Converting the Escanaba Generating Station Feedstock to Powder River Basin (PRB) Coal

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Acknowledgments

All of the information contained in this document related to market pricing, conversion cost estimates, engineering costs, fuel costs and other outsourced services or estimates were solicited from electric industry experts, other utilities, and vendors and suppliers of the Escanaba Electric Department. All the information in this document is presented as the best available information at the time of development of this document.

Background

In 1958, the City of Escanaba constructed a power generation facility consisting of 2 identical 12.5 MW Allis-Chalmers steam turbines. These turbines were coupled with 2 identical Allis-Chalmers generators and 2 identical Babcock & Wilcox boilers. The equipment was designed to operate with the use of Central Appalachian coal. Over the years, the supply and cost of Central Appalachian coal remained available and affordable. The City of Escanaba began to see this trend change in the early 2000's, which has since been reflected in higher electrical rates for the utility customer over the last several years.

In 2007, through a competitive bidding process, the cost of Central Appalachian coal was $69/ton delivered to Escanaba. In 2008, in the City's first round of competitive bidding, the cost of Central Appalachian coal was $72.45/ton delivered. However, due to circumstances beyond the control of the City and the Supplier, the contract price of $72.45/ton could not be honored due to a forced bankruptcy of the mine and the supplier's inability to secure the coal due to the forced legal action. In an effort to secure coal for the City of Escanaba, the supplier, the C. Reiss Coal Company, offered to sell the City of Escanaba a replacement coal. The coal that was offered was a western bituminous coal with a price of $95/ton delivered to Escanaba. This western bituminous coal was very similar to Central Appalachian coal in many of the major characteristics such as heat content, sulfur content, ash content, and moisture content. In early 2008, the City of Escanaba directed Wisconsin Public Service (WPS), who arranges the coal purchases for the City as specified in the plant operating agreement, to secure quotes for Central Appalachian coal from other suppliers. These quotes for Central Appalachian coal ranged from $120 to $130/ton. Due to the cost differential, the City agreed to buy 1 boatload of western bituminous coal so that a test burn could be conducted at the plant. In that the test burn was favorable, the City ordered 7 additional trainloads of western bituminous coal for 2008.

While the cost of Central Appalachian coal has risen substantially over the past few years, the cost of western sub-bituminous coal from the Powder River Basin (PRB) has stayed relatively constant and much lower than Central Appalachian coal. In late March of 2008, a preliminary analysis was performed by City Administration with Electric Advisory Committee (EAC) input that showed production costs at the Escanaba Generating Station could be reduced by converting the plant to PRB coal. Requests for proposals (RFPs) for a PRB conversion study were sent to seven (7) engineering firms in April of 2008. Proposals were received from six (6) firms and were opened on May 6, 2008. An RFP review committee was formed to review and independently score each proposal so that a recommendation could be made to the Electric Advisory Committee, who in turn would make a recommendation to the City Council and citizens of the community. In the course of the review, the scoring results unanimously determined that the proposal from Sargent & Lundy of Chicago, IL was the best proposal received for the following reasons: Responsiveness to the RFP, firm qualifications and experience, project

team qualifications, and firm resources. The cost included with the Sargent & Lundy proposal was $125,000 and would cover all expenses needed to perform a comprehensive conversion study. In that this proposed study would be needed and the price of this study is substantial, the City of Escanaba is now at the point where a decision needs to be made as to whether to proceed with this proposed PRB fuel conversion study or to choose another course of action.

Discussion

The PRB coal is a very different type of coal than the Escanaba Generating Station was designed to burn. It has a lower heat content, which results in more fuel needed to get the same amount of electric energy as compared to Central Appalachian coal. The percentage of ash content is less, but by needing to burn more, there will be a similar amount of ash produced. The moisture content of PRB coal is much higher than the Central Appalachian coal. The sulfur content of PRB coal is lower than the Central Appalachian coal. Appendix A lists some of the major characteristics of each type of coal.

Current Assets

The Escanaba Generating Station has been in service for fifty years. The average age of electric generating stations in Michigan is 48 years. The Escanaba Generating Station consists of 2 identical 12.5 MW steam turbines supplied by Allis-Chalmers. These turbines are coupled to identical Allis-Chalmers generators and are powered by 2 identical Babcock & Wilcox boilers. The boilers operate at 600 psi and 825 degrees F and can produce 125,000 pounds of steam per hour. The coal is delivered into the plant via dump trucks from the C. Reiss coal dock near the plant. The coal is fed into the boilers by Alstom stokers. The coal is burned on traveling grates inside the boilers and electrostatic precipitators are used to control particulate emissions discharged by the boilers.

Future Assets

Should the Escanaba Generating Station be converted to burn PRB coal, it is expected that many of the components of the plant would have to be replaced. PRB coal is quite dusty and flammable. The dust can create an explosive atmosphere inside the plant if dust collection and housekeeping are not addressed. It also has a high moisture content, which can cause operational issues. The coal bunkers may have to be altered to address the stickiness of the coal. The combustion air system may have to be redesigned and resized to supply more air to the boilers. Additionally, the combustion air may have to be pre-heated to help drive the moisture out of the PRB coal to improve the combustion process. Without a combustion air pre-heating upgrade, the steam production capacity of the boilers may be reduced. The pollution control system may have to be replaced with baghouses**.** Lastly, the ash handling system may need to be replaced.

Estimated Costs

Throughout the recent proposal process, informal conversion cost estimates were received from various engineering firms. These estimates were in the range of $20,000,000 to $30,000,000 for the Escanaba Generating Station. While these engineering firms had little knowledge of the details of the Escanaba Generating Station, they are experienced in stoker fired generating plants and have completed numerous studies and actual conversions. As an example, the New Ulm (MN) Public Utilities Commission recently received the results of a phase 1 study to convert one (1) of their boilers from natural gas to a mix of 90% PRB coal, with the remaining 10% being biomass and refuse derived fuel. The estimated cost of conversion is $28.8M +/- 30%. There are some differences in the New Ulm study compared to what could be expected for Escanaba. They are looking at a mix of fuels which would increase the costs. However, this is for only 1 boiler, while the Escanaba Generating Station has 2 boilers, which would increase Escanaba's costs. It is reasonable to believe that these 2 differences would cancel each other out somewhat, giving real world validity to the informal cost estimates received through this process.

A major cost component of all electric generating stations is the fuel cost. As stated earlier, the Escanaba Generating Station is currently burning a western bituminous coal that costs $95/ton delivered to Escanaba. This coal contains 12,300 Btu/pound. Energy is typically priced in dollars per million British thermal units (Btu) ($/MMBtu). The current cost for the Escanaba Generating Station fuel is $3.862/MMBtu.

In recent discussions with a fuel procurement agent for WPS, it was estimated that PRB coal delivered to Escanaba could range from $38 to $53/ton. The wide range of these costs is mainly due to the rail transportation charges in delivering the coal from the Powder River Basin area of the western United States. These rail charges may be as low as $15/ton for existing long-term contracts and would be as high as $30/ton for all new contracts. These higher rail rates are mainly due to recent diesel fuel price increases. The coal itself costs about $15/ton at the mine, which has stayed relatively constant over the past few years. The vessel charge to deliver the coal from Chicago to Escanaba is estimated at $8/ton. Adding these 3 components together yields the range of $38 - $53/ton delivered to Escanaba. Being that Escanaba would be a new PRB customer, we should expect PRB delivered to Escanaba to be in the mid $40's – low $50's/ton range.

In recent discussions with regional PRB coal users, delivered costs ranged from $38/ton to $47/ton for PRB coal that contains 8,800 Btu/lb. This equates to a range of $2.159/MMBtu to $2.670/MMBtu. These regional PRB users were in various stages of multi-year contracts and all expected their costs to be in the mid $40's/ton to low $50's/ton when new contracts are negotiated. Another regional PRB user burns a non-typical PRB coal that contains 9,100 Btu/lb with a delivered cost of $41/ton, or $2.253/MMBtu. There are some operational issues with this particular type of PRB coal that make it less desirable to many other PRB users. It should be noted that Central

Appalachian coal and western bituminous coals are expected to stay at their current high prices for the near future. Cost comparisons can be found in Appendix A.

Conclusion(s)

While there are many estimates used in these cost estimates, it is clear that converting the Escanaba Generating Station to 100% PRB coal would be a substantial investment for the City of Escanaba. From Appendix B, the best case scenario using a typical PRB coal is approximately $1.9M/yr more expensive than purchasing full requirements energy. The key assumptions used to arrive at this estimate may be overly optimistic. A capital investment of $20,625,000 is at the low end of the informal estimates that have been received from various engineering firms, 20 years for debt repayment may be unreasonably long for a 50 year old plant, and PRB delivered to Escanaba for $38/ton is most likely not available. A more reasonable scenario of $25,625,000 for capital investment, 15 years for debt repayment, and $45/ton for PRB delivered results in a cost differential of $3.7M/yr more when compared to purchasing full requirements energy. A worst-case scenario of $30,625,000 for capital investment, 10 years for debt repayment, and $53/ton for PRB delivered results in a cost differential of $6.3M/yr more when compared to purchasing full requirements energy. Using a non-typical PRB coal containing 9,100 Btu/lb, with a delivered cost of $41/ton, a $25,625,000 conversion cost, and 15 years for debt repayment, results in a cost differential of $3.0M/yr more when compared to purchasing full requirements energy.

Possible Courses of Action

1) Continue to operate the plant as is with Central Appalachian coal or western bituminous coal. This option requires no capital investment, but it has a high operational cost.

City Load	163,000 MWh/yr
Cost of fuel ($/ton)	$95/ton
Cost of fuel ($/MMBtu)	$3.862/MMBtu
Heat value	12,300Btu/lb
Tons of fuel needed per year	96,077 tons
Heat Rate of plant, Btu/kWh	14,500
Fixed Costs (labor, insurance, etc)	$5,000,000

Fuel Cost: ($3.862/1,000,000 Btu)*(14,500Btu/kWh)*(1000kWh/1MWh) =	$56.00/MWh
Ash Disposal, which is derived from actual results of the plant:	$1.60/MWh
Fixed Costs/MWh: ($5,000,000/163,000 MWh) =	$30.67/MWh
Total Costs: $56.00 + $1.60 + $30.67 =	$88.27/MWh

2) Retain an engineering firm to study the costs and feasibility of converting the plant to burn 100% PRB coal. This option would require a very high capital investment, but it would have a lower operational cost than the current operation.

City Load	163,000 MWh/yr
Cost of fuel ($/ton)	$38 - $53/ton
Cost of fuel ($/MMBtu)	$2.159 - $3.011/MMBtu
Heat value	8,800Btu/lb
Tons of fuel needed per year	134,290 tons
Heat Rate of plant, Btu/kWh	14,500
Fixed Costs (labor, insurance, etc)	$5,500,000

Fuel Cost:
@$38/ton: ($2.159/1,000,000 Btu)*(14,500Btu/kWh)*(1000kWh/1MWh) = $31.31/MWh
@$53/ton: ($3.011/1,000,000 Btu)*(14,500Btu/kWh)*(1000kWh/1MWh) = $43.66/MWh
Ash Disposal: ($1.60*(12,300Btu/lb/8800Btu/lb))*(5.5% ash/12% ash) = $1.03/MWh
Fixed Costs/MWh: ($5,500,000/163,000 MWh) = $33.74/MWh

Total Generation Costs: ($31.31 - $43.66) + $1.03 + $33.74 = $66.08 - $78.43/MWh

*** The $66.08 - $78.43 range shown above does NOT include the cost of capital needed for a PRB conversion. ***

3) Retain an engineering firm to study the costs and feasibility of blending PRB coal with our current fuel. A regional PRB user that was recently contacted uses a 33% mix of PRB coal in the summer and up to a 66% mix of PRB in the winter. This boiler was originally designed to burn Central Appalachian coal and there were few modifications made to the boiler to add PRB coal to the fuel mix. They must use a lower percentage of PRB in the summer to meet summer peak loads as their boiler is derated by using the PRB. This option requires a moderate capital investment, and it would result in marginally lower operational costs than current costs.

4) Discontinue operation and/or sell the plant to a private electric energy supplier/entity and purchase full requirements power from a third party supplier. The best calculations and figures available demonstrate this option to be the least expensive option available to the City of Escanaba at this time.

	As-is	PRB Conversion	Wholesale
Fuel Costs $/ton	$95	$38 - $53	N/A
Fuel Costs/MWh	$56.00	$31.31 - $43.66	N/A
Ash Disposal/MWh	$1.60	$1.03	N/A
Fixed Costs/MWh	$30.67	$33.74	N/A
Total Costs/MWh	$88.27	$66.08 - $78.43	$64.42 - $68.10
City Load, MWh	163,000	163,000	163,000
Total Annual Gen. Costs	$14.4M	$10.8M - $12.8M	$10.5M – $11.1M
Debt Repayment	$0	$1.7M - $4.0 M	$0
Total Annual Costs	$14.4M	$12.4M - $16.8M	$10.5M - $11.1M

Appendix A – Major characteristics of various coal types

	Central Appalachian	Western bituminous	PRB
Heat Content, Btu/lb	12,300	12,300	8,800
Moisture, %	7	7	27
Sulfur, %	1.3	1.3	.25
Ash, %	12	12	5.5
Fusion Temp, F	2700	2600	2290
Cost range per ton	$120-$140	$95-$110	$38-$53
Cost range ($/MMBtu)	$4.878 - $5.691	$3.862 - $4.472	$2.159 - $3.011

Appendix B – Cost Estimates

Key assumptions used for all comparisons:

City load = 163,000 MWh/yr
Escanaba Generating Station Heat Rate = 14,500 Btu/kWh
Total fixed costs for Central Appalachian and western bituminous= $5,000,000
Total fixed costs for PRB coal = $5,500,000
Heat content for Central Appalachian and western bituminous = 12,300 Btu/lb
Heat content for typical PRB = 8,800 Btu/lb, non-typical PRB = 9,100 Btu/lb
Interest rate for debt repayment = 5.00%
The Escanaba Generating Station will produce all power used for City Load, i.e. no purchased energy
Conversion costs include $125,000 for Sargent & Lundy study, plus $500,000 for bond preparation

Various scenarios used for comparisons:

1) Full service supply contract, Party #3

2) Full service supply contract, Party #1

3) "Best Case", typical PRB coal conversion
PRB delivered to Escanaba for $38/ton
$20,625,000 conversion cost
20 years for debt repayment

4) "Middle Case", non-typical PRB coal conversion
PRB delivered to Escanaba for $41/ton
$25,625,000 conversion cost
15 years for debt repayment

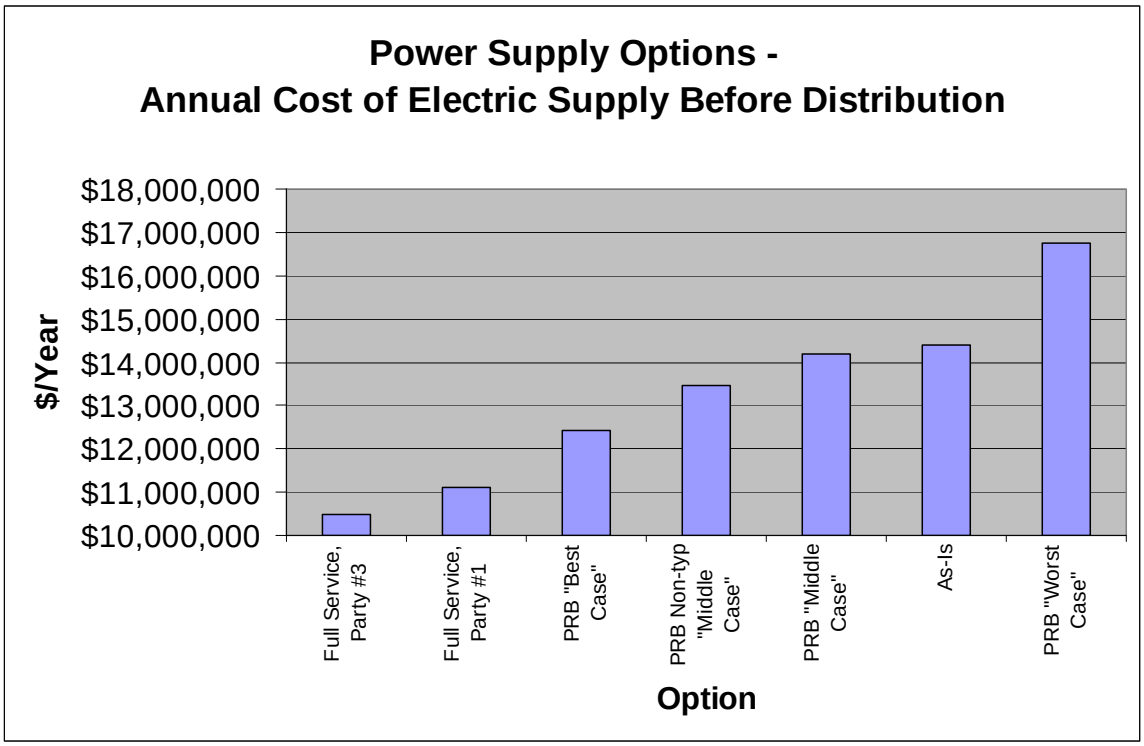
5) "Middle Case", typical PRB coal conversion
PRB delivered to Escanaba for $45/ton
$25,625,000 conversion cost
15 years for debt repayment

6) "As-is" with West Ridge coal

7) "Worst Case", typical PRB coal conversion
PRB delivered to Escanaba for $53/ton
$30,625,000 conversion cost
10 years for debt repayment

Power Supply Option	Full Service Supply Contract Party 3	Full Service Supply Contract Party 1	Convert Plant to Typical Western PRB coal	Convert Plant to Non-Typical Western PRB coal	Convert Plant to Typical Western PRB coal	Present Operation Westridge Coal	Convert Plant to Typical Western PRB coal
Power Plant							
Fuel Type			PRB	PRB	PRB	Western Bit	PRB
$/Ton			$38.00	$41.00	$45.00	$95.00	$53.00
$/MMBtu			$2.159	$2.253	$2.557	$3.862	$3.011
$/Yr			$5,103,011	$5,324,368	$6,043,040	$9,127,337	$7,117,358
Qty, Tons/Yr			134,290	129,863	134,290	96,077	134,290
Heat Value, Btu/lb			8,800	9,100	8,800	12,300	8,800
City Load, MWh/Yr	163,000	163,000	163,000	163,000	163,000	163,000	163,000
Fixed Total Costs			$5,500,000	$5,500,000	$5,500,000	$5,000,000	$5,500,000
Power Plant Heat Rate, Btu/kWh			14,500	14,500	14,500	14,500	14,500
Est Cap Investment	$0	$0	$20,625,000	$25,625,000	$25,625,000		$30,625,000
Interest Rate	5.00%	5.00%	5.00%	5.00%	5.00%		5.00%
Years for repayment	10	10	20	15	15		10
Yearly Payment	$0	$0	$1,655,003	$2,468,771	$2,468,771		$3,966,078
Generation Cost, $/MWh							
Variable							
Fuel			$31.31	$32.66	$37.07	$56.00	$43.66
Ash Disposal			$1.03	$1.03	$1.03	$1.60	$1.03
Fixed			$33.74	$33.74	$33.74	$30.67	$33.74
Total, $/MWh	$64.42	$68.10	$66.08	$67.44	$71.85	$88.27	$78.44
Total Generation costs, $/Yr	$10,500,460	$11,100,300	$10,770,901	$10,992,258	$11,710,930	$14,388,137	$12,785,248
Debt Repayment	$0	$0	$1,655,003	$2,468,771	$2,468,771		$3,966,078
Total Costs, $/Yr	**$10,500,460**	**$11,100,300**	**$12,425,905**	**$13,461,029**	**$14,179,701**	**$14,388,137**	**$16,751,326**
Annual Savings versus 08-'09 Westridge coal, $/Yr	$3,887,677	$3,287,837	$1,962,232	$927,108	$208,436	$0	-$2,363,189

The fixed costs associated with all the PRB options have been increased by $500,000 to reflect the additional expenses associated with PRB use. The additional expenses would include additional labor for increased coal handling, increased dust collection needed, increased air flow for combustion air and forced draft air, and increased housekeeping needed to address the dustiness of the PRB.


Power Supply Options -
Annual Cost of Electric Supply Before Distribution
$/Year
$18,000,000
$17,000,000
$16,000,000
$15,000,000
$14,000,000
$13,000,000
$12,000,000
$11,000,000
$10,000,000
Full Service, Party #3
Full Service, Party #1
PRB "Best Case"
PRB Non-typ "Middle Case"
PRB "Middle Case"
As-Is
PRB "Worst Case"
Option