Appendix A ¾ Construction Aspects for Conversion Options

1.0 Pulverized Coal (PC)

1.1 Conversion Plan Description

This option considers the conversion of Bellefonte Units 1 and 2 in four phases of 600 MW blocks of power each:

Phase	Completion Date From the Start of Engineering (October 1, 1997)
1 - 1st 600 MW	2nd Quarter 2002
2 - 2nd 600 MW (Completion of "Unit 1")	2nd Quarter 2003
3 - 3rd 600 MW	2nd Quarter 2004
4 - 4th 600 MW (Completion of "Unit 2")	2nd Quarter 2005

Each phase of the project would convert one half of an existing unit at the Bellefonte Plant. Thus, it would require the completion of two phases of the project to fully convert one "Unit" at Bellefonte. One fully converted unit consists of two new pulverized coal fired steam generators which would provide main steam to two new 3,600 rpm topping turbine-generators, each of which would generate electric power. The expanded steam is reheated and admitted to a new intermediate-pressure turbine which replaces the existing 1,800 rpm high-pressure steam turbine which was part of the nuclear plant steam cycle. The new 1,800 rpm intermediate-pressure turbine would exhaust to the existing low-pressure turbines. The low-pressure turbines and condenser would be re-used, as well as most of the existing condensate system.

New air quality control equipment consists of low NO_x burners (and possibly Selective Catalytic Reduction for NO_x removal if required by a BACT analysis), an electrostatic precipitator system for flue gas particulate removal, and a scrubber system, without flue gas reheat, for SO_2 removal. The exhaust flue gas is released through a single chimney with two flues for each pair of 600 MW boilers.

New coal handling facilities are constructed for barge unloading of coal. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed. NEW waste storage areas for ash and flue gas desulfurization waste solids are constructed.

1.2 Design Criteria

1.2.1 Design Basis

The following design criteria are the basis for the pulverized coal alternative:

- The total conversion of the Bellefonte Plant Units 1 and 2, would be 2,400 MW net power production. However, the project would be built out at 600 MW increments while accommodating provisions for expanding the conversion to include the completion of Unit 1 and then Unit 2 in a similar manner.
- The design would utilize as much of Bellefonte Unit 1 & 2 equipment and facilities as is cost effective.
- Unit would be base loaded with an 85% capacity factor.
- FGD system would be positive pressure without bypass and without reheat. The scrubber solids slurry is forced oxidized to produce a gypsum which can be processed into wallboard or other similar material.
- FGD waste solids would be wet stacked in accordance with TVA design guidelines. This results in a 1:3 slope at the outside of the stack with 15-feet wide benches, 25-feet high. Ash wastes would be stacked in a similar manner.
- The coal specified for the study is Modified Illinois No. 6, with ultimate analysis shown in Table 1.2.1-1.
- The analysis of the design basis limestone is shown in Table 1.2.1-2.

Table 1.2.1-1 Modified Illinois No. 6 Ultimate Analysis

Constituent	As Received	Dry
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

Table 1.2.1-2 Design Basis Limestone Analysis

	Typical	**Minimum**	**Maximum**
Calcium Carbonate (Dry Basis)	90.1%	90%	
Magnesium Carbonate (Dry Basis)	4.6%		5%
Silica (Dry Basis)	5.4%		5.4%
Moisture			5%
Hardness as kvs Work Index			13
Grindability		2.99	
Particle Size Distribution	3/4 x 0 inch	50% retained on a ¼" screen	

1.2.2 Coal and Sorbent Handling

Coal receiving would be by barge only and limestone receiving would be initially by truck (during the first 1,200 MW of operation) and subsequently by barge with re-use of the initial low capacity coal unloading equipment. This plan for receiving of coal and limestone is the result of an economic analysis which compared initial truck unloading of limestone but switching to barge unloading at that point in time when truck traffic is deemed excessive (greater than six trucks per hour over a 12 hour receiving period) against only barge unloading of limestone. This results in limestone truck delivery requirements of approximately 4 ½ trucks/hour at 40 hours per week during the 1st 600 MW operation and an increase to six trucks per hour at 60 hours per week during 1,200 MW operation (to limit limestone unloading truck traffic to approximately six trucks per hour).

The coal unloading equipment and facilities for the first 600 MW would be designed such that with minor modifications, the unloading equipment can be converted to allow limestone unloading for the third construction phase of 600 MW (1,800 MW total buildout). At that stage, limestone unloading would be shifted to the barge unloading area where the clamshell unloader initially used for coal unloading during the first 600 MW phase of operation, would be used for unloading limestone barges.

At the second 600 MW phase of construction, new continuous bucket wheel coal unloading equipment would be installed in order to meet the higher coal unloading requirements for 1,200 MW operation. The construction sequence is shown in Table 1.2.1-3.

Table 1.2.1-3 Construction Sequence for Unloading Equipment

	LIMESTONE UNLOADING	COAL UNLOADING
600 MW	Truck Unloading Station 4 ½ Trucks Per Hour, 108 tph	Barge Unloading Area #1 1,800 tph
1,200 MW	Truck Unloading Station 6 Trucks Per Hour, 144 tph	Barge Unloading Area #1 Upgrade to 3,500tph
1,800 MW	Barge Unloading Area #1 Modify the coal unloading equipment for Limestone unloading, 360 tph	Barge Unloading Area #2 Upgrade to 5,300 tph
2,400 MW	Barge Unloading Area #1 No changes required except for daily throughput, 500 tph	Barge Unloading Area #2 Upgrade to 7,000 tph

1.2.2.1 Limestone System

The required limestone feed rate at 100% rated plant capacity for 2,400 MW is 120 tons per hour (tph). The limestone handling system has the following design criteria:

- Limestone receiving and stockout operation at up to 12 hours per day, five days per week.
- Limestone reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total limestone storage (excluding the silos)
- Three days of live limestone storage (excluding the silos)
- 16 hours limestone storage in the silos
- 12 hours of limestone slurry storage

Limestone stockout is via a conveyor discharging into a concrete stacking tube. Reclaim is through reclaim hoppers located under the stacking tube and conveyor into the Additive Preparation Silos.

Limestone Receiving

Trucks discharge the limestone into one of two limestone receiving hoppers with isolation gates and variable rate feeders. The feeders discharge onto collecting conveyor C-1 for transfer to stockout conveyor C-2. Conveyor C-1 has a capacity of 500 tph and includes all the necessary chute work to transfer the limestone between the conveyors.

Limestone Storage and Reclaim

Conveyor 2 transfers limestone from the collecting conveyor (Conveyor 1) to a concrete stacking tube at the limestone stockout pile. Conveyor 2 is furnished with an electronic belt scale and a two-stage sampling system complete with stainless steel chute work and sample collector. Conveyor 2 is rated at 500 tph.

Conveyor 2 builds the active storage pile directly over the dual reclaim hoppers. The pile capacity is equivalent to 30 days of limestone consumption at the 2,400 MW requirement, 84,000 tons. The pile is 270 ft in diameter by 95 ft high with a 35° angle of repose. The reclaim hoppers are 16 ft x 20 ft with a minimum valley angle of 65°. The hoppers include dewatering slide gates and two variable rate belt feeders discharging to Conveyor 3 which conveys limestone to the Additive Preparation Building. Conveyor 3 is a 36 in belt conveyor rated at 600 tph. Conveyor 3 is furnished with an electronic belt scale.

The head end of Conveyor 3 is complete with reducer, coupling, and motor and a magnetic separator with tramp iron chute and container.

Conveyor 3 transfers limestone from the reclaim hopper to a series of conveyors and flop gates into the limestone day bins. There are a total of five day bins for the 2,400 MW plant, one of which is for spare capacity. Each bin has a capacity of 600 tons. The bins are 24 ft diameter. x 35 ft tall (straight side length) with vibrating bin bottom, slide gate and pulse jet type bin vent filter. Four of the bins feed active limestone ball mills. One feeds a standby ball mill. The conveying system is sized to fill all of the active bins in 16 hours. The active bins provide a limestone surge capacity of 16 hours. Two of the five bins and associated downstream preparation equipment are constructed during the first 600 MW phase of construction. Thereafter, one bin and preparation train are provided for each 600 MW phase of construction.

The limestone conveyors are open type trusses with corrugated covers over the belts. One 3-feet walkway of galvanized expanded metal is provided with each gallery. Protective cover plates are provided in areas above roadways, waterways, and building roofs. Exits are provided at 300 ft minimum spacing. The conveyor gallery support bents consist of exposed, braced, simply supported space frames with foundations on spread footings and piers. The foundations, piers, excavation, handrail, structural steel, and ladders are included. The conveyor belting, stringer supports, conveyor drive systems, spray dust suppression, and fire protection are included. The conveyors have 35° troughing idlers. Maximum allowable conveyor slope is 15°.

Dust Control

Dust control for the limestone handling system would consist of a freeze protected spray foam system.

1.2.2.2 Coal System

The required coal burn rate at 100% rate plant capacity for 2,400 MW is approximately 1,100 tph burning Illinois No. 6 coal. The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at 12 hours per day, five days per week during 1st 600 MW (clamshell coal unloading) and 10 hours per day, five days per week after completion of the 2,400 MW buildout.
- Coal reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total coal storage (excluding the silos)
- Three days of live coal storage (excluding the silos)
- 16 hours of storage in the silos

The coal handling system includes the equipment required for unloading, conveying, preparing, and storing the coal delivered to the plant. The scope is from the barge unloader and barge breasting equipment to the tripper conveyors feeding the coal silos at the boiler front. The system is designed to provide short term coal storage in the coal silos for 16 hours of operation using the lowest specification heat content of the coal while operating the boiler at the rated 100% load. The reclaim rate is capable of providing the necessary coal to allow filling the 16-hour coal silos in eight hours.

The phased construction of the coal handling facilities would be as follows.

- Coal Unloading and Stockout: For the initial construction phase, the barge unloading equipment is sized for unloading coal barges at the required rate for a 600 MW power block, however, the collecting belt and stockout belts are sized to handle the required rate for 1,200 MW. For the 2nd 600 MW construction phase, the unloading equipment would be upgraded for the 1,200 MW unloading requirement and the barge unloader used for the first 600 MW operating phase would be placed in a standby mode. For the 3rd 600 MW construction phase, a new high capacity barge unloading system would be constructed downstream from the operating unloader along with a new transfer conveyor and stockout conveyor. The new unloader and conveyors would be designed with conveying capacity sufficient for the 2,400 MW unloading requirements. The barge unloader used during the first phase of construction would be modified for barge unloading of limestone.
- Coal Reclaiming: For the initial construction phase, the coal reclaiming equipment, from the coal pile to the plant transfer building, would have the required conveying and crushing capacity for 1,200 MW. At the 1,800 MW construction phase, the reclaiming system would be duplicated, providing the capacity for the f,ull 24,00 MW.

The system includes the following for the initial 600 MW plant:

- Barge Unloading: Coal is delivered by barge. Assuming 1,600 ton capacity barges (195 ft x 35 ft x 9 ft draft), approximately 6 barges must be unloaded per day. An 1,800 tph clamshell type unloader with self-contained breasting system, barge unloading collecting conveyor, electrical room, control cab, and jib crane is provided. The chute work and collecting conveyor has a capacity of

3,500 tph. The barge unloader collecting conveyor feeds the coal onto Conveyor C-4 which has a conveying capacity of 3,500 tph. Conveyor C-4 conveys the coal to the Coal Transfer Building.

- Transfer Building: Conveyor C-4 transfers coal through a flop gate to the active storage pile stacker reclaimer conveyor C-3. Conveyor C-4 is equipped with an electronic belt scale, a magnetic separator with tramp iron chute and container, and an electronic metal detector, paint marking system, and electronic belt scale. Conveyor C-4 also has a 2-stage "as-received" sampling system complete with stainless steel chute work, sample crusher, and automated final sample collectors. The stacker reclaimer conveyor C-3 is a reversing conveyor feeding a trencher type stacker/reclaimer which can stack at a rate of ,3500 tph or reclaim at rates up to 2,000 tph. When reclaiming, conveyor C-3 discharges into the crusher surge bin. The reclaim head of conveyor C-3 also has a magnetic separator with tramp iron chute and container and an electronic metal detector, paint marking system, and electronic belt scale.
- Coal Crushing: The crusher surge bin in the transfer building includes level controls, a load cell system, two discharge hoppers, isolation gates, and variable rate feeders. The belt feeders feed two crushers which can feed transfer conveyors C-6A and C-6B. Conveyors C-6A and C-6B transfer the coal to the Plant Transfer Building, each at a rate of 800 tph. Conveyors C-6A and C-6B are each equipped with electronic metal detector, paint marking system, electronic belt scale and 2-stage "as-fired" sampling systems (similar to the "as-received" sampling system).
- Plant Transfer Building: Conveyors C-6A and C-6B transfer coal to a surge hopper in the Plant Transfer Building. The surge hopper has four variable rate feeders which feed the tail end of transfer conveyors C-101A and C-103A and tripper conveyors C-101B and C-102B. Each conveyor is rated at 800 tph. Transfer conveyors C-101A and C-103A feed the Boiler 1A tripper conveyors C-102A and C-104A, respectively. There are two traveling tripper conveyors over each row of coal silos (two for boiler 1A and two for Boiler 1B). Each tripper is self-propelled with single leg discharge and a flat belt seal system over the silo top opening.
- Dust Control: Dust control for the coal handling system would consist of a spray foam system which would spray at various points in the conveying system to prevent dusting.

1.2.3 Coal and Sorbent Preparation and Feed

The coal preparation and feed system includes the coal silos, feeders, pulverizers, and piping to the coal burners. This equipment is provided by the turnkey boiler vendor.

The sorbent preparation and feed system includes the Scrubber Additive Preparation System which prepares, stores and supplies limestone slurry for the scrubber modules. The Scrubber Additive Preparation System for the first 600 MW power block (Boiler 1A) consists of two horizontal closed circuit ball mill systems, one operating and one standby, which produce a 30% solids limestone slurry with product size of 90% passing 325 mesh. The mill systems are each rated at 33 tph and operate continuously. The product slurry is stored in a 430,000 gallon storage tank for use by the Scrubbers. The tank is constructed of rubber lined carbon steel, 50-feet diamater. x 32-feet tall. An additional system of 1 mill and one storage silo is required for each subsequent 600 MW power block with an additional 430,000 gallon slurry tank to be added at phase 3 such that at 2,400 MW, the slurry tanks would have a capacity for 12 hours. At the full 2,400 MW buildout, there would be five storage silos and five mill systems with one spare for the entire 2,400 MW.

Each mill system includes a limestone feeder with weigh scale, a horizontal, closed circuit, trunnion type ball mill (with gear reducer, clutch, lubrication system and drive motor), a mill slurry sump tank, two mill classifier feed pumps, a mill classifier with hydrocyclone modules, ball charging hopper, and hoist.

The mill classifier assemblies produce limestone slurry by gravity through a distribution box to the limestone slurry storage tank.

1.2.4 PC Boiler and Accessories

The Steam Generator and Auxiliary Equipment (the Boiler Island) which would be provided by a turnkey vendor includes the following for the first phase of construction (600 MW). The requirements for each successive 600 MW phase of construction are similar.

Steam Generator (Boiler) for producing 600 MW power which would include:

- Furnace,
- Superheater,
- Superheater Desuperheaters,
- Reheater,
- Economizer,
- Boiler Structural Steel and platforms,
- Foundations,
- Insulation and lagging,
- Soot Blowing Steam System,
- Two FD Fans and electric motor drivers and isolation and control dampers,
- Two PA Fans and electric motor drivers and isolation and control dampers,
- Two Secondary Air regenerative air heaters,
- One Primary Air regenerative air heater,
- ID Fans and electric motor drivers and isolation and control dampers,
- Interconnecting ductwork and dampers,
- Two Stages of air preheating coils (at FD Fan inlet and at FD Fan outlet),
- Ignitor Fuel Oil System,
- Particulate Removal System,
- Flue Gas Desulfurization System,
- Limestone Handling and Preparation System,
- Coal Handling and Feed System,
- Instrumentation and Controls for all equipment in scope,
- Bottom Ash, Fly Ash, and Gypsum conveying systems, and
- Continuous Emissions Monitoring Equipment.

The Boiler Island interfaces include:

- Feedwater Inlet,
- Main Steam Outlet,
- Cold Reheat Inlet,
- Hot Reheat Outlet,
- Boiler Blowdown and Blowoff Tank drains,
- Boiler Drains,
- FGD Waste (slurry pump discharge),
- Bottom Ash conveyor discharge,
- Fly Ash Holding Silo Unloading discharge points
- Cooling Water Supply,
- Cooling Water Return,
- Control Air, and
- Fire Protection Water Supply.

1.2.5 Hot Gas Cleanup

The flue gas cleanup systems are provided by the turnkey boiler vendor and include particulate collection and flue gas desulfurization. Selective Catalytic Reduction is not included but may be required if a BACT analysis so indicates. The NO_x emissions are to be limited to 0.15 Lb/MMBtu. Low NO_x burners are provided to achieve this.

Particulates (fly ash) are collected in an electrostatic precipitator system which is located in the flue gas path at the outlet of the air heaters and just upstream of the induced draft fans. The system is designed to meet an emissions limit of 0.03 lb/MMBtu heat input. The fly ash collected by the precipitator elements collects in the hoppers at the bottom of the casing and is pneumatically conveyed to the fly ash collection silos which are located near the waste ash disposal area.

Flue Gas Desulfurization is accomplished by a wet flue gas scrubber which utilizes a limestone slurry which reacts with the SO_2 in the flue gas to form salable gypsum product. The scrubber is designed for 95% SO_2 removal. The scrubber is located downstream from the induced draft fans and includes one absorber module per 600 MW power block. There is no reheat and there is no spare capacity. The scrubbed flue gas is directed to one of the flues in the chimney (which serves two boilers). The gypsum is pumped as a slurry to the on site gypsum wet stacking areas where the dewatering occurs. The runoff from the wet stacking area is collected and routed to the recycle basin which is the collection point for all the waste storage areas as well as coal pile runoff. The recycle basin has a pumping station which pumps the collected liquid back to the scrubber system for re-use.

1.2.6 Ducting and Stack

The ducting includes the primary air and secondary air ducts supplying the new boiler and the ducts carrying flue gas exiting the boiler and through to the stack.

The primary air ductwork is from the primary air fans to the air heater to the pulverizers where pulverized coal is added to the air stream which enters the coal piping going to the coal burners on the boiler.

The secondary air ductwork is from the outlet of the forced draft fans to the air heater and on to the windbox of the new boiler.

The flue gas, after exiting the economizer section of the new boiler, enters ductwork carrying it to the air heaters and then to the electrostatic precipitators. From the precipitators, the ductwork carries the flue gas to the inlet of the induced draft fans. From the outlet of the induced draft fans, the ductwork carries the flue gas to the scrubber and then to the stack.

A single stack is provided for each 1,200 MW power block (serving two boilers). The stack contains a single independent flue for each 600 MW boiler. Stack height is based on the GEP (Good Engineering Practice) stack height calculation which results in a stack height of 503 ft.

1.2.7 Steam Turbine-Generator

Each 1,200 MW phase of operation includes two new HP Turbine-Generators (one associated with each new boiler), one new IP Turbine (to replace the existing nuclear plant HP Turbine), and one existing LP Turbine which along with the IP Turbine is coupled to one existing generator. The new HP Turbines would each be located in a new turbine island building adjacent to and south of the new boiler island. The new turbine building would house all the associated HP Turbine-Generator equipment as well as the two new HP feedwater heaters (0A and 1A).

The IP and LP Turbine-Generators are located in the existing turbine building along with the condensate system equipment, boiler feed pumps and deaerator.

1.2.8 Cooling Water System

1.2.8.1 New Power Block Cooling Water System

The new Power Block area, which includes the boiler, flue gas treatment, high-pressure topping turbine, and high-pressure feedwater heaters has the following cooling loads:

- Generator Hydrogen Cooling,
- Alternator Cooling,
- Stator Winding Cooling,
- Bus Duct Cooling,
- Turbine Lube Oil Cooling,
- Electro-Hydraulic Control Oil Cooling,
- Primary Air Fan Bearing Cooling,
- Forced Draft Fan Bearing Cooling,
- Pulverizer Bearing Cooling,
- Boiler Access Door Cooling, and
- Sample Cooling.

These loads are cooled by a new once-through open cycle cooling water system. A new 12 in supply header is provided to each 600 MW power block. The 12 in header for each power block branches off each of the four existing 36 in essential raw cooling Water headers which are located underground in the vicinity of the new power block. During the initial 600 MW phase of construction, stub-ups would be provided for the entire 2,400 MW buildout. As each phase of construction commences, the stub-up for that phase would be uncapped and the header would be extended through the plant to the associated equipment for that phase. The return header is an 18-in header which is common to two 600 MW power blocks and is routed to the existing control building where it ties into the 42-in headers which return the water to the cooling tower basins as makeup. The full 2,400 MW buildout has two 18-in cooling water return headers routed from the new power block area to the control building which house the existing two 42-in cooling tower basin return lines (which serve as cooling tower makeup lines).

1.2.8.2 Existing Turbine Building Cooling Water System

The existing raw cooling water pumps (4 for each 1,200 MW power block) provide the cooling water requirements for the existing Secondary System (non-nuclear power generation equipment). This system would be re-used. The four pumps take suction from the condenser circulating water supply duct, just upstream from the inlet to the main condenser. The heated water is returned to the condenser circulating water return duct, downstream from the main condenser outlet. Raw water recirculating pumps are included in this system to recirculate heated water to the generator coolers to maintain a minimum cooling water temperature.

1.2.9 Ash Handling System

Bottom ash and fly ash from the boiler gas passage hoppers is collected from the boiler area by a submerged scraper conveyor. The system cools the ash as it drops through the water filled trough of the conveyor and dewaters it as it is conveyed and lifted out of the trough. The ash is conveyed to a discharge point where a flop gate directs the ash into a truck for transport to the disposal area or onto a belt conveyor for conveying to a temporary storage area.

Fly ash from the electrostatic precipitators is collected in hoppers below the casing of each precipitator. A dense phase pneumatic conveying system is provided which conveys the fly ash to either of the two fly ash storage silos which each have a three day storage capacity. The silos are equipped with a fluidizing air system, dustless unloader, and pug mill ash conditioner so that the ash may be unloaded dry into an enclosed transport vehicle, or wet into the bed of an open haul truck for disposal at the on site ash disposal area. The silos are also equipped with vent filters and level instrumentation. Two silos are provided for each 600 MW power block. The silos would require truck unloading at the rate of four 24-ton trucks per hour on a 40-hour per week basis for each 600 MW power block.

1.2.10 Improvements to Site

1.2.10.1 Site Arrangement

The suggested site arrangement for the Pulverized Coal Plant is in Appendix B. The Civil/Structural features and work necessary to implement this arrangement are described in the sections that follow. The location of the new power generation blocks was determined from an economic analysis of three possible locations: east of the existing service & office building (the location decided upon), the area directly east of the auxiliary building, and the area south of the cooling towers. The main factors in the resulting location were the longer distances required to run high energy piping for the location south of the cooling towers and the greater excavation required for the area east of the Reactor Building.

1.2.10.2 Demolition

To accommodate the new power plant, existing buildings and utilities would require demolition or relocation. The buildings and utilities requiring demolition or relocation are generally located south and east of the existing plant site. The following would require demolition:

- Power Stores Warehouse,
- Construction warehouses and storage buildings, including concrete slabs and underground utilities. Approximately 50 buildings are included, and
- Fencing.

The following would be relocated:

- Construction office located east of the hot machine shop,
- Mechanical fabrication, electrical fabrication, and paint/solvent shops, and
- Miscellaneous underground and overhead utilities.

Cooling tower blowdown lines would be lowered to prevent interference with barge traffic in the barge unloading area.

The barge unloading area would consist of a loaded barge storage dock, unloading dock, and empty barge storage dock. The docks would be constructed of cells interconnected with walkways. The cells would be constructed of sheet pile walls with a granular fill material. Cells which support the barge unloader equipment and barge pulling equipment would be topped with 2-feet thick reinforced concrete slabs. Fifty 20-feet diameter cells have been included in the estimate plus a double cell at the barge unloading structure.

To accommodate the draft of the barges, the two existing cooling tower blowdown diffuser pipes would need to be lowered. The pipes are 54-inch diameter approach pipes with 42 and 36 in diffuser pipes at each end. Approximately 425 ft of one pipe and 475 ft of the other blowdown diffuser pipe would be lowered from the barge unloading dock to the end of the pipes. The pipes would be lowered approximately five ft and be bedded similar to their current construction. Lowering of the pipes would require approximately 1,000 cubic yards of soils and 1,000 cubic yards of rock excavation in the river bed.

In addition to lowering the diffuser pipes, the river in the area of the barge storage and loading areas would require dredging.

1.2.10.3 Site Preparation

The boiler island and the high pressure turbine-generator island would be constructed in an area to the east of the existing plant site. After completion of demolition described above, this area would be cleared and grubbed to remove existing vegetation. The area would be leveled to elevation 640 for construction of the plant. This elevation was selected to provide the best balance between cuts and fill with consideration of the underlying rock elevation.

The existing ERCW pipes and conduit banks which are located underground in this area would not be relocated. Foundations which are above these pipes and conduit banks would be designed to span over them without placing excessive forces on the pipes or conduit banks.

1.2.10.4 Fly Ash And Bottom Ash Disposal

The fly ash and bottom ash disposal areas are shown (along with the gypsum disposal storage areas) in Appendix B. Phase I disposal for fly ash and bottom ash would be provided by a common pile located northwest of the existing plant. An existing water tank and pumphouse would require demolition to make way for the disposal area. The existing road which loops past the training facility and back to the main road would be abandoned.

The disposal area would be surrounded by a dike to elevation 605 to protect the pile from a 500 year flood. The area would not be lined. Runoff from the area would be collected and piped to the recycle basin.

Fly ash and bottom ash would be placed in separate piles within the disposal area and the piles would be allowed to run together. The disposal area occupies an area of approximately 110 acres and would be piled to a maximum height of 200 ft. The sides of the pile would have slopes of 3:1 with 15-feet wide benches at 25 feet intervals. A haul road would be provided for access to the pile. The pile would be covered with earth taken from borrow areas on site.

The Phase I disposal area would provide approximately 14 years of disposal at 2,400 MW. After the Phase I area is filled, a new disposal area would be created on the hillside between the river and the plant. This area of the site has the potential to hold an additional 27 years of ash disposal.

As an option, a disposal area could be provided in the area to the south and west of the cooling towers. Full utilization of this area would require that the existing 500 kV transmission line be relocated. This area has the potential for 18 years of ash disposal.

1.2.10.5 Gypsum Disposal

Disposal for gypsum would be provided by a pile located north of the existing plant. The existing north access road would be closed to provide the maximum possible volume in this area. A road at the base of the pile between the pile and town creek would provide a means of egress in that direction from the plant site.

The disposal area would be surrounded by a dike to elevation 605 to protect the pile from a 500 year flood. The area would be lined. Runoff from the area would be collected and piped to the recycle basin.

The disposal area occupies an area of approximately 196 acres and would be piled to a maximum height of 200 ft. The sides of the pile would have slopes of 3:1 with 15-feet wide benches at 25 feet intervals. A haul road would be provided for access to the pile. The pile would be covered with earth taken from borrow areas on site.

The eastern edge of this disposal area was stopped at the edge of the potential SWMU’s (Solid Waste Management Units). Stopping the pile at this location would provide approximately 20 years of disposal at 2,400 MW. If the pile is allowed to extend to the river, the disposal area has the potential to add 20 additional years of capacity.

1.2.10.6 Coal Storage

The coal pile would be located on a predominately level area south of the cooling towers. This area was chosen over the area to the east of the cooling towers to reduce earthwork costs for preparation of the coal pile area. The area to the east of the cooling towers would have required considerable excavation into the existing hillside to create a level area for the coal pile.

The coal pile would be sized for a 30 day supply of coal based on the requirements for 2,400 MW. The area under the coal pile would be lined to prevent runoff from infiltrating the ground water. Prior to placing the lining, the area would be probed and voids in the rock would be grouted. A geotextile would be provided under the liner to provide protection to the liner. The liner would be covered with four feet of graded fill material equipped with an underdrain system to collect leachate. Runoff from the coal pile would be collected and pumped to the recycle basin.

1.2.10.7 Limestone Storage

Limestone storage would be provided in an area east of the existing plant. The limestone storage area would not be lined. Run off from this storage area would be collected and pumped to the recycle basin.

1.2.10.8 Bottom Ash Day Storage

After the bottom ash is conveyed out of the collection trough, it is discharged either into the bed of a haul truck for transport to the on site disposal area or it is discharged onto a nearby storage pile until such time as it can be loaded onto a haul truck for on site disposal.

1.2.10.9 Recycle Basin

A recycle basin would be provided in an area west of the existing intake pumping station. This recycle basin would accept flow from the ash storage area run off, gypsum storage area run off, coal pile run off, limestone storage run off, cooling tower blowdown, and miscellaneous other drains. Water from the recycle basin would be re-used. This basin would be lined.

1.2.10.10 Foundation Design

Foundation systems final design is dependent upon the depth of soil over rock and the extent of sinkholes and subsurface voids at the location of each structure.

Heavily loaded and settlement-sensitive structures are founded on rock. Where rock is determined to be near the ground surface, a reinforced concrete mat is placed on rock after excavating any voided rock zone. If the rock is too deep to allow the use of a mat, drilled piers or piles would be used. For purposes of the estimate we have assumed mat foundations founded on rock.

Lightly loaded structures or structures which allow some settlement, such as tanks, are supported by spread footings or mat foundations. If significant subsurface voids are detected, ground improvement using probe and grout may be used to limit the potential for the collapse of voids or subsidence of soil into voids.

2.0 Natural Gas Combined Cycle (NGCC)

2.1 Conversion Plan Description

The Bellefonte conversion using NGCC would convert only one Bellefonte steam turbine. To leave Unit 1 available for potential nuclear service, only Unit 2 is converted. Convertion consists of nine new natural gas fired combustion turbine-heat recovery steam generator (HRSG) blocks that send steam to a new Unit 2 1,800 rpm replacement HP turbine section and the existing Unit 2 LP steam turbine-generator. Superheated steam is generated in dedicated heat recovery steam generators and expanded through the steam turbine.

Full buildout of the facility is planned by developing three phases of three CTs-HRSGs. The NGCC power plant consists of nine Westinghouse 501F combustion turbines with dedicated HRSGs located in a power block located to the south of the existing Bellefonte cooling towers. The HRSGs are of a three pressure design with the high pressure section superheater feeding the new HP turbine section. The HRSG intermediate pressure section superheater supplies steam to mix with the HP turbine section outlet steam, providing steam to the LP turbine section. The HRSG low pressure section supplies an integral deaerator.

2.2 Design Criteria

2.2.1 Design Basis

The design basis, related to this conceptual study, is as follows.

- Convert Bellefonte Unit 2 only, and preserve as much of Unit 1 as possible. The Unit 2 design should accommodate provisions for converting of Unit 1.
- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Transmission system limitation is 2,400 MW at 40°C (104°F) and 115% of 2,400 MW (2,760 MW) at 0°C (32°F). The replacement of two power circuit breakers at the Madison Substation is required to exceed the 2,400 MW limitation. To meet the 2,400 MW limitation under all temperature conditions, the combustion turbine combined cycle plant would be limited to a nominal net capacity of 2,400 MW at performance rating conditions of 15°C (59°F).
- The existing Bellefonte LP Steam Turbine is converted by implementing only one of the two double flow sections to allow for reasonable low load turndown. This limits the LP Turbine inlet steam flow to a maximum of 5,400,000 lb/hr. The minimum allowable steam flow is 1,200,000 lb/hr.
- Advanced (“G”) technology combustion turbines, with 2350+°F firing temperature are used as the basis for conceptual design and cost estimate. Advanced (“F”), GT 24 and ATS machines were modeled. Conceptual design and layout differences are noted for these options in the report.

- The existing steam turbine bypass system passes approximately 7.3 million lb/hr of steam at 1049.7 psia and 630°F. Therefore, upon loss of the high-pressure or low-pressure steam turbine, steam from the HRSGs may be attemperated to the equivalent enthalpy and injected up to this maximum rate. This arrangement permits all combustion turbine capacity to be maintained and operated (using the steam bypass system) upon a trip of the high-pressure or low-pressure turbine.
- Combustion turbine supplemental backup fuel is not included.
- HRSG duct supplemental firing is included for operational considerations and power augmentation for operation with less than nine CTs in operation.
- Hot gas bypass is included to allow continued operation in simple cycle mode should the steam turbine-generator or condenser become unavailable. Switching to total simple cycle operation would impact approximately 730 MW, and 1,570 MW would remain available from combustion turbine simple cycle operation.
- Design capacity factor is 85% for NGCC.
- The natural gas combined cycle is installed in phases, with approximately 1 year between phases. All construction would be in phases of two or three combustion turbine-heat recovery steam generators (CT-HRSG) per phase.

Phase	Approximate Plant Capacity upon Completion (for F machines)
1	731 MW
2	1,466 MW
3	2,206 MW

Phase	Approximate Plant Capacity upon Completion (for G machines)
1	628 MW
2	1,256 MW
3	2,248 MW

- Ambient dry-bulb temperature range is -29 to 43°C (20 to 110°F). One percent design wet-bulb temperature is 26°C (78°F). One percent design dry-bulb temperature is 35°C (95°F). Average annual relative humidity is 70%. Average annual precipitation is 1.4 m (55 in). Existing plant site elevation is 192 m (630 ft) above sea level. New combustion turbine-HRSG plant site elevations would be stepped to conform to existing grade and underlying rock elevations. With full buildout there would be three different plant site elevations.
- Minimal discharge to Town Creek is allowed for non-contaminated surface water runoff. All sumps have controlled discharge via CCW diffuser. Design for minimum wastewater discharge from the plant site.
- During construction, surface water runoff is collected in a settling pond to allow settling of solids and monitoring the water quality discharged to Town Creek. This pond is left in place for operation to be utilized as a containment for any spill and for future regulation requirements.

2.2.2 Natural Gas Feed

Natural gas would be supplied to the Bellefonte Plant site by means of a buried gas line. Onsite, the gas line branches into supply lines to each block of two combustion turbines.

Pipeline	Natural Gas per Combustion Turbine
Flow, lb/hr	73,870
Parallel Lines	1
Press, psig	400
Temp, ^{o}F	60
Main Line Size, in.	24

Fuel gas delivery to the site is anticipated to be 400 psig. For the F machines, this is adequate pressure so that gas compressors are not required. For the ATS, G and GT 24, gas compression may be required, however, costs for gas compression were not included in the scope of this supply. A pressure regulating station is provided for each block of two combustion turbines. The fuel gas supply to each combustion turbine includes a gas scrubber, dual gas filters, and flow metering equipment. A drain tank is provided for each block of two combustion turbines to collect wastewater discharged from the fuel gas scrubbers and filters.

The Fuel Gas System delivers cleaned fuel gas to the combustion turbine fuel flow control equipment at the pressure range required by the combustion turbine manufacturer through carbon steel piping. The main fuel gas header is 24-inches diameter.

2.2.3 Combustion Turbine and Accessories

The combustion turbines would be provided by the turnkey vendor. Three types of Advanced “F” Technology combustion turbines are available in this size range: The ABB GT 24; the General Electric MS7231FA; and the Westinghouse W501F. All three vendors are involved in the U.S. DOE Advanced Turbine Systems (ATS) program. Vendor estimates of capital costs of the General Electric and Westinghouse turbines in this class are roughly equivalent, with the cost of the ABB machine being slightly higher. Results with the GE would be very close, with the ABB machine generating higher electrical output due to recent performance improvements.

The Advanced “G” Technology and ATS combustion turbines were also modeled. The combustion turbine-generator selected for this application is based on the Westinghouse 501G. This machine is an axial flow, single spool, constant speed unit, with variable inlet guide vanes. The combustion turbine is provided with dry low NO_x burners for natural gas firing. Although the 501F is used here, the other combustion turbines would be compared to the 501F.

The ATS technology was investigated. There are concerns for the use of the ATS machine due to lack of maturity. To date, no ATS technology units have been built. This alone would rule out the ATS machines as a viable option. However, due to the performance potential of the ATS technology, the ATS was modeled. Modeling results indicate that the ATS technology is reasonable for greenfield or brownfield configuration but is not recommended for Bellefonte conversion.

2.2.4 HRSG, Ducting and Stack

2.2.4.1 HRSG

The HRSG, ducting, bypass stack and stack would be provided by the turnkey vendor. Each of the heat recovery steam generators is a drum type, triple pressure design that is matched to the characteristics of Westinghouse 501F exhaust gas when firing natural gas. The HRSGs are flat bottom, natural circulation, bottom supported units equipped with inlet and outlet ductwork, insulation and architectural lagging, bypass stack, diverting damper and exhaust stack. All heat transfer in the steam generator is accomplished by convection through banks of finned tubes.

Major equipment supplied with the HRSG include an integral deaerator and economizer, an IP economizer, a steam drum with IP evaporator, an IP superheater, an HP economizer, a steam drum with HP evaporator, and an HP superheater.

NO_x emissions are controlled in the combustion turbine by use of dry low NO_x combustors.

Insulation and architectural lagging of the HRSG exterior walls, ducts, and piping are provided to reduce heat loss from the unit and to provide safe maintenance areas around the steam generator.

Safety valves and vent piping are provided for overpressure protection. Blowdown tanks are provided to receive HRSG high energy drains.

Each HRSG is of the modular design, comprising approximately six modules, and is provided with easy access to valves and operators and other equipment requiring maintenance.

The Heat Recovery Steam Generator System is designed for the maximum possible combustion turbine exhaust gas flow.

The G machine HRSG nominal steam conditions are as follows:

High-Pressure Steam	602,400 lb/hr at 1,005 psig and 1,005°F
Intermediate-Pressure Steam	117,800 lb/hr at 91 psig and 404°F.
Low-Pressure Steam	Operates at 8 psig and saturation temperature (integral deaerator).

The F machine HRSG nominal steam conditions are as follows:

High-Pressure Steam	520,600 lb/hr at 1,006 psig and 1,005°F
Intermediate-Pressure Steam	71,153 lb/hr at 77 psig and 417°F.
Low-Pressure Steam	Operates at 8 psig and saturation temperature (integral deaerator).

2.2.4.5 Stack

There are nine steel shell combined cycle chimneys with an 18 ft inside diameter and 200-ft height. This study uses 200-ft height. A stack of the full 200-ft height is not necessary for meeting area concentrations, however Good Engineering Practice (GEP) is 200 ft. If the stack is less than GEP (200 ft), downwash modeling would have to be done before using the reduced height. One lined steel shell stack is used for each heat recovery steam generator unit. The system includes an access ladder, gas sampling platforms, and aviation warning lights.

2.2.4.7 Bypass Stack

The HRSG is provided with an inlet bypass stack and diverting damper at the inlet of the HRSG for start-up and emergency simple cycle operation. The bypass stack is approximately 85-100-feet tall due to the better dispersion at the elevated exhaust temperatures.

2.2.5 Steam Turbine-Generator

The Steam Turbine-Generator System consists of two turbines: high-pressure turbine and the low-pressure turbine-generator.

2.2.6 Cooling Water System

2.2.6.1 CT-HRSG Auxiliary Cooling Water System

The Auxiliary Cooling Water System provides cooling water to all the components in the new CT-HRSG power block which require water cooling. This includes for each CT-HRSG set:

- Combustion Turbine-Generator Hydrogen Cooler,
- Combustion Turbine Lube Oil Cooler,
- Combustion Turbine Electro-Hydraulic Control Oil Cooler,
- Boiler Feed Pump Lube Oil Cooler,
- Steam Cycle Sampling System Coolers, and
- CEMs Equipment Coolers.

A new 36 inch header would supply cooling water from the existing Essential Raw Cooling Water Headers located in the existing Auxiliary Building to the new CT-HRSG power block. The header would have two supply sources, the “A” ERCW header and the “B” header. Either of these sources can be open or isolated to the header which would provide redundancy to the cooling water system. At the power block, the single header would supply the individual cooling loads by a distribution piping system. The oil coolers and hydrogen coolers would have temperature control valve bypasses (provided by the equipment supplier) to maintain required setpoint temperatures. The heated water would be returned to the cooling tower basin by a new 36 inch header.

The full size supply and return headers would be installed with the initial power block construction phase. The following phases would only require extension of the header. Isolation valves would be provided at the end of the header during each phase of construction to allow the buildout without interruption of cooling water to equipment operating from the previous phases.

2.2.6.2 Turbine Building Auxiliary Cooling Water System

The auxiliary equipment requiring cooling in the existing Turbine Building would be cooled by the existing raw cooling water system. This system pumps condenser circulating water (CCW) from the CCW inlet duct just upstream of the main steam turbine condenser into the cooling water distribution piping system and returns the heated water to the CCW discharge duct, downstream from the main steam condenser outlet, for return to the cooling tower. No appreciable modification to this system would be required.

2.2.7 Improvements to Site

2.2.7.1 Site Arrangement

The suggested site arrangement for the Natural Gas Combined Cycle Plant is shown in Appendix B. The Civil-Structural features and work necessary to implement this arrangement are described in the sections that follow.

2.2.7.2 Site Preparation

The Combined Cycle Plant site is located in an area south of the existing cooling towers. The area slopes downward from east to west and was used as a construction laydown, storage, and parking area during construction of the nuclear plant. The site preparation work includes demolition and removal of the following:

Construction warehouses and storage buildings, including concrete slabs and underground utilities. Approximately 40 buildings are included.

- Desilting pond,
- Alum sludge ponds,
- Fencing,
- Clearing and grubbing of site areas, and
- Earthwork to provide a level stepped for the units.

Site Improvements

- The site improvements include the following new features,
- Asphalt roads and parking areas,
- Potable waterline,
- Natural gas pipeline,
- Soils exploration and underground voids detection,
- Grouting underground voids in rock,
- Sanitary sewer system connection to existing sewage treatment plant,
- Storm drainage system, including oil/water separators,
- Combustion turbine yard runoff pond/wastewater collection basin,
- Security fencing and gates,
- Crushed stone surfacing within the power block area, and
- Finish grading, seeding, mulching, and fertilizing.

3.0 Integrated Gasification Combined Cycle (IGCC)

3.1 Conversion Plan Description

Conversion consists of eight new integrated gasification combined cycle blocks that send steam to a new 1,800 rpm topping turbine and existing LP steam turbine generator. Coal is gasified in each of the gasification units. No. 2 fuel oil is the start-up fuel. The synthesis gas produced in each gasifier is cleaned of impurities and fired in advanced combustion turbine generators. Steam is generated and superheated in dedicated heat recovery steam generators, then expanded through the steam turbine.

An air separation plant is constructed for each gasifier to supply the pressurized 95% (by volume) oxygen required for the oxygen blown gasifiers. The air separation units receive part of their air from the combustion turbine compressors and return excess nitrogen to the combustion turbines for power augmentation and NO_x control.

New coal handling facilities for barge unloading of coal are constructed to deliver fuel to the gasification blocks. The existing Unit 2 cooling tower and circulating water systems are utilized for cycle heat rejection. The existing substations are augmented. A new auxiliary power system is constructed. A new Distributed Control System is constructed. A new slag storage area for gasifier solids is constructed.

3.1.1 Configuration

The IGCC power plant is composed of eight trains, each with an oxygen-blown Texaco entrained flow quench mode gasifier integrated with an “F” technology combustion turbine, followed by one heat recovery steam generator. Steam produced from the gasification train and HRSG is fed to the existing Bellefonte steam turbine to produce a net total of 1,951 MW. Raw gas exiting each gasifier is quenched in the bottom of the gasifier to an equilibrium temperature of 475°F, followed by convective coolers and knockout drums to reach a gas cleanup temperature of 105°F. Sulfur compounds are removed with a Dow Gas Spec selective amine process, then recovered as elemental sulfur from a Claus plant. The Claus plant is followed by a Beavon-Stretford tail gas treatment process.

3.1.1.1 Gasification

Each Texaco gasifier is a single stage, pressurized, down-flow entrained bed process featuring a water slurry feed, sized for a nominal throughput of 3,000 TPD as-received coal. Feed coal is finely ground (70% passing through 200 mesh), then slurried with enough water to make a 65% coal/35% water slurry (includes coal moisture). The coal/water slurry and 95% pure oxygen are then fed into a burner mounted at the top of the gasifier. The gasification reactions take place at approximately 2,700°F. No steam injection is required since the water in the slurry moderates the reaction. By maintaining the operating temperature above the ash fusion temperature of the coal, molten slag forms and coats the walls, then drains by gravity into a water-filled slag tank where it is quenched and shattered. Slag, suitable for landfill, is removed from the bottom of the gasifier through a water-sealed lock hopper. In the quench gasifer mode, hot raw gas leaving the gasifier is cooled and water quenched by passing downward through an annular water-flooded quench ring along with the slag where the equilibrium temperature of 450°F is reached. Following the quench, the gas temperature is cooled to 105°F in a convective cooler and condensed water is removed in knockout drums before entering the sulfur removal process.

3.1.1.2 Fuel Gas Cleaning and Sulfur Recovery

During this cooling, any NH_3 remaining in the fuel gas stream is condensed and sent to the waste water treatment section. No separate COS hydrolysis unit is needed since the Gas Spec solvent absorbs both COS and H_2S. The cool raw gas is routed to a counter-current absorber where it contacts the Gas Spec solvent. Approximately 99.4% of the H_2S is removed from the raw gas stream. Clean fuel gas then flows to the fuel gas preheater.

The Dow Gas Spec reduction process was selected because of its high selectivity towards H_2S over CO_2. This is needed for the desulfurization of fuel gases with the relatively high CO_2 concentrations produced by a Texaco gasifier. For the Gas Spec stripper, medium pressure steam (150 psia) is used to regenerate the Gas Spec solvent in a separate stripper column. The H_2S containing gas stream, or acid gas, is routed to the Claus Plant.

Elemental sulfur is produced from the separated H_2S in the sulfur recovery unit (Claus unit). The tail gas from the sulfur recovery unit, which contains three to five percent of the original sulfur removed by the Gas Spec solvent, is treated in a Beavon-Stretford tail gas treating unit. In the gas treating process, at least 90% of the remaining sulfur compounds are recovered, resulting in a total sulfur recovery of 99.5% based on the original sulfur removed in the acid gas removal unit. The only contaminants in the cleaned fuel gas leaving the acid gas removal unit are residual H_2S and HCN, both in very low concentrations.

3.1.1.3 Air Separation Unit

Each air separation plant is designed to produce a nominal output of 2,500 tons/day of 95% pure O_2. The high pressure plant is designed with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen.

The oxygen stream is produced in the air separation unit (ASU) from the combustion turbine compressed air supply (216 psia). Separation occurs in a “cold box” by means of cryogenic distillation. Prior to the distillation, water and CO_2 are removed by molecular sieves. Medium pressure steam (350 psia) is used to regenerate the molecular sieves.

The efficiency of the cycle is improved by using the combustion turbine compressor to supply part of the air to the ASU. The oxygen stream (95% purity) is compressed to 500 psia for usage in the gasifier. The remaining nitrogen stream from the ASU is compressed (using intercooling) and fed to the combustion turbine burners to reduce NO_x emission, as well as providing additional gas flow.

3.1.1.4 Combustion Turbine

Three types of “F-Technology” combustion turbines are available in this size range: The ABB GT-24; the General Electric MS7231FA; and the Westinghouse W501-F. All three vendors are involved in the U.S. DOE Advanced Turbine Systems (ATS) program. Vendor estimates of capital costs of the General Electric and Westinghouse turbines in this class are equivalent to within 6 percent, with the cost of the ABB machine being slightly higher. Westinghouse is currently testing medium-Btu combustors for use with advanced pressurized fluidized bed combustion (PFBC) systems. However, General Electric Frame

MS7231FA combustion turbines have been used in the most IGCC applications, and have been selected for this application as well.

3.1.1.5 Steam Recovery and Generation

The only steam generated from the quenched gas path is low pressure steam which is integrated with feed to the existing Bellefonte steam turbine. High pressure steam is generated in a HRSG.

The Steam Turbine-Generator System consists of two turbines: high-pressure turbine and the low-pressure turbine-generator. The high-pressure (HP) turbine receives steam from the HRSG HP superheater outlets via the HP steam piping. The new HP turbine replaces the existing HP turbine to accommodate the following nominal steam conditions:

- Throttle Temperature--1,000°F.
- Throttle Pressure--1215 psia.
- Exhaust pressure--67 psia.

The low-pressure (LP) turbine generator consists of existing Unit 2, which is one of two existing ABB tandem compound 1,800 rpm double flow low-pressure (LP) turbines located in the existing Turbine Building. In addition, a 1,800 rpm hydrogen cooled generator, capable of an output of 1,314 MW, is existing and is reused. Both LP sections would be needed to handle the steam flow.

3.2 Design Criteria

The systems, components, and structures constituting the converted Bellefonte Unit 2 station are further described in this section. This section states the design criteria established by TVA to direct conceptual design for the IGCC Option. The resultant design is then described by functional areas within the power plant.

3.2.1 Design Basis

The Design Basis for this conceptual study is presented in three groups: plant design criteria, site characteristics, and emission limits. Site characteristics and emission limits are listed in Section 4. Plant design criteria for this conversion option are listed below.

- Convert Bellefonte Unit 2 only, and preserve as much of Unit 1 as possible. The Unit 2 design should accommodate provisions for converting of Unit 1.
- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Transmission system limitation is 2,400 MW at 104°F and 115% of 2,400 MW (2,760 MW) at 32°F with the replacement of two power circuit breakers at the Madison Substation. To meet the 2,400 MW limitation under all temperature conditions, the combustion turbine combined cycle plant would be limited to a nominal net capacity of 2,400 MW at performance rating conditions of 59°F.
- Advanced (“F”) technology combustion turbines, with 2350+ °F firing temperature are used as the basis for conceptual design.
- The existing steam turbine bypass system passes approximately 7.3 million lb/hr of steam at 1029.7 psia or 1015 psig and 630°F. Therefore, upon loss of the high-pressure or low-pressure steam turbine, steam from the HRSGs may be attemperated and dumped to the main condenser up to this maximum flow rate. This arrangement permits all combustion turbine capacity to be maintained (using the steam bypass system) upon a trip of the high-pressure or low-pressure steam turbine.
- Oil storage capacity allows for simple cycle operation of the combustion turbine during startup, which is conservatively assumed to be 24 hours.
- Coal is delivered either by barge or, if necessary, by barge and rail. The unloading facility should accommodate 12 barges.
- Selective catalytic reduction (SCR) is not included. Space is provided for possible retrofit at a later date.
- Design capacity factor is 85% for IGCC and 90 percent for chemical coproduction.
- The IGCC is installed in four phases of approximately equal generating capacity, with approximately 9 months between phases.
- If the flows from all gasifiers or all combustion turbines need to be combined into a single header, the header is sized to accommodate the final flows for the complete 2,400-MW plant.
- Design complies with TVA Occupational Health and Safety Design Requirements released March 1994.
- Sound level does not exceed OSHA standards for unlimited exposure with attenuation.
- A Distributed Control System is used.
- No asbestos is utilized.
- The coal specified for the study is Modified Illinois No. 6, the ultimate analysis of which is shown in Table 3.1-1.

Table 3.1-1 Modified Illinois No. 6 Ultimate Analysis

Constituent	**As Received**	**Dry**
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

3.2.2 Coal Handling

The Modified Illinois No. 6 bituminous coal is delivered to the site by barges measuring 35 ft x 195 ft. The 2" x 0 coal is discharged from the barge unloader onto a belt conveyor to the reclaim area. The conveyor passes under a magnetic plate separator to remove tramp iron, and then on to the reclaim pile. Coal from the reclaim pile is fed by two vibratory feeders, located under the pile, onto a reclaim conveyor which conveys the reclaimed coal to the crusher surge bin. The crusher surge bin with two isolation gates and variable rate feeders, feed coal into either of two crushers. The coal is reduced in size to 1" x 0 in the crushers, and then passed through flop gates onto two belt conveyors which transport the coal to the transfer tower. Two additional conveyors continue the transport of the coal to the top of the coal silos.

The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at 8 hours per day, 5 days per week,
- Coal reclaim operation at 8 hours per day, 7 days per week (56 hours per week),
- 30 days of total coal storage (excluding the silos),
- 3 days of live coal storage (excluding the silos), and
- 16 hours of storage in the silos.

Coal Handling Requirements and Design Basis (8 gasifiers)

- Coal Burn Rate,
- Maximum Coal Burn Rate = 1,988,592 lb/hr = 994 tph plus 10% margin = 1,094 tph ,
- (based on the 100% MCR rating for the plant, plus 10% design margin),
- Average Coal Burn Rate = 1,859,334 lb/hr = 930 tph,
- (based on MCR Rate multiplied by an assumed capacity factor) ,
- Coal Delivered to the Plant by Barge,
- Conveying Rate to Storage Piles = 3,905 tph (maximum, both conveyors in operation) ,
- Reclaim Rate = 3,905 tph,
- Storage Piles with liners, Run-off Collection, and Treatment Systems,
- Live Storage = 78,748 tons (72 hours at maximum burn rate), and
- Dead Storage = 669,360 tons (30 days at average burn rate).

The conceptual design for this area includes the new equipment and systems listed below.
- New coal receive & unload,
- New coal stackout & reclaim,
- New coal conveyors & yard crush,
- New other coal handling, and
- New Coal Handling Foundations.

3.2.3 Coal Preparation and Feed

After crushing, a conveyor delivers the Modified Illinois No. 6 coal to the rod mill feed hopper which provides a surge capacity of about six hours of downstream throughput. A vibrating feeder supplies the weigh feeder which in turn feeds the rod mill.

The rod mill grinds the coal to 200 mesh and wets it with treated slurry water from a slurry water tank. The slurry is then pumped from the rod mill product tank to slurry storage and slurry blending tanks, then fed to the pressurized Texaco gasifier.

The coal grinding and conveying systems are equipped with a dust suppression system consisting of water sprays aided by a wetting agent. The degree of dust suppression required would depend on local environmental regulations.

The slurry feed pump takes suction from the slurry run tank in the coal slurry section. The slurry feed pump discharge is sent to the feed injector. During preparation for start-up, the coal feed is diverted back to the slurry run tank. Oxygen from the air separation unit is vented during preparation for start-up and is sent to the feed injector during normal operation.

The conceptual design for this area includes the new equipment and systems listed below.

- New Coal Crushing,
- New Coal Conveyor and Storage,
- New Coal Injection System
- New Misc. Coal Prep and Feed,
- New Booster Air Supply System, and
- New Coal Feed Foundation

3.2.4 Gasifier and Accessories

Modified Illinois No. 6 coal is ground to 200 mesh and mixed with water and fed as a slurry to eight new pressurized Texaco oxygen-blown gasifiers. The slurry is fired with oxygen to produce medium Btu gas consisting mainly of CO, H_2, and CO_2. The gas is quench cooled to 400°F.

The gasifiers have the following features:

- Operating pressure of 480 psig.

- Partial integration with air separation unit (ASU). Part of the air into the ASU is supplied by the combustion turbine compressor, oxygen from the ASU is fed to the gasifier, and nitrogen from the ASU is forwarded to the combustion turbine combustors.
- Hot gas quench to 400°F
- Water wash to remove NH_3 and HCN
- Hydrolysis to convert COS to H_2S
- Selective chemical amine acid gas removal to remove H_2S, which is then concentrated and converted to elemental sulfur in a Claus plant.

The eight new air separation plants are designed to produce a nominal output of 19,551 ton/day of 95% pure O_2. Each gasifier train is designed with one full-capacity production train, with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen.

3.2.5 HRSG, Ducting and Stack

3.2.5.1 HRSG

Each of the heat recovery steam generators is a drum type, triple pressure design that is matched to the characteristics of GE MS7231FA exhaust gas when firing coal gas. The HRSGs are flat bottom, natural circulation, bottom supported units equipped with inlet and outlet ductwork, insulation and architectural lagging, bypass stack, diverting damper and exhaust stack. All heat transfer in the steam generator is accomplished by convection through banks of finned tubes.

Major equipment supplied with the HRSG include an integral deaerator (LP steam drum), preheater, and LP evaporator; an IP economizer, IP steam drum with IP evaporator, an IP superheater; an HP economizer, an HP steam drum with HP evaporator, and an HP superheater.

3.2.5.2 Stack

There are 4 lined steel shell chimneys, 22 ft inside diameter and 325-feet high. One lined steel shell chimney is used for each two heat recovery steam generator units.

3.2.5.3 Bypass Stack

The HRSG is provided with an inlet bypass stack and diverting damper at the inlet of the HRSG for start-up and emergency simple cycle operation. The bypass stack would be between 85 and 100-feet high.

3.2.6 Cooling Water System

3.2.6.1 CT-HRSG Auxiliary Cooling Water System

The auxiliary cooling water system provides cooling water to all the components in the new CT-HRSG power block which require water cooling. This includes for each CT-HRSG set:

- Combustion Turbine Generator Hydrogen Cooler
- Combustion Turbine Lube Oil Cooler
- Combustion Turbine Electro-Hydraulic Control Oil Cooler
- Boiler Feed Pump Lube Oil Cooler
- Steam Cycle and Feedwater Sampling System Coolers

A new 36” header would supply cooling water from the existing essential raw cooling water headers located in the existing auxiliary building to the new CT-HRSG power block. The header would have two supply sources, the “A” ERCW header and the “B” header. Either of these sources can be open or isolated to the header which would provide redundancy to the cooling water system. At the power block, the single header would supply the individual cooling loads by a distribution piping system. The oil coolers and hydrogen coolers would have temperature control valve bypasses (provided by the equipment supplier) to maintain required setpoint temperatures. The heated water would be returned to the cooling tower basin by a new 36 inch header.

The full size supply and return headers would be installed with the initial power block construction phase. The following phases would only require extension of the header. Isolation valves would be provided at the end of the header during each phase of construction to allow the buildout without interruption of cooling water to equipment operating from the previous phases.

3.2.6.2 Turbine Building Auxiliary Cooling Water System

The auxiliary equipment requiring cooling in the existing turbine building would be cooled by the existing raw cooling water system. This system pumps condenser circulating water (CCW) from the CCW inlet duct just upstream of the main steam turbine condenser into the cooling water distribution piping system and returns the heated water to the CCW discharge duct, downstream from the main steam condenser outlet, for return to the cooling tower. No appreciable modification to this system would be required.

3.2.7 Ash Handling System

The ash handling system conveys, stores and disposes of ash removed from the gasification process. The ash is removed from the process as slag.

Spent material drains from the gasifier bed into a slag quench vessel, and then through a lock hopper system to let down the pressure to atmospheric. The cooled, solidified slag is stored in a storage hopper. The hopper is sized for a nominal holdup capacity of 3,937 tons, which represents about 36 hours of full load operation.

Ash would be stored on site. The ash handling system removes ungasified solids from the gasification process equipment. These solids are made up from the ash and unconverted coal components, primarily carbon and glass encapsulated metals, that exit the gasifier in the solid phase.

4.0 IGCC with Chemical Coproduction (IGCC/C)

4.1 Candidate Chemicals and Markets

TVA and their consultants conducted a market assessment to compile a list of products and prices for coproduction. The analysis consists of two phases: an initial screening of the complete list of products, including year 2001 prices; and, upon selection of the final list, a full market analysis of the remaining products including price forecasts through 2020.

Price forecasts, screening criteria, and suggestions of chemicals to select or reject for further consideration were developed by consultants. TVA combined their analyses to arrive at Year 2001 price forecasts for all 24 chemicals and the selection of coproduct chemicals for more detailed analysis.

Selection criteria included:

- Growth rates greater than two percent.
- Potential market size great enough for world scale facility.
- Relatively low cost raw materials.

The selected chemicals and the rationale for their selection is presented in Table 4.1-1:

Table 4.1-1 Rationale for Selection of Chemicals

Acetic Acid	High growth rate, but a joint venture with a chemical company to use to avoid marketing risks would be necessary.
Ammonia	The Bellefonte location may be advantageous for supplying it as fertilizer for rice crops.
Carbon Dioxide	Production of this chemical would be dependent on economics of other coproducts.
Formaldehyde	High growth rate of two to three percent.
Methanol	High growth rate of 2.6 percent and the variable costs are very dependent on the input energy costs.
Urea	High growth rate of 2.5 percent.
Methyl Tertiary Butyl Ether (MTBE)	High growth rate depends on oxygenate fuel policy

The chemicals selected fall into two major classes, agricultural chemicals and the methanol based chemicals. The agricultural chemicals (ammonia and urea), are manufactured by first shifting the syngas to hydrogen. The methanol based chemicals, (methanol, formaldehyde, acetic acid, MTBE) require that methanol be made from the syngas. CO_2 can be recovered as a byproduct from both types of processes.

4.2 Definition of Cases

For the seven chemicals selected, nineteen different cases were analyzed and a profitability index calculated for each.

1a. Syngas to Ammonia with N_2 from the Air Separation Unit,
1b. Syngas to Ammonia with N_2 from the Air Separation Unit, CO_2 byproduct,
2a. Syngas to Ammonia to Urea with CO_2 recovery for Urea,
2b. Syngas to Ammonia to Urea with CO_2 recovery for Urea, CO_2 byproduct,
2c. Syngas to Ammonia and Urea with CO_2 recovery for Urea,
2d. Syngas to Ammonia and Urea with CO_2 recovery for Urea, CO_2 byproduct,
2e. Syngas to Ammonia and Urea with CO_2 for Urea and a CO_2 byproduct,one gasifier,
3a. Syngas to Methanol via vapor phase,
3b. Syngas to Methanol via vapor phase, CO_2 byproduct,
4a.. Syngas to Methanol via liquid phase, and
4b. Syngas to Methanol via liquid phase and $CO_{2.}$

Using the liquid phase methanol route abov:e
5. Syngas to Methanol to Formaldehyde,
6a. Syngas to Methanol and Formaldehyde,
6b. Syngas to Methanol and Formaldehyde and $CO_{2,}$
7. Syngas to Methanol to Acetic Acid,
8a. Syngas to Methanol and Acetic Acid,,
8b. Syngas to Methanol and Acetic Acid and CO_2
10a. Mixed Liquid Phase Alcohols to MTBE and Methanol, and
10b. Mixed Liquid Phase Alcohols to MTBE and Methanol and $CO_{2.}$

Cases 1a and 1b produce ammonia with and without CO_2 recovered as a byproduct utilizing nitrogen from the air separation unit. Cases 2a and 2b utilize ammonia as a feedstock to produce urea with and without CO_2 recovery. Cases 2c and 2d produce both ammonia and urea. Case 2e reduced the ammonia production to below TVA's projected market allowing the plant to operate with one coal gasification unit.

Cases 3a and 3b produce methanol by the conventional vapor phase reaction process again with and without CO_2 recovery. Cases 4a and 4b utilize the soon to be commercially demonstrated liquid phase methanol process. Because of the lower capital requirements and its potential to be integrated with an IGCC power plant, this process was selected for the methanol based chemical cases.

Case 5 utilizes methanol as a feedstock to produce formaldehyde. Cases 6a and 6b produce both methanol and formaldehyde with and without CO_2 recovery. Case 7 utilizes methanol as a feedstock to produce acetic acid. Cases 8a and 8b produce both methanol and acetic acid with and without CO_2 recovery. The CO utilized in the acetic acid synthesis is recovered from the syngas.

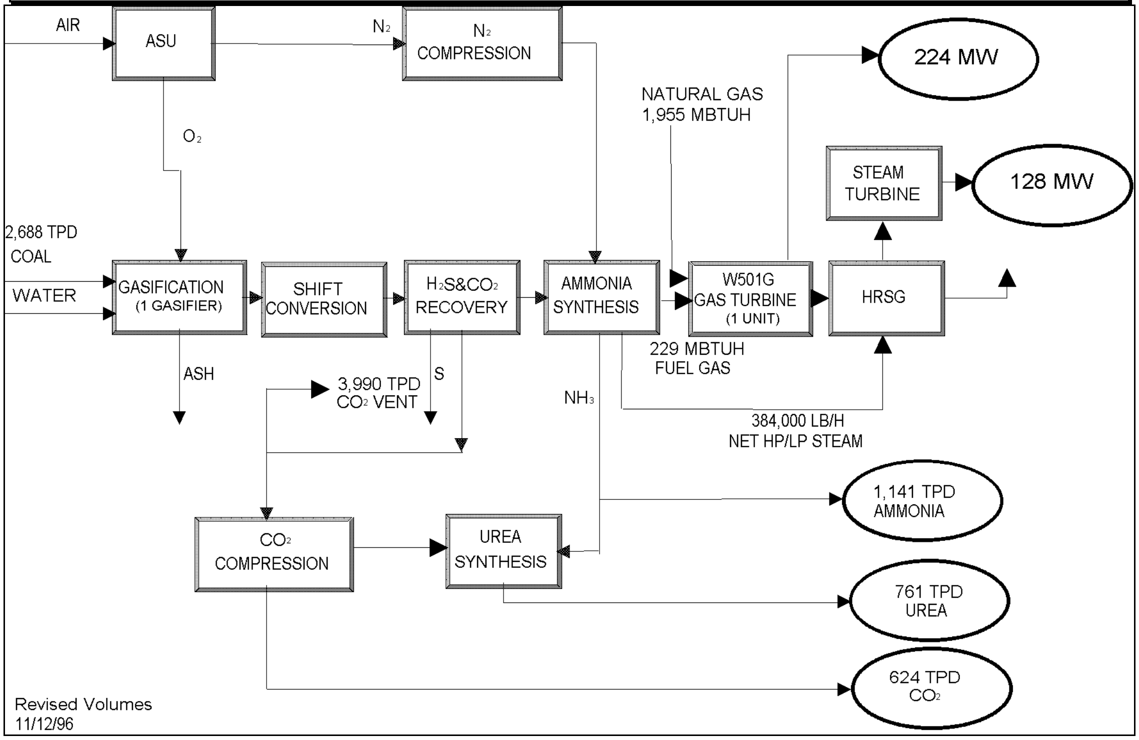
Cases 10a and 10b assume a variation of the liquid phase methanol process which is under development. This process produces mixed alcohols. Methanol and isobutanol are separated and utilized as a feedstock to produce MTBE.

4.3 Coproduction Design Basis

The design basis for the gasification and power generation systems involved in IGCC coproduction is similar to that for IGCC. Refer to the description presented earlier in this appendix (for IGCC) for more detailed information about those systems and design assumptions.

Converting the Bellefonte Nuclear Plant with IGCC and the coproduction of chemical products is a potential option. Case 2e was selected as the IGCC with chemical coproduction option. Under this scenario, the coproduct plant is assumed to consist of one gasifier providing syngas to fuel the coproduct facility and, with supplemental natural gas, a “G” technology combustion turbine. The facility would be able to generate approximately 287 net MW (352 gross MW) with the capability to produce ammonia, urea and CO_2. Figure 4-1 shows a block flow diagram of this option. The coproduct facility is assumed to be sited at Bellefonte and as such, existing facilities would be utilized.

Figure 4-1 Case 2e - Syngas to Maximun Urea, Ammonia to Match One Gasifier and CO_2 Byproduct Integrated for Power



4.4 Design Criteria

4.4.1 Design Basis

Converting the Bellefonte Nuclear Plant with IGCC and the coproduction of chemical products is a potential option. A screening study identified agricultural chemicals as the most promising coproducts.

Under this scenario, the coproduct plant is assumed to consist of one 2,688 TPD (as received) gasifier providing syngas to fuel the coproduct facility and, with supplemental natural gas, a Westinghouse “G” technology combustion turbine. The facility would be able to generate approximately 287 net MW with the capability to produce 1,141 TPD ammonia and 761 TPD of urea.

The coproduct facility was assumed to be a stand alone plant with its own steam turbine. It was assumed to be sited at Bellefonte and as such, existing facilities would be utilized. Therefore, the conceptual design generated for the coproduct plant reflected the use of existing Bellefonte facilities. Plant design criteria for this conversion option are listed below.

- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Advanced Westinghouse “G” technology combustion turbines are used as the basis for conceptual design and cost estimate.
- A new steam turbine would be used for this combined cycle facility.
- Natural gas allows for simple cycle operation of the gas turbine during startup, which is conservatively assumed to be 24 hours.
- Coal is delivered by barge. The unloading facility should accommodate several barges for the coproduction plant. Rail facilities would be provided for the sale of sulfur.
- Selective catalytic reduction (SCR) is not included. A best available control technology is required to determine whether SCR is ultimately required. Space is provided for possible retrofit at a later date.
- Design capacity factor is 90 percent for chemical coproduction.
- Design complies with TVA <u>Occupational Health and Safety Design</u> <u>Requirements</u> released March 1994.
- Sound level does not exceed OSHA standards for unlimited exposure with attenuation.
- A Distributed Control System is used.
- No asbestos is utilized.
- The coal specified for the study is Modified Illinois No. 6, the ultimate analysis of which is shown in Table 4.4-2.

Table 4.4-2 Modified Illinois No. 6 Ultimate Analysis

Constituent	**As Received**	**Dry**
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

4.4.2 Coal Handling

The Modified Illinois No. 6 bituminous coal is delivered to the site by barges as previously described.

The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at eight hours per day, five days per week
- Coal reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total coal storage (excluding the silos)
- Three days of live coal storage (excluding the silos)
- 16 hours of storage in the silos

Coal Handling Requirements and Design Basis (one gasifier)

- Coal Burn Rate
- Maximum Coal Burn Rate = 224,000 lb/h = 112 tph plus 10% margin = 123 tph
- (based on the 100% MCR rating for the plant, plus 10% design margin)
- Average Coal Burn Rate = 221,760 lb/h = 111 tph
- (based on MCR Rate multiplied by an assumed capacity factor)
- Coal Delivered to the Plant by Barge
- Conveying Rate to Storage Piles = 466 tph (maximum, one conveyor in operation)
- Reclaim Rate = 466 tph
- Storage Piles with liners, Run-off Collection, and Treatment Systems:
- Active Storage = 8,870 tons (72 hours at maximum burn rate)
- Dead Storage = 79,834 tons (30 days at average burn rate)

4.4.3 Coal Preparation and Feed

After crushing, a conveyor delivers the Modified Illinois No. 6 coal to the rod mill feedhopper which provides a surge capacity of about six hours of downstream throughput. A vibrating feeder supplies the weigh feeder which in turn feeds the rod mill. The rod mill grinds the coal and wets it with treated slurry water from a slurry water tank. The slurry is then pumped from the rod mill product tank to slurry storage and slurry blending tanks.

The coal grinding and conveying systems are equipped with a dust suppression system consisting of water sprays aided by a wetting agent. The degree of dust suppression required would depend on local environmental regulations.

4.4.4 Gasifier and Accessories

One Texaco quench gasifier is utilized for IGCC/Coproduction. The gasifier operating characteristics are identical to that described in Section 4.2.

The gasifier is one new Texaco oxygen-blown gasifier with hot gas quench and with the following features:

- Operating pressure of 970 psig.
- No operational integration with air separation unit (ASU). Air for the ASU is supplied by a dedicated compressor, oxygen (95%) from the ASU is fed to the gasifier, and nitrogen from the ASU is forwarded to the ammonia plant.
- Hot gas quench to 450°F
- Water wash to remove NH_3 and HCN

- Rectisol acid gas removal to remove H_2S and CO_2. H_2S is then concentrated and converted to elemental sulfur in a Claus plant. CO_2 is either compressed and stored as a liquid product or vrnted off site.

The new air separation plant is designed to produce a nominal output of 2,500 ton/day of 95% pure O_2 with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen. For the purposes of this conceptual design, the air compressor in each train is powered by an electric motor.

4.4.5 Syngas Cleanup and Synthesis

4.4.5.1 Shift Reactors

Maximum conversion to CO_2 is achieved by utilizing a high, intermediate and low temperature shift reactor in series. For this application, a sulfided Cobalt/Molybderrum catalyst is utilized which is sulfur compatible and has a relatively high activity over the range of 390°F to 890°F. The presence of H_2S suppresses carbon formation, thereby reducing the steam requirement. The shift catalyst also promotes COS hydrolysis. Following the low temperature shift reactor, the fuel gas is cooled before being fed to the Rectisol unit. During this cooling, part of the water vapor condenses. This water is sent to the water treatment plant.

4.4.5.2 Acid Gas Removal

Rectisol was selected because of its high selectivity toward both H_2S and CO_2 when operated in a two-stage mode which is needed for the desulfurization of fuel gases with relative high CO_2 concentrations as produced during the shift reaction. For the Rectisol stripper, medium pressure-steam is used to liberate the acid gas from the Rectisol solvent.

The fuel gas is cleaned in a dual column Rectisol unit consisting of two packed bed absorbers. The first column removes most of the H_2S (99.4%) and a small fraction of the CO_2. The second column removes the greater portion of the CO_2. Because of the two column arrangement, H_2S and CO_2 leave the Rectisol unit in separate streams. In this unit the fuel gas is counter-currently contacted with Rectisol solvent in a packed bed absorber. Acid gas scrubbing is necessary in order to meet the required H_2S concentration in the cleaned coal gas and to recover CO_2. To ensure complete removal of CO_2 and H_2O from the syngas, a final wash with liquid N_2 is conducted.

From the separated H_2S, elemental sulfur is produced in the sulfur recovery unit (Claus unit). The tail gas from the sulfur recovery unit, which contains three to five percent of the original sulfur removed in the acid gas removal unit, is treated in a Beavon-Stretford tail gas treating unit. In the Beavon-Stretford tail gas treating process at least 90% of the remaining sulfur compounds are recovered, resulting in a total sulfur recovery of 99.5% based on the original sulfur removed in the acid gas removal unit.

Also needed are provisions for:

- Ammonia Transfer and Storage - Ammonia is stored as a pressurized refrigerated liquid in large spherical tanks (Horton spheres). When the ammonia market is favorable, these storage tanks would be used as a shipping buffer to hold several hours of production. When the ammonia market is unfavorable, the process is altered and ammonia is neither produced nor stored. The nominal ammonia production rate is about 1,200 tons (60,000 liquid cubic feet) per day.
- Urea Transfer and Storage - Urea is prilled and stored as a solid. When the urea market is favorable, the storage area would be used as a shipping buffer to hold several hours of production. When the urea market is unfavorable, the process is altered and urea is neither produced nor stored. The nominal urea production rate is about 750 tons (25,000 cubic feet) per day.
- CO_2 Transfer and Storage - CO_2 can be stored as a pressurized liquid in cylindrical pressurized storage tanks. In view of the continuous supply of CO_2 stream available from the syngas, CO_2 storage is not deemed necessary. When the CO_2 market is unfavorable, the CO_2 is vented to the atmosphere. The nominal CO_2 production rate is about 680 tons per day.
- Sulfur Transfer and Storage - Sulfur is a benign solid that can be stored on site. When the sulfur market is favorable, sulfur is stored as a liquid in heated storage tanks as a shipping buffer to hold several hours of production. When the sulfur market is unfavorable, the process is altered and sulfur is solidified and stored as a solid. The nominal sulfur production rate is about 82 tons per day, having a bulk volume of about 2,000 cubic feet.
- Ammonia Loading Facilities
- Urea Loading Facilities
- CO_2 Loading Facilities
- Sulfur Loading Facilities

4.5 Ash Handling System

The ash handling system conveys, stores and disposes of ash removed from the gasification process. The ash is removed from the process as slag.

Spent material drains from the gasifier bed into a slag quench vessel, and then through a lock hopper system to let down the pressure to atmospheric. The cooled, solidified slag is stored in a storage hopper. The hopper is sized for a nominal holdup capacity of 450 tons, which represents about 36 hours of full load operation.

Ash would be stored on site.

Appendix B ¾ SITE DRAWINGS

Pulverized Coal Combustion Units (PC)
Natural Gas Combined Cycle Units (NGCC)
Integrated Gasification Combined Cycle Units (IGCC)
Integrated Gasification Combined Cycle Units with Chemical Coproduction (IGCC/C)
Integrated Gasificatio Combined Cycle Unit, Natural Gas Combined Cycle Units with Chemical Coproduction (Combination)
Bellefonte SPCC Drawing
Bellefonte Environmental Features
Combustion Waste Disposal Sites for PC

Appendix C ¾ Employee Estimates for Each Conversion Option

Employment for Each Option

Conversion Option	Option 1 Totals Pulverized Coal				Option 2 Totals Natural Gas Combined Cycle			
	Const.	EPC	Op & Maint.	Total Manpower	Const.	EPC	Op & Maint	Total Manpower
FY1998	-	-	-	-	-	-	-	-
2nd Quarter	16	-	10	26	30	-	10	40
3rd Quarter	16	-	10	26	30	-	10	40
4th Quarter	108	10	20	138	45	5	25	75
FY1999	159	25	20	204	90	10	25	125
2nd Quarter	331	25	40	396	205	10	25	240
3rd Quarter	679	25	50	754	255	15	25	295
4th Quarter	948	35	70	1,053	280	20	25	325
FY2000	918	50	80	1,048	305	20	35	360
2nd Quarter	998	50	103	1,151	330	25	55	410
3rd Quarter	1,006	50	123	1,179	330	30	65	425
4th Quarter	960	45	133	1,138	330	25	75	430
FY2001	917	45	153	1,115	345	30	75	450
2nd Quarter	826	50	165	1,041	330	30	75	435
3rd Quarter	658	50	185	893	330	25	85	440
4th Quarter	783	45	195	1,023	345	30	105	480
FY2002	998	45	215	1,258	330	30	115	475
2nd Quarter	918	50	225	1,193	330	25	125	480
3rd Quarter	1,014	50	258	1,322	345	30	125	500
4th Quarter	1,006	50	268	1,324	330	30	125	485
FY2003	1,052	55	288	1,395	330	25	135	490
2nd Quarter	968	60	298	1,326	345	30	155	530
3rd Quarter	998	50	330	1,378	330	30	165	525
4th Quarter	1,006	50	340	1,396	330	25	175	530
FY2004	1,052	55	360	1,467	345	30	175	550
2nd Quarter	968	60	370	1,398	330	30	175	535
3rd Quarter	1,014	50	403	1,467	300	25	175	500
4th Quarter	1,006	50	413	1,469	300	25	180	505
FY2005	1,052	55	433	1,540	240	20	190	450
2nd Quarter	968	60	443	1,471	125	15	200	340
3rd Quarter	998	50	475	1,523	90	15	200	305
4th Quarter	1,006	50	485	1,541	50	10	200	260
FY2006	1,052	55	505	1,612	25	5	200	230
2nd Quarter	968	60	515	1,543	15	5	200	220
3rd Quarter	998	50	538	1,586	-	-	200	200
4th Quarter	990	50	548	1,588	-	-	200	200
FY2007	944	45	558	1,547	-	-	200	200
2nd Quarter	809	35	568	1,412	-	-	200	200
3rd Quarter	666	25	580	1,271	-	-	200	200
4th Quarter	327	25	580	932	-	-	200	200
FY2008	104	20	580	704	-	-	200	200
2nd Quarter	50	10	580	640	-	-	200	200
3rd Quarter	-	-	580	580	-	-	200	200
4th Quarter	-	-	580	580	-	-	200	200

Employment for Each Option (Cont'd)

Conversion Option	Option 3 Totals **Integrated Gasification Combined Cycle**				Option 4 Totals **IGCC/C**			
	Const.	**EPC**	**Op & Maint**	**Total Manpower**	**Const.**	**EPC**	**Op & Maint**	**Total Manpower**
FY1998	-	-	-	-	-	-	-	-
2nd Quarter	50	-	10	60	50	-	10	60
3rd Quarter	50	-	10	60	50	-	10	60
4th Quarter	180	15	25	220	180	15	25	220
FY1999	289	35	35	359	289	35	35	359
2nd Quarter	589	35	35	659	589	35	35	659
3rd Quarter	1,089	35	35	1,159	1,059	35	35	1,129
4th Quarter	1,420	50	35	1,505	1,290	45	35	1,370
FY2000	1,338	70	45	1,453	1,244	60	45	1,349
2nd Quarter	1,497	70	140	1,707	1,498	90	140	1,728
3rd Quarter	1,548	70	150	1,768	1,589	90	145	1,824
4th Quarter	1,575	75	175	1,825	1,430	100	155	1,685
FY2001	1,353	75	195	1,623	1,749	110	180	2,039
2nd Quarter	1,497	70	285	1,852	2,089	135	340	2,564
3rd Quarter	1,548	70	195	1,813	2,419	130	250	2,799
4th Quarter	1,575	75	195	1,845	2,160	85	250	2,495
FY2002	1,353	75	205	1,633	2,439	100	260	2,799
2nd Quarter	1,497	70	300	1,867	2,418	130	350	2,898
3rd Quarter	1,548	70	310	1,928	1,909	125	355	2,389
4th Quarter	1,575	75	335	1,985	1,130	70	365	1,565
FY2003	1,353	75	355	1,783	1,250	50	380	1,680
2nd Quarter	1,497	70	445	2,012	1,000	50	520	1,570
3rd Quarter	1,548	70	355	1,973	500	50	430	980
4th Quarter	1,575	75	355	2,005	-	-	430	430
FY2004	1,353	75	365	1,793	-	-	430	430
2nd Quarter	1,497	70	460	2,027	-	-	430	430
3rd Quarter	1,548	70	470	2,088	-	-	430	430
4th Quarter	1,575	75	495	2,145	-	-	430	430
FY2005	1,353	75	505	1,933	-	-	430	430
2nd Quarter	1,497	70	595	2,162	-	-	430	430
3rd Quarter	1,548	70	505	2,123	-	-	430	430
4th Quarter	1,575	75	505	2,155	-	-	430	430
FY2006	1,353	75	505	1,933	-	-	430	430
2nd Quarter	1,497	70	510	2,077	-	-	430	430
3rd Quarter	1,498	70	510	2,078	-	-	430	430
4th Quarter	1,395	60	520	1,975	-	-	430	430
FY2007	1,064	40	520	1,624	-	-	430	430
2nd Quarter	908	35	530	1,473	-	-	430	430
3rd Quarter	459	35	530	1,024	-	-	430	430
4th Quarter	155	25	530	710	-	-	430	430
FY2008	15	5	530	550	-	-	430	430
2nd Quarter	-	-	530	530	-	-	430	430
3rd Quarter	-	-	530	530	-	-	430	430
4th Quarter	-	-	530	530	-	-	430	430

Employment Estimates for Each Option (Cont'd)

	Option 5 Totals Combination			
Conversion Option	**Const.**	**EPC**	**Op & Maint**	**Total Manpower**
FY1998	-	-	-	-
2nd Quarter	30	-	10	40
3rd Quarter	30	-	10	40
4th Quarter	45	5	25	75
FY1999	140	10	35	185
2nd Quarter	225	10	35	270
3rd Quarter	390	25	50	465
4th Quarter	479	45	60	584
FY2000	689	45	60	794
2nd Quarter	1,154	45	60	1,259
3rd Quarter	1,475	65	60	1,600
4th Quarter	1,468	90	70	1,628
FY2001	1,927	120	165	2,212
2nd Quarter	2,418	115	170	2,703
3rd Quarter	2,480	125	180	2,785
4th Quarter	2,698	135	205	3,038
FY2002	2,922	160	365	3,447
2nd Quarter	2,848	155	275	3,278
3rd Quarter	2,425	115	275	2,815
4th Quarter	2,638	125	285	3,048
FY2003	2,832	155	375	3,362
2nd Quarter	2,738	150	380	3,268
3rd Quarter	2,180	95	390	2,665
4th Quarter	2,229	75	405	2,709
FY2004	1,878	80	545	2,503
2nd Quarter	999	85	455	1,539
3rd Quarter	365	30	465	860
4th Quarter	300	20	485	805
FY2005	370	30	495	895
2nd Quarter	480	30	505	1,015
3rd Quarter	540	35	505	1,080
4th Quarter	520	40	545	1,105
FY2006	430	35	555	1,020
2nd Quarter	420	40	575	1,035
3rd Quarter	380	40	585	1,005
4th Quarter	355	30	595	980
FY2007	360	35	605	1,000
2nd Quarter	330	30	605	965
3rd Quarter	300	25	605	930
4th Quarter	300	25	610	935
FY2008	240	20	620	880
2nd Quarter	125	15	630	770
3rd Quarter	90	15	640	745
4th Quarter	50	10	640	700
FY2009	25	5	640	670
2nd Quarter	15	5	640	660
3rd Quarter	-	-	640	640
4th Quarter	-	-	640	640

Appendix D ¾ Properties of Coproduction Chemicals

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Acetaldehyde	CH_3CHO	Color liquid or gas with a pungent fruity odor	Suspect Carcinogen OSHA (200)	MW: 44.1 BP: 69 F SOL: Miscible Fl.P. -36F IP: 10.22 eV Sp.Gr.: 0.79 VP: 740MM FRZ:-190F UEL: 60% LEL: 4.0%	Class IA Flammable Liquid	**eyes**, skin, resp sys, CNS, **repro sys**	manufacture of acetic acid and acetic anhydride, n-butanol, 2-ehtylhexanol, peracetic acid, aldol, pentaerythritol, pyridines, chloral, 1,3 bu-tylene glycol, and trimethylolpropane; synthetic flavors
Acetic Acid - Glacial - 99.8 %	CH_3COOH	Colorless liquid or crystals with sour, vinegar like odor	10 ppm STEL 15 ppm, OSHA 10 ppm	MW: 60.1 BP: 244 F SOL: Miscible Fl.P.: 103F IP: 10.66 eV Sp.Gr.: 1.05 VP: 11MM FRZ: 62F UEL: 19.9% (200F) LEL: 4.0%	Class II Combustible Liquid	eyes, skin, resp sys, teeth	Acetic anhydride, cellulose acetate, plastics, pharmaceuticals, dyes insecticides, photographic chemicals, latex coagulant, textile printing - Vinegar.
Acetic Anhydride	$(CH_3CO)_2O$	Colorless liquid with strong pungent, vinegar odor	NIOSH - C 5 ppm OSHA 5 ppm	MW: 102.1 BP: 282F SOL: 12% Fl.P. 120F IP: 10.00 eV Sp.Gr.: 1.08 VP: 4MM FRZ:-99F UEL: 10.3% LEL: 2.7%	Class II combustible liquid	eyes, skin, resp sys	cellulose acetate fibers and plastics, vinyl acetate; dehydrating and acetylatin agen in production of pharmaceuticals, dyes, perfumes, explosives; etc.; aspirin, Esterifying agen for food starch.
Ammonia, Liquid Anhydrous - refrigerated	NH_3	colorless gas with pungent, suffocating odor - easily liquified under pressure	25 - STEL 35 ppm OSHA STEL 50 ppm	MW: 17.0 BP: -28 F SOL: 34% Fl.P.: NA(Gas) IP: 10.18 eV RGasD: 0.60 VP: 8.5 atm FRZ: -108F UEL:28% LEL:15% - Ref Den - 5.04 lb/gal	Should be treated as a flammable gas	eyes, **skin**, resp sys	Fertilizer, Nitric acid, urethane acrylonitrile, refrigerant, synthetic fibers dyeing latex preservatives, explosives, fuel cells, rocked fur; yeast nutrient
Ammonium Nitrate	NH4NO3	Colorless crystal		MW: 80.0 BP: 210 C decomposes SOL: soluble M.P. 169.6C Sp.Gr.: 1.725	Oxidizer, explosion hazard	eyes, skin, resp sys	Fertilizers, explosives, Pyrotechnics, hervicides an insecticides, maufactur of nitrous oxide, absorbent for nitrogen oxides, nutrient for antibiotics and yeast, catalyst
Ammonium Phosphate	Dibasic - $(NH_4)_2 HPO_4$ Hemi - $NH_4H_2PO_4*H_3PO_4$ Mono -$NH_4H_2PO_4$	White crystals or powder, - Hemi - somewhat hygroscopic, Mono - Brilliant white		MW: Di - 132.1, Hemi - 213.1, Mono -115.04 SOL: soluble to moderately soluble Sp.Gr.: Di - 1.619,, Mono - 1.803	non flammable	No date available	fertilizers, flameproofing f wood, papter and textiles, coating vegetation to retard forext fires, manufacture of yeast, vinegar, and bread improvers, flux for soldering tin, copper, brass, zinc. purifying sugar, in annoniated dentrifices,food additive

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Ammonium Sulfate	$(NH_4)_2SO_4$	Brownish-gray to white crystals		MW: 132.1 MP: 513 C decomposes SOL: soluble Sp.Gr.: 1.77	non flammable		Fertilizers, water treatment, fermentation, fireproofing compositions, viscose rayon, tanning, food additive
Carbon Dioxide	CO_2	Colorless, odorless gas, shipped as a liquified compressed gas - solid form is dry ice	Niosh - 5000ppm st 30,000ppm OSHA 5000ppm	MW: 44.0 BP: sublimes SOL: 0.3% Fl.P. -22F IP: 10.08eV RGasD: 1.53 VP: 56.5 atm FRZ:-109F UEL:na LEL: na	nonflammable gas	**resp sys**, CVS	Refrigerant, carbonated beverages, aerosol propellant, chemical intermediated, low-temperature testing, fire extinguishing, inert atmospheres, municipal water treatment, medicine, mining, miscible pressure source, shielding gas for welding…
Chloromethanes - Methyl chloride	CH_2Cl	Colorless gas with a faint sweet odor whichis not noticable at dangerous concentrations	suspect carcinogen OSHA 100ppm 300 ppm (5 min Max peak in any 3 hrs.)	MW: 50.5 BP: -12 F SOL: 0.5% Fl.P. N/A IP: 11.00 eV RGasD: 1.78 VP: 5.0 atm FRZ: -144F UEL: 17.4% LEL: 8.1%	Flammable Gas	CNS, liver kidneys, **repro sys**	Catalyst carrier in low temperature polymerization, tetramethyl lead, silicones, refridgerant, methylating agent in organic synthesis, extractant and low temperature solvent, herbicide, topical anesthetic
Dimethyl terephthalate	$C_6H_4(COOCH_3)_2$	Colorless crystal		MW: 162.1 MP: 140 C Sublimes: 300C SOL: insoluble	nonflammable		Polyester resin for film and fiber production, especially polyethylene terephthalate, intermediate
Formaldehyde - 37% soln with Water Also known as - Formalin	HCHO	Soln: Colorless liquid with pungent odor, pure: Nearly colorless gas with pungent odor	0.016 ppm, 0.1 ppm (15min) OSHA 0.75 ppm STEL 2 ppm - Suspected Carcinogen	MW: 22.44 BP: 214F SOL: Miscible Fl.P. 185F IP: ? Sp.Gr.: 1.08 VP: 0.1 (86F) FRZ: ?F UEL: 73% LEL: 7%	Class IIIA Combustible Liquid	eye, resp sys, **[nasal cancer]**	resin, ethylene glycol, embalming fluids, preservative, durable press treatment of textile fabrics, foam insulation particle board, plywood.
Granular Urea, Solid	$NH_2C{=}O$ NH_2	Pure: White crystals or powder, almost odorless, with saline taste		MW: 60 MLT: 132.7C Sp.Gr.: 1.335 Bulk Density: 0.74g/cm3 Cp: 1.44 J/kgK	Non Compustible	skin, resp sys	Fertilizer, animal feed, plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics, …
Isobutanol - Isobutyl Alcohol	$(CH_3)_2$ $CHCH_2OH$	Colorless, oily liquid with a sweet, musty odor	NIOSH 50 ppm OSHA 100ppm	MW: 74.1 BP: 227 F SOL: 10% Fl.P. 82F IP: 10.12 eV Sp.Gr.: 0.80 VP: 9MM FRZ: -162F UEL: (202F) 10.6% LEL:(123F) 1.7%	Class IC Flammable Liquid	Eyes, skin, resp sys, **CNS**	Organic synthesis, latent solvent in paints and laquers, intermediate for amino coating resins, substitute for n-butanol. pain removers, fruit flavor concentrates

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Isobutylene, isobutene	$(CH_2)_3C:CH_2$	Colorless, volatile liquid with a coal gas odor		MW: 74.1 BP: -6.9 C SOL: none Fl.P. -105F IP: 10.12 eV Sp.Gr.: 0.60 AI.P.: 869F UEL: 8.8% LEL: 1.8%	Class IA Flammable Liquid	resp sys	Production of isooctane, high octane aviation gasoline, butyl rubber, polyisobutene resins, tert-butyl chloride, co-polymer resins with butadiene, acrylonitrile…
Mehtyl Methacrylate	$CH_2=C (CH_3) COOCH_3$	Colorless liquid with an acrid, fruity odor	NIOSH/OSHA 100 ppm	MW: 1001 BP: 214 F SOL: 1.5% Fl.P. 50F IP: 9.70 eV Sp.Gr.: 0.94 VP: 29MM FRZ: -54F UEL: 8.2% LEL: 1.7%	Class IB Flammable liquid	Eyes, skin, resp sys	monomer for polymethacrylate resins, impregnation of concrete
Methanol, Liquid State	CH_3OH	colorless liquid with charactistic pungent odor	200 ppm - STEL 250 ppm (skin) OSHA - 200 ppm	MW: 32.1 BP: 147 F SOL: Miscible Fl.P. 52F IP: 10.84 eV Sp.Gr.: 0.79 VP: 96MM FRZ:-144F UEL: 36% LEL: 6.0%	Class IA Flammable Liquid	eyes, skin, **resp sys**, CNS, GI tract	chemical intermediate, antifreeze solvent , denaturant for ethanol, dehydrator for NG, fuel cell
Methylamine	CH_3NH_2	Colorless gas with a fish- or ammonia like odor	NIOSH/OSHA 10 ppm	MW: 31.1 BP: 21 F SOL: soluble Fl.P. 14F(liq) IP: 8.97 eV Sp.Gr.: 0.70 (13F) RGasD: 1.08 VP: 3MM FRZ: -32F UEL: (250F) 7.9% LEL:(151F) 1.1%	Class IA Flammable liquid	Eyes, skin, resp sys	Intermediate for accelerators, dyes , pharmaceuticals, insecticides, fungicides, surface active agents, tanning dyeing of acetate textiles, fuel additive, polymerization inhibitor, component of paint removers, solvent, photographic developer…
Methyl-*tert*-Butyl ether, Liquid State	CH_3OH	colorless liquid		MW: 88 BP: 55C SOL: 4% Fl.P.: 52F Sp.Gr.: 0.74 FRZ:-110C	Flammable - equivalent to a Class IA Flamable Liquid	eyes	Octane booster for Unleaded Gasoline (7% Vol)
Nitric Acid	HNO_3	Colorless, yellow or red, fuming liguid with an acrid, suffocating odor	NIOSH/OSHA 2ppm ST 4PPM	MW: 63.0 BP: 181 F SOL: miscible Fl.P. NA IP: 11.95 eV Sp.Gr.: (77F)1.50 (13F) VP: 48MM FRZ: -44F UEL: NA LEL: NA	Noncombustible gas but increases the flammablility of combustible materials	Eyes, skin, resp sys, teeth	Manufacture of ammonium nitrate, organic synthesis (dyes, drugs, explosives, cellulose nitrate, nitrate salts) metallurgy, photoengraving, etching steel, ore flotation, urethanes, rubber chemicals, reprocessing spent nuclear fuel
Nitrogen Solution - nitrogen gas	N_2	Colorless, odorless, tasteless gas - colorless liquid		MW: 28 BP: -195.5C SOL: slightly Fl.P. NA Sp.Gr.: 0.804(liq) RGasD: 0.96737 VP: 48MM FRZ: -210 C	Combustible	resp sys	Production of ammonia, acrylonitrine, nitrates, cyanamide,…, inert gas for purgin, blanketing, and exerting pressure, electric and electronic industries, in-transit food refrigeration and freeze drying, food antioxidant, source of pressure in oil wells…

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Oxo Alcohol - **N-Butanol**, 2-Ethyl Hexanol	$CH_3(CH_2)_2CH2OH$	colorless liquid, vinous odor		MW: 28 BP: 117.7C SOL: 7.7% Fl.P. 95F Sp.Gr.: 0.8109 FRZ: -89 C AI.P.: 689 F	Class IC Flammable Liquid		Preparatio of esters, expecially butyl acetate, solvent for resins and coatind, plasticizers, dyein assistant, hydraulic fluids, detergen formulations, dhydrating agent, intermediate, glycol ethers, bytul acrylate
Urea Ammonium Nitrate (UAN Solution) N=32: Urea 35.4%, Ammonium Nitrate 44.3%, Water 20.3% by weight				placeMW: 60.3 Sp.Gr.: 1.32 Dens: 11lb/gal Hsol: 65.1 Btu/lb Crys: 28F			Fertilizer, explosives, pyrotechnics, herbicides nitrous plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics, …

Appendix E ¾ COAL REFINING CHAR

Coal refining (CR) is a process capable of producing end-use products and chemical feed stocks (coproducts) directly from coal. CR rearranges the hydrogen molecules (H_2) to produce coproducts in excess of the volatile content of the feed coal. The CR concept would integrate many technologies that are commercially available in the petroleum refining industry with a coal/hot gas reactor design for coal hydrocracking and char separation.

The CR process was initially proposed by Carbon Fuels Corporation (CFC) as a means of upgrading subbituminous Wyoming coal to a higher heating value low sulfur fluidic boiler fuel–thus the name, the Charfuel® coal refining process. As the process was first conceived, the char (which remains after the coal is reacted) and some of the hydrocarbon oils (which are formed during the reaction) would be combined into the “char-fuel” fluid. CFC envisioned transporting the charfuel fluid by rail or through existing oil pipelines to utilities throughout the country as a replacement boiler fuel to meet compliance regulations.

Process Description

The heart of the CR process is based on results of the Cities Services/Rockwell (CS/R) flash-hydropyrolysis tests in which coal is thermally devolatilized by heating in a H_2 atmosphere. The CS/R work was partially funded by the U.S Department of Energy (DOE) from 1975 until funding was terminated in 1986. CFC calls the process “coal hydrocracking” and has taken some of the public access information from earlier CS/R tests (tests in which coal liquefaction was the primary objective) and further elaborated on the downstream possibilities, specifically:

- Hydrotreating of the oils to produce refinery feedstocks
- Recycle of H_2 inherent in the coal–thereby eliminating expensive externally generated H_2.

CFC also claims to have developed a slot reactor design for the coal hydrocracker to accommodate higher coal feed rates necessary for commercial operation. The design was successful in cold flow tests.

Coal and air are the only feedstocks for the CR process. The process is not limited to a specific type or grade of coal. When a higher grade coal is used, coproduct yield/unit of feed coal increases. A more complex CR process can yield a varied slate of high value coproducts such as BTX, naphtha, fuel oil, methanol, as well as byproducts such as sulfur, ammonia, and industrial grade CO_2.

TVA has evaluated several coproduction options as a means of reducing the cost of electricity including an IGCC Coproduction Demonstration Project (CDP) for the Clean Coal Technology (CCT) program sponsored by DOE. Coproduction of chemicals provides:

- Enhanced economic performance through the synergistic use of process equipment and flow streams, lowering the cost of producing both the coproduct chemical and electricity and
- Revenues from the sale of a high value chemical product.

TVA has conducted preliminary evaluations of the direct coproduction CR process for use with IGCC. Using the CFC CR coproduct yields, capital cost numbers, and the TVA CDP IGCC costs, the combined CR/IGCC economics for a 300 MW demonstration unit appear very promising To achieve the maximum coproduct output to enhance the overall economics and to produce the same amount of power as a stand-alone IGCC, more than twice the amount of feed coal is required for a CR/IGCC. The coproduct revenue is substantial, though some of the economic advantage for CR/IGCC is clearly “cost of scale.”

Verification of CFC’s assumptions for the CR process requires additional pilot plant studies. However, TVA is proceeding–to the maximum extent possible without specific pilot plant data–with a computer simulation evaluation of the CR/IGCC process to verify:

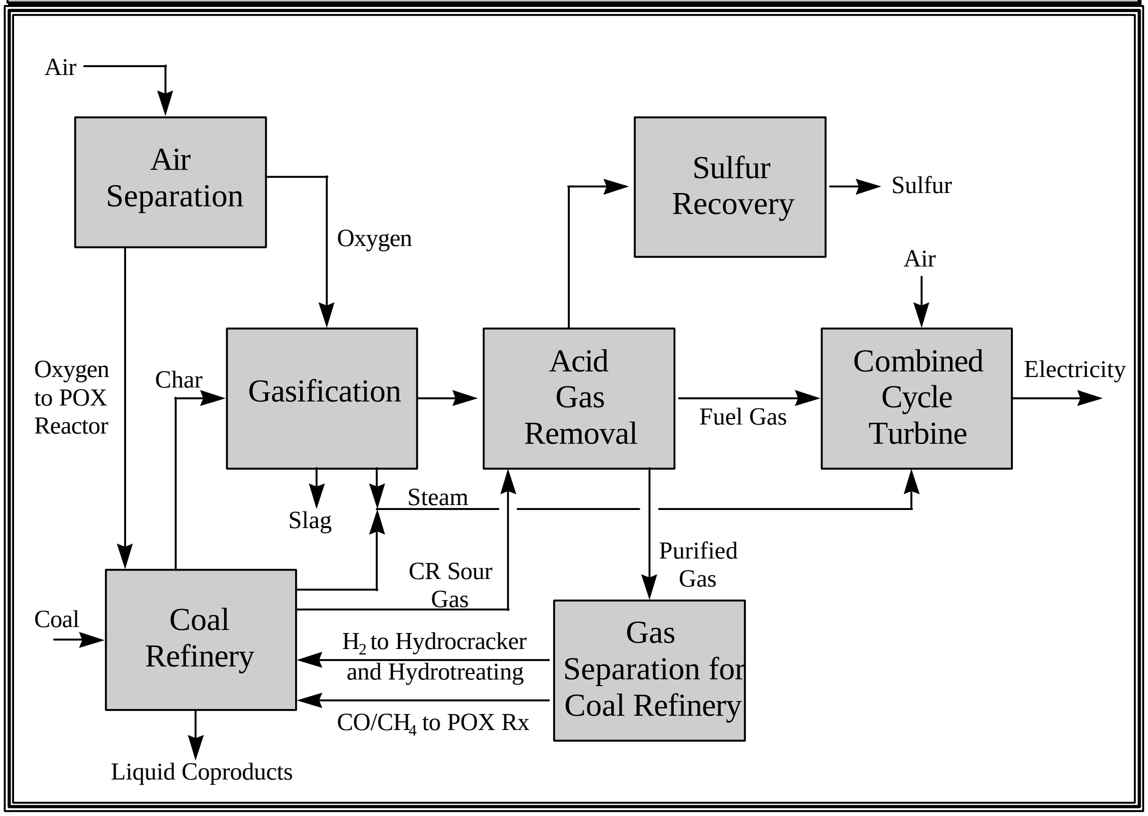
- Heat and material balances,
- H_2 requirements,
- Recycle requirements,
- Equilibrium relationships
- Separation feasibilities,
- Equipment requirements and sizes, and
- Equipment costs.

The essence of the CR process is rapidly heating demoisturized, pulverized coal in the presence of H_2 to effect a short residence time devolatilization and subsequent hydrogenation (fluidized hydrocracking) to produce char, H_2 rich gases, and hydrocarbon liquids. A generalized block flow diagram is shown in the figure below.

The processes involved are:

- Hot partial oxidation (POX) gas enters the down-flow entrained flow coal hydrocracker to provide the required energy and hydrogen-rich atmosphere for hydrocracking of the dried coal.
- Coal is rapidly heated by contact with the hot POX gas to volatilization temperatures of 1600 to 1800°F. The residence time of the coal in the first stage of the hydrocracker is less than 100 milliseconds and less than one second in the second stage. CS/R concluded that by controlling certain variables (such as reactor operating temperature, residence time, gas to coal feed ratio, and to a lesser extent pressure) production of liquids, the highest value material, is maximized while production of char and gas is minimized.

CR/ IGCC Coproduction



- Flash volatilization of the coal is followed by a partial quench to hydrogenation temperature of 1200-1400°F using recycled heavy oil and hydrogen to control cracking (conversion of large molecules to smaller molecules) of the heavy unsaturated hydrocarbons thereby maximizing formation of and partially hydrogenating the liquid hydrocarbons to enhance liquid quality. The products are further quenched to about 1000°F to essentially terminate the reaction.

- Char is separated from the hydrocarbon gas phase and sent by pressure differential to IGCC gasification. No additional grinding is required for the free-flowing char. Nearly all of the char carbon is partially gasified to CO in a commercial gasifier operating at 2600°F.
- The sour gas is cooled to generate steam and routed to acid gas removal with the cooled CR gas.
- After coal hydrocracking and separation from the char, the hot quenched hydrocarbon vapors are sent to the cooling separation section, where the vapor is cooled in consecutive stages to condense the water and hydrocarbon liquids.
- The water and hydrocarbon liquid are separated by an oil-water separator, with the heavier hydrocarbons recycled back to the coal hydrocracker as oil quench.
- The condensed light oil is sent to the hydrotreating & fractionation section, where the light oils are hydrotreated (elimination of sulfur and nitrogen by the action of hydrogen under pressure over a catalyst).
- The resulting liquid is fractionated to separate the benzene, toluene, and xylene (BTX) from the naphtha and middle oils (fuel oil).
- Water from the cooling separation section is stripped of ammonia in the ammonia recovery section by conventional means.
- The cooled sour gas is sent to acid gas removal where CO_2 is removed and the sulfur containing compounds (H_2S, COS, etc.) are removed and sent to sulfur recovery.
- The treated CR/IGCC gases are separated into a H_2 rich gas and a CO/CH_4 rich gas.
- The H_2 rich gas is recycled to oil hydrotreating and to the coal hydrocracker.
- Up to half of the CO/CH_4 rich stream is recycled to a high temperature POX reactor where the CH4 and CO are sub-stoichiometrically reacted with O_2 to produce H_2 and additionally CO.
- Steam is added to the POX reactor to shift water and part of the CO to H_2 which is sent to the coal hydrocracker. The amount of recycle gas to the POX reactor is dependent on the amount of CH_4 in the recycle gas (to produce the required H_2) and the quantity of heat necessary to raise the temperature and devolatilize the coal.
- The remaining CO/CH_4 rich gas is sent to the combined cycle as fuel gas or all or part of the remaining CO/CH_4 rich gas is fed to an indirect liquefaction process where part of the gas is reacted with part of the separated H_2 in a once through methanol synthesis reactor.
- Gas that does not react is separated from the methanol and routed to the combined cycle as fuel gas for the gas turbine.

The only references available for CR emissions are the CCT proposals submitted by CFC to U.S. Department of Energy (DOE). The estimates are based on the CS/R pilot plant data. A review of the CS/R data did not lend any information more than an ultimate analysis of the char and the amount of sulfur and nitrogen release from the selected feed coal that could be expected at specific operating conditions. From that information, CFC tried to estimate quantities for NOx, SOx, and PM for the Charfuel® compliance boiler fuel. The CO, PM10, and solid waste amounts followed the same guidelines as an equivalent pulverized coal power plant/MBtu. Air toxics were not quantified because of lack of data.

The CR liquid coproducts would be hydrotreated to remove sulfur and nitrogen. The design of the hydrotreater would be similar to petroleum refinery processes and should be a matter of following guidelines already established by the petroleum refining industry.

The CR and IGCC gases would be treated in a combined acid gas removal process. The expected release of controlled substances would be selected for the design specifications chosen based on computer simulation models and/or more extensive pilot plant data. The selected acid gas removal process would be an efficient licensed process well established in commercial applications for both coal gas liquefaction processes and coal gasification processes.

For a fully integrated CR/IGCC process, it is nominal if the sulfur, nitrogen, or particulate is removed in the CR section or the IGCC section. Emissions and efficiencies are expected to be equivalent to that of IGCC. However, as stated earlier, the quantity of coal necessary to produce the same amount of electrical power for full coproduct recovery of a combined CR/IGCC is more than double the amount of coal required for a stand-alone IGCC. Therefore, if the same removal efficiencies are assumed for the combined CR/IGCC process as for a stand-alone IGCC process, the total emissions would more than double based simply on the amount of feed coal.

Conclusions

It is concluded that not enough is known about coal refining to fully assess its availability as a proven technology for use at Bellefonte, its technical feasibility or economic viability. However, coal refining offers considerable promise as a future fuel for power and chemicals production.

Appendix F ¾ Geologic Setting

This information provides more technical detail in support of Section 3.2.1, Seismicity and Faulting.

1.1 Seismotectonic Setting

The Bellefonte site is located within the North American crustal plate. This intraplate tectonic setting is far removed from any of the tectonic activity that takes place at boundaries between the earth's crustal plates. The tectonic stress regime throughout the southern Appalachians and most of eastern North America is characterized by a maximum compressive stress that lies near horizontal and is oriented east-west to northeast-southwest (Zoback and Zoback, 1991).

The *New Madrid Seismic Zone* is located in the Central Mississippi Valley within the Reelfoot Rift. The New Madrid Seismic Zone has produced damaging earthquakes in historical time including at least three earthquakes estimated to have had moment magnitudes of 8.0 or greater in the 1811-12 sequence. Johnston and Nava (1985) have determined recurrence intervals for NMSZ earthquakes based on historical and instrumental data. Their study indicates that a moment magnitude earthquake 6.0 or greater can be expected to occur somewhere within the zone one or more times in 70 years.

A recent compilation of studies related to the New Madrid Seismic Zone was published in Seismological Research Letters (1992). The New Madrid Seismic Zone is approximately 400 kilometers (250 miles) west-northwest of the Bellefonte site.

The *Wabash Valley Seismic Zone* is an area of moderate seismicity located in southwestern Indiana and southeastern Illinois. This area has produced moderately strong earthquakes in historical times including a magnitude 5.4 event in 1968. Evidence of at least one major, prehistoric earthquake has been found in this region by Obermeir (1992). This earthquake occurred approximately 2,400 years ago and is estimated to have had a magnitude of at least 6.5. The Wabash Valley Seismic Zone is located approximately 530 kilometers (330 miles) northwest of the Bellefonte site.

During historical time, only the New Madrid Seismic Zone has produced stronger earthquakes than the *Charleston, South Carolina Seismic Zone*. In 1886, an earthquake with estimated moment magnitude of 7.6 occurred near Charleston, South Carolina (Algermissen and Bollinger, 1993). Other strong earthquakes are believed to have occurred in this area in prehistoric time based on paleoliquefaction evidence (Talwani and Cox, 1985). The Charleston Seismic Zone is located about 460 kilometers east-southeast (285 miles) of the Bellefonte site. Additional information on the Charleston Seismic Zone can be found in Nuttli, et al., (1986) and Gohn (1983).

The *Southern Appalachian Seismic Zone* stretches from southwestern Virginia to northeastern Alabama, and may extend farther to the southwest to the Alabama-Mississippi border region. The largest earthquake in this zone (estimated magnitude 5.8) occurred in southwestern Virginia in 1897. However, over the past twenty years and perhaps longer, seismic activity within this zone has been concentrated in a band from about 50 kilometers north of Knoxville, Tennessee southwestward to the Alabama - Georgia border about 60 kilometers south of Chattanooga. This portion of the Southern Appalachian Seismic Zone is called the Eastern Tennessee Seismic Zone. Recent investigations of the Eastern Tennessee Seismic Zone can be found in Powell, et al., (1994) and Chapman, et al., (1996).

Due to its rate of seismic activity and proximity to the Bellefonte site, the Southern Appalachian Seismic Zone is the most important contributor to Bellefonte’s seismic hazard, particularly for structures that would respond strongly to high frequency ground motion.

No recent surface faulting is known near Bellefonte; however, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Essentially all of these recent earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 kilometers. Reactivation of zones of existing weaknesses within the basement rocks are believed to be responsible for present day earthquake activity in the region (Algermissen and Bollinger, 1993).

1.2 Physiography

The present valley floor is in all respects like those of the folded Ridge and Valley province to the east. Due to the easier weathering of the weaker rocks below the sandstone cover, the valley walls, which are bounded by escarpments, remain steep. The straightness of the valley merely reflects the straightness of the structural contours. Base-leveling of the upturned hard rocks on the flanks was never completed and these remain as low monoclinal ridges that are interrupted at intervals by gaps cut down to general level. At the site, the valley is approximately 8 km wide, and the Tennessee River flows southwestward forming the upper reaches of the Guntersville Reservoir. The river entrenched its course to about 174 m-msl before impoundment of the reservoir. The plant site occupies the former floodplain and gently rolling terrain of the river valley (around 192 m-msl). The valley is regionally bounded on the southeast by the prominent flank of Sand Mountain, which rises to about 425 m-msl. The highly dissected and irregular edge of the Cumberland Plateau, rises to similar elevations and forms the northwestern flank of the valley.

Geologic formations within the region are primarily sedimentary rocks of Paleozoic age. The predominant strata are of Carboniferous age. In Alabama, the majority of the bedrock in the Appalachian Plateaus province are made of the:

- *Knox Group,*
- *Chickamauga Formation,*
- *Red Mountain Formation, the Bangor Limestone, and*
- *Pottsville Formation.*

The *Pottsville Formation* (~365-m thick) is a succession of shale and sandstone beds, and represents the youngest Paleozoic rocks in Alabama, as well as the coal bearing rocks. The *Knox Group* (~760 to 915 m thick) consists mostly of dolomite with some limestone. The *Chickamauga Formation* of Ordovician age underlies the Bellefonte site and is mainly alternating layers of limestone, siltstone, and shale approximately 425-m thick. The *Red Mountain Formation* (~7 to 215-m thick) is partly composed of sandstone (closely associated with the Fort Payne Chert) and is almost entirely clastic material such as sand, pebbles, and clay. The *Bangor Limestone* consists of thick-bedded, oolitic limestone over most of the region and ranges in thickness from ~30 to 215 m.

Most of the major faulting in the region lies within the Valley and Ridge province to the east, which is complexly folded and faulted. The Appalachian Plateaus province contains a few minor folds and thrust faults trending northeast-southwest, particularly adjacent to the Valley and Ridge province. The Appalachian Plateaus province is bounded on all sides by outfacing escarpments, which reflect the regional synclinal structure of the plateau. The Paleozoic sedimentary rocks of the region are basically flat-lying.

Directly southeast of the plant, a low ridge is developed in the more resistant beds of the southeastward-dipping Chickamauga Formation. The ridge separates the site from the Tennessee River by a distance of about 915 m and stands at an elevation of about 245 m-msl. Gaps in the ridge are due to erosional development along normal dip joint systems and no cross-faulting is evident.

Northwest of the plant, the land slopes gently downward to a linear depression known as Town Creek Embayment. Quite typical of the area, the Town Creek Embayment exhibits erosional development along the more soluble belts of the lower Chickamauga and Upper Knox Formations. The Knox Group underlies the Chickamauga and outcrops to the northwest near the reservation boundary.

Only the Chickamauga Formation of Middle Ordovician age is involved in the foundations for the major structures. At the site, the Chickamauga is primarily overlain by a relatively thin (0 to 11 m) regolith of residual silts and clays derived from in-place weathering of the underlying rock. As shown in Figure B.1-1 overburden has been disturbed by plant construction activities. In many undisturbed areas, there is no sharp interface between residuum and sound rock.

A mineralogical analysis was performed on selected soil samples from monitoring wells W14, W15, W17, and W18. In general, the samples (2.7 to 10.8-m deep) contained clays, quartz, calcite (except W14), and traces of iron oxide (Table B.1-1). The clay fractions of all the samples contained illite, kaolinite, and montmorillonite. Muscovite, which has an x-ray diffraction pattern similar to that of illite, was determined by polarized light microscopy to be present in all samples except W19. The estimated amounts of clay in the samples are the totals for all clay phases determined to be present in each sample. Iron oxide is present in all the samples at concentrations of less than 2%, mainly as amorphous $Fe_2O_3 \cdot nH_2O$. A chemical characterization has also been performed for selected soil samples from wells W12, W14, W15, W16, W17, W18, and W19 to measure geochemical parameters required for attenuation analyses.

Figure 1 Landfills, Borrow Pits, & Spoil Areas

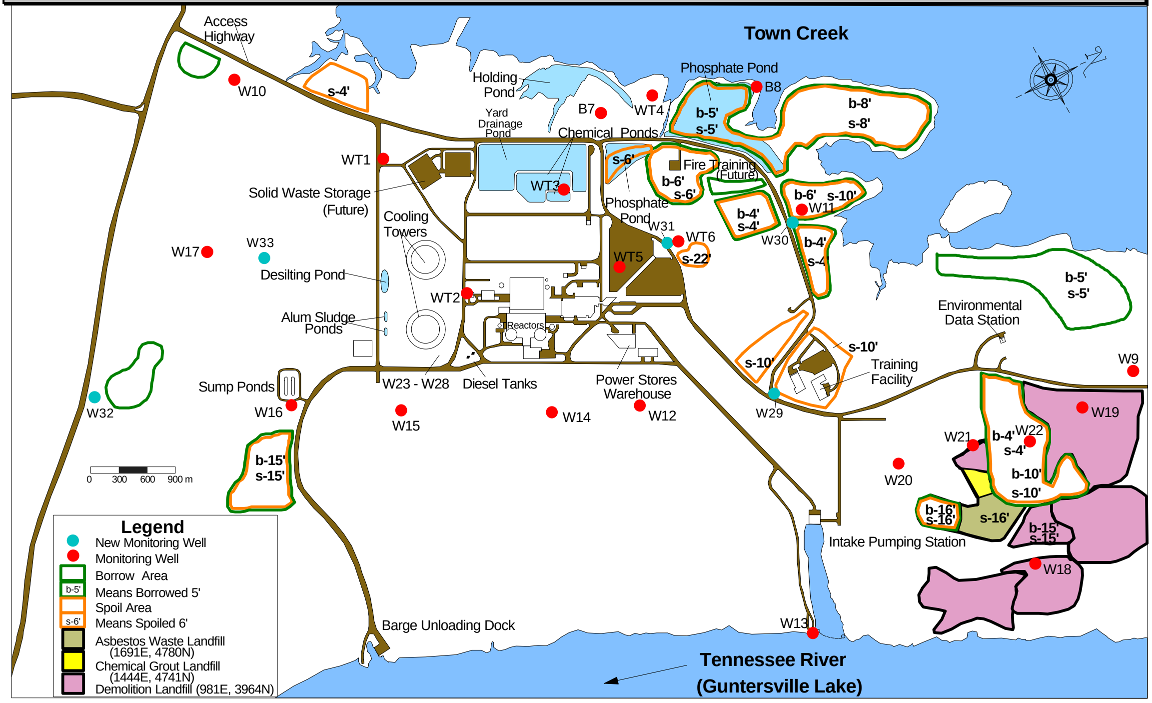


Table 1 Estimated Mineral Phases of Site Residual Soils

Well No.	Depth (m)	Total Clay[a] (%)	Quartz (%)	Calcite (%)	Iron Oxide
W-14	10.4-10.8	50 (I,K,M,C)	50	--	trace
W-15	2.7-3.2	30 (I,K,M,C)	40	30	trace
W-17	2.7-3.2	35 (I,K,M,C)	30	35	trace
W-18	4.3-4.7	15 (I,K,M)	80	5	trace

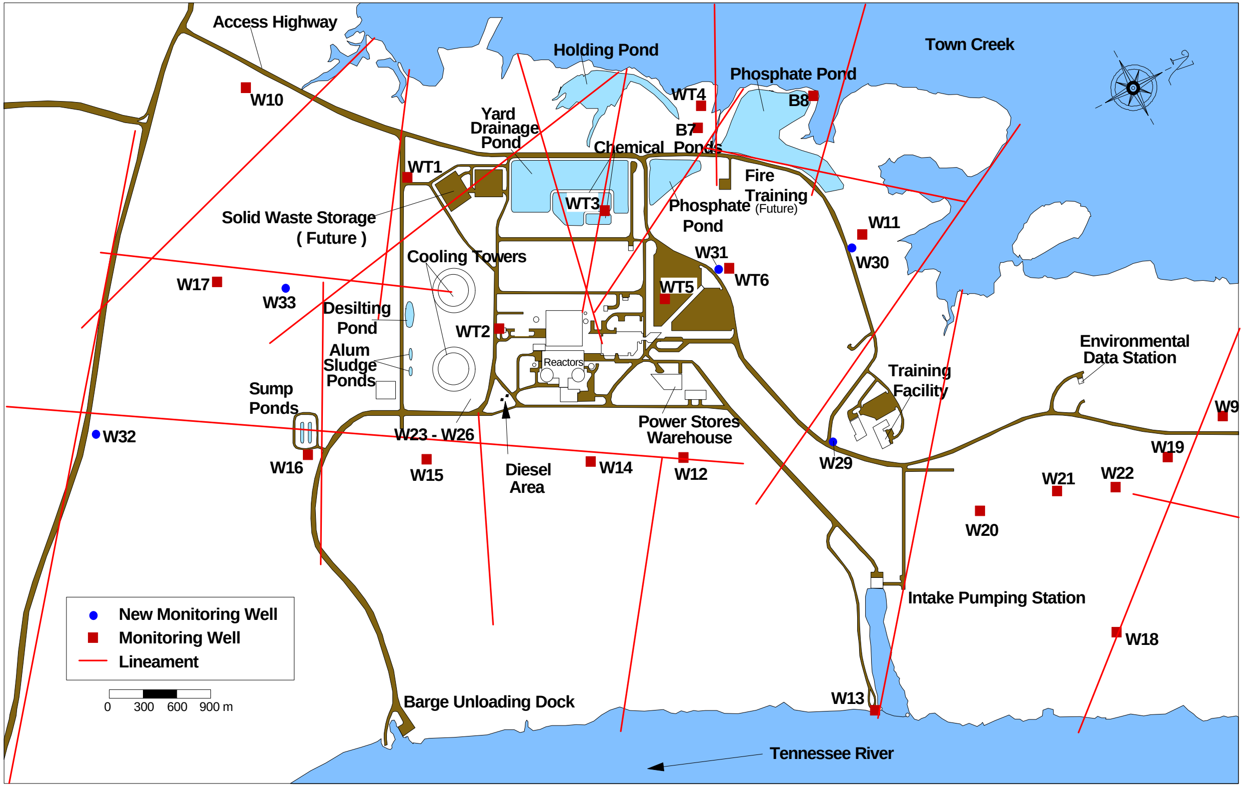
[a] Clay phases identified in each sample are given in parentheses beside the estimate of total amount of clay in each sample. Identified clay phases are as follows: I=illite, K=kaolinite, M=montmorillonite, and C=muscovite.

Site Bedrock and Lineaments

There is no intense folding or major faulting of the site bedrock. The strata strike N39° to 40° and dip to the southeast (toward the Tennessee River) at angles of about 17°. Throughout the plant site, fault zones are present that contain small shears and larger thrust faults. Three prominent joint sets have been mapped. One nearly parallels the strike N30° to 50° and dips steeply 70-80° to the northwest, another set strikes N80°E with dips ranging from 70° to the northwest to near vertical, and the last set strikes N50° to 80°W and is near vertical.

Figure 2 shows lineaments at the site that were derived from 1972 (predisturbed) and 1990 aerial photographs. The term lineament is used to describe linear topographic features of regional extent. Lineaments may represent long, narrow, relatively straight vegetation, soil tonal features, or drainage (subsurface or surface) features. Lineaments can be attributed to joints, faults, fractures, bedrock openings, and major structural relief forms on a localized basis. The dominant lineaments in Figure B.1-2 are oriented parallel and orthogonal to bedrock strike and may represent solutionally enlarged joints and/or fractures that can serve as privileged routes for groundwater movement. These features are generally referred to as strike/dip joints and are oriented well with those joint sets delineated in the Bellefonte FSAR. It is important to note that no field reconnaissance has been performed to verify these lineament locations.

Figure 2 Lineament Map



Characteristically, a large number of joints are parallel. However, the apertures of joints in three dimensions are rarely known. For example, in an area of low relief, even with 100% exposure, the vertical dimension of the joints is unknown. The size of joints is also difficult or impossible to analyze statistically. However, preferred orientations and attitudes of joints might provide some insight regarding the local movement of groundwater.

Differential weathering at the soil/bedrock interface has produced a zone of material above bedrock that consists of gravel and weathered shales in a silty clay matrix. This irregular weathering front also results in a bedrock surface that appears corrugated along bedrock strike due to the occurrence of purer limestone units and fracturing. Recharge from rainfall is relatively diffuse through the overburden, depending on cover, and percolating water usually accomplishes 50-80% of its solutional work within about 9 m of the ground surface. This is supported by exploratory drilling logs.

Appendix G ¾ Surface Water

Supporting table for Section 3.6.3, Surface Water Quality, Bellefonte Vicinity.

Average Water Quality Characteristics

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
Sample Height	% RT BANK	70	40	60		
Temperature	C	18.47	18.063	18.91	25.355	25.758
Sample Weight	g	-	-	-	685.9	-
Incident Light	%	-	-	15.35	-	-
Sample Length	mm	-	-	-	369.2	-
Stream Flow	inst-cfs	-	-	-	42507	-
Surface Elevation	ft	593.92	593.78	593.79	594.51	-
Turbidity	JTU	-	-	8.86	-	-
Turbidity	HACH FTU	-	-	8.83	-	-
Transp	m	1.2175	1.3075	1.54	1.8377	1.4478
Color, Total	PT-CO UNITS	10.046	10.2	10.29	10.572	10.79
Apparent Color	PT-CO UNITS	14.909	14.8	20.11	17.945	15
Redox	mV	324.01	331.74	326.25	406.34	466.08
Conductivity,Field	umhos/cm	174.43	176.94	170.88	177.16	180.19
Conductivity,Lab	umhos/cm	-	-	168.04	-	-
Sample Depth	m	-	-	3.15	6.8509	3.5042
Dissolved Oxygen	mg/L	8.4889	8.5759	7.81	6.5418	7.0302
Bod 5 Day	mg/L	1.16	1.2	1.48	-	-
Chemical Oxygen Demand Low Level	mg/L	5.5	4.9	6.29	-	-
Ph, FIELD	SU	7.5679	7.4831	7.26	7.4457	7.4943
Ph, LAB	SU	-	-	7.28	-	-
Total Alkalinity,Lab	mg/L	-	-	51.06	-	-
Phen-Ph-Lfin Alk	mg/L	-	-	0.00	-	-
Total Alkalinity,Field	mg/L	61.05	60.8	52.10	55.333	58.5
Residue,Total Nonfilterable	mg/L	9.5455	10.667	8.22	3.4524	3.4737
Oil-Grease Freon-Gr	mg/L	13	13	12.00	-	-
Organic Nitrogen	mg/L	0.145	0.1571	0.20	0.2824	0.2411
Nh3+Nh4-N Total	mg/L	0.04409	0.0505	0.08	0.0385	0.0406
Ammonia- Mud	MG/KG-N	-	-	-	61.333	61
Un-Ionzdnh3-N	mg/L	-	-	-	0.0006	0.0007
Un-Ionzdnh3-Nh3	mg/L	-	-	-	0.0008	0.0009
Kjeldln Total-Mud	MG/KG	-	-	-	793.33	1200
No2&No3n-Total	mg/L	0.32955	0.3405	0.44	0.2276	0.2971
Phosphorus,Total	mg/L	0.05909	0.057	0.04	0.0291	0.0339
Phosphorus-Dissolved	mg/L	0.025	0.025	0.02	-	-
Phosphorus -Ortho,Dissolved	mg/L	-	-	-	0.0082	0.0161
Total Organic Carbon	mg/L	1.3773	1.45	2.73	2.4581	2.379

Average Water Quality Characteristics (cont'd)

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
Dissolved Organic Carbon	mg/L	-	-	12.00	2.0556	2.4
Bm Organic Carbon	GM/KG-C	-	-	-	19	-
Cyanide,Total	mg/L	0.02	0.02	0.02	-	-
Sulfide,Total	mg/L	0.02	0.02	0.02	-	-
Calcium,Total	mg/L	20.773	20.75	19.53	18.375	19.889
Calcium-Mud	MG/KG-CA	-	-	-	3266.7	3650
Mercury-Mud	MG/KG-MG	-	-	-	4133.3	2450
Magnesium, Total	mg/L	5.4818	5.555	4.64	4.95	4.8111
Sodium,Total	mg/L	6.8273	6.88	6.29	-	-
Potassium,Total	mg/L	1.4636	1.46	1.40	1.3792	1.4445
Chloride, Total	mg/L	7.5909	7.7	7.50	-	-
Sulfate,Total	mg/L	15.381	15.6	14.21	-	-
Fluoride,Total	mg/L	0.15	0.1	0.17	-	-
Silica, Disolved	mg/L	3.7	3.45	3.94	-	-
Arsenic, Dissolved	µg/L	1	2	1.00	-	-
Arsenic,Total	µg/L	1	1	3.17	-	-
Barium,Dissolved	µg/L	19	20	18.75		-
Barium,Total	µg/L	22	21.539	60.04		-
Berylium,Dissolved	µg/L	1	1	1.00		-
Berylium,Total	µg/L	1	1	5.42		-
Boron,Total	µg/L	145	120	81.86	-	-
Cadmium,Dissolved	µg/L	1.7263	1.3533	1.42	-	-
Cadmium,Total	µg/L	0.15	0.125	0.60	-	-
Cadmium,Total	µg/L	0.10909	0.105	0.67	-	-
Cadium-Mud	SED MG/KG-CD	-	-	-	4	2
Chromium-Mud	SED MG/KG-CR	-	-	-	45.8	21
Chromium,Dissolved	µg/L	1.5	1.3333	1.75	-	-
Chromium,Total	µg/L	1.5	2	4.79	-	-
Cobalt,Dissolved	µg/L	1	1	1.00	-	-
Cobalt,Total	µg/L	1.2	1.25	1.00	-	-
Copper,Dissolved	µg/L	25	90	10.00	-	-
Copper,Total	µg/L	11.429	12	34.75	40	10
Copper-Mud	SED MG/KG-CU	-	-	-	42.6	25.5
Iron,Total	µg/L	528.57	577	504.47	204.58	275
Iron,Dissolved	µg/L	10	10	65.07	10	-
Ferrous Iron	µg/L	-	-	96.25	-	-
Lead,Dissolved	µg/L	2.75	1.6667	4.83	-	-
Lead,Total	µg/L	2.125	2.4286	10.57	-	-
Lead-Mud	SED MG/KG-PB	-	-	-	63.8	26.5

Average Water Quality Characteristics (cont'd)

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
Manganese-Mud	SED MG/KG-MN	-	-	-	3966.7	2250
Manganese,Total	µg/L	61.947	70	63.15	28.227	21.667
Manganese,Dissolved	µg/L	13.4	10.5	17.18	2300	-
Thallium,Dissolved	µg/L	50	50	50.00	-	-
Thallium,Total	µg/L	93.333	76.667	90.00	-	-
Moly,Total	µg/L	20	20	25.00	-	-
Nickel,Dissolved	µg/L	3	2.5455	2.50	-	-
Nickel,Total	µg/L	1.6667	2	11.04	-	-
Nickel-Mud	SED MG/KG-NI	-	-	-	38.6	18
Nickel-Wet	TIS MG/KG-NI	-	-	-	0.8556	-
Thallium-Wet	TIS MG/KG-TH	-	-	-	0.6625	-
Silver,Dissolved	µg/L	10	10	10.00	-	-
Silver,Total	µg/L	10	10	10.00	-	-
Strontum,Dissolved	µg/L	120		-	-	-
Strontum,Total	µg/L	50	50	50.00	-	-
Vanadium,Total	µg/L	10	10	10.00	-	-
Zinc,Dissolved	µg/L	88	67.5	72.50	-	-
Zinc,Total	µg/L	108.57	116.67	62.28	26.25	50
Zinc-Mud	SED MG/KG-ZN	-	-	-	280	175
Antimony,Total	µg/L	2.4286	1.6	2.83	-	-
Antimony-Wet	TIS MG/KG-AN	-	-	-	1.55	-
Tin,Total	µg/L	175	190	235.00	-	-
Aluminum,Total	µg/L	429.5	431.5	496.48	100.53	157.14
Aluminum- Mud	SED MG/KG-AL	-	-	-	39,200	15,000
Lithium,Total	µg/L	10	10	10.00	-	-
Silicon,Total	µg/L	2,645	2,777.8	2876.20	-	-
Selenium,Dissolved	µg/L	2	1	1.50	-	-
Selenium,Total	µg/L	1.2	1	2.33	-	-
Selenium-Wet	TIS MG/KG-SE	-	-	-	0.33	-
Titanium,Total	µg/L	24.333	25.333	21.88	-	-
Iron Mud	SED MG/KG-FE	-	-	-	42600	27,500
Tot Coli	MFM-FCBR/100ML	-	-	214.38	-	-
Fec Coli	MFM-FCBR/100ML	38.833	27.125	39.47	281.14	12.111
Diclbrmt, Total	µg/L	10	10	10.00	-	-

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Carbntet, Total	µg/L	10	10	10.00	-	-
Bromofrmwhl-Wtr	µg/L	10	10	10.00	-	-
Cldibrmt, Total	µg/L	10	10	10.00	-	-
Chloroform, Total	µg/L	10	10	10.00	-	-
Chlrphyl A	µg/L	-	-	1.38	7.3256	3.4211
Chlorophyl B	µg/L	-	-	1.38	1.0769	1.5
Chlorophyl C	µg/L	-	-	2.04	1.2222	1.1
Pheophtna	µg/L	-	-	1.49	1.6487	1.3333
Phenols,Total	µg/L	0.91318	0.007	0.87	-	-
Toluene, Total	µg/L	10	10	10.00	-	-
Benzene, Total	µg/L	7.5	6.6667	6.67	-	-
Acenaphthylene. Total	µg/L	5	5	5.00	-	-
Acenaphthene, Total	µg/L	5	5	5.00	-	-
Acrolein, Total	µg/L	100	100	100.00	-	-
Acrylonitrile, Total	µg/L	100	100	100.00	-	-
Anthracene, Total	µg/L	5	5	5.00	-	-
Benzbfluorant, Total	µg/L	10	10	10.00	-	-
Benzo(K)Fluorant, Total	µg/L	10	10	10.00	-	-
Benzo(A)Pyrene, Total	µg/L	10	10	10.00	-	-
Berylium-Wet	TIS MG/KG-C	-	-	-	0.0175	-
Beta Bhc-Mud	µg/L	-	-	-	10	10
Beta Bhc-Wet	TIS MG/KG	-	-	-	0.01	-
Delta Bhc, Total	µg/L	0.01	0.01	0.01	-	-
Delta Bhc-Mud	mg/KG	-	-	-	10	10
Delta Bhc-Wet	TIS MG/KG	-	-	-	0.01	-
Bis-2-Chloroethyl Ester, Total	µg/L	5	5	5.00	-	-
Bis-2-Chloroethoxymethane, Total	µg/L	5	5	5.00	-	-
Bis-2-Chloroisopropyl, Total	µg/L	5	5	5.00	-	-
Nbb Phth,Total	µg/L	5	5	5.00	-	-
Chlorobenzene, Total	µg/L	10	10	10.00	-	-
Chloroethane, Total	µg/L	10	10	10.00	-	-
Chrysene, Total	µg/L	10	10	10.00	-	-
Diethylphthalate, Total	µg/L	5	5	5.00	-	-
Endsulsf, Total	µg/L	0.01	0.01	0.01	-	-
Endsulsf-Mud	mg/KG	-	-	-	10	10
Endsulsf-Wet	TIS MG/KG	-	-	-	0.01	
B-Endosulfan, Total	µg/L	0.01	0.01	0.01	10	10
Bendosul-Mud	µg/L	-	-	-	0.01	-

Average Water Quality Characteristics (cont'd)

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
Bendosul-Wet	TIS MG/KG	-	-	-	-	-
A-Endosulfan, Total	µg/L	0.01	0.01	0.01	-	-
Dimethylphthalate, Total	µg/L	5	5	5.00	-	-
Aendosul-Mud	mg/KG	-	-	-	10	10
Aendosul-Wet	TIS MG/KG	-	-	-	0.01	-
Endrinaldehyde, Total	mg/L	0.01	0.01	0.01	406	505
Endrinal-Wet	MG/KG-CD	-	-	-	0.01	-
Ethylbenzene, Total	µg/L	10	10	10.00	-	-
Fluoranthene, Total	µg/L	5	5	5.00	-	-
Fluorene, Total	µg/L	5	5	5.00	-	-
Hexachlorocyclopentadiene, Total	µg/L	5	5	5.00	-	-
Hexachloroethane, Total	µg/L	5	5	5.00	-	-
Indeno(123cd)Pyrene, Total	µg/L	10	10	10.00	-	-
Isophorone, Total	µg/L	5	5	5.00	-	-
Methylbromide, Total	µg/L	10	10	10.00	-	-
Methylchloride, Total	µg/L	10	10	10.00	-	-
Methylenechloride,Total	µg/L	10	10	10.00	-	-
Nitrosodipropylamine, Total	µg/L	5	5	5.00	-	-
Nitrosodiphenylamine, Total	µg/L	5	5	5.00	-	-
Nitrobenzene, Total	µg/L	5	5	5.00	-	-
Parachlorometacr, Total	µg/L	30	30	30.00	-	-
Phenanthrene, Total	µg/L	5	5	5.00	-	-
Pyrene, Total	µg/L	5	5	5.00	-	-
Silver-Wet	TIS MG/KG	-	-	-	0.1	-
Tetrachloroethylene, Total	mg/L	10	10	10.00	-	-
Trichlorofluoromethane, Total	µg/L	10	10	10.00	-	-
1-1-Dichloroethane, Total	µg/L	10	10	10.00	-	-
1-1-Dichloroethylene, Total	µg/L	10	10	10.00	-	-
1-1-1-Trichloroethane, Total	µg/L	10	10	10.00	-	-
1-1-2-Trichloroethane, Total	µg/L	10	10	10.00	-	-
1-1-2-2-Tetrachloroethane, Total	µg/L	10	10	10.00	-	-
Benzo(Ghi)Peryle, Total	µg/L	10	10	10.00	-	-
Benzo(A)Anthrace, Total	µg/L	5	5	5.00	-	-
1-2-Dichloroethane, Total	µg/L	10	10	10.00	-	-
1-2-Dichlorobenzene, Total	µg/L	5	5	5.00	-	-
1-2-Dichloropropane, Total	µg/L	10	10	10.00	-	-
1-2-Dichloroethene, Total	µg/L	10	10	10.00	-	-

Average Water Quality Characteristics (cont'd)

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
1-2-4-Trichlorobenzene, Total	µg/L	5	5	5.00	-	-
Dibenz(Ah)Anthrace, Total	µg/L	10	10	10.00	-	-
1-3-Dichlorobenzene, Total	µg/L	5	5	5.00	-	-
1-4-Dichlorobenzene, Total	µg/L	5	5	5.00	-	-
2-Chloroethylvinyl, Total	µg/L	10	10	10.00	-	-
2-Chloronaphthale, Total	µg/L	5	5	5.00	-	-
2-Chlorophenol, Total	µg/L	5	5	5.00	-	-
2-Nitrophenol, Total	µg/L	5	5	5.00	-	-
Dinoctph, Total	µg/L	10	10	10.00	-	-
2-4-Dichlorophenol, Total	µg/L	5	5	5.00	-	-
2-4-Dimethylphenol, Total	µg/L	5	5	5.00	-	-
2-4-Dinitrotoluene, Total	µg/L	5	5	5.00	-	-
2-4-Dinitrophenol, Total	µg/L	20	20	20.00	-	-
2-4-6-Trichlorophenol, Total	µg/L	20	20	20.00	-	-
2-6-Dinitrotoluene, Total	µg/L	5	5	5.00	-	-
3-3-Dichlorobenzide, Total	µg/L	25	25	25.00	-	-
4-Bromophenylphenol, Total	µg/L	5	5	5.00	-	-
4-Chlorophenylphenol, Total	µg/L	5	5	5.00	-	-
4-Nitrophenol, Total	µg/L	30	30	30.00	-	-
4-6-Dinitroorthocr, Total	µg/L	30	30	30.00	-	-
Pcb-1221-Wet	TIS MG/KG	-	-	-	0.1	-
Pcb-1232-Wet	TIS MG/KG	-	-	-	0.1	-
Pcb-1248-Wet	TIS MG/KG	-	-	-	0.0938	-
Pcb-1260-Wet	TIS MG/KG	-	-	-	0.165	-
Pcb-1016, Total	µg/L	0.1	0.1	0.10	-	-
Phenol, Total	µg/L	5	5	5.00	-	-
Napthalene , Total	µg/L	5	5	5.00	-	-
Trans-1,3-Dcp, Total	µg/L	10	10	10.00	-	-
Cis-1,3-Dcp,Total	µg/L	10	10	10.00	-	-
Mbas	mg/L	0.1	0.1	0.10	-	-
Pcp, Total	µg/L	30	30	30.00	-	-
B2ethhxlphthalate, Total	µg/L	5	5	5.00	-	-
Dnb Phth,Total	µg/L	5	5	5.00	-	-
Benzidin, Total	µg/L	50	50	50.00	-	-
Vinyl Chloride. Total	µg/L	10	10	10.00	-	-
Trichlorethylene. Total	µg/L	10	10	10.00	-	-
P,P'ddt, Total	µg/L	-	0.02	-	-	-
P,P'ddd, Total	µg/L	0.01	0.01	0.01	-	-

Average Water Quality Characteristics (cont'd)

		Tennessee River Mile				
Analyte	**Units**	**392.2 Point B**	**392.2 Point C**	**391.2 Point D**	**350**	**375.2**
P,P'dde, Total	µg/L	0.01	0.01	0.01	-	-
Aldrin, Total	µg/L	0.01	0.01	0.01	-	-
Alpha Bhc, Total	µg/L	0.01	0.01	0.01	-	-
Beta Bhc, Total	µg/L	0.01	0.01	0.01	-	-
Gamma Bhc, Total	µg/L	0.01	0.01	0.01	-	-
Chlrdanetech&Met	µg/L	0.01	0.01	0.01	-	-
Dieldrin, Total	µg/L	0.01	0.01	0.01	-	-
Endrin, Total	µg/L	0.01	0.01	0.01	-	-
Toxaphene, Total	µg/L	0.5	0.5	0.50	-	-
Heptchlr, Total	µg/L	0.01	0.01	0.01	-	-
Hpchlrep, Total	µg/L	0.01	0.01	0.01	-	-
Methoxychlor,Total	µg/L	0.01	0.01	0.01	-	-
Pcb-1221, Total	µg/L	0.1	0.1	0.10	-	-
Pcb-1232, Total	µg/L	0.1	0.1	0.10	-	-
Pcb-1242, Total	µg/L	0.1	0.1	0.10	-	-
Pcb-1248, Total	µg/L	0.1	0.1	0.10	-	-
Pcb-1254, Total	µg/L	0.1	0.1	0.10	-	-
Pcb-1260, Total	µg/L	0.1	0.1	0.10	-	-
Pcbs	µg/L	0.1	0.1	0.10	-	-
Hcb, Total	µg/L	5	5	5.00	-	-
Hexclbd, Total	µg/L	5	5	5.00	-	-
Hardness	mg/L	74.5	74.7	67.87	-	-
Residue,Dissolved-180	C mg/L	100	100.5	93.82	-	-
Residue, Total Volitile	%	-	-	4.47	-	-
Phosphorus-Ortho, Total	mg/L	-	-	0.02	-	-
Bromide, Total	mg/L	0.1	0.1	0.10	-	-
Mercury,Dissolved	µg/L	0.2	0.2	0.20	-	-
Mercury,Total	µg/L	0.2	0.2	0.20	-	-
Total Sedsieve	%<.062mm	-	-	50.22	-	-
Total Sedsieve	%<.125mm	-	-	65.35	-	-
Total Sedsieve	%<.500mm	-	-	89.64	-	-
Total Sedsieve	%<2.00mm	-	-	95.07	-	-
Turbidty -Lab	NTU	7.8182	7.8	8.50	-	-

Appendix H ¾ Groundwater

1.0 Groundwater Occurrence and Movement

All water at the site is derived from precipitation or is imported by pipeline from the Tennessee River. Additional groundwater recharge may occur from leaking water and wastewater pipelines, process pipelines, and impoundments. All water eventually leaves the site as streamflow and runoff, is removed by pumping, or is consumed by evapotranspiration. Except for barren landscape features, paved and roofed areas, the land surface is permeable. Water that is not removed by runoff, evapotranspiration, or the site drainage system moves laterally through the subsurface to the Town Creek embayment and the Tennessee River. It appears that all groundwater is discharged to surface waters and none is known to leave the site as underflow.

Groundwater Levels

A total of 35 groundwater monitoring wells have been installed at the site since 1973. The well locations are shown in Figures 1 and 2 with pertinent construction data provided in Table 1. Groundwater movement is generally toward the Town Creek Emabyment at all times. Groundwater levels normally reach maximum elevations during the months of January through March. During September and October water levels are usually at a minimum. The water table generally ranges from 0 to 22 ft below land surface at the plant site.

Figures 3 and 4 show water levels for several monitoring wells across the site. Figure 3 shows the groundwater level data from 3 deep bedrock wells (WT1, WT3, and WT4) located on the western side of the main plant site. The plot indicates that groundwater movement is generally towards Town Creek embayment at all times. The horizontal hydraulic gradient form WT3 and WT4 is about 0.006 and the gradient from WT1 to WT3 is about 0.002. The large shifts in groundwater elevations during the period from 1973 to 1976 are attributed entirely to plant construction activities.

Table 1 Site Groundwater Monitoring Wells

Well ID	Date Installed	Depth Range (m)	Soil or Bedrock	Purpose	Reference
WT1 - WT6	1973	13.9	Bedrock	Background Water Quality and Water Level Data	TVA (1976)
B7 & B8	1981	6.5 - 7.4	Bedrock	Monitor Groundwater Quality Near TSP[a] Ponds	Lindquist (1990)
W9 - W11	1984	0.9 - 1.3	Soil	Monitor Groundwater Quality Near TSP[a] Land Applications	Lindquist (1990)
BNP01 - BNP03, BNP06 & BNP07	1987	0.4 - 0.5	Soil	Monitor Groundwater Quality Near Diesel Tanks	Young and Lindquist (1988)
W12 - W19	1990	0.9 - 3.3	Both	Background Water Quality and Water Level Data	Julian (1990)
W21 - W22, B & C	1992	3.8 - 4.4	Bedrock Soil	Monitor Groundwater Quality Near Landfill	Browman (1994)
W23 - W26	1993	0.9 - 1.4	Bedrock	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1993)
W27 & W28	1994	1.4	Both	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1994)

Figure 1 Monitoring Well Locations

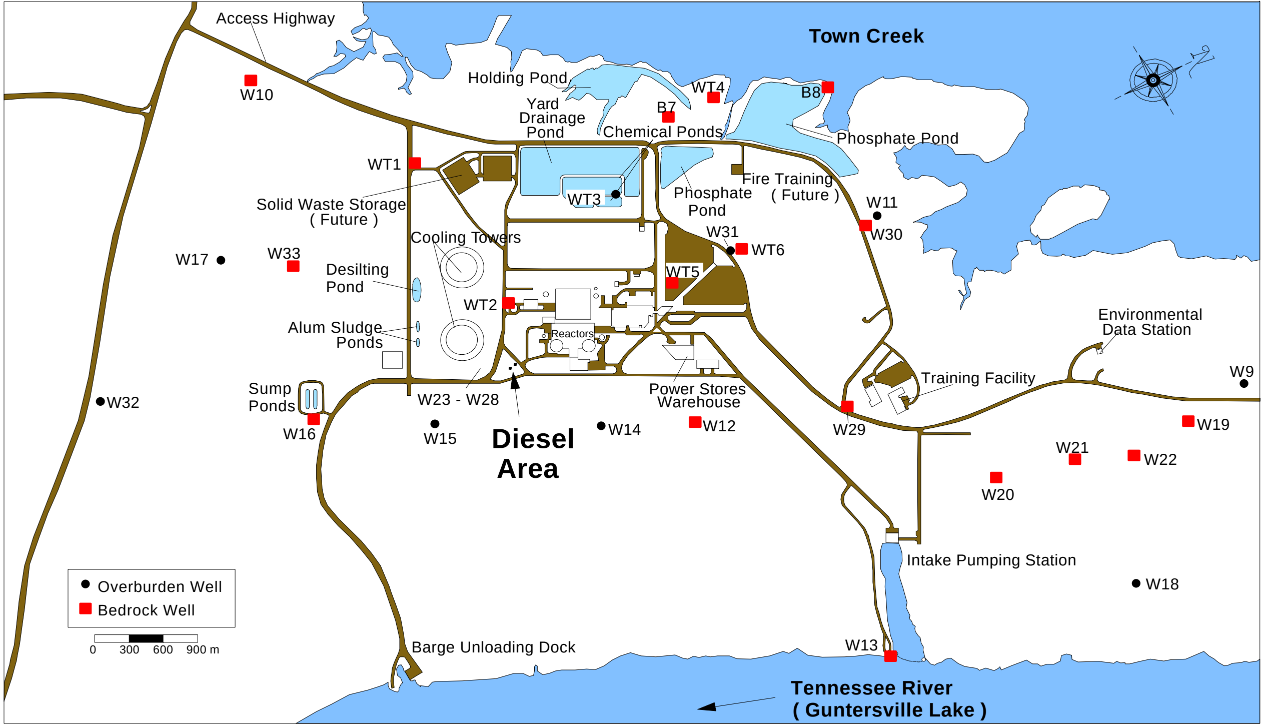


Figure 2 Groundwater Wells and Elevations Near Diesel Tanks

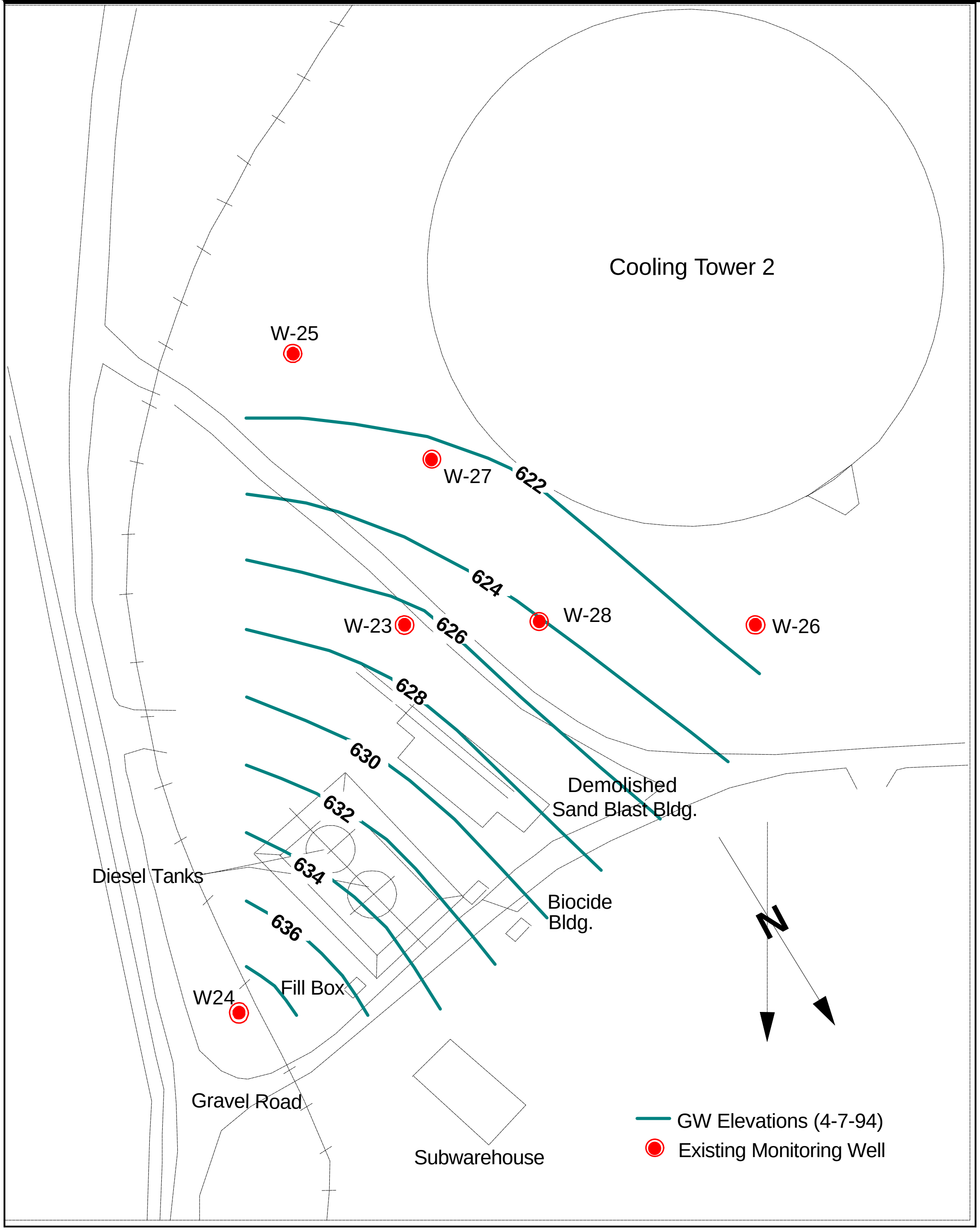


Figure 3 Groundwater Levels at Wells WT1, WT3, and WT4

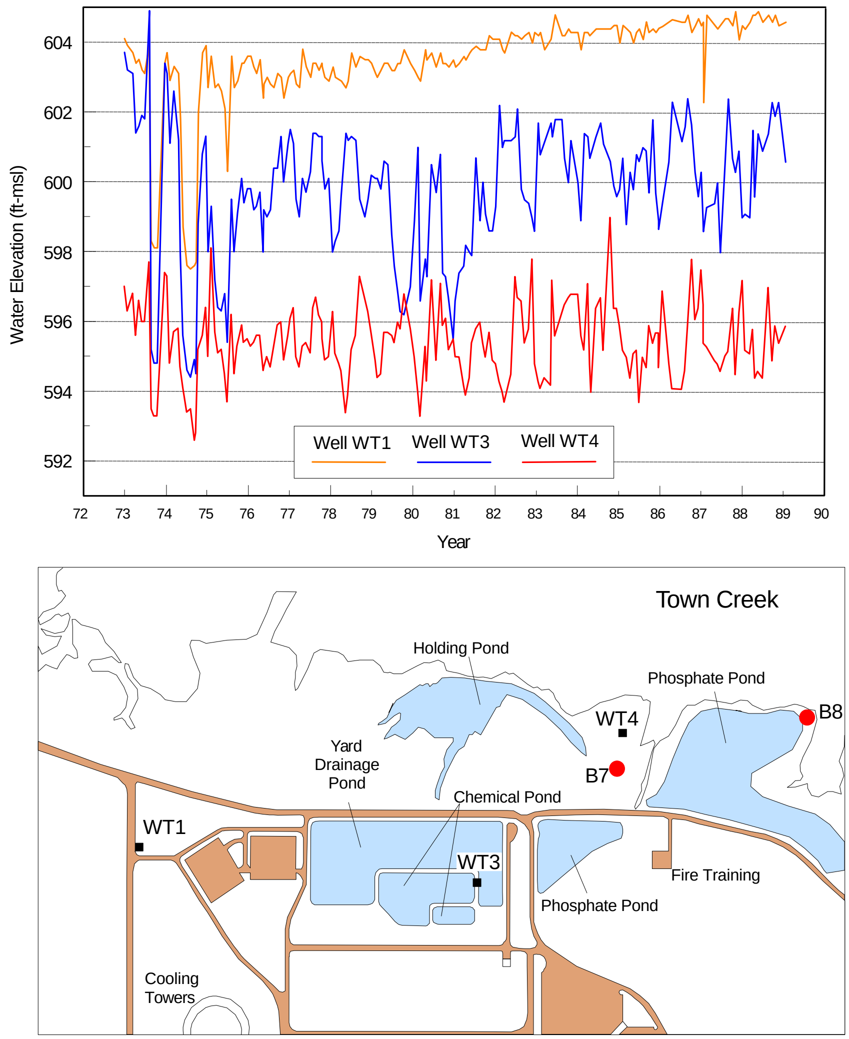
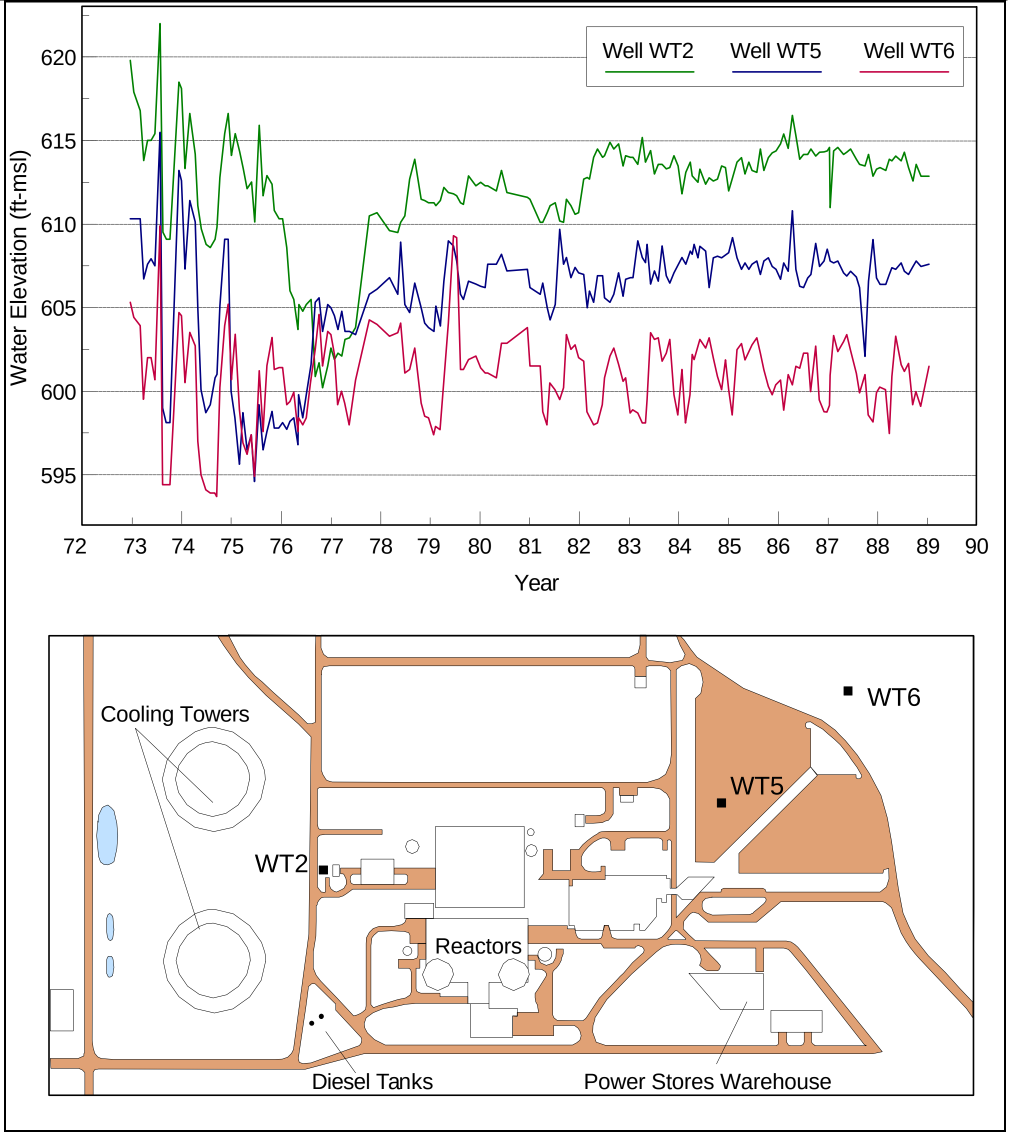


Figure 4 shows the groundwater level data from deep bedrock wells WT2, WT5 and WT6 that are located across the approximate middles of the main plant. The data indicate that the direction of groundwater in this vicinity (west of the main parking lot) is also in the general direction of Town Creek embayment. Horizontal hydraulic gradients in this vicinty range from about 0.004 to 0.007. The large fluctuations in water levels during the first 2 ½ years can again be attributed to plant construction.

Figure 4 Groundwater Levels at Wells WT2, WT5, and WT6



Examination of remaining groundwater level data indicates that the general trend in groundwater movement is north-northwest toward Town Creek Embayment and from topographic highs to lows. Exceptions occur from the east side of the main parking lot toward the intake channel (roughly along the route of the ERCW pipeline) and possibly from the southern corner of the site (near the sump collection ponds) toward the barge unloading dock.

Groundwater levels normally reach maximum elevations during the months of January through March. During September and October water levels are usually at a minimum. The water table generally ranges from 0 to 22 ft below land surface at the plant site.

2.0 Groundwater Occurrence

Certain amounts of overland flow occur in the study area as a result of precipitation on urban facilities and barren landscape features (i.e. gravel roads, bare soil areas, and rock outcrops. Surface runoff, stormflow, and groundwater move from higher elevations toward discharge points at lower elevations (i.e. Town Creek Embayment). The water table generally occurs at depths of 0 to 7 m below land surface at the plant and is typically at or below the bedrock/overburden interface in the plant area during the dry season and very near the interface during the wet season.

The subsurface flow of water that eventually discharges to Town Creek Embayment occurs both in a shallow zone just beneath land surface and in a deeper zone below the water table. Transient lateral flows of water probably are rare in the intervening vadose zone. The properties of the hydrologic subsystems are locally influenced by hydrostratigraphic units. Although many factors influence groundwater flow on the site, topography, surface cover, geologic structure, lithology, and human disturbance exhibit strong influence. Variations in these features result in water flux variations. Because of topographic relief and a marked decrease in permeability, subsurface flow is predominately shallow. In addition to groundwater flow, contaminant migration rates are strongly influenced by geochemical processes, including ion exchange, sorption, and precipitation/dissolution of mineral phases. The retardation of contaminants at the site resulting from geochemical processes is specific to each contaminant.

The geologic units beneath the site primarily constitute aquitards, in which flow is dominated by fractures. The subsurface flow system in the aquitard units can be divided as follows: the stormflow zone; the vadose zone; the groundwater zone (which can be subdivided into the water table interval, the intermediate interval, and the deep interval); and the aquiclude (Figure 3.1.8-5). These hydrologic subsystems are defined on the basis of water flux, which decreases with depth. The largest flux is associated with the stormflow zone (where present and well developed) and the smallest with the deep interval. Note that these zones are vertically gradational and are usually not separated by discrete boundaries. It is important to understand that major processes within a subsystem, as well as interactions that occur between subsystems, are functions of the system as a whole.

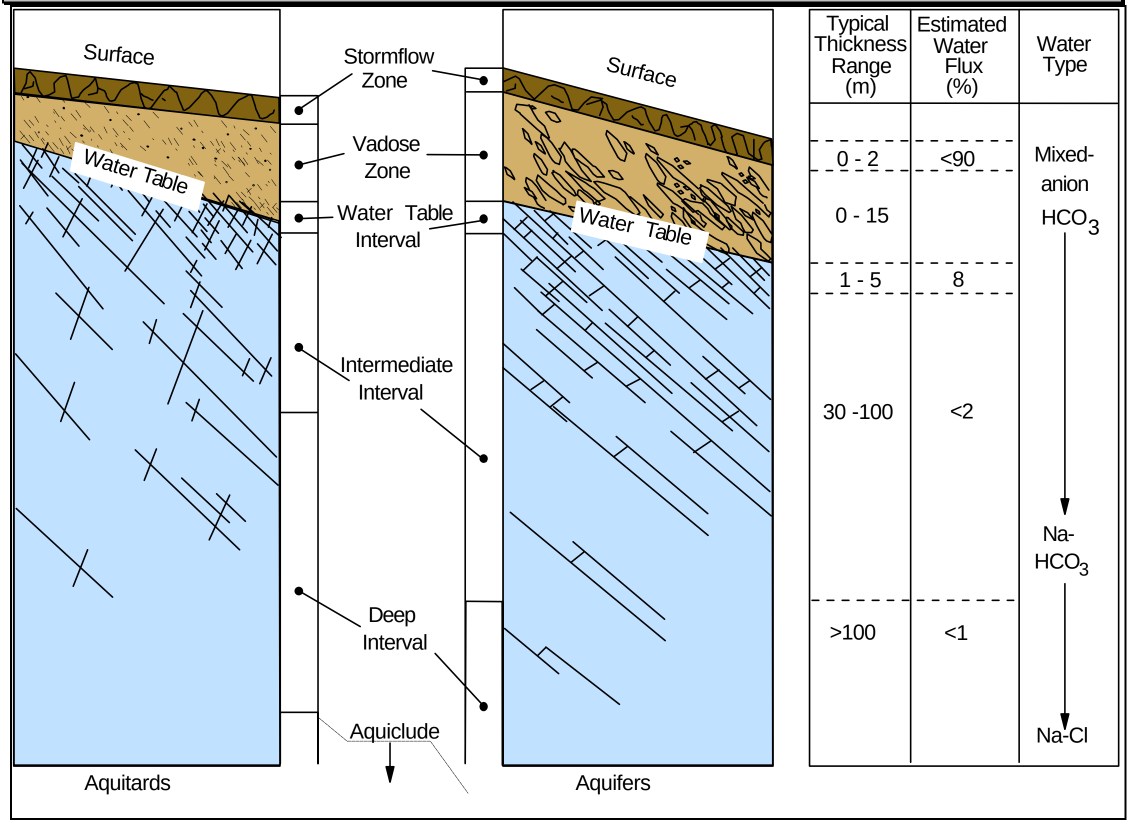
Stormflow Zone - Where present, the majority of active subsurface flow occurs through the 1 to 2-m deep stormflow zone. Undisturbed area of the site are heavily vegetated, and the stormflow zone approximately corresponds to the root zone. Across the site, the stormflow zone might be described as poorly to well developed. In heavily vegetated areas, it is probably well developed. In areas extremely disturbed by construction and compaction (the majority of the active plant site), the stormflow zone might be absent or penetrate to much more shallow depths such that it is considered poorly developed.

Vadose Zone - A vadose zone exists through the site except where the water table is at land surface. The thickness of the vadose zone is greatest beneath topographic highs, and thins toward drainage boundaries. The vadose zone consists of a regolith composed primarily of clay and silt, most of which is derived from the weathering of bedrock materials and which has significant water storage capacity. The downward percolation of water in the vadose zone is controlled by vertical hydraulic conductivity, which may be considerably smaller than the infiltration rate because of anisotropy.

Water Table Interval - Flow paths in the groundwater zone (Figure 5) generally follow topographic trends but are tortuous. Water-bearing (active) fractures are ubiquitous below the water table, but enlarged fractures and cavities are common only at shallow depths and most of these are fully to partially infilled with clayey sediments. The groundwater zone can be described as consisting of closely spaced, connected fractures in an otherwise impermeable bedrock. The water table is the level at which water stands in shallow wells and is presumed to be the same level as in a fracture at that point. Cyclic changes in water table elevations alter the saturated thickness of the permeable groundwater zone and may result in an order-of-magnitude fluctuation in groundwater discharge rates.

Intermediate and Deep Intervals - Below the water table interval (Figure 5), fracture control becomes dominant in the flow path direction. In the intermediate interval of the groundwater zone, groundwater movement occurs primarily in permeable fractures that are poorly connected in three dimensions. Below the intermediate interval, it is estimated that only small quantities of groundwater are transmitted through discrete fractures in the deep interval. The active fractures in the deep interval are probably fewer in number, shorter in length, and more greatly spaced than in other intervals. Fracture orientations are likely, however, to be similar to overlying intervals.

Figure 5 Schematic Profile Showing Subsurface Flow Zones, General Thickness Layers, and Estimated Water Flux With Depth



3.0 Groundwater Movement

Within the vadose zone, groundwater movement is essentially vertical and relatively diffuse with average saturated hydraulic conductivities (K_{sat}) generally ranging from 10^{-6} to 10^{-8} cm/s. The smaller values of K_{sat} are associated with residual silty clay (10^{-7} to 10^{-8} cm/s), while larger values might be related to alluvial activity and reworking of residual soils(10^{-6} cm/s). Studies at sites with similar soils (i.e. Widows Creek Fossil Plant) indicate that these residual silts and clays can be expected to display a vertical to horizontal hydraulic conductivity ratio of about 1:10. The downward percolation of water in the vadose zone is controlled by vertical hydraulic conductivity (K_v).

Vestigial solution activity along bedding planes, joints, and fractures has produced enlarged openings and effective routes for groundwater movement. With regard to groundwater movement, the most transmissive zone is generally the weathered zone. The bedrock drainage matrix yields a very complex groundwater flow system and there is a probability for relatively rapid movement of groundwater via the bedrock fractures. These drainage networks may have groundwater velocities several orders of magnitude greater than those expected in the regolith. Thin shale beds and clay seams in the Chickamauga Formation generally serve as lithologic controls to the movement of groundwater in this flow regime. Additionally, fissures that are considerably widened by corrosion close with depth. As a result, infiltration into the epikarstic aquifer may be much easier than drainage out of it (Wouldiams, 1983). The ratio of vertical to horizontal flows depends on the contrast in hydraulic conductivity in the upper and lower parts of this zone. In the well bedded, near horizontal carbonates at Bellefonte, this depends preeminently on the frequency and pattern of solutionally corroded joints and bedding planes.

Based on packer tests, a hydraulic conductivity range of 3.28 to 0.004 m/d is provided in the Bellefonte FSAR (TVA, 1986) with 92 % of the values being less than 0.30 m/d Slug testing by Julian (1994) provided hydraulic conductivity values of 1.38 to 0.008 cm/s for bedrock fracture zones near the Aboveground Diesel Fuel Storage Area. Recent single-well pumping and recovery tests were conducted at nine Bellefonte bedrock wells distributed across the site. With the exception of two outlying (low K) results from recovery curve analyses, the distribution of hydraulic conductivity values is lognormal. The geometric mean K values from analyses of these pumping and recovery test data are 0.043 and 0.032 m/d, respectively.

Appendix I ¾ Aquatic Ecology

This table supports information presented in section 3.1.10.

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q[a]	1994
TRM 420.0 (Inflow)								
HYDROIDA	Hydridae	*Hydra americana*						1
TRICLADIDA	Planariidae	*Dugesia tigrina*				21.8	19.1	64
		Dugesia sp.		1.7	25.3			
HAPLOTAXIDA	Naididae							7
		Nais sp.					1.8	
	Tubificidae			5	201.1	163.6	190.9	49
		Branchiura sowerbyi			45.3			
		Limnodrilus hoffmeisteri	14.5		103.2		5.5	3
		Limnodrilus sp.				10		
LUMBRICULIDA	Lumbriculidae				1.1		2.7	
		Lumbriculus sp.				19	6.4	
HIRUNDINEA								5
RHYNCHOBDELLIDA	Glossiphoniidae				1.1	0.9		
		Helobdella sp.				0.9		
PHARYNGOBDELLIDA	Erpobdellidae				1.1			
ISOPODA	Asellidae	*Caecidotea sp.*					15.5	
		Lirceus fontinalis	3.6	11.7				
		Lirceus sp.			16.8	15.4	12.7	8
AMPHIPODA	Crangonyctidae	*Crangonyx sp.*				5.4	8.2	
	Gammaridae					7.2	8.2	
		Gammarus sp.	40	63.3	196.8	49	60	160
ODONATA	Coenagrionidae	*Argia sp.*			1.1			
		Enallagma sp.			1.1			
	Corduliidae	*Neurocordulia sp.*					0.9	
	Gomphidae	*Gomphus sp.*			1.1			
EPHEMEROPTERA	Ephemerellidae	*Ephimerella sp.*		1.7				
	Ephemeridae	*Hexagenia limbata*	3.6	23.3		29	44.6	4
		Hexagenia sp.			12.6			
EPHEMEROPTERA	Heptogeniidae						5.5	
		Stenacron interpunctatum				18.1	16.4	5
		Stenacron sp.	3.6		72.6			

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 420.0 (Inflow)								
TRICOPTERA	Hydropsychidae	*Cheumatopsyche sp.*				0.9		
		Hydropsyche sp.	1.8					
	Leptoceridae	*Ceraclea sp.*						2
		Oecetis sp.				0.9	2.7	
	Polycentropodidae	*Cyrnellus fraternus*				0.9		
MEGALOPTERA	Sialidae	*Sialis sp.*						2
DIPTERA	Ceratopogonidae	*Bezzia sp.*			2.1	3.6	10.9	4
	Chironomidae				2.1	10.9		5
		Ablabesmyia annulata			3.2	1.8	7.3	1
		Ablabesmyia mallochi			2.1			
		Ablabesmyia sp.			1.1			
		Axarus sp.		13.3				
		Chironomus sp.	1.8			4.5	1.8	3
		Cladotanytarsus sp.					1.8	
		Coelotanypus tricolor					19.1	4
		Coelotanypus sp.		1.7	6.3	19		
		Conchapelopia sp.		1.7				
		Cryptochironomus fulvus					0.9	
		Cryptochironomus sp.		1.7	15.8	0.9	5.5	3
		Dicrotendipes sp.				0.9		3
		Harnischia sp.						1
		Microtendipes sp.			2.1			
		Nanocladius sp.			1.1		0.9	
		Paracladopelma sp.					1.8	
		Parametriocnemus sp.			1.1			
		Paratendipes sp.				0.9		
		Polypedilum sp.				3.6	24.6	5
		Procladius sp.			3.2			3
		Pseudochironomus sp.				0.9	4.6	4
		Rheotanytarsus sp.			2.1			
		Stenochironomus sp.			2.1		1.8	
		Stictochironomus sp.				1.8		
		Tanytarsus sp.			1.1	0.9		
		Tribelos sp.			3.2			
		Zavrelia sp.			1.1			
	Empididae	*Hemerodromia sp.*					0.9	
		Lithasia verrucosa						5
	Pleuroceridae	*Lithasia sp.*		1.7				
		Pleurocera calaliculata	7.3					
		Pleurocera sp.		11.7		1.8		2
	Viviparidae	*Campeloma sp.*						3

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	**FAMILY**	***SPECIES***	**Number Per Square Meter**					
			1990	1991	1992	1993	1993-Q	1994
TRM 420.0 (Inflow)								
DIPTERA	Tabanidae				1.1			
COLEOPTERA	Elmidae	*Ancyronyx variegatus*			1.1			
		Dubiraphia sp.	1.8		8.4	0.9		1
		Macronychus glabratus			1.1			
		Optioservus sp.			4.2			
		Stenelmis sp.				0.9	0.9	
MESOGASTROPODA	Hydobiidae	*Somatogyrus sp.*		11.7				
BASOMMATOPHORA	Ancylidae	*Ferrissia rivularis*					3.6	
		Ferrissia sp.			1.1			
UNIONOIDA	Unionidae	*Cyclonaias tuberculata*			1.1			
		Obliquaria reflexa			1.1			
		Potamilus alatus				0.9		
		Quadrula metanevra			1.1			
		Quadrula pustulosa			2.1			
VENEROIDA	Corbiculidae	*Corbicula fluminea*	92.7	512	967.4	264.5	243.6	196
	Sphaeridiae					1.8	1.8	
		Pisidium sp.				4.5		
		Total Abundance	171	662	1719	668	733	553
		Metrics:[b]						
		TAXA (Score)		3.5 (1)	9.8 (5)	6.5 (3)	7.5 (3)	7 (3)
		LONGL (Score)		0.9 (5)	1 (5)	1 (5)	0.9 (5)	1 (5)
		EPT (Score)		0.2 (1)	1.2 (3)	1.1 (3)	1 (3)	0.5 (1)
		PCHIR (Score)		3.3 (5)	4.7 (5)	2.5 (5)	4 (5)	5.3 (5)
		PTUBI (Score)		1.2 (5)	14.7 (5)	9.7 (5)	13.8 (5)	7.4 (5)
		DOMN (Score)		91.4 (1)	79.8 (3)	79.6(3)	71.8 (3)	77.7 (3)
		TOTNONCT (Score)		638 (3)	1381 (5)	452 (1)	464 (1)	468 (1)
		ZEROS (Score)		0 (5)	0 (5)	0 (5)	0 (5)	0 (5)
		Total Score		26	36	30	30	28
TRM 396.8 (Riverine)								
HAPLOTAXIDA	Tubificidae			1.7				
		Limnodrilus hoffmeisteri	1.1					
HIRUDINEA			1.1					
AMPHIPODA	Gammeridae	*Gammarus minus*	40.6					
		Gammarus sp.		8.3				

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
TRM 396.8 (Riverine)			1990	1991	1992	1993	1993-Q	1994
EPHEMEROPTERA	Ephemerellidae	*Eurylophella sp.*		1.7				
EPHEMEROPTERA	Ephemeridae	*Hexagenia limbata*	1.1					
	Heptogeniidae	*Stenacron interpunctatum*	11	5				
DIPTERA	Chironomidae	*Glyptotendipes sp.*	1.1					
		Polypedilum fallax		1.7				
		Procladius sp.	2.2					
		Tanytarsus sp.	3.3					
GASTROPODA			1.1					
VENEROIDA	Corbiculidea	*Corbicula fluminea*	70.2	13.3				
	Sphaeridae	*Musculium transversum*		5				
		Total Abundance	133	37				
TRICLADIDA	Planariidae	*Dugesia tigrina*				1.6		
		Dugesia sp.			1.7			
HAPLOTAXIDA	Tubificidae				33.3	111.6		52
		Branchiura sowerbyi			20	65		12
LUMBRICULIDA	Lumbriculidae							3
		Lumbriculus sp.				5		
RHYNCHOBDELLIDA	Glossiphoniidae	*Helobdella stagnalis*				10		15
		Helobdella sp.				1.6		
		Placobdella montifera						2
AMPHIPODA	Crangonyctidae	*Crangonyx sp.*				10		
	Gammeridae	*Gammarus fasciatus*				16.6		
		Gammarus sp.			28.3	1.6		7
	Talitridae	*Hyalella azteca*				60		218
EPHEMEROPTERA	Ephemeridae	*Hexagenia limbata*			28.3	170		195
		Hexagenia sp.			216.7			
		Stenonema sp.				1.6		
TRM 375.2 (Transition)								
TRICHOPTERA	Hydropilidae	*Hydroptila sp.*				3.3		
	Leptoceridae	*Oecetis sp.*				15		
	Polycentropodidae	*Cyrnellus fraternus*				5		
MEGALOPTERA	Sialidae	*Sialis sp.*				1.6		
DIPTERA	Ceratopogonidae				3.3			
		Bezzia sp.			1.7			
	Chironomidae				6.7	1.6		2
		Ablabesmyia annulata			35	35		18
		Ablabesmyia mallochi						3
		Axarus sp.			3.3			
		Chironomus sp.			3.3	8.3		5
		Coelotanypus tricolor				228.3		127
		Coelotanypus sp.			98.3	23.3		
		Cricotopus bicintus				1.6		

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
TRM 375.2 (Transition)			1990	1991	1992	1993	1993-Q	1994
DIPTERA		*Cryptochironomus fulvus*				16.6		
		Cryptochironomus sp.			8.3	5		33
		Dicrotendipes neomodestus				16.6		
		Dicrotendipes sp.				5		60
		Einfeldia sp.				1.6		5
		Epoicocladius sp.						2
		Glyptotendipes sp.			6.7	1.6		
		Polypedilum sp.			10			
		Procladius sp.			50	43.3		47
		Rheotanytarsus sp.						3
COLEOPTERA	Elmidae	*Dubiraphia sp.*				1.6		
HYDRACHNELLAE						3.3		
	Hydrachnidae	*Hydrachna sp.*			3.3			
	Unionicolidae	*Unionicola sp.*						3
TRM 375.2 (Transition)								
MESOGASTROPODA	Hydobiidae					13.3		
	Pleuroceridae	*Pleurocera sp.*				21.6		
	Viviparidae	*Campeloma sp.*			3.3	5		
		Viviparus sp.				8.3		2
BASOMMATOPHORA	Physidae	*Physella sp.*						2
UNIONOIDA	Unionidae	*Cyclonaias tuberculata*						2
		Potamilus alatus						2
VENEROIDA	Corbiculidae	*Corbicula fluminea*			355	345		328
	Spheariidae	*Eupera cubensis*						13
		Musculium transversum			265	66.6		123
		Pisidium sp.				6.6		
		Total Abundance			1182	1339		1284
		Metrics:[b]						
		TAXA (Score)			6.5 (3)	10.8 (5)		9.8 (5)
		LONGL (Score)			1 9 (5)	1 (5)		1 (5)
		EPT (Score)			0.8 (3)	1.5 (5)		1.3 (3)
		PCHIR (Score)			22.1 (5)	27.6 (5)		22.7 (5)
		PTUBI (Score)			6.4 (5)	11.2 (5)		5.6 (5)
		DOMN (Score)			83.3 (3)	65 (5)		73.7 (5)
		TOTNONCT (Score)			906.7 (5)	775 (5)		915 (5)
		ZEROS (Score)			0 (5)	0 (5)		0 (5)
		Total Score			34	40		38
TRM 350.0 (Forebay)								
HAPLOTAXIDA	Tubificidae			133	101.7	96.7		102
		Branchiura sowerbyi				13.3		10
		Limnodrilus hoffmeisteri	47.2		5			3

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 350.0 (Forebay)								
HIRUDINEA					13.3			
RHYNCHOBDELLIDA	Glossiphoniidae	*Helobdella stagnalis*	3.6	18.3	11.7	10		10
		Placobdella montifera	1.8			3.3		3
PHARYNGOBDELLIDA	Erpobdellidae	*Mooreobdella microstoma*				3.3		
AMPHIPODA	Gammeridae	*Gammarus minus*	47.2					
		Gammarus sp.			5			
	Talitridae	*Hyalella azteca*				1.7		
EPHEMEROPTERA	Caenidae	*Caenis sp.*		1.7				
	Ephemeridae	*Hexagenia limbata*	69	63.3	71.7	78.3		68
	Heptogeniidae	*Stenacron interpunctatum*		1.7				
TRICHOPTERA	Polycentropodidae	*Cyrnellus fraternus*				1.7		
MEGALOPTERA	Sialidae	*Sialis sp.*	3.6					
DIPTERA	Chaoboridae	*Chaoborus sp.*	3.6					
	Chironomidae							2
		Ablabesmyia annulata			6.7	23.3		33
		Ablabesmyia philosphagnos		31.7				
		Ablabesmyia sp.	20		16.7			
		Chironomus sp.	38.2	18.3	6.7			
		Clinotanypus sp.	12.7					
		Coelotanypus tricolor				208.3		278
		Coelotanypus sp.	165	475	286.7	75		
		Cryptochironomus sp.			6.7	6.7		8
		Dicrotendipes sp.				3.3		5
		Einfeldia sp.				8.3		43
		Epoicocladius sp.						2
MESOGASTROPODA	Hydobiidae	*Somatogygyrus sp.*		3.3				
	Pleuroceridae	*Pleurocera calaliculata*	3.6					
		Xenochironomus xenolabis				1.7		
	Viviparidae				3.3			
		Viviparus subpurpureus	9.1					
		Viviparus sp.				73.3		

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 350.0 (Forebay)								
BASOMMATOPHORA	Planorbidae					1.7		
VENEROIDA	Corbiculidae	*Corbicula fluminea*	133	183	195	140		127
		Eupera cubensis	1.8					12
		Musculium transversum	79.9	46.7	13.3	3.3		
		Total Abundance	667	1033	748.4	771.7		738
		Metrics:[b]						
		TAXA (Score)		7.2 (5)	5.9 (3)	6.8 (3)		6.9 (3)
		LONGL (Score)		1 (5)	1 (5)	0.9 (5)		1 (5)
		EPT (Score)		1.1 (5)	0.8 (3)	0.8 (3)		1 (5)
		PCHIR (Score)		58.9 (3)	43.4 (5)	50.8 (3)		54.1 (3)
		PTUBI (Score)		11.7 (5)	15.8 (3)	13.9 (5)		15.2 (3)
		DOMN (Score)		80 (5)	77.4 (5)	80.2 (3)		82 (3)
		TOTNONCT (Score)		318.3 (3)	313.3 (3)	316.7 (3)		220 (1)
		ZEROS (Score)		0 (5)	0 (5)	0 (5)		0 (5)
		Total Score		36	32	30		28

[a] - 1993Q = Quality Assurance Samples Collected from TRM 420.0 during 1993.

[b] - Metric Definitions and Criteria:

Reservior Zone:	**Forebay**			**Transition**			**Inflow**		
Rating/Criteria:	1	3	5	1	3	5	1	3	5
TAXA = average total number taxa/sample	≤4.6	4.6-6.9	>7.0	≤6.0	6.1-8.9	9.0	≤5.0	5.1-7.9	≥8.0
LONGL = proportion of samples with at least 1 long-lived organism (Corbicula, Hexagenia, mussles, and snails) present	≤0.5	0.6-0.8	≥0.9	≤0.5	0.6-0.9	1.0	≤0.5	0.6-0.8	≥0.9
EPT = average total number of Ephemeroptera, Plecoptera, and Tichoptera per sample	≤0.5	0.6-0.9	≥1.0	≤0.5	0.6-1.4	≥1.5	≤0.8	0.9-1.9	≥2.0
PCHIR = average percentage of chironomids/sample	≥60.0	45.1-59.9	≤40.0	≥60.0	35.1-59.9	≤35.0	≥40.0	10.1-39-9	≤10.0
PTUBI = average percentage of tubificids/sample	≥30.0	15.1-29.9	≤15.0	≥30.0	15.1-29.9	≤15.0	≥30.0	15.1-29.9	≤15.0
DOMN = average percentage of the two dominant families/sample (eveness score).	≥90.0	80.1-89.9	≤80.0	≥85.0	75.1-84.9	≤75.0	≥85.0	70.1-84.9	≤70.0
TOTNONCT = average number of organisms excluding chironomids and tubificids/sample	≤250	250.1-324.9	≥325	≤300	300.1-699.9	≥700	≤500	500.1-9.999	≥1000
ZEROS = number of samples with no organisms present	≤1	-	0	1	-	0	≥1	-	0

Scores: 1 = poor; 3 = fair; 5 = good

Live Freshwater Mussels Encountered During Searches of 50-Meter Transects Adjacent to Bellefonte, Tennessee River Miles 390.5-292.5, August 29-30, 1995.

Transect	2	1	3	4	5	6	7	8	9	11	10	12	13	14[a]		
Location (River Mile)	**390.5**	**390.7**	**390.9**	**391.1**	**391.1**	**391.2**	**391.3**	**391.4**	**391.5**	**391.8**	**392.0**	**392.2**	**392.5**	**392.3**		
Depth Range (ft)	**4-26**	**9-25**	**6-25**	**4-26**	**9-26**	**21-24**	**7-26**	**4-24**	**4-26**	**5-24**	**7-26**	**4-27**	**5-25**	**22-30**		
Substrate[b]	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**Totals**	**Sites**
Mussel Species																
Megalonaias nervosa			12	24	4	10	11	13	6	2	3	1	3		89	11
Potamilus alatus	3	7	4	11	16	4	6	4	10	7	4	2	4		82	13
Pleurobema cordatum		3	3	13		3	1	1	1	1	1		2		29	10
Elliptio crassidens			1	7	1	1						1	2		13	6
Quadrula pustulosa			2	2		2					1				7	4
Quadrula metanevra				4	1							1			6	3
Amblema plicata	1						1	1		1					4	4
Ellipsaria lineolata				3											3	1
Obliquaria reflexa				1				1						1	3	3
Cyclonaias tuberculata		1													1	1
Tritogonia verrucosa					1										1	1
Totals																
Specimens	4	11	22	65	23	20	19	20	17	11	9	5	11	1	238	13
Species	2	3	5	8	5	5	4	5	3	4	4	4	4	1	11	

[a] Transect from Bellefonte Island into the river channel toward Bellefonte.

[b] Substrate abbreviations: C - cobble, G - gravel, S - silt/clay

Appendix J ¾ AIR QUALITY

This appendix provides technical information which supports Chapter 4 evaluations of air quality impacts. Model receptor locations and their elevations above mean sea level are shown in Figure 1. Tables 1 and 2 contain input data used to estimate ambient air pollutant concentrations for criteria pollutants using the SCREEN3 model. Note that information is presented for the five basic conversion options and seven variant option configurations. Table 3 contains SCREEN3 modeling results for each of the 12 sets of results.

Figure 1 Model Receptor Locations

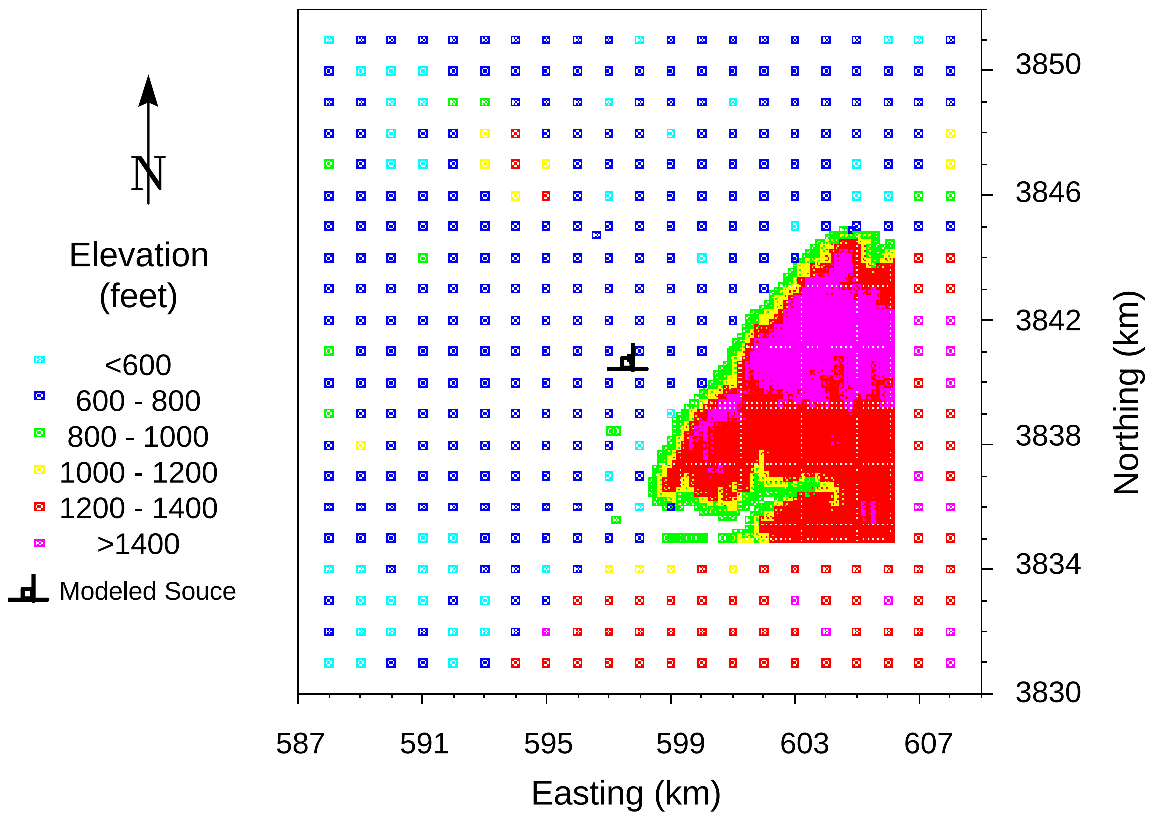


Table 1 Model Inputs: Location and Conditions

1A. PC Coal [a]

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
Stack	1	1,162.80	(795.292)	174.65	11.720	19.660	321.30
Stack	2	1,162.80	(255.000)	174.65	11.720	19.660	321.30

1B. PFBC Coal

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
Stack	1	1,162.80	(795.292)	106.68	13.42	18.3	380.00
Stack	2	1,162.80	(255.000)	106.68	13.42	18.3	380.00

2A. NGCC Natural Gas

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-HRSG	1	(1,967.56)	(234.686)	60.96	5.490	20.270	380.00
F-HRSG	2	(1,967.56)	(114.688)	60.96	5.490	20.270	380.00
F-HRSG	3	(1,967.56)	5.310	60.96	5.490	20.270	380.00
F-HRSG	4	(1,967.56)	125.308	60.96	5.490	20.270	380.00
F-HRSG	5	(1,967.56)	245.306	60.96	5.490	20.270	380.00
F-HRSG	6	(1,967.56)	365.304	60.96	5.490	20.270	380.00
F-HRSG	7	(1,967.56)	485.302	60.96	5.490	20.270	380.00
F-HRSG	8	(1,967.56)	605.300	60.96	5.490	20.270	380.00
F-HRSG	9	(1,967.56)	725.297	60.96	5.490	20.270	380.00

2B. NGCC Natural Gas Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	ExitVel (m/s)	Exit Temp (ºK)
F-Bypass	1	(1,813.45)	(234.686)	25.91	5.490	46.177	860.93
F-Bypass	2	(1,813.45)	(114.688)	25.91	5.490	46.177	860.93
F-Bypass	3	(1,813.45)	5.310	25.91	5.490	46.177	860.93
F-Bypass	4	(1,813.45)	125.308	25.91	5.490	46.177	860.93
F-Bypass	5	(1,813.45)	245.306	25.91	5.490	46.177	860.93
F-Bypass	6	(1,813.45)	365.304	25.91	5.490	46.177	860.93
F-Bypass	7	(1,813.45)	485.302	25.91	5.490	46.177	860.93
F-Bypass	8	(1,813.45)	605.300	25.91	5.490	46.177	860.93
F-Bypass	9	(1,813.45)	725.297	25.91	5.490	46.177	860.93

2C. NGCC Oil

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-HRSG-oil	1	(1,967.56)	(234.686)	60.96	5.490	20.270	380.00
F-HRSG-oil	2	(1,967.56)	(114.688)	60.96	5.490	20.270	380.00
F-HRSG	3	(1,967.56)	5.310	60.96	5.490	20.270	380.00
F-HRSG	4	(1,967.56)	125.308	60.96	5.490	20.270	380.00
F-HRSG	5	(1,967.56)	245.306	60.96	5.490	20.270	380.00
F-HRSG	6	(1,967.56)	365.304	60.96	5.490	20.270	380.00
F-HRSG	7	(1,967.56)	485.302	60.96	5.490	20.270	380.00
F-HRSG	8	(1,967.56)	605.300	60.96	5.490	20.270	380.00
F-HRSG	9	(1,967.56)	725.297	60.96	5.490	20.270	380.00

[a] - Note: x, y coordinates are based on a plant grid with the center of reactor 1 as 0,0 (in meters). Source elevation, i.e., stack base, is 610 feet (186 m) above mean sea level.

Table 1 Model Inputs: Location and Conditions (cont'd)

2D. NGCC Oil Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-Byps-oil	1	(1,813.45)	(234.686)	25.91	5.490	46.177	860.93
F-Byps-oil	2	(1,813.45)	(114.688)	25.91	5.490	46.177	860.93
F-Bypass	3	(1,813.45)	5.310	25.91	5.490	46.177	860.93
F-Bypass	4	(1,813.45)	125.308	25.91	5.490	46.177	860.93
F-Bypass	5	(1,813.45)	245.306	25.91	5.490	46.177	860.93
F-Bypass	6	(1,813.45)	365.304	25.91	5.490	46.177	860.93
F-Bypass	7	(1,813.45)	485.302	25.91	5.490	46.177	860.93
F-Bypass	8	(1,813.45)	605.300	25.91	5.490	46.177	860.93
F-Bypass	9	(1,813.45)	725.297	25.91	5.490	46.177	860.93

3A. IGCC Petroleum Coke

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,116.18)	(314.458)	99.10	6.710	17.790	380.00
CT/HRSG	2	(2,116.18)	288.782	99.10	6.710	17.790	380.00
CT/HRSG	3	(2,116.18)	892.022	99.10	6.710	17.790	380.00
CT/HRSG	4	(2,116.18)	1,495.260	99.10	6.710	17.790	380.00
Tail Gas	5	(2,339.58)	(525.302)	99.10	1.220	24.690	1,033.00
Tail Gas	6	(2,339.58)	(217.736)	99.10	1.220	24.690	1,033.00
Tail Gas	7	(2,339.58)	89.830	99.10	1.220	24.690	1,033.00
Tail Gas	8	(2,339.58)	397.396	99.10	1.220	24.690	1,033.00
Tail Gas	9	(2,339.58)	704.962	99.10	1.220	24.690	1,033.00
Tail Gas	10	(2,339.58)	1,012.528	99.10	1.220	24.690	1,033.00
Tail Gas	11	(2,339.58)	1,320.094	99.10	1.220	24.690	1,033.00
Tail Gas	12	(2,339.58)	1,627.662	99.10	1.220	24.690	1,033.00

3B. IGCC Petroleum Coke Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT-Bypass	1	(1,914.45)	(434.453)	25.91	6.710	46.177	861.00
CT-Bypass	2	(1,914.45)	228.955	25.91	6.710	46.177	861.00
CT-Bypass	3	(1,914.45)	892.363	25.91	6.710	46.177	861.00
CT-Bypass	4	(1,914.45)	1,555.771	25.91	6.710	46.177	861.00
Tail Gas	5	(2,339.58)	(525.302)	99.10	1.220	24.690	1,033.00
Tail Gas	6	(2,339.58)	(217.736)	99.10	1.220	24.690	1,033.00
Tail Gas	7	(2,339.58)	89.830	99.10	1.220	24.690	1,033.00
Tail Gas	8	(2,339.58)	397.396	99.10	1.220	24.690	1,033.00
Tail Gas	9	(2,339.58)	704.962	99.10	1.220	24.690	1,033.00
Tail Gas	10	(2,339.58)	1,012.528	99.10	1.220	24.690	1,033.00
Tail Gas	11	(2,339.58)	1,320.094	99.10	1.220	24.690	1,033.00
Tail Gas	12	(2,339.58)	1,627.662	99.10	1.220	24.690	1,033.00

Table 1 Model Inputs: Location and Conditions (cont'd)

4. IGCC/C Petroleum Coke

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00

5A. Combination

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
HRSG	7	(2,033.10)	924.700	99.10	5.490	20.270	380.00
HRSG	8	(2,033.10)	1,182.650	99.10	5.490	20.270	380.00
HRSG	9	(2,033.10)	1,440.600	99.10	5.490	20.270	380.00
HRSG	10	(2,033.10)	1,698.550	99.10	5.490	20.270	380.00
HRSG	11	(2,278.45)	1,358.900	99.10	5.490	20.270	380.00
HRSG	12	(2,476.40)	1,100.950	99.10	5.490	20.270	380.00

5B. Combination Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT-Bypass	1	(1,858.85)	(227.034)	99.10	6.710	46.177	861.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
Bypass	7	(1,835.15)	924.700	25.91	5.490	20.270	860.93
Bypass	8	(1,835.15)	1,182.650	25.91	5.490	20.270	860.93
Bypass	9	(1,835.15)	1,440.600	25.91	5.490	20.270	860.93
Bypass	10	(1,835.15)	1,698.550	25.91	5.490	20.270	860.93
Bypass	11	(2,278.45)	1,358.900	25.91	5.490	20.270	860.93
Bypass	12	(2,476.40)	1,358.900	25.91	5.490	20.270	860.93

Table 1 Model Inputs: Location and Conditions (cont'd)

5C. Combination Oil

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
HRSG-oil	7	(2,033.10)	924.700	99.10	5.490	20.270	380.00
HRSG-oil	8	(2,033.10)	1,182.650	99.10	5.490	20.270	380.00
HRSG	9	(2,033.10)	1,440.600	99.10	5.490	20.270	380.00
HRSG	10	(2,033.10)	1,698.550	99.10	5.490	20.270	380.00
HRSG	11	(2,278.45)	1,358.900	99.10	5.490	20.270	380.00
HRSG	12	(2,476.40)	1,100.950	99.10	5.490	20.270	380.00

Table 2 Model Inputs: Criteria Pollutant and CO_2 Emissions

1A. PC Coal

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
Stack	1	397.00	575.0	43.00	37.39	-
Stack	2	397.00	575.0	43.00	37.39	-

1B. PFBC Coal

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
Stack	1	353.00	519.8	76.6	-	-
Stack	2	353.00	519.8	76.6	-	-

2A. NGCC Natural Gas

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-HRSG	1	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	2	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	9	0.27	32.21	3.78	40.32	36,451 - 289,040

2B. NGCC Natural Gas Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-Bypass	1	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	2	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040

2C. NGCC Oil

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-HRSG-oil	1	18.22	32.21	9.34	40.32	53,362 - 423,176
F-HRSG-oil	2	18.22	32.21	9.34	40.32	53,362 - 423,176
F-HRSG	3	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	4	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	5	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	6	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	7	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	8	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	9	0.27	32.21	3.78	40.32	36,451 - 423,176

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

2D. NGCC Oil Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-Byps-oil	1	18.22	32.21	9.34	40.32	53,363 - 423,176
F-Byps-oil	2	18.22	32.21	9.34	40.32	53,363 - 423,176
F-Bypass	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040

3A. IGCC Petroleum Coke

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	2	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	3	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	4	34.97	150.62	5.54	31.75	184,656 - 1,464,362
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	6	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	7	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	8	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	9	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	10	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	11	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	12	5.39	0.43	2.08	0.23	715,000 -5,670

3B. IGCC Petroleum Coke Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT-Bypass	1	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	2	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	3	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	4	34.97	150.62	5.54	31.75	184,656 - 1,464,362
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	6	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	7	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	8	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	9	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	10	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	11	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	12	5.39	0.43	2.08	0.23	715,000 -5,670

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

4. IGCC/C Petroleum Coke

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,328 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-

5A. Combination

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,328 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
HRSG	7	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	8	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	9	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	10	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	11	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	12	0.27	32.21	1.54	40.32	36,451 - 289,040

5B. Combination Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT-Bypass	1	34.97	150.62	5.54	31.75	92,181 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	10	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	11	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	12	0.27	32.21	3.78	40.32	36,451 - 289,040

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

5C. Combination Oil

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,181 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
HRSG-oil	7	18.22	32.21	7.45	40.32	53,363 - 423,176
HRSG-oil	8	18.22	32.21	7.45	40.32	53,363 - 423,176
HRSG	9	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	10	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	11	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	12	0.27	32.21	3.78	40.32	36,451 - 289,040

Table 3 Dispersion Model Results

PC Coal [a]

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	5.393
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	111.057
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	90.063
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	573.069
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	399.519
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	971.065
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	920.409

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	7.811
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	160.850
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	130.444
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	830.011
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	578.648
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	1406.454
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	1333.086

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	0.584
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	12.029
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	9.755
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	62.070
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	43.273
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	105.178
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	99.692

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	0.508
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	10.459
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	8.482
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	53.972
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	37.627
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	91.456
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	86.685

[a] - This table contains detailed modeling results discussed in Section 4.2.1, “Air Quality.” Receptor x, y locations are UTM coordinates (easting, northing) and z location is terrain elevation in feet above mean sea level.

Table 3 Dispersion Model Results (cont'd)

PFBC Coal

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	3.717
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	126.6
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	102.9
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	623.3
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	490.0
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	783.2
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	781.6

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	2.736
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	93.217
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	75.787
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	458.931
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	360.806
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	576.683
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	575.536

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	0.403
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	13.734
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	11.166
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	67.615
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	53.158
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	84.963
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	84.794

CO Concentrations - not modeled due to insignificant emissions

Table 3 Dispersion Model Results (cont'd)

NGCC Natural Gas

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	0.073
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	1.806
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	1.339
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	7.316
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	5.323
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	8.417
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	8.326

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	8.616
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	212.860
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	157.845
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	862.165
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	627.273
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	991.868
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	981.179

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.011
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	24.980
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	18.524
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	101.179
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	73.614
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	116.400
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	115.146

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	10.785
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	266.448
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	197.583
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	1079.216
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	785.189
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	1241.571
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	1228.191

Table 3 Dispersion Model Results (cont’d)

NGCC Natural Gas Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.030
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	0.881
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	0.596
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	3.817
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	2.580
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	3.895
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	3.879

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.416
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	12.176
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	8.221
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	52.772
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	35.660
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	53.842
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	53.619

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	4.434
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	129.875
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	87.683
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	562.884
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	380.363
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	574.297
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	571.917

Table 3 Dispersion Model Results (cont'd)

NGCC Oil

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.137
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	28.140
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	20.863
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	113.993
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	82.939
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	131.148
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	129.730

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.341
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	33.145
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	24.579
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	134.251
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	97.676
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	154.447
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	152.783

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	10.785
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	266.448
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	197.583
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	1079.216
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	785.189
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	1241.571
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	1228.191

Table 3 Dispersion Model Results (cont'd)

NGCC Oil Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.467
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	13.727
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	9.286
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	59.474
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	40.200
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	60.689
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	60.440

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.552
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	16.156
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	10.908
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	70.021
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	47.316
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	71.441
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	71.145

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(μg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	4.434
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	129.875
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	87.683
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	562.884
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	380.363
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	574.297
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	571.917

Table 3 Dispersion Model Results (cont'd)

IGCC Petroleum Coke

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	5.190
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	127.820
2nd high 24-hr	306	600.66	3839.64	1247.0	79	64	24	97.516
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	591.585
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	411.555
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	638.190
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	636.677

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	13.957
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	375.500
2nd high 24-hr	335	600.81	3839.49	1431.0	79	275	24	270.855
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	1665.050
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	1206.050
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	1871.041
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	1863.919

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.454
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	30.547
2nd high 24-hr	302	600.66	3839.49	1329.0	79	275	24	24.304
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	141.234
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	96.232
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	148.334
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	148.127

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	2.993
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	80.224
2nd high 24-hr	335	600.81	3839.49	1431.0	79	275	24	57.877
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	356.385
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	257.695
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	399.775
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	398.277

Table 3 Dispersion Model Results (cont'd)

IGCC Petroleum Coke Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	3.647
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	83.441
2nd high 24-hr	302	600.66	3839.49	1329.0	79	275	24	63.415
High 3-hr	227	600.21	3839.04	1304.0	82	354	24	297.084
2nd high 3-hr	298	600.51	3839.34	1309.0	82	287	21	233.911
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	361.187
2nd high 1-hr	176	599.91	3838.74	1315.0	82	61	4	360.757

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	5.725
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	184.353
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	122.946
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	788.664
2nd high 3-hr	177	599.91	3838.44	1423.0	79	334	6	522.705
High 1-hr	214	600.06	3838.74	1417.0	82	5	2	803.094
2nd high 1-hr	214	600.06	3838.74	1417.0	79	64	22	800.847

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.255
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	24.150
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	19.417
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	93.337
2nd high 3-hr	66	599.16	3837.69	1151.0	82	100	21	69.978
High 1-hr	176	599.91	3838.74	1315.0	82	61	4	103.333
2nd high 1-hr	176	599.91	3838.74	1315.0	82	5	2	103.299

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	1.258
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	39.931
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	26.378
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	166.870
2nd high 3-hr	177	599.91	3838.44	1423.0	79	334	6	110.677
High 1-hr	214	600.06	3838.74	1417.0	82	5	2	170.597
2nd high 1-hr	214	600.06	3838.74	1417.0	79	64	22	170.153

Table 3 Dispersion Model Results (cont'd)

IGCC/C Petroleum Coke

SO$_2$ Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.826
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	40.043
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	31.884
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	181.392
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	125.192
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	195.265
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	194.964

NO$_x$ Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.706
High 24-hr	298	600.51	3839.34	1309.0	79	25	24	91.816
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	72.069
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	408.140
2nd high 3-hr	233	600.21	3839.19	1219.0	79	249	24	301.276
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	471.112
2nd high 1-hr	2557	600.00	3839.00	1229.0	80	194	1	469.584

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.049
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	19.221
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	17.385
High 3-hr	194	600.06	3839.19	1131.0	82	354	24	73.044
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	249	24	59.248
High 1-hr	136	599.61	3838.59	1168.0	80	197	2	96.076
2nd high 1-hr	2557	600.00	3839.00	1229.0	79	249	24	89.790

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.720
High 24-hr	298	600.51	3839.34	1309.0	79	25	24	18.325
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	13.957
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	82.171
2nd high 3-hr	233	600.21	3839.19	1219.0	79	249	24	59.077
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	92.373
2nd high 1-hr	167	599.91	3838.89	1226.0	80	194	1	92.260

Table 3 Dispersion Model Results (cont'd)

COMBINATION

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.857
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	41.227
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	32.781
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	185.040
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	129.436
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	201.183
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	200.859

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2514	599.00	3837.00	1278.0	82	365	24	8.651
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	228.617
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	178.188
High 3-hr	226	600.21	3838.89	1399.0	80	366	3	981.346
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	802.064
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	1169.318
2nd high 1-hr	167	599.91	3838.89	1226.0	80	197	2	1166.337

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.225
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	25.237
2nd high 24-hr	273	600.51	3839.49	1234.0	79	275	24	20.686
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	101.362
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	249	24	81.114
High 1-hr	148	599.76	3838.74	1196.0	79	249	23	125.733
2nd high 1-hr	2557	600.00	3839.00	1229.0	79	249	24	122.567

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	38	598.86	3836.79	1237.0	82	365	24	7.331
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	193.946
2nd high 24-hr	265	600.36	3839.34	1231.0	79	275	24	145.373
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	890.142
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	672.559
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	976.140
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	972.358

Table 3 Dispersion Model Results (cont'd)

COMBINATION Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.467
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	28.087
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	22.881
High 3-hr	164	599.91	3839.04	1131.0	80	366	3	109.372
2nd high 3-hr	66	599.16	3837.69	1151.0	82	100	21	82.575
High 1-hr	2557	600.00	3839.00	1229.0	80	366	1	114.513
2nd high 1-hr	167	599.91	3838.89	1226.0	80	295	23	113.959

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	4.981
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	131.755
2nd high 24-hr	297	600.51	3839.64	1172.0	79	64	24	92.206
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	531.951
2nd high 3-hr	2557	600.00	3839.00	1229.0	82	309	3	375.320
High 1-hr	167	599.91	3838.89	1226.0	82	61	4	566.487
2nd high 1-hr	167	599.91	3838.89	1226.0	82	5	2	566.404

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.437
High 24-hr	194	600.06	3839.19	1131.0	79	25	24	30.339
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	25.073
High 3-hr	164	599.91	3839.04	1131.0	80	366	3	118.223
2nd high 3-hr	229	600.21	3839.34	1150.0	82	287	21	86.474
High 1-hr	136	599.61	3838.59	1168.0	80	197	2	140.761
2nd high 1-hr	148	599.76	3838.74	1196.0	80	211	20	130.779

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2383	594.00	3831.00	1360.0	82	365	24	5.212
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	144.485
2nd high 24-hr	297	600.51	3839.64	1172.0	79	64	24	99.588
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	597.728
2nd high 3-hr	229	600.21	3839.34	1150.0	82	287	21	398.311
High 1-hr	2557	600.00	3839.00	1229.0	79	26	3	605.620
2nd high 1-hr	2557	600.00	3839.00	1229.0	80	366	1	604.837

Table 3 Dispersion Model Results (cont'd)

COMBINATION Oil

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	38	598.86	3836.79	1237.0	82	365	24	2.753
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	67.450
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	51.994
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	286.635
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	6	227.101
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	332.331
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	331.495

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2514	599.00	3837.00	1278.0	82	365	24	8.651
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	228.617
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	178.188
High 3-hr	226	600.21	3838.89	1399.0	80	366	3	981.346
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	802.064
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	1169.318
2nd high 1-hr	167	599.91	3838.89	1226.0	80	197	2	1166.337

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	38	598.86	3836.79	1237.0	82	365	24	1.684
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	40.543
2nd high 24-hr	273	600.51	3839.49	1234.0	79	275	24	32.253
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	172.884
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	133.291
High 1-hr	148	599.76	3838.74	1196.0	79	249	23	200.788
2nd high 1-hr	148	599.76	3838.74	1196.0	80	194	1	198.740

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	38	598.86	3836.79	1237.0	82	365	24	7.331
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	193.946
2nd high 24-hr	265	600.36	3839.34	1231.0	79	275	24	145.373
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	890.142
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	672.559
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	976.140
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	972.358

Appendix K ¾ FORM AD 1006 (replicated)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART 1 (*To be completed by Federal Agency*)	Date of Land Evaluation Request Jan. 25, 1996
Name Of Project Bellefonte IGCC Repowering Project	Federal Agency Involved Tennessee Valley Authority
Proposed Land Use Electric Power Plant	County And State Jackson Alabama
PART II (*To be completed by SCS*)	Date Request Received by SCS 2/1/96

Does the site contain prime, unique, statewide or local important farmland? Yes No (*If no, the FPPA does not apply - do not complete additional parts of this form*). X ☐ ☐	Acres Irrigated	Average Farm Size 189
Major Crop(s) Cotton, Soybean, Patatoes	Farmable Land In Govt. Jurisdiction Acres: 355,778 %50.7	Amount Of Farmland As Defined in FPPA Acres: 151,939 %22.1
Name Of Land Evaluation System Used LESA	Name Of Local Site Assessment System	Date Land Evaluation Returned by SCS 3/4/96

		Alternative Site Rating			
PART III (*To be completed by Federal Agency*)		Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly		1610			
B. Total Acres To Be Converted Indirectly		0			
C. Total Acres In Site		1610			
PART IV (*To be completed by SCS*) Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		437.9			
B. Total Acres Statewide And Local Important Farmland					
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		2.9			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		45.3			
PART V (*To be completed by SCS*) Land Evaluation Criterion Relative Value Of Farmland To Be Converted (*Scale of 0 to 100 Points*)		44			
PART VI (*To be completed by Federal Agency*) Site Assessment Criteria (*These criteria are explained in 7 CFR 658.5(b)*)	Maximum Points				
1. Area In Nonurban Use	15	12			
2. Perimeter In Nonurban Use	10	8			
3. Percent of Site Being Farmed	20	1			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	5			
6. Distance To Urban Support Services	15	0			
7. Size Of Present Farm Unit Compared To Average	10	10			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	0			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	1			
TOTAL SITE ASSESSMENT POINTS	160	42			
PART VII (*To be completed by Federal Agency*)					
Relative Value Of Farmland (*From Part V*)	100	44			
Total Site Assessment (*From Part VI above or a local site assessment*)	160	42			
TOTAL POINTS (*Total of above 2 lines*)	260	86			

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 - Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 - Originator will send copies A, B, and C together with maps indicating locations of site(s), to the Soil Conservation Service (SCS) local field office and retain copy D for their files. (Note: SCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the SCS State Conservationist in each state).

Step 3 - SCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide, or local important farmland.

Step 4 - In cases where farmland covered by the FPPA will be converted by the proposed project, SCS field offices will complete Parts II, IV, and V of the form.

Step 5 - SCS will return copies A and B of the form to the Federal agency involved in the project. (Copy C will be retained for SCS records).

Step 6 - The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 - The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions, list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

PART III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g., highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in 658.5(b) of CFR. In cases of corridor-type projects such as transportation, powerline, and flood control, criteria #5 and #6 will not apply and will be weighed zero; however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160.
Example: If the site assessment maximum is 200 points and alternative Site "A" is rated 180 points:
Total points assigned Site A = 180 x 160 = 144 points for Site "A."
Maximum points possible 200

Appendix L ¾ BEST MANAGEMENT PRACTICES (BMPs)

1.0 BMPs During Construction Acitivites

State law and Alabama Department of Environmental Management (ADEM) regulations require that appropriate, effective Best Management Practices (BMPs) for the control of pollutants in storm water run-off be fully implemented and maintained for all construction and land disturbance activities regardless of permit status or size of the disturbance to prevent/minimize discharges of sediment and other pollutants to waters of the State of Alabama. Discharges of pollutants resulting from failure to implement effective BMPs are considered unpermitted discharges to state waters. [1]

A person, company, or construction operator is required to take all measures necessary to prevent sediment and other pollutants in water used in the construction process or storm water runoff from disturbed areas, from leaving the construction site or associated areas regardless of the permit status or size of the disturbance. Phase I of the storm water regulations require an operator to apply for a permit from ADEM for construction and land disturbance activities and associated areas that exceed five acres or is part of a larger common plan of development or sale that may eventually exceed five acres. Phase II of the storm water regulations currently under consideration may result in changes to current requirements or may require smaller construction and land disturbance sites to obtain a permit in the future. [1]

On August 1, 1992, ADEM issued a National Pollutant Discharge Elimination System (NPDES) General Permit (GP) ALG610000 for Storm water runoff activities, and associated areas. This GP was developed and issued to allow industry a simpler method to comply with federal regulations for discharging storm water and would expire on July 1, 1997. The GP would be reissued at that time, with any necessary changes, for a period not to exceed five years. The construction GP requires a company or individual to use BMPs to control storm water run-off. The GP requires inspections on a monthly basis, in response to rainfall accumulation, and as often as necessary to insure that adequate BMPs have been implemented. The permittee must also monitor representative discharges from the site a minimum of once every six months. These samples are to be analyzed for pH, TSS, SS, flow, and under some circumstances Oil and Grease, BOD5, and COD. Upstream and downstream turbidity in the receiving stream must be monitored to ensure compliance with State water quality standards. Onsite precipitation must also be recorded. [1]

The State of Alabama Nonpoint Source Management Program incorporates BMPs with state-wide applicability for control of erosion from construction activities that were previously developed by the Birmingham Regional Planning Commission as part of a 208 Planning project and published in a document titled Best Management Practices for Controlling Sediment and Erosion from Construction Activities. [2]

BMPs are measures to minimize runoff from a construction site. There are 3 types of BMPs that should be taken into consideration before, during and after the construction process. [3] They include:

1.1 Sediment and Erosion Control BMPs

Immediate measures to control sedimentation include use of:
- silt fences,
- staked hay bale rows,
- netting or mesh,
- rock filter check dams, etc. and
- small catch basins, if necessary.

Immediate measures to control erosion include:
- applying hay mulch,
- seeding with temporary grass mix,
- hydro-seeding,
- reducing slopes,
- netting or mesh, and
- cover with gravel or rock, etc.

Long term measures should be done as soon as possible include:
- proper grading and
- permanent revegetation.

1.2 Good Housekeeping BMPs for Pollutants Other Than Sediments

- Pesticides
  - Strict adherence to recommended practices for the use of insecticides, herbicides, and rodenticides.

- Petrochemicals

1. Used oil, grease and rags should be disposed of in proper receptacles and kept out of contact with rainfall or runoff water.
2. The dumping of waste materials, including used petrochemical containers, at the site should be prohibited.
3. Liquid and solid waste should be collected in containers and regularly transported from the site to sanitary landfills.
4. Equipment repairs and washing should be undertaken at specific locations and the runoff collected in holding ponds.

- Fertilizers
  1. Avoid applications during bad weather.
  2. Plant during periods of best plant generation to minimize use of fertilizer.
  3. Fertilize and lime according to a soil test report.

1.3 Storm water Management BMPs

- Increasing infiltration in the drainage area.
- Decreasing the time of run-off concentration by utilizing existing stable drainage ways.
- Providing temporary storage facilities to release stored water at controlled rates.

2.0 BMPs during Operation

These BMPs were identified in a current site Best Management Practices and Storm Water Pollution Prevention Plan from a TVA fossil plant located in Alabama.

2.1 Existing Baseline Best Management Practices

2.1.1 Good Housekeeping and Material Management

To maintain a high level of program effectiveness, the facility should include the following good housekeeping procedures:

1. Incorporate information sessions on good housekeeping practices into the facility’s employee training program.
2. Display signs reminding employees of the importance of good housekeeping.
3. Clearly identify the location of brooms, vacuums, absorbents, foams, neutralizing agents, and other spill response equipment.

4. Ensure that spill cleanup procedures are understood by employees.
5. Promptly remove spilled materials including coal spillage and ash wastes to prevent pollution of runoff.
6. Maintain clean floors, ground surfaces, and paved area by using brooms and sweepers.
7. Regularly pick up and dispose of waste materials, used drums, and trash.

A clean and orderly work environment reduces the probability of accidental spills caused by the mishandling of equipment and materials. The following good housekeeping measures would be adopted in locations containing hazardous substances:

1. Neat and orderly storage of containers.
2. Prompt removal of small spills.
3. Provisions for storing containers or drums to prevent them from being struck by pedestrians or mobile equipment.

Improper storage and handling of materials can result in the release of materials to the environment. Proper storage and handling techniques include the following:

1. Raw materials, such as coal, should be stockpiled in trimmed compacted piles to avoid erosion by wind and water.
2. Drum and material storage areas should be neatly organized in designated areas. Used drums should be disposed of promptly.

Dry hazardous substance spillage must be swept, vacuumed, or otherwise cleaned up in a manner such to prevent the possible washdown to floor drains or drainage ditches. Liquid hazardous substance spillage on the ground or floor would be cleaned up using absorbent or other methods to prevent further transport to other areas and possibly surface waters.

All toxic and hazardous substance containers must be labeled to show the substance type, expiration date, and health hazards. The exception to the rule of full disclosure is when a hazardous substance transferred to a portable container for immediate use and would remain in the vicinity of the user. In this case, the portable container only needs to be marked with the name or type of product using a temporary marker (such as a grease pencil).

An updated inventory of all materials (hazardous and nonhazardous) should be maintained onsite.

2.1.2 Materials Compatibility

Materials compatibility encompasses three aspects: compatibility of the material with the storage container, compatibility of the container with the environment, and compatibility of substances during storage and usage. Periodically, the BMP Program Committee would evaluate the effectiveness of the current compatibility practices by reviewing inspection record and past incidents.

All hazardous substance containers would be clearly marked. This identification would ensure positive identification of the contents by all users or handlers.

All hazardous substance containers would be compatible with their contents. The compatibility of currently used products with their containers is based on experience. New hazardous products would not be transferred from their original shipping container until a determination is made about the compatibility of the substance.

Compatibility of different hazardous substances when mixed is defined as the absence of any significant physical or chemical effects. Mixing hazardous substances that are incompatible can result in a violent reaction, fire, explosion, or release of dangerous vapors. New processes that involve the mixing of one or more hazardous substances must be reviewed by personnel with expertise in reaction chemistry before being approved for use. Hazardous substance containers would be designed, constructed, maintained, and located to ensure compatibility with their environments.

2.1.3 Hazardous Substance Spill Prevention Requirements

Spill prevention procedures should be designed to prevent any material from breaching primary containment. Spill prevention for petroleum-based substances would be addressed in the plant's SPCC *Plan*. The following spill prevention procedures address all materials stored, used, or produced at the plant:

1. Incorporate information sessions on good spill prevention practices into the facility's employee training program.

2. Display signs reminding employees of the procedure to be followed in the event of a spill.
3. Maintain accurate and updated records of reported spills.
4. Review spill reports and implement corrective action immediately after the incident.
5. Maintain an active inventory of spill response supplies and equipment.
6. Maintain a list of personnel trained in spill response and cleanup procedures.
7. Regularly review and update material handling practices to avoid spills.

During transfer operation of hazardous substances, the following procedures should be followed:

1. Trained personnel familiar with the operation should oversee the transfer.
2. The available capacity of the receiving tank should be determined.
3. Audible and/or visual overfill warning systems should be provided.
4. A warning system (lights, physical barriers, and signs) should be provided to prevent the vehicle from leaving before lines are disconnected.
5. Drip pans should be placed under all connections.
6. Emergency spill response equipment and supplies should be present during transfer operations.
7. All storm drains, catch basins, or other conveyances with the potential to receive spillage should be covered or blocked.
8. During transfer, all lines and connections should be continuously observed to ensure leaks/spills are detected as soon as possible.
9. If any leaks/spills are detected during transfers, the operation should be terminated immediately and necessary repairs or corrections made before continuing transfer operations.
10. Transfer operations should be documented and a check sheet of transfer procedures completed and signed.

During the loading and unloading of hazardous substances, the following procedures should be followed:

1. Trained personnel should oversee loading and unloading of hazardous substances.
2. Emergency spill response equipment and supplies should be present during loading and unloading of hazardous substances.
3. All storm drains, catch basins, or other conveyances with the potential to receive spillage should be covered or blocked.

2.1.4 Security

All areas handling or storing hazardous substances would be sufficiently secured and/or guarded to prevent access by unauthorized persons. Requirements such as patrolling, fencing, traffic control, visitor passes, and secured entrances are addressed in the *Joint Security Plan for Fossil Plants.* [4]

Drain valves and pump starter controls that can cause a discharge of hazardous substances into the environment shall have adequate security measures to ensure that they remain in the closed position or electrically isolated at a secure location when in non-operating or non-standby status.

Loading and unloading connections from pipelines and tanks would be plugged, capped, or blank-flanged when not in service.

Facility lighting would be commensurate with the type and location of the facility. In determining the type and location of lighting, consideration would be to the areas that have a high potential for leaks during darkness and areas prone to vandalism.

If a hazardous substance is spilled, the requirements of the plant's *Hazardous Waste Contingency Plan* must be implemented regarding spill containment and cleanup.

The cleanup of hazardous substance spills should be accomplished to the greatest extent practicable by mechanical means such as sweeping, vacuuming, absorbing, and/or pumping. Spills of dry hazardous substance should be cleaned up without the addition of any liquid substances if possible. Solvents, detergents, water, and/or chemical agents would not be used if discharging a significant amount of the hazardous substance, the liquid agent or a combination of the substance and liquid agent to the environment is possible. Spill cleanup should include provisions to prevent the eventual discharge of hazardous substances by leaching, washing, or percolating the removed contaminated soil or the equipment decontamination residue. The disposal of hazardous waste resulting from cleanup activities (i.e., used absorbent materials and/or cleanup residues) must be in accordance with all federal and state regulations. Technical assistance for hazardous substance spill cleanup and hazardous waste disposal is available from Environmental Affairs.

2.1.5 Training Program Requirements

This section outlines the needed training associated with pollution prevention and hazardous substances management. In general, the Environmental Training Procedure provides for the following:

- In-depth pollution prevention for new employees and
- Annual refresher courses

Employee training program topics include the following:

- Environmental Awareness Modular
    - Good housekeeping
    - Material handling and storage
    - General environmental laws and facility compliance requirements
- SPCC Spill Prevention Modular
    - Spill prevention techniques
    - Facility spill plan overview
    - Maintenance activities for spill prevention
    - Spill reporting

2.2 Advanced Best Management Practices

Advanced BMPs are methods used in addition to the baseline BMPs and are specific to groups of chemical substances and sources of chemical substances. An advanced BMP is any practice that reduces the risk of exposure of a hazardous substance to the environment. These practices can be grouped into the following categories: prevention of release, control through containment and flow diversion, mitigation of the release, cleanup of the release, treatment of the release, and disposal of the material.

2.2.1 Generic Advanced BMPs

Examples of each type of advanced BMPs are provided below to illustrate common effective methods.

> <u>Prevention</u> - Prevention BMPs include monitoring of inventory levels to minimize storage, nondestructive tank integrity testing, proper labeling of containers, and covering volatile liquids when not in use.
> <u>Containment</u> - Containment BMPs are methods used to physically contain a release of material. Flow diversion and secondary containment are examples.
> <u>Mitigation</u> - Mitigation BMPs are cleanup and treatment methods used once a hazardous substance spill has been contained. Mitigation minimizes danger to plant personnel and the environment.
> <u>Cleanup</u> - Cleanup BMPs include physical, mechanical, and chemical methods.
> <u>Treatment</u> - Treatment BMPs are used to reduce the potential impact of the material on the environment. This may consist of treating the material before disposal or separating the material for recycling.
> <u>Ultimate Disposal</u> - Disposal BMPs are associated with final disposal of a spilled material. Disposal alternatives include discharge to a receiving water (after proper treatment), reclamation, and contract disposal.

2.2.2 Specific Advanced BMPs

This section presents specific advanced BMPs recommended for implementation. These advanced BMPs address areas of concern observed as part of the Hazardous Substances Management and Risk Assessment for the facility.

The following are procedural advanced BMPs:

Waste Minimization Program

A program to reduce waste products produced at the facility should be developed and implemented. The EPA publication *Waste Minimization Assessment Manual (EPA625/7-88/003)* can assist with the development and implementation of a program. The guidelines listed below should be followed as a minimum for a waste minimization program:

- Obtain corporate commitment to a waste minimization initiative,
- Establish a waste minimization task force including personnel of varying expertise and experience,
- Prepare a policy statement to describe the intent and goals of the program signed by the plant manager,
- Establish measurable waste reduction goals to be achieved by the program,
- Identify waste generating sites and processes,
- Conduct a detailed site inspection,
- Prepare an assessment of each waste product detailing alternatives that would reduce waste produced and the associated costs (include using less hazardous products, adjusting operations and procedures, internal recycling of wastes, and onsite treatment),
- Formally analyze the feasibility of alternatives and adopt feasible alternatives,
- Prepare an implementation schedule with responsibilities assigned, and
- Measure the program effectiveness at least annually while continuing the reduction assessment.

Hazardous Material Management Program

The following guidelines should be followed in developing a hazardous materials management program:

- Develop a baseline inventory of existing hazardous materials,
- Evaluate/develop a standard list of hazardous material and adopt as an approved list,
- Evaluate/improve requisition and procurement process,
- Evaluate/improve work practices and tracking, and
- Evaluate/improve waste management.

Consolidated Facility Plan

Prepare a consolidated oil spill and hazardous substance response procedure.

The following are physical advanced BMPs:

Drain Blocks
Evaluate the feasibility of using permanent or temporary drain blocks in areas recommended.
Caustic and Acid Transfers
Develop a feasibility study for providing containment under the caustic and acid transfer connections. Also, evaluate the feasibility of using temporary drain blocks during acid and caustic transfers.
Sluice Lines
Conduct a feasibility study with an implementation schedule for developing a containment system for the ash sluice lines.

3.0 References

1. Alabama Department of Environmental Management, Permits/Compliance Section, Mining and Nonpoint Source Branch, Handout: “Stormwater Runoff Construction, Mining, and Land Disturbance General Permit Requirements,” February 1, 1996.
2. ADEM, State of Alabama Nonpoint Source Management Program, April 1989.
3. Birmingham Regional Planning Commission, “Best Management Practices for Controlling Sediment and Erosion from Construction Activities,” Sediment and Erosion Control BMP Manual, August 1980.
4. Tennessee Valley Authority, “Joint Security Plan for Fossil Plants.”

Appendix M ¾ Evaluation of Alternatives for Combustion Waste Disposal Sites for the Pulverized Coal Conversion Option

1.0 Background

Conversion Option 1 consists of the construction of four 600 MW boilers designed to burn pulverized coal. Each boiler would be equipped with flue gas desulfurization systems and fabric filters or electrostatic precipitators. The combustion of pulverized coal results in the generation of combustion wastes which require disposal and of byproducts which could be marketed. Three solids streams are produced during normal operation: fly ash (from the fabric filters), bottom ash (from the boilers), and gypsum (from the flue gas desulfurization).

TVA would attempt to market or otherwise utilize (subsidize use, etc.) the bottom ash and gypsum produced during operation of the PC plant. Despite this, a considerable quantity (mostly off-specification material), would require disposal. To be conservative, TVA assumed that none of the combustion solids would be marketed and calculated the life of available disposal areas on this basis.

The wastes/byproducts generated for the PC Option are ash, flyash, and gypsum. The largest stream is gypsum at slightly over 1.1 million cubic yards, followed by fly ash at 771,000 and bottom ash at 228,000 cubic yards. The land area required for storage of these materials depends on the pile height, pile slope, berming technique and the shape of the available area. Three disposal choices were considered: on-site, offsite nearby, and offsite at Widows Creek Fossil Plant.

2.0 Screening of Disposal Site Scenarios

Widows Creek now operates a flue gas desulfurization system for removal of sulfur and operates a fully permitted gypsum/ash handling and storage facility. Despite the pressures that would be exerted on the available storage at Widows Creek, trucking unmarketable bottom ash, fly ash and gypsum from Bellefonte to Widows Creek (located approximately 15 miles to the northeast) is an option. Rail or barge transport is not considered economically feasible for this option because of the additional handling involved for these two modes. However, trucking wastes to Widows Creek involves a considerable cost and offers additional significant environmental and social impacts. The costs are associated with purchasing and maintaining a fleet of trucks, gasoline, and labor for truck drivers. The environmental and social impacts include increased wear and tear on highway surfaces, higher dust emissions from haul trucks, reduced highway service availability, and higher accident potential to motorists on plant access roads and U.S. Highway 72. For these mostly qualitative reasons, trucking of wastes to Widows Creek was eliminated as an option.

Another offsite disposal option would be to use land near Bellefonte that could be purchased. As with the Widows Creek option, trucking waste would be preferable over rail and barge because of the inefficiencies in loading and unloading for such short haul distances. The same costs and environmental and social impacts associated with transporting wastes, even for a short distance, would be undesirable as described above (even though haul distances would be greatly reduced; probably less than 5 miles). Utilizing offsite land would also involve significant additional costs for environmental assessments and permitting as compared with an onsite disposal option. Additional significant costs would be incurred during the purchase of suitable land from private owners located in the vicinity. Possibly associated with this option is the difficult process of acquiring land from property owners who do not wish to sell their land. For these reasons, offsite disposal near the Bellefonte site was eliminated as an option.

The third disposal option, and the one selected for accommodating the combustion residue generated at Bellefonte for the PC options, is to use land TVA currently owns at the Bellefonte site. Bellefonte consists of approximately 1600 acres divided among developed (constructed upon) site, a hilly ridge between most of the developed area and the river and some currently unused land that is mostly flat. Based on past experience it has generally been more economical to dispose of large quantities of waste products from coal fired power plants as close as possible to the source of their generation. This is due to the high transportation or pumping costs. Areas should be near existing roadways or situated to allow the construction of access roadways. Normally, bottom ash and fly ash are trucked and the gypsum is pumped to storage sites, versus other modes of delivery such as rail or conveyors.

3.0 Site Criteria

Storage/disposal areas should meet the following criteria:

- First the land used should be relatively flat. Storage/disposal areas in flat terrain are much cheaper to construct and operate than in hilly terrain, and generally result in fewer environmental impacts. For example, it is much easier and less expensive to construct liners and develop the rim-ditch method of gypsum storage in a flat area than in an area with hilly terrain. Leachate and surface runoff diversion, recovery and treatment systems, which rely heavily on gravity induced flow, would be less costly to construct and maintain on flat terrain. Less excavation and site preparation is required to be able to accept combustion residues and later recovery for utilization would be enhanced.

- Storage/disposal areas should minimize impacts to environmental resources where practical, including terrestrial habitat (i.e., wooded areas), wetlands, and natural buffer zones which provide visual and noise insulation between industrial activities and nearby residents.

- Siting of storage/disposal areas should avoid features of Bellefonte in use for another critical purpose such as buildings, power line rights-of-way, surface water bodies or treatment ponds, switchyards, or vehicle parking areas.

4.0 Characteristics of Potential Sites

Five potential on-site areas for storage were evaluated (see Figure in Appendix B). All of these areas were outside of wetlands. Characteristics and features of the five areas are presented in the following:

1. Area 1 to the north of the power plant training facility, bisected by the north access road (200 acres). This area is bounded by wetlands to the west, the TVA property boundary to the north, existing disposal facilities to the east, and the training center and proposed recycle basin to the south. This area is generally treeless which would facilitate construction and site preparation activities. In addition, the runoff water from the site can be sent back to the recycle basin without pumping.

However, this area does extend slightly into the 100 year floodplain. The area would not be large enough to store 20 years of gypsum (a conversion design criterion) if no disposal operations were allowed in the 100 year floodplain. It is not anticipated that this small encroachment on Town Creek would have any affect on the 100-year flood levels. The utilization of this area would result in the displacement of 123 acre feet of reservoir storage capacity. Approximately one-fifth of the acreage is within the 100 year floodplain, all on the northwest border of the site which is adjacent to Town Creek Embayment.

2. Area 2 located upstream of the plant cooling water intake channel and between Area 1 and Guntersville Lake (130 acres). This area contains several formerly used disposal sites, including discarded asbestos, grout, and waste paint and solvents. These sites are being addressed by TVA in a remediation effort as part of a state approved closure plan. It would be expensive to develop a new storage area on top of existing disposal facilities. In addition, the area is hilly and would be more difficult than the flat area for site preparation and storage of waste materials. The area is primarily wooded thereby providing terrestrial habitat for local species of birds and animals. This area could be used in the future if the primary storage areas for ash and gypsum are filled to capacity. Approximately 25 acres on the northeast border of the site is located within the 100 year floodplain.

3. Area 3 is the area to the north of the power plant employee parking lot (110 acres). The area is the closest to the project location of the pulverized coal plant and therefore trucking/conveying costs would be minimized. The area is relatively flat and a disposal facility would be easy to construct thereby minimizing costs for site development. The area is adjacent to the proposed location of the recycle basin so runoff water can be reused for the power plant. However, this area does extend slightly into the 100-year flood plain. However, the area would not be large enough to store 20 years of fly ash and bottom ash or gypsum if no disposal operations were allowed in the 100-year flood plain. The utilization of this area would result in the displacement of 149 acre feet of reservoir storage capacity. Approximately one-fifth of the acreage is within the floodplain, all on the northwest border of the site which is adjacent to Town Creek Embayment.

4. Area 4 is located to the southwest of the power plant adjacent to proposed coal yard location (135 acres). This land is a potential site for disposal/storage, because it is flat and open. It is relatively far removed from the generation source and would incur the highest transportation cost of the available sites. There are major (500kV) transmission lines passing through the middle of the site. The relocation of these lines would be required to enable full utilization of the storage capacity of the site

(combustion residue could not be stacked beneath the line right-of-way. It would be very expensive to move these lines nearer the Bellefonte plant boundary or offsite (which would involve acquiring new right-of way from local property owners).The site is immediately adjacent to public road (Jackson County 33) and the Bellefonte main entrance road, making it visible to passersby on Jackson County road 33 and visitors to Bellefonte. The utilization of this area would result in removal of approximately 75 acre feet from reservoir storage capacity. Over one-third of the site is at an elevation that is below the 500 year flood plain.

5. Area 5 is located to the south and southeast of the main plant center and between the plant and the river (1340 acres). The area consists of two sub-areas situated to either side of the roadway connecting the plant proper to the barge unloading area. The proposal calls for the construction of coal and limestone conveyors along the existing road bed. This area would be very expensive to develop due to its rough terrain and heavy woods. The woods provide terrestrial habitat for numerous local species of birds and animals. This area is visible from the river and special precautions would be necessary to prevent material from getting washed into the river. There are no good locations along the river to construct a sedimentation basin for surface water runoff collection and treatment.

5.0 Conclusions

Area 1 was selected as the primary gypsum disposal area and would provide 19 years of capacity (using TVA design guidelines) at maximum plant operation, based on the conservative assumption of no marketing of this material. At a pile height of 800 feet above mean sea level, this area would provide storage for 30.7 million cubic yards of gypsum. Based on the above discussion of potential onsite areas, Area 1 is the only practicable alternative for disposal of gypsum.

Area 3 was selected as the primary bottom ash and fly ash disposal area and would provide at least 14 years of capacity (using TVA design guidelines) at maximum plant operation, based on the conservative assumption of no marketing of these materials. At a pile height of 805 feet above mean sea level, this area would provide storage for 14 million cubic yards of ash and flyash. Based on the above discussion of the potential onsite areas, Area 3 is the only practicable alternative for disposal of fly ash and bottom ash.

Appendix N ¾ SUMMARY OF APPROACH IN FORECASTING NOISE LEVELS AT RECEPTOR LOCATIONS

Noise levels were predicted at each of the four receptor locations for each power plant option and for truck and automobile traffic passing along the access road connecting the plant to U. S. Highway 72.

Methodology

For power plant noise modeling, predictive methods described in Edison Electric Institute's Power Plant Environmental Noise Guide, 1984, (EEI) were adapted to this project. Equipment noise source levels and predictive algorithms from EEI were used where possible. Locations of sources and receptors were provided by TVA and terrain elevation features were obtained from USGS maps. For forecast of vehicle traffic, methods adapted from Harris's, Noise Control Handbook, were used.

Table 1 Combinations Of Equipment Projected For Each Of The Options

	Receptor Number	1		2		3		4	
	Equiv. Day/night or Equiv. Sound Level (dBA)	Ldn	Leq	Ldn	Leq	Ldn	Leq	Ldn	Leq
Pulverized Coal	Plant Operation	57	50	52	46	43	37	56	49
	Plant Operation With Flare	NA	NA	NA	NA	NA	NA	NA	NA
	Plant Operation With Barge Unloading	57	50	52	46	43	37	57	52
NGCC	Plant Operation	43	37	35	29	21	15	14	9
	Plant Operation With Flare	NA	NA	NA	NA	NA	NA	NA	NA
	Plant Operation With Barge Unloading	NA	NA	NA	NA	NA	NA	NA	NA
IGCC	Plant Operation	55	49	45	39	35	28	56	49
	Plant Operation With Flare	NA	64	NA	62	NA	53	NA	60
	Plant Operation With Barge Unloading	55	49	45	39	35	28	57	52
IGCC/C	Plant Operation	55	49	45	39	33	27	47	41
	Plant Operation With Flare	NA	64	NA	62	NA	53	NA	57
	Plant Operation With Barge Unloading	55	49	45	39	33	27	48	44
Combination	Plant Operation	55	49	45	39	34	28	53	46
	Plant Operation With Flaring	NA	64	NA	62	NA	53	NA	57
	Plant Operation With Barge Unloading	55	49	45	39	34	28	54	49

Sound Power Level (Lw)

Sound power level of each source was obtained from both EEI and supplemented by TVA staff and TVA contractors.

Acoustic Center

At large distances, an array of noise sources would acoustically behave as a single source. The combination of noise sources may be represented as a single source by combining all sources at a single location using ratioing techniques. This location may then be used as the acoustic center for prediction purposes. Equipment of the power plant for Locations A and B in Figure 4.2.17-1 of this EIS were analyzed and the acoustic center calculated for each option. The coal dock, being at a large distance from the power block, was treated as a separate acoustic center.

Attenuation of Noise Emissions

Attenuation of noise emissions from source to receptor was determined by combining the effects of standard day atmospheric molecular absorption (Am), hemispherical spreading (Ah), barrier of terrain elevation (At), and effects of ground attenuation (Ag). Acoustically "soft ground" was used in the latter attenuation component.

Source - Receptor Relationship

The sound level at a receptor location of interest was approximated by the relationship:

$$Lr = Lw - 10 \times \log R - Am - Ah - Ag - At$$

where:

Lr is the sound level at a receptor,
Lw is the sound power level of the source at its acoustic center,
R is the distance from the source to receptor,
Am is the attenuation in sound level as a consequence of molecular absorption,
Ah is the attenuation in sound level as a consequence of hemispherical spreading,
Ag is the attenuation in sound level as a consequence of ground effects, and
At is the attenuation in sound level as a consequence of terrain acoustical barrier effects.

Equivalent Day Night Sound Level (Ldn)

Once the sound level was determined at each receptor location, Ldn was calculated by logarithmically combining the daytime (0700-2200) and night time (2200-0700) sound levels and adding ten dB to the night-time values.

Traffic Noise Prediction

An algorithm for computing the equivalent continuous sound level (Leq) was adopted to forecast the sound level experienced by a receptor from the passing of trucks and automobiles on the access road to U. S. Highway 72.

$$Lr = Lref - 10xLog(Rr/Rref) - 5xLog(Rr/Rref)$$

where:

Lr is the equivalent continuos sound level (Leq) at the receptor location,
Lref is the sound level at a known distance from vehicle passage,
Rr is the distance from the vehicle to the receptor, and
Rf is the distance from the reference location to the receptor,

Once the sound level and time of exposure to that level was determined at the receptor location, Ldn was calculated by logarithmically combining the daytime (0700-2200) and night time (2200-0700) sound levels and adding ten dB to the night time values.

Assumptions And Inputs

Table 2 lists the assumptions and source inputs used in the modeling by option.

Table 2 Assumptions And Specific Source Inputs Used In The Modeling

Noise Source	PC	NGCC	IGCC	IGCC/C	Combination	EEI Ref.	Lw Basic Relationship
Power Block							
Net MW (unit based)	2,400	2,230	2,370	450	2,880		All in Overall SPL
Location	B	A	A	A	A		
Existing Steam Turbine	2	1	1	1	1		
(MW/Turbine)	1,200	700	850	260	1,200	4.8	Lw=113+4Log(MW)
Boilers	4	NA	NA	NA	NA	4.4	Lw=115+15Log(MW)
ID fans	4	NA	NA	NA	NA	4.54	Lw=42+10LogQ+20LogSP
(cfm/fan)	1,000,000	NA	NA	NA	NA		
Pumps and motors	30	30	30	30	30	4.24	Lw=113 Overall
(avg hp/motor)	5,000	5,000	5,000	5,000	5,000		
Gasification Units	0	0	8	4	4	4.34	Lw=89+10Log(hp)
(Compressors/unit)	0	0	4	4	4		
(avg hp/compressor)	0	0	5,000	5,000	5,000		
Combustion Turbines	0	9	8	1	7		
(MW/turbine)	0	170	190	190	240	Msmt.	72@426' (TVA comm)
Coal Yard							Overall SPL
Location	B	A	A	A	A		
Coal Crushers	4	NA	4	2	2	4.83	Data
Limestone Mill	4	NA	NA	NA	NA	4.9	Data
Conveyor Tower	4	NA	4	2	2	4.85	Data
Vehicles	4	NA	4	4	4	4.87	Lw=98+10Log(hp)
(hp/vehicle)	250	NA	250	250	250		
(duty cycle/vehicle)	0.25	NA	0.25	0.25	0.25		
Vehicular Traffic						Harris Hand Book Of Noise Control	
Trucks							
Haul Capacity (tons)	25	NA	25	25	25		
(no./hour)	14	NA	4	2	2		
Haul Period (hrs/day)	24	NA	Daytime	Daytime	Daytime		
Average Speed (mph)	30	NA	30	30	30		
Passenger							
(no./hour)	25	8	20	8	27		
Period (hrs/day)	24	24	24	24	24		
Average Speed (mph)	30	30	30	30	30		
Location	U. S. Highway 72 access road						
Flares						Hydrocarbon Processing, December, 1988	
Number	NA	1	1	1	1		General dBA
Elevation (feet)	NA	200	200	200	200		
Capacity (cal/second)	NA	115,360,000	115,360,000	115,360,000	115,360,000		Lw=10Log(G/R^2)+96
Coal Dock							
Bucket shell unloaders	2	NA	2	1	1	4.81	Data - 25% duty
location	river dock	NA	river dock	river dock	river dock		

Appendix O ¾ Permit Applicability and Requirements

1.0 Air Quality

1.1 Relevant Statutes and Regulations

State

(1) Law - Alabama Air Pollution Control Act of 1971, Act No. 769, Regular Session, 1971.
(2) Regulations:
  -- Alabama Air Pollution Control Regulations, Chapter 335-3-14
  -- Control of Particulate Emissions, Chapter 335-3-4
  -- Control of Sulfur Compound Emissions, Chapter 335-3-5
  -- Standards of Performance for New Stationary Sources, Chapter 335-3-10

Federal

(1) Law - Clean Air Act, as amended, 42 United States Code, Section 7401 et seq.
(2) Regulations:
  -- 40 CFR Part 60 - New Source Performance Standards (NSPS), Subpart GG Stationary Gas Turbines
  -- 40 CFR 60.250 - NSPS for Coal Preparation Plants
  -- 40 CFR Parts 51 and 52 - Prevention of Significant Deterioration of Air Quality
  -- 40 CFR Part 70 - Operating Permits
  -- 59 FR 12407-12450 and 59 FR 19402-19625 (amendments to 40 CFR Part 63) National Emission Standards for Hazardous Air Pollutants for Source Categories.
  -- 40 CFR Part 63, Synthetic Organic Chemical Manufacturing Industries (SOCMI)

1.2 Required Permits

- State construction permit which includes the federal Prevention of Significant Deterioration (PSD) and nonattainment permitting requirements. This permit must be issued prior to construction.
- State operating permit for operation of proposed IGCC/C plant.
- Federal Clean Air Act Title V Operating permit. This permit must be applied for within 12 months after the facility starts operation.

1.3 Applicability

Construction

The ADEM has received PSD and nonattainment permitting delegation from the U.S. EPA Region IV. Therefore, the state is the permit issuing entity; Region IV has the opportunity to comment on any draft permits. Jackson County is redesignated as attainment for all criteria pollutants, so nonattainment issues are not addressed here.

Each of the conversion options is a named source category; therefore PSD applies if emissions of any regulated pollutant are 100 tpy or greater (which all conversion options do) and therefore, PSD applies. Once PSD applies for any pollutant, PSD applicability for the remaining regulated air pollutants is determined by comparing the proposed maximum emission rates with PSD significance levels.

The estimated annual emissions and PSD significance levels are presented in the following table. The pollutants for which PSD applies are shown in bold type.

Estimated Annual Air Pollutant Emissions for Bellefonte Conversion Options

	Annual Emissions (tons/yr)					
Pollutant[a]	**PSD Significance Levels**	**PFBC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Particulate Matter	25	**2,269**	**427**	**1350**	**797**	**893**
PM10	15	-	-	-	-	-
Sulfur Dioxide	40	**20,948**	**76**	**7,500**	**2,581**	**2650**
Nitrogen Dioxide	40	**30,341**	**20,993**	**21,000**	**5,690**	**25,480**
Carbon Monoxide	100	**1,973**	**1,400**	**4,470**	**1,130**	**2,760**
VOC	40	-	-	**152**	**51**	29
Lead	0.6	0.54	-	0.557	0.009	0.009
Mercury	0.1	-	-	**5.16**	0.085	0.085
Beryllium	0.004	**0.027**	-	**0.32**	**0.005**	**0.005**
Fluorides	3	-	-	**12.3**	0.204	0.204
Sulfuric Acid Mist	7	0.96	-	**37.6**	**18.8**	**18.8**
Hydrogen Sulfide	10	-	-	**14.1**	7.05	7.05

a - PSD significance levels also exist for asbestos, vinyl chloride, and reduced sulfur compounds, but no data were available for the emission of these compounds for the conversion options.

Operation

An operating permit, under Title V of the Federal Clean Air Act Amendments of 1990, must be applied for within 12 months after start of operation.

In March 16 and April 22, 1994 amendments to 40 CFR Parts 60, 61, and 63, EPA published comprehensive rules affecting the operation of chemical plants and other sources. The regulations in part 63 begin to regulate the emissions of certain organic hazardous air pollutants from synthetic processes which are part of major sources under section 112 of the Clean Air Act as amended in 1990. This rule is called the hazardous organic NESHAP or the HON. The HON requires sources to achieve emission limits reflecting the application of the maximum achievable control technology (MACT) consistent with the Act. The rule addresses over half of the listed hazardous air pollutants emitted from both existing and new sources, and includes certain wastewater discharges.

Sections with information for determining the applicability and requirements for the conversion options involving a chemical plant are 40 CFR Part 63 subpart F (lists regulated HAPs and present general industry standards), subpart G (explains how MACT standards for specific process vents, storage vessels, transfer operations and wastewater are determined) and subparts H and I (presents MACT standards for equipment and process leaks). It is not possible to define specific standards of the BEP project at this time. The regulations are long (about 275 pages in the Federal Register) and complicated. Specific process design plans and specifications would be needed to define specific MACT requirements and limits for sources. Emissions averaging is allowed to demonstrate compliance.

From a preliminary inspection of the SOCMI regulations, it would appear that emission limits may not apply to all of the coproducts under evaluation. Specific monitoring, record keeping and reporting requirements are contained in the regulation.

The following performance standards may apply to a conversion option at Bellefonte:

- State - Chapter 335-3-10.02 (33), Standards of Performance for New Stationary Gas Turbines.
- Federal: NSPS for Gas Turbines and Coal Preparation Plants. These standards are incorporated by reference into Alabama Regulations.
- Federal: Synthetic Organic Chemical Manufacturing Industries, Maximum Achievable Control Technology required for air and wastewater emissions.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- PSD Ambient Monitoring -Normally includes preparation and coordination of PSD monitoring plan, the actual monitoring, data validation, and data analyses and reporting. ADEM has approved the use of data collected earlier in the vicinity of Bellefonte for this conversion project, so no new ambient air data would be needed.
- PSD Best Available Control Technology (BACT) Analysis - Evaluate control technology alternatives, based primarily on incremental cost of the controls, provided no air quality problems are expected. BACT would apply for each pollutant emitted in "significant amounts" (i.e., SO_2, CO, NO_x, PM and PM_{10}). "Top down" approach would be used.
- PSD Ambient Air Quality Analysis - Evaluate project's impacts with respect to PSD ambient air increments and National Ambient Air Quality Standards.
- PSD Additional Impact Analyses - Evaluate project impacts on growth, soils, vegetation, and visibility in any Class I area. No Class I area is located within 50 miles of Bellefonte.
- ADEM Air Toxics Policy - Evaluate project's impacts of any pollutants that do not have state or federal air quality standards and which have emission rates greater than 0.1 pounds per hour. Project impacts are compared to a specified fraction of the pollutant's Threshold Limit Value (TLV), either 1/40th of TLV for 1-hour average of 1/420th of TLV for annual average.
- SOCMI Analysis, Tests, and Record keeping - Determine allowable emission limits, evaluate MACT technology alternatives and compliance strategies for meeting 40 CFR Part 63 requirements for chemical manufacturing. Develop wastewater management and treatment methodology.

2.0 Wastewater Discharges

2.1 Relevant Statutes and Regulations

State

(1) Law - Alabama Water Pollution Control Act, Title 22 Code of Alabama Chapter 22.
(2) Regulations:
-- Alabama NPDES Permit Regulations, Alabama Administrative Code (AAC) Chapter 335-6-6.
-- Alabama Water Quality Criteria Standards, AAC, Chapter 335-6-10.

Federal

(1) Law - Federal Water Pollution Control Act, as amended, 33 USC Section 1251 et seq.
(2) Regulations:
-- 40 CFR Part 122 - NPDES Permit Regulations
-- 40 CFR Part 400 et seq. - National Categorical Effluent Limitations and Guidelines

2.2 Required Permits

- National Pollutant Discharge Elimination System (NPDES) storm water permit for construction activities.
- NPDES permit for direct discharges of pollutants to surface waters during operation of the facility.

2.3 Applicability

Construction

The ADEM requires a state-administered National Pollutant Discharge Elimination System (NPDES) storm water permit before site construction activities can commence. The NPDES permit would include direct discharges of pollutant during construction for those outfalls which are active. Bellefonte Nuclear Plant is currently operating with an NPDES Permit at the proposed site. Specific site outfall and storm water monitoring is being performed routinely. This permit (AL0024635), issued September 30, 1992, is due to expire September 30, 1997. Once the new facilities are operational, the NPDES permit would cover both the process and storm water discharge of pollutants.

During periods of active construction where areas greater than five acres have been disturbed, the affected storm water points shall be monitored for pH, TSS, SS, BOD, COD, Oil & Grease, Flow, and Precipitation. As part of the existing NPDES Permit, five uncontaminated storm water runoff points are presently being monitored. No discharge limits have been applied to these discharges, but are observed at least once per month for evidence of oil contamination, as evidenced by an oil sheen on the surface. The upstream and downstream turbidity of all affected watercourses would need to be monitored during construction.

Operation

The analytical results of sampling for all priority pollutants for all outfalls within one year of first achieving 100% power must be submitted to ADEM. The runoff from any coal piles would require special treatment and handling requirements. Coal pile drainage results from percolation of rainfall through stored coal. The water quality of the drainage is affected by the leaching of oxidation products of metallic sulfides associated with the coal. If the runoff water that enters the coal storage runoff pond is hazardous (i.e., by characteristic or listing), or if a hazardous waste is generated in the pond (e.g., by concentration or precipitation), the pond is a hazardous waste unit and would then be regulated as a waste storage facility under RCRA (Subpart K - Surface Impoundment) requiring a permit, double liner, and a leachate collection and removal system. In addition, spills and leaks of listed hazardous waste that accidentally enter non-RCRA ponds may cause these ponds to become RCRA units (see Section 4.1.5 Hazardous Waste Disposal).

Performance standards may apply to a conversion option at Bellefonte. Performance standards may take the form of technology-based effluent limitations, based in part on national categorical effluent limits and guidelines, or water quality-based limitations specified in applicable ADEM regulations:

State water quality-based limitations include the following:

- Use classification of upper stretch of Tennessee River Basin is public water supply (PWS), swimming, fish and wildlife protection
- Select water quality criteria for PWS-designated segments are (1) maximum instream temperature less than or equal to 86.5°F and maximum allowable increase in ambient temperature less than or equal to 5°F (unless alternate limits demonstrated), (2) dissolved oxygen more than or equal to 5mg/L, (3) concentrations of toxic pollutants in state waters cannot exceed criteria derived from calculations in rule, taking into account designated water uses. Effluent limits are back calculated from criteria, as needed.
- All industrial, sanitary, and/or combined discharges are subject to secondary treatment or its equivalent for biologically degradable waste. Parameters of interest are BOD_5, SS, and pH.

Federal requirements and limits include:

- Steam electric power generation (40 CFR Part 423), includes new source performance standards for cooling water (pH, total residual chlorine), low volume wastes (TSS and Oil & Grease), chemical metal cleaning wastes (TSS, Oil & Grease, Copper, Iron), bottom ash transport water (TSS, Oil & Grease), and coal pile runoff (TSS).
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Ammonia Subpart B) applicable to discharges of ammonia and pH resulting from the manufacture of ammonia.
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Urea Subpart C) applicable to discharges of ammonia, and organic nitrogen resulting from the manufacture of urea.
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Ammonium Nitrate Subpart D) applicable to discharges of ammonia, and nitrate resulting from the manufacture of ammonium nitrate.
- Organic Chemicals, Plastics, and Synthetic Fibers (40 CFR Part 414), includes NSPS for the area subcategories (Subpart F - Commodity Organic Chemicals, and Subpart G - Bulk Organic Chemicals) applicable to discharges of acetic acid, ethanol, formaldehyde, methanol, and methyl tert-butyl ether resulting from the manufacture of ammonium nitrate.

- Recent NESHAPS for cooling tower blowdown prohibit the use of chromium containing chemicals.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Best Management Practices - A Best Management Practices (BMP) Plan addresses containment of any or all process liquids or solids that these materials do not present a significant potential for discharge. When submitted and approved, the BMP becomes a part of the NPDES Permit and all requirements of the BMP Plan become requirements of this permit. One component of the plan is a pollution prevention plan for new site construction exceeding 5 acres. The applicant must provide spill prevention, control and/or management sufficient to prevent any spills of pollutants from entering the waters of the state, or a publicly owned treatment works (POTW).
- Spill Prevention Control and Countermeasures (SPCC) Plan - The SPCC Plan, prepared in accordance with 40 CFR Section 112, addresses chemical and fuel oil storage facilities and their operation.
- Facility Response Plan - Operators of any non-transportation-related onshore facility that, because of it location, could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines must prepare and submit a facility response plan to the EPA Regional Administrator. This plan includes an emergency response action plan.
- Engineering Report - Before construction of new, or modification of existing waste treatment facilities or ponds, an Engineering Report, in accordance with the State Regulations, must be submitted to ADEM and final comments from ADEM shall be received by the permittee.

3.0 Solid Waste Disposal and Byproduct Management

3.1 Relevant Statutes and Regulations

State
(1) Nonhazardous wastes:
Law - Alabama Solid Waste Act
Rules - Alabama Administrative Code (AAC) Ch. 335-13.
(2) Hazardous wastes:
Law - Alabama Hazardous Wastes Management and Minimization Act, Title 22, Ch. 30.
Rules - AAC Ch. 335-14.
Federal
(1) Nonhazardous wastes:
Law - Resource Conservation and Recovery Act (RCRA), as amended, 42 USC Section 6901 et seq, Subtitle D.
Rules - No federal Subtitle D rules for industrial nonhazardous wastes
(2) Hazardous wastes:
Law - RCRA, Subtitle C.
Rules - 4O CFR Parts 260-270.

3.2 Required Permits

- None for materials handling and storage.
- Permit required for on-site disposal of nonhazardous wastes such as sludges. If any of these non-hazardous wastes are sluiced to surface impoundments they are typically managed by NPDES, not solid waste.
- No hazardous waste permit if no on-site treatment, storage (for > 90 days), or disposal of any hazardous wastes.

3.3 Applicability

Construction
No applicable requirements or standards

Operation

There is no state or federal permitting program for materials handling and storage facilities that may impact groundwater resources. Design considerations for these types of facilities would likely be involved, however, in issuance of an NPDES permit.

All of the solid wastes generated by the project that are not exempt from RCRA Subtitle C regulation pursuant to 40 CFR Sec. 261.4(b)(7)(vi) are required to be assessed to determine whether they are a characteristic or a listed hazardous waste. [Two gasification process streams, process wastewater and gasifier ash, are exempt from Subtitle C regulation pursuant to 40 CFR Sec. 261.4(b)(7)(vi) and (vii) and AAC Sec. 335-14-2-.01(4)(a)7]. If any of these streams are hazardous wastes, then certain management standards apply to the on-site storage for <90 days. Industrial nonhazardous wastes may be sent to certain municipal landfills.

The ADEM issues permits for the on-site disposal of industrial nonhazardous waste. According to a state contact, there are no rules or guidelines on what constitutes “disposal" vs long-term “storage" of industrial by-products; he indicated that it depends on the intent of the facility with respect to the material. The state contact knows of some facilities that have been accumulating and storing by-products on-site long term without a state permit, while others (a tire recycler and an on-site landfill for non-utility ash) went ahead and secured a permit to resolve any long-term questions the state might have. Legal advice may be needed to resolve TVA's position regarding the time limit distinction between accumulation of waste for subsequent marketing and "disposal".

Certain materials handling activities and land-based wastewater/byproduct (slag) storage facilities have the potential to impact ground water resources. Operation of the IGCC plant would result in generation of a number of solid wastes, such as fly ash, spent sorbent, water and wastewater treatment sludges and residuals, used oils, and maintenance wastes (solvents and paints). ADEM has determined that ash "Resulting from the combustion of coal or other fossil fuels at Electric Generating Plants" is not solid waste. Hazardous wastes and wastewater treatment plant sludge would be disposed of off site.

The following are applicable performance standards:

- Groundwater quality - [see Section 4.1 Alabama Wastewater Discharges Performance Standards, (Subsection 3) design guidance for ponds and Other Considerations, (Subsection 3) Best Management Practices Plan]
- Hazardous Wastes - a large-quantity generator (generates >1,000 kg/mo.) can store hazardous waste on site for up to 90 days prior to off-site disposal without needing a RCRA permit for storage. The standards for “temporary accumulation" of hazardous waste, found at 40 CFR Sec. 26234 and AAC Sec. 335-14-3-.03(5), require that the hazardous waste be stored in labeled containers or tanks [the tank(s) must meet certain design standards] and that certain emergency preparedness, prevention, and response procedures be implemented (including a contingency plan). Lesser standards apply to generators of <1,000 kg/mo. who wish to temporarily accumulate hazardous waste on site.
- Industrial nonhazardous wastes - are considered as state special wastes per AAC Sec. 335-13-1-.03 definition also depends on handling and processing requirements. Special wastes can be sent to municipal landfills as long as state prescribed procedures are met.
- The technical standards for on-site disposal of industrial nonhazardous wastes are determined on a site by site basis. However, for sites located in northern Alabama, the guidance provided for ponds would equally apply to solid waste cells (i.e., a prior hydrogeological investigation, probably lining and modified groundwater monitoring requirements). One recently permitted inert landfill in North Alabama has been required to install a 5-foot thick chert-free clay liner, while a proposed landfill for boiler ash for a major paper processing company would include a 3-foot clay and synthetic liner.

The following analyses/evaluations may apply to a conversion at Bellefonte:

- For solid waste permitting, the results of hydrogeologic investigations, hazard determinations, and marketability studies (for slag and fly ash) would be necessary.
- Solid waste permits typically require groundwater monitoring and reporting.
- Hazardous waste generators are required to register with the USEPA regional office and state per 40 CFR Sec. 262.12 and AAC Sec. 335-14-3-.01(3) as a hazardous waste generator and secure a USEPA/State identification number. This is not a permitting procedure; however, it is basically an administrative procedure to secure an identification number.
- All special waste must be characterized by the Toxicity Characteristic Leaching Procedure and this characterization submitted to the ADEM on a solid/hazardous waste determination form. The ADEM would issue a letter accepting the form and confirming the facility’s

selection of an off-site disposal facility. Sanitary landfills can dispose of special wastes as long as they have groundwater monitoring and the waste is generated within their permitted geographical area.

- The permit application requirements for industrial nonhazardous waste disposal facilities are patterned after the requirements for municipal solid waste landfills (in AAC Ch. 335-13), but should be negotiated first with the state to tailor the requirements for the specific site. The state allows the process to take place in two stages: first, the hydrogeologic review and site suitability determination by the state (particularly important for northern Alabama), and, if the site is suitable, submittal and review of the technical design for the facility.

4.0 Surface Water

4.1 Relevant Statutes and Regulations

- Section 10 of the River and Harbor Act (33 USC 403)
- Section 26a of the Tennessee Valley Authority Act
- 33 CFR 330 - Nationwide Permits
- Section 404 of the Clean Water Act

4.2 Required Permits

A section 10 permit is required from U.S. Army Corps of Engineers for the placement of structures in navigable waters. (In the past TVA has not been required to obtain Section 10 permits for water use facilities constructed in the Tennessee River Basin. However, TVA remains subject to obtaining Section 404 permits when such activities require the discharge of dredged or fill material in waters of the U. S.)

4.3 Applicability

Construction

Alabama does not require approval to use the surface waters in the Tennessee River. However, permits are required from the U.S. Army Corps of Engineers under authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act for the construction of water use facilities such as water intake and outfall structures and barge terminal facilities. An intake structure has been constructed to serve the nuclear plant but modifications may be needed to support the BEP. Alabama has recently passed legislation requiring the annual reporting of water withdrawals but TVA's position is that this legislation does not apply to TVA.

Section 10 of the River and Harbor Act prohibits the obstruction or alteration of navigable waters without a permit. Section 26a of the TVA Act ensures that construction, in, across, and along the Tennessee River and its tributaries that can potentially affect navigation, flood control, or public lands is reviewed and approved by TVA. The review process for TVA's projects would be conducted through the NEPA process. Site-specific criteria are used in the evaluation of the applications by the COE to ensure that navigation, flood control, and public river uses are not impaired.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Application and supporting documentation should be combined with 404 wetlands permit, if required.
- Completion and submission of ENG Form 4345 and supporting documentation related to project need, wetland avoidance and minimization, mitigation plans, drawings, etc., and Draft EIS.
- COE would issue public notice upon receipt of complete application package. With rare exceptions, the dredge and fill (404) application and the River and Harbor Act Section 10 (see water rights/withdrawals and obstruction to navigation) application are processed together.

5.0 Land Use

5.1 Relevant Statutes and Regulations

The relevant legislation affecting land use is the Farmlands Protection Policy Act of 1981, (7 USC 4201 et seq), Farmland Protection Policy (7 CFR 658).

5.2 Required Permits

No land use/zoning permits apply. As part of this draft EIS, the potential for converting prime farmland to other uses is addressed.

5.3 Applicability

As a federal agency, TVA is not subject to local land use laws.

6.0 Wetlands

6.1 Relevant Statutes and Regulations

- USC 1344 (Section 404 of the Clean Water Act of 1977)
- USC 1341 (Section 404 of the Clean Water Act of 1977)

6.2 Required Permits

- Army Corps of Engineers (COE) Section 404 Dredge and Fill Permit.
- Under Section 401 of Clean Water Act, the state is required to certify that the proposed activity would meet applicable water quality standards.

6.3 Applicability

Construction activities that result in the discharge of dredged or fill material in waters of the U. S. including wetlands are subject to regulations. A permit would be required only if construction affected these waters. A wetlands determination should be made by a qualified expert, based upon the COE's 1987 manual for wetlands determination. There are two types of 404 permits: individual and general. The latter are generally for activities that affect smaller areas or less critical wetland habitats and often do not require an application (although reporting may be required). If the affected wetlands area is more than 3 acres, an individual permit would be required, and could be required for non-tidal wetlands of between 1 and 3 acres.

Generally, applicants for 404 individual permits must demonstrate the public and private need for the project, that these projects cannot practically avoid waters of the U. S. , that the project minimized impacts to these waters, and that compensatory mitigation would be performed to offset losses. Typical compensatory mitigation for wetland losses requires at least 2 acres restoration/enhancement for every 1 acre disturbed.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Completion and submission of ENF Form 4345 and supporting documentation related to project need, wetland avoidance and minimization, mitigation plans, drawings, etc.
- COE would issue public notice upon receipt of complete application package. With rare exceptions, the dredge and fill (404) application and the River and Harbor Act Section 10 (see water rights/withdrawals) and (obstructions to navigation) application are processed together.

7.0 Floodplains

7.1 Relevant Statutes and Regulations

- Executive Order No. 11988

7.2 Required Permits

- The project siting must be consistent with Executive Order No. 11988.
- Floodplain analyses (including those required for E.O. 11988) must be included in the EIS. This information would also be used to ensure compliance with local floodplain regulations adopted by communities for participation in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA).

7.3 Applicability

The analysis for flood risk involves ensuring that the proposed facilities would be sited to provide a reasonable level of protection from flooding. Because federal funds are involved in the plant's construction, the E.O. 11988 applies, and because of the nature of the project itself (e.g., flooding of the plant would be an added element of flooding disaster), the plant is a "critical action" under E.O. 11988. This means it should be located above the 500-year floodplain.

Applicable performance standards are as follows:

- Project structures should avoid contributing to a rise in flooding (i.e., cannot obstruct the floodway).
- Project structures should be above 500-year floodplain.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Floodplain analyses (e.g., hydraulic modeling and flooding profile and floodway determinations, hydrological profiling and modeling).

8.0 Biological Resources

8.1 Relevant Statutes and Regulations

- Endangered Species Act (ESA) (16 USC 1536)
- 50 CFR Parts 17, 222, 225, 226, 227, and 402 implement the ESA.
- Fish and Wildlife Coordination Act (16 USC 661)
- Alabama non-game species regulation is Conservation Regulation 220-2-92 and Alabama's invertebrate species regulation is CR. 220-2-.98

8.2 Required Permits

A consultation process (documented by clearance letters) between TVA and the U.S. Fish and Wildlife Service (F&WS) must be completed prior to construction under the following regulations:

- Section 7 Endangered Species Act
- Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act does not apply to TVA but could apply to the project because of USACE involvement.

8.3 Applicability

Construction and operation of the plant could potentially affect wildlife resources including endangered or threatened species (listed for protection by the federal or state government). Because the project involves major construction, and is subject to NEPA, the federal consultation process with F&WS (Section 7 of

ESA) must occur if listed, threatened, or endangered species may be affected. Consideration should also be given to state-protected species during the NEPA review process.

If applicable, evaluations of impacts are based on biological assessments. The standard for determining whether a species is "jeopardized" under ESA is whether the project would likely result in its "diminished survival" and "recovery." State standards may include "harassment" of a protected species. The ESA Section 7 consultation process includes "listed" and "proposed to be listed" species. "Candidate species" are also frequently assessed both in the Section 7 consultation process and in the NEPA review process. State listings overlap, but may include different species.

The first set of data is usually provided by the F&WS and/or the state's "heritage program." It includes a list of species that may be in the project area. This list is sent upon request in response to the project developer's project and site description. The biological assessment, if required, is conducted by the project applicant and based upon field surveys of the project site area, estimations of the occurrence of listed species, and estimations of project impacts.

The Section 7 ESA consultation is focused on endangered species; the Fish and Wildlife consultation is focused more broadly on aquatic wildlife. Both are usually handled by the F&WS office in a parallel process. The state agencies are usually involved in the consultation to address any state-specific concerns (or listed species). The typical process is as follows:

1. Project sponsor sends letter to F&WS field office providing project description and site locations (on a USGS map). The F&WS responds with a list and information about ESA compliance.
2. Project sponsor conducts a biological assessment pursuant to 50 CFR 401.12 if a "may affect" situation exists. This is submitted to the F&WS (and applicable state agencies).
3. If TVA were to conclude that there is no adverse impact on listed species and if F&WS were to concur, the F&WS would document this is a letter and the consultation process would be completed. The clearances letters (from F&WS for both the ESA Section 7 and Fish and Wildlife Coordination Act and from the state agencies) could be published in the EIS along with the results of the biological assessment.
4. If F&WS concludes that adverse impacts are likely, a 90-day formal consultation process begins with TVA's agreement to enter consultation. At the end of this period F&WS would issue either a "no jeopardy" opinion or a "jeopardy" opinion along with "reasonable and prudent" alternatives.
5. If TVA and F&WS agree on measures that would avoid jeopardy to all listed species, these are documented in a letter, and the consultation process if completed.

9.0 Cultural Resources

9.1 Relevant Statutes and Regulations

- National Historic Preservation Act (NHPA), (16 USC 470)
- CFR 800 “Protection of Historic and Cultural Properties” (51 FR 31118-311125, 9/2/86)
- Native American Graves Protection and Repatriation Act (NAGPRA), (25 USC 3001-13).

9.2 Required Permits

Completion of a “Section 106 review process” is required prior to the approval of the expenditure of any federal funds on construction of the project. The product of this review process is as follows:

1. Concurrence by the State Historic Preservation Officer (SHPO) in TVA’s determination that the project would have <u>no effect</u> on historic properties.
2. SHPO concurrence in a determination of <u>no adverse effect</u>.
3. A memorandum of agreement (MOA) with the Advisory Council on Historic Preservation (ACHP) and/or the SHPO on how <u>adverse effects</u> would be taken into account. Any of these documents is equivalent to a permit to proceed with the project.

9.3 Applicability

Section 106 of the NHPA requires federal agencies to take into account the effects of their proposed actions on properties listed in or eligible for listing in the National Register of Historic Places (National Register). The National Register is a listing of sites, buildings, areas, objects, and structures significant in American history or culture. Because of the size, scope, and federal involvement in this Project, the NHPA Section 106 consultation would apply and would require a historic properties survey unless the site has been previously surveyed. NAGPRA requires the protection of Native American graves and other cultural items. The law encourages avoidance of archaeological sites that contain burials or those portions of sites that contain graves through in situ preservation, but may encompass other actions to preserve these remains and items.

Criteria for listing in the National Register are provided in the implementing regulations (36 CFR 60) and in the National Register. Efforts to identify historic properties that may be affected are conducted in consultation with the SHPO. Identification efforts should follow the Secretary of Interior's "Standards and Guidelines for Archaeology and Historic Preservation" (48 FR 44716).

Under Section 106, TVA is required to perform the following:

1. Review existing information on historic properties that could be affected.
2. Request the views of the SHPO on further actions to identify historic properties.
3. Seek information from local governments, Indian tribes, public and private organizations, etc., likely to have knowledge of historic properties in the area.
4. Based on the above information, TVA then determines the need for further actions, such as field surveys, to identify historic properties. TVA, in consultation with the SHPO, would then determine the National Register eligibility of all sites within the area affected by the project. If no eligible sites would be affected, the project may proceed. If eligible sites would be adversely affected, TVA would execute on MOA with the ACHP and/or the SHPO stipulating measures to be taken to avoid or minimize adverse effects.

Normally, these measures would include such actions as data recovery excavations at eligible archaeological sites and recording of historic structures. The Section 106 consultation process is documented as part of the EIS. Historic property identification results are summarized in the EIS.

Section 106 consultation is required for all federal undertakings. The submittal of the letter of inquiry to the SHPO and the submittal of a Phase I Survey trigger the 106 consultation process, which leads to a finding of no effect or no adverse effect or a MOA stipulating measures to avoid or minimize adverse effects.

NOTE: Construction activities for the plant and ancillary facilities (e.g., pipelines) would not adversely affect historic properties (any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places). The entire Bellefonte site has been surveyed and investigated for relevant properties and cleared of any protected elements.

10.0 Air Navigation

10.1 Relevant Statutes and Regulations

- Federal Aviation Act, 49 USC Section 1304 et seq.
- CFR Part 77 "Obstruction Standards."

10.2 Required Permits

A determination of no hazard to air navigation from Federal Aviation Administration (FAA) is required.

10.3 Applicability

The highest structures (buildings, stacks) should avoid causing a hazard to aircraft navigation. The highest structures at the plant are the existing cooling towers at 477 feet above ground level. Review is required for all structures that exceed 200 feet above ground level. Because the plant has at least one structure at 350 feet, the no hazard determination would be needed.

Developer is required to notify FAA if either the height of tallest structure exceeds 200 feet or if the proposed location of the structure is within 20,000 feet of the nearest public-use airport runway and if the height of the structure exceeds X, where:

$$X = \frac{\text{distance to runway in feet}}{100}$$

Where height exceeds either the 200 feet or X value above, FAA would either issue a determination-of-no-hazard letter (with or without conditions) or would require further study, including negotiating with project developers which could lead to either project modifications or a rejection by FAA.

11.0 Noise

11.1 Relevant Statutes and Regulations

- Noise Control Act of 1972 (PL92-574) and Quiet Communities Act of 1978 (PL95-609).
- 40 CFR 201 addresses railroad noise.
- 40 CFR 202 addresses heavy truck traffic.
- 40 CFR 204 addresses air compressors.
- 40 CFR 1910 addresses occupational limits.

11.2 Required Permits

No permits are required, although evaluation of noise impacts are required as part of EIS and local standards may exist that must be met. No local standards were identified.

11.3 Applicability

Intermittent and temporary noise impacts would be from operation of construction equipment. Permanent impacts would be associated with operation of plant, particularly coal handling and crushing, gasification, turbines, air compressors, boiler feed pumps, and trains and trucks. The equipment noise standards and occupational limits would also apply. Equipment specific standards and occupational safety standards have been promulgated.

There are no state or federal environmental noise limits that apply to facility operation, This Draft EIS uses EPA's "Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (March 1974)" as a guideline. The EPA document sets a day/night level (Ldn) of 55 dBA as adequate protection for residential areas. Similar guidelines from the U.S. Department of Housing and Urban Development are also used. Equipment-related standards include trucks (80 dBA at 50 feet) and portable air compressors (76 dBA at 23 feet). OSHA noise exposure for construction and operating personnel is set at 90 dBA for a 8-hour shift with hearing conservation programs for when noise levels reach 85 dBA.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- A background noise survey and noise modeling to estimate operational impacts at the fence line and at nearby sensitive receptors (e.g., homes, schools) would probably be necessary at a minimum.
- Estimates of the effectiveness of mitigation techniques (e.g., equipping turbine air inlets with silencers) may also be required as part of the EIS noise analysis.

12.0 Emergency Planning

12.1 Relevant Statutes and Regulations

- Emergency Planning and Community Right-to-Know Act of 1986 (42 USC 11001 et seq.).

12.2 Required Permits

No permits are required, but periodic reporting is required. Compliance demonstration is not required before construction.

12.3 Applicability

Use, processing, or storage of certain chemicals for use in operation and maintenance would subject the plant to the Emergency Planning and Community Right-to-Know Act (EPCRA). (TVA is technically exempt from EPCRA but complies as a matter of internal policy.)

The plant would use, process, and/or store many substances subject to the EPCRA reporting requirements. These substances are likely to include laboratory chemicals, maintenance chemicals (e.g., oil, degreasers, compressed gases), water treatment and wastewater materials (e.g., chlorine), feedstocks and fuel (e.g., ammonia, fuel oil), and products and by-products (e.g., fly ash).

Reporting requirements under EPCRA are linked to the presence, production, release of various lists of chemicals (e.g., 360 “extremely hazardous substances,” the CERCLA Sec. 102(a) substances, OSHA hazardous chemicals, the 337 “toxic chemicals”). It is almost certain that the plant would trigger some or all of these reporting requirements. The planning and reporting involves the facility, a local planning committee and local fire marshals, and a state emergency planning commission.

There are no performance standards as such. Generally, EPCRA requires planning and reporting based on the presence, use, production, or discharge (accidental and routine) of various chemicals. These are as follows:

- Section 301-303 of EPCRA requires that facility develop an Emergency Response Plan with the LEPC.
- Section 304 requires accidental release reporting.
- Sections 311 and 312 require that facility inform the local public of the inventory sizes and locations of certain hazardous chemicals.
- Section 313 requires annual reporting of routine and emergency releases of 337 toxic chemicals. [Not applicable to SIC Code 9911 (IGCC portion)]

As part of its voluntary compliance with EPCRA, TVA would develop estimates of use, storage, production, and release of the various chemicals by list.

13.0 Health And Safety

13.1 Relevant Statutes and Regulations

- State: None
- Federal: 29 CFR Part 1910 - general industry standards 29 CFR Part 1926 - construction standards
- TVA's Occupational Health and Safety Manual

13.2 Required Permits (None)

13.3 Applicability

Construction and operation of the plant could potentially impact worker health and safety. OSHA does not directly apply to federal agencies. However, TVA must implement equivalent standards. Also, OSHA would apply directly to contractors. The standards include requirements relating to walking-working surfaces, means of ingress and egress from structures, operation of powered equipment, occupational exposure monitoring and controls for chemical and physical agents, hazard communication training, process safety evaluations, fire protection, and electrical equipment safeguards.