

# **Risk Evaluation of Meridian Substation Transformers**

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## **Reliability Evaluation of Meridian Substation Transformers (Executive Summary)**

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Meridian substation has two 500/230 kV transformers T1 and T3. The purpose of this study is to quantify the risk due to possible failures of the MDN transformers. Intuitively, the risk includes the following aspects:

- When one transformer fails, another transformer may be overloaded.
- Even if the limited overload on a transformer is allowed for a relatively short time in operation, this will result in reduction of transformer life.
- If two transformers fail simultaneously, the metro area will be in a blackout. Although the probability is very low, the consequence will be extremely severe. The BUT generating units can only supply 450 MW at its maximum capacity and it takes time for these units to start up.
- When a transformer is out-of-service for maintenance, the risk becomes high during the maintenance period. The substation configuration does not meet the N-1-1 criterion.

The quantified risk evaluation indicates:

- (1) The failure frequencies for double forced outage events and for single forced outage events during another transformer in maintenance are both low.
- (2) The EENS (Expected Energy Not Supplied) due to double forced outage events is 423 MWh/year and that due to single outage during another transformer in maintenance is 267 MWh/year. The total EENS is 690 MWh/year.
- (3) The total risk cost due to transformer failures is about \$1.4 million/year, with \$41.4 k/year for possible BCH revenue losses and \$1.38 million/year for possible social damage. It should be noted that the risk cost is an expected average over long time but not a cost that will happen every year.

## **Reliability Evaluation of Meridian Substation Transformers**

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### **1. Introduction**

Meridian substation has two 500/230 kV transformers T1 and T3. Each one contains three single-phase transformers. The capacity of each transformer is 1200 MVA. T1 was in service in 1976 and T3 in 1977. There is a single-phase spare transformer that is sitting at MDN substation. When one single-phase transformer has a severe failure, this spare could be used but it would take up to 14 days to remove the faulty transformer and replace it. Historical outage statistics shows that a repairable minor failure could be fixed within one day.

In the present operation practice, the BUT generating station does not run any unit in the normal state. All power demand in the local area is supplied through the two transformers, leading to a high loading level. In an emergency situation, the BUT generating units of total 450 MW can be brought to operation but it would take about 12 hours to start up. Intuitively, the risk includes the following aspects:

- When one transformer fails, another transformer may be overloaded.
- Even if the limited overload on a transformer is allowed for a relatively short time in operation, this will result in reduction of transformer life.
- If two transformers fail simultaneously, the metro area will be in a blackout. Although the probability is very low, the consequence will be extremely severe. The BUT generating units can only supply 450 MW at its maximum capacity with a time delay.
- When a transformer is out-of-service for maintenance, the risk becomes high during the maintenance period. The substation configuration does not meet the N-1-1 criterion.

The purpose of this study is to quantify the risk due to possible failures of the MDN transformers.

### **2. Investigations into actual flows on the transformers**

The actual hourly current and voltage data for the last fiscal year (April 1 2004 to March 31, 2005) are retrieved from the PI system. The MVA values are calculated. It is found that the total MVA flow on the two transformers exceeded 1200 MVA (one transformer's capacity) for 586 hours. The maximum loading flow is 1441 MVA. The MVA flow data of the 586 hours are given in Attachment 1.

### **3. Study Conditions in the Risk Evaluation**

The study is based on the following conditions:

- (1) The transformer is assumed to allow overloading up to 1441 MVA. In other words, one transformer can carry all the power demand when another transformer fails or is out-of-service for maintenance. The risk analysis is only associated with double forced outages and N-1-1 states (when one is in maintenance, another one fails).
- (2) The load curve is based on actual load profile in last fiscal year (April 1, 2004 to March 2005).
- (3) Both repairable and aging failure modes are considered. A repairable failure is considered as a minor failure and can be repaired within one day, whereas an aging failure is thought as a severe failure and the failed single-phase transformer has to be replaced in 14 days.
- (4) Repairable failure data is based on last 20 year's records on MDN T1 and T3.
- (5) The aging failure mode is based on the Weibull model with the assumption of 45 year's mean life and 13 year's standard deviation.
- (6) It is assumed that the maintenance activity for T1 or T3 takes 4 days and will occur in May.
- (7) Double forced outages can happen in any time during the year. In calculating EENS, the load profile in January is used, which may be a relatively pessimistic assumption.
- (8) When both the transformers are out-of-service, it takes 12 hours for the BUT generating units to pick up loads. After the first 12 hours, the difference between the BUT maximum capacity (450 MW) and the total load demand has to be curtailed until at least one transformer is brought back in operation due to completion of repair, or replacement, or maintenance.

#### 4. Data

The hourly load curve data for January, 2005 and May 20 to June 2, 2004 are given in Attachments 2 and 3 respectively.

The repairable failure data of MDN T1 and T3 are shown in Table 1. The unavailability data due to aging failure of MDN T1 and T3 were calculated using the SPARE program and are shown in Table 2. The output of running SPARE is given in Attachment 4. With the unavailability due to aging failure and the replacement time, an equivalent failure frequency due to aging failure can be calculated. The calculations of risk indices were performed on spreadsheets, which are given in Attachment 5.

Table 1 Repairable failure data of T1 and T3

Failure data	T1	T3
Failure frequency (f/y)	0.3	0.15
Repair time (hrs/f)	23	14
Unavailability	0.00079	0.00024

Table 2 Unavailability due to aging failure of T1 and T3

Outage data	T1	T3
Unavailability	0.00833	0.00746
Replacement time (days)	14	14

## 5. Results

The risk analysis is performed for the following two cases:

- (1) Both transformers are forced to outage simultaneously.
- (2) The second transformer fails when the first one is in maintenance.

The risk indices for the two cases are shown in Tables 3 and 4. The unit interruption cost for possible BCH revenue losses is assumed to be \$60/MWh and the unit interruption cost for social damage is assumed to be \$2000/MWh. The total risk cost is shown in Table 5.

Table 3 Risk indices for double forced outage events

Outage events	Failure freq. (failures/yr)	Recovery time (hrs)	EENS (MWh/yr)
T1 and T3 repairable failures	0.000190068	8.7	1.80
T1 repairable, T3 aging failures	0.002391196	22	50.00
T1 aging, T3 repairable failures	0.001301563	14	19.59
T1 and T3 aging failures	0.003240251	168	351.33
total	0.007123078		422.72

Table 4 Risk indices for events of one forced outage and one maintenance outage

Outage events	Failure freq. (failures during maintenance)	Recovery time (hrs)	EENS (MWh/yr)
T1 maintenance, T3 repairable failure	0.001643836	14	17.21
T1 maintenance, T3 aging failure	0.002131429	96	93.93
T3 maintenance, T1 repairable failure	0.003287671	23	51.35
T3 maintenance, T1 aging failure	0.002380000	96	104.88
total	0.009442935		267.37

Table 5 Risk cost (interruption costs)

Case	BCH revenue loss (\$/yr)	Social damage (\$/yr)	Total (\$/yr)
Double forced outage events	25,363	845,448	870,811
One forced outage and one maintenance outage	16,042	534,751	550,793
Total	41,405	1,380,199	1,421,604

## 6. Summary

The following observations can be made:

- (1) The failure frequencies for double forced outage events and for single forced outage events during another transformer in maintenance are both low.
- (2) The EENS (Expected Energy Not Supplied) due to double forced outage events is 423 MWh/year and that due to single outage during another transformer in maintenance is 267 MWh/year. The total EENS is 690 MWh/year.
- (3) The total risk cost due to transformer failures is about \$1.4 million/year, with \$41.4 k/year for possible BCH revenue losses and \$1.38 million/year for possible social damage. It should be noted that the risk cost is an expected average over long time but not a cost that will happen every year.

**Attachment 1 MVA flow data of the 586 hours exceeding 1200MVA from April 04 to March 05**

04-Nov-04 18:00:00	1441.581	27-Oct-04 13:00:00	1324.615	26-Oct-04 20:00:00	1300.72
29-Nov-04 17:00:00	1427.1704	27-Oct-04 11:00:00	1324.576	07-Dec-04 19:00:00	1300.72
04-Nov-04 19:00:00	1411.7817	05-Jan-05 08:00:00	1324.109	21-Dec-04 19:00:00	1300.283
11-Jan-05 18:00:00	1410.8297	07-Jan-05 11:00:00	1322.926	25-Oct-04 13:00:00	1300.191
25-Oct-04 18:00:00	1409.2593	26-Oct-04 19:00:00	1322.686	20-Oct-04 18:00:00	1298.744
11-Jan-05 17:00:00	1395.0355	12-Jan-05 12:00:00	1322.632	29-Nov-04 13:00:00	1298.633
29-Nov-04 18:00:00	1387.4505	09-Dec-04 18:00:00	1321.305	11-Jan-05 14:00:00	1298.595
25-Oct-04 19:00:00	1379.2576	11-Jan-05 09:00:00	1320.212	05-Nov-04 18:00:00	1298.235
11-Jan-05 19:00:00	1379.2411	14-Dec-04 18:00:00	1319.375	23-Dec-04 11:00:00	1298.197
04-Nov-04 17:00:00	1370.6715	11-Jan-05 20:00:00	1319.375	22-Oct-04 13:00:00	1297.789
17-Jan-05 18:00:00	1364.3223	27-Oct-04 10:00:00	1318.576	04-Jan-05 13:00:00	1297.789
25-Oct-04 17:00:00	1361.3128	23-Dec-04 18:00:00	1317.421	14-Dec-04 17:00:00	1296.959
04-Nov-04 20:00:00	1360.4337	25-Oct-04 16:00:00	1316.064	13-Dec-04 18:00:00	1296.121
07-Jan-05 10:00:00	1358.963	17-Dec-04 17:00:00	1316.064	21-Dec-04 17:00:00	1295.284
11-Jan-05 11:00:00	1357.6239	07-Jan-05 08:00:00	1316.064	23-Dec-04 17:00:00	1294.813
06-Nov-04 18:00:00	1356.671	27-Oct-04 12:00:00	1316.018	04-Jan-05 12:00:00	1294.242
07-Feb-05 18:00:00	1356.6344	02-Nov-04 19:00:00	1316.017	04-Jan-05 09:00:00	1293.229
11-Jan-05 16:00:00	1355.9493	06-Jan-05 20:00:00	1315.227	04-Jan-05 11:00:00	1293.229
10-Jan-05 17:00:00	1352.6383	06-Jan-05 21:00:00	1315.227	30-Dec-04 17:00:00	1292.898
17-Jan-05 17:00:00	1352.6383	06-Nov-04 19:00:00	1314.399	02-Jan-05 18:00:00	1292.772
05-Nov-04 17:00:00	1351.6262	15-Feb-05 18:00:00	1313.797	25-Oct-04 15:00:00	1292.766
29-Nov-04 19:00:00	1350.7655	21-Oct-04 19:00:00	1312.424	18-Jan-05 18:00:00	1292.723
07-Jan-05 12:00:00	1350.1645	15-Jan-05 19:00:00	1312.171	04-Jan-05 08:00:00	1292.388
29-Nov-04 16:00:00	1349.142	07-Dec-04 17:00:00	1311.916	15-Jan-05 18:00:00	1292.35
17-Dec-04 18:00:00	1348.4899	08-Nov-04 18:00:00	1311.597	23-Dec-04 10:00:00	1291.547
02-Nov-04 18:00:00	1345.0496	04-Nov-04 21:00:00	1311.182	18-Dec-04 18:00:00	1291.098
31-Dec-04 18:00:00	1343.4925	15-Feb-05 19:00:00	1311.182	28-Dec-04 18:00:00	1290.228
11-Jan-05 10:00:00	1341.8296	08-Feb-05 19:00:00	1310.714	21-Feb-05 18:00:00	1290.19
07-Feb-05 19:00:00	1341.613	29-Nov-04 20:00:00	1309.494	16-Jan-05 18:00:00	1289.025
06-Dec-04 18:00:00	1341.4201	11-Jan-05 13:00:00	1309.404	14-Dec-04 19:00:00	1288.54
11-Jan-05 08:00:00	1340.9923	06-Dec-04 17:00:00	1308.912	15-Dec-04 17:00:00	1288.117
21-Dec-04 18:00:00	1340.5416	09-Dec-04 17:00:00	1308.912	05-Jan-05 09:00:00	1287.75
07-Jan-05 13:00:00	1339.3558	20-Dec-04 19:00:00	1308.688	25-Oct-04 12:00:00	1287.665
25-Oct-04 20:00:00	1339.1135	09-Dec-04 19:00:00	1308.21	19-Oct-04 19:00:00	1287.498
07-Jan-05 09:00:00	1337.1643	22-Oct-04 12:00:00	1308.078	12-Jan-05 08:00:00	1287.385
06-Nov-04 17:00:00	1336.6447	20-Oct-04 19:00:00	1307.789	02-Nov-04 17:00:00	1287.343
08-Dec-04 18:00:00	1336.0448	17-Jan-05 19:00:00	1306.93	05-Dec-04 18:00:00	1287.343
08-Feb-05 18:00:00	1334.9631	18-Jan-05 17:00:00	1306.93	01-Nov-04 12:00:00	1286.428
07-Dec-04 18:00:00	1330.86	11-Jan-05 15:00:00	1304.418	25-Oct-04 11:00:00	1285.662
11-Jan-05 12:00:00	1330.2218	30-Dec-04 18:00:00	1303.204	29-Nov-04 14:00:00	1285.662
12-Jan-05 10:00:00	1329.3845	04-Jan-05 10:00:00	1302.401	29-Nov-04 11:00:00	1284.828
27-Oct-04 09:00:00	1329.0348	08-Dec-04 17:00:00	1301.944	04-Nov-04 11:00:00	1284.442
20-Dec-04 18:00:00	1327.7099	22-Dec-04 18:00:00	1301.944	21-Oct-04 20:00:00	1284.43
12-Jan-05 09:00:00	1326.0734	17-Dec-04 19:00:00	1301.933	04-Nov-04 12:00:00	1283.942
29-Nov-04 12:00:00	1325.4591	25-Oct-04 14:00:00	1301.784	31-Dec-04 19:00:00	1283.724
12-Jan-05 11:00:00	1324.7476	06-Dec-04 19:00:00	1301.522	22-Oct-04 14:00:00	1283.638
27-Oct-04 08:00:00	1324.7444	21-Feb-05 19:00:00	1301.069	23-Dec-04 19:00:00	1283.177

28-Oct-04 18:00:00	1283.177	04-Nov-04 10:00:00	1269.48	21-Jun-04 13:00:00	1256.463
08-Dec-04 19:00:00	1282.801	02-Dec-04 17:00:00	1269.439	29-Jul-04 22:00:00	1256.269
23-Nov-04 18:00:00	1282.543	17-Feb-05 20:00:00	1269.348	07-Jan-05 14:00:00	1256.244
02-Dec-04 18:00:00	1282.375	05-Jan-05 11:00:00	1269.274	22-Dec-04 17:00:00	1256.198
13-Dec-04 17:00:00	1281.164	17-Feb-05 19:00:00	1268.998	03-Jan-05 18:00:00	1256.198
24-Nov-04 18:00:00	1280.674	28-Feb-05 19:00:00	1268.681	26-Oct-04 21:00:00	1255.9
17-Jan-05 13:00:00	1280.173	17-Jan-05 11:00:00	1268.681	22-Oct-04 11:00:00	1255.891
10-Jan-05 18:00:00	1279.49	15-Jan-05 17:00:00	1268.322	22-Oct-04 15:00:00	1255.048
12-Jan-05 13:00:00	1279.49	17-Nov-04 18:00:00	1268.047	29-Oct-04 18:00:00	1254.781
04-Jan-05 14:00:00	1279.329	25-Nov-04 18:00:00	1267.675	08-Nov-04 17:00:00	1254.781
09-Dec-04 20:00:00	1279.012	02-Jan-05 19:00:00	1267.209	18-Jan-05 19:00:00	1254.191
05-Jan-05 21:00:00	1279.012	02-Jan-05 17:00:00	1267.023	26-Nov-04 17:00:00	1253.724
14-Jan-05 10:00:00	1279.012	25-Oct-04 21:00:00	1266.43	16-Feb-05 19:00:00	1253.724
23-Dec-04 09:00:00	1278.652	21-Dec-04 20:00:00	1265.37	28-Feb-05 18:00:00	1253.686
01-Dec-04 18:00:00	1278.29	01-Mar-05 18:00:00	1264.902	03-Nov-04 18:00:00	1253.542
14-Jan-05 09:00:00	1278.171	01-Dec-04 17:00:00	1264.153	25-Nov-04 17:00:00	1253.515
30-Dec-04 19:00:00	1278.082	25-Oct-04 10:00:00	1263.992	28-Dec-04 19:00:00	1253.347
28-Oct-04 19:00:00	1277.952	24-Nov-04 14:00:00	1263.992	18-Dec-04 19:00:00	1253.347
06-Jan-05 12:00:00	1277.815	20-Oct-04 20:00:00	1263.903	30-Nov-04 11:00:00	1252.05
20-Dec-04 17:00:00	1277.815	29-Dec-04 18:00:00	1263.814	31-Mar-05 19:00:00	1251.658
31-Dec-04 17:00:00	1277.449	06-Dec-04 20:00:00	1263.698	06-Jan-05 18:00:00	1251.212
22-Dec-04 19:00:00	1277.016	17-Jan-05 15:00:00	1263.695	12-Dec-04 17:00:00	1250.615
17-Jan-05 16:00:00	1276.978	05-Dec-04 17:00:00	1263.554	10-Feb-05 19:00:00	1249.672
15-Jan-05 20:00:00	1275.687	01-Nov-04 17:00:00	1263.151	06-Jan-05 10:00:00	1249.297
29-Nov-04 15:00:00	1275.285	03-Dec-04 18:00:00	1262.936	31-Jan-05 18:00:00	1249.179
23-Dec-04 20:00:00	1275.205	09-Aug-04 12:00:00	1262.243	21-Feb-05 20:00:00	1249.125
17-Jan-05 14:00:00	1275.146	01-Nov-04 11:00:00	1262.021	05-Nov-04 11:00:00	1248.625
15-Dec-04 18:00:00	1275.107	24-Nov-04 15:00:00	1261.656	09-Aug-04 14:00:00	1248.463
05-Nov-04 19:00:00	1275.005	15-Feb-05 20:00:00	1261.469	29-Nov-04 10:00:00	1248.319
21-Oct-04 18:00:00	1274.98	10-Feb-05 18:00:00	1261.079	01-Nov-04 13:00:00	1248.131
09-Nov-04 18:00:00	1274.136	23-Nov-04 17:00:00	1261.04	08-Nov-04 19:00:00	1248.131
01-Nov-04 18:00:00	1273.679	20-Dec-04 21:00:00	1259.509	29-Nov-04 21:00:00	1248.131
17-Jan-05 12:00:00	1273.667	16-Jan-05 17:00:00	1259.226	12-Jan-05 18:00:00	1247.901
05-Dec-04 19:00:00	1273.608	13-Dec-04 19:00:00	1259.18	22-Oct-04 10:00:00	1247.629
06-Jan-05 11:00:00	1273.202	02-Nov-04 20:00:00	1258.71	06-Jan-05 08:00:00	1247.629
14-Feb-05 18:00:00	1273.195	05-Nov-04 16:00:00	1258.374	05-Nov-04 13:00:00	1247.475
24-Nov-04 17:00:00	1273.077	04-Jan-05 17:00:00	1258.144	05-Nov-04 14:00:00	1247.475
06-Jan-05 13:00:00	1272.83	05-Jan-05 20:00:00	1258.144	05-Dec-04 20:00:00	1247.475
17-Jan-05 10:00:00	1272.829	01-Mar-05 19:00:00	1258.074	29-Nov-04 08:00:00	1247.29
26-Oct-04 18:00:00	1271.931	25-May-04 17:00:00	1257.872	03-Feb-05 12:00:00	1247.29
25-May-04 18:00:00	1271.805	03-Dec-04 17:00:00	1257.872	03-Feb-05 13:00:00	1247.055
17-Nov-04 17:00:00	1271.521	08-Dec-04 20:00:00	1257.53	08-Feb-05 20:00:00	1247.041
07-Feb-05 20:00:00	1271.255	05-Jan-05 10:00:00	1257.53	02-Nov-04 11:00:00	1246.631
20-Dec-04 20:00:00	1270.962	26-Nov-04 18:00:00	1257.337	14-Dec-04 20:00:00	1246.631
11-Jan-05 21:00:00	1270.962	17-Dec-04 20:00:00	1256.686	10-Jan-05 19:00:00	1246.631
24-Feb-05 19:00:00	1270.08	18-Jan-05 16:00:00	1256.686	18-Feb-05 18:00:00	1246.45
07-Dec-04 20:00:00	1269.967	14-Feb-05 19:00:00	1256.48	06-Nov-04 20:00:00	1246.429



30-Dec-04 20:00:00	1246.089	10-Feb-05 09:00:00	1237.059	09-Dec-04 21:00:00	1230.589
02-Dec-04 19:00:00	1245.609	15-Dec-04 19:00:00	1236.913	06-Jan-05 22:00:00	1230.4323
17-Jan-05 20:00:00	1245.427	01-Jan-05 18:00:00	1236.829	06-Dec-04 16:00:00	1230.2561
20-Oct-04 17:00:00	1245.068	21-Sep-04 19:00:00	1236.687	29-Jul-04 10:00:00	1230.2256
07-Jan-05 20:00:00	1244.981	20-Jan-05 18:00:00	1236.666	29-Jul-04 13:00:00	1230.2094
16-Feb-05 18:00:00	1244.59	22-Dec-04 20:00:00	1236.255	27-Oct-04 19:00:00	1230.0592
28-Nov-04 18:00:00	1244.552	19-Dec-04 18:00:00	1235.731	07-Aug-04 12:00:00	1229.8596
28-Dec-04 17:00:00	1244.552	01-Nov-04 10:00:00	1235.618	30-Nov-04 13:00:00	1229.6441
02-Jan-05 20:00:00	1244.297	28-Feb-05 20:00:00	1235.418	10-Jan-05 16:00:00	1229.5951
22-Oct-04 16:00:00	1243.943	03-Feb-05 16:00:00	1235.368	12-Jan-05 20:00:00	1229.5951
13-Jan-05 22:00:00	1243.927	05-Nov-04 10:00:00	1235.198	09-Nov-04 17:00:00	1229.4379
29-Nov-04 09:00:00	1243.265	01-Feb-05 18:00:00	1235.17	24-Jan-05 18:00:00	1229.3983
24-Nov-04 19:00:00	1243.125	06-Dec-04 21:00:00	1234.887	21-Sep-04 18:00:00	1229.2035
02-Mar-05 19:00:00	1243.086	27-Dec-04 18:00:00	1234.887	21-Dec-04 13:00:00	1228.1709
03-Feb-05 15:00:00	1242.916	23-Feb-05 19:00:00	1234.887	07-Oct-04 19:00:00	1228.0666
07-Dec-04 10:00:00	1242.466	05-Jan-05 12:00:00	1234.887	18-Jan-05 11:00:00	1227.3267
02-Nov-04 12:00:00	1242.375	09-Nov-04 19:00:00	1234.755	21-Dec-04 21:00:00	1227.3266
02-Nov-04 10:00:00	1242.171	06-Jan-05 17:00:00	1234.619	18-Jan-05 14:00:00	1227.3266
27-Oct-04 14:00:00	1242.078	05-Nov-04 08:00:00	1234.173	30-Dec-04 21:00:00	1227.2641
03-Feb-05 14:00:00	1242.078	12-Jan-05 19:00:00	1234.043	09-Aug-04 15:00:00	1227.1101
26-Oct-04 08:00:00	1241.864	02-Mar-05 18:00:00	1233.914	29-Jul-04 11:00:00	1226.7527
10-Nov-04 18:00:00	1241.637	25-May-04 11:00:00	1233.888	26-Oct-04 22:00:00	1226.7264
22-Nov-04 18:00:00	1241.481	18-Dec-04 17:00:00	1233.782	26-Nov-04 11:00:00	1226.3433
18-Feb-05 19:00:00	1241.443	17-Jan-05 09:00:00	1233.781	21-Dec-04 14:00:00	1226.2459
08-Aug-04 21:00:00	1241.206	05-Nov-04 15:00:00	1233.626	08-Aug-04 22:00:00	1226.1108
01-Dec-04 19:00:00	1240.759	15-Feb-05 09:00:00	1233.604	23-Nov-04 19:00:00	1226.0504
07-Dec-04 11:00:00	1240.759	06-Nov-04 16:00:00	1233.454	29-Oct-04 14:00:00	1225.9452
07-Dec-04 12:00:00	1240.759	20-Dec-04 22:00:00	1233.237	09-Aug-04 11:00:00	1225.9349
03-Feb-05 17:00:00	1240.754	21-Oct-04 21:00:00	1233.073	04-Nov-04 13:00:00	1225.7964
15-Jan-05 21:00:00	1240.602	02-Jan-05 21:00:00	1233.073	07-Dec-04 13:00:00	1225.6764
24-Feb-05 18:00:00	1240.404	06-Jan-05 09:00:00	1233.073	20-Feb-05 19:00:00	1225.6764
19-Oct-04 20:00:00	1240.205	06-Jan-05 19:00:00	1232.944	18-Jan-05 10:00:00	1225.5824
09-Aug-04 13:00:00	1240.201	01-Jan-05 17:00:00	1232.492	22-Feb-05 19:00:00	1225.5824
08-Dec-04 16:00:00	1239.566	31-Jul-04 11:00:00	1232.466	31-Jul-04 13:00:00	1225.5706
04-Nov-04 22:00:00	1239.353	05-Nov-04 12:00:00	1232.393	01-Nov-04 19:00:00	1225.4466
14-Jan-05 11:00:00	1238.959	07-Dec-04 09:00:00	1232.232	03-Jan-05 19:00:00	1225.4466
15-Mar-05 19:00:00	1238.959	16-Mar-05 12:00:00	1232.232	04-Jan-05 15:00:00	1224.7416
18-Jan-05 12:00:00	1238.226	24-Nov-04 12:00:00	1232.181	12-Dec-04 18:00:00	1224.7416
18-Jan-05 13:00:00	1238.226	29-Dec-04 17:00:00	1232.134	16-Dec-04 18:00:00	1224.6094
25-Nov-04 19:00:00	1238.152	21-Dec-04 15:00:00	1232.107	29-Jul-04 16:00:00	1224.1812
25-Feb-05 19:00:00	1237.93	21-Dec-04 16:00:00	1232.107	30-Jul-04 12:00:00	1223.9008
19-Oct-04 18:00:00	1237.93	16-Jan-05 19:00:00	1231.392	27-Oct-04 15:00:00	1223.7511
28-Oct-04 08:00:00	1237.892	19-Dec-04 17:00:00	1231.27	06-Nov-04 11:00:00	1223.194
21-Jun-04 14:00:00	1237.277	14-Jan-05 08:00:00	1231.068	08-Dec-04 21:00:00	1223.1434
06-Nov-04 12:00:00	1237.277	31-Jul-04 12:00:00	1231.023	06-Nov-04 13:00:00	1223.0983
21-Dec-04 11:00:00	1237.093	16-Feb-05 20:00:00	1230.704	22-Nov-04 17:00:00	1223.0983
21-Dec-04 12:00:00	1237.093	24-Feb-05 20:00:00	1230.704	28-Nov-04 19:00:00	1222.8399

07-Feb-05 17:00:00	1222.618	24-Nov-04 11:00:00	1215.226	02-Mar-05 20:00:00	1209.694
07-Dec-04 08:00:00	1222.219	30-Nov-04 08:00:00	1214.923	01-Mar-05 20:00:00	1209.583
06-Jan-05 14:00:00	1222.097	25-Jan-05 18:00:00	1214.919	27-Oct-04 18:00:00	1209.561
03-Dec-04 19:00:00	1221.493	10-Dec-04 09:00:00	1214.777	25-Oct-04 22:00:00	1209.161
16-Mar-05 17:00:00	1221.493	10-Jan-05 13:00:00	1214.777	30-Nov-04 09:00:00	1209.098
01-Nov-04 09:00:00	1221.378	28-Oct-04 20:00:00	1214.728	20-Jan-05 19:00:00	1208.97
20-Oct-04 21:00:00	1221.298	07-Dec-04 16:00:00	1214.728	10-Dec-04 18:00:00	1208.905
21-Dec-04 10:00:00	1221.26	25-May-04 12:00:00	1214.638	18-Jan-05 20:00:00	1208.905
26-Jan-05 18:00:00	1220.909	03-Aug-04 11:00:00	1214.638	19-Nov-04 17:00:00	1208.881
29-Jul-04 17:00:00	1220.906	29-Jul-04 12:00:00	1214.506	05-Jan-05 22:00:00	1208.815
24-Nov-04 13:00:00	1220.576	01-Oct-04 11:00:00	1214.125	16-Feb-05 10:00:00	1208.617
25-May-04 16:00:00	1220.461	15-Dec-04 20:00:00	1213.888	31-Dec-04 20:00:00	1208.476
04-Nov-04 16:00:00	1220.29	08-Feb-05 08:00:00	1213.888	24-Nov-04 10:00:00	1208.42
30-Nov-04 12:00:00	1220.067	16-Mar-05 11:00:00	1213.888	01-Jan-05 19:00:00	1208.061
28-Dec-04 20:00:00	1219.805	04-Dec-04 17:00:00	1213.87	16-Jan-05 20:00:00	1208.04
31-Jan-05 19:00:00	1219.805	10-Dec-04 17:00:00	1213.839	19-Jan-05 18:00:00	1208.04
29-Oct-04 19:00:00	1219.785	01-Feb-05 19:00:00	1213.813	06-Dec-04 12:00:00	1208.04
15-Feb-05 21:00:00	1219.762	07-Dec-04 21:00:00	1213.684	07-Aug-04 17:00:00	1208.025
29-Mar-05 19:00:00	1219.735	03-Nov-04 19:00:00	1213.658	14-Dec-04 16:00:00	1207.978
16-Dec-04 17:00:00	1219.624	13-Dec-04 21:00:00	1213.088	24-Nov-04 20:00:00	1207.31
17-Feb-05 21:00:00	1218.933	29-Nov-04 22:00:00	1213.047	07-Dec-04 14:00:00	1207.217
22-Feb-05 18:00:00	1218.933	16-Feb-05 09:00:00	1213.047	01-Oct-04 10:00:00	1207.199
02-Nov-04 21:00:00	1218.825	25-May-04 13:00:00	1213.002	13-Jan-05 17:00:00	1207.199
23-Dec-04 21:00:00	1218.786	02-Feb-05 18:00:00	1213.002	06-Dec-04 11:00:00	1206.935
03-Feb-05 11:00:00	1218.637	08-Feb-05 17:00:00	1212.926	29-Oct-04 12:00:00	1206.825
31-Jul-04 14:00:00	1218.191	26-Nov-04 19:00:00	1212.47	08-Aug-04 17:00:00	1206.741
05-Nov-04 20:00:00	1218.053	01-Oct-04 13:00:00	1212.464	01-Nov-04 14:00:00	1206.682
29-Dec-04 19:00:00	1218.053	05-Dec-04 21:00:00	1212.244	31-Jul-04 17:00:00	1206.588
15-Mar-05 20:00:00	1218.053	24-Dec-04 17:00:00	1212.164	23-Feb-05 09:00:00	1206.411
01-Oct-04 12:00:00	1217.987	13-Jan-05 18:00:00	1212.042	21-Oct-04 11:00:00	1206.4
02-Nov-04 13:00:00	1217.984	29-Jul-04 15:00:00	1211.68	29-Oct-04 17:00:00	1206.397
17-Jan-05 21:00:00	1217.949	12-Nov-04 18:00:00	1211.531	02-Dec-04 20:00:00	1206.372
29-Jul-04 14:00:00	1217.841	08-Aug-04 18:00:00	1211.525	18-Dec-04 20:00:00	1206.372
29-Oct-04 13:00:00	1217.486	24-Feb-05 10:00:00	1211.4	11-Jan-05 07:00:00	1206.341
18-Jan-05 15:00:00	1217.272	16-Mar-05 19:00:00	1211.327	01-Oct-04 14:00:00	1206.268
16-Mar-05 13:00:00	1217.213	16-Feb-05 08:00:00	1211.086	21-Sep-04 20:00:00	1206.221
13-Dec-04 20:00:00	1217.112	10-Feb-05 08:00:00	1210.751	13-Aug-04 11:00:00	1206.146
24-Nov-04 16:00:00	1216.949	08-Dec-04 12:00:00	1210.674	13-Feb-05 18:00:00	1206.114
05-Jan-05 07:00:00	1216.74	26-Oct-04 11:00:00	1210.596	06-Dec-04 13:00:00	1206.05
25-Feb-05 18:00:00	1216.275	08-Nov-04 20:00:00	1210.594	29-Jul-04 09:00:00	1205.708
30-Jul-04 11:00:00	1215.927	25-Nov-04 20:00:00	1210.594	01-Mar-05 17:00:00	1205.556
04-Jan-05 07:00:00	1215.709	15-Feb-05 11:00:00	1210.543	12-Jan-05 21:00:00	1205.528
14-Feb-05 20:00:00	1215.583	21-Oct-04 12:00:00	1210.524	17-Dec-04 16:00:00	1205.466
24-Feb-05 09:00:00	1215.583	02-Nov-04 09:00:00	1210.413	24-Feb-05 08:00:00	1205.466
31-Mar-05 18:00:00	1215.583	31-Jul-04 15:00:00	1209.75	26-Oct-04 12:00:00	1205.466
22-Oct-04 19:00:00	1215.382	31-Jul-04 16:00:00	1209.75	24-Feb-05 11:00:00	1205.466
13-Feb-05 19:00:00	1215.291	10-Jan-05 14:00:00	1209.75	16-Nov-04 18:00:00	1204.686

17-Aug-04 21:00:00	1204.677
01-Dec-04 08:00:00	1203.878
27-Oct-04 20:00:00	1203.874
25-May-04 14:00:00	1203.829
18-Feb-05 20:00:00	1203.829
07-Feb-05 10:00:00	1203.829
23-Feb-05 18:00:00	1203.829
03-Mar-05 19:00:00	1203.034
07-Aug-04 13:00:00	1203.034
28-Oct-04 21:00:00	1203.034
19-Dec-04 19:00:00	1203.033
06-Dec-04 15:00:00	1203.018
22-Dec-04 21:00:00	1202.992
22-Oct-04 08:00:00	1202.992
07-Oct-04 20:00:00	1202.174
28-Nov-04 17:00:00	1202.155
28-Oct-04 12:00:00	1202.054
31-Jul-04 18:00:00	1201.993
22-Nov-04 19:00:00	1201.417
10-Jan-05 20:00:00	1201.383
14-Jan-05 12:00:00	1201.352
25-Feb-05 20:00:00	1201.352

## Attachment 2 Hourly MW load curve data in January 05

Date/time	BUT units out	BUT units in
04-Jan-05 00:00:00	922.6517721	472.6517721
04-Jan-05 01:00:00	903.6570649	453.6570649
04-Jan-05 02:00:00	986.0609087	536.0609087
04-Jan-05 03:00:00	1019.375203	569.3752028
04-Jan-05 04:00:00	1019.375203	569.3752028
04-Jan-05 05:00:00	1042.738623	592.7386232
04-Jan-05 06:00:00	1094.981472	644.9814718
04-Jan-05 07:00:00	1211.588906	761.5889064
04-Jan-05 08:00:00	1288.512893	838.5128928
04-Jan-05 09:00:00	1289.356298	839.3562977
04-Jan-05 10:00:00	1298.555958	848.5559584
04-Jan-05 11:00:00	1289.356298	839.3562977
04-Jan-05 12:00:00	1290.372293	840.3722935
04-Jan-05 13:00:00	1293.929699	843.9296988
04-Jan-05 14:00:00	1275.41415	825.4141502
04-Jan-05 15:00:00	1220.652069	770.6520689
04-Jan-05 16:00:00	1169.54837	719.5483698
04-Jan-05 17:00:00	1254.16371	804.1637098
04-Jan-05 18:00:00	1191.314887	741.3148873
04-Jan-05 19:00:00	1152.804234	702.8042343
04-Jan-05 20:00:00	1120.99508	670.99508
04-Jan-05 21:00:00	1075.160979	625.1609792
04-Jan-05 22:00:00	1057.46844	607.4684399
04-Jan-05 23:00:00	1151.205088	701.2050879
05-Jan-05 00:00:00	1140.823205	690.8232049
05-Jan-05 01:00:00	1088.289489	638.2894889
05-Jan-05 02:00:00	1055.403689	605.4036891
05-Jan-05 03:00:00	1049.912591	599.9125905
05-Jan-05 04:00:00	1037.404727	587.4047268
05-Jan-05 05:00:00	1053.066524	603.066524
05-Jan-05 06:00:00	1107.02972	657.02972
05-Jan-05 07:00:00	1212.623573	762.6235728
05-Jan-05 08:00:00	1320.327243	870.327243
05-Jan-05 09:00:00	1283.860517	833.8605165
05-Jan-05 10:00:00	1253.547484	803.5474836
05-Jan-05 11:00:00	1265.328016	815.3280159
05-Jan-05 12:00:00	1230.831241	780.8312411
05-Jan-05 13:00:00	1184.291286	734.2912858
05-Jan-05 14:00:00	1128.519134	678.5191338
05-Jan-05 15:00:00	1083.237327	633.237327
05-Jan-05 16:00:00	1025.345633	575.3456326
05-Jan-05 17:00:00	1089.071393	639.0713931
05-Jan-05 18:00:00	1135.194834	685.1948335
05-Jan-05 19:00:00	1148.622722	698.6227222
05-Jan-05 20:00:00	1254.16371	804.1637098
05-Jan-05 21:00:00	1275.095953	825.0959525
05-Jan-05 22:00:00	1204.671301	754.6713008

05-Jan-05 23:00:00	1152.611332	702.6113318
06-Jan-05 00:00:00	1115.548428	665.5484277
06-Jan-05 01:00:00	1049.688136	599.6881365
06-Jan-05 02:00:00	1011.904605	561.9046053
06-Jan-05 03:00:00	999.3459512	549.3459512
06-Jan-05 04:00:00	1007.718798	557.7187983
06-Jan-05 05:00:00	1021.198193	571.1981929
06-Jan-05 06:00:00	1079.860011	629.8600106
06-Jan-05 07:00:00	1099.035633	649.0356326
06-Jan-05 08:00:00	1243.615017	793.6150171
06-Jan-05 09:00:00	1229.011281	779.0112814
06-Jan-05 10:00:00	1245.288012	795.2880125
06-Jan-05 11:00:00	1269.268928	819.2689275
06-Jan-05 12:00:00	1273.895902	823.8959015
06-Jan-05 13:00:00	1268.895074	818.8950743
06-Jan-05 14:00:00	1217.999128	767.999128
06-Jan-05 15:00:00	1172.971317	722.9713167
06-Jan-05 16:00:00	1111.23316	661.2331604
06-Jan-05 17:00:00	1230.562059	780.5620593
06-Jan-05 18:00:00	1247.20958	797.2095805
06-Jan-05 19:00:00	1228.881866	778.8818657
06-Jan-05 20:00:00	1311.419318	861.419318
06-Jan-05 21:00:00	1311.419318	861.419318
06-Jan-05 22:00:00	1226.361492	776.3614915
06-Jan-05 23:00:00	1143.365704	693.3657035
07-Jan-05 00:00:00	1077.326551	627.3265511
07-Jan-05 01:00:00	1040.47409	590.4740902
07-Jan-05 02:00:00	995.1588872	545.1588872
07-Jan-05 03:00:00	975.8748928	525.8748928
07-Jan-05 04:00:00	980.062773	530.062773
07-Jan-05 05:00:00	1007.718798	557.7187983
07-Jan-05 06:00:00	1042.969605	592.9696046
07-Jan-05 07:00:00	1162.122862	712.1228624
07-Jan-05 08:00:00	1312.259022	862.259022
07-Jan-05 09:00:00	1333.419555	883.4195549
07-Jan-05 10:00:00	1355.278468	905.278468
07-Jan-05 11:00:00	1319.140976	869.1409757
07-Jan-05 12:00:00	1346.455884	896.4558844
07-Jan-05 13:00:00	1335.617032	885.6170325
07-Jan-05 14:00:00	1252.257551	802.2575508
07-Jan-05 15:00:00	1075.141706	625.1417064
07-Jan-05 16:00:00	1059.164643	609.1646428
07-Jan-05 17:00:00	1138.743368	688.7433679
07-Jan-05 18:00:00	1175.453651	725.4536507
07-Jan-05 19:00:00	1190.502757	740.5027575
07-Jan-05 20:00:00	1240.957685	790.9576852
07-Jan-05 21:00:00	1030.376132	580.3761319
07-Jan-05 22:00:00	956.5486332	506.5486332
07-Jan-05 23:00:00	878.825135	428.825135
08-Jan-05 00:00:00	783.3844453	333.3844453

08-Jan-05 01:00:00	719.0751552	269.0751552
08-Jan-05 02:00:00	730.0780684	280.0780684
08-Jan-05 03:00:00	716.5560684	266.5560684
08-Jan-05 04:00:00	707.2163051	257.2163051
08-Jan-05 05:00:00	717.3702345	267.3702345
08-Jan-05 06:00:00	737.7081485	287.7081485
08-Jan-05 07:00:00	795.1829679	345.1829679
08-Jan-05 08:00:00	842.9080246	392.9080246
08-Jan-05 09:00:00	916.5662452	466.5662452
08-Jan-05 10:00:00	982.6193608	532.6193608
08-Jan-05 11:00:00	1006.83198	556.8319796
08-Jan-05 12:00:00	1009.336853	559.3368528
08-Jan-05 13:00:00	1006.83198	556.8319796
08-Jan-05 14:00:00	997.6526437	547.6526437
08-Jan-05 15:00:00	1001.821295	551.8212948
08-Jan-05 16:00:00	981.7774649	531.7774649
08-Jan-05 17:00:00	1110.39257	660.3925695
08-Jan-05 18:00:00	1137.902775	687.9027754
08-Jan-05 19:00:00	1089.498356	639.4983561
08-Jan-05 20:00:00	1022.702337	572.7023367
08-Jan-05 21:00:00	976.7275527	526.7275527
08-Jan-05 22:00:00	945.3857722	495.3857722
08-Jan-05 23:00:00	872.9144055	422.9144055
09-Jan-05 00:00:00	796.0343124	346.0343124
09-Jan-05 01:00:00	757.9974979	307.9974979
09-Jan-05 02:00:00	709.773796	259.773796
09-Jan-05 03:00:00	700.471089	250.471089
09-Jan-05 04:00:00	691.1267108	241.1267108
09-Jan-05 05:00:00	691.1267108	241.1267108
09-Jan-05 06:00:00	718.2606476	268.2606476
09-Jan-05 07:00:00	737.7075963	287.7075963
09-Jan-05 08:00:00	785.936771	335.936771
09-Jan-05 09:00:00	856.3203262	406.3203262
09-Jan-05 10:00:00	923.227622	473.227622
09-Jan-05 11:00:00	949.1390449	499.1390449
09-Jan-05 12:00:00	962.5711469	512.5711469
09-Jan-05 13:00:00	962.5711469	512.5711469
09-Jan-05 14:00:00	980.9359577	530.9359577
09-Jan-05 15:00:00	971.7539884	521.7539884
09-Jan-05 16:00:00	995.1279768	545.1279768
09-Jan-05 17:00:00	1111.23316	661.2331604
09-Jan-05 18:00:00	1162.963494	712.9634941
09-Jan-05 19:00:00	1123.766166	673.7661659
09-Jan-05 20:00:00	1088.685977	638.6859769
09-Jan-05 21:00:00	1033.562248	583.5622483
09-Jan-05 22:00:00	976.6010874	526.6010874
09-Jan-05 23:00:00	852.9482708	402.9482708
10-Jan-05 00:00:00	780.0957332	330.0957332
10-Jan-05 01:00:00	733.4865726	283.4865726
10-Jan-05 02:00:00	693.6865517	243.6865517

10-Jan-05 03:00:00	683.5260221	233.5260221
10-Jan-05 04:00:00	681.9084893	231.9084893
10-Jan-05 05:00:00	718.8539209	268.8539209
10-Jan-05 06:00:00	795.1722928	345.1722928
10-Jan-05 07:00:00	914.8821102	464.8821102
10-Jan-05 08:00:00	992.6414839	542.6414839
10-Jan-05 09:00:00	998.5109011	548.5109011
10-Jan-05 10:00:00	1016.889797	566.8897968
10-Jan-05 11:00:00	1171.948282	721.9482819
10-Jan-05 12:00:00	1184.581539	734.5815391
10-Jan-05 13:00:00	1210.653952	760.6539523
10-Jan-05 14:00:00	1205.609071	755.6090705
10-Jan-05 15:00:00	1195.51922	745.5192196
10-Jan-05 16:00:00	1225.521506	775.5215063
10-Jan-05 17:00:00	1348.936571	898.9365713
10-Jan-05 18:00:00	1275.575793	825.5757933
10-Jan-05 19:00:00	1242.613302	792.6133015
10-Jan-05 20:00:00	1197.213739	747.2137389
10-Jan-05 21:00:00	1149.260169	699.2601693
10-Jan-05 22:00:00	1075.160979	625.1609792
10-Jan-05 23:00:00	990.1170712	540.1170712
11-Jan-05 00:00:00	961.438561	511.438561
11-Jan-05 01:00:00	932.1830483	482.1830483
11-Jan-05 02:00:00	995.1588872	545.1588872
11-Jan-05 03:00:00	1015.284466	565.2844663
11-Jan-05 04:00:00	1004.377426	554.3774259
11-Jan-05 05:00:00	1021.264615	571.2646147
11-Jan-05 06:00:00	1078.552772	628.5527721
11-Jan-05 07:00:00	1202.188665	752.188665
11-Jan-05 08:00:00	1337.258024	887.2580241
11-Jan-05 09:00:00	1316.419289	866.4192891
11-Jan-05 10:00:00	1338.097728	888.0977281
11-Jan-05 11:00:00	1353.935755	903.9357545
11-Jan-05 12:00:00	1326.457592	876.457592
11-Jan-05 13:00:00	1305.579502	855.5795025
11-Jan-05 14:00:00	1294.738948	844.7389476
11-Jan-05 15:00:00	1300.579036	850.5790362
11-Jan-05 16:00:00	1352.256533	902.2565328
11-Jan-05 17:00:00	1391.446296	941.4462961
11-Jan-05 18:00:00	1407.281045	957.281045
11-Jan-05 19:00:00	1375.610967	925.6109667
11-Jan-05 20:00:00	1315.579511	865.5795112
11-Jan-05 21:00:00	1267.0218	817.0218005
11-Jan-05 22:00:00	1168.807847	718.8078466
11-Jan-05 23:00:00	1091.1703	641.1702995
12-Jan-05 00:00:00	1062.809414	612.8094144
12-Jan-05 01:00:00	992.6414839	542.6414839
12-Jan-05 02:00:00	969.2288914	519.2288914
12-Jan-05 03:00:00	955.8754271	505.8754271
12-Jan-05 04:00:00	942.4808929	492.4808929

12-Jan-05 05:00:00	942.4808929	492.4808929
12-Jan-05 06:00:00	1021.020073	571.020073
12-Jan-05 07:00:00	1156.373382	706.3733824
12-Jan-05 08:00:00	1283.495022	833.4950223
12-Jan-05 09:00:00	1322.296985	872.2969854
12-Jan-05 10:00:00	1325.61787	875.6178699
12-Jan-05 11:00:00	1320.967456	870.9674556
12-Jan-05 12:00:00	1318.845712	868.8457119
12-Jan-05 13:00:00	1275.575516	825.5755156
12-Jan-05 14:00:00	1174.651915	724.6519151
12-Jan-05 15:00:00	1076.85674	626.8567397
12-Jan-05 16:00:00	1084.481926	634.4819265
12-Jan-05 17:00:00	1188.822326	738.8223261
12-Jan-05 18:00:00	1243.887459	793.887459
12-Jan-05 19:00:00	1229.984208	779.9842079
12-Jan-05 20:00:00	1225.521506	775.5215063
12-Jan-05 21:00:00	1201.372865	751.3728649
12-Jan-05 22:00:00	1129.881639	679.8816394
12-Jan-05 23:00:00	1123.177493	673.1774928
13-Jan-05 00:00:00	1029.569465	579.5694647
13-Jan-05 01:00:00	974.262521	524.262521
13-Jan-05 02:00:00	948.1324208	498.1324208
13-Jan-05 03:00:00	939.7541999	489.7541999
13-Jan-05 04:00:00	953.1671776	503.1671776
13-Jan-05 05:00:00	984.2497436	534.2497436
13-Jan-05 06:00:00	978.3722885	528.3722885
13-Jan-05 07:00:00	1005.878606	555.878606
13-Jan-05 08:00:00	1115.933955	665.9339554
13-Jan-05 09:00:00	1027.034891	577.0348908
13-Jan-05 10:00:00	1030.375978	580.375978
13-Jan-05 11:00:00	1030.375978	580.375978
13-Jan-05 12:00:00	1022.004931	572.0049308
13-Jan-05 13:00:00	1000.191132	550.1911321
13-Jan-05 14:00:00	1010.253689	560.2536893
13-Jan-05 15:00:00	996.8491314	546.8491314
13-Jan-05 16:00:00	1076.52086	626.5208598
13-Jan-05 17:00:00	1203.050017	753.0500175
13-Jan-05 18:00:00	1207.909427	757.909427
13-Jan-05 19:00:00	1176.241395	726.2413948
13-Jan-05 20:00:00	1156.985683	706.9856829
13-Jan-05 21:00:00	1119.272376	669.2723763
13-Jan-05 22:00:00	1239.900845	789.9008451
13-Jan-05 23:00:00	1173.748387	723.7483866
14-Jan-05 00:00:00	1089.071393	639.0713931
14-Jan-05 01:00:00	1042.163294	592.1632937
14-Jan-05 02:00:00	1008.563759	558.5637589
14-Jan-05 03:00:00	1003.532039	553.5320388
14-Jan-05 04:00:00	1007.718798	557.7187983
14-Jan-05 05:00:00	1040.473791	590.4737912
14-Jan-05 06:00:00	1027.035059	577.0350594



14-Jan-05 07:00:00	1026.229007	576.2290072
14-Jan-05 08:00:00	1226.999115	776.9991152
14-Jan-05 09:00:00	1274.252588	824.2525877
14-Jan-05 10:00:00	1275.095953	825.0959525
14-Jan-05 11:00:00	1234.916456	784.9164562
14-Jan-05 12:00:00	1197.182505	747.1825048
14-Jan-05 13:00:00	1146.934841	696.9348415
14-Jan-05 14:00:00	1160.361194	710.3611936
14-Jan-05 15:00:00	1146.934507	696.9345066
14-Jan-05 16:00:00	1031.220698	581.2206979
14-Jan-05 17:00:00	1126.792805	676.7928047
14-Jan-05 18:00:00	1182.109988	732.1099876
14-Jan-05 19:00:00	1146.934841	696.9348415
14-Jan-05 20:00:00	1133.506842	683.5068424
14-Jan-05 21:00:00	1095.825673	645.8256726
14-Jan-05 22:00:00	1171.645746	721.6457463
14-Jan-05 23:00:00	1131.857403	681.857403
15-Jan-05 00:00:00	1044.62032	594.6203202
15-Jan-05 01:00:00	1007.718798	557.7187983
15-Jan-05 02:00:00	1008.563687	558.5636867
15-Jan-05 03:00:00	1020.315164	570.3151645
15-Jan-05 04:00:00	1001.842272	551.8422725
15-Jan-05 05:00:00	1001.726988	551.726988
15-Jan-05 06:00:00	1026.229007	576.2290072
15-Jan-05 07:00:00	1058.057098	608.0570979
15-Jan-05 08:00:00	1107.369409	657.3694087
15-Jan-05 09:00:00	1128.106231	678.1062308
15-Jan-05 10:00:00	1172.159379	722.1593787
15-Jan-05 11:00:00	1178.81528	728.8152796
15-Jan-05 12:00:00	1182.961326	732.961326
15-Jan-05 13:00:00	1163.867155	713.8671547
15-Jan-05 14:00:00	1150.591018	700.5910182
15-Jan-05 15:00:00	1140.623758	690.6237579
15-Jan-05 16:00:00	1159.720845	709.720845
15-Jan-05 17:00:00	1264.373468	814.373468
15-Jan-05 18:00:00	1288.474863	838.4748627
15-Jan-05 19:00:00	1308.35441	858.3544098
15-Jan-05 20:00:00	1271.760889	821.7608887
15-Jan-05 21:00:00	1236.564876	786.564876
15-Jan-05 22:00:00	1184.602872	734.6028723
15-Jan-05 23:00:00	1111.713019	661.7130186
16-Jan-05 00:00:00	1050.532926	600.5329257
16-Jan-05 01:00:00	983.4048376	533.4048376
16-Jan-05 02:00:00	950.6695028	500.6695028
16-Jan-05 03:00:00	941.4075206	491.4075206
16-Jan-05 04:00:00	927.9927054	477.9927054
16-Jan-05 05:00:00	922.9574419	472.9574419
16-Jan-05 06:00:00	902.8111811	452.8111811
16-Jan-05 07:00:00	912.0391415	462.0391415
16-Jan-05 08:00:00	1011.098333	561.0983328

16-Jan-05 09:00:00	1092.448704	642.4487042
16-Jan-05 10:00:00	1153.862523	703.8625231
16-Jan-05 11:00:00	1196.272258	746.2722582
16-Jan-05 12:00:00	1182.162492	732.162492
16-Jan-05 13:00:00	1182.162492	732.162492
16-Jan-05 14:00:00	1158.884038	708.8840376
16-Jan-05 15:00:00	1163.030084	713.0300841
16-Jan-05 16:00:00	1195.436084	745.4360844
16-Jan-05 17:00:00	1255.249116	805.249116
16-Jan-05 18:00:00	1285.139731	835.1397308
16-Jan-05 19:00:00	1227.324113	777.3241131
16-Jan-05 20:00:00	1203.89401	753.8940096
16-Jan-05 21:00:00	1156.141676	706.1416758
16-Jan-05 22:00:00	1078.209742	628.2097425
16-Jan-05 23:00:00	984.1616982	534.1616982
17-Jan-05 00:00:00	940.3687057	490.3687057
17-Jan-05 01:00:00	904.0818517	454.0818517
17-Jan-05 02:00:00	867.8546135	417.8546135
17-Jan-05 03:00:00	863.604746	413.604746
17-Jan-05 04:00:00	873.7261923	423.7261923
17-Jan-05 05:00:00	893.1151462	443.1151462
17-Jan-05 06:00:00	946.8811321	496.8811321
17-Jan-05 07:00:00	1065.062266	615.0622662
17-Jan-05 08:00:00	1192.985129	742.9851287
17-Jan-05 09:00:00	1229.721731	779.7217312
17-Jan-05 10:00:00	1268.894874	818.8948737
17-Jan-05 11:00:00	1264.733567	814.7335671
17-Jan-05 12:00:00	1269.734824	819.7348241
17-Jan-05 13:00:00	1276.2608	826.2608
17-Jan-05 14:00:00	1271.21814	821.2181401
17-Jan-05 15:00:00	1259.732362	809.7323618
17-Jan-05 16:00:00	1273.056217	823.0562174
17-Jan-05 17:00:00	1348.936571	898.9365713
17-Jan-05 18:00:00	1360.652264	910.6522642
17-Jan-05 19:00:00	1303.098188	853.0981884
17-Jan-05 20:00:00	1241.405846	791.4058456
17-Jan-05 21:00:00	1213.836564	763.8365636
17-Jan-05 22:00:00	1127.93116	677.9311605
17-Jan-05 23:00:00	1011.971238	561.9712379

**Attachment 3 Hourly MW load curve data from May 20 to June 2 04**

Date/time	BUT units out	BUT units in
20-May-04 00:00:00	716.0227071	266.0227071
20-May-04 01:00:00	635.4582958	185.4582958
20-May-04 02:00:00	590.302297	140.302297
20-May-04 03:00:00	575.3089128	125.3089128
20-May-04 04:00:00	566.4516847	116.4516847
20-May-04 05:00:00	592.0823654	142.0823654
20-May-04 06:00:00	663.3938051	213.3938051
20-May-04 07:00:00	784.3803594	334.3803594
20-May-04 08:00:00	929.4069115	479.4069115
20-May-04 09:00:00	1002.715208	552.7152079
20-May-04 10:00:00	1038.662704	588.6627036
20-May-04 11:00:00	1091.041407	641.0414066
20-May-04 12:00:00	1093.292708	643.2927083
20-May-04 13:00:00	1089.071393	639.0713931
20-May-04 14:00:00	1088.226969	638.2269689
20-May-04 15:00:00	1083.237327	633.237327
20-May-04 16:00:00	1074.548629	624.5486285
20-May-04 17:00:00	1047.406359	597.4063592
20-May-04 18:00:00	1039.772901	589.7729006
20-May-04 19:00:00	994.5982401	544.5982401
20-May-04 20:00:00	969.9972194	519.9972194
20-May-04 21:00:00	934.6020059	484.6020059
20-May-04 22:00:00	969.9578409	519.9578409
20-May-04 23:00:00	867.5409717	417.5409717
21-May-04 00:00:00	789.6193987	339.6193987
21-May-04 01:00:00	748.6571012	298.6571012
21-May-04 02:00:00	711.8158715	261.8158715
21-May-04 03:00:00	702.5524636	252.5524636
21-May-04 04:00:00	692.4367787	242.4367787
21-May-04 05:00:00	713.5209955	263.5209955
21-May-04 06:00:00	760.787249	310.787249
21-May-04 07:00:00	836.5774284	386.5774284
21-May-04 08:00:00	948.26603	498.26603
21-May-04 09:00:00	1012.543489	562.543489
21-May-04 10:00:00	1041.234222	591.2342218
21-May-04 11:00:00	1050.270489	600.2704887
21-May-04 12:00:00	1066.644723	616.6447233
21-May-04 13:00:00	1056.36813	606.3681304
21-May-04 14:00:00	1052.803081	602.8030811
21-May-04 15:00:00	1038.076327	588.0763266
21-May-04 16:00:00	1028.514739	578.5147394
21-May-04 17:00:00	1032.720949	582.7209488
21-May-04 18:00:00	1023.543729	573.5437288
21-May-04 19:00:00	1006.793329	556.7933286
21-May-04 20:00:00	976.7275527	526.7275527
21-May-04 21:00:00	983.4227574	533.4227574
21-May-04 22:00:00	935.2657445	485.2657445

21-May-04 23:00:00	881.8125148	431.8125148
22-May-04 00:00:00	788.468982	338.468982
22-May-04 01:00:00	748.2939781	298.2939781
22-May-04 02:00:00	709.2506197	259.2506197
22-May-04 03:00:00	694.1364342	244.1364342
22-May-04 04:00:00	694.986195	244.986195
22-May-04 05:00:00	699.1930825	249.1930825
22-May-04 06:00:00	705.9108564	255.9108564
22-May-04 07:00:00	725.5641295	275.5641295
22-May-04 08:00:00	785.8734387	335.8734387
22-May-04 09:00:00	833.854576	383.854576
22-May-04 10:00:00	887.6757835	437.6757835
22-May-04 11:00:00	890.6424367	440.6424367
22-May-04 12:00:00	916.3079197	466.3079197
22-May-04 13:00:00	909.2234963	459.2234963
22-May-04 14:00:00	893.153282	443.153282
22-May-04 15:00:00	881.334664	431.334664
22-May-04 16:00:00	870.3646046	420.3646046
22-May-04 17:00:00	865.6141019	415.6141019
22-May-04 18:00:00	870.6430604	420.6430604
22-May-04 19:00:00	845.8683608	395.8683608
22-May-04 20:00:00	833.2307284	383.2307284
22-May-04 21:00:00	834.303019	384.303019
22-May-04 22:00:00	877.6197396	427.6197396
22-May-04 23:00:00	849.2827002	399.2827002
23-May-04 00:00:00	780.0938434	330.0938434
23-May-04 01:00:00	732.4099756	282.4099756
23-May-04 02:00:00	702.1745386	252.1745386
23-May-04 03:00:00	692.8691259	242.8691259
23-May-04 04:00:00	682.6702021	232.6702021
23-May-04 05:00:00	678.4398318	228.4398318
23-May-04 06:00:00	668.2742753	218.2742753
23-May-04 07:00:00	674.3972064	224.3972064
23-May-04 08:00:00	712.3143601	262.3143601
23-May-04 09:00:00	776.2715695	326.2715695
23-May-04 10:00:00	812.0402126	362.0402126
23-May-04 11:00:00	849.0477831	399.0477831
23-May-04 12:00:00	863.1264496	413.1264496
23-May-04 13:00:00	840.6424194	390.6424194
23-May-04 14:00:00	828.863895	378.863895
23-May-04 15:00:00	818.7771036	368.7771036
23-May-04 16:00:00	823.8221472	373.8221472
23-May-04 17:00:00	849.0322678	399.0322678
23-May-04 18:00:00	854.9209179	404.9209179
23-May-04 19:00:00	835.5631499	385.5631499
23-May-04 20:00:00	799.6844346	349.6844346
23-May-04 21:00:00	823.1143486	373.1143486
23-May-04 22:00:00	846.2387781	396.2387781
23-May-04 23:00:00	785.1642296	335.1642296
24-May-04 00:00:00	746.0228362	296.0228362

24-May-04 01:00:00	700.471089	250.471089
24-May-04 02:00:00	666.5065668	216.5065668
24-May-04 03:00:00	651.9008136	201.9008136
24-May-04 04:00:00	643.4702723	193.4702723
24-May-04 05:00:00	651.9008136	201.9008136
24-May-04 06:00:00	646.6970953	196.6970953
24-May-04 07:00:00	679.6714346	229.6714346
24-May-04 08:00:00	713.8149503	263.8149503
24-May-04 09:00:00	788.4567137	338.4567137
24-May-04 10:00:00	851.2980159	401.2980159
24-May-04 11:00:00	894.6203707	444.6203707
24-May-04 12:00:00	911.2964154	461.2964154
24-May-04 13:00:00	910.4644666	460.4644666
24-May-04 14:00:00	894.4269019	444.4269019
24-May-04 15:00:00	889.3895986	439.3895986
24-May-04 16:00:00	884.3502379	434.3502379
24-May-04 17:00:00	906.0013968	456.0013968
24-May-04 18:00:00	916.9552495	466.9552495
24-May-04 19:00:00	900.7739048	450.7739048
24-May-04 20:00:00	891.4535176	441.4535176
24-May-04 21:00:00	899.6483285	449.6483285
24-May-04 22:00:00	917.1128254	467.1128254
24-May-04 23:00:00	821.3876432	371.3876432
25-May-04 00:00:00	747.2631188	297.2631188
25-May-04 01:00:00	685.2311369	235.2311369
25-May-04 02:00:00	679.2981675	229.2981675
25-May-04 03:00:00	682.4433113	232.4433113
25-May-04 04:00:00	677.852292	227.852292
25-May-04 05:00:00	674.2146784	224.2146784
25-May-04 06:00:00	689.4581137	239.4581137
25-May-04 07:00:00	813.8919912	363.8919912
25-May-04 08:00:00	959.2039009	509.2039009
25-May-04 09:00:00	1007.11195	557.1119502
25-May-04 10:00:00	1192.072319	742.0723188
25-May-04 11:00:00	1229.828523	779.8285228
25-May-04 12:00:00	1210.514164	760.5141639
25-May-04 13:00:00	1208.87206	758.8720596
25-May-04 14:00:00	1199.668291	749.6682908
25-May-04 15:00:00	1190.464269	740.4642694
25-May-04 16:00:00	1216.357079	766.357079
25-May-04 17:00:00	1253.890933	803.8909326
25-May-04 18:00:00	1267.867208	817.8672078
25-May-04 19:00:00	1037.619359	587.6193592
25-May-04 20:00:00	1023.80992	573.8099201
25-May-04 21:00:00	1011.122935	561.1229354
25-May-04 22:00:00	972.5983414	522.5983414
25-May-04 23:00:00	851.1869605	401.1869605
26-May-04 00:00:00	782.7271747	332.7271747
26-May-04 01:00:00	737.0886239	287.0886239
26-May-04 02:00:00	707.9372035	257.9372035

26-May-04 03:00:00	709.6283808	259.6283808
26-May-04 04:00:00	699.5570068	249.5570068
26-May-04 05:00:00	718.0440483	268.0440483
26-May-04 06:00:00	798.0954169	348.0954169
26-May-04 07:00:00	861.3396896	411.3396896
26-May-04 08:00:00	964.8586183	514.8586183
26-May-04 09:00:00	1012.413197	562.4131967
26-May-04 10:00:00	975.0964758	525.0964758
26-May-04 11:00:00	1019.50869	569.5086904
26-May-04 12:00:00	1034.388957	584.3889569
26-May-04 13:00:00	1028.070676	578.0706755
26-May-04 14:00:00	1020.315164	570.3151645
26-May-04 15:00:00	1009.408647	559.4086474
26-May-04 16:00:00	1004.212057	554.2120565
26-May-04 17:00:00	1017.910146	567.910146
26-May-04 18:00:00	1014.231158	564.2311576
26-May-04 19:00:00	945.0585909	495.0585909
26-May-04 20:00:00	911.626259	461.626259
26-May-04 21:00:00	916.7293732	466.7293732
26-May-04 22:00:00	885.4870751	435.4870751
26-May-04 23:00:00	786.1919338	336.1919338
27-May-04 00:00:00	738.7629409	288.7629409
27-May-04 01:00:00	714.7821104	264.7821104
27-May-04 02:00:00	687.7926164	237.7926164
27-May-04 03:00:00	662.6879694	212.6879694
27-May-04 04:00:00	639.2603777	189.2603777
27-May-04 05:00:00	652.7565212	202.7565212
27-May-04 06:00:00	723.6396635	273.6396635
27-May-04 07:00:00	755.8016357	305.8016357
27-May-04 08:00:00	850.9490597	400.9490597
27-May-04 09:00:00	898.6351258	448.6351258
27-May-04 10:00:00	1003.250734	553.2507336
27-May-04 11:00:00	1022.113081	572.1130807
27-May-04 12:00:00	1019.375708	569.3757078
27-May-04 13:00:00	901.5195362	451.5195362
27-May-04 14:00:00	893.9757624	443.9757624
27-May-04 15:00:00	886.4308839	436.4308839
27-May-04 16:00:00	877.7250161	427.7250161
27-May-04 17:00:00	952.1483628	502.1483628
27-May-04 18:00:00	1030.294651	580.2946513
27-May-04 19:00:00	1015.049321	565.0493211
27-May-04 20:00:00	970.1036982	520.1036982
27-May-04 21:00:00	989.2819899	539.2819899
27-May-04 22:00:00	985.2367991	535.2367991
27-May-04 23:00:00	930.5293494	480.5293494
28-May-04 00:00:00	829.8631044	379.8631044
28-May-04 01:00:00	766.4344981	316.4344981
28-May-04 02:00:00	725.8392951	275.8392951
28-May-04 03:00:00	714.7778102	264.7778102
28-May-04 04:00:00	716.3525323	266.3525323

28-May-04 05:00:00	734.9191372	284.9191372
28-May-04 06:00:00	783.4210785	333.4210785
28-May-04 07:00:00	917.3694978	467.3694978
28-May-04 08:00:00	1052.418028	602.4180284
28-May-04 09:00:00	978.0462797	528.0462797
28-May-04 10:00:00	1054.006934	604.0069343
28-May-04 11:00:00	1051.947149	601.9471485
28-May-04 12:00:00	1098.320331	648.3203313
28-May-04 13:00:00	1104.191461	654.1914611
28-May-04 14:00:00	1085.73225	635.7322497
28-May-04 15:00:00	1057.506683	607.5066828
28-May-04 16:00:00	993.6119519	543.6119519
28-May-04 17:00:00	1026.597728	576.597728
28-May-04 18:00:00	1007.904343	557.9043434
28-May-04 19:00:00	1008.270408	558.2704082
28-May-04 20:00:00	976.2752128	526.2752128
28-May-04 21:00:00	978.4043245	528.4043245
28-May-04 22:00:00	999.2971287	549.2971287
28-May-04 23:00:00	967.2963029	517.2963029
29-May-04 00:00:00	852.1551773	402.1551773
29-May-04 01:00:00	738.78532	288.78532
29-May-04 02:00:00	694.2863573	244.2863573
29-May-04 03:00:00	656.8343402	206.8343402
29-May-04 04:00:00	665.935685	215.935685
29-May-04 05:00:00	665.935685	215.935685
29-May-04 06:00:00	685.2886365	235.2886365
29-May-04 07:00:00	761.6712271	311.6712271
29-May-04 08:00:00	805.2204813	355.2204813
29-May-04 09:00:00	854.7288388	404.7288388
29-May-04 10:00:00	886.0055435	436.0055435
29-May-04 11:00:00	910.3475533	460.3475533
29-May-04 12:00:00	912.8847674	462.8847674
29-May-04 13:00:00	902.8111811	452.8111811
29-May-04 14:00:00	909.5465095	459.5465095
29-May-04 15:00:00	895.5737646	445.5737646
29-May-04 16:00:00	880.9669719	430.9669719
29-May-04 17:00:00	890.2360428	440.2360428
29-May-04 18:00:00	907.0494961	457.0494961
29-May-04 19:00:00	896.5131674	446.5131674
29-May-04 20:00:00	881.1990555	431.1990555
29-May-04 21:00:00	895.6601484	445.6601484
29-May-04 22:00:00	873.7403914	423.7403914
29-May-04 23:00:00	866.8525627	416.8525627
30-May-04 00:00:00	833.1467068	383.1467068
30-May-04 01:00:00	810.3471369	360.3471369
30-May-04 02:00:00	774.1753722	324.1753722
30-May-04 03:00:00	767.9944441	317.9944441
30-May-04 04:00:00	751.6725564	301.6725564
30-May-04 05:00:00	751.4324018	301.4324018
30-May-04 06:00:00	747.1721807	297.1721807

30-May-04 07:00:00	765.01289	315.01289
30-May-04 08:00:00	835.3932047	385.3932047
30-May-04 09:00:00	858.980528	408.980528
30-May-04 10:00:00	925.8342943	475.8342943
30-May-04 11:00:00	935.3514438	485.3514438
30-May-04 12:00:00	919.0542871	469.0542871
30-May-04 13:00:00	910.7445874	460.7445874
30-May-04 14:00:00	899.4637745	449.4637745
30-May-04 15:00:00	891.0820402	441.0820402
30-May-04 16:00:00	869.2342939	419.2342939
30-May-04 17:00:00	906.7376649	456.7376649
30-May-04 18:00:00	923.9226299	473.9226299
30-May-04 19:00:00	901.9637968	451.9637968
30-May-04 20:00:00	917.9204453	467.9204453
30-May-04 21:00:00	937.1312073	487.1312073
30-May-04 22:00:00	957.519941	507.519941
30-May-04 23:00:00	854.7542558	404.7542558
31-May-04 00:00:00	813.7840131	363.7840131
31-May-04 01:00:00	807.0175416	357.0175416
31-May-04 02:00:00	780.8256987	330.8256987
31-May-04 03:00:00	759.9834945	309.9834945
31-May-04 04:00:00	759.9834945	309.9834945
31-May-04 05:00:00	779.2494172	329.2494172
31-May-04 06:00:00	840.5314348	390.5314348
31-May-04 07:00:00	916.0650927	466.0650927
31-May-04 08:00:00	960.7369764	510.7369764
31-May-04 09:00:00	992.6618508	542.6618508
31-May-04 10:00:00	1100.814551	650.8145515
31-May-04 11:00:00	1077.364819	627.3648192
31-May-04 12:00:00	1088.264531	638.2645305
31-May-04 13:00:00	1076.52013	626.5201298
31-May-04 14:00:00	1120.115994	670.1159937
31-May-04 15:00:00	1115.933621	665.9336212
31-May-04 16:00:00	1115.933621	665.9336212
31-May-04 17:00:00	1115.933621	665.9336212
31-May-04 18:00:00	1079.457044	629.4570443
31-May-04 19:00:00	949.6849007	499.6849007
31-May-04 20:00:00	938.7017852	488.7017852
31-May-04 21:00:00	981.7145469	531.7145469
31-May-04 22:00:00	971.4164485	521.4164485
31-May-04 23:00:00	860.2032575	410.2032575
01-Jun-04 00:00:00	801.0996089	351.0996089
01-Jun-04 01:00:00	832.3409941	382.3409941
01-Jun-04 02:00:00	800.4439932	350.4439932
01-Jun-04 03:00:00	758.1767731	308.1767731
01-Jun-04 04:00:00	749.4895975	299.4895975
01-Jun-04 05:00:00	767.5069817	317.5069817
01-Jun-04 06:00:00	775.8679869	325.8679869
01-Jun-04 07:00:00	878.0044249	428.0044249
01-Jun-04 08:00:00	941.6374627	491.6374627



01-Jun-04 09:00:00	938.6681834	488.6681834
01-Jun-04 10:00:00	986.0458242	536.0458242
01-Jun-04 11:00:00	1001.837531	551.8375309
01-Jun-04 12:00:00	1014.439147	564.4391466
01-Jun-04 13:00:00	1039.505303	589.5053026
01-Jun-04 14:00:00	1025.225114	575.2251144
01-Jun-04 15:00:00	1020.216426	570.2164257
01-Jun-04 16:00:00	1030.23511	580.2351103
01-Jun-04 17:00:00	1028.551605	578.5516048
01-Jun-04 18:00:00	1011.94258	561.9425799
01-Jun-04 19:00:00	961.4373275	511.4373275
01-Jun-04 20:00:00	937.8502222	487.8502222
01-Jun-04 21:00:00	951.6556042	501.6556042
01-Jun-04 22:00:00	966.4929322	516.4929322
01-Jun-04 23:00:00	911.6561627	461.6561627
02-Jun-04 00:00:00	833.4743779	383.4743779
02-Jun-04 01:00:00	787.5616226	337.5616226
02-Jun-04 02:00:00	766.6636555	316.6636555
02-Jun-04 03:00:00	748.8491895	298.8491895
02-Jun-04 04:00:00	760.5513841	310.5513841
02-Jun-04 05:00:00	742.1115272	292.1115272
02-Jun-04 06:00:00	812.7503547	362.7503547
02-Jun-04 07:00:00	918.2027182	468.2027182
02-Jun-04 08:00:00	975.1503478	525.1503478
02-Jun-04 09:00:00	1025.525913	575.525913
02-Jun-04 10:00:00	1088.910299	638.910299
02-Jun-04 11:00:00	1115.00749	665.0074897
02-Jun-04 12:00:00	1124.796271	674.7962708
02-Jun-04 13:00:00	1130.617944	680.6179444
02-Jun-04 14:00:00	1121.486403	671.4864034
02-Jun-04 15:00:00	1111.517156	661.5171562
02-Jun-04 16:00:00	1114.827248	664.8272477
02-Jun-04 17:00:00	1125.015125	675.0151249
02-Jun-04 18:00:00	1119.113729	669.1137292
02-Jun-04 19:00:00	1062.216697	612.2166971
02-Jun-04 20:00:00	1036.180737	586.180737
02-Jun-04 21:00:00	1005.222558	555.2225578
02-Jun-04 22:00:00	1050.254691	600.2546914
02-Jun-04 23:00:00	991.5825788	541.5825788

## Attachment 4 Output from running the SPARE program

Thu Jun 2 15:46:29 2005

System Input Summary:

Your input file for this run is: mdn.dat

Probability Analysis Only  
(No Probabilistic Cost Analysis)

RELIABILITY MODEL: REPAIRABLE AND NON-REPAIRABLE  
(Only aging failures for non-repairable)  
(Posteriori normal distribution for aging failures)

Analysis starting year : 2005  
Subsequent operating years : 1.0  
Component mean life : 45.0  
Mean life standard deviation : 13.0  
Number of components : 2

### Component Data

Component ID	In-serv Year	Oper Year	Fail Freq. (f/yr)	Repair Time (hr/f)	Chance Fail rate (f/yr)	Adjustment Coefficient
MDNT1	1976	29	0.333	23.0		1.000
MDNT3	1977	28	0.167	14.4		1.000

- \* "Fail Freq." and "Repair Time" are failure frequency and repair time for repairable failures.
- \* "Chance Fail rate" is chance failure rate for non-repairable failures.
- \* Adjustment coefficient is a percentage factor for probability to failure and unavailability of aging failure

Output:

Component Availability/Unavailability

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Component	Repairable		Non-Repairable			
Total	Avail.	Unavail	Availability	Unavailability	Chance	Aging
ID	Avail.	Unavail	Chance	Aging	Chance	Aging
MDNT1	0.99913	0.00087	0.99167	0.00833	0.99080	0.00920
MDNT3	0.99973	0.00027	0.99254	0.00746	0.99227	0.00773

---

- \* "Availability" is average probability being found available during a given period (i.e., "subsequent years" in input data).
  - \* "Unavailability" is average probability being found unavailable during a given period.
  - \* "Chance" refers to non-repairable chance failure.
  - \* "Aging" refers to non-repairable aging failure.
- 

Component Survival/Failure Probability

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Component	Chance		Aging		Toatal	
ID	Surv. Prob.	Prob. to Fail.	Surv. Prob.	Prob. to Fail.	Surv. Prob.	Pro. to Fail.
MDNT1			0.98307	0.01693	0.98307	0.01693
MDNT3			0.98484	0.01516	0.98484	0.01516

---

- \* "Surv. Prob." is probability that a component still has survived by the end of the given period (never failed).
  - \* "Prob. to Fail." is probability that a component has failed at some point within the given period.
  - \* "Chance" refers to non-repairable chance failure.
  - \* "Aging" refers to non-repairable aging failure.
-

## Attachment 5 Spreadsheets for calculating risk indices

### Calculations for double forced outage events

sum of first 9 hrs	9488.942045	5438.942045
sum of first 12 hrs	13366.2106	7966.210599
sum of 13 and 14 hrs		1684.301992
sum of 13 to 22 hrs		7544.355472
sum of 13 hrs to 168 hrs)		95060.49803

	recovery time	failure freq.	unavailability	recovery time (years)
T1 repairable failure	23 hrs	0.3	0.00079	0.002625571
T3 repair failure	14 hrs	0.15	0.00024	0.001598174
T1 aging failure	14 days	0.217175	0.00833	0.038356164
T3 aging failure	14 days	0.194492857	0.00746	0.038356164

Risk analysis - risk due to forced double outages

Outage events	failure freq.	recovery time	EENS (MWh)
T1 and T3 repairable failures	0.000190068	8.702702703	1.803548916
T1 repairable, T3 aging failures	0.002391196	21.5264624	50.00127091
T1 aging, T3 repairable failures	0.001301563	13.44	19.58918279
T1 and T3 aging failures	0.003240251	168	351.3297511
total	0.007123078		422.7237537

Loss analysis	loss in \$
BCH revenue loss at \$60/MWh	25363.42522
Social damage at \$2000/MWh	845447.5074

Note:

1. It is assumed that the MDN substation meets the single contingency criterion - one transformer can carry all loads
2. The load curve is based on actual load profile in last fiscal year and retrieved from PI system (April 1, 2004 to March 2005)
3. Both repairable and aging failure modes are considered. Repairable failure data is based on last 20 year's records on MDN T1 and T3.
4. Aging failure is based on the Weibull model with the assumption of 45 year's mean life and 13 year's standard deviation.
5. It is assumed that double contingency events happen in January.
6. After the two transformers fails, it takes 12 hours for BUT to pick up 450 MW.
7. The average repair time is one day for T1 and 14 hours for T3.
8. A fatal failure requires 14 days to complete the replacement.

### Calculations for single forced outage events during one transformer in maintenance

sum of first 12 hrs	9185.226657	3785.226657
sum of 13 and 14 hrs		1282.364101
sum of 13 to 23 hrs		6434.711592
sum of 13 hr to end 4 days)		34883.97691

	recovery time	failure freq.	unavailability
T1 repairable failure	23 hrs	0.3	0.00079
T3 repair failure	14 hrs	0.15	0.00024
T1 aging failure	14 days	0.217175	0.00833
T3 aging failure	14 days	0.194492857	0.00746
T1 maintenance	4 days		
T3 maintenance	4 days		

Risk analysis - risk due to one planned maintenance and one forced outage

Outage events	failure freq.	recovery time	EENS (MWh)
T1 maintenance, T3 repairable failure	0.001643836	14 hrs	17.20699851
T1 maintenance, T3 aging failure	0.002131429	4 days	93.9303596
T3 maintenance, T1 repairable failure	0.003287671	23 hrs	51.35322164
T3 maintenance, T1 aging failure	0.00238	4 days	104.8847045
total	0.009442935		267.3752842

  

Loss analysis	loss in \$
BCH revenue loss at \$60/MWh	16042.51705
Social damage at \$2000/MWh	534750.5685

Note:

1. It is assumed that the MDN substation meets the single contingency criterion - one transformer can carry all loads
2. The load curve is based on actual load profile in last fiscal year and retrieved from PI system (April 1, 2004 to March 2005)
3. Both repairable and aging failure modes are considered. Repairable failure data is based on last 20 year's records on MDN T1 and T3.
4. Aging failure is based on the Weibull model with the assumption of 45 year's mean life and 13 year's standard deviation.
5. It is assumed that maintenance activities will happen in May.
6. After the two transformers fails, it takes 12 hours for BUT to pick up 450 MW.
7. The average repair time is one day for T1 and 14 hours for T3.
8. A fatal failure requires 14 days to complete the replacement.
9. The maintenance duration is assumed to be 4 days.