14A.1 Introduction

The Electric Power Research Institute (EPRI) is conducting an engineering and economic study of various pressurized fluidized bed combustor (PFBC) power plant technologies. The objective of this program is to provide the information necessary to allow PFBC technologies to be compared, on a consistent basis, between themselves and with other fossil power generating technologies.

This work commenced in 1991 and by the end of 1994 studies had been completed on four PFBC designs. Two studies involved ABB-Carbon’s bubbling PFBC; one incorporating only cyclones for dust removal in conjunction with a ruggedized gas turbine; and the other incorporating high-temperature, high-pressure (HTHP) filtration for dust removal in conjunction with a conventional gas turbine. The other two studies completed are Ahlstrom Pyropower’s circulating PFBC and Foster Wheeler’s advanced PFBC. Future studies will include assessments of British Coal’s Topping Cycle and Lurgi–Lentjes–Babcock’s circulating PFBC. All studies will be updated and kept current with advances being made as the technologies develop and mature.

The cost estimates presented in this addendum are consistent with an EPRI Class II Preliminary Estimate, as defined in EPRI’s Technical Assessment Guide (TAG) (EPRI, 1993). The information is generally consistent with that presented in chapter 14.

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14A.2 Design criteria

General design criteria include the following:

- The plant is built on a green-field site in Kenosha, Wisconsin.
- All designs are based on a combined cycle configuration.
- The nominal output is 350 MWe.
- The steam conditions are 169 kg/cm²/538°C/538°C.
- The condenser operates at 63.5 mm Hg.
- All designs are based on a 15°C ambient temperature.
- High sulfur, Illinois bituminous is the base coal for the study.
- The sorbent is limestone as it produces an ash with greater end-use potential.
- All designs are for 95% sulfur retention.
- Cost of electricity is based on an 80% capacity factor.
- Equipment sizing and sparing are based on 80% minimum availability.
- All equipment is designed for a 30-year plant life.
- All designs are to maximize plant efficiency wherever prudent.
- Plant designs and costs are based on a mature technology.

Sensitivity studies were also carried out to examine the effects of various process parameters on process performance and costs. These parameters included lower condenser pressures, more stringent steam conditions, and the use of alternative coals.

14A.3 Plant descriptions

Brief descriptions are presented here giving only sufficient detail to understand how the designs differ. Full plant descriptions are presented elsewhere.

14A.3.1 ABB-Carbon’s bubbling PFBC (Wheeldon et al., 1993).

The coal is mixed with water and fed as a paste, while the limestone is fed pneumatically. The combustor operates at around 14 kg/cm² and 843°C, which is also the inlet temperature to the gas turbine. The majority of the heat transfer occurs in the boiler, which is constructed of waterwall tubing and contains in-bed evaporation, superheat, and reheat tubing. Over 99.9% of the dust in the flue gas is removed by two stages of cyclones ahead of the turbine which is ruggedized to resist erosion by the residual dust. The blades are of a more robust design than those of a conventional turbine and coated with erosion-resistant material. They are assumed to require replacement every 3 years. The turbine is a variable-speed machine which drives the generator and the compressor. An intercooler is provided between the low and high pressure compression stages to control the high pressure discharge air temperature to around 315°C.

The expanded flue gases at around 398°C enter an economizer which is