2. GENERAL EVALUATION BASIS

The performance, environmental, and cost figures developed in this report are the result of maintaining a consistent design basis throughout. Common design inputs for site, ambient, and fuel characteristics were developed and are defined in the following subsections. Power plant configurations were identified to fit the expected load demand for the years 2000 to 2010.

2.1 SITE AND COAL CHARACTERISTICS

The plant designs utilize a common generic site with conditions typical to a south central United States location. Table 2-1 lists the ambient characteristics of this site.

Table 2-1
SITE CHARACTERISTICS

Topography	Level
Elevation	500 feet
Design Air Pressure	14.4 psia
Design Temperature, Dry Bulb	63°F
Design Temperature, Wet Bulb	54°F
Relative Humidity	55%
Transportation	Rail access
Water	Municipal
Ash Disposal	Off site

The site consists of approximately 300 usable acres (not including ash disposal) within 15 miles of a medium-sized metropolitan area, with a well-established infrastructure capable of supporting the required construction work force. The site is served by a river of adequate quantity for use as makeup cooling water with minimal pretreatment and for the receipt of cooling system blowdown discharges. A railroad line suitable for unit coal trains passes within 2-1/2 miles of the site boundary.

The coal-based plants utilize Illinois No. 6 coal, delivered by unit train. Limestone is delivered by car loads, which are individually handled. The coal specification in Table 2-2 is based on the

Illinois No. 6 Seam from Old Ben No. 26 Mine. Table 2-3 presents the limestone analysis for the Greer limestone used as the basis in all technologies that utilize limestone.

Table 2-2
BASE COAL ANALYSIS - ILLINOIS NO. 6 SEAM, OLD BEN NO. 26 MINE

Proximate Analysis	As-Received (wt%)	Dry Basis (wt%)
Moisture	11.12	
Ash	9.70	10.91
Volatile Matter	34.99	39.37
Fixed Carbon	44.19	49.72
TOTAL	100.00	100.00
HHV (Btu/lb)	11,666	13,126
Ultimate Analysis	**As-Received (wt%)**	**Dry Basis (wt%)**
Moisture	11.12	-
Carbon	63.75	71.72
Hydrogen	4.50	5.06
Nitrogen	1.25	1.41
Chlorine	0.29	0.33
Sulfur	2.51	2.82
Ash	9.70	10.91
Oxygen (by difference)	6.88	7.75
TOTAL	100.00	100.00

Table 2-3
GREER LIMESTONE ANALYSIS

	Dry Basis, %
Calcium Carbonate, $CaCO_3$	80.40
Magnesium Carbonate, $MgCO_3$	3.50
Silica, SiO_2	10.32
Aluminum Oxide, Al_2O_3	3.16
Iron Oxide, Fe_2O_3	1.24
Sodium Oxide, Na_2O	0.23
Potassium Oxide, K_2O	0.72
Balance	0.43

2.2 GENERATING UNIT CONFIGURATIONS

Generating duty cycles for the subcritical PC, supercritical, ultra-supercritical PC, IGCC, CPFBC, and gas turbine plants are a result of the plants having been evaluated for baseload operation. The PC subcritical, supercritical, and ultra-supercritical plants are classified as baseload plants, primarily because the cycle is best suited operationally for this dispatch mode. IGCC plants are characterized as having higher than average capital costs, low fuel costs, high efficiency, and relatively long construction lead time. Because of the baseload classification, IGCC duty cycles are projected to be nominally 65 to 85 percent. The CPFBC plants are also characterized as having higher than average capital costs, low fuel costs, high efficiency, and relatively long construction lead times. The CPFBC duty cycles are projected to be nominally 65 to 85 percent. The gas turbine could be classified as either a baseload or a peaking unit, having low capital and good turndown capability.

The configurations for the PC plants were based on current operating plants. The configurations were established based on consideration given to process flows, costs, construction requirements, rail access, and roadways. The steam conditions selected for the state-of-the-art PC plant were 2400 psig/1000°F/1000°F for the subcritical, 3500 psig/1050°F/1050°F for the supercritical, and 4500 psig/1100°F/1100°F/1100°F for the ultra-supercritical cycle.

The configurations for the IGCC power plants were derived from the CCT plants nearing the demonstration phase. The configurations utilize the gasifiers and gas turbines, which are expected to be commercially offered in the period of 2000 to 2010, thereby minimizing both actual and perceived risk associated with the project. The economic viability of IGCC plants is dependent upon the successful demonstration and commercialization of advanced technology attributes currently under development.

Accordingly, the IGCC plant configurations described in this report utilize advanced gas cleanup concepts. Table 2-4 lists the featured components of the IGCC plant configurations as well as those of the state-of-the-art pulverized coal plants, CPFBC plant, and the NGCC plants.

Table 2-4
GENERATING PLANT CONFIGURATIONS

	IGCC FOAK	IGCC Intermediate	IGCC Advanced #1	IGCC Advanced #2	PC Plant Subcritical	PC Plant Supercritical	PC Plant Ultra-Supercritical	CPFBC	NGCC #1	NGCC #2
Year Available to Build	2001	2005	2010	2010	1998	2000	2010	2005	1998	2005
Net Electric Output, MWe	543	349	398	428	397	402	399	380	326	395
Heat Rate, Btu/kWh	8,522	7,514	6,870	6969	9,077	8,568	8,251	7,269	6,743	6,396
Coal Flow Rate, lb/h	396,794	224,910	234,442	255,510	309,270	295,100	282,675	236,260		
Natural Gas Flow Rate, lb/h									100,700	115,700
Gasifier	Destec O_2-blown	Destec O_2-blown	MW Kellogg air-blown transport	Destec O_2-blown						
Gas Turbine	GE MS 7001FA	Westinghouse W501G	GE “H” ATS	GE “H” ATS				Westinghouse W501G	Westinghouse W501G	GE “H” ATS
Gas Cleanup, Particulates	Ceramic candle	Ceramic candle	Ceramic candle	Ceramic candle	ESP	Fabric filter	Fabric filter	Ceramic candle		
Gas Cleanup, Desulfurization	COS Hydrolysis	Transport reactor with Zn sorbent	Transport reactor with Zn sorbent	Transport reactor with Zn sorbent	Wet limestone FGD	Wet limestone FGD	Wet limestone FGD	Limestone injection		
Sulfur Recovery	Sulfuric acid	Sulfuric acid	Sulfuric acid	Sulfuric acid	Gypsum landfill	Gypsum landfill	Gypsum landfill	Landfill		
Gas Cleanup, NOx	Combustion	Combustion	Combustion	Combustion	Combustion	Combustion and SCR	Combustion and SNCR	Combustion	Combustion	Combustion

The first-of-a-kind IGCC plant presented herein is based on the Dynegy Power Corporation (referred to as "Destec" in this report) oxygen-blown gasifier configuration demonstrated at Wabash River, with the addition of gas cleanup utilizing a ceramic candle filter for particulate removal and an amine-based acid gas process for sulfur removal. The gasifier supplies medium-Btu gas to two GE M57001FA gas turbines, which exhaust through a heat recovery steam generator (HRSG) to generate steam for an 1800 psi/1000°F/1000°F steam cycle. Total net plant output for this case is a nominal 550 MWe.

The intermediate IGCC plant presented in this report is based on an advanced version of the Destec oxygen-blown gasifier, offering higher coal-to-gas conversion ratios than the first-of-a-kind unit. For this configuration, a transport reactor is used for desulfurization of the syngas. A ceramic candle filter is retained for particulate removal. The intermediate IGCC gasifier supplies medium-Btu gas to a Westinghouse 501G gas turbine, exhausting through a HRSG to provide steam for a 1800 psig/1000°F/1000°F steam cycle. Total net plant output is a nominal 350 MWe for this case.

Advanced IGCC plant No. 1 described in this report is based on the air-blown transport reactor concept under development by M.W. Kellogg Co. A transport reactor desulfurizer and ceramic candle filter are used for sulfur and particulate removal, respectively. This gasifier case is based on a conceptual model of the General Electric "H" gas turbine, which incorporates ATS technology. The exhaust gas passes through a HRSG generating steam for an 1800 psig/1000°F/ 1000°F steam cycle to generate a total net plant output of 400 MWe, nominal.

Advanced IGCC plant No. 2 described in this report is based on an advanced version of the Destec oxygen-blown gasifier, offering higher coal-to-gas conversion ratios than the first-of-a-kind unit. For this configuration, a transport reactor is used for desulfurization of the syngas. A ceramic candle filter is retained for particulate removal. The intermediate IGCC gasifier supplies medium-Btu gas to a conceptual model of the General Electric "H" gas turbine, which incorporates ATS technology. The exhaust gas passes through a HRSG generating steam for an 1800 psig/1000°F/ 1000°F steam cycle to generate a total net plant output of 500 MWe, nominal.

The configuration for the CPFBC power plant is derived from the plant nearing the demonstration phase. This configuration utilizes a carbonizer and gas turbine that are expected to be commercially offered in the period of 2000 to 2010, thereby minimizing both actual and perceived risk associated with the project. The CPFBC plant configuration described in this report utilizes advanced gas cleanup concepts.

The CPFBC generating unit is sized to be in a greenfield mode of design. The CPFBC plant is sized for a nominal 400 MW utilizing a modified Westinghouse Type 501G gas turbine. The exhaust gas from the turbine operating in a combined cycle mode goes through a HRSG, which is a drum-type, double-pressure design. Also used to generate steam is the fluidized-bed heat exchanger (FBHE). The two steam generators are matched to generate steam at 2400 psig/1050°F/1050°F, which is used in the steam turbine. The steam turbine chosen for this application contains three pressure sections.

Two NGCC configurations are presented. The first configuration is based on commercially operating systems. The gas turbine chosen for this case is the commercially available Westinghouse 501G. The exhaust gases from the gas turbine enter the HRSG, which is a triple-pressure design. The steam turbine associated with the NGCC is a triple-admission turbine with inlet steam conditions of 1650 psig/1000°F, 375 psig/1000°F, and 57 psig/585°F.

The second configuration is based on the selection of a gas turbine represented by the General Electric "H" machine. The exhaust gas from the gas turbine enters the HRSG, which is a triple-pressure design. The steam turbine associated with this NGCC is a triple-admission turbine with inlet conditions of 1800 psig/1050°F, 395 psig/1050°F, and 66 psig/630°F.