

Liberty Assessment of the Merrimack Unit 2 HP/IP Turbine Replacement in 2008

Liberty viewed the economic analysis done by PSNH to be a simplistic first cost analysis¹. Many items are not considered when using a simplistic approach as PSNH did. Some items add to the economics of the project and some subtract from the economics of the project. The shortcomings of the analysis as noted by Liberty were that inflation was not considered, the time value of money was not considered, no sensitivity analysis was performed, project life was not included, and maintenance savings beyond the year of installation was not included. PSNH, however, did use conservatism in some of the study assumptions.

If Liberty were to redo the analysis using inputs as known today, such an analysis would be an economic review of project economics with hindsight. The Liberty approach was to take the inputs used by PSNH, use very conservative assumptions, and consider the factors mentioned above to look at what one might consider a worst case scenario with regard to the economics of the project. Liberty took this approach rather than to do a multitude of sensitivity analyses due to the strong economics exhibited by the project in the PSNH simplistic analysis.

Liberty discusses each input assumption here as used by PSNH or Liberty. They are as follows and are presented in tabular form further below:

- The capital cost of the project was estimated at \$9 million. PSNH used this estimate and Liberty assumed a 33-1/3 percent cost overrun and used \$12 million for the project cost.
- The expected increase in unit output was 6 to 10 MW. PSNH used the midpoint of 8 MW, while Liberty assumed the low end of the estimate of 6 MW.
- The estimated 2008 maintenance savings were \$1.85 million. PSNH used this figure. Liberty considered this figure as relatively firm and used it also.
- The estimated 2013 maintenance savings were \$2 to \$4 million. PSNH did not include these savings in their analysis. Liberty looked at project economics both with and without 2013 budgeted maintenance savings of \$1.45 million (2008\$).
- No values were provided for 2023 maintenance savings in the second turbine inspection cycle. PSNH did not consider the second maintenance cycle and ignored these savings. Liberty assumed that at the 10-year inspection of the turbine that the manufacturer recommended returning to the standard 5-year maintenance cycle resulting in no further maintenance savings.
- PSNH estimated the market price of energy to be \$81.75/MWH and used this value. Liberty assumed a 50 percent drop in market price from the outset of the analysis and used a 2008 value of \$41.00/MWH.
- PSNH used a unit capacity factor of 0.75. This value is considered to be a low value and was also used by Liberty.
- PSNH used a value for capacity of \$6.37/kW-Month. Liberty assumed a 50 percent drop in market price from the outset of the analysis and used a 2008 value of \$3.20/kW-month.

¹ Data Request STAFF-01, Q STAFF-029.

- PSNH did not include maintenance savings generated in 2013 or beyond in its study. Liberty did its analysis with and without maintenance savings in 2013, but did not consider maintenance savings after that time. Liberty used a 20-year life.
- PSNH did not consider inflation in its analysis. Liberty used a 3.00 percent inflation factor.
- PSNH did not consider the time value of money in its analysis. Liberty used a NPV discount rate of 9.00 percent.
- PSNH did not consider the carrying costs (return, taxes, depreciation, etc.) of the investment in the new turbine. Liberty uses a value of 1.6 times the investment as a proxy for the NPV of the project over its life.

| <u>Assumptions</u> | <u>PSNH</u> | <u>Liberty</u> |
|---|------------------|------------------|
| Cost of Project (\$9.00 M) | \$9.00 M | \$12.00 M |
| Output Increase (6.0 to 10.0 MW) | 8.0 MW | 6.0 MW |
| 2008 Maintenance savings (\$1.85 M) | \$1.85 M | \$1.85 M |
| 2013 Maintenance Savings (\$1.45 M) | Did Not Use | \$1.45 M and \$0 |
| 2023 Maintenance savings (Same as 2013) | Did Not Use | Did Not Use |
| Market Price of Energy (\$81.75/MWH) | \$81.75/MWH | \$41.00/MWH |
| Unit Capacity Factor (0.75) | 0.75 | 0.75 |
| Value of Capacity (\$6.37/KW-Month) | \$6.37/KW-Month | \$3.20/KW-Month |
| Study Length | First Cost Basis | 20 Years |
| Inflation Rate | None | 3.00 Percent |
| NPV Discount Factor | None | 9.00 Percent |

Study Results

Liberty NPV analysis of Merrimack HP/IP Turbine Replacement (Nominal Dollars and 2008 Dollars X 10⁶ as Noted)

| Year | Energy Savings Nominal \$ | NPV of Energy Savings 2008 \$ | Cumulative NPV of Energy Savings 2008 \$ | Maint. Savings Nominal \$ | NPV of Maintenance Savings 2008 \$ | Capacity Savings Nominal \$ | NPV of Capacity Savings 2008 \$ | Cumulative NPV of Capacity Savings 2008 \$ |
|------|---------------------------|-------------------------------|--|---------------------------|------------------------------------|-----------------------------|---------------------------------|--|
| 2008 | 1.62 | 1.62 | | 1.85 | 1.85 | 0.23 | 0.23 | |
| 2009 | 1.67 | 1.53 | | | | 0.24 | 0.22 | |
| 2010 | 1.72 | 1.45 | | | | 0.24 | 0.20 | |
| 2011 | 1.77 | 1.37 | | | | 0.25 | 0.19 | |
| 2012 | 1.82 | 1.29 | 7.26 | | | 0.26 | 0.18 | 1.02 |
| 2013 | 1.88 | 1.22 | 8.48 | 1.68 | 1.09 | 0.27 | 0.18 | 1.20 |
| 2014 | 1.93 | 1.15 | 9.63 | | | 0.27 | 0.16 | 1.36 |
| 2015 | 1.99 | 1.09 | 10.72 | | | 0.28 | 0.15 | 1.51 |
| 2016 | 2.05 | 1.03 | 11.75 | | | 0.29 | 0.15 | 1.66 |
| 2017 | 2.11 | 0.97 | 12.72 | | | 0.30 | 0.14 | 1.80 |

| | | | | | | | |
|---------------|------|--------------|--------------|--|-------------|-------------|-------------|
| 2018 | 2.18 | 0.92 | | | 0.31 | 0.13 | |
| 2019 | 2.24 | 0.87 | | | 0.32 | 0.12 | |
| 2020 | 2.31 | 0.82 | | | 0.33 | 0.12 | |
| 2021 | 2.38 | 0.78 | | | 0.34 | 0.11 | |
| 2022 | 2.45 | 0.73 | 16.84 | | 0.35 | 0.10 | 2.38 |
| 2023 | 2.52 | 0.69 | | | 0.36 | 0.10 | |
| 2024 | 2.60 | 0.65 | | | 0.37 | 0.09 | |
| 2025 | 2.68 | 0.62 | | | 0.38 | 0.09 | |
| 2026 | 2.76 | 0.59 | | | 0.39 | 0.08 | |
| 2027 | 2.84 | 0.55 | 19.94 | | 0.40 | 0.08 | 2.82 |
| Totals | | 19.94 | | | 2.94 | 2.82 | |

The analysis above is a NPV analysis of savings. The NPV of savings at any point in time must be compared to the NPV of the investment including carrying charges. The total cost of the project as assumed by Liberty would be \$19.20 million (\$12 times 1.6). For example, the economic of the project at 20 years would show \$25.7 million in NPV savings versus a NPV cost of \$19.2 million.

The analysis shows that the 10-year NPV of the project is \$17.46 million (\$12.72 + \$2.94 + \$1.80) and that the 15-year NPV of the project is \$22.16 million (\$16.84 + \$2.94 + \$2.38) including the savings of the first 5-year maintenance cycle. These values indicate a project payback late in the 12th year.

If one were to further assume that the first 5-year maintenance savings did not occur, the 10-year NPV of the project is \$16.37 million (\$12.72 + \$1.85 + \$1.80) and that the 15-year NPV of the project is \$21.07 million (\$16.84 + \$1.85 + \$2.38). These values indicate a project payback late in the 13th year.

Liberty concluded that the HP/IP turbine replacement project exhibits very strong economic benefits even if very conservative layered assumptions are used and proceeding with the project was in customers' best interests.