REFERENCES

[1] The World Bank Official Web Site, http://data.worldbank.org/

[2] Ceylon Electricity Board, "Annual Report, 2012"

[3] B.W. Kennedy, *Energy Efficient Transformers*,1998, McGraw Hill Companies, Inc, United States of America

[4] Ceylon Electricity Board, Statistical Unit, "Statistical Digest, 2013"

[5] Pavlos. S. Georgilakis," Environmental cost of distribution transformer losses" Applied Energy 88 (2011) 3146–3155.

[6] CEB Specification, 108-1:2014_5 MVA 33 kV\11 kV Power Transformer with on load Tap Changer.

[7] CEB standard, 108-1:2014_5 MVA 33 kV\11 kV Power Transformer with on load Tap Changer.

[8] CEB Specification, 098_2000_MEDIUM VOLTAGE DISTRIBUTION TRANSFORMERS.

[9] Loss evaluation guide, IEEE C57.120-1991

[10] CEB, MEDIUM VOLTAGE DISTRIBUTION SYSTEM DEVELOPMENT PLAN 2014/2023, DISTRIBUTION DIVISION 03.

[11] Bulk Supply Tariff Forecast based on Tariff Methodology, 2011, Deputy General Manager (Energy Marketing Branch)

[12] Central Bank of Sri Lanka web site, www.cbsl.gov.lk

[13] Ceylon Electricity Board, "Annual Report, 2011"

[14] D.J. Downing, B.W. Mcconnell, P.R. Barns, S.W Hadley, J.W. Van Dyke; Economic analysis of efficient distribution transformer trends,1998, Oak Ridge National Laboratory, ORNL-6927.

[15] NEMA Standards publication TP 1-2002, Guide for Determining Energy Efficiency of Distribution Transformers. National Electrical Manufacturers Association. Rosslyn, Virginia

[16] Ceylon Electricity Board, Statistical Unit, "Statistical Digest, 2002-2012

[17] B.W. Mcconnell, P.R. Barns, S. Das J.W. Van Dyke; Supplement to the "Determination Analysis" (ORNL-6847) and Analysis of the NEMA Efficiency Standard for Distribution Transformers, 1998, Oak Ridge National Laboratory, ORNL-6927.

[18] Tender specifications. (2013), Lanka Transformers Limited

[19] Super Star Engineering Ltd. (2014) Distribution-Transformers [online] Available from;http://superstarengineering.com/11-415kv-distribution-transformer [Accessed: 10th April 2015]

[20] Mustafa, K. M., Tahreen T. C., & Siban S. (2013) Energy Subsidies in Bangladesh: A profile of groups vulnerable to reform. Bangladesh Institute of Development Studies. *Research Report*. International Institute for Sustainable Development.

[21] General Electric Manufacturing Company Limited. (2013) Distribution-Transformers price list [online] Available from;http://www.gemco.gov.bd/index.php?option=staticpagemanager&task=price_list [Accessed: 26 th April 2015]

[22] Ceylon Electricity Board, "Price List, 2013"

APPENDIX 01

Monthly Inflation Percentage Rates Year 2010-2013 [12]

	Year			
Month	**2010**	**2011**	**2012**	**2013**
January	3.2	6.1	6.5	8.1
February	3.3	6.1	6.1	8.6
March	3.4	6.2	5.9	8.8
April	3.8	6.4	5.7	8.8
May	3.9	6.6	5.6	8.8
June	4.3	6.7	5.8	8.6
July	4.6	7.0	6.0	8.3
August	4.9	7.1	6.3	8.0
September	5.3	7.2	6.5	7.8
October	5.7	7.1	6.8	7.6
November	6.1	6.9	7.2	7.3
December	6.2	6.7	7.6	6.9

APPENDIX 02

Monthly Average Weighted Fixed Deposit Percentage Rates, Year 2010-2013 [12]

	Year			
Month	**2010**	**2011**	**2012**	**2013**
January	10.46	8.16	9.11	13.53
February	9.99	8.14	9.37	13.82
March	9.71	8.17	9.84	13.94
April	9.61	8.16	10.56	13.83
May	9.50	8.24	10.38	13.90
June	9.40	8.22	10.78	13.61
July	9.28	8.16	11.27	13.36
August	9.17	8.11	11.54	12.82
September	8.68	8.11	11.92	12.57
October	8.48	8.12	12.32	12.38
November	8.17	8.21	12.78	11.96
December	8.20	8.95	13.21	11.78

APPENDIX 03

Data (Demand in 'W') of Mapalana Distribution Transformer- C056 (160 kVA)

Time/ Date	2013.05.11	2013.05.12	2013.05.13	2013.05.14	2013.05.15	2013.05.16	2013.05.17
0:00	13116.58	12816.39	12374.91	12968.63	14461.01	13068.36	14773.03
0:15	12774.88	12394.48	11393.47	12051.27	13357.21	13398.5	14536.71
0:30	11977.3	12025.2	11259.93	12084.17	12944.55	12737.68	14218.66
0:45	11374.97	11979.02	11266.38	11934.72	12742.84	12534.41	14435.85
1:00	11289.6	11954.08	11145.95	11617.97	12702.41	12325.45	13418.5
1:15	11144.23	11972.73	11094.35	11897.73	12317.71	12658.98	13373.77
1:30	10838.61	11606.57	11062.25	11634.69	12175.35	12744.99	13171.85
1:45	10824.68	11445.51	11221.86	11610.87	11943.97	12892.72	13250.34
2:00	10578.89	11561.63	11127.03	11468.73	11909.78	12607.15	13084.33
2:15	10548.14	11590.44	11156.71	11328.95	11951.92	12416.41	13213.13
2:30	10654.37	11566.57	11133.48	11404	12135.78	12435.98	13184.32
2:45	10935.86	11916.44	11142.73	11299.06	12440.28	12502.37	13097.01
3:00	10763.77	11461.63	10854.36	11286.16	12984.33	12514.04	13127.55
3:15	10527.93	11648.93	10816.51	11297.99	12821.76	12502.37	13026.26
3:30	10405.3	11483.35	10652.44	11105.31	12694.03	12535.97	13035.73
3:45	10452.67	11639.04	10948.12	11154.13	12508.88	12516.62	12799.77
4:00	10521.26	11894.51	11015.43	11638.18	12627.15	12778.75	12939.17
4:15	10451.81	11901.82	10986.4	11900.75	12927.35	12451.25	12991.86
4:30	10684.48	12351.25	11206.38	12139.65	14149.2	12872.94	13132.49
4:45	11116.49	12686.5	12184.81	13984.27	14490.69	13745.79	13196.36
5:00	11566.57	13143.46	12926	16963.22	14719.49	14854.75	13405.33
5:15	13221.31	14366.82	13786.65	17709.41	14908.08	16180.69	14071.36
5:30	16166.49	15073.88	14376.5	15342.03	16846.88	17952.19	15085.92
5:45	18726.12	16975.26	19264.36	17102.56	17085.79	20846.84	16814.84
6:00	18468.07	21660.77	18345.92	16466.05	16899.08	22268.26	18116.48
6:15	20092.27	18871.27	18553.65	15001.41	16392.72	21461.16	17217.82
6:30	21239.93	18691.06	17558.18	15348.91	15687.17	19697.02	15495.14
6:45	18976.85	15981.34	17303.2	11603.77	13511.18	14422.09	12517.26
7:00	15219.67	12757.68	13541.07	13638.48	13115.94	10325.58	12130.41
7:15	10757.81	9025.01	11714.9	12943.69	11471.53	9978.45	11059.72
7:30	8842.66	8795.08	10376.97	10589.65	9225.86	9671.21	10396.11
7:45	7749.83	8744.39	8803.31	10273.32	8286.14	7921.21	9968.77
8:00	7837.13	7758	7496.94	9444.99	8207.86	7627.47	9003.3
8:15	9960.87	6903.81	6844.94	10958.65	7222.98	7792.62	7193.09
8:30	8445.21	6623.02	7481.89	10998.44	7344.48	7039.98	9449.29
8:45	8516.02	6630.54	7195.02	9632.88	8024.22	6538.94	7587.69
9:00	8297.96	7459.95	7765.74	9120.28	6794.4	6745.38	7437.16
9:15	7753.48	7718.86	8393.23	9532.94	6391.42	7404.47	7584.52

9:30	7641.23	7847.03	7989.17	9885.18	7239.75	7063.63	4719.97
9:45	8116.9	9327.95	7499.31	9651.64	7998.2	6778.49	6813.33
10:00	8123.57	9977.37	7906.38	7827.03	7997.12	7111.16	6151.44
10:15	8006.16	8539.02	8437.96	8604.83	7392.43	7715.85	7457.16
10:30	7368.56	9144.15	6854.4	8743.31	6317.23	7027.29	6527.54
10:45	7895.19	8385.7	7757.14	8993.19	6689.73	7924.66	5694.04
11:00	7896.7	8831.69	8349.79	9752.5	8274.53	7876.7	5936.4
11:15	7598.01	11129.18	8469.35	9175.76	7345.98	6600.44	6051.01
11:30	7740.58	8103.78	9177.69	8247.22	8397.53	7579.3	5727.16
11:45	10226.23	7601.23	8149.59	7865.95	7814.77	7204.27	6802.79
12:00	8844.6	7231.58	8101.63	9350.8	8763.74	7104.06	6055.74
12:15	8025.29	7922.72	7814.34	8521.39	11380.99	8103.35	6264.12
12:30	8254.31	7854.34	9801.74	9645.19	9507.99	7672.84	7252.87
12:45	9464.34	6667.75	8552.36	8908.89	11276.91	7958.2	7630.27
13:00	7154.6	6923.43	8754.92	7836.06	9761.26	9494.82	6778.06
13:15	6827.31	6755.48	8863.3	7240.18	10286.22	6902.57	6194.23
13:30	8624.18	7316.52	8470.64	8357.75	9371.66	6442.6	5988.17
13:45	8218.4	7689.83	8760.73	9004.59	8957.49	6888.16	7179.76
14:00	8492.58	7529.63	8062.93	9232.1	8756.43	7296.95	6305.19
14:15	9671.86	7171.37	8171.31	8825.46	9874.21	7790.69	6490.12
14:30	8812.99	8406.13	9198.5	9444.77	9272.74	7759.29	6643.23
14:45	8600.96	8679.23	8623.54	9460.04	9584.33	8272.97	7912.18
15:00	9310.16	8195.39	9389.94	9624.98	8032.82	9033.83	7896.05
15:15	9376.82	7881.22	7994.33	8794.49	8555.58	8618.16	8600.53
15:30	7981.64	8040.13	7793.7	9659.81	8404.19	8030.02	8271.3
15:45	8355.81	9972.7	7501.89	10745.98	8066.8	7071.38	10980.16
16:00	7688.33	9275.75	7544.68	11222.08	9121.57	8051.1	10205.37
16:15	6510.23	9136.62	8326.51	8396.02	11778.39	8473.65	8290.01
16:30	8641.81	8427.85	8210.87	8191.52	10584.92	7285.77	7388.78
16:45	9160.92	11453.84	10057.58	9360.91	8255.82	7268.57	7683.17
17:00	9003.73	8685.25	10316.12	10141.93	7729.61	8600.31	8861.58
17:15	7407.91	8308.5	8688.48	10835.44	7938.42	9810.34	8011.96
17:30	8114.32	7945.08	9801.74	12333.41	10216.34	8350.22	8474.94
17:45	10228.38	9013.83	11048.33	11543.73	12726.07	10168.81	10227.3
18:00	8877.07	10498.25	14717.12	11524.86	12470.82	10391.38	7551.99
18:15	11131.98	13057.02	13360.65	20533.1	16163.7	11130.47	10723.19
18:30	15171.07	16527.98	17446.2	21060.59	18902.45	15214.94	16102.2
18:45	19757.66	22283.52	24066.2	23652.68	24291.78	19711.21	21072.85
19:00	27107.95	27206	25671.26	29955.29	29408.87	25067.86	27740.81
19:15	27373.31	28917.51	29183.3	28478.18	28298.19	26988.33	30073.13
19:30	25891.89	28288.95	29523.71	29304.36	28768.05	28919.01	34556.07
19:45	27119.34	28386.79	29876.59	29749.71	29585.85	28885.47	30657.4
20:00	27047.95	29044.17	29111.69	30143.45	29090.18	28602.04	30686.21

20:15	26943.23	26599.81	28699.24	30814.38	28370.23	29001.37	29612.09
20:30	25966.73	27212.24	28276.26	29318.77	28198.84	28816.44	30377.41
20:45	26078.76	27884.67	27850.05	28818.16	27590.71	29892.28	29881.96
21:00	27135.9	26132.74	29482.2	29539.83	26956.29	28984.82	28538.82
21:15	27255.03	24958.41	26072.31	28095.62	26447.99	25643.52	27094.18
21:30	27262.99	24114.8	24767.67	28436.03	23367.75	25562.67	26967.04
21:45	26437.24	22398.78	23729.4	26824.74	22141.38	23832.46	26731.2
22:00	25324.62	19890.13	21090.27	24838.84	20561.48	23519.14	24779.92
22:15	22303.31	21265.31	18815.14	23772.46	18332.16	21775.6	22657.91
22:30	20052.7	17209.65	17230.08	20417.84	16828.17	19704.55	21525.94
22:45	18468.93	16152.95	16038.98	18493.23	16239.39	18288.08	20046.84
23:00	16628.62	14097.59	14768.09	18171.74	15895.33	17386.63	17629.84
23:15	15591.26	12937.83	14441.44	17000.63	14741.42	16613.35	16429.49
23:30	14337.79	12581.99	13887.88	15754.91	14018.03	15516.86	15565.46
23:45	13871.37	12251.91	13416.99	14553.69	13512.9	14890.45	14981.84

APPENDIX 04

Data (Demand in 'W') of Rakwana Distribution Transformer- Q071 (160 kVA)

Time/ Date	2013.09.06	2013.09.07	2013.09.08	2013.09.09	2013.09.10	2013.09.11	2013.09.12
0:00	67797.03	59356.43	57314.36	57450.49	56905.94	58811.88	60037.13
0:15	68750	59492.57	53910.89	56905.94	57178.22	55408.41	58948.02
0:30	63849.01	55408.41	52685.64	52549.5	55680.69	54319.31	56361.38
0:45	62079.21	55272.28	53230.2	51868.81	55544.55	54047.03	56633.66
1:00	62351.48	48601.48	51868.81	51596.53	56633.66	49826.73	53366.34
1:15	61670.79	54727.72	48193.07	49962.87	51324.26	49146.04	52141.09
1:30	63712.87	52141.09	51188.12	47240.1	51188.12	51596.53	51460.39
1:45	60173.27	52549.5	49146.04	48601.48	49418.32	48056.93	51732.67
2:00	57858.91	51732.67	48465.35	49962.87	52685.64	49690.59	50507.42
2:15	60173.27	52141.09	50915.84	47648.51	52277.23	48873.76	52685.64
2:30	59764.85	53230.2	47376.24	48193.07	51188.12	45878.71	51051.98
2:45	58267.33	52413.37	49009.9	48873.76	50779.7	46831.68	52277.23
3:00	59084.16	50779.7	50643.56	49282.18	51188.12	49009.9	51868.81
3:15	58539.6	53230.2	49146.04	49282.18	51051.98	48329.21	52957.92
3:30	56769.8	49690.59	50779.7	48465.35	52413.37	49962.87	52277.23
3:45	58403.46	51732.67	47512.38	47648.51	52549.5	47920.79	48737.62
4:00	61534.65	52413.37	50643.56	46559.4	53230.2	47784.65	53094.06
4:15	58811.88	56089.11	52549.5	50779.7	57586.63	53910.89	55272.28
4:30	61398.51	55816.83	54591.58	47784.65	58267.33	51324.26	53774.75
4:45	67252.47	60581.68	59492.57	50779.7	59356.43	54183.17	56089.11
5:00	74876.24	70519.8	68886.14	56769.8	64801.98	57858.91	59628.71
5:15	82908.41	76101.48	71064.35	59492.57	72970.3	57722.77	58539.6
5:30	86311.88	79096.53	82772.28	61670.79	82091.58	66163.36	60990.1
5:45	87400.99	84950.49	85631.19	62079.21	84269.8	68205.44	63440.59
6:00	92710.39	86584.16	82908.41	60037.13	80049.5	68341.58	65891.09
6:15	89987.62	82500	86992.57	58675.74	81002.47	66163.36	66299.5
6:30	80049.5	79913.36	78279.7	57722.77	85086.63	63985.15	62759.9
6:45	74467.82	75420.79	81955.44	57586.63	80730.2	64393.56	59220.3
7:00	78415.84	69566.83	76509.9	57450.49	63849.01	69158.41	64665.84
7:15	76101.48	61398.51	62215.35	61534.65	65346.53	62351.48	63849.01
7:30	74603.96	62079.21	62351.48	64938.12	64257.42	63032.18	69022.28
7:45	62896.04	63576.73	69294.55	78007.42	69294.55	68750	62759.9
8:00	63985.15	69430.69	67116.34	78415.84	79641.09	80457.92	66844.06
8:15	68477.72	78824.26	70383.66	70928.22	81683.17	82500	67660.89
8:30	73242.57	71608.91	63168.32	74059.4	76782.18	88353.96	73106.43
8:45	84133.66	71200.49	60915	72970.3	73242.57	103329.21	80730.2
9:00	97883.66	94888.61	50915.84	70383.66	97202.97	101150.99	78960.39
9:15	118304.45	88081.68	85495.05	71881.19	105235.15	105371.28	72289.6

9:30	116126.24	87264.85	83589.11	75693.07	101559.4	112314.35	71745.05
9:45	107277.23	94071.78	95977.72	73514.85	115037.13	115173.26	80185.64
10:00	92710.39	89170.79	87537.13	78551.98	96930.69	104554.45	83997.52
10:15	79368.81	76373.76	75284.65	78960.39	104282.18	77871.29	74603.96
10:30	98564.35	89170.79	85358.91	79913.36	108774.75	87809.4	71881.19
10:45	115853.96	101423.27	84950.49	75284.65	117079.21	120482.67	80321.78
11:00	112722.77	92029.7	85495.05	75012.37	109727.72	118032.18	82363.86
11:15	113131.19	96658.41	90123.76	82227.72	113539.6	109455.44	86856.43
11:30	122116.33	92846.53	91893.56	85222.77	117759.9	111905.94	92438.12
11:45	123477.72	90668.31	100061.88	89579.21	108094.06	114628.71	71064.35
12:00	118440.59	105779.7	95160.89	88898.51	113675.74	108502.47	83725.25
12:15	116806.93	106732.67	95024.75	89851.48	127698.02	119801.98	84678.22
12:30	113131.19	102240.1	103056.93	89170.79	124702.97	132462.87	88490.1
12:45	110136.14	107685.64	102103.96	91485.15	116943.07	128106.43	88353.96
13:00	113811.88	98428.22	90668.31	84950.49	103873.76	117759.9	85631.19
13:15	117215.34	86992.57	78143.56	81955.44	91076.73	90940.59	82227.72
13:30	100061.88	81274.75	86992.57	81683.17	94888.61	77054.45	81410.89
13:45	99653.46	74603.96	90123.76	75829.21	101014.85	93254.95	73106.43
14:00	99108.91	76373.76	91485.15	76509.9	97202.97	90123.76	69839.11
14:15	92165.84	85222.77	75965.34	78824.26	113131.19	87400.99	73923.27
14:30	112722.77	94344.06	74603.96	75965.34	138044.55	98836.63	79641.09
14:45	115445.54	103737.62	76373.76	78824.26	139542.08	105507.42	74603.96
15:00	101831.68	100334.16	77735.15	74331.68	133688.12	91757.42	78007.42
15:15	96522.28	101150.99	78143.56	73242.57	136955.44	94752.47	87945.54
15:30	103193.07	88762.37	70519.8	67797.03	121299.5	88898.51	77599.01
15:45	107277.23	98700.49	82363.86	68341.58	115173.26	88898.51	77190.59
16:00	87673.27	95024.75	79913.36	66435.64	121980.2	93935.64	79232.67
16:15	97611.38	71472.77	78688.12	72425.74	105371.28	94071.78	77190.59
16:30	90259.9	76373.76	80321.78	70655.94	108502.47	76509.9	76101.48
16:45	81955.44	74603.96	76918.32	67797.03	84269.8	73242.57	68750
17:00	84133.66	75420.79	78824.26	66163.36	83861.38	77054.45	68477.72
17:15	90940.59	81138.61	82772.28	63985.15	83452.97	83997.52	70383.66
17:30	86311.88	83180.69	85903.46	68886.14	84133.66	87945.54	73514.85
17:45	84133.66	75556.93	84542.08	75693.07	85086.63	91076.73	77871.29
18:00	91076.73	87809.4	86039.6	78279.7	89579.21	94752.47	82091.58
18:15	91485.15	96658.41	89306.93	89443.07	92029.7	97066.83	93663.36
18:30	105779.7	98564.35	98836.63	103329.21	100742.57	105235.15	109863.86
18:45	115717.82	109863.86	115309.4	113675.74	112178.22	106051.98	122388.61
19:00	118304.45	109863.86	120346.53	114220.29	121435.64	113811.88	129467.82
19:15	119529.7	114628.71	120618.81	124022.27	124975.24	123477.72	130420.79
19:30	120891.09	118440.59	117079.21	125928.22	119121.28	122252.47	130693.07
19:45	118440.59	118304.45	119393.56	126608.91	122933.17	121844.06	130693.07
20:00	122388.61	121163.36	115173.26	126472.77	124566.83	117351.48	125792.08

20:15	129467.82	122797.03	114356.43	127289.6	121844.06	119393.56	124839.11
20:30	127970.29	121299.5	118576.73	122797.03	117623.76	121435.64	125111.38
20:45	125519.8	119121.28	115717.82	121435.64	115990.1	114356.43	123341.58
21:00	112858.91	108366.33	116126.24	114084.16	117215.34	109863.86	117759.9
21:15	108910.89	105235.15	113948.02	110136.14	110272.27	107413.36	112178.22
21:30	109727.72	101014.85	105371.28	106732.67	104690.59	101695.54	106051.98
21:45	103193.07	99653.46	97883.66	104554.45	97066.83	96522.28	103737.62
22:00	98292.08	95705.44	95160.89	95433.17	90532.18	93118.81	94888.61
22:15	89306.93	86856.43	87673.27	87264.85	89715.34	90532.18	92982.67
22:30	83861.38	81955.44	81955.44	80049.5	82363.86	87809.4	87264.85
22:45	75420.79	74876.24	75284.65	76509.9	78279.7	79641.09	80594.06
23:00	74740.1	72698.02	73650.99	70519.8	72561.88	72425.74	76646.04
23:15	69702.97	66707.92	67388.61	64257.42	70655.94	73650.99	71745.05
23:30	66163.36	63440.59	64393.56	62896.04	67252.47	69430.69	66299.5
23:45	62896.04	59628.71	59356.43	60037.13	62623.76	64257.42	64529.7

APPENDIX 05

Data (Demand in 'W') of Yodagama Distribution Transformer-R039 (400 kVA)

Time/ Date	2013.03.11	2013.03.12	2013.03.13	2013.03.14	2013.03.15	2013.03.16	2013.03.17
0:00	46150	49030	39210	42750	38620	36150	36620
0:15	46290	49420	39040	42280	38740	33190	38060
0:30	42570	49250	37730	43580	37810	32930	37520
0:45	42900	48690	37160	40010	37390	31740	37850
1:00	43690	50120	37790	39580	38620	32330	35660
1:15	46060	48620	36100	39650	38570	32950	35830
1:30	45820	49410	37430	39310	37940	32040	35210
1:45	47940	47220	36870	40060	38160	31260	35090
2:00	47350	45970	36040	38450	39110	31270	35400
2:15	46160	47620	36520	37880	38240	32040	36190
2:30	46580	48430	36320	38920	38240	31530	37120
2:45	44710	46790	35330	39110	38350	30330	36100
3:00	41980	46260	36780	38090	38290	29930	36500
3:15	43840	41690	35700	37690	37270	30580	35640
3:30	43310	41090	35240	38490	38730	30130	36060
3:45	42570	46510	35960	37260	38240	30410	37110
4:00	43500	48860	33480	39460	39400	30840	37680
4:15	45110	48390	34310	38650	44710	31920	35980
4:30	46810	44220	35240	39030	45140	35400	38210
4:45	46530	44750	35670	38720	49090	38320	38590
5:00	46460	54600	40500	41680	48950	41070	38750
5:15	49770	57580	43440	46020	51670	42410	39610
5:30	51690	72160	46720	48500	55550	47830	42580
5:45	50350	70950	50690	56340	58810	60360	44950
6:00	51220	75730	57630	54570	65220	65710	52040
6:15	55430	81620	57790	60360	59670	65300	55650
6:30	56940	78680	54530	55580	55280	67810	55820
6:45	54580	68900	49020	54500	51710	61110	47060
7:00	55900	59100	43140	58620	52030	53240	44180
7:15	59280	62050	45190	41860	55340	52240	55980
7:30	70390	53960	48660	39660	55520	55040	67080
7:45	71040	65260	48100	45700	70810	54980	61070
8:00	68040	62810	79360	60890	122700	61760	54190
8:15	78340	60930	111900	59500	127300	48910	54850
8:30	96560	62300	106100	82730	116900	49570	79890
8:45	100400	55990	102800	47260	56820	57510	108400
9:00	72350	51720	85630	36970	59090	65820	86200
9:15	74170	64920	58530	86820	97690	54100	101800

9:30	84900	74690	93990	117000	95580	53770	107200
9:45	91290	64280	125900	121200	110700	63300	155700
10:00	74020	63260	126600	97360	92310	67980	154400
10:15	71490	65690	125600	97840	74600	67440	143400
10:30	71930	74660	126700	92350	78690	73720	148900
10:45	87200	70980	104700	104600	78230	85820	127500
11:00	77530	62740	88940	108300	72360	113300	112700
11:15	89000	63860	123700	116200	72830	115200	152100
11:30	112100	70890	121800	113800	75350	107500	142500
11:45	111200	69770	118900	103000	109200	113500	132200
12:00	116000	68230	117100	105100	125500	107600	103400
12:15	117700	75070	111100	141400	134500	106300	114800
12:30	119300	81210	116400	136500	119700	115800	108000
12:45	101600	90260	112100	109400	74130	104500	64180
13:00	91940	83680	91620	80670	66390	72010	72330
13:15	89400	61240	90750	60360	67750	57490	77940
13:30	81170	62170	83760	57540	70010	64510	79320
13:45	63750	67690	70050	66620	108600	68630	124600
14:00	65520	66770	67080	77900	94860	74890	133200
14:15	67180	69440	83320	113600	117800	116800	130200
14:30	64370	68290	82760	118000	134700	158900	123700
14:45	61460	76560	84460	115600	138900	151400	125500
15:00	66050	90000	95530	114400	132000	145300	92500
15:15	61670	108200	103500	115600	127800	123000	58410
15:30	58350	115200	110900	113200	127500	115400	95370
15:45	60330	118000	92630	108500	116300	60540	115500
16:00	58880	114400	97870	93560	67410	80890	123800
16:15	61740	118400	95460	91580	55030	99750	108400
16:30	54920	76050	96880	93490	57870	100800	98840
16:45	51880	76140	68620	83880	58310	83290	106900
17:00	49050	69940	60850	86090	53310	89850	72450
17:15	53350	65330	58380	97000	54290	77370	61350
17:30	52910	64040	57120	96110	57750	78880	55430
17:45	52880	58610	62310	97490	56130	82930	65950
18:00	53330	60960	64360	99970	58970	89680	63160
18:15	64200	66640	66860	79460	65530	93810	72400
18:30	61610	68460	67480	67180	72370	73090	75310
18:45	66150	72960	66090	65900	75820	71690	75820
19:00	63200	79280	66950	66900	69770	71630	77030
19:15	69640	77770	70140	73640	63570	72880	75070
19:30	70200	78610	75820	71360	63880	71190	74860
19:45	75460	80100	75730	72220	62620	67640	75480
20:00	78220	85180	72510	74630	67150	73050	76340

20:15	77100	77670	75230	80200	67420	72870	69030
20:30	82200	74940	74390	78080	59480	70730	67880
20:45	76880	72970	73730	74920	59830	66440	68560
21:00	68140	66700	67580	73970	62570	64440	65360
21:15	61760	63990	63570	71590	54030	64050	66860
21:30	57480	60030	61700	65330	51370	58970	64620
21:45	56310	57580	61230	59640	48870	55550	56060
22:00	54450	60810	57550	57820	46190	50430	56390
22:15	51650	55820	54710	55210	43430	46130	53940
22:30	48350	50950	54050	51690	42570	44780	52370
22:45	47300	49190	48900	51460	40100	41830	51400
23:00	47580	47550	47280	48290	38670	40540	49780
23:15	51330	47150	42020	44440	39490	39300	48650
23:30	48880	43040	40620	42700	38810	39610	48200
23:45	49970	39090	42240	41340	37330	37670	47230

APPENDIX 06

Microsoft Excel Macro Code for Computer Based Calculation of Capitalization Values

```
%============================================================%

Private Sub CommandButtonto2LLF_Click()

Me.Hide

FormLLF.Show

End Sub

Private Sub CommandButtonBack2TD_Click()

'Unload Me

MsgBox ("Please input values and proceed with 'next' button")

End Sub

Private Sub CommandButtonPWFCRF_Click()

Dim TFlifetime, RateOfReturn, Inflation As Double

Dim nValue As Double

Dim aValue As Double

Dim iValue As Double

TFlifetime = Val(TextBox1.Value)

RateOfReturn = Val(TextBox2.Value) / 100

Inflation = Val(TextBox3.Value) / 100

PresentEnerCost = Val(TextBox4.Value)

nValue = TFlifetime

aValue = Inflation

iValue = RateOfReturn

Call RefreshNresult(nValue)

Call RefreshAResult(aValue)

Call RefreshIResult(iValue)

Dim CRFvalue As Double

Dim PWFValue As Double

Dim ECValue As Double
```

```
CRFvalue = (RateOfReturn * ((1 + RateOfReturn) ^ TFlifetime)) / (((1 + RateOfReturn) ^
TFlifetime) - 1)

LabelCRF.Caption = CRFvalue

PWFValue = (1 - ((1 + Inflation) / (1 + RateOfReturn)) ^ TFlifetime) / (RateOfReturn -
Inflation)

LabelPWF.Caption = PWFValue

ECValue = PresentEnerCost * PWFValue * CRFvalue

LabelEC.Caption = ECValue

Call RefreshECresult(ECValue)

End Sub

%=============================================================%

Private Sub CommandButtonBack2PL_Click()

Me.Hide

FormPL.Show

End Sub

Private Sub CommandCalLLF_Click()

Dim LossFac, LossofLoadFac, PeakLoad As Double

Dim llfValue As Double

Dim plValue As Double

LossFac = Val(TextBox1.Value) / 100

LossofLoadFac = (0.2 * LossFac) + (0.8 * LossFac ^ 2)

PeakLoad = LossFac / (Sqr(LossofLoadFac))

LabelLLF.Caption = LossofLoadFac

LabelPL.Caption = PeakLoad

llfValue = LossofLoadFac

plValue = PeakLoad

Call RefreshLLFresult(llfValue)

Call RefreshUAPLresult(plValue)

End Sub

Private Sub GotoformFC_Click()

'MsgBox (LLFValuePass)
```

```
Me.Hide
FormFC.Show
End Sub
%=============================================================%
Dim RateOfReturn, BookDepre, Taxes, LocalPropTaxInsuara, Sum As Double
Private Sub CommandButtonBack2LLF_Click()
Me.Hide
FormLLF.Show
End Sub
Private Sub CommandButtonFC_Click()
RateOfReturn = Val(TextBox1.Value)
BookDepre = Val(TextBox2.Value)
Taxes = Val(TextBox3.Value)
LocalPropTaxInsuara = Val(TextBox4.Value)
Sum = RateOfReturn + BookDepre + Taxes + LocalPropTaxInsuara
LabelFC.Caption = Sum
Call RefreshFCresult(Sum)
'sgBox (FCValuePass)
End Sub
Private Sub CommandButton2FormABD_Click()
Unload Me
FormSC.Show
End Sub
%=============================================================%
Dim SysCap As Double
Private Sub CommandButton_GoTOFormABD_Click()
Call RefreshSCresult(Val(TextBoxSCValue.Value))
'MsgBox (SCValuePass)
Me.Hide
FormABD.Show
```

```
End Sub

Private Sub CommandButtonBack2TD_Click()

Unload Me

FormFC.Show

End Sub

Private Sub CommandButtonSC_Click()

Me.TextBoxSCValue.Value = Val(TextBoxGCValue.Value) +
Val(TextBoxTCValue.Value) + Val(TextBoxDCValue.Value)

End Sub

Private Sub OptionButton1_Click()

Me.CommandButtonSC.Enabled = True

Me.TextBoxGCValue.Visible = True

Me.TextBox13.Visible = True

Me.TextBoxDCValue.Visible = True

Me.TextBoxSCValue.Enabled = False

SysCap = Val(TextBoxGCValue.Value) + Val(TextBoxTCValue.Value) +
Val(TextBoxDCValue.Value)
```



```
End Sub

Private Sub OptionButton2_Click()

Me.TextBoxGCValue.Visible = False

Me.TextBoxTCValue.Visible = False

Me.TextBoxDCValue.Visible = False

Me.CommandButtonSC.Enabled = False

Me.TextBoxSCValue.Enabled = True

' RefreshSCresult (Val(TextBoxSCValue.Value))

End Sub

%============================================================%

Dim Inflat, RateOfReturn, EnergyCost, HoursPerYear, PeakLoadFac, LossofLoadFac,
PeakResponsibleFac, FixedChargeRate, SysCapCost, EfficiencyOfTransmisson,
IncreasingFac, aValue, Bvalue As Double

Dim TFlifetime As Integer

Private Sub CommandButtonEF_Click()
```

```
' Variables for Calculate transformer loss data

Inflat = Val(TextBox8.Value) / 100

RateOfReturn = Val(TextBox9.Value) / 100

TFlifetime = Val(TextBox7.Value)

EnergyCost = Val(TextBox10.Value)

HoursPerYear = Val(TextBox1.Value)

PeakLoadFac = Val(TextBox17.Value)

PeakResponsibleFac = Val(TextBox3.Value) / 100

LossofLoadFac = Val(TextBox18.Value)

FixedChargeRate = Val(TextBox16.Value) / 100

SysCapCost = Val(TextBox19.Value)

EfficiencyOfTransmisson = Val(TextBox20.Value)

IncreasingFac = Val(TextBox21.Value)

aValue = (SysCapCost + HoursPerYear * EnergyCost) / (FixedChargeRate *
EfficiencyOfTransmisson * IncreasingFac * 1000)

Bvalue = (((SysCapCost * PeakResponsibleFac ^ 2) + (HoursPerYear * EnergyCost *
LossofLoadFac)) * (PeakLoadFac ^ 2)) / (FixedChargeRate * EfficiencyOfTransmisson *
IncreasingFac * 1000)

LabelAval.Caption = Round(aValue, 2)

LabelBval.Caption = Round(Bvalue, 2)

End Sub

Private Sub RestWork_Click()

' Unload.Me

Me.Hide

FormPL.Show

End Sub

Private Sub CommandButtonBack2SC_Click()

Me.Hide

FormSC.Show

End Sub

Private Sub UserForm_Initialize()
```

```
TextBox7.Value = nValuePass

TextBox9.Value = iValuePass

TextBox8.Value = aValuePass

TextBox10.Value = ECValuePass

'TextBox9.Value = MARValuePass

TextBox17.Value = UAPLValuePass

TextBox16.Value = FCValuePass

TextBox19.Value = SCValuePass

TextBox18.Value = LLFValuePass

End Sub

%============================================================%

Public nValuePass, iValuePass, aValuePass As Double

Public PLValuePass, CRFValuePass, ECValuePass, MARValuePass, FCValuePass,
SCValuePass As Double

Public LLFValuePass, UAPLValuePass As Double

Function RefreshNresult(n As Double)

nValuePass = n

End Function

Function RefreshPLresult(testres2 As Double)

PLValuePass = testres2

End Function

Function RefreshCRFresult(testres3 As Double)

CRFValuePass = testres3

End Function

Function RefreshECresult(testres4 As Double)

ECValuePass = testres4

End Function

Function RefreshMARresult(testres5 As Double)

MARValuePass = testres5

End Function

Function RefreshFCresult(testres6 As Double)
```

```
FCValuePass = testres6
End Function
Function RefreshSCresult(testres7 As Double)
SCValuePass = testres7
End Function
Function RefreshLLFresult(LLF As Double)
LLFValuePass = LLF
End Function
Function RefreshUAPLresult(uapl As Double)
UAPLValuePass = uapl
End Function
Function RefreshAResult(a As Double)
aValuePass = a
End Function
Function RefreshIResult(i As Double)
iValuePass = i
End Function
Sub Button1_Click()
FormPL.Show
End Sub
%=============================================================%
```

years over which to annualize cost (years)	35
transformer life (years)	35
Expected annual inflation rate (%) (a)	6.425
Discount rate (%) (i)	10.42
Hours per year (HPY)	8760
Load Factor (%) (LF)	
Peak responsible factor (RF)	
Loss Multiplier (LM)	10.79
Efficiency of Transmission (ET = 100 - LM)	
Increasing factor (IF)	

System capacity cost (Rs/KWh-year) (SC)	24084.82
Levelized energy cost (Rs/KWh) (EC)	36.75
Fixed Charge rate (%) (FC)	15.71

Loss factor (llf) = 0.2*LF + 0.8*(LF)^2
uniform annual peak load (PL=LF/Squar(llf)