

Chapter 4 - Appendix A

Fatal Flaw Analysis

Option	Description	Fatal Flaw
Coal	Meramec - Ultra-Supercritical (USC) PC	✓
Coal	Meramec Repowering - Unit 3 Boiler Replacement and STG Rebuild	✓
Coal	Meramec Repowering - Unit 4 Boiler Replacement and STG Rebuild	✓
Coal	Meramec - Oxyfuel Coal with CCC	✓
Coal	Meramec Repowering - Oxyfuel Coal Boiler Replacement	✗
Coal	Meramec - Subcritical CFB	✓
Coal	Meramec Repowering - CFB Boiler Replacement	✗
Coal	Rush Island - USCPC	✓
Coal	Greenfield - USCPC	✓
Coal	Rush Island - Oxyfuel Coal with CCC	✓
Coal	Greenfield - Oxyfuel Coal with CCC	✓
Coal	Rush Island - Integrated Gasification Combined Cycle (IGCC)	✓
Coal	Greenfield - IGCC	✓
Coal	Rush Island - Subcritical CFB	✓
Coal	Greenfield - Subcritical CFB	✓
Coal	Greenfield - Supercritical CFB	✓
Coal	Greenfield - Pressurized Circulating Fluidized Bed (CFB)	✗
Coal	Greenfield - Pressurized Bubbling Fluidized Bed (BFB)	✗
Coal	Greenfield - USCPC with Amine-Based Post-Combustion CCC	✓
Coal	Greenfield - Subcritical CFB with Amine-Based Post-Combustion CCC	✓
Coal	Greenfield - Oxyfuel Coal with CCC	✓
Coal	Greenfield - IGCC with Pre-Combustion CCC	✓
Coal	Efficiency Improvements to Existing Plants – Duct Draft Reductions	✓
Coal	Efficiency Improvements to Existing Plants – Condenser Back-pressure	✓
Gas	Greenfield - CCCT Amine-Based Post-Combustion CCC	✓
Gas	Venice - 2-on-1 501F CCCT Conversion	✓
Gas	Meramec - 2-on-1 501F CCCT	✓
Gas	Greenfield - 2-on-1 501F CCCT	✓
Gas	Goose Creek - Inlet Chilling SCCT Power Augmentation	✓
Gas	Goose Creek - Wetted Media SCCT Power Augmentation	✓
Gas	Mexico - One GE LM6000 Sprint SCCT (5% CF)	✓
Gas	Mexico - One GE LM6000 Sprint SCCT (10% CF)	✓
Gas	Raccoon Creek - One GE 7EA SCCT (5% CF)	✓
Gas	Raccoon Creek - One GE 7EA SCCT (10% CF)	✓
Gas	Meramec Repowering - Unit 3 Boiler NG Conversion	✓

Option	Description	Fatal Flaw
Gas	Meramec Repowering - Unit 4 Boiler NG Conversion	✓
Gas	Meramec Repowering - Unit 4 STG in a 3-on-1 CCCT Conversion	✓
Gas	Meramec Repowering - Unit 3 & Unit 4 STGs in Separate CCCT	✗
Gas	Meramec Repowering - Unit 3 & Unit 4 STGs in a Shared CCCT	✗
Gas	Greenfield - Molten Carbonate Fuel Cell	✓
Gas	Greenfield - Natural Gas Fueled Rankine Cycle	✗
Gas	Greenfield - Twelve Wartsila 20V34SG Simple Cycle Reciprocating	✓
Gas	Greenfield - Two 501F SCCTs (5% CF)	✓
Gas	Greenfield - Two 501F SCCTs (10% CF)	✓
Gas	Greenfield – 2-on-1 Wartsila 20V34SG Combined Cycle Reciprocating	✓
Gas	Greenfield – GE 7EA Cheng Cycle	✓

A high-level fatal flaw analysis was conducted as part of the first stage of the supply-side selection analysis. Options that did not pass the high-level fatal flaw analysis consist of those options that could not be reasonably developed or implemented by Ameren Missouri¹.

Meramec Repowering – Unit 3 & Unit 4 STGs in Separate CCCT Conversions (Option A10)

This option is not feasible because of transmission limitations. The electrical output from the current units is roughly 850 MW. If the Unit 3 and 4 steam turbine generators (STGs) were converted for use in separate combined cycles, the Unit 3 block would produce an estimated net output of 600 to 700 MW, and the Unit 4 block would produce an estimated net output of 800 to 900 MW, for a total net plant output of approximately 1,500 MW. Such an increase in net plant output would likely require major upgrades to the three 138 kV transmission lines tied to Meramec. For the purposes of this study, only the conversion of the Unit 4 STG (Option A09) in a combined cycle was evaluated. If the preliminary characteristics for the Unit 4 STG conversion in a combined cycle option seem promising, then further study could be performed to evaluate the potential for conversion of the Unit 3 STG or Unit 3 and 4 STGs in combined cycles.

Meramec Repowering – Unit 3 & Unit 4 STGs in a Shared CCCT Conversion (Option A11)

This option is not feasible for the same reasons that Option A10 is not feasible.

Greenfield – Natural Gas-Fueled Rankine Cycle (Option A14)

This technology is considered obsolete. Past generation planning efforts have shown this option to be noncompetitive compared with other technologies. Black & Veatch is

¹ 4 CSR 240-22.040(1); 4 CSR 240-22.040(9)(A)3.

not aware of any new projects that were developed with this technology in the recent past.

Meramec – Unit 3 & 4 Boiler Replacement with Oxyfuel Coal Boilers (Option B04)

This option is not feasible because of space requirements and performance impacts. Space available around the Unit 3 and 4 boilers is inadequate for siting of the air separation units (ASUs). On the basis of previous Black & Veatch estimates, the increased auxiliary loading due to the ASUs would reduce the net plant output by approximately 25 percent and would reduce plant efficiency in excess of 10 percentage points.

Meramec – Unit 3 & 4 Boiler Replacement with CFB Boilers (Option B06)

Replacing existing pulverized coal (PC) boilers with new circulating fluidized bed (CFB) boiler would require extensive demolition and modification to the existing units and would most likely result in a reduction in net capacity. A brief summary of issues is listed below:

- CFB boilers have a lower thermal efficiency than PC boilers. Based on previous Black & Veatch estimates, plant efficiency with CFB boilers is typically between 1.0 and 1.5 percentage points lower than that of PC fired facilities.
- A CFB boiler is larger than the existing PC boiler. The cost to modify the existing structure to accommodate CFB boilers would be prohibitive.
- Existing coal preparation equipment would have to be replaced and/or modified.
- New limestone handling and preparation equipment would be required, which would be expensive to site.

Greenfield – Pressurized Circulating Fluidized Bed (Option B13)

At its current developmental status, this technology is not competitive compared with other technologies presented in this effort. No significant development advances have been substantiated in recent years. Limited success with pressurized fluidized bed combustion (PFBC) technology was realized with American Electric Power's Tidd Unit 1, which concluded operations in 1991. More recent pressurized fluidized bed (PFB) projects are currently in operation in Japan, such as Chugoku Electric Power Company's Ohsaki plant, Kyushu Electric Power's Karita plant, and Hokkaido Electric Power Company's Tomatouatsuma plant. Other commercial plants in operation in Europe include Fortum's Vartan plant and E.ON's Escatron plant. A number of operational and performance issues have been experienced with the greatest frequency of incidences occurring in the hot gas cleanup from the PFB to the gas turbine and gas turbine blade deposition, erosion and corrosion due to particulate carry-over in the hot gas path. Due to a relative lack of performance and cost sharing, Black & Veatch is unable to comment on the performance and cost of these projects.

In the United States, recent efforts exploring Advanced PFBC, where the gas turbine is driven partially by hot gases from a pressurized circulating fluidized bed and partially from a topping combustor that receives syngas from a fluidized bed carbonizer (often referred to as a gasifier), have resulted in little progress. In 1990, pilot scale component testing of Advanced PFBC components and systems integration began at the Wilsonville Power Systems Design Facility (PSDF). In 2000, after 170 hours of operation on coal, Foster Wheeler, the major equipment supplier, pulled out of the project and further testing was cancelled. No significant efforts have succeeded this work.

Greenfield – Pressurized Bubbling Fluidized Bed (Option B14)

Similar to Option B13, Option B14 has not been proven competitive.

Compliance References

4 CSR 240-22.040(1) 2
4 CSR 240-22.040(9)(A)3. 2