8.3 Sensitivity Analysis

In addition to examining the impact of market development scenarios, the sensitivity of the option-ranking to three other critical parameters was also examined. The following table shows the parameters that were investigated, the range over which each of the parameters was varied, and the resulting NPV and ranking of each of the three options under the stated conditions. The analysis was conducted using medium load growth and an assumed average wind-farm generation level into Brinkworth of 80 MW, as discussed previously.

Parameter incurring variation (all studies at 10%pa discount rate, DNSP forecast loads and $30/MW.h cost of losses, unless stated otherwise)	Net Present Cost ($M)					
	Option 1 Establish a 1x160 MV.A 275/132kV substation at Bungama and replace the existing Brinkworth 60 MV.A transformer with a 160 MV.A unit	Rank	Option 2 Establish a 2x160 MV.A 275/132kV substation at Bungama	Rank	Option 3 Establish a new 132 kV substation at Bungama and new dual-circuit 132kV line from Playford to Bungama	Rank
Discount Rate (% pa)						
7.5%	**$26.39**	**1**	$26.63	2	$35.18	3
10%	**$22.44**	**1**	$22.61	2	$30.04	3
12.5%	**$19.73**	**1**	$19.91	2	$26.32	3
Cost of losses						
$25/MW.h	**$22.82**	**1**	$23.03	2	$30.36	3
$30/MW.h	**$22.44**	**1**	$22.61	2	$30.04	3
$35/MW.h	**$22.56**	**1**	$22.75	2	$30.14	3
Capital Cost of project						
15% less than estimated cost	**$19.17**	**1**	$19.33	2	$25.62	3
estimated cost	**$22.44**	**1**	$22.61	2	$30.04	3
15% more than estimated cost	**$26.21**	**1**	$26.45	2	$34.89	3

As can be seen in this table, Option 1 is the highest-ranked option under all scenarios. These sensitivity analysis results are consistent with the base case economic analysis, and demonstrate that the outcome is robust in terms of variations in the parameters assessed.

9.0 DISCUSSION OF RESULTS

The following conclusions have been drawn from the analysis presented in this report:

- There is no acceptable 'do-nothing' option. The projected network limitations must be addressed as soon as possible, otherwise it will not be possible to maintain system security and reliability standards during a single contingency on the Playford-Davenport 275 kV transmission line.

- In the first half of 2003 ElectraNet carried out an initial consultation inviting interested parties to propose either network or non-network solutions to the network limitations, with 30th May 2003 as the closing date for submissions. No submissions were received.

- Economic analysis has identified that Option 1 is the least-cost solution over the fifteen-year period of analysis under all of the scenarios considered. On this basis, augmentation comprising the establishment of a single-transformer 160 MV.A 275/132 kV substation at Bungama with 275 kV supply provided by diverting the Davenport-Para 275 kV "west" circuit in-and-out of the new substation, and the disconnection of the existing 60 MV.A transformer at Brinkworth and installation adjacent to it in a spare transformer bay a 160 MV.A unit, will satisfy the ACCC Regulatory Test.

- Sensitivity analysis showed that this conclusion was robust when considered against variations in capital cost and other factors outside of the influence of ElectraNet. Option 1 is also the highest-ranked option under all of the applicable market development scenarios.

- The "west" circuit does not incorporate an overhead earth-wire and its recorded performance during lightning storms is significantly poorer than equivalent lines with an overhead earth-wire. In the case of Option 2, this represents an increased risk of outage at Bungama 275/132 kV substation. The recommended development features a second high-capacity supply to Bungama from Brinkworth, and therefore provides superior diversity and reliability of supply to the region.

- Implementation issues significantly favour Option 1, in preference to Option 2, since it will be extremely difficult to maintain supply to the loads supplied out of Bungama substation – notably, the Port Pirie Industrial load - without the need for costly generation support during the installation of the two 275/132 kV transformers proposed in Option 2. In contrast, Option 1 can be staged such that the Brinkworth transformer is initially replaced with a bigger unit, thus providing sufficient additional capacity at Brinkworth to enable it to supply a major portion of the Bungama load as well as its own local load while the required work is then undertaken at Bungama.

- Dynamic stability analysis shows that Option 1 enhances network stability more than the other options considered, indicating that it is more conducive than are the other options to the installation of future generation in the area should this occur.

- In addition to minimisation of the NPV cost, the Regulatory Test requires that a TNSP optimise the timing of any proposed network augmentation that is justified under the Regulatory Test. This project must be implemented as soon as possible in order to meet the reliability standards of the SATC. The construction time for the recommended network solution will require works to commence as early as practically possible (early 2004) to ensure completion within the required timeframe.

10.0 RECOMMENDATION

Based on the conclusions drawn from the analysis, this Application Notice recommends that the following 'new large network assets' be constructed to address the projected transmission network limitations in the Lower Flinders region of South Australia:

- The disconnection of the existing 60 MV.A transformer at Brinkworth substation, and the installation in the spare transformer bay adjacent to it of a 160 MV.A unit to replace the function of the existing transformer.

- The establishment of a single-transformer 160 MV.A 275/132 kV substation adjacent to the existing 132 kV switchyard at Bungama, with 275 kV supply provided by diverting the Davenport-Para 275 kV "west" circuit in-and-out of the new substation. (The existing 132 kV switchyard would subsequently be dismantled and removed.)

The Brinkworth transformer replacement, which will improve reliability and security of supply in the region to a significant degree, must be commissioned as soon as possible, but no later than November 2004. The new 275/132 kV connection point at Bungama is required to be commissioned by November 2005.

The total cost of these new assets is estimated to be $30.6M.

Technical details relevant to this proposed new large network assets are contained in Appendix 1. Following the completion of the consultation process (assuming there are no changes required), ElectraNet will proceed immediately to implement the recommendations contained in this Application Notice.

The proposed construction timetable provides for award of equipment and construction contracts and the commencement of on-site construction in early 2004, following satisfactory resolution of Development Approvals, to ensure completion within the required timeframe.

Because of the potential downsizing of a magnesium smelting plant in Queensland, there is the potential that ElectraNet may be able to obtain plant and equipment at discounted prices. This specifically applies to the purchase of the 275/132 kV transformer proposed for Brinkworth (the Brinkworth transformer replacement being the more pressing of the two stages of the recommended option), where it may be possible to purchase an already manufactured 200 MV.A unit at an equivalent or lower price than a new 160 MV.A unit. ElectraNet proposes to pursue this aspect, if available, with a view to minimising the overall capital cost of the project to the NEM.

11.0 CONSULTATION

In accordance with Code requirements, ElectraNet invites submissions from Code Participants and interested parties on this application notice. Submissions are due by Monday 24th November 2003.

Please address submissions to:

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APPENDIX 1

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSETS

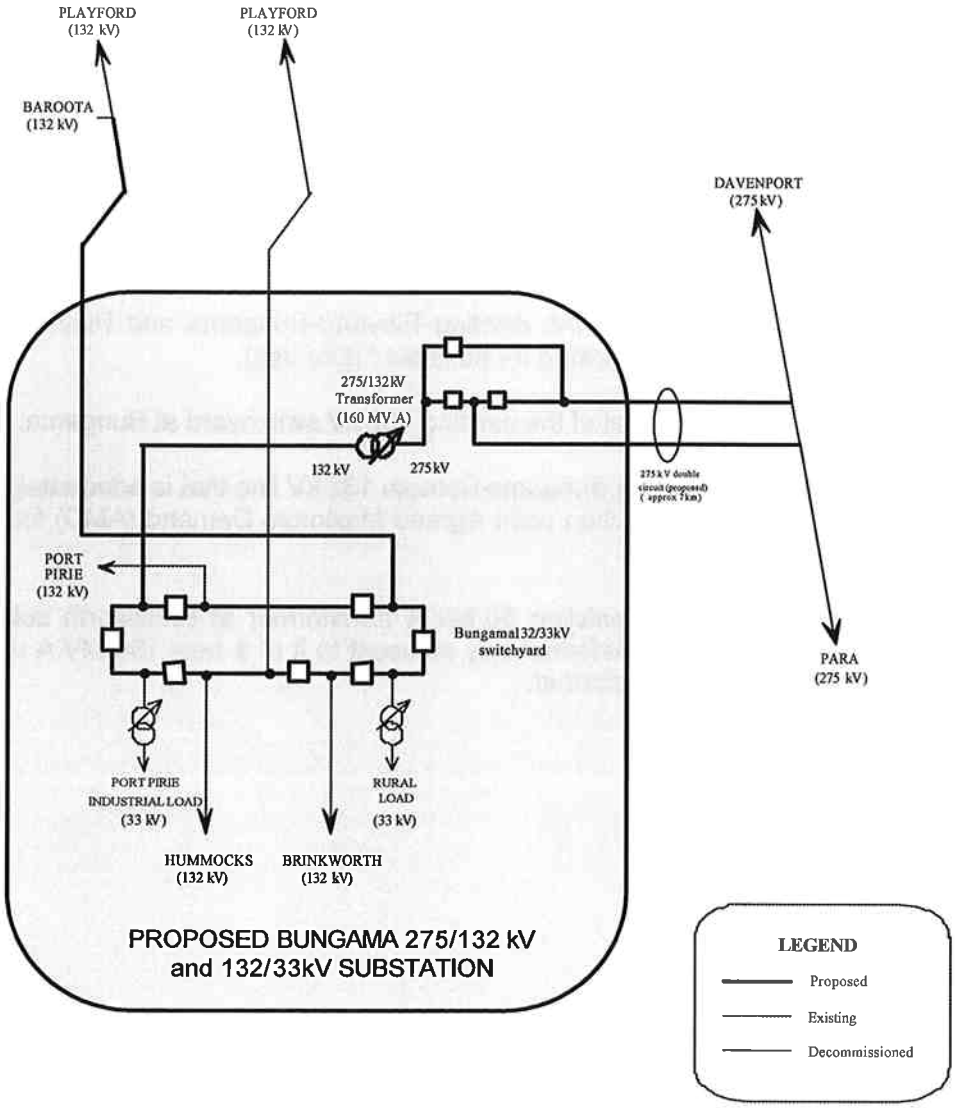
The proposed new large network assets recommended in this Application Notice comprise the following works:

- The establishment of a new 275/132 kV substation containing a single 160 MV.A transformer adjacent the existing site Bungama 132/33 kV substation;
- The construction of a new 132 kV section within the new 275/132 kV substation, with the layout of the new 132 kV section functionally identical to that of the existing, aged substation at Bungama, except that supply presently derived from the Playford-Bungama 132 kV network would instead be replaced by supply from the single 275/132 kV transformer;
- The provision of 275 kV supply to the new Bungama 275/132 kV substation by diverting the existing Davenport-Para 275 kV "west" circuit in-and-out of the substation, and the construction of approximately 7 kilometres of dual-circuit 275 kV line to facilitate the re-routing of this existing line to the new substation;
- The erection of additional 132 kV structures to facilitate the connection of existing 132 kV lines to the new substation;
- The removal from service of the existing Playford-Bungama and Playford-Baroota 132 kV lines (with the easements retained for possible future use);
- The dismantling and removal of the existing 132 kV switchyard at Bungama;
- The retention of the existing Bungama-Baroota 132 kV line that is adequately rated to support the forecast Baroota connection point Agreed Maximum Demand (AMD) for some years into the future;
- The disconnection of the existing 60 MV.A transformer at Brinkworth substation, and the installation in the spare transformer bay adjacent to it of a new 160 MV.A unit to replace the function of the existing transformer.

Option 1

1x160 MVA 275/132kV transformer at Bungama and 1x160 MVA 275/132kV transformer at Brinkworth

(Only the Bungama portion of the proposed work has been represented in the following diagram since the Brinkworth transformer simply involves the replacement of the existing transformer.)



APPENDIX 2

Financial Analysis Summary – Transmission Use of System (TUOS) Charges

15 Year Analysis Period

Discount rate 10%	Scenario A *Low load Growth, 0MW wind generation*		Scenario B *Medium load Growth, 0MW wind generation*		Scenario C *High load Growth, 0MW wind generation*		Scenario D *Low load Growth, 80MW wind generation*		Scenario E *Medium load Growth, 80MW wind generation*		Scenario F *High load Growth, 80MW wind generation*		Scenario G *Low load Growth, 160MW wind generation*		Scenario H *Medium load Growth, 160MW wind generation*		Scenario I *High load Growth, 160MW wind generation*	
	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank	NPV ($M)	Rank
Option 1: single transformer at Bungama, single transformer at Brinkworth	**$22.46**	**1**	**$22.09**	**1**	**$21.69**	**1**	**$22.51**	**1**	**$22.44**	**1**	**$23.01**	**1**	**$22.52**	**1**	**$22.43**	**1**	**$22.14**	**1**
Option 2: two transformers at Bungama	$22.67	2	$22.23	2	$21.74	2	$22.73	2	$22.61	2	$23.21	2	$22.73	2	$22.60	2	$22.24	2
Option 3: rebuild existing 132kV Playford-Bungama lines, new 132kV substation at Bungama, 160MV.A transformer at Brinkworth	$30.06	3	$29.74	3	$29.40	3	$30.11	3	$30.04	3	$30.53	3	$30.11	3	$30.03	3	$29.78	3

Development Options	Scenario A *Low load Growth, 0MW wind generation*	Scenario B *Medium load Growth, 0MW wind generation*	Scenario C *High load Growth, 0MW wind generation*	Scenario D *Low load Growth, 80MW wind generation*	Scenario E *Medium load Growth, 80MW wind generation*	Scenario F *High load Growth, 80MW wind generation*	Scenario G *Low load Growth, 160MW wind generation*	Scenario H *Medium load Growth, 160MW wind generation*	Scenario I *High load Growth, 160MW wind generation*
Option 1									
TF at Bung, TF at Brinkworth	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05
15Mvar capacitor at Hummocks	11/12	09/10	07/08	11/12	09/10	07/08	11/12	09/10	07/08
Option 2									
2 TFs at Bungama	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05
15Mvar capacitor at Hummocks	13/14	11/12	09/10	13/14	11/12	09/10	13/14	11/12	09/10
Option 3									
Rebuild 132 kV line TF at Brin	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05
15Mvar capacitor at Hummocks	06/07	05/06	04/05	06/07	05/06	04/05	06/07	05/06	04/05

Scenario A		*Low load Growth, 0MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.103	-0.106	-0.108	-0.112	-0.114	-0.115	-0.119	-0.122	-0.126	-0.128	-0.132	-0.137	-0.140	-0.143
=> NPV of Losses	-$0.88															
Total for Option 1	**$22.46**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.115	-0.118	-0.121	-0.124	-0.127	-0.128	-0.132	-0.136	-0.140	-0.143	-0.147	-0.152	-0.156	-0.159
=> NPV of Losses	-$0.98															
Total for Option 2	**$22.67**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.088	-0.091	-0.093	-0.095	-0.098	-0.098	-0.101	-0.104	-0.108	-0.110	-0.113	-0.117	-0.120	-0.122
=> NPV of Losses	-$0.75															
Total for Option 2	**$30.06**															

Scenario B		*Medium load Growth, 0MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.104	-0.166	-0.172	-0.177	-0.183	-0.189	-0.194	-0.205	-0.213	-0.224	-0.237	-0.259	-0.276	-0.300
=> NPV of Losses	-$1.36															
Total for Option 1	**$22.09**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.115	-0.185	-0.191	-0.197	-0.204	-0.210	-0.216	-0.228	-0.237	-0.250	-0.264	-0.288	-0.307	-0.334
=> NPV of Losses	-$1.52															
Total for Option 2	**$22.23**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.088	-0.142	-0.147	-0.151	-0.156	-0.161	-0.166	-0.175	-0.182	-0.192	-0.203	-0.221	-0.236	-0.256
=> NPV of Losses	-$1.16															
Total for Option 2	**$29.74**															

Scenario C		*High load Growth, 0MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107	0.106
==> NPV of TUOS	$0.56															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.117	-0.132	-0.150	-0.170	-0.194	-0.222	-0.255	-0.288	-0.335	-0.385	-0.458	-0.549	-0.668	-0.840
=> NPV of Losses	-$1.91															
Total for Option 1	**$21.69**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.130	-0.146	-0.167	-0.189	-0.215	-0.247	-0.283	-0.321	-0.372	-0.428	-0.509	-0.611	-0.743	-0.935
=> NPV of Losses	-$2.12															
Total for Option 2	**$21.74**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.100	-0.112	-0.128	-0.145	-0.165	-0.190	-0.218	-0.246	-0.286	-0.328	-0.391	-0.469	-0.571	-0.718
=> NPV of Losses	-$1.63															
Total for Option 2	**$29.40**															

Scenario D		*Low load Growth, 80MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.57**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$22.79**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.15**															

Scenario E		*Medium load Growth, 80MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.69**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$22.89**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.25**															

Scenario F		*High load Growth, 80MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107	0.106
==> NPV of TUOS	$0.56															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.83**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$23.01**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.37**															

Scenario G		*Low load Growth, 160MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.57**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$22.79**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.15**															

Scenario H		*Medium load Growth, 160MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.69**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$22.89**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112
==> NPV of TUOS	$0.30															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.25**															

Scenario I		*High load Growth, 160MW wind generation*														
Option 1		**TF at Bungama and TF at Brinkworth**														
1 TF at Brinkworth, 1 at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		1.998	3.398	3.352	3.306	3.260	3.214	3.168	3.122	3.076	3.030	2.984	2.938	2.892	2.846	2.800
==> NPV of TUOS	$23.03															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107	0.106
==> NPV of TUOS	$0.56															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101	-0.101
=> NPV of Losses	-$0.76															
Total for Option 1	**$22.83**															
Option 2		**Two TFs at Bungama**														
2 TFs at Bungama		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.033	3.458	3.411	3.364	3.318	3.271	3.224	3.177	3.130	3.083	3.037	2.990	2.943	2.896	2.849
==> NPV of TUOS	$23.44															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112	-0.112
=> NPV of Losses	-$0.85															
Total for Option 2	**$23.01**															
Option 3		**Rebuild 132 kV lines + TF at Brinkworth**														
Rebuild 132 kV line - TF at Brinkworth		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		2.655	4.515	4.454	4.393	4.332	4.271	4.209	4.148	4.087	4.026	3.965	3.904	3.842	3.781	3.720
==> NPV of TUOS	$30.61															
18 Mvar Capacitor at Hummocks		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
Relative Losses		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
* Losses $		-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086	-0.086
=> NPV of Losses	-$0.65															
Total for Option 2	**$30.37**															