16.40	102.70
27	67343	HESKETT7	115	652	67345	HESKET2G	13.8	652	1	80	82.10	102.60
28	63314	BIGSTON4	230	626	63315	BIGSTN1G	24	626	1	471.5	482.80	102.40
29	66442	GARRISN7	115	652	66460	GARISN4G	13.8	652	1	100	102.30	102.30
30	66435	FARGO 4	230	652	66440	FARGOM14	230	652	1	100	102.20	102.20
31	67315	COYOTE1G	24	626	67316	COYOTE 3	345	626	1	428	435.30	101.70
32	66266	NUNDRWDT	230	652	66484	NUNDRWD4	230	652	1	100	101.20	101.20
33	66266	NUNDRWDT	230	652	66485	NUNDRWD7	115	652	1	100	101.20	101.20
34	67105	LELANDO3	345	652	67201	LELND1TY	345	652	1	250	250.50	100.20
35	67106	LELANDO4	230	652	67201	LELND1TY	345	652	1	250	250.50	100.20
36	64711	GENTLM2G	23.4	640	64831	GENTLMN3	345	640	1	710	710.70	100.10

Table 11-2 Bus Voltage Violations in Case 8-100 MW & 50 MW at All Sites

Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang		Sl. No.	Bus ID	Bus Name	Bus KV	Bus Area	Bus PU	Bus Ang
1	63297	ROLETTE7	115	626	0.932	107.13		34	68685	SWIFTCU4	230	672	1.067	245.46
2	66792	MAPLE R3	345	626	0.947	326.79		35	68609	KENNEDY4	230	672	1.067	245.50
3	63198	BUFFALOY	345	626	0.947	326.80		36	63287	ORTQUAR7	115	626	1.069	122.91
4	63358	BUFFALO3	345	626	0.948	326.91		37	68608	FLEETST4	230	672	1.069	245.96
5	63306	ESMOND Y	115	626	0.948	109.07		38	63216	ORTONVL7	115	626	1.070	123.03
6	62982	HUTCHMN7	115	618	0.949	109.11		39	67940	NOTIGI 6	138	667	1.071	147.75
7	67508	PONTON 4	230	667	1.050	241.50		40	68607	REGINA 4	230	672	1.075	247.15
8	68570	COTEAU 6	138	672	1.050	144.90		41	65338	S3456T4T	345	645	1.075	370.73
9	61696	TAC HBR6	138	608	1.051	144.98		42	68666	LLOYDMI4	230	672	1.075	247.25
10	61578	MUDLKJCT	115	608	1.051	120.90		43	60141	NORDIC 7	115	626	1.075	123.64
11	66440	FARGOM14	230	652	1.052	241.85		44	66712	PRAIRIE7	115	626	1.077	123.87
12	63265	DEVILSE7	115	626	1.052	121.03		45	68612	CONDIE 4	230	672	1.078	247.89
13	63266	RAMSEY 7	115	626	1.053	121.05		46	68630	EBCAMPB4	230	672	1.078	247.94
14	65036	MOORE Y	345	640	1.054	363.58		47	68616	PEEBLES4	230	672	1.080	248.36
15	64605	CB MID5	161	635	1.055	169.84		48	68686	ASSINIB4	230	672	1.082	248.95
16	65025	E.COL. Y	230	640	1.055	242.64		49	67941	RUTTNTP6	138	667	1.083	149.45
17	65024	COOPER Y	345	640	1.056	364.35		50	68649	CODETTE4	230	672	1.084	249.24
18	64787	COOPER 5	161	640	1.056	170.08		51	67944	LEAFRPD6	138	667	1.084	149.63
19	65044	TWINCH Y	230	640	1.058	243.23		52	67943	RUTTNLK6	138	667	1.085	149.67
20	65043	TEKAMA Y	161	640	1.058	170.28		53	68650	NIPAWIN4	230	672	1.087	250.01
21	67170	STEGALDC	230	652	1.058	243.36		54	68601	BD 4	230	672	1.088	250.24
22	67939	NELHOUS6	138	667	1.060	146.23		55	65031	HOSKIN Y	230	640	1.090	250.61
23	67171	MBPP-1	230	652	1.060	243.84		56	60172	SHYSWCP7	115	626	1.090	125.35
24	63217	APPLETN7	115	626	1.062	122.11		57	68610	POPLAR 4	230	672	1.091	251.00
25	68638	BEATTY 4	230	672	1.062	244.24		58	68621	SHAND 4	230	672	1.091	251.00
26	68670	COTEAU 4	230	672	1.062	244.34		59	67942	LAURRIV6	138	667	1.091	150.61
27	63289	CORRELL7	115	626	1.064	122.32		60	68683	MCNEILL4	230	672	1.093	251.29
28	62000	MARSHLK7	115	626	1.064	122.39		61	67553	POINTDB7	121	667	1.094	132.39
29	66705	DRAYTON7	115	626	1.064	122.41		62	67554	SLAVEFL7	121	667	1.096	132.65
30	63214	BIGSTON7	115	626	1.065	122.42		63	67648	POINTD27	121	667	1.100	133.11
31	63215	HIWY12 7	115	626	1.066	122.56		64	60116	PRASWCP7	115	626	1.106	127.16
32	66788	DRAYTO2T	230	626	1.066	245.25		65	67556	WHTSL1 4	220	667	1.107	243.53
33	63288	ODESSA 7	115	626	1.067	122.70		66	67589	WHTSL2 4	220	667	1.107	243.52

Table 11-3 Area and Network Losses in Case 8-100 MW & 50 MW at All Sites

Area	Generation	Load	Bus Shunt	Line Shunt	Charging	To Net Int	Losses	Desired Net Int
600	8550	8333	0	0	0	-74	284	-28
XEL-NSP	407	1830	-3033	728	2169	377	2674	
608	1818	1788	0	0	0	-93	123	-105
MP	399	599	-1239	0	548	13	1574	
613	91	288	0	0	0	-198	1	-198
SMMPA	41	72	-27	0	8	-1	5	
618	1717	1365	0	0	0	220	132	159
GRE	701	75	-1281	0	311	196	2023	
626	1505	2312	0	0	0	-969	163	-914
OTP	339	272	-748	26	598	46	1343	
633	159	159	0	0	0	-1	0	-1

MPW	51	40	0	0	9	11	10	
635	4382	4240	0	0	0	28	115	43
MEC	577	891	-404	51	1286	-48	1374	
640	2815	2436	0	0	0	261	142	-58
NPPD	395	483	-468	263	1161	-25	1311	
645	1982	2028	0	0	0	-66	20	-68
OPPD	480	607	-73	14	346	-94	371	
650	21	591	0	0	0	-575	6	-575
LES	2	97	-93	0	87	-13	97	
652	5234	3009	0	0	0	1846	354	766
WAPA	455	561	-640	721	3114	-246	3164	
667	3559	3910	0	0	0	-495	145	833
MH	349	650	-2310	348	1341	-57	3059	
672	3511	3548	0	0	0	-151	114	0
SPC	408	597	-387	63	1091	99	1127	
680	1209	978	0	0	0	148	72	140
DPC	129	168	-144	0	190	-104	393	
Network MW	**513196**						**10835**	
MVAR	**84407**						**151065**	