

1 Q. Re: 2013 Capital Projects Over 50,000 but less than 200,000: p. E-41 Purchase Low
2 Pressure Screw Compressor Set:
3 Please fully explain how Table 3: Cost Benefit Analysis was determined showing all
4 assumptions and calculations.

5
6

7 A. The following explains how Table 3: Cost Benefit Analysis was determined showing
8 assumptions and calculations. Two alternatives were explored:

- 9
 - Alternative 1: Add a new low pressure (LP) compressor to the existing

10 system.

11
 - Alternative 2: Status quo, continuing with existing two high pressure (HP)

12 compressors.

13

14 **Alternative 1:**

15 The following is a list of assumptions for Alternative 1.

16 Assumptions:

- 17
 - The compressors have a depreciable life of 40 years, both LP and HP

18
 - The preventive maintenance (PM) cost of the LP is \$ 500 based on other

19 similar compressors;

20
 - The PM cost for the HP was not included, as this is estimated to be the same

21 in both alternatives;

22
 - Overhaul frequency of the LP compressor is 20 years;

23
 - Overhaul frequency of the HP compressor is ten years;

24
 - The year an overhaul is performed the corrective maintenance (CM) cost is

25 reduced;

26
 - When HP compressors are replaced in 2040 there is a decrease in the

27 corrective maintenance for the next five years; and

- Energy saving are based on ten hours/day less running time, a smaller compressor (7.5 horse power instead of 15 which is equivalent to 0.0056 MW savings), used the NLH Proxy Marginal Costs (i.e. the approximate cost per megawatt during that year) note after 2032 it was assumed that a 2% increase per year for inflation, savings in first year lower to account for installation half way through the year.

Calculations:

The following is a list of attachments showing the calculation tables for Alternative 1 and a sample calculation for the year 2013.

a) Attachment 1: *Alternative 1 – Operating and Maintenance (O&M) Cost*

Calculations:

The following is a sample calculation for year 2013;

\$ 500.00 (Low pressure compressor PM costs) + \$4,300 (Average CM costs)
= \$4,800 for the estimate year of 2012, therefore with an escalation of 2.2%
for 2013 the Annual O&M costs are $\$4,800 * 0.022 = \$4,906$.

b) Attachment 2: *Alternative 1 - Benefit Calculation*

The following is a sample calculation for year 2013;

$\$178.46/\text{MWh} * \text{ten hours/day} * 0.0056 \text{ MW} * 192 \text{ days} = \$1,919$

c) Attachment 3: *Alternative 1 - CPW Calculation*

The following is a sample calculation for year 2013;

Total costs = Annual O&M Costs + Total in Service Project Cost

= \$4,906 + \$97,300

= \$102,206

Net = Total costs + Benefits

= \$102,206 – \$1,963

= \$100,242

CPW = Net * (1 – (1 + Discount Rate)⁻ⁿ) / Discount Rate

Where n is the number of years

= \$100,050

Alternative 2:

The following is a list of assumptions for Alternative 2.

Assumptions:

- The compressors have a depreciable life of 40 years, however due to overuse it is estimated that the compressors will have to be replaced after 30 years of service;
- The PM cost for the HP was not included, as this would be the same in both alternatives;
- Overhaul frequency of the HP compressor is five years due to overuse;
- In the year that an overhaul is performed the corrective maintenance cost is reduced;.
- When HP compressors are replaced in 2030 there is a decrease in the corrective maintenance for the next four years; and
- Corrective maintenance is based on average historical maintenance costs;

1 Calculations:

2 The following is a list of attachments showing the calculation tables for Alternative
3 2 and a sample calculation for the year 2013.

5 Attachment 1: *Alternative 2 - O&M Cost Calculation*

6 The following is a sample calculation for year 2013;
7 \$6,400 (Average CM costs) for the estimate year of 2012, therefore with an
8 escalation of 2.2 % for 2013 the Annual O&M costs are $\$6,400 * 0.022 =$
9 \$6,541.

11 Attachment 2: *Alternative 2 - CPW Calculation*

12 The following is a sample calculation for year 2013;

14 Total costs = Annual O&M Costs
15 = \$6,541

17 Net = Total costs
18 = \$6,541

20 $CPW = Net * (1 - (1 + \text{Discount Rate})^{-n}) / \text{Discount Rate}$

21 Where n is the number of years

22 = \$6,113

	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX
2	PROJECT COST / BENEFIT ANALYSIS TEMPLATE											
3	BDE - Purchase LP Screw Compressor Set											
4	Alternative 1											
5	LP Compressor Addition											
6	Note: Costs are shown as positive values; Benefits as negative values											
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23	A	B	C	D	E	F	G	H	I	J	K	L
24	Year		Annual O&M Cost \$	Annual Fuel Price (if applicable)	Annual Fuel Cost \$	Other Cost \$	Total Costs \$	Benefit 1 (specify) \$	Benefit 2 (specify) \$	NET \$	P.W. January 2013	Cumulative Present Worth
25												
26												
27	0	2012	-		-	-	-	-	-	-	-	-
28	1	2013	4,906		-	-	102,206	(1,963)	-	100,242	100,050	100,050
29	2	2014	5,014		-	-	5,014	(4,232)	-	782	683	100,732
30	3	2015	5,124		-	-	5,124	(4,648)	-	475	388	101,121
31	4	2016	5,237		-	-	5,237	(4,872)	-	365	278	101,399
32	5	2017	5,352		-	-	5,352	(1,386)	-	3,966	2,828	104,227
33	6	2018	5,469		-	-	5,469	(1,530)	-	3,939	2,625	106,851
34	7	2019	5,590		-	-	5,590	(1,691)	-	3,899	2,428	109,280
35	8	2020	5,713		-	-	5,713	(1,867)	-	3,846	2,238	111,518
36	9	2021	14,596		-	-	14,596	(2,032)	-	12,564	6,834	118,352
37	10	2022	5,967		-	-	5,967	(2,211)	-	3,756	1,909	120,261
38	11	2023	6,098		-	-	6,098	(2,406)	-	3,692	1,754	122,015
39	12	2024	6,232		-	-	6,232	(2,618)	-	3,614	1,605	123,620
40	13	2025	6,369		-	-	6,369	(2,849)	-	3,520	1,461	125,081
41	14	2026	6,510		-	-	6,510	(2,964)	-	3,545	1,375	126,456
42	15	2027	6,653		-	-	6,653	(3,026)	-	3,627	1,315	127,770
43	16	2028	6,799		-	-	6,799	(3,119)	-	3,680	1,247	129,017
44	17	2029	6,949		-	-	6,949	(3,215)	-	3,734	1,182	130,199
45	18	2030	7,102		-	-	7,102	(3,315)	-	3,787	1,120	131,319
46	19	2031	18,145		-	-	18,145	(3,417)	-	14,727	4,072	135,392
47	20	2032	7,418		-	-	7,418	(3,524)	-	3,894	1,006	136,398
48	21	2033	15,477		-	-	15,477	(3,666)	-	11,811	2,853	139,250
49	22	2034	7,747		-	-	7,747	(3,814)	-	3,933	888	140,138
50	23	2035	7,918		-	-	7,918	(3,968)	-	3,950	833	140,971
51	24	2036	8,092		-	-	8,092	(4,129)	-	3,964	781	141,753
52	25	2037	8,270		-	-	8,270	(4,295)	-	3,975	732	142,485
53	26	2038	8,452		-	-	8,452	(4,469)	-	3,983	686	143,171
54	27	2039	8,638		-	-	8,638	(4,649)	-	3,989	642	143,813
55	28	2040	3,678		-	354,982	358,661	(4,837)	-	353,823	53,216	197,029
56	29	2041	4,699		-	-	4,699	(5,033)	-	(334)	(47)	196,982
57	30	2042	5,763		-	-	5,763	(5,236)	-	527	69	197,051
58	31	2043	6,871		-	-	6,871	(5,448)	-	1,424	175	197,226
59	32	2044	8,026		-	-	8,026	(5,668)	-	2,358	271	197,496
60	33	2045	9,843		-	-	9,843	(5,897)	-	3,946	423	197,920
61	34	2046	10,059		-	-	10,059	(6,135)	-	3,925	393	198,313
62	35	2047	10,281		-	-	10,281	(6,383)	-	3,898	365	198,678
63	36	2048	10,507		-	-	10,507	(6,641)	-	3,866	338	199,017
64	37	2049	10,738		-	-	10,738	(6,909)	-	3,829	313	199,330
65	38	2050	27,436		-	-	27,436	(7,188)	-	20,248	1,548	200,878
66	39	2051	11,216		-	-	11,216	(7,478)	-	3,737	267	201,145
67	40	2052	11,462		-	-	11,462	(7,780)	-	3,682	246	201,391
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2	PROJECT COST / BENEFIT ANALYSIS TEMPLATE											
3	BDE - Purchase LP Screw Compressor Set											
4	Alternative 2											
5	Status Quo											
6	Note: Costs are shown as positive values; Benefits as negative values											
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NLH 2013 Capital Budget

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	Year	For GDP Escalation	For Combustion Turbine Escalation	For CCCT Escalation	For Hydraulic Escalation	For Transmission Escalation	For Transformer Escalation	For Distribution Escalation	For Non Escalation	Benefits 1 (Current \$)	Comments / Explanations	Extra work Area if needed					
326																	
327																	
328																	
329																	
330	0	2012								-							
331	1	2013								1,963	> Energy savings based on 10 hours /day less running time, smaller						\$178
332	2	2014								4,232	compressor (7.5 Hp), using NLH Proxy marginal Costs, note after 2032 it						\$195
333	3	2015								4,648	was assumed that a 2% increase per year for inflation.						\$207
334	4	2016								4,872	> Values for the Proxy Marginal Costs in column R						\$214
335	5	2017								1,386	> Lower benefit in the first year due to installation 1/2 way thru the year.						\$60
336	6	2018								1,530							\$65
337	7	2019								1,691							\$71
338	8	2020								1,867							\$77
339	9	2021								2,032							\$82
340	10	2022								2,211							\$87
341	11	2023								2,406							\$93
342	12	2024								2,618							\$99
343	13	2025								2,849							\$106
344	14	2026								2,964							\$108
345	15	2027								3,026							\$108
346	16	2028								3,119							\$109
347	17	2029								3,215							\$110
348	18	2030								3,315							\$111
349	19	2031								3,417							\$113
350	20	2032								3,524							\$114
351	21	2033								3,666							\$116.08
352	22	2034								3,814							\$118.40
353	23	2035								3,968							\$120.77
354	24	2036								4,129							\$123.18
355	25	2037								4,295							\$125.64
356	26	2038								4,469							\$128.16
357	27	2039								4,649							\$130.72
358	28	2040								4,837							\$133.33
359	29	2041								5,033							\$136.00
360	30	2042								5,236							\$138.72
361	31	2043								5,448							\$141.50
362	32	2044								5,668							\$144.33
363	33	2045								5,897							\$147.21
364	34	2046								6,135							\$150.16
365	35	2047								6,383							\$153.16
366	36	2048								6,641							\$156.22
367	37	2049								6,909							\$159.35
368	38	2050								7,188							\$162.53
369	39	2051								7,478							\$165.79
370	40	2052								7,780							\$169.10

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	B	C	D	E	F	G	H	I	J	K	L	M	N	O
22														
23														
24														
25														
26														
27	0	2012				Average CM Wor	O/H 2 HP Comp							1.0000
28	1	2013				6400			6400	6,541	**PM costs of HP not included			1.0000
29	2	2014				6400			6400	6,685	as these would be the same for			1.0000
30	3	2015				6400			6400	6,832	both alt.			1.0000
31	4	2016				2500	10000		12500	13,637				1.0000
32	5	2017				6400			6400	7,136				1.0000
33	6	2018				6400			6400	7,293				1.0000
34	7	2019				6400			6400	7,453				1.0000
35	8	2020				6400			6400	7,617				1.0000
36	9	2021				2500	10000		12500	15,204				1.0000
37	10	2022				6400			6400	7,956				1.0000
38	11	2023				6400			6400	8,131				1.0000
39	12	2024				6400			6400	8,310				1.0000
40	13	2025				6400			6400	8,493				1.0000
41	14	2026				2500	10000		12500	16,952				1.0000
42	15	2027				6400			6400	8,870				1.0000
43	16	2028				6400			6400	9,066				1.0000
44	17	2029				6400			6400	9,265				1.0000
45	18	2030				2500			2500	3,699	> Note unit replaced in 2030,			1.0000
46	19	2031				3500			3500	5,292	therefore next O/H estimated to			1.0000
47	20	2032				4500			4500	6,954	be in 2035. CM costs lower, but			1.0000
48	21	2033				5500			5500	8,686	estimated to be back to 6.4K			1.0000
49	22	2034				6400			6400	10,330	level by 2034.			1.0000
50	23	2035				2500	10000		12500	20,620				1.0000
51	24	2036				6400			6400	10,790				1.0000
52	25	2037				6400			6400	11,027				1.0000
53	26	2038				6400			6400	11,269				1.0000
54	27	2039				6400			6400	11,517				1.0000
55	28	2040				2500	10000		12500	22,990				1.0000
56	29	2041				6400			6400	12,030				1.0000
57	30	2042				6400			6400	12,294				1.0000
58	31	2043				6400			6400	12,565				1.0000
59	32	2044				6400			6400	12,841				1.0000
60	33	2045				2500	10000		12500	25,632				1.0000
61	34	2046				6400			6400	13,413				1.0000
62	35	2047				6400			6400	13,708				1.0000
63	36	2048				6400			6400	14,009				1.0000
64	37	2049				6400			6400	14,317				1.0000
65	38	2050				2500	10000		12500	28,579				1.0000
66	39	2051				6400			6400	14,954				1.0000
67	40	2052				6400			6400	15,283				1.0000

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	B	C	D	E	F	G	H	I	J	K	L	M	N	O
23	Year		Working Area Below (if required)						Annual O&M costs (Constant \$)	Annual O&M costs (Current \$)	Comments / Explanations	User Chosen Annual % Change	Cumulative Change Factor	
24														
25														
27	0	2012			PM costs of LP	Average CM Wor	O/H 2 HP Com	O/H 1 LP Comp			**PM costs of HP not included			1.0000
28	1	2013			500	4300			4800	4,906	as these would be the same for			1.0000
29	2	2014			500	4300			4800	5,014	both alt.			1.0000
30	3	2015			500	4300			4800	5,124				1.0000
31	4	2016			500	4300			4800	5,237				1.0000
32	5	2017			500	4300			4800	5,352				1.0000
33	6	2018			500	4300			4800	5,469				1.0000
34	7	2019			500	4300			4800	5,590				1.0000
35	8	2020			500	4300			4800	5,713				1.0000
36	9	2021			500	1500	10000		12000	14,596	Lower CM costs due to rebuild			1.0000
37	10	2022			500	4300			4800	5,967				1.0000
38	11	2023			500	4300			4800	6,098				1.0000
39	12	2024			500	4300			4800	6,232				1.0000
40	13	2025			500	4300			4800	6,369				1.0000
41	14	2026			500	4300			4800	6,510				1.0000
42	15	2027			500	4300			4800	6,653				1.0000
43	16	2028			500	4300			4800	6,799				1.0000
44	17	2029			500	4300			4800	6,949				1.0000
45	18	2030			500	4300			4800	7,102				1.0000
46	19	2031			500	1500	10000		12000	18,145	Lower CM costs due to rebuild			1.0000
47	20	2032			500	4300			4800	7,418				1.0000
48	21	2033			500	4300		5000	9800	15,477				1.0000
49	22	2034			500	4300			4800	7,747				1.0000
50	23	2035			500	4300			4800	7,918				1.0000
51	24	2036			500	4300			4800	8,092				1.0000
52	25	2037			500	4300			4800	8,270				1.0000
53	26	2038			500	4300			4800	8,452				1.0000
54	27	2039			500	4300			4800	8,638				1.0000
55	28	2040			500	1500			2000	3,678	replacement year, reduced CM			1.0000
56	29	2041			500	2000			2500	4,699	over the next few years, but			1.0000
57	30	2042			500	2500			3000	5,763	will be back to average by 2045			1.0000
58	31	2043			500	3000			3500	6,871				1.0000
59	32	2044			500	3500			4000	8,026				1.0000
60	33	2045			500	4300			4800	9,843				1.0000
61	34	2046			500	4300			4800	10,059				1.0000
62	35	2047			500	4300			4800	10,281				1.0000
63	36	2048			500	4300			4800	10,507				1.0000
64	37	2049			500	4300			4800	10,738				1.0000
65	38	2050			500	1500	10000		12000	27,436	Lower CM costs due to rebuild			1.0000
66	39	2051			500	4300			4800	11,216				1.0000
67	40	2052			500	4300			4800	11,462				1.0000