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EXECUTIVE SUMMARY



The purpose of this study is to establish the Order-of-Magnitude FGD Cost Estimate to assist American Electric Power (AEP) with the selection of an FGD technology for Big Sandy Plant Unit 2.

Order-of-Magnitude FGD Cost Estimates were prepared for the following four FGD Technologies:

- **Wet (WFGD):** Wet FGD Spray Tower and Integrated Wet ESP
- **Dry (DFGD):** Dry FGD Spray Dryer Absorber (SDA) and Fabric Filter (FF)
- **IAQCS:** Integrated Air Quality Control System (IAQCS) Dry SDA/FF and Wet FGD Spray Tower
- **NID:** Dry FGD NID and Fabric Filter

For each technology, capital cost estimates were prepared for fuel specifications with sulfur content of 1.7, 3.0, 4.5 and 7.5 lb SO₂/MMbtu. A base fuel was selected for each technology and a capital cost estimate was prepared for each assuming an Engineer, Procure, Construct (EPC) contracting approach. Adjustments were then made to the base cost estimate to develop the remaining fuel estimates for that specific technology. The cost estimates also consider both the existing ESP in and removed from service for the Dry, IAQCS and NID technologies. The ESP is required to remain in service for the WFGD technology for protection from erosion and wear of the ID fans and FGD system components (pumps, piping, nozzles, etc.).

The estimates were based upon the AEP Order of Magnitude/Relative Capital Installed Cost Estimate Specification (BS2-FGDSCE-052010, Rev. 1) which provided design basis and performance requirements and conceptual design deliverables prepared by S&L for each technology. The conceptual deliverables, consisting of project general arrangements, process flow diagrams, mass balances, water balances and single lines, formed the basis for development of preliminary major equipment sizes and commodity estimates. Attention was focused on the significant elements that changed from one fuel to another, such as storage, handling and disposal of reagent and byproduct materials. The OEM equipment costs were taken from recent vendor quotes and adjusted for Big Sandy specifications, schedule and unit size.

The IAQCS system was evaluated assuming a phased implementation in order to make it more competitive at lower sulfur fuel cases. The DFGD portion would be installed initially and for estimate purposes the WFGD followed 5 years later for the 1.7 lb and 3.0 lb SO₂/MMbtu fuels. For the higher sulfur fuels both systems would be constructed to meet the earlier completion date.

The results of the capital cost estimates prepared for the WFGD, DFGD, IAQCS and NID technologies are tabulated in the following tables. Costs are tabulated without (Table ES-1) and with (Table ES-2) escalation and contingency. These total costs include costs provided by AEP for the wet and dry chimney installation and CEM equipment. The estimates exclude AEP costs for associated project work (new landfill, haul road, coal blending equipment etc.) which are typically not included in FGD cost estimates.

T ES-1

TECHNOLOGY CAPITAL COST ESTIMATE COMPARISON SUMMARY
(EXCLUDES ESCALATION AND CONTINGENCY)

Technology	ESP Option	1.7 lb/MMbtu	3.0 lb/MMbtu	4.5 lb/MMbtu	7.5 lb/MMbtu
WFGD	ESP	\$617,031,100	\$625,465,400	\$631,805,100	\$639,763,000
DFGD	ESP	\$423,505,200	\$433,859,900	N/A	N/A
	N/ESP	\$420,086,200	\$430,099,900	N/A	N/A
IAQCS	ESP	\$810,378,500	\$829,909,000	\$803,312,200	\$811,858,400
	N/ESP	\$797,792,800	\$816,091,300	\$791,747,600	\$800,770,000
NID	ESP	\$390,264,600	\$396,951,100	\$412,540,400	\$463,425,900
	N/ESP	\$380,011,400	\$387,790,200	\$403,062,500	\$454,587,100

ESP = ESP In-Service

N/ESP = ESP Out-of-Service

Table ES-2

TECHNOLOGY CAPITAL COST ESTIMATE COMPARISON SUMMARY
(INCLUDES ESCALATION AND CONTINGENCY)

Technology	ESP Option	1.7 lb/MMbtu	3.0 lb/MMbtu	4.5 lb/MMbtu	7.5 lb/MMbtu
WFGD	ESP	\$761,524,000	\$722,222,600	\$781,239,000	\$789,763,700
DFGD	ESP	\$517,264,900	\$530,206,600	N/A	N/A
	N/ESP	\$513,293,300	\$525,096,100	N/A	N/A
IAQCS	ESP	\$1,058,018,500	\$1,082,790,800	\$985,953,700	\$996,766,600
	N/ESP	\$1,042,203,600	\$1,065,704,900	\$971,509,000	\$983,223,800
NID	ESP	\$481,797,500	\$489,846,100	\$509,075,900	\$571,797,900
	N/ESP	\$469,053,000	\$477,867,300	\$496,469,800	\$560,242,100

ESP = ESP In-Service

N/ESP = ESP Out-of-Service

Variable and fixed O&M costs were determined for each technology and fuel specification in accordance with the economic basis agreed to with AEP. These costs are tabulated in Table ES-3. See Exhibit 1-7 for a breakdown of these costs including auxiliary power values.

Table ES-3

FIXED & VARIABLE O&M COST COMPARISON SUMMARY

Technology	Fuel lb SO₂/MMbtu	ESP Option	Total Cost Fixed O&M	Total Cost Variable O&M
WFGD	1.7	ESP	\$5,268,000	\$4,808,000
	3.0	ESP	\$5,565,000	\$8,076,000
	4.5	ESP	\$5,853,000	\$10,871,000
	7.5	ESP	\$6,165,000	\$15,986,000
DFGD	1.7	N/ESP	\$4,292,000	\$16,253,000
	3.0	N/ESP	\$4,392,000	\$28,708,000
	1.7	ESP	\$4,292,000	\$15,099,000
	3.0	ESP	\$4,392,000	\$30,474,000
IAQCS (Phase 1 - DFGD Only)	1.7	N/ESP	\$4,292,000	\$16,253,000
	3.0	N/ESP	\$4,392,000	\$28,708,000
	4.5	N/ESP	N/A	N/A
	7.5	N/ESP	N/A	N/A
	1.7	ESP	\$4,292,000	\$15,099,000
	3.0	ESP	\$4,392,000	\$30,474,000
	4.5	ESP	N/A	N/A
	7.5	ESP	N/A	N/A

Technology	Fuel lb SO ₂ /MMbtu	ESP Option	Total Cost Fixed O&M	Total Cost Variable O&M
IAQCS (Phase 2 - DFGD + WFGD and Non- Phased)	1.7	N/ESP	\$8,396,000	\$10,725,000
	3.0	N/ESP	\$8,525,000	\$14,483,000
	4.5	N/ESP	\$8,650,000	\$17,782,000
	7.5	N/ESP	\$8,785,000	\$23,880,000
	1.7	ESP	\$8,396,000	\$8,054,000
	3.0	ESP	\$8,525,000	\$12,057,000
	4.5	ESP	\$8,650,000	\$15,583,000
	7.5	ESP	\$8,785,000	\$21,513,000
NID	1.7	N/ESP	\$4,846,000	\$18,139,000
	3.0	N/ESP	\$4,956,000	\$29,864,000
	4.5	N/ESP	\$5,066,000	\$40,961,000
	7.5	N/ESP	\$5,286,000	\$58,143,000
	1.7	ESP	\$4,846,000	\$15,565,000
	3.0	ESP	\$4,956,000	\$27,593,000
	4.5	ESP	\$5,066,000	\$38,926,000
	7.5	ESP	\$5,286,000	\$56,066,000

ESP = ESP In-Service



N/ESP = ESP Out-of-Service

One EPC project schedule was developed for each technology, with exception of the IAQCS which has two due to both phased and non-phased options being considered. Level 2 project schedules are provided in the report. Using the results of the capital cost estimates and the EPC project schedules a preliminary project monthly cash flow was developed for each technology. The schedule and cost information is summarized in Tables ES-4, ES-5, ES-6, ES-7 and ES-8, which provide key milestone dates and annual cash flow data. Two tables are provided for the IAQCS technology to clearly define the phased and non-phased approaches.

Table ES-4
WFGD MILESTONE SCHEDULE AND CASH FLOW SUMMARY

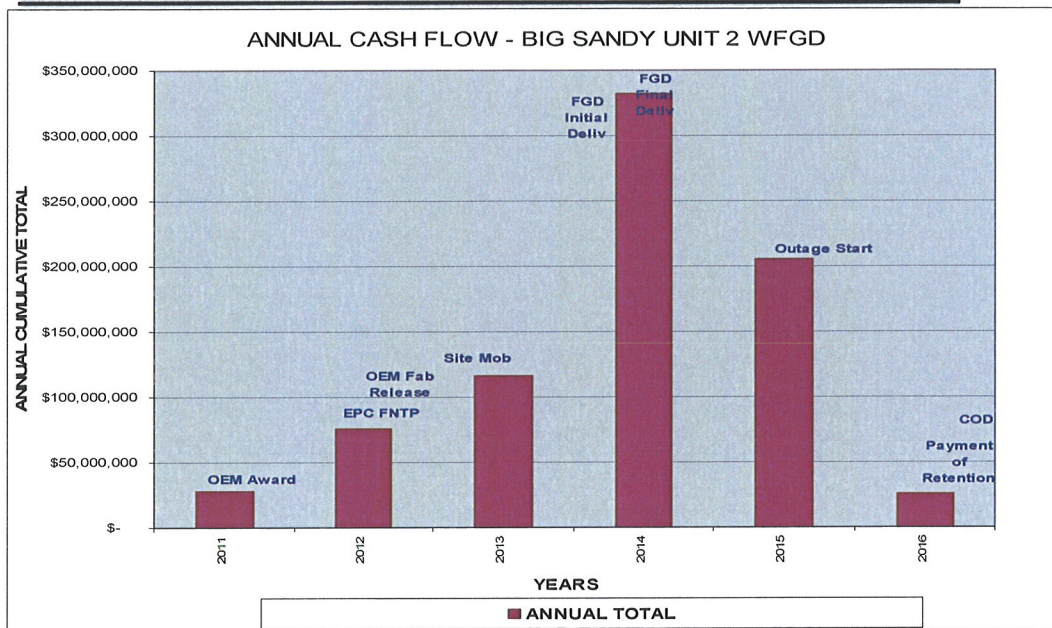


Table ES-5
DFGD MILESTONE SCHEDULE AND CASH FLOW SUMMARY

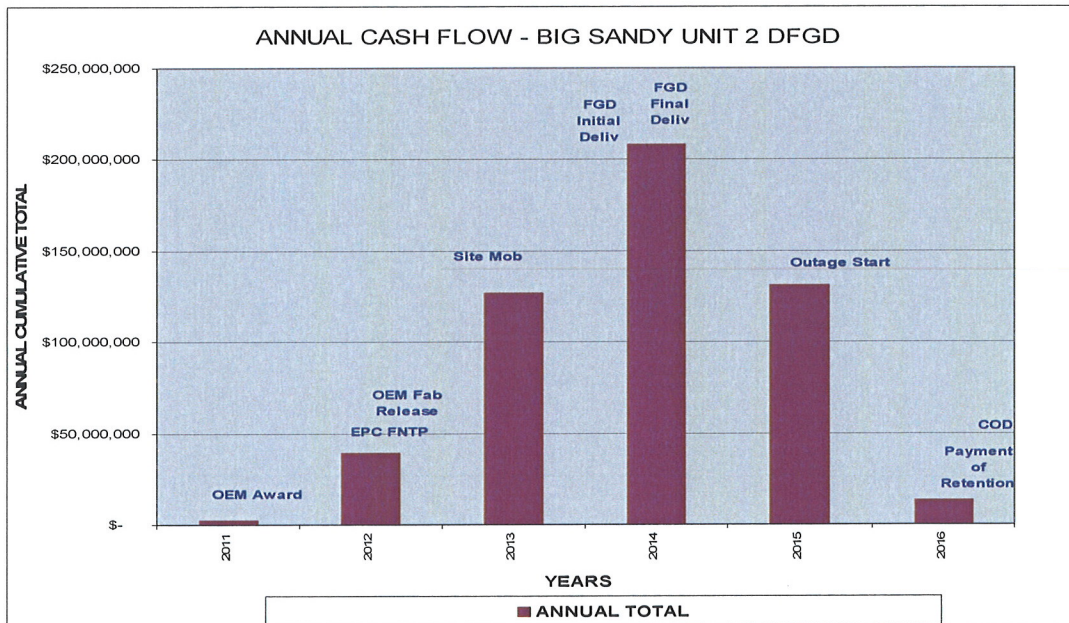


Table ES-6
IAQCS (PHASED) MILESTONE SCHEDULE AND CASH FLOW SUMMARY

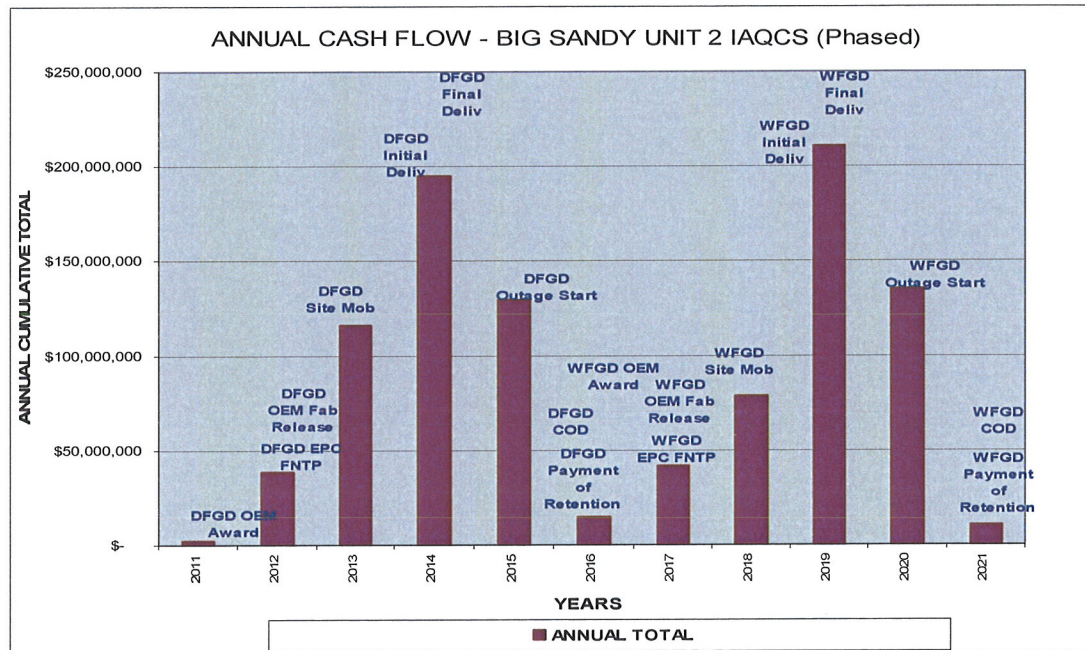


Table ES-7
IAQCS (NON-PHASED) MILESTONE SCHEDULE AND CASH FLOW SUMMARY

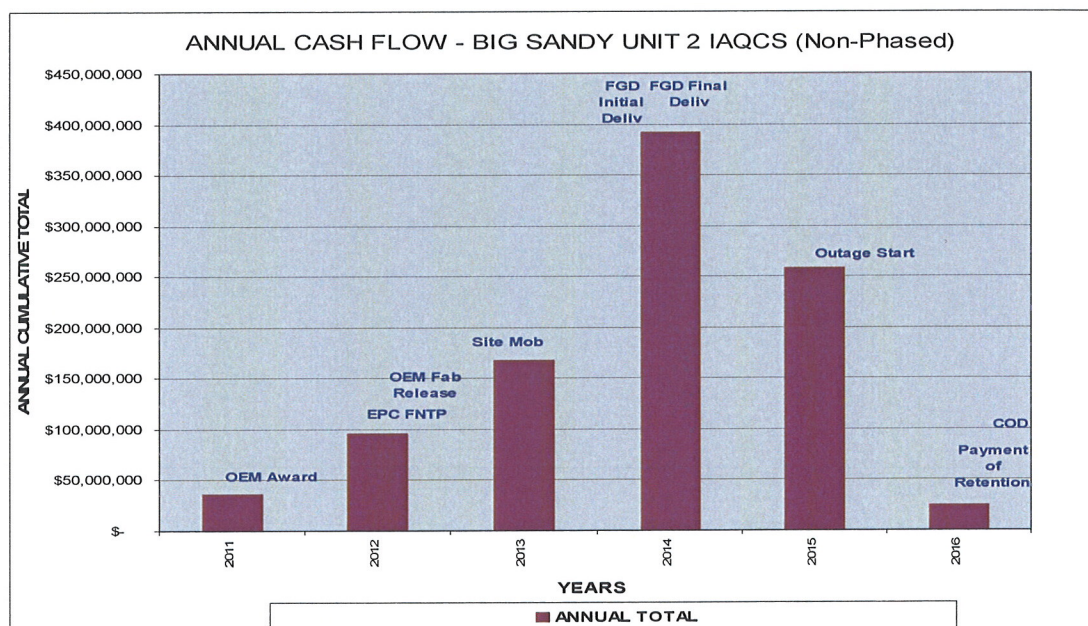
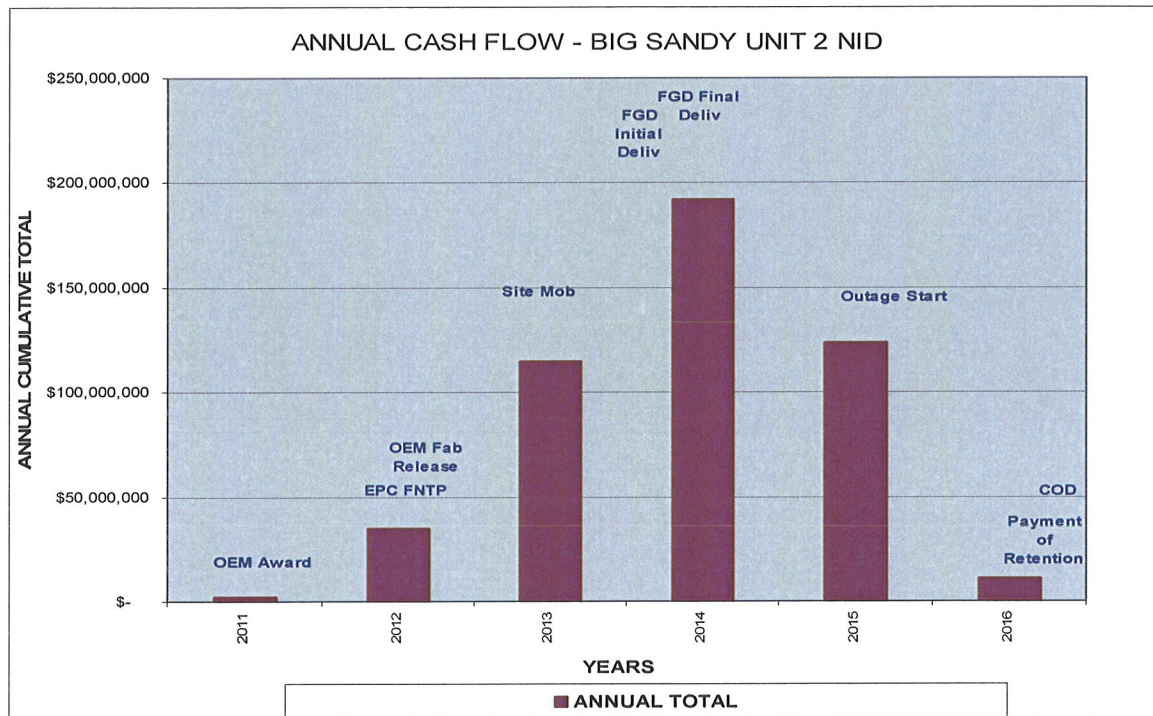


Table ES-8
NID MILESTONE SCHEDULE AND CASH FLOW SUMMARY



The technical and commercial basis to develop the capital and O&M cost estimates is defined in the following report.

1.0 INTRODUCTION

The purpose of this document is to establish the Basis of the Order-of-Magnitude FGD Cost Estimate to assist American Electric Power (AEP) with the selection of an FGD technology for Big Sandy Plant Unit 2. It is also intended to organize and present the deliverables for each technology that are used to develop the Order-of-Magnitude FGD Cost Estimates. This document will define the project scope of work for each technology, the organization of the capital cost estimate structure and the technical and commercial basis used to develop the Capital and O&M Cost Estimates. It will also define the assumptions used in preparing the cost estimates.

The Order-of-Magnitude FGD Cost Estimate Report is comprised of five (5) volumes as follows:

<u>Volume</u>	<u>Description</u>
1	Summary Report
2	WFGD Technology
3	DFGD Technology
4	IAQCS Technology
5	NID Technology

Order-of-Magnitude FGD Cost Estimates were prepared for the following four FGD Technologies:

- **Wet (WFGD):** Wet FGD Spray Tower and Integrated Wet ESP
- **Dry (DFGD):** Dry FGD Spray Dryer Absorber (SDA) and Fabric Filter (FF)
- **IAQCS:** Integrated Air Quality Control System (IAQCS) Dry SDA/FF and Wet FGD Spray Tower
- **NID:** Dry FGD NID and Fabric Filter

For each technology, cost estimates were prepared considering fuel specifications with sulfur content of 1.7, 3.0, 4.5 and 7.5 lb SO₂/MMBtu (as applicable). A base fuel was selected for each technology and a capital cost estimate was prepared for each assuming an Engineer, Procure, Construct (EPC) contracting approach. Adjustments were then made to the base cost estimate to develop the remaining fuel

estimates for that specific technology. The cost estimates also consider both the existing ESP in and removed from service for the Dry, IAQCS and NID technologies. The ESP is required to remain in service for the WFGD technology for protection from erosion and wear of the ID fans and FGD system components (pumps, piping, nozzles, etc.).

The estimates were based upon conceptual design deliverables prepared by S&L for each technology and the AEP Order of Magnitude/Relative Capital Installed Cost Estimate Specification (BS2-FGDSCE-052010, Rev. 1) which provided design basis and performance requirements. The conceptual deliverables, consisting of project general arrangements, process flow diagrams, mass balances, water balances and single lines, formed the basis for development of preliminary major equipment sizes and commodity estimates. Attention was focused on the significant elements that changed from one fuel to another, such as storage, handling and disposal of reagent and byproduct materials. The OEM equipment costs were taken from recent vendor quotes and adjusted for Big Sandy specifications, unit capacity, and escalated to 2010 dollars.

The IAQCS system was evaluated assuming a phased implementation in order to make it more competitive at lower sulfur fuel cases. The DFGD portion would be installed initially and for estimate purposes the WFGD followed 5 years later for the 1.7 lb and 3.0 lb SO₂/MMBtu fuels. For the non-phased higher sulfur fuels both systems would be constructed to meet the earlier completion date. In the phased approach the future WFGD infrastructure was considered in the site layout and estimate development for the DFGD Phase. For example, costs for the limestone rail hopper foundation installation were included in the DFGD Phase in order to avoid impacting lime delivery during the WFGD installation in Phase II. The non-phased site layout was optimized to reduce ductwork costs by swapping the chimney and WFGD absorber locations. In addition to higher ductwork costs the phased approach also has significantly higher escalation costs due to the staggered schedule.

Table 1-1 illustrates the total of twenty four (24) cost estimates that were prepared.

Table 1-1
EPC COST ESTIMATES

Technology	1.7 lb SO ₂ /MMbtu	3.0 lb SO ₂ /MMbtu	4.5 lb SO ₂ /MMbtu	7.5 lb SO ₂ /MMbtu
Wet	Wet Est-2	Wet Est-3	Wet Base Est-1	Wet Est-4
Dry (ESP)	Dry Est-2A	Dry Base Est-1A	N/A	N/A
Dry (N/ESP)	Dry Est-2B	Dry Base Est-1B	N/A	N/A
IAQCS (ESP)	IAQCS Est-2A	IAQCS Est-3A	IAQCS Base Est-1A	IAQCS Est-4A
IAQCS (N/ESP)	IAQCS Est-2B	IAQCS Est-3B	IAQCS Base Est-1B	IACCS Est-4B
NID (ESP)	NID Est-2A	NID Base Est-1A	NID Est-3A	NID Est-4A
NID (N/ESP)	NID Est-2B	NID Base Est-1B	NID Est-3B	NID Est-4B

ESP= ESP In Service

N/ESP = ESP Out of Service

2.0 TECHNICAL BASIS

The Design Basis used to establish the project scope of work is fully defined in the AEP Specification BS2-FGDSCE-052010 Revision 1, titled Order of Magnitude/Relative Capital Installed Cost Estimate Specification (Exhibit 1-1). Additional Design Basis documents were provided by AEP for use in establishing the design and scope and are not attached to this report. Table 2-1 identifies the AEP Design Basis documents utilized in this study.

Table 2-1
DESIGN BASIS DOCUMENTS

SPECIFICATION	DESCRIPTION
BS2-FGDSCE-052010	Order of Magnitude/Relative Capital Installed Cost Estimate Specification
GESP-06-004	Civil Design Criteria
SES-7018	Structural Design Criteria for Fossil Fuel Project
DC-NGDE-002	Architectural Design Criteria
DC-MECH-001	Mechanical Design Criteria
DC-ELEC-001-00	Fleet Plant Electrical Design Criteria
DC-FGD/SCR-004-03	Fleet FGD/SCR Control and Instrumentation Design Criteria
-----	Engineering Services Technically Approved Suppliers List (3/2/10)

The Order-of-Magnitude FGD Cost Estimates were also based on the Big Sandy Plant Unit 2 FGD Retrofit Project conceptual design developed during the course of the study. These conceptual design deliverables are tabulated in the Project Deliverable Index within each technology volume and described below.

2.1 FGD Technology Process Flow Diagrams

Conceptual Process Flow Diagrams were prepared for each technology to identify the major components of the specific FGD system and the supporting systems, such as material handling, wastewater treatment systems, service water systems, etc. These documents were developed early in the estimating process to define the basic scope of each technology. They were utilized to develop the general arrangements, preliminary equipment lists and sparing philosophy. The Process Flow Diagrams for the Wet, Dry, IAQCS and NID Technologies are included as Attachments 2-1, 3-1, 4-1 and 5-1 respectively.

2.2 Site Plan and General Arrangement Drawings

Conceptual Site Plan and General Arrangement Drawings for each technology were prepared to identify the general arrangement and layout of the specific FGD system at the Big Sandy Plant. These drawings conceptually show the arrangement of the FGD Island and supporting systems/equipment. The General Arrangements were a critical part of the commodity development for the cost estimates. The Site Plan and General Arrangement Drawings for the Wet, Dry, IAQCS and NID Technologies are included as Attachments 2-2, 3-2, 4-2 and 5-2 respectively.

2.3 Mass Balances

Mass Balances were prepared for each technology and consider three separate variables; flue gas, solids and water. The Mass Balances also consider the existing cold-side ESP in-service and out of service (as applicable). The Mass Balances were utilized in the development of equipment sizing and O&M costs.

The Mass Balances for the Wet, Dry, IAQCS and NID Technologies are included as Attachments 2-3, 3-3, 4-3 and 5-3 respectively..

2.4 Water Balances

Water Balances were prepared for each technology to show the source of FGD system make-up water. The Water Balances also consider the existing cold-side ESP in-service and out of service (as applicable). The Water Balances, similar to the Mass Balances, were utilized in the development of equipment sizing and O&M costs. The Water Balances for the Wet, Dry, IAQCS and NID Technologies are included as Attachments 2-4, 3-4, 4-4 and 5-4 respectively.

2.5 Electrical One-Lines

The existing electrical one-lines and switchyard one-lines were reviewed to establish options for the auxiliary power required for each technology. Conceptual load lists were prepared for each technology based on in-house data from other projects. The electrical one-lines were utilized to define the basic scope of the electrical system. Electrical equipment sizing and associated costs were then determined for the estimates. The Electrical One-Lines for the Wet, Dry, IAQCS and NID Technologies are included as Attachments 2-5, 3-5, 4-5 and 5-5 respectively.

3.0 COMMERCIAL BASIS

3.1 Capital Cost Estimate Outline

The Capital Cost Estimate prepared for the Big Sandy Plant FGD Project is organized by Area/Equipment. The cost estimate structure is defined in Exhibit 1-2.

3.2 Capital Cost Estimate Accuracy Range

3.2.1 Cost Estimate Classification

The capital cost estimate prepared for the Big Sandy Plant FGD Project was classified in accordance with AACE International Recommended Practice No. 18R-97 dated February 2, 2005 (refer to Exhibit 3-2). As a recommended practice of AACE International, the Cost Estimate Classification

System provides guidelines for applying the general principles of estimate classification to project cost estimates.

Based on the current level of project definition for the Big Sandy Plant FGD Project, (1% to 15% of full project definition), the capital cost estimate was categorized as a Class 4 estimate in accordance with the AACE International Recommended Practice No. 18R-97. Therefore, the expected accuracy range of the cost estimate typically varies in the low and high ranges as follows:

Low:	-15% to -30%
High:	+20% to +50%

The Estimate Input Checklist (Figure 2B of AACE International 18R-97) and Maturity Matrix (Figure 4 of AACE International 18R-97) were utilized to further justify the estimate Class 4 determination.

3.2.2 Contingency Analysis

The capital cost estimate contingency was determined using the range estimating process and Monte Carlo analysis. The Palisade Corporation @RISK software program was used to perform the risk analysis using Monte Carlo simulation. Range estimating (1) determines the probability of having a cost overrun, (2) identifies how large the overrun can be, and (3) identifies how much contingency to add to the cost estimate to reduce the residual risk to an acceptable level. Range estimates were determined for each of the cost elements in the cost estimate reflecting the confidence in the cost estimate. Risk drivers included OEM costs, BOP quantities, relocation/reinforcement costs. Refer to Exhibit 1-4 for the Contingency Analysis summary and other reports that established the contingency used.

3.3 Equipment/Material Cost

- 3.3.1** The OEM equipment pricing for the WFGD, DFGD and NID Technologies are from a 2009 Alstom bid for a confidential client. The bid was an “engineer and furnish only” proposal for a project in which

S&L was involved. The costs were adjusted to meet the Big Sandy project specifications. For example the WFGD vessel costs were increased to account for the C-276 materials specified in the design basis specification. The installation labor costs were added based upon manhour data furnished by various equipment manufacturers and once again was adjusted to meet the Big Sandy specifications and location. This pricing was then benchmarked on a \$/kW basis against other S&L FGD projects over the last 4 years. Note that the NID benchmarking was done through comparison to similar Circulating Dry Scrubber (CDS) projects. The IAQCS FGD was estimated as a combination of wet and dry systems with adjustments in lime consumption for the non-phased installation. The other equipment and material costs included in the capital cost estimate (for S&L estimated items) is based on recent vendor proposals, S&L's in-house cost database, vendor catalogs or published estimating manuals and adjusted, as required, for capacity, size, or material type.

3.4 Construction Labor Wage

Crew labor rates (Crew Hourly Rate) for the cost estimate are from the TriState Union Wage Rates from Huntington, West Virginia as provided by AEP. State specific Workman Comp % Rates were provided by AEP. The craft rates were incorporated into work crews appropriate for the activities by adding allowances for small tools, construction equipment, insurance, and site overheads to arrive at crew rates detailed in the cost estimate (See Exhibit 3-4: Union Labor Rate Summary). A 1.10 regional labor productivity multiplier is included based on Compass International Global Construction Yearbook, 2010 Edition plus and additional 5% for safety related issues for a total productivity multiplier of 1.15.

3.4.1 Labor Work Schedule and Incentives

The estimate assumes a 5x10 work week.

A productivity penalty of +8% (in hours) and premium time cost (1-1/2 times the base rate) between the 40 single and 50 single shift will be included.

Per-diem subsistence will be excluded for craft labor.

3.4.2 Base Craft Rates

The base labor crafts used for the capital cost estimate are defined in page 1 of Exhibit 1-5.

3.4.3 Labor Crews

The construction/erection labor cost is based on the use of applicable construction crews required for the scope of work of this project.

3.4.4 Crew Mixes

Major crew mixes used in the cost estimates are defined in page 2 of Exhibit 1-5.

3.4.5 Quantity Sources

Quantities of pieces of equipment and/or bulk material commodities used in this cost estimate are intended to be reasonable and representative of projects of this type. Material quantities were estimated from the site plan and general arrangement drawings, sketches and past project data provided by the S&L Engineers. Equipment quantities were defined in the AEP estimate specification and the conceptual process flow diagrams.

3.4.6 Construction Indirects

Allowances are included in the cost estimate as direct costs as noted for the following:

- Freight: 5% of the total equipment and material costs.
- Heavy Construction Equipment/Crane: Is based upon 9 months of heavy crane usage at \$75,000 per month crane rental with crane crew of 4 persons full time for this duration. Cost of small cranes and machinery is included in the wage rates.
- Mobilization and Demobilization: included in labor wage rates as 3.52% of total payroll wages + other + construction equipment (refer to Union Labor Rate Summary – Exhibit 1-5)
- Scaffolding: 5% of total material and labor costs.
- Consumables: 0.5% of total material and labor cost
- Loss of Productivity due to working 5-10's for extended periods and Premium Time Pay will be included as noted in 3.4.1 above

- Per Diem Costs: Excluded from the estimate as noted in 3.4.1 above.
- General and Administrative Costs: Excluded from the estimate per AEP direction.
- Profit: Excluded from the estimate per AEP direction.

Contractor allowance percentages noted above are base estimating percentages used for this type of major construction project on an Order-of-Magnitude estimate. These percentages are applied across the entire estimate and are not intended to be representative of individual estimate work areas.

3.4.7 Engineering/Design/Procurement Services

Sargent & Lundy has included estimated costs for Engineering, Design, Procurement Services and Project Management and Administrative Services. In addition costs for Training Services, and Outside Contractors are included as separate line items.

3.4.8 Construction Management/Field Engineering

Construction Management/Field Engineering is estimated at 3% of total direct and construction indirect costs.

3.4.9 Start-Up Commissioning

Start-Up/Commissioning is estimated at 1% of total direct and construction indirect costs.

3.4.10 Craft Startup Support

A fixed allowance for Craft Startup Support is included.

3.4.11 Initial Fills

Initial Fills are estimated at 0.3% of total direct and construction indirect costs.

3.4.12 Owners Costs

Owner costs are not included and will be provided by AEP for the following:

- Project Engineering
- Project Administration
- Owner Construction Management
- Owner Startup & Commissioning
- Permits & Fees
- Air Modeling
- Legal Fees

3.4.13 Sales/Use Tax

Sales/Use Tax is not included in the cost estimate.

3.4.14 Escalation

S&L has been monitoring over 200 U.S. indices from nine sources to track past escalation. These include indices for various pieces of equipment, various types of material, labor by city, and other items relevant to power plants. Some of the equipment includes heat exchangers, pumps, and transformers. Some of the material types tracked includes structural steel, pipe, and conduit.

Data for up to the last ten years is used to calculate past escalation. Then using the most current data as a base the average annual escalation is calculated over various time periods from the last six months, last one year, last two years, last three years, etc., up to the last ten years. We then used that past escalation to help predict future escalation while realizing that past escalation is not an indication of future escalation; but it is an appropriate benchmark along with knowledge of the current market to make predictions. Since anything can occur in a short time frame it is not uncommon to see wide escalation fluctuations for the data of less than about three years. After about three years the data is usually more stable and can start to show a long term trend. Also since three years is a reasonable time frame for purchases to be made on many projects this data point is usually used as the starting point for making predictions before current market conditions are factored in. Since using only one data source is very

risky, multiple indices from various sources are evaluated and their average is used in the calculation of past escalation.

The average escalation for the last three years is used as the starting point for making predictions before current market conditions are factored in. In addition to this the average escalation for the last five years is used to make escalation predictions after three years in the future before current market conditions are factored in. Based upon this evaluation along with input from AEP we have used the following escalation percentages:

Equipment: 4.0%/yr of total equipment cost escalated for five years (2011-2015).

Material: 2.0%/yr of total material cost escalated for four years (2012-2015)

Labor: 2.5%/yr of total labor cost escalated for five years (2011-2015)

Indirects: 2.5%/yr of total indirect costs escalated for five years (2011-2015).

For the IAQCS technology, due to the phased and non-phased approach, escalation is calculated as follows:

For the Dry FGD portion:

Equipment: 4.0%/yr of total equipment cost escalated for five years (2011-2015). Due to assumed equipment procurement cycle of average 2.5 years, actual escalation in the cost estimate is based on January 2011 to July 2013.

Material: 2.0%/yr of total material cost escalated for five years (2011-2015). Due to assumed material procurement cycle of 3.5 years, actual escalation in the cost estimate is based on January 2011 to July 2014.

Labor: 2.5%/yr of total labor cost escalated for five years (2011-2015). Due to significant craft labor loading that is typical during the first 12 months following mobilization, actual escalation in the cost estimate is based on January 2011 to July 2014 (3.5 years).

Indirects: 2.5%/yr of total indirect cost escalated for five years (2011-2015). Similar to Labor escalation, escalation for indirects in the cost estimate is based on January 2011 to July 2014 (3.5 years).

For the Wet FGD portion:

Equipment: 3.0%/yr of total equipment cost escalated for 10 years (2011-2020). Due to assumed equipment procurement cycle of average 2.5 years, starting on January 2016, actual escalation in the cost estimate is based on January 2011 to July 2018.

Material: 2.0%/yr of total material cost escalated for five years (2011-2015). Due to assumed material procurement cycle of 3.5 years, starting on January 2016, actual escalation in the cost estimate is based on January 2011 to July 2019.

Labor: 2.5%/yr of total labor cost escalated for five years (2011-2015). Due to significant craft labor loading that is typical during the first 12 months following mobilization, actual escalation in the cost estimate is based on January 2011 to July 2018 (7.5 years).

Indirects: 2.5%/yr of total indirect cost escalated for five years (2011-2015). Similar to Labor escalation, escalation for indirects in the cost estimate is based on January 2011 to July 2018 (7.5 years).

3.4.15 Contingency

After completion of the cost estimate a Risk Analysis was performed to develop the contingency to be applied to the cost estimates. Cost categories were defined for establishing target, maximum and minimum values depending on the confidence of achieving the target costs. For each category a range (minimum and maximum values) was determined based on level of design, equipment pricing, material / commodity pricing, labor pricing, and volatility in equipment, material, and labor pricing. These ranges were then entered into a software program utilizing Monte Carlo Simulation to determine an overall contingency for the project. The Monte Carlo Simulation is based on running 10,000 iterations where the inputs are randomly generated from probability distribution curves to simulate the process of sampling. The output is a curve where a point on the curve gives % confidence factor and corresponding

overall dollar amount for the project to meet that confidence factor. The software program also provides an output listing contingency % in terms of total direct and indirect costs. For this project we used 95% confidence factor to determine contingency dollars. Commercially available “@Risk” program was used to perform the risk analysis. Refer to Exhibit 1-4 for the contingency analysis summary.

3.4.16 AFUDC

Costs associated with AFUDC are not included.

3.4.17 Scope Excluded

The following additional scope items are not included.

- New landfill
- By-product disposal at landfill
- Private road to landfill (includes bridge)
- New coal handling equipment required for coal blending
- New coal storage/reclaim system

Table 3-1
INDIRECTS COMPARISON – BASE CASE TECHNOLOGIES

<u>Item Description</u>	WFGD BASE EST-1 4.5 LB SO ₂ /MMBTU	DFGD BASE EST - 1B (N/ESP) 3.0 LB SO ₂ /MMBTU	IAQCS BASE EST - 1B (N/ESP) 4.5 LB SO ₂ /MMBTU	NID BASE EST-1B (N/ESP) 3.0 LB SO ₂ /MMBTU
OVERTIME TOTAL LABOR COSTS FOR 50 HR WEEK	\$262,116,856	\$161,322,374	\$324,802,755	\$147,726,180
OVERTIME TOTAL LABOR COSTS FOR 40 HR WEEK	\$224,773,800	\$139,051,600	\$280,184,420	\$127,343,400
ADDITIONAL CRANE ALLOWANCE	\$1,337,400	\$2,333,520	\$3,670,920	\$1,337,400
COST DUE TO OVERTIME INEFFICIENCY - 8%	\$18,212,000	\$10,810,000	\$21,710,000	\$9,915,000
COST DUE TO OVERTIME PAY @1.5 TIMES OVERTIME PAY RATE - 10% ADDITIONAL HOURS PAID ON ACTUAL HOURS WORKED	\$19,131,056	\$11,460,774	\$22,908,335	\$10,467,780
CONSUMABLES - 0.5% of ACCT NO. 90	\$1,438,284	\$926,813	\$1,781,869	\$850,770
FREIGHT ON MATERIAL - 5% of ACCT NO. 90	\$3,944,645	\$2,331,050	\$4,719,260	\$2,156,025

<u>Item Description</u>	WFGD BASE EST-1 4.5 LB SO ₂ /MMBTU	DFGD BASE EST - 1B (N/ESP) 3.0 LB SO ₂ /MMBTU	IAQCS BASE EST - 1B (N/ESP) 4.5 LB SO ₂ /MMBTU	NID BASE EST-1B (N/ESP) 3.0 LB SO ₂ /MMBTU
FREIGHT ON EQUIPMENT - 5% of ACCT NO. 90	\$7,082,845	\$5,426,355	\$9,157,430	\$4,530,575
SCAFFOLDING - 5% OF ACCT NO. 90	\$14,382,835	\$4,634,065	\$17,818,685	\$8,507,695
CONTRACTOR'S GENERAL AND ADMINISTRATION EXPENSE & PROFIT - 15% of ACCT NO. 90	\$43,148,505	\$27,804,390	\$53,456,055	\$25,523,085
ENGINEERING, PROCUREMENT, & PROJECT SERVICES	\$30,000,000	\$25,000,000	\$45,000,000	\$25,000,000
CONSTRUCTION MANAGEMENT	\$17,169,900	\$11,402,300	\$21,272,500	\$10,335,400
S-U / COMMISSIONING	\$5,723,300	\$3,800,800	\$7,090,800	\$3,445,100
CRAFT START-UP SUPPORT	\$2,649,200	\$1,638,400	\$3,276,300	\$1,500,500
INITIAL FILLS	\$1,717,000	\$1,140,200	\$2,127,300	\$1,033,500
CONTINGENCY	\$92,638,200	\$64,186,900	\$108,308,600	\$56,485,500
ESCALATION	\$56,795,700	\$29,787,000	\$71,452,800	\$33,591,600

Note: Acct. 90 is the Total Direct and Construction Indirect Costs

3.5 Assumptions

3.5.1 All utilities such as electricity and water, required for the construction of this project, will be furnished by the owner and made available for use by the installation contractors.

3.5.2 All fuel required for construction equipment will be the responsibility of the installation contractors. This cost is included in the estimate wage rates.

3.5.3 Initial fills for testing and startup are furnished by the owner and include the following:

- Lime
- Limestone
- Service Water

3.5.4 Consumables are included as a line item in the estimates totaling 0.5% of Total Direct and Construction Indirect Costs and are comprised of the following:

- Welding Rods
- Solder and Flux
- Tapes of all Types
- Splicing Materials
- Cable-Pulling Compounds
- Sealing Compounds
- Cleaning Fluids

3.5.5 Expendables are included in the labor rates and are comprised of the following:

- Sandpapers
- Emery Cloth
- Rags
- Twine

3.6 Capital Cost Estimate Summary

Refer to the following Exhibits for the summaries.

- Wet FGD Base Case Capital Cost Estimate Summary (Exhibit 1-6.1)
- Dry FGD Base Case w/o ESP Capital Cost Estimate Summary (Exhibit 1-6.2)
- IAQCS FGD Base Case w/o ESP Capital Cost Estimate Summary (Exhibit 1-6.3)
- NID FGD Base Case w/o ESP Capital Cost Estimate Summary (Exhibit 1-6.4)

For detailed capital cost estimates see the individual technology volumes 2 through 5.

3.7 Capital Cost Estimate Comparison

The cost estimates prepared for each technology were summarized in a roll-up of individual accounts for comparison purposes. The cost differences between fuels were noted and technical items which account for the differences in cost between the options are tabulated. See Exhibits 1-8 (WFGD), 1-9 (DFGD), 1-10 (IAQCS) and 1-11 (NID).

4.0 O&M COST ESTIMATES

The O&M Cost Estimate Summary for the WFGD, DFGD, IAQCS and NID Technologies are provided in Exhibit 1-7. The detailed O&M Cost Estimates for the WFGD, DFGD, IAQCS and NID Technologies are provided in the individual technology volumes in Attachments 2-5, 3-5, 4-5 and 5-5 respectively. A comparative summary of fixed and variable O&M costs is also provided in the executive summary table ES-3.

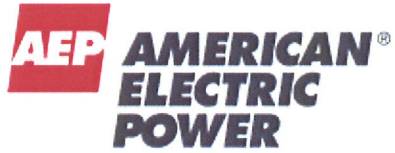
5.0 PROJECT SCHEDULE

An EPC Project Schedule was developed for each base case technology. For Technologies with two base cases only the ESP out of service base case schedule was prepared since the differences between the ESP in service and out of service are negligible. For the IAQCS technology separate project schedules were prepared for the phased and non-phased options. The level 2 project schedules are provided in the individual technology volumes. See Attachments 2-15 (WFGD), 3-15 (DFGD), 4-23 (IAQCS Non-Phased), 4-24 (IAQCS Phased) and 5-23 (NID).

Based on the capital cost estimate and the EPC project schedule a cash flow was developed for each technology (Base cost estimate ESP out of service case only). A summary page for each technology containing key milestone dates and an annual cash flow are provided in Tables ES-4 through ES-8. The monthly project cash flows are included in the individual technology volumes. (Refer to Exhibits 2-6 (WFGD), 3-6 (DFGD), 4-6 (IAQCS) and 5-6 (NID)).

6.0 REFERENCES

- 6.1 Order of Magnitude/Relative Capital Installed Cost Estimate Specification, BS2-FGDSCE-052010, Rev. 1, Dated June 21, 2010. Attached as Exhibit 1-1
- 6.2 AACE INTERNATIONAL Recommended Practice No. 18R-97 (February 2, 2005): Cost Estimate Classification System – As Applied In Engineering, Procurement, And Construction For The Process Industries. Attached as Exhibit 1-3



Big Sandy Unit 2
Kentucky Power Company
American Electric Power Service Corporation
Order-of-Magnitude FGD Cost Estimate
Draft (WFGD, DFGD, IAQCS & NID)
September 10, 2010

EXHIBIT 1-1
Order of Magnitude/Relative Capital Installed
Cost Estimate Specification