TABLE I THERMAL UNIT DATA

Thermal Unit	Unit Cost Coefficients			Pmax (MW)	Pmin (MW)	Initial State (h)	Min Dn(h)	Min Up(h)	Ramp (MW/h)	Start Up (MBtu)	Fuel Price ($/MBtu)
	a(Mbtu/MWh2)	b(MBtu/MWh)	c(MBtu)								
1001	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1002	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1003	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1004	0.01088	12.8875	6.78	300	150	-8	8	8	150	440	1
1005	0.01088	12.8875	6.78	300	100	-8	8	8	150	110	1
1006	0.06966	26.24382	31.67	30	10	-1	1	1	15	40	1
1007	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1008	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1009	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1010	0.01088	12.8875	6.78	300	100	-8	8	8	150	100	1
1011	0.00300	10.76	32.96	350	100	-8	8	8	175	100	1
1012	0.06966	26.24382	31.67	30	8	-1	1	1	15	40	1
1013	0.06966	26.24382	31.67	30	8	-1	1	1	15	40	1
1014	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1015	0.06966	26.24382	31.67	30	8	-1	1	1	15	40	1
1016	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1017	0.06966	26.24382	31.67	30	8	-1	1	1	15	40	1
1018	0.06966	26.24382	31.67	30	8	-1	1	1	15	40	1
1019	0.01280	17.82	10.15	100	25	-5	5	5	50	59	1
1020	0.00240	12.3299	28	250	50	-8	8	8	125	100	1
1021	0.00240	12.3299	28	250	50	-8	8	8	125	100	1
1022	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1023	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1024	0.00440	13.29	39	200	50	-10	8	8	100	100	1
1025	0.00440	13.29	39	200	50	-10	8	8	100	100	1
1026	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1027	0.01059	8.339148	64.16	420	100	-10	10	10	210	250	1
1028	0.01059	8.339148	64.16	420	100	-10	10	10	210	250	1
1029	0.01088	12.8875	6.78	300	80	-10	8	8	150	100	1
1030	0.04592	15.47077	74.33	80	30	-4	4	4	40	45	1
1031	0.06966	26.24382	31.67	30	10	-1	1	1	15	40	1
1032	0.06966	26.24382	31.67	30	5	-1	1	1	15	40	1
1033	0.02830	37.69679	17.95	20	5	-1	1	1	10	30	1

1034	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1035	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1036	0.01088	12.8875	6.78	300	150	-10	8	8	150	440	1
1037	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1038	0.06966	26.24382	31.67	30	10	-1	1	1	15	40	1
1039	0.00300	10.76	32.96	300	100	-10	8	8	150	440	1
1040	0.01088	12.8875	6.78	200	50	-10	8	8	100	400	1
1041	0.02830	37.69679	17.95	20	8	-1	1	1	10	30	1
1042	0.00977	22.94226	58.81	50	20	-1	1	1	25	45	1
1043	0.01088	12.8875	6.78	300	100	-8	8	8	150	100	1
1044	0.01088	12.8875	6.78	300	100	-8	8	8	150	100	1
1045	0.01088	12.8875	6.78	300	100	-8	8	8	150	110	1
1046	0.02830	37.69679	17.95	20	8	-1	1	1	10	30	1
1047	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1048	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1049	0.02830	37.69679	17.95	20	8	-1	1	1	10	30	1
1050	0.00977	22.94226	58.81	50	25	-2	2	2	25	45	1
1051	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1052	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1053	0.01280	17.82	10.15	100	25	-5	5	5	50	50	1
1054	0.00977	22.94226	58.81	50	25	-2	2	2	25	45	1

TABLE II SYSTEM LOAD DATA

Hour	**Total System Load (MW)**												
	Base Case	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**	**Scenario 7**	**Scenario 8**	**Scenario 9**	**Scenario 10**	**Scenario 11**	**Scenario 12**
1	3314.4	3263.6328	3260.019	3278.2586	3217.979	3402.4473	3305.1328	3375.2085	3257.6232	3209.9612	3455.6021	3363.8175	3297.9749
2	3010.72	3077.2807	3014.3749	2979.2018	2986.4038	3091.9439	2946.8114	2996.4391	3022.0366	3076.0466	3142.5204	2977.364	3029.9514
3	2403.36	2312.8923	2379.2571	2424.0478	2387.5051	2364.3662	2325.9354	2279.3962	2445.2579	2431.6195	2413.6948	2415.2006	2405.2979
4	1036.8	1013.3706	1028.3944	1051.9596	1022.361	1037.3952	1072.5508	1020.8615	1031.167	1060.422	1050.134	1042.1773	1068.9878
5	1796	1763.6561	1885.1033	1824.7629	1865.6894	1839.2289	1802.7914	1735.8267	1839.9321	1785.5531	1794.599	1804.5748	1777.4999
6	2555.2	2494.6721	2571.4536	2651.2416	2573.7376	2482.2771	2507.3341	2499.8915	2413.8232	2455.5486	2561.5812	2592.9606	2446.9955
7	3314.4	3411.0673	3266.1727	3309.6497	3346.6274	3289.9603	3367.732	3436.7371	3300.8169	3327.7006	3274.3913	3304.3408	3264.6412
8	3921.76	3904.4903	3930.2794	3905.6176	4117.1973	3877.7756	3969.1115	3894.6261	3914.1599	3856.6023	3910.9236	3889.6965	4007.1484
9	4225.44	4154.8495	4310.5156	4193.476	4157.1188	4146.8266	4141.8899	4384.7242	4215.528	4433.5892	4226.7275	4171.6576	4239.2645

10	4680.96	4718.038	4786.275	4595.897	4750.7833	4632.7443	4621.314	4662.8643	4751.6121	4641.131	4601.0967	4680.5981	4821.9906
11	4756.88	4714.7881	4891.8057	4672.0985	4703.6389	4847.9585	4874.1179	4715.367	4893.4232	4656.374	4724.9324	4764.1012	4640.8029
12	4377.28	4309.4323	4344.7495	4515.4827	4430.9539	4344.6604	4521.8876	4322.4334	4493.3601	4314.4539	4452.0125	4228.3562	4439.6637
13	4073.6	4116.5103	4117.7914	4025.8301	4001.7997	4155.8044	4213.2445	4083.4778	4094.728	4067.5223	4107.8541	4142.2791	4012.7267
14	3769.92	3752.5228	3759.5366	3755.3165	3778.7182	3651.5469	3694.0528	3800.8369	3761.3025	3763.2171	3795.6838	3856.5563	3779.1371
15	4680.96	4739.4789	4721.7669	4689.7766	4619.9732	4644.4761	4596.6352	4598.6159	4772.3204	4584.0316	4628.0616	4613.9665	4816.0965
16	4832.8	4863.0238	4878.1396	4921.7941	4836.8902	4959.1577	4875.7417	4762.5193	4772.2213	4782.5002	4775.4114	4797.2704	4953.8858
17	4453.2	4401.0831	4570.0253	4264.0997	4458.8283	4471.5558	4387.711	4397.836	4448.6347	4421.4053	4430.5969	4545.8625	4384.4541
18	4756.88	4583.9602	4802.0387	4705.5564	4768.4895	4699.5802	4859.8481	4684.9538	4692.1258	4870.6355	4724.9004	4927.157	4815.2147
19	5136.48	5139.4131	4952.4673	5222.9421	5208.727	5112.1832	5087.3083	5099.2281	5083.2346	5148.5253	5193.5668	5211.1472	5020.3838
20	5440.16	5407.9553	5708.7124	5410.0234	5366.7534	5359.436	5326.3894	5292.5816	5498.8396	5516.4563	5744.3994	5456.2099	5401.4369
21	5592	5581.3644	5774.881	5617.5772	5631.6422	5712.6667	5447.2998	5639.7156	5535.8371	5559.9635	5748.8432	5378.8076	5537.2093
22	4832.8	4872.6891	4748.049	4867.8037	4975.5281	4780.7923	4802.5003	4804.2986	4909.4352	4806.4966	4896.5994	4902.8117	4888.2606
23	4605.04	4724.5223	4646.5897	4579.0492	4620.3319	4560.7144	4646.3466	4387.3306	4547.2308	4736.0324	4634.0218	4487.359	4628.7344
24	4225.44	4193.6672	4127.1312	4182.7098	4298.5817	4178.0588	4160.0225	4154.2061	4329.94	4223.0262	4214.7621	4205.839	4311.3268

TABLE III WIND INJECTION

Hour	**Wind Power (MW)**											
	Base Case			**Scenario 1**			**Scenario 2**			**Scenario 3**		
	W1 (bus 36)	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**
1	177.25	210.91	207.02	174.1295	198.4702	201.1194	185.0563	218.2	206.7169	179.9845	206.6544	213.3797
2	171.03	206.65	211.71	172.7824	198.5206	203.2744	181.9251	214.2068	213.8207	178.2077	203.5177	217.5354
3	157.58	197.16	210.79	162.1137	195.8421	204.0863	170.5614	206.0297	216.7222	164.3833	194.0975	214.0588
4	145.43	189.44	204.2	144.2099	194.827	197.4545	159.6699	194.5369	209.7911	148.4766	187.9138	208.6927
5	142.4	175.42	200	141.0249	184.4583	193.1445	156.0758	179.452	202.867	140.9214	172.1385	208.9818
6	137.77	143.91	198.43	143.2804	148.243	195.7589	150.3303	145.8513	193.71	132.7728	142.3407	207.4454
7	119.2	111.31	181.72	122.5224	107.5876	172.6179	132.7678	112.7842	169.0225	114.7668	110.7883	191.8451
8	109.45	80.783	147.92	109.4527	76.5107	137.4158	118.6782	82.976	136.7322	107.5864	75.2014	160.7714
9	115.52	58.678	120.91	118.0281	59.3753	114.2609	116.2164	63.4929	114.8229	112.1305	53.138	126.9088
10	116.31	60.474	113.06	118.2664	64.6391	107.0742	118.5035	63.7845	105.1735	114.0971	55.4506	115.911
11	116.79	82.159	115.21	116.3046	97.0108	106.0699	123.9174	74.8437	106.6736	112.7702	69.4111	115.2933
12	114.89	90.131	113.64	120.6589	109.9834	102.8739	129.5305	78.7622	107.4029	100.2301	69.6268	119.4031

13	114.18	92.767	107.2	126.2169	110.2645	102.8422	124.098	77.1466	98.8582	100.169	70.9494	112.8076
14	109.21	93.605	101.49	121.6648	107.0814	97.5013	115.4303	79.3605	91.9641	106.135	78.1564	103.7315
15	106.82	83.711	101.26	115.2452	92.0237	92.8863	114.119	74.7131	90.1179	104.5815	72.8779	97.4008
16	111.48	85.596	106.67	117.9888	84.9937	98.0428	118.2179	77.8325	96.7157	108.9883	80.8924	97.5079
17	102.7	85.328	112.46	103.9769	78.4102	110.7837	111.0095	84.733	104.1337	96.9789	83.9127	103.6134
18	90.549	77.954	120.81	92.064	72.6232	117.0148	99.8148	81.5722	108.5378	83.1962	75.7489	112.8412
19	99.545	76.884	122.88	106.3961	75.3782	113.3613	108.1342	78.5872	112.1981	89.3474	77.4682	120.8531
20	120.28	91.872	130.31	126.8398	85.3873	115.6085	121.5989	86.9934	123.7677	109.6747	94.2056	124.3032
21	126.64	116.29	160.06	127.7806	100.1846	141.2987	134.2818	110.3324	149.6641	106.1367	122.0772	146.4348
22	136.7	123.33	181.18	132.1701	105.1372	154.3528	148.9301	121.6312	172.2925	118.167	127.4549	168.94
23	160.15	116.35	194.02	154.1272	98.7808	173.2872	173.7353	109.4799	185.7492	148.3874	120.3731	185.9689
24	175.23	102.62	202.23	169.6597	81.7231	186.8343	186.6084	103.4643	195.519	169.8104	106.8662	189.7336
Hour	**Scenario 4**			**Scenario 5**			**Scenario 6**			**Scenario 7**		
	W1 (bus 36)	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**
1	186.246	211.6215	200.7009	178.7991	206.3455	203.4182	180.1187	208.3602	197.2657	175.1233	210.6055	200.0364
2	177.4021	207.8028	206.4686	172.8422	202.3194	206.7833	178.0593	207.7394	201.9035	168.2699	209.1291	205.928
3	167.1182	195.4764	206.4617	158.6875	189.7596	203.8014	168.2306	205.6494	203.6074	158.8637	195.428	209.3931
4	143.5339	186.4473	201.1197	146.2691	180.1431	193.8881	151.4821	197.3799	202.4586	150.9672	183.1572	207.5705
5	130.3139	175.1319	197.4831	144.7616	161.4571	193.6844	143.7603	181.8748	199.9467	148.3376	170.7275	204.6211
6	121.5951	145.4248	194.0198	141.918	128.8098	196.13	132.9421	145.6309	192.9041	138.6382	137.828	202.1005
7	94.8307	113.3998	178.4153	123.5619	90.5635	179.0682	114.5246	110.837	178.9405	117.7078	102.4802	188.6214
8	84.0448	81.6437	146.498	106.2826	58.9648	143.7308	109.2452	80.5039	155.002	112.1414	72.4508	150.9405
9	95.9489	61.4765	115.5959	104.4502	47.0013	111.9601	127.5981	56.5501	132.2048	116.9146	46.8088	120.2333
10	95.3452	62.9158	106.5607	101.3089	57.9893	108.1912	134.2811	58.4741	124.8796	115.1233	46.8661	111.1746
11	99.4802	83.7441	115.1552	100.3489	86.5153	113.6718	135.7409	85.6765	123.9786	118.471	63.883	110.8514
12	98.0731	95.6166	115.0097	99.9453	96.7033	111.5115	127.9878	85.7764	119.7153	121.9512	70.9492	103.249
13	103.8428	97.1194	107.8453	100.4874	95.5126	103.9858	125.813	81.7821	110.8388	127.0111	78.6942	91.8445
14	103.9171	85.2234	104.0501	99.5339	93.6836	101.9047	116.1501	88.6983	98.4475	121.6582	81.3452	90.1926
15	103.2918	73.3882	102.9135	101.1837	85.4622	99.8407	105.4536	86.5645	103.223	121.4143	70.2725	91.296
16	113.2935	74.1654	103.6879	98.0485	93.5484	98.8193	108.5086	92.1701	106.2989	118.7884	73.5622	97.9348
17	114.5461	68.7236	107.5672	86.9268	98.0501	103.2206	102.0557	97.1988	109.4731	107.4076	85.1	98.4448
18	101.877	65.3757	111.7734	74.7417	87.06	108.3631	88.3015	93.7395	120.2322	93.7636	73.7415	93.4303

19	111.8762	71.6994	113.1086	82.3361	70.5834	106.4265	91.3041	88.8366	128.3436	104.4636	68.5696	94.9196
20	135.1513	85.3418	112.7347	100.0533	72.1331	117.8856	108.6519	108.2882	137.4424	127.2737	94.6357	107.4771
21	141.3076	111.5001	129.5111	104.4995	85.2419	154.5691	121.3965	136.4462	160.5213	130.0718	127.7779	134.065
22	143.145	121.0727	150.4366	124.7087	90.6805	166.5804	141.9541	141.795	170.9961	143.722	140.0724	162.5507
23	161.3866	111.8188	158.3997	154.2193	86.9249	164.4643	168.5479	135.9441	186.3711	164.6141	138.1414	169.3079
24	168.0091	96.7168	167.6272	164.8423	75.615	172.8902	179.3743	120.0354	201.7053	170.9904	117.4913	174.4665
Hour	**Scenario 8**			**Scenario 9**			**Scenario 10**			**Scenario 11**		
	W1 (bus 36)	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**	**W1 (bus 36)**	**W2 (bus 77)**	**W3 (bus 69)**
1	171.8353	225.1449	213.5896	180.9192	205.7113	204.0286	176.8218	220.4197	203.2693	173.9143	208.2328	205.194
2	167.167	220.7967	215.8293	173.1054	207.1835	210.9607	171.2719	212.6751	206.3722	167.13	202.7002	212.5814
3	156.0909	207.4716	212.7377	157.593	202.6096	211.8875	156.1514	202.0732	208.7124	150.1992	190.6484	214.7848
4	142.6746	198.6109	204.2522	144.1336	199.5502	205.7175	139.1803	194.37	209.2548	136.457	184.8142	202.0606
5	136.9813	186.5975	203.7395	144.4463	193.8101	197.1816	144.3023	177.1474	198.8052	133.7596	175.7696	193.3214
6	123.3995	155.5302	206.4164	142.4816	171.0511	197.6645	139.4318	142.9848	188.3924	132.4341	142.9622	194.1284
7	101.5469	119.9139	188.2688	124.6788	144.7224	183.621	119.5453	107.8879	168.2032	114.1411	107.2207	181.7484
8	88.9136	85.6975	151.6531	122.5	112.0769	153.7072	112.1982	73.4312	132.4048	101.0881	74.985	147.6289
9	94.7601	60.1947	122.9645	134.1208	82.3138	132.2372	122.1647	53.1969	108.0916	107.3558	49.6123	121.8705
10	98.9091	65.9042	112.1489	131.9194	83.818	127.6263	116.6039	60.2457	101.4688	109.3294	50.6565	109.7273
11	109.3956	94.5522	112.2802	135.059	109.2447	136.343	112.0035	82.024	102.3314	114.2179	67.1277	108.8804
12	118.9038	102.0078	107.2985	127.1812	119.0499	129.9009	111.2149	86.5316	99.2632	116.0065	68.671	114.1211
13	123.3942	104.8165	101.8747	116.0746	120.174	121.2014	104.4336	87.9482	95.6846	119.0008	74.9504	108.0486
14	120.4782	115.6506	87.6951	104.3633	123.5796	114.7569	98.1469	87.8659	96.4971	109.0653	71.3418	110.8048
15	122.5788	113.121	76.4915	101.6457	107.9649	108.4492	97.8463	78.4046	104.0157	96.0215	61.0174	116.5851
16	127.9234	116.487	77.0895	110.4897	101.2238	100.2392	106.4077	81.0723	114.7289	101.6872	74.7935	127.3088
17	114.1769	107.2844	81.1437	107.7647	94.5811	96.1536	93.9617	79.9035	117.9346	92.1732	88.1243	138.413
18	97.1227	93.896	104.1669	92.421	75.4115	105.8265	88.6244	73.6778	130.856	90.7919	79.5151	144.7906
19	99.2028	87.4266	119.7165	93.9473	66.3749	106.2214	98.1694	74.4653	136.377	98.815	70.9173	145.1322
20	113.9048	87.4146	129.4663	108.2329	78.861	112.3077	114.9383	78.8399	142.4139	102.3294	79.2698	157.8277
21	115.8901	98.3888	159.4956	113.7062	101.305	138.6738	122.2635	96.9019	171.952	100.27	108.3374	194.1304
22	124.194	97.195	179.0066	131.4591	117.8293	155.0144	139.3047	101.4244	194.4949	106.068	115.9374	220.8452
23	143.8297	80.7775	193.9535	164.6509	116.3871	167.2675	168.0611	98.182	207.2404	132.9291	112.5481	229.2273
24	158.3454	60.2301	217.8458	183.9236	93.9046	185.036	181.8314	92.2396	220.8558	160.9578	107.1166	226.4076

Hour	Scenario 12		
	W1 (bus 36)	W2 (bus 77)	W3 (bus 69)
1	186.8154	213.8288	197.9643
2	177.3607	210.9906	202.7026
3	163.2413	203.4256	200.867
4	152.5421	199.0817	199.4335
5	148.7212	187.2508	199.4541
6	139.0082	160.2248	195.1057
7	117.9772	127.9225	181.1911
8	111.2442	100.4667	158.8923
9	116.1142	81.3515	135.3968
10	110.5595	80.3901	124.7835
11	110.9816	101.5811	123.4066
12	118.1128	118.0366	123.2254
13	119.4494	125.9508	116.045
14	113.8581	124.7151	105.7954
15	110.3532	117.0059	106.8502
16	113.6378	119.1485	110.0264
17	113.7293	113.6057	126.1756
18	110.8571	95.0547	133.0259
19	119.4138	86.0639	132.5269
20	139.362	96.2149	136.9971
21	145.0455	117.7905	163.8707
22	148.6148	121.6071	175.1926
23	176.3437	107.7912	180.6826
24	187.2614	96.6388	178.0053

TABLE IV BRANCH DATA

Name	From Bus	To Bus	CID	Status	R (pu)	X(pu)	B(pu)	RATEA(MW)	RATEB(MW)	RATEC(MW)	GI(pu)	BI(pu)	GJ(pu)	BJ(pu)	Length(miles)
BR1	1	2	1	1	0.0303	0.0999	0.0254	175	175	175	0	0	0	0	9.99
BR2	1	3	1	1	0.0129	0.0424	0.01082	175	175	175	0	0	0	0	4.24
BR3	4	5	1	1	0.00176	0.00798	0.0021	500	500	500	0	0	0	0	0.798
BR4	3	5	1	1	0.0241	0.108	0.0284	175	175	175	0	0	0	0	10.8
BR5	5	6	1	1	0.0119	0.054	0.01426	175	175	175	0	0	0	0	5.4
BR6	6	7	1	1	0.00459	0.0208	0.0055	175	175	175	0	0	0	0	2.08
BR7	8	9	1	1	0.00244	0.0305	1.162	500	500	500	0	0	0	0	3.05
BR8	8	5	1	1	0	0.0267	0	500	500	500	0	0	0	0	2.67
BR9	9	10	1	1	0.00258	0.0322	1.23	500	500	500	0	0	0	0	3.22
BR10	4	11	1	1	0.0209	0.0688	0.01748	175	175	175	0	0	0	0	6.88
BR11	5	11	1	1	0.0203	0.0682	0.01738	175	175	175	0	0	0	0	6.82
BR12	11	12	1	1	0.00595	0.0196	0.00502	175	175	175	0	0	0	0	1.96
BR13	2	12	1	1	0.0187	0.0616	0.01572	175	175	175	0	0	0	0	6.16
BR14	3	12	1	1	0.0484	0.16	0.0406	175	175	175	0	0	0	0	16
BR15	7	12	1	1	0.00862	0.034	0.00874	175	175	175	0	0	0	0	3.4
BR16	11	13	1	1	0.02225	0.0731	0.01876	175	175	175	0	0	0	0	7.31
BR17	12	14	1	1	0.0215	0.0707	0.01816	175	175	175	0	0	0	0	7.07
BR18	13	15	1	1	0.0744	0.2444	0.06268	175	175	175	0	0	0	0	24.44
BR19	14	15	1	1	0.0595	0.195	0.0502	175	175	175	0	0	0	0	19.5
BR20	12	16	1	1	0.0212	0.0834	0.0214	175	175	175	0	0	0	0	8.34
BR21	15	17	1	1	0.0132	0.0437	0.0444	500	500	500	0	0	0	0	4.37
BR22	16	17	1	1	0.0454	0.1801	0.0466	175	175	175	0	0	0	0	18.01
BR23	17	18	1	1	0.0123	0.0505	0.01298	175	175	175	0	0	0	0	5.05
BR24	18	19	1	1	0.01119	0.0493	0.01142	175	175	175	0	0	0	0	4.93
BR25	19	20	1	1	0.0252	0.117	0.0298	175	175	175	0	0	0	0	11.7
BR26	15	19	1	1	0.012	0.0394	0.0101	175	175	175	0	0	0	0	3.94
BR27	20	21	1	1	0.0183	0.0849	0.0216	175	175	175	0	0	0	0	8.49
BR28	21	22	1	1	0.0209	0.097	0.0246	175	175	175	0	0	0	0	9.7
BR29	22	23	1	1	0.0342	0.159	0.0404	175	175	175	0	0	0	0	15.9
BR30	23	24	1	1	0.0135	0.0492	0.0498	175	175	175	0	0	0	0	4.92

BR31	23	25	1	1	0.0156	0.08	0.0864	500	500	500	0	0	0	0	8
BR32	26	25	1	1	0	0.0382	0	500	500	500	0	0	0	0	3.82
BR33	25	27	1	1	0.0318	0.163	0.1764	500	500	500	0	0	0	0	16.3
BR34	27	28	1	1	0.01913	0.0855	0.0216	175	175	175	0	0	0	0	8.55
BR35	28	29	1	1	0.0237	0.0943	0.0238	175	175	175	0	0	0	0	9.43
BR36	30	17	1	1	0	0.0388	0	500	500	500	0	0	0	0	3.88
BR37	8	30	1	1	0.00431	0.0504	0.514	175	175	175	0	0	0	0	5.04
BR38	26	30	1	1	0.00799	0.086	0.908	500	500	500	0	0	0	0	8.6
BR39	17	31	1	1	0.0474	0.1563	0.0399	175	175	175	0	0	0	0	15.63
BR40	29	31	1	1	0.0108	0.0331	0.0083	175	175	175	0	0	0	0	3.31
BR41	23	32	1	1	0.0317	0.1153	0.1173	140	140	140	0	0	0	0	11.53
BR42	31	32	1	1	0.0298	0.0985	0.0251	175	175	175	0	0	0	0	9.85
BR43	27	32	1	1	0.0229	0.0755	0.01926	175	175	175	0	0	0	0	7.55
BR44	15	33	1	1	0.038	0.1244	0.03194	175	175	175	0	0	0	0	12.44
BR45	19	34	1	1	0.0752	0.247	0.0632	175	175	175	0	0	0	0	24.7
BR46	35	36	1	1	0.00224	0.0102	0.00268	175	175	175	0	0	0	0	1.02
BR47	35	37	1	1	0.011	0.0497	0.01318	175	175	175	0	0	0	0	4.97
BR48	33	37	1	1	0.0415	0.142	0.0366	175	175	175	0	0	0	0	14.2
BR49	34	36	1	1	0.00871	0.0268	0.00568	175	175	175	0	0	0	0	2.68
BR50	34	37	1	1	0.00256	0.0094	0.00984	500	500	500	0	0	0	0	0.94
BR51	38	37	1	1	0	0.0375	0	500	500	500	0	0	0	0	3.75
BR52	37	39	1	1	0.0321	0.106	0.027	175	175	175	0	0	0	0	10.6
BR53	37	40	1	1	0.0593	0.168	0.042	175	175	175	0	0	0	0	16.8
BR54	30	38	1	1	0.00464	0.054	0.422	175	175	175	0	0	0	0	5.4
BR55	39	40	1	1	0.0184	0.0605	0.01552	175	175	175	0	0	0	0	6.05
BR56	40	41	1	1	0.0145	0.0487	0.01222	175	175	175	0	0	0	0	4.87
BR57	40	42	1	1	0.0555	0.183	0.0466	175	175	175	0	0	0	0	18.3
BR58	41	42	1	1	0.041	0.135	0.0344	175	175	175	0	0	0	0	13.5
BR59	43	44	1	1	0.0608	0.2454	0.06068	175	175	175	0	0	0	0	24.54
BR60	34	43	1	1	0.0413	0.1681	0.04226	175	175	175	0	0	0	0	16.81
BR61	44	45	1	1	0.0224	0.0901	0.0224	175	175	175	0	0	0	0	9.01
BR62	45	46	1	1	0.04	0.1356	0.0332	175	175	175	0	0	0	0	13.56

BR63	46	47	1	1	0.038	0.127	0.0316	175	175	175	0	0	0	0	12.7
BR64	46	48	1	1	0.0601	0.189	0.0472	175	175	175	0	0	0	0	18.9
BR65	47	49	1	1	0.0191	0.0625	0.01604	175	175	175	0	0	0	0	6.25
BR66	42	49	1	1	0.0715	0.323	0.086	175	175	175	0	0	0	0	32.3
BR67	42	49	2	1	0.0715	0.323	0.086	175	175	175	0	0	0	0	32.3
BR68	45	49	1	1	0.0684	0.186	0.0444	175	175	175	0	0	0	0	18.6
BR69	48	49	1	1	0.0179	0.0505	0.01258	175	175	175	0	0	0	0	5.05
BR70	49	50	1	1	0.0267	0.0752	0.01874	175	175	175	0	0	0	0	7.52
BR71	49	51	1	1	0.0486	0.137	0.0342	175	175	175	0	0	0	0	13.7
BR72	51	52	1	1	0.0203	0.0588	0.01396	175	175	175	0	0	0	0	5.88
BR73	52	53	1	1	0.0405	0.1635	0.04058	175	175	175	0	0	0	0	16.35
BR74	53	54	1	1	0.0263	0.122	0.031	175	175	175	0	0	0	0	12.2
BR75	49	54	1	1	0.073	0.289	0.0738	175	175	175	0	0	0	0	28.9
BR76	49	54	2	1	0.0869	0.291	0.073	175	175	175	0	0	0	0	29.1
BR77	54	55	1	1	0.0169	0.0707	0.0202	175	175	175	0	0	0	0	7.07
BR78	54	56	1	1	0.00275	0.00955	0.00732	175	175	175	0	0	0	0	0.955
BR79	55	56	1	1	0.00488	0.0151	0.00374	175	175	175	0	0	0	0	1.51
BR80	56	57	1	1	0.0343	0.0966	0.0242	175	175	175	0	0	0	0	9.66
BR81	50	57	1	1	0.0474	0.134	0.0332	175	175	175	0	0	0	0	13.4
BR82	56	58	1	1	0.0343	0.0966	0.0242	175	175	175	0	0	0	0	9.66
BR83	51	58	1	1	0.0255	0.0719	0.01788	175	175	175	0	0	0	0	7.19
BR84	54	59	1	1	0.0503	0.2293	0.0598	175	175	175	0	0	0	0	22.93
BR85	56	59	1	1	0.0825	0.251	0.0569	175	175	175	0	0	0	0	25.1
BR86	56	59	2	1	0.0803	0.239	0.0536	175	175	175	0	0	0	0	23.9
BR87	55	59	1	1	0.04739	0.2158	0.05646	175	175	175	0	0	0	0	21.58
BR88	59	60	1	1	0.0317	0.145	0.0376	175	175	175	0	0	0	0	14.5
BR89	59	61	1	1	0.0328	0.15	0.0388	175	175	175	0	0	0	0	15
BR90	60	61	1	1	0.00264	0.0135	0.01456	500	500	500	0	0	0	0	1.35
BR91	60	62	1	1	0.0123	0.0561	0.01468	175	175	175	0	0	0	0	5.61
BR92	61	62	1	1	0.00824	0.0376	0.0098	175	175	175	0	0	0	0	3.76
BR93	63	59	1	1	0	0.0386	0	500	500	500	0	0	0	0	3.86
BR94	63	64	1	1	0.00172	0.02	0.216	500	500	500	0	0	0	0	2

BR95	64	61	1	1	0	0.0268	0	500	500	500	0	0	0	0	2.68
BR96	38	65	1	1	0.00901	0.0986	1.046	500	500	500	0	0	0	0	9.86
BR97	64	65	1	1	0.00269	0.0302	0.38	500	500	500	0	0	0	0	3.02
BR98	49	66	1	1	0.018	0.0919	0.0248	500	500	500	0	0	0	0	9.19
BR99	49	66	2	1	0.018	0.0919	0.0248	500	500	500	0	0	0	0	9.19
BR100	62	66	1	1	0.0482	0.218	0.0578	175	175	175	0	0	0	0	21.8
BR101	62	67	1	1	0.0258	0.117	0.031	175	175	175	0	0	0	0	11.7
BR102	65	66	1	1	0	0.037	0	500	500	500	0	0	0	0	3.7
BR103	66	67	1	1	0.0224	0.1015	0.02682	175	175	175	0	0	0	0	10.15
BR104	65	68	1	1	0.00138	0.016	0.638	500	500	500	0	0	0	0	1.6
BR105	47	69	1	1	0.0844	0.2778	0.07092	175	175	175	0	0	0	0	27.78
BR106	49	69	1	1	0.0985	0.324	0.0828	175	175	175	0	0	0	0	32.4
BR107	68	69	1	1	0	0.037	0	500	500	500	0	0	0	0	3.7
BR108	69	70	1	1	0.03	0.127	0.122	500	500	500	0	0	0	0	12.7
BR109	24	70	1	1	0.00221	0.4115	0.10198	175	175	175	0	0	0	0	41.15
BR110	70	71	1	1	0.00882	0.0355	0.00878	175	175	175	0	0	0	0	3.55
BR111	24	72	1	1	0.0488	0.196	0.0488	175	175	175	0	0	0	0	19.6
BR112	71	72	1	1	0.0446	0.18	0.04444	175	175	175	0	0	0	0	18
BR113	71	73	1	1	0.00866	0.0454	0.01178	175	175	175	0	0	0	0	4.54
BR114	70	74	1	1	0.0401	0.1323	0.03368	175	175	175	0	0	0	0	13.23
BR115	70	75	1	1	0.0428	0.141	0.036	175	175	175	0	0	0	0	14.1
BR116	69	75	1	1	0.0405	0.122	0.124	500	500	500	0	0	0	0	12.2
BR117	74	75	1	1	0.0123	0.0406	0.01034	175	175	175	0	0	0	0	4.06
BR118	76	77	1	1	0.0444	0.148	0.0368	175	175	175	0	0	0	0	14.8
BR119	69	77	1	1	0.0309	0.101	0.1038	175	175	175	0	0	0	0	10.1
BR120	75	77	1	1	0.0601	0.1999	0.04978	175	175	175	0	0	0	0	19.99
BR121	77	78	1	1	0.00376	0.0124	0.01264	175	175	175	0	0	0	0	1.24
BR122	78	79	1	1	0.00546	0.0244	0.00648	175	175	175	0	0	0	0	2.44
BR123	77	80	1	1	0.017	0.0485	0.0472	500	500	500	0	0	0	0	4.85
BR124	77	80	2	1	0.0294	0.105	0.0228	500	500	500	0	0	0	0	10.5
BR125	79	80	1	1	0.0156	0.0704	0.0187	175	175	175	0	0	0	0	7.04
BR126	68	81	1	1	0.00175	0.0202	0.808	500	500	500	0	0	0	0	2.02

BR127	81	80	1	1	0	0.037	0	500	500	500	0	0	0	0	3.7
BR128	77	82	1	1	0.0298	0.0853	0.08174	200	200	200	0	0	0	0	8.53
BR129	82	83	1	1	0.0112	0.03665	0.03796	200	200	200	0	0	0	0	3.665
BR130	83	84	1	1	0.0625	0.132	0.0258	175	175	175	0	0	0	0	13.2
BR131	83	85	1	1	0.043	0.148	0.0348	175	175	175	0	0	0	0	14.8
BR132	84	85	1	1	0.0302	0.0641	0.01234	175	175	175	0	0	0	0	6.41
BR133	85	86	1	1	0.035	0.123	0.0276	500	500	500	0	0	0	0	12.3
BR134	86	87	1	1	0.02828	0.2074	0.0445	500	500	500	0	0	0	0	20.74
BR135	85	88	1	1	0.02	0.102	0.0276	175	175	175	0	0	0	0	10.2
BR136	85	89	1	1	0.0239	0.173	0.047	175	175	175	0	0	0	0	17.3
BR137	88	89	1	1	0.0139	0.0712	0.01934	500	500	500	0	0	0	0	7.12
BR138	89	90	1	1	0.0518	0.188	0.0528	500	500	500	0	0	0	0	18.8
BR139	89	90	2	1	0.0238	0.0997	0.106	500	500	500	0	0	0	0	9.97
BR140	90	91	1	1	0.0254	0.0836	0.0214	175	175	175	0	0	0	0	8.36
BR141	89	92	1	1	0.0099	0.0505	0.0548	500	500	500	0	0	0	0	5.05
BR142	89	92	2	1	0.0393	0.1581	0.0414	500	500	500	0	0	0	0	15.81
BR143	91	92	1	1	0.0387	0.1272	0.03268	175	175	175	0	0	0	0	12.72
BR144	92	93	1	1	0.0258	0.0848	0.0218	175	175	175	0	0	0	0	8.48
BR145	92	94	1	1	0.0481	0.158	0.0406	175	175	175	0	0	0	0	15.8
BR146	93	94	1	1	0.0223	0.0732	0.01876	175	175	175	0	0	0	0	7.32
BR147	94	95	1	1	0.0132	0.0434	0.0111	175	175	175	0	0	0	0	4.34
BR148	80	96	1	1	0.0356	0.182	0.0494	175	175	175	0	0	0	0	18.2
BR149	82	96	1	1	0.0162	0.053	0.0544	175	175	175	0	0	0	0	5.3
BR150	94	96	1	1	0.0269	0.0869	0.023	175	175	175	0	0	0	0	8.69
BR151	80	97	1	1	0.0183	0.0934	0.0254	175	175	175	0	0	0	0	9.34
BR152	80	98	1	1	0.0238	0.108	0.0286	175	175	175	0	0	0	0	10.8
BR153	80	99	1	1	0.0454	0.206	0.0546	200	200	200	0	0	0	0	20.6
BR154	92	100	1	1	0.0648	0.295	0.0472	175	175	175	0	0	0	0	29.5
BR155	94	100	1	1	0.0178	0.058	0.0604	175	175	175	0	0	0	0	5.8
BR156	95	96	1	1	0.0171	0.0547	0.01474	175	175	175	0	0	0	0	5.47
BR157	96	97	1	1	0.0173	0.0885	0.024	175	175	175	0	0	0	0	8.85
BR158	98	100	1	1	0.0397	0.179	0.0476	175	175	175	0	0	0	0	17.9

BR159	99	100	1	1	0.018	0.0813	0.0216	175	175	175	0	0	0	0	8.13
BR160	100	101	1	1	0.0277	0.1262	0.0328	175	175	175	0	0	0	0	12.62
BR161	92	102	1	1	0.0123	0.0559	0.01464	175	175	175	0	0	0	0	5.59
BR162	101	102	1	1	0.0246	0.112	0.0294	175	175	175	0	0	0	0	11.2
BR163	100	103	1	1	0.016	0.0525	0.0536	500	500	500	0	0	0	0	5.25
BR164	100	104	1	1	0.0451	0.204	0.0541	175	175	175	0	0	0	0	20.4
BR165	103	104	1	1	0.0466	0.1584	0.0407	175	175	175	0	0	0	0	15.84
BR166	103	105	1	1	0.0535	0.1625	0.0408	175	175	175	0	0	0	0	16.25
BR167	100	106	1	1	0.0605	0.229	0.062	175	175	175	0	0	0	0	22.9
BR168	104	105	1	1	0.00994	0.0378	0.00986	175	175	175	0	0	0	0	3.78
BR169	105	106	1	1	0.014	0.0547	0.01434	175	175	175	0	0	0	0	5.47
BR170	105	107	1	1	0.053	0.183	0.0472	175	175	175	0	0	0	0	18.3
BR171	105	108	1	1	0.0261	0.0703	0.01844	175	175	175	0	0	0	0	7.03
BR172	106	107	1	1	0.053	0.183	0.0472	175	175	175	0	0	0	0	18.3
BR173	108	109	1	1	0.0105	0.0288	0.0076	175	175	175	0	0	0	0	2.88
BR174	103	110	1	1	0.03906	0.1813	0.0461	175	175	175	0	0	0	0	18.13
BR175	109	110	1	1	0.0278	0.0762	0.0202	175	175	175	0	0	0	0	7.62
BR176	110	111	1	1	0.022	0.0755	0.02	175	175	175	0	0	0	0	7.55
BR177	110	112	1	1	0.0247	0.064	0.062	175	175	175	0	0	0	0	6.4
BR178	17	113	1	1	0.00913	0.0301	0.00768	175	175	175	0	0	0	0	3.01
BR179	32	113	1	1	0.0615	0.203	0.0518	500	500	500	0	0	0	0	20.3
BR180	32	114	1	1	0.0135	0.0612	0.01628	175	175	175	0	0	0	0	6.12
BR181	27	115	1	1	0.0164	0.0741	0.01972	175	175	175	0	0	0	0	7.41
BR182	114	115	1	1	0.0023	0.0104	0.00276	175	175	175	0	0	0	0	1.04
BR183	68	116	1	1	0.00034	0.00405	0.164	500	500	500	0	0	0	0	0.405
BR184	12	117	1	1	0.0329	0.14	0.0358	175	175	175	0	0	0	0	14
BR185	75	118	1	1	0.0145	0.0481	0.01198	175	175	175	0	0	0	0	4.81
BR186	76	118	1	1	0.0164	0.0544	0.01356	175	175	175	0	0	0	0	5.44

TABLE V TRANSFORMER DATA

Name	From Bus	To Bus	Circuit ID	Tap	Angle (degree)	TapMin	TapMax	AngleMin (degree)	AngleMax (degree)
TF1	8	5	1	0.985	0	0	0	0	0
TF2	26	25	1	0.96	0	0	0	0	0
TF3	30	17	1	0.96	0	0	0	0	0
TF4	38	37	1	0.935	0	0	0	0	0
TF5	63	59	1	0.96	0	0	0	0	0
TF6	64	61	1	0.985	0	0	0	0	0
TF7	65	66	1	0.935	0	0	0	0	0
TF8	68	69	1	0.935	0	0	0	0	0
TF9	81	80	1	0.935	3.57	0	0	-15	15

TABLE VI DRP BIDS DATA

EC = Energy Cost for DRR point
CC = Capacity Cost for DRR point

DRP No	Bus	DRR 1 (MW)	CC 1 ($/MW)	EC 1 ($/MWh)	DRR 2 (MW)	CC 2 ($/MW)	EC 2 ($/MWh)	DRR 3 (MW)	CC 3 ($/MW)	EC 3 ($/MWh)
1	1	1.8047	6	15	3.6093	6.5	16.25	5.414	7	17.5
2	2	0.70767	6	15	1.4153	6.5	16.25	2.123	7	17.5
3	3	1.38	6	15	2.76	6.5	16.25	4.14	7	17.5
4	4	1.0617	6	15	2.1233	6.5	16.25	3.185	7	17.5
5	6	1.84	6	15	3.68	6.5	16.25	5.52	7	17.5
6	7	0.67233	6	15	1.3447	6.5	16.25	2.017	7	17.5
7	11	2.477	6	15	4.954	6.5	16.25	7.431	7	17.5
8	12	1.663	6	15	3.326	6.5	16.25	4.989	7	17.5
9	13	1.203	6	15	2.406	6.5	16.25	3.609	7	17.5
10	14	0.49533	6	15	0.99067	6.5	16.25	1.486	7	17.5
11	15	3.1847	6	15	6.3693	6.5	16.25	9.554	7	17.5
12	16	0.88467	6	15	1.7693	6.5	16.25	2.654	7	17.5
13	17	0.38933	6	15	0.77867	6.5	16.25	1.168	7	17.5
14	18	2.123	6	15	4.246	6.5	16.25	6.369	7	17.5
15	19	1.5923	6	15	3.1847	6.5	16.25	4.777	7	17.5
16	20	0.637	6	15	1.274	6.5	16.25	1.911	7	17.5

17	21	0.49533	6	15	0.99067	6.5	16.25	1.486	7	17.5
18	22	0.354	6	15	0.708	6.5	16.25	1.062	7	17.5
19	23	0.24767	6	15	0.49533	6.5	16.25	0.743	7	17.5
20	27	2.194	6	15	4.388	6.5	16.25	6.582	7	17.5
21	28	0.60167	6	15	1.2033	6.5	16.25	1.805	7	17.5
22	29	0.84933	6	15	1.6987	6.5	16.25	2.548	7	17.5
23	31	1.5217	6	15	3.0433	6.5	16.25	4.565	7	17.5
24	32	2.0877	6	15	4.1753	6.5	16.25	6.263	7	17.5
25	33	0.814	6	15	1.628	6.5	16.25	2.442	7	17.5
26	34	2.0877	6	15	4.1753	6.5	16.25	6.263	7	17.5
27	35	1.1677	6	15	2.3353	6.5	16.25	3.503	7	17.5
28	36	1.097	6	15	2.194	6.5	16.25	3.291	7	17.5
29	39	0.9	6	15	1.8	6.5	16.25	2.7	7	17.5
30	40	0.66667	6	15	1.3333	6.5	16.25	2	7	17.5
31	41	1.2333	6	15	2.4667	6.5	16.25	3.7	7	17.5
32	42	1.2333	6	15	2.4667	6.5	16.25	3.7	7	17.5
33	43	0.6	6	15	1.2	6.5	16.25	1.8	7	17.5
34	44	0.53333	6	15	1.0667	6.5	16.25	1.6	7	17.5
35	45	1.7667	6	15	3.5333	6.5	16.25	5.3	7	17.5
36	46	0.93333	6	15	1.8667	6.5	16.25	2.8	7	17.5
37	47	1.1333	6	15	2.2667	6.5	16.25	3.4	7	17.5
38	48	0.66667	6	15	1.3333	6.5	16.25	2	7	17.5
39	49	2.9	6	15	5.8	6.5	16.25	8.7	7	17.5
40	50	0.56667	6	15	1.1333	6.5	16.25	1.7	7	17.5
41	51	0.56667	6	15	1.1333	6.5	16.25	1.7	7	17.5
42	52	0.6	6	15	1.2	6.5	16.25	1.8	7	17.5
43	53	0.76667	6	15	1.5333	6.5	16.25	2.3	7	17.5
44	54	3.7667	6	15	7.5333	6.5	16.25	11.3	7	17.5
45	55	2.1	6	15	4.2	6.5	16.25	6.3	7	17.5
46	56	2.8	6	15	5.6	6.5	16.25	8.4	7	17.5
47	57	0.4	6	15	0.8	6.5	16.25	1.2	7	17.5
48	58	0.4	6	15	0.8	6.5	16.25	1.2	7	17.5
49	59	9.2333	6	15	18.467	6.5	16.25	27.7	7	17.5
50	60	2.6	6	15	5.2	6.5	16.25	7.8	7	17.5

BASE MVA = 100 MVA