Tab 3

NEWFOUNDLAND & LABRADOR HYDRO

Holyrood Generating Station

**Evaluation of Options to
Refurbish Stack Steel Liner #2**

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1.0 Stack Liner

The existing steel liner, which is held in position laterally by the concrete shell, is 34 years old and was constructed from ¼" thick mild steel to a vertical height of 300 ft.

A combination of many factors, such as age, chemical composition and velocity of the flue gas, temperature variations, proximity to marine climate (salt), etc., has lead to its present state of deterioration.

1.1 Identification of Major Maintenance and Liability Issues

Annual inspections, and in particular those of recent years, have identified several areas of concern. These include:

- 27 locations of thin steel (less than 60% of original thickness);
- 3 thin rings (4 ft high for the full circumference);
- 2 locations of buckling (from elevation 83 ft to 229 ft);
- Thin steel and holes developed within portions of the hopper;
- Numerous locations of pitting of the steel surface;
- Numerous locations of missing insulation (including the top half that cannot be easily or economically replaced); and
- Substantial loss of metal through out its full height such that the ability to support its own weight (originally 60 tons) is much more questionable.

It is estimated that it would take 3 months to replace the stack liner (on-site) on a planned basis. A catastrophic failure of the stack liner (buckling) will likely result in an outage that could extend beyond 6 months, assuming that the failure does not cause any damage to the concrete shell or any consequential damage to the ductwork or the boiler. This would depend upon the failure mechanism. It could possibly affect the whole plant, if it fails during operation. Additional factors that could affect the length of the outage include: material availability, time of the year, weather, removal of steel liner and components, etc.

2.0 Alternatives

Various alternatives have been investigated for the upgrade of the Stack #2 liner at the Holyrood Generating Station. These include:

1. Reinforcement and continue with current practice consisting of inspection, maintenance and repair to the stack liner;
2. Perform immediate repair and maintenance to the stack liner and provide vertical reinforcement during the next major unit outage planned in 2011;
3. Replace the entire stack liner.

2.1 Reinforcement and Continue with Current Practice

Under the current practice the entire stack, including the stack liner, concrete shell, breeching and associated utilities are inspected on an annual basis by an experienced chimney/stack inspection company. The inspection identifies stack maintenance requirements and only the repairs that are deemed to be necessary to maintain generation for the immediate operating season are performed.

To structurally reinforce and then continue with emergency maintenance to provide the minimum reliability for this liner will require:

Description of Work	Estimated Value
Vertical Reinforcement	$500,000
Replace Hopper	$50,000
Reinforce 3 identified thin rings	$104,000
Patch 20% of identified thin steel	$60,000
Total:	$714,000

Subsequent annual inspection, maintenance and repair costs are estimated to be $70,000/year.

Note: Adding vertical reinforcement (columns) to the inside of the liner would likely reduce the output capability of the generating unit.

These expenditures are considered adequate in the next few years to provide an acceptable level of reliability but may not be sufficient to extend the life of the stack liner until 2020.

2.2 Perform Immediate Repairs and Maintenance and Plan Future Reinforcement

This option is similar to the option described above, except that the main vertical reinforcement identified will be delayed until 2011.

To perform immediate repairs in 2005, then continue with emergency maintenance and future vertical reinforcement in 2011, to provide the minimum reliability for this liner will require:

Description of Work	Estimated Value
Replace Hopper	$50,000
Reinforce 3 identified thin rings	$104,000
Patch identified thin steel	$303,000
Sub-Total (Work 2005):	$457,000
Vertical Reinforcement (in 2011)	$500,000
Total (Work 2005 & 2011):	$957,000

Subsequent annual inspection, maintenance and repair costs are estimated to be $70,000/year.

Note: Adding vertical reinforcement (columns) to the inside of the liner would likely reduce the output capability of the generating unit.

This option would also provide an acceptable level of reliability but is dependent on the continued rate of deterioration of the 34 year old mild steel in a very harsh environment.

2.3 Replace Steel Liner

This option involves the removal of the existing stack liner and support structure and the installation of a new stack liner at a cost of $1,200,000 in 2005. This option will provide the greatest reliability with respect to the stack liner and hence generation availability. It is expected that bi-annual inspections of the new liner would be required for continuous reliable operation.

3.0 Evaluation of Alternatives

The previous section presented three alternatives for the refurbishment of the stack liner. These options are evaluated below to determine the most cost effective solution.

3.1 Evaluation

All alternatives were evaluated on their respective capital and operating costs.

The table below indicates each alternative and associated cost.

	Option #1	**Option #2**	**Option #3**
	Reinforcement and Continue Current Practice	Perform Immediate Repairs and Maintenance and Plan Future Reinforcemnt	Replace Stack Liner
Capital Cost**	$714,000	$457,000	$1,200,000
		$500,000 Vertical Reinforcement - 2011	
O & M Costs	$70,000/Year	$70,000/Year	$20,000/Bi-Annual

** Capital cost excluding internal engineering & construction management, environment cost, overhead or contingency.

3.2 Cost Comparison

A cumulative present worth comparison was conducted for the three options listed above. The cumulative present worth calculation assumed an 16-year horizon, discount rate of 9%, average inflation rate of 1.6%, and an increase in annual maintenance and repair costs of 3% due to larger areas requiring repairs.

The results of these calculations revealed that the replacement of the stack liner is the least cost option over the 16-year evaluation period. The results of the comparison are shown in Appendix A, Cumulative Present Worth Comparison.

3.3 Summary

The analysis does not consider the possibility of a catastrophic failure, which, would impact the overall plant and make the unit unavailable for at least six months and would significantly increase the cost of repairs.

In addition, any shortfall in power or energy supply would have to be replaced by the gas turbines, assuming that sufficient capacity is available, at approximately double the cost of Holyrood energy.

The option that provides the best reliability (lowest risk) and availability until 2020 and at the lowest cost is the replacement of the liner (Option #3) during the major outage scheduled in 2005. This, also, avoids the risk of catastrophic failure and its associated increased cost and potential increased maintenance cost.

PUB granted approval in 2002 for the replacement of Stack Steel Liner #1. This work is scheduled to be complete in August 2003.

APPENDIX A

CUMULATIVE PRESENT WORTH COMPARISON

Annual Stats		Notes
Annual Escalation (%)	1.6	Inflation
Annual Discount Rate	9.0	Hydro

Option #1

Capital Cost (2003 dollars)	
Construction	714,000

Operating Cost (2003 dollars)	
Annual Inspection & Maintenance	70,000
Annual Maintenance Cost (%)	3

	Year	Cash Flow	CPW
0	2005	$725,424	$725,424
1	2006	$73,220	$792,598
2	2007	$76,588	$857,061
3	2008	$80,111	$918,922
4	2009	$83,796	$978,285
5	2010	$87,651	$1,035,252
6	2011	$91,683	$1,089,920
7	2012	$95,900	$1,142,380
8	2013	$100,312	$1,192,723
9	2014	$104,926	$1,241,034
10	2015	$109,753	$1,287,395
11	2016	$114,801	$1,331,884
12	2017	$120,082	$1,374,577
13	2018	$125,606	$1,415,547
14	2019	$131,384	$1,454,864
15	2020	$137,427	$1,492,593
16	2021	$143,749	$1,528,799
17	2022	$150,362	$1,563,543

Option #2

Capital Cost (2003 dollars)	
Construction	457,000

Operating Cost (2003 dollars)	
Annual Inspection & Maintenance	70,000
Annual Maintenance Cost (%)	3
Install Vertical Reinforcement (2011)	500,000

	Year	Cash Flow	
0	2005	$464,312	$464,312
1	2006	$73,220	$531,486
2	2007	$76,588	$595,949
3	2008	$80,111	$657,810
4	2009	$83,796	$717,173
5	2010	$87,651	$774,140
6	2011	$591,683	$1,126,941
7	2012	$95,900	$1,179,402
8	2013	$100,312	$1,229,745
9	2014	$104,926	$1,278,056
10	2015	$109,753	$1,324,416
11	2016	$114,801	$1,368,906
12	2017	$120,082	$1,411,599
13	2018	$125,606	$1,452,569
14	2019	$131,384	$1,491,885
15	2020	$137,427	$1,529,614
16	2021	$143,749	$1,565,820
17	2022	$150,362	$1,600,565

Option #3

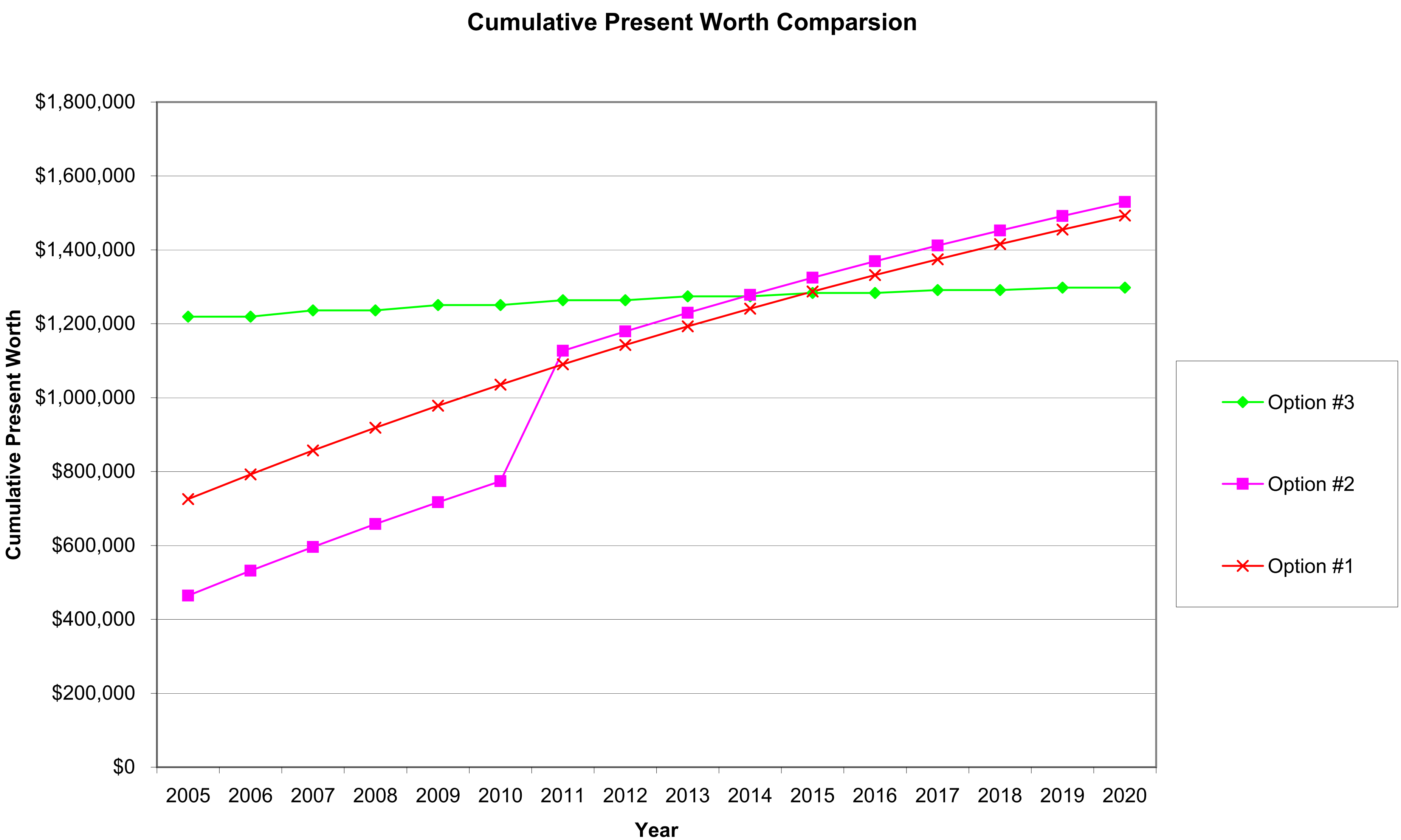
Capital Cost (2003 dollars)	
Construction	1,200,000

Operating Cost (2003 dollars)	
Bi-Annual Inspection & Maintenance	20,000

	Year	Cash Flow	CPW
0	2005	$1,219,200	$1,219,200
1	2006	$0	$1,219,200
2	2007	$20,320	$1,236,303
3	2008	$0	$1,236,303
4	2009	$20,645	$1,250,928
5	2010	$0	$1,250,928
6	2011	$20,975	$1,263,435
7	2012	$0	$1,263,435
8	2013	$21,311	$1,274,131
9	2014	$0	$1,274,131
10	2015	$21,652	$1,283,277
11	2016	$0	$1,283,277
12	2017	$21,998	$1,291,098
13	2018	$0	$1,291,098
14	2019	$22,350	$1,297,786
15	2020	$0	$1,297,786
16	2021	$22,708	$1,303,506
17	2022	$0	$1,303,506

NOTES: Capital and Operating Costs have been escalated from 2003 dollars to 2005 dollars.

Since the Work is expected to be completed in 2005, the Cummulative Present Worth Comparsion is calculated for that year.


Cumulative Present Worth Comparsion
Cumulative Present Worth
$1,800,000
$1,600,000
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
Option #3
Option #2
Option #1