3.0 Alternative Technologies

Several technologies may be applicable to biomass and biomass/fossil fuel mixes to generate electricity. Some fifty years ago, traveling grate /stoker boilers were used and this type of boiler is still in use today. Some smaller modern plants use stoker boiler technology in combination with modern pollution controls. In the fluidized bed boiler technology area, there are circulating fluidized beds, which re-circulate the ash/unburned fuel and bubbling fluidized beds, which use a lesser air velocity through the boiler and keep all unburned fuel in the bed until it becomes ash. Generally, the recirculation type is favored where the range of fuel and fuel mixes is wide, taking advantage of higher air velocity and recirculation, and the bubbling type is used where the fuel mix is narrow and the air velocity is not varied much. A third technology involves the gasification of the solid fuel, and the syngas is used to fire a combustion turbine, which often is designed to recover the exhaust gas heat in a boiler to drive a steam turbine in combined cycle mode. This technology is referred to as integrated gasification combined cycle (IGCC). As the stoker technology is well established and the fluidized bed technology is described herein, the following analysis is provided of the newest process: IGCC.

3.1 Integrated Gasification Combined Cycle

Integrated Gasification Combined Cycle (IGCC) is a power generation method by which coal (or other solid or liquid feedstock such as Pet Coke, Biomass or heavy oil) is gasified and the gas is used as the feedstock for a combustion turbine combined cycle power block. Coal-fired power generation in this manner has the potential to be more efficient and have fewer emissions and/or permit CO_2 capture than if generated from a pulverized coal (PC)

fired boiler. Separately, the technologies of gasification and combine cycle power blocks are proven. However, combined into an IGCC power plant, the reliability is still considered to be far less than what can be achieved for a PC or biomass plant. Also, the anticipated cost to construct an IGCC plant is significantly greater than for a PC or biomass plant, the Facility's use of biomass (CO_2 neutral) and limitations on types of biomass fuels were considerations to use fluidized bed technology over IGCC.

The proposed Facility is being developed as a renewal energy project. As such, the Facility is intended to be fired primarily on biomass, which is considered to be CO_2 neutral (plant growth takes up CO_2 emission), so the CO_2 capture consideration of IGCC for coal is not as relevant. Biomass IGCC was studied at the five facilities shown in Table 2-1. The facilities were demonstration scale and were not scaled up to commercial. In fact, the only facility that ran for any length of time was the Värnamo, Sweden facility. The facility was not intended for long-term power generation and was eventually closed. Absent federal funding to offset the risks associated with an unproven technology and additional cost requirements, the combination of these factors makes obtaining commercial funding for IGCC project virtually impossible. Therefore, biomass IGCC is not a proven technology and will not be considered further in this report as a viable alternative to the proposed design.

TABLE 3-1
IGCC Biomass-Fired Power Plant Summary
Yellow Pine Energy
Clay County, Georgia

Plant	Location	Operation	Power MW (net)	Design Feedstock	Financial Support
Hawaii Commercial and Sugar Company	Paia, Hawaii	Did not operate in IGCC mode	Not Applicable	Sugar Cane Reside	State of Hawaii, Gas Technology Institute, Westinghouse Electric, and U.S. DOE
McNeil Generating	Burlington,	Did not operate	Not	Biomass	Future Energy Resources, Burlington

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Plant	Location	Operation	Power MW (net)	Design Feedstock	Financial Support
Sation	Vermont	in IGCC mode	Applicable		Electric, Battelle, U.S. DOE, and the National Renewal Energy Laboratory
Minnesota Agri-Power Plant	Granite Falls, Minnesota	Not Constructed	Not Applicable	Alfalfa Stems	Minnesota Valley Alfalfa Producers, Electric Utility, University, Private Partners, State of Minnesota, and U.S. DOE
Värnamo Plant [1]	Värnamo, Sweden	1998 – 1999	6	Biomass (wood)	Sydkraft AB, Foster Wheeler, Electricity of France, Elkraft, Elforsk AB, Swedish National Energy Administration, and the European Commission.
ARBRE Project [2]	Eggborough, United Kingdom	2001 – 2002	8	Biomass	Yorkshire Water, European Union, and Others

[1] The facility operated as an integrated facility for 3500 hours with the majority of hours during 1998 and 1999. The demonstration of the technology was completed in 1999 and the facility was closed.

[2] The project was terminated in 2002 due to financial, project management, engineering design, and operational issues.

A final consideration is related to the biomass fuel types to be used at the Facility. Some biomass gasifiers, which use heated tube bundles in the vessel, do not work well on biomass with entrained soil or sand. Because Yellow Pine Energy plans to use waste wood from land clearings, which has entrained solids, these types of gasifiers are not compatible with the biomass fuel mix. Additionally, some gasifiers are not compatible with biomass feed stocks such as peanut shells, as the elemental silicon may glass over the vessel interior. Another

type of biomass gasifier uses a circulating sand bed. This type of gasifier can better tolerate entrained materials. However, the first commercial-scale bed gasifier (25 MWs) has not completed performance testing (i.e. in construction), and there are no plants in the 110 MW size, presenting scale-up and financing risks. Therefore, in order to utilize all of the biomass feedstocks in the region using a proven technology at this size, fluidized bed technology was selected.