Power Supply Options Study

Final Report

Performed for the

City of Columbia

Water & Light Department

Black & Veatch

March 1, 2006

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ENERGY WATER INFORMATION GOVERNMENT

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1.0 Purpose of the Power Supply Options Study

Black & Veatch was retained by the City of Columbia, Water & Light Department (the City) in August 2005 to perform a Power Supply Options Study (the Study). The Study was undertaken to determine how to best meet the City's additional capacity needs arising from the expiration of an existing purchase agreement with Ameren Energy Marketing Company (Ameren) and from the continued growth in the City's forecasted peak demand and energy requirements. The need for additional capacity during the study period under the base case assumptions is show in Table 1-1. The table reflects the loss of capacity associated with the Ameren contract, the assumed addition of 20 MW from Iatan II in 2010, the addition of 10 MW of capacity from landfill gas generation and distributed generation, and the retirement of the City-owned generating units 5 and 7 in 2011 that will occur in the absence of a substantial refurbishment. All capacity balances developed in the study assume that the City will continue to meet its renewable energy portfolio targets throughout the planning horizon.

As a result of the expected system growth and supply side developments, Table 1-1 indicates that the need for additional capacity will increase from 68 MW in 2008 to 208 MW in 2027. *The purpose of the Study is to determine the capacity option(s) most consistent with the City's objectives of securing a safe, adequate, and reliable power supply at the lowest reasonable cost and in an environmentally acceptable manner*.

Table 1-1
City of Columbia Forecast Capacity Requirements

Year	Peak Demand (MW)	15% Reserve (MW)	Total Capacity Requirement (MW)	Available Capacity Without Additions (MW)*	Additional Landfill Gas & Dist. Gen (MW)	Additional Capacity Required to Maintain 15% Reserve Margin(MW)
2008	278	42	320	252	0	68
2009	284	43	327	252	0	75
2010	289	43	332	272	10	50
2011	295	44	339	233	10	96
2012	300	45	345	233	10	102
2013	306	46	352	233	10	109
2014	311	47	358	233	10	115
2015	317	48	365	233	10	122
2016	322	48	370	233	10	127
2017	328	49	377	233	10	134
2018	333	50	383	233	10	140
2019	339	51	390	233	10	147
2020	344	52	396	233	10	153
2021	350	53	403	233	10	160
2022	357	54	411	233	10	168
2023	364	55	418	233	10	175
2024	371	56	426	233	10	183
2025	378	57	434	233	10	191
2026	385	58	442	233	10	199
2027	392	59	451	233	10	208

* Available capacity increases in 2010 due to the addition of 20 MW from Iatan II. Capacity decreases in 2011 with the assumed retirement of generating units 5 and 7.

2.0 Power Supply Options Considered

The City has several capacity alternatives available to meet its power needs during the 2008 through 2027 planning period, including a number of self-build options at the City's existing Municipal Power Plant. Alternatives 1 through 3 presented below were the initial self-build alternatives considered, based on a feasibility study completed for the City by Stanley Consultants, Inc. in 2005. A fourth coal fired alternative was subsequently included, as were a number of variations on these four alternatives discussed in Section 5.0. While Stanley Consultants, Inc. listed the commercial operation date as 2010, Black & Veatch has pushed this expectation back to 2011 to accommodate a more realistic construction schedule.

- Alternative 1: Construction of a 108.5 MW circulating fluidized bed (CFB) coal fired unit to be located at the City's Municipal Power Plant site. The unit is assumed to be operational by 2011, and generating units 5 and 7 are assumed to be retired in January 2011.
- Alternative 2: Phase 1 would consist of a new 70 MW CFB plant at the City's site to be operational by 2011, followed in Phase 2 by a CFB boiler to repower existing steam turbine generators 5, 7, and 8 (73.5 MW).
- Alternative 3: Phase 1 would consist of a new 70 MW CFB to be operational in 2011, followed in Phase 2 by the refurbishment of stoker fired boilers 6 and 7, natural gas-fired boiler 8, and a refurbishment of the steam turbine generators if needed.
- Alternative 4: City ownership of 150 MW out of a 250 MW CFB located at the City's existing site with commercial operation assumed to occur in 2011. An equity partner is assumed to own the remaining 100 MW. Generating units 5 and 7 are retired in January 2011.

Black & Veatch's scope of work included development and issuance of a power supply request for proposals (RFP) to prospective bidders potentially interested in selling the City firm power through a long-term power purchase agreement (PPA), through a system power sale, or through an offer involving partial City ownership of a bidder's generating unit. Black & Veatch issued the RFP on October 12, 2005 and the following bids were received:

- Ameren offered a "slice of system" sale in which the City would purchase 75 MW of capacity in 2008, with the amount of the purchase increasing thereafter to approximately track the City's growth in demand. Subsequent discussions with Ameren indicated that the offer is fairly flexible with the amount ultimately taken, provided a minimum of 50 MW is purchased. The City's cost for this power would be linked to the average cost of the Ameren portfolio of units (located in Illinois), and a pro rata share of associated fixed costs.
- LS Power submitted two offers. The first would involve a long-term PPA for up to 100 MW from its 650 MW Plum Point coal plant to be constructed in northeastern Arkansas. The second offer would involve an ownership share of a comparable amount of capacity in the Plum Point facility, which is projected to be commercially operational in 2010.
- Peabody Energy submitted two primary offers. The first would involve a long-term PPA for 50 MW to 100 MW from its 2 x 791 MW supercritical Prairie State coal plant to be constructed in southern Illinois and expected to be commercially operational in mid-2010 (Unit 1) and late-2010 (Unit 2). Several PPA alternatives were offered that involved a partial up-front lump sum payment by the City in exchange for a lower capacity price during the PPA term. The second primary offer involved 50 MW of equity participation in the Prairie State coal plant, with certain payments to begin as soon as an agreement is reached.

3.0 Evaluation Methodology

Upon receipt of the proposals on November 18, 2005, Black & Veatch conducted a preliminary screening of alternatives based upon various economic and risk factors. The economic screening used a bus-bar comparative methodology in which all fixed and variable costs of an option were stated on a levelized cost/kWh basis and compared across a range of plant capacity factors. Options clearly not competitive were eliminated form further consideration.

As a result of the preliminary screening, Alternative 2 and Alternative 3 of the self-build options were eliminated for economic reasons. In addition, the LS Power offer was eliminated from the subsequent detailed analysis due to risk factors. While the LS Power project is deemed to be a viable alternative that is likely to meet its target commercial operation date, it did not have an economic advantage over the Peabody proposal and included significant risks associated with delivery of power to the City's system. *As a result of the screening analysis, self-build Alternative 1, Alternative 4, the*

Peabody PPA and equity offers, and the Ameren offer were carried forward for detailed economic analysis.

The detailed analysis involved developing a long-term capacity expansion plan for each option under consideration. A capacity expansion plan is a schedule that details the timing of capacity additions necessary to satisfy forecast capacity requirements for each year of the planning horizon. The intent is to identify the plan that will meet utility objectives in the least-cost manner. In utility planning, the least-cost plan is that which minimizes the present value of power costs to utility customers over the long-term planning horizon, usually assumed to be at least 20 years. The present value cost of an expansion plan is derived by: 1) estimating the total system production costs (fuel plus variable O&M costs) for each year in the planning horizon, 2) adding in the annual fixed costs (fixed O&M and levelized capital costs) associated with new capacity options, and 3) discounting the total production costs plus fixed costs for each year to the beginning of the planning period. The cumulative present worth cost (CPWC) of each expansion plan is determined by aggregating the sum of the annual present worth costs for each year of the planning period. The CPWC of various capacity expansion plans are then compared to one another in order to identify the least-cost alternative. This process is performed under base case assumptions and for numerous sensitivity cases to determine whether the plan having the lowest CPWC in the base case is robust, meaning that it remains a cost-effective option under alternative but realistic alternative future conditions. Appendix A of this report contains the CPWC sheets for all plans reported in the report tables.

To produce accurate CPWC estimates, detailed production costing models are usually used in expansion planning analyses. Black & Veatch used its production costing model POWRPRO for this analysis. POWRPRO was used to simulate the hour by hour dispatch of the City’s generating resources in order to meet forecasted energy requirements for each year of the planning horizon and to estimate the associated production costs. POWRPRO is a chronological production costing model that dispatches capacity resources on an hourly basis according to the relative economics of a unit. Units having the lowest production costs are dispatched first, subject to unit specific constraints such as ramp rates, minimum on-line and off-line times, etc. POWRPRO dispatches available capacity resources on an economic basis, subject to any dispatch constraints, until energy requirements are met in each hour. Figure 3-1 illustrates the hour-by-hour energy requirements for the City that are met through POWRPRO’s dispatch algorithms. The load profile illustrated in Figure 3-1 was developed based on historical City load requirements.

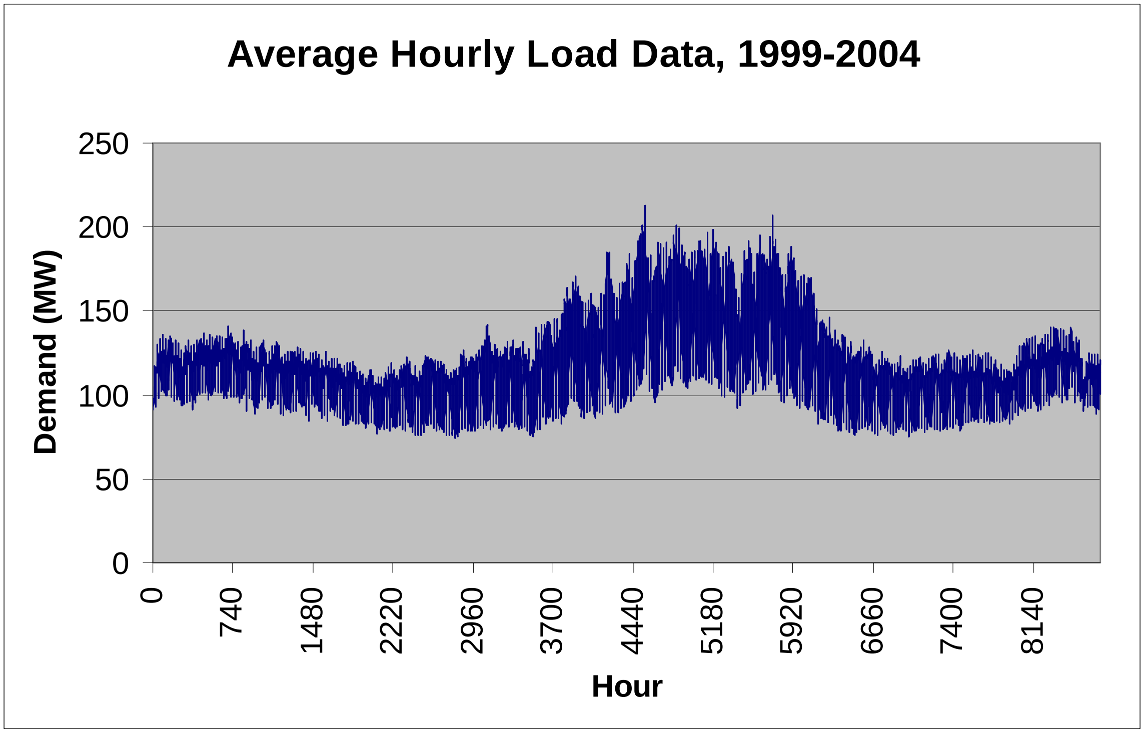

Figure 3-1 City Load Profile

4.0 Major Assumptions

Many assumptions and inputs are required to perform an expansion planning analysis. The primary inputs and assumptions for the City's analysis are described below:

- Costs and characteristics for existing units and purchases were provided by the City. Costs and characteristics for alternatives proposed through the RFP process were provided by bidders and reviewed for reasonableness by Black & Veatch.
- The system energy and peak load forecasts were provided by the City. The energy requirements forecast was reduced for assumed levels of renewable energy purchases consistent with the City's renewable energy portfolio targets and the resulting load shape was input into POWRPRO.
- All scenarios assumed 10 MW of additional landfill gas and distributed generation capacity would be added to the system in 2010. All scenarios also included the 20 MW Iatan II purchase in 2010 and the ownership of 72 MW of capacity from the Columbia Energy Center.

- Base case natural gas prices were assumed to start at $7.32/MBtu in 2008 and increase at an average annual growth rate of 3.5 percent. Coal was assumed to start at $2.05/MBtu in 2008 for new coal units and increase at a 2.5 percent average annual growth rate. A lower (as bid) fuel price forecast was used for Prairie State since it will be a mine mouth power plant.
- The cost of financing for the City was assumed to be 5.0 percent. Ownership options were assumed to be financed over a 30-year period. Other fixed costs contained in the levelized fixed charge rate include a 12 month debt service reserve fund, a 1.0 percent bond issuance fee, and 0.5 percent for the cost of plant insurance.
- A general inflation rate of 3.0 percent was used for O&M and capital cost escalation.
- Because all options other than the Ameren offer require market purchases in 2008 through 2010, it was assumed that a short-term, firm capacity bridge purchase could be secured at a 10 percent cost premium above the cost of the Ameren offer. When additional capacity was needed on the system in the later years of each capacity expansion plan, it was assumed that firm market purchases could be procured at a 10 percent premium over the Ameren offer for each particular year.
- All scenarios assumed that excess energy from the City's coal capacity and purchases could be sold on the market for a 20 percent premium over the associated unit production costs.
- It was assumed that expansion plans involving the retirement of all City-owned coal capacity would require the City to purchase ancillary services such as spinning reserves and voltage regulation on the market at a cost of $2.1 million. It was assumed that this cost would begin in 2011 when generating units 5 and 7 were retired; these costs were escalated at 3.0 percent thereafter. Scenarios involving the retirement of the existing generators 5 and 7 were also assumed to benefit from a reduction of $500,000 in fixed O&M costs beginning in 2011 and escalating at 3.0 percent annually thereafter.
- Estimates involving the import of power from Ameren or Prairie State were adjusted for line losses. Transmission upgrade costs were either estimated by Black & Veatch or reviewed for reasonableness and included as a scenario cost. A transmission tariff of 0.5 cents per kWh was applied to power imports.

5.0 Evaluation of Base Case Capacity Expansion Plans

Table 5-1 lists the base case capacity expansion plans evaluated in the detailed economic analyses. In addition to the Case Number and Case Description, the table contains columns labeled " '08 '09 Bridge?" and "1st Yr. to Market." The column marked " '08 '09 Bridge?" indicates whether the City would have to purchase bridge capacity before the option listed in the Case Description comes on line in 2010 or 2011. This is an indication of near-term market risk and it is seen from Table 5-1 that bridge capacity purchases apply to all options other than cases involving the Ameren purchases. This will be quantified in one of the sensitivity scenarios in the last section of this report. The final column of Table 5-1 lists the first year that the City would be required to add subsequent capacity or go into the market following the first capacity addition listed in the Case Description. For modeling purposes, the base case assumed that subsequent market capacity would be available in 25 MW blocks at a cost of 10 percent above the Ameren cost for any year. This is another market risk, and is more pronounced for scenarios involving an early market purchase date.

The Case Descriptions in Table 5-1 are largely self-explanatory. Some cases, however, are combinations of alternatives or otherwise require additional explanation. Cases 6, 7, 8, 9, 10, 11, and 12 that involve combinations of capacity assume that capacity the Ameren capacity is added in 2008, Peabody is capacity is added in 2010, and the self-build capacity is added in 2011 except for Case 13 that adds self-build capacity in 2015. For combination plans involving additional market purchases, the market purchases are added in the year in which the need arises. In addition, the following information is provided for selected cases.

- Case BC-3. The "Ameren Match Need" option assumes that the City's level of purchases from Ameren could vary from the proposed purchase levels to meet the City's year-by-year capacity requirements during the entire planning period. As with all Ameren offers, it was assumed that the annual level of capacity had to be taken at a 70 percent load factor. This is a take or pay level that cannot be exceeded and was specified by Ameren in its offer.
- Case BC-13. This combination scenario assumes that the City's generating units 5 and 7 are renovated to operate until 2015 with a $10 million capital investment. In 2015, these units are retired and a 108.5 MW CFB enters operation. The option also includes the purchase of capacity from Ameren at the level needed to meet subsequent capacity requirements, subject to a 50 MW minimum.

- Case BC-14. This combination scenario assumes as-bid levels of capacity from Ameren, plus the rehabilitation of units 5 and 7 at a capital cost of $94 million. Market purchases also occur as needed to meet forecast capacity requirements.
- Case BC-15. This scenario was added as a self-owned option during the detailed analysis and assumes that the City would construct a 1x1 GE 7EA combined cycle unit with a capacity of 120.8 MW in lieu of a 108.5 MW CFB generator. The combined cycle unit would consist of one combustion turbine (GE 7EA), one heat recovery steam generator (HRSG), and one steam turbine, and it would be fueled by natural gas. It is assumed that the unit would enter operation in 2011 and would require a capacity bridge purchase during 2008, 2009, and 2010 to meet the capacity needs of the City.

Table 5-1 Base Case Expansion Plan Evaluated

Sensitivity	Case #	Case Description	'08 '09 Bridge?	1st Yr. to Market
Base Case	Case 1	Self Build 108.5	Y	2013
	Case 2	Self Build 250	Y	2020
	Case 3	Ameren Match Need	N	n/a
	Case 4	Peabody PPA 100	Y	2012
	Case 5	Peabody Equity 50	Y	2011
	Case 6	Ameren Bid + Market	N	2011
	Case 7	Peabody PPA 100 + Equity 50	Y	2019
	Case 8	Ameren Bid + Peabody Equity 50	N	2019
	Case 9	Self Build 108.5 + Peabody Equity 50	Y	2021
	Case 10	Ameren 100 + Peabody Equity 50	N	2019
	Case 11	Ameren Bid + Self Build 108.5	N	n/a
	Case 12	Peabody Prepay PPA 100 + Equity 50	Y	2019
	Case 13	Ameren Match Need + 2015 SB - Extend 5, 7	N	n/a
	Case 14	Ameren Bid + Market - No Retire 5, 7	N	2017
	Case 15	Combined Cycle Alternative	Y	2015

6.0 Base Case Results

The CPWC results of the base case expansion plans are presented in Table 6-1. The order of the cases is the same as in Table 5-1. Results indicate that the two best options are Case 12 and Case 9, both of which involve the Peabody Equity (50 MW) alternative. The highest ranked plan involving Ameren is Case 8 (ranked 5th), in which the Ameren as-bid purchase is combined with the 50 MW Peabody Equity purchase.

Finally, the highest ranked plan involving a self-build unit is plan Case 9 (ranked 2nd), which is the 108.5 MW self-build option in 2011 with a Peabody Equity amount of 50 MW beginning in 2010.

One of the key factors in evaluating the base case results is to determine whether a specific case is associated with an acceptable risk level and therefore should not be carried forward to the sensitivity analyses. Following discussions with the City, it was agreed that the cases shown with a highlighted background in Table 6-1 would be carried forward for further evaluation. Some of the highest ranked plans, such as Case 12 (ranked 1st) and Case 5 (ranked 3rd), were not carried forward. Case 5 would require the City to return to the market to purchase bridge capacity in 2008 and 2009, and would also require a return to the market in 2011. This early and recurring purchase requirement represents uncertainty and is treated as a risk for the City. Case 12 was not carried forward because the economics of the offer are the result of a required prepayment associated with the Peabody Equity offer. The City staff noted that the prepayment concept for equity participation would not likely be approved. Thus, from the 15 base case plans, the cases numbered 1, 2, 3, 8, 9, and 10 were carried forward to the sensitivity analyses.

Sensitivity	Case #	Case Description	'08 '09 Bridge?	1st Yr. to Market	% Diff. from #1 Ranking	Base Rank	Base ($'000)
Base Case	Case 1	Self Build 108.5	Y	2013	4.4	7	$1,344,683
	Case 2	Self Build 250	Y	2020	1.9	4	$1,312,129
	Case 3	Ameren Match Need	N	n/a	5.0	8	$1,352,756
	Case 4	Peabody PPA 100	Y	2012	6.5	12	$1,372,274
	Case 5	Peabody Equity 50	Y	2011	1.5	3	$1,307,219
	Case 6	Ameren Bid + Market	N	2011	6.0	10	$1,365,734
	Case 7	Peabody PPA 100 + Equity 50	Y	2019	5.7	9	$1,361,732
	Case 8	Ameren Bid + Peabody Equity 50	N	2019	2.4	5	$1,318,652
	Case 9	Self Build 108.5 + Peabody Equity 50	Y	2021	1.0	2	$1,300,749
	Case 10	Ameren 100 + Peabody Equity 50	N	2019	3.5	6	$1,333,556
	Case 11	Ameren Bid + Self Build 108.5	N	n/a	12.3	15	$1,446,212
	Case 12	Peabody Prepay PPA 100 + Equity 50	Y	2019	n/a	1	$1,287,933
	Case 13	Ameren Match Need + 2015 SB - Extend 5, 7	N	n/a	9.0	14	$1,404,062
	Case 14	Ameren Bid + Mkt - No Retire 5, 7	N	2017	6.8	11	$1,375,449
	Case 15	Combined Cycle Alternative	Y	2015	9.2	13	$1,406,083

Table 6-1 Base Case Results

7.0 Sensitivity Case Results

Sensitivity scenarios were developed to determine the relative ranking of the six plans carried forward under alternative future conditions. The first sensitivity assumes that the capacity bridge purchases and any necessary incremental capacity purchases during the remaining planning period would cost 20 percent above the Ameren bid. This represents an increase from the 10 percent assumed in the base case scenario.

The second sensitivity is a high fuel cost scenario. This case assumes that coal prices escalate at 3.0 percent annually as opposed to the base case value of 2.5 percent. The exception is that the Prairie State fuel cost is assumed to escalate at 1.5 percent instead of the base value of 1.0 percent; the escalation difference is due to the mine-mouth character of the plant. The high fuel cost scenario also assumes that natural gas prices in 2008 are 20 percent above the base case assumption and escalate at 3 percent.

The third sensitivity is a low fuel costs scenario that assumes coal prices escalate at 1.0 percent as opposed to the base assumption of 2.5 percent. Prairie State coal prices are assumed to increase at 1.5 percent annually. Natural gas prices in 2008 are assumed to be 15 percent lower than the base case and escalate at 3 percent per year thereafter.

The final two sensitivities relate to load growth. The first sensitivity assumes that the City experiences high load growth resulting in a peak load 4 percent higher than in the base case. The second scenario assumes that the City undertakes an accelerated conservation and demand-side management program, reducing peak demand by 4 percent with respect to the base scenario. The annual peak demand and hourly energy requirements utilized by POWRPRO were adjusted to reflect each of these load growth scenarios.

The results from these sensitivities are shown in Table 7-1. Across all sensitivity scenarios, Cases 2, 8, and 9 consistently rank among the best alternatives. Case 9 is the best plan in all sensitivity scenarios based on the CPWC rankings in Table 7-1. Therefore, the average ranking for Case 9 in Table 7-2 is 1.0. Case 2 consistently ranks as the second least-cost alternative in the sensitivities and has an average ranking of 2.0, followed by Case 8 (3.2 average ranking), Case 10 (4.4 average ranking), Case 1 (4.6 average ranking), and Case 3 (5.8 average ranking).

Table 7-1 Sensitivity Results for Each Expansion Case							
Case #	**Case Description**	**Base ($'000)**	**Am+20**	**High Fuel**	**Low Fuel**	**High Load**	**DSM**
Case 1	**Self Build 108.5**	1,344,683	1,348,588	1,358,619	1,307,194	1,403,188	1,291,808
Case 2	**Self Build 250**	1,312,129	1,314,943	1,326,526	1,273,240	1,357,925	1,271,713
Case 3	**Ameren Match Need**	1,352,756	1,352,756	1,356,632	1,342,289	1,408,292	1,343,016
Case 8	**Ameren Bid + Peabody Equity 50**	1,318,652	1,318,765	1,324,082	1,313,536	1,360,950	1,289,645
Case 9	**Self Build 108.5 + Peabody Equity 50**	1,300,749	1,303,226	1,312,898	1,272,498	1,341,313	1,261,347
Case 10	**Ameren 100 + Peabody Equity 50**	1,333,556	1,333,697	1,339,131	1,327,650	1,364,510	1,326,079

Table 7-2 Relative Ranking for Each Expansion Case							
Case #	**Case Description**	**Am+20**	**High Fuel**	**Low Fuel**	**High Load**	**DSM**	**Avg.**
Case 1	Self Build 108.5	5	6	3	5	4	4.6
Case 2	Self Build 250	2	2	2	2	2	2.0
Case 3	Ameren Match Need	6	5	6	6	6	5.8
Case 8	Ameren Bid + Peabody Equity 50	3	3	4	3	3	3.2
Case 9	Self Build 108.5 + Peabody Equity 50	1	1	1	1	1	1.0
Case 10	Ameren 100 + Peabody Equity 50	4	4	5	4	5	4.4

Table 7-3 CPWC Percent Above the Best Alternative (%)							
Case #	**Case Description**	**Am+20**	**High Fuel**	**Low Fuel**	**High Load**	**DSM**	**Average**
Case 1	Self Build 108.5	3.48	3.48	2.73	4.61	2.41	3.34
Case 2	Self Build 250	0.90	1.04	0.06	1.24	0.82	0.81
Case 3	Ameren Match Need	3.80	3.33	5.48	4.99	6.47	4.82
Case 8	Ameren Bid + Peabody Equity 50	1.19	0.85	3.23	1.46	2.24	1.80
Case 9	Self Build 108.5 + Peabody Equity 50	0.00	0.00	0.00	0.00	0.00	0.00
Case 10	Ameren 100 + Peabody Equity 50	2.34	2.00	4.33	1.73	5.13	3.11

Another method of comparing the CPWC results is to determine the average percent difference in CPWC between each case and the top ranked plan in each scenario. A breakdown of these values can be seen in Table 7-3, based on an equal weighting of all results presented. When this is done, Case 1, Case 3, and Case 10 appear to be significantly more costly than the other cases carried forward to the sensitivity evaluations. On average, Case 1 is 3.3 percent more costly than the top ranked plan across all scenarios, Case 3 is 4.8 percent more costly, and Case 10 is 3.1 percent more expensive. Case 2 is 0.8 percent more costly and is followed by Case 8 (1.8 percent). Since Case 9 is the always the least-cost alternative, it has an average percent difference of 0.0 percent. A relative cost differential of more than 2 percent is generally considered by Black & Veatch to be a significant difference. Applying this criterion would mean that Cases 2, 8, and 9 remain potentially viable options that can be further refined as additional detail is incorporated into the analysis. However, the additional considerations and sensitivities discussed in Section 8.0 should also be considered before further reductions in cases are made.

8.0 Additional Considerations and Sensitivities

Following the base case and initial sensitivity results, discussions were held with the City staff and this led to additional sensitivity analyses. These additional scenarios included:

- the modification of the Peabody Equity 50 MW alternative to a 75 MW capacity amount,
- a +5 percent / -5 percent Peabody Equity cost sensitivity,
- a +20 percent / -20 percent self-build cost sensitivity, and
- a change of the Ameren alternative from a 70 percent load factor to an 80 percent load factor.

These scenarios are evaluated below. The difference in the cost variation assumed in Peabody Equity versus the self-build options (5 percent versus 20 percent) is due to the level of detail previously put into developing the cost figures. The Peabody cost figures have undergone a great deal of analysis and reflect EPC proposals, while the self-build costs are the product of a pre-feasibility study analysis and would be expected to have a greater level of uncertainty.

8.1 Assumed 75 MW Peabody Equity Amount

This scenario assumes that the increase of the Peabody Equity amount to 75 MW. Of the cases evaluated in Section 7.0, only Case 8, Case 9, and Case 10 would be affected by the changed of the Peabody Equity purchase amount from 50 MW to 75 MW. The results of this change, as compared to the base case results, can be seen in Table 8-1 as being less economical. The higher CPWC occurs because, while there is significant benefit to carrying the increased capacity in the later years of the study, there is also significant cost to carrying that capacity during the initial years when it is not fully utilized. *The increased carrying costs are not overcome by the reduced incremental purchases and increased off-system sales, and this leads to an increase in CPWC values for this scenario.*

An additional related scenario added was labeled Case 10.5. This scenario involves 75 MW of Peabody Equity and 75 MW of Ameren purchase. The results of this case indicate that there is a benefit to increasing the Peabody Equity alternative while simultaneously decreasing the Ameren purchase. While attractive, this option is not as cost-effective as Case 9 or Case 2 under the base case assumptions. Furthermore, there is some question regarding the willingness of Peabody to increase the equity share from 50 MW to 75 MW, though this can conceivably be achieved through negotiations.

Table 8-1 Increased Peabody Equity Amount - 75 MW

Case #	Case Description	Base Equity 50 MW	Increased Equity 75 MW
Case 8	Ameren Bid + Peabody Equity 50	1,318,652	1,331,598
Case 9	Self Build 108.5 + Peabody Equity 50	1,300,749	1,303,175
Case 10	Ameren 100 + Peabody Equity 50	1,333,556	1,347,293
Case 10.5	Ameren 75 + Peabody Equity 75	NA	1,313,818

8.2 Peabody Cost Uncertainty

As noted above, a sensitivity was also performed with regard to the capital costs of the self-build and Peabody Equity (50 MW) alternatives. Case 8, Case 9, and Case 10 were analyzed to determine the effect of a +/- 5 percent change in the capital cost for the Peabody Equity purchase. The results of this analysis can be seen in Table 8-2. As would be expected, an increase in capital cost led to an increase in all of the CPWC values while a decrease in the capital cost caused all of the CPWC values to decrease.

The key result, however, is the finding that the CPWC is very insensitive to this range of cost variation and only changes by about 0.4 percent from the base case result in each case. *Thus, there is little price risk associated with the Peabody offer and this should be considered relative to the self-build and Ameren price risks.*

Table 8-2 Capital Cost Variation for Peabody Equity (50 MW)

Case #	Case Description	Base ($'000)	PCap+5	PCap-5
Case 8	Ameren Bid + Peabody Equity 50	1,318,652	1,322,629	1,314,675
Case 9	Self Build 108.5 + Peabody Equity 50	1,300,749	1,304,726	1,296,772
Case 10	Ameren 100 + Peabody Equity 50	1,333,556	1,337,533	1,329,579

8.3 Self-Build Cost Uncertainty

Case 1, Case 2, and Case 9 were all analyzed with regard to the effect of a +/- 20 percent change in the capital cost for the self-build 108.5 MW CFB generator. The results of this analysis can be seen in Table 8-3. As would be expected, an increase in capital cost led to an increase in all of the CPWC values while a decrease in the capital cost caused all of the CPWC values to decrease. The associated CPWC impact of a 20 percent cost increase is 3.4 percent for Case 1, 3.8 percent for Case 2, and 3.2 percent for Case 9. Thus, were costs to increase to the high end of the cost range for the self-build option, the CPWC for Case 9 would actually rank 7th among all base case plans considered in Table 6-1 rather than second; and the impacts on Case 1 and Case 2 would be of a similar magnitude. *This implies that a more detailed cost estimate of the self-build option is warranted before the self-build option can be prudently recommended.*

Table 8-3 Capital Cost Variation for the Self Build Alternatives

Case #	Case Description	Base ($'000)	SBCap+20	SBCap-20
Case 1	Self Build 108.5	1,344,683	1,390,630	1,306,546
Case 2	Self Build 250	1,312,129	1,362,178	1,262,080
Case 9	Self Build 108.5 + Peabody Equity 50	1,300,749	1,342,791	1,258,707

8.4 Ameren 80 Percent Load Factor

One additional scenario was considered. The Ameren bid currently requires a 70 percent load factor (take-or-pay). While Ameren has not indicated any flexibility to deviate from this requirement, analyses was performed to evaluate the change in CPWC if the load factor could be increased to 80 percent for select cases involving Ameren. The results of this analysis are presented in Table 8-4. The analysis shows that if the load factor were increased to 80 percent, then Case 3, Case 8, and Case 10 would each be lower in CPWC than Case 9 (CPWC of $1,300,749 from Table 6-1). Thus, *the Ameren option still has the potential to be part of the most cost-effective option for the City, and the load factor requirement should be a primary focus during subsequent negotiations. In addition, subsequent discussions should seek additional detail about potential costs associated with compliance with regulatory requirements and meeting possible emission limits that may apply in the future.*

Table 8-4 CPWC Impact of an 80 Percent Load Factor for the Ameren Purchase ($000s)

Case #	Case Description	Base Case	80% LF
Case 3	Ameren Match Need	1,352,756	1,292,996
Case 8	Ameren Bid + Peabody Equity 50	1,318,652	1,279,220
Case 10	Ameren 100 + Peabody Equity 50	1,333,556	1,294,596

9.0 Conclusions and Recommendations

The results presented in this report will help the City to decide which options it will continue to pursue and the parties it may wish to negotiate with. This study indicated that Case 2: the self-build 108.5 MW CFB option, Case 8: the 50 MW Peabody Equity plus Ameren Bid offer, and Case 9: the self-build 108.5 MW CFB plus Peabody Equity offer all appear competitive and could emerge as the least cost option for the City. It is therefore appropriate to continue discussions with Peabody and Ameren, and to continue to study the self-build option in more detail. Going forward, each plan and each capacity options has particular issues and areas of focus:

- Peabody Equity: this option appears robust in that there is likely little variation in the capital cost estimate. Primary areas of focus include additional effort to confirm costs of transportation, remaining risks associated with the air permit, and the ability to further optimize the level of equity purchases. If Case 9 involving Peabody and the self-build option is selected, it also leaves the City in need of a near-term bridge purchase under the base case assumptions.
- Ameren As Bid: Case 8 involving the Ameren bid generally ranks third best, although the sensitivity analysis in Section 8.0 clearly indicates that the option could improve to the best plan if the 70 percent load factor requirement is relaxed to 80 percent. This should be a focus of the

discussions with Ameren going forward, and transmission delivery is also in need of additional study. The possible costs associated with emission compliance for the fleet of units, and the possibility of adding a new coal unit to the feet could also impact the future costs of power, though outside of these issues, it can be said that the Ameren offer is based on verifiable historical accounting data and subject to even less uncertainty than is the Peabody offer.

- The self-build option combined with a 50 MW Peabody Equity option was shown to generally be the least cost plan in the base case and additional sensitivities. In the capital cost sensitivity, however, it was seen that there is a relatively high degree of cost uncertainty in the capital cost of the self-build CFB option, and that a capital cost increase of 20 percent would drive the CPWC of this option significantly upward and drop the ranking of the plan several places. Therefore, before this option can be prudently recommended, additional study of the capital cost should be undertaken. While the primary concern is that the cost of the self-build option could increase and make the plan non-competitive, there is also the possibility that the costs of this option could decrease and make the plan a clear winner over other options.

It should be further noted that the results contained in this report reflect an estimate of the direct economic costs of various expansion plans under different future scenarios. There may be additional factors that will influence the City's final decision. These may include, for example, the socioeconomic benefits and costs of maintaining self-generation capacity, the potential for short-term capacity sales, reduced risks associated with locally controlled generation, and the risks associated with the long-term availability of transmission service at reasonable costs.

Also, Peabody Energy has indicated that it would likely need a commitment from the City, but not necessarily a final agreement, by the end of the first quarter of 2006 given that the unit capacity is nearly fully subscribed. It is also noted that Peabody now has an experienced plant operator that will retain a long-term ownership share of approximately 20 percent, although the name of the operator has not yet been released. This will help alleviate previous concerns regarding incentive to minimize operational costs of the facility. These and other factors and considerations should be discussed by the City staff and Board and given proper weight in future evaluations and decisions.