ORIGINAL

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ALLEN BENSE
Speaker

Joseph A. McGlothlin
Associate Public Counsel

November 29, 2006

Blanca S. Bayo, Director
Division of Records and Reporting
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399-0850

Re: Docket No. 060658-EI

Dear Ms. Bayo:

Enclosed for filing in the above-referenced dockets are the original and 15 copies of Citizens' Notice of Filing of Exhibits Omitted From Original Submission.

Please indicate the time and date of receipt on the enclosed duplicate of this letter and return it to our office.

Sincerely,

Joe McGlothlin

Joseph A. McGlothlin
Associate Public Counsel

CMP
COM 5
CTR orig.
ECR
GCL 1
JAM:bsr
OPC
RCA Enclosures
SCR
SGA
SEC 1
OTH Kim P Lockand- cover ltr.

ORIGINAL

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In Re: Petition on behalf of Citizens of the State of Florida to required Progress Energy Florida, Inc. to refund customers $143 million	)))))	DOCKET NO. 060658-EI Filed: November 29, 2006

CITIZENS' NOTICE OF FILING
OF EXHIBITS OMITTED FROM ORIGINAL SUBMISSION

The Citizens of the State of Florida, through the Office of Public Counsel, hereby give Notice of the filing of two exhibits to the direct testimony of Robert L. Sansom to which the witness referred in testimony, but which were omitted from the original exhibit package.

At page 7 of his testimony, Mr. Sansom stated that Babcock & Wilcox designed Crystal River Units 4 and 5 to burn 50% subbituminous Powder River Basin coal, and referred to Exhibit __ (RS-2). Exhibit __(RS-2) contains documentation applicable to Crystal River 4, but the corresponding supporting document for Crystal River 5 was not included in the original package. Citizens are attaching a Crystal River 5 "counterpart" to cure that omission. Excerpted from a document entitled, "Instructions for the Care and Operation of Babcock & Wilcox Equipment furnished on Contract RB-603 for Florida Power Corporation Crystal River Plant Unit 5," the exhibit refers to the coal blend on which the guarantees on Crystal River Unit 5 are based. To avoid confusion, it is identified as Exhibit __ (RS-2A).

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The second document is the redacted version of a study conducted by the firm of Sargent and Lundy for Progress Energy, dated October 14, 2005, that Progress Energy Florida Inc. provided to Citizens during discovery. Mr. Sansom referred to and drew from the study and other related documents at page 25 of his direct testimony, and indicated that "relevant supporting documents" would be attached as Exhibit 12. The attached document should have been included as part of that package. The purpose of this filing is to cure that omission. To avoid confusion, the document has been identified as Exhibit __ (RS-12A).

Harold McLean
Public Counsel

Joseph A. McGlothlin
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c/o The Florida Legislature
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Room 812
Tallahassee, FL 32399-1400

Attorney for the Citizens
of the State of Florida

DOCKET NO. 060658-EI
<u>CERTIFICATE OF SERVICE</u>

I HEREBY CERTIFY that a true and correct copy of Citizens' Notice of Service of Filing of Exhibits Omitted from Original Submission, has been furnished by electronic mail and U.S. Mail on this 29th day of November, 2006, to the following:

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Joseph A. McGlothlin
Associate Public Counsel

Instructions

for the

Care and Operation

of

Babcock & Wilcox Equipment

furnished on Contract

RB-603

for

Florida Power Corporation

Crystal River Plant

Unit 5

UNIT DESCRIPTION

PLANT

This unit is installed as Unit No. 5 at the Crystal River Plant located near Crystal River, Florida. Plant elevation is 11 feet above sea level.

The unit supplies steam to a GE turbine rated at 665 MW. The consulting engineer is Black & Veatch, Kansas City, Missouri.

BOILER

This is a semi-indoor, balanced draft Carolina Type Radiant Boiler designed for pulverized coal firing. The unit has 54 Dual-Register burners arranged in three rows of nine burners each on both the front and rear walls. Furnace dimensions are 79 feet wide, 57 feet deep, and 201 feet from the centerline of the lower wall headers to the drum centerline. The steam drum is 72 inches ID.

The maximum continuous rating is 5,239,600 lb/hr of main steam flow at 2640 psig and 1005° F at the superheater outlet with a reheat flow of 4,344,700 lb/hr at 493 psig and 1005° F with a normal feedwater temperature of 546° F. This is a 5% overpressure condition. The full load rating is 4,737,900 lb/hr of main steam flow at 2500 psig and 1005°F with a reheat flow of 3,959,800 lb/hr at 449 psig and 1005°F with a normal feedwater temperature of 535° F. Main steam and reheat steam temperatures are controlled to 1005°F from MCR load down to half load (2,368,900 lb/hr) by a combination of gas recirculation and spray attemperation.

The unit is designed for cycling service and is provided with a full boiler by-pass system. The unit can be operated with either constant or variable turbine throttle pressure from 63% of full load on down.

The design pressures of the boiler, economizer, and reheater are 2975, 3050, and 750 psig respectively.

Steam for boiler soot blowing is taken off the primary superheater outlet header. Steam for air heater soot blowing is taken off the secondary superheater outlet.

SCOPE OF SUPPLY

The major items of equipment supplied by B&W include:

- RBC unit pressure parts including boiler, primary and secondary superheater, economizer, and reheater.
- Fifty-four Dual-Register burners and lighters.
- Six MPS-89GR pulverizers and piping to burners.
- By-pass system including valves and piping.
- Two stages of superheat attemperators (first stage tandem) and one stage of reheat attemperation (2 nozzles); nozzles only, no block or control valves or spray water piping.
- Three Rothemuhle air heaters (one primary and two secondary).
- Ducts from secondary air heaters to windbox.

RB-603 Jan 83

- Primary air system: two TLT centrifugal PA fans and ducts from fans to pulverizers.
- Gas recirculation system: one TLT centrifugal GR fan, one dust collector and flues.
- Six Stock gravimetric coal feeders and drives.
- Bailey burner controls.
- Safety valves and ERV.
- Brickwork, refractory, insulation and lagging (BRIL).
- Seal air piping and fans.
- Erection.
- Recommended spare parts.

FUEL

The guarantees for this unit are based on firing a 50/50 blend of Eastern bituminous and Western sub-bituminous coal. The performance coal is classified as high slagging and medium fouling. Performance was also checked on Illinois deep-mined coal which is classified as severe slagging and high fouling. The furnace and convection pass are designed for a severe slagging and severe fouling coal.

Ultimate Analysis: % by Weight

	Performance	Illinois
Ash	7.90	13.00
Sulfur	0.49	4.20
Hydrogen	3.90	4.40
Carbon	58.80	62.00
Chlorine	0.03	0.02
Water	18.50	10.00
Nitrogen	1.10	1.38
Oxygen	9.28	5.00
Total	100.00	100.00
Higher Heating Value	10285 Btu/lb	11000 Btu/lb

PEF-FUEL-004091

RB-603

A — FUEL AS FIRED

SAMPLES				
ANALYSES 50/50 BLEND, EASTERN & WESTERN				
KIND				
ASTM — CLASS				
ASTM — GROUP				
SOURCE — MINE				
SOURCE — SEAM				
SOURCE — DISTRICT				
SOURCE — COUNTY				
SOURCE — STATE				
COAL — SIZE				
COAL — GRINDABILITY				48
COAL — SURFACE MOISTURE, %				
				PERF.
ASH SOFT.TEMP.,F (REDUCING)				
PROX. ANAL. % — MOISTURE, TOTAL				18.5
PROX. ANAL. % — VOLATILE MATTER				31.0
PROX. ANAL. % — FIXED CARBON				42.6
PROX. ANAL. % — ASH				7.9
PROX. ANAL. % — TOTAL				100.0

ULTIMATE ANALYSIS

FUEL	BIT.	SUB-BIT.		
% BY	WT.	WT.		WT.
ASH	10.0	5.0		7.90
S	0.5	0.48		0.49
H_2	4.4	3.4		3.90
C	69.0	48.5		58.80
CH_4				
C_2H_4				
C_2H_6				
C_3H_8				
C_4H_{10}				
C_5H_{12}				
C_6H_{14}				
CO				
CO_2				
Cl	0.05	0.02		0.03
H_2O	7.0	30.0		18.50
N_2	1.4	0.7		1.10
O_2	7.65	11.1		9.28
TOTAL	100.00	100.00		100.00
BTU/LB	12,450	8,125		10,285
BTU/CU FT AT 60F 30 IN.HG				

*EXCLUDING VALVES AND STATIC HEAD.

B — PREDICTED PERFORMANCE

STEAM LEAVING SH, M LB/HR		2368.9	4737.9	5239.6
STEAM LEAVING RH¹, M LB/HR		2063.8	3959.8	4344.7
STEAM LEAVING RH², M LB/HR				
TYPE OF FUEL		PC	PC	PC
LOAD CONDITION		CONT.	CONT.	CONT.
EXCESS AIR LEAVING ECON., %		35	20	20
NO. OF BURNERS IN OPERATION		45	54	54
FUEL INPUT, MKB/HR		3348	6053	6581
HEAT AVAIL.MKB/HR (FUEL & HEATED AIR)		3615	6367	6886
QUANTITY, M LB/HR — FUEL (MCFH-NAT. GAS)		325.5	588.6	639.8
QUANTITY — FLUE GAS ENTERING AIR HEATER		3728	6051	6579
QUANTITY — AIR TO BURNING EQUIPMENT		3327	5419	5891
QUANTITY — AIR HEATER LEAKAGE	PRI/SEC	107/210	128/272	131/286
PRESSURE, PSIG — STEAM AT SH OUTLET		2425	2500	2640
PRESSURE — STEAM AT RH¹ INLET		240	474	520
PRESSURE — STEAM AT RH² INLET				
PRESSURE DROP — REHEATER 1		13	25	27
PRESSURE DROP — REHEATER 2				
PRESSURE DROP — ECONOMIZER *		5	20	25
PRESSURE DROP — DRUM TO SH OUTLET		39	155	189
TEMPERATURE, F — STEAM — LEAVING SUPERHEATER		1005	1005	1005
STEAM — LEAVING REHEATER 1		1005	1005	1005
STEAM — ENTERING REHEATER 1		528	598	604
STEAM — LEAVING REHEATER 2				
STEAM — ENTERING REHEATER 2				
FLUE — LEAVING ECONOMIZER		630	689	697
FLUE — LEAVING AH (EXCL.LKG)	PRI/SEC	280/260	280/278	280/279
FLUE — LEAVING AH (INCL. LKG)	PRI/SEC	258/249	261/267	262/269
WATER ENTERING ECONOMIZER		459	535	546
AIR — ENTERING UNIT	PRI/SEC	85/99	95/82	95/80
AIR — LEAVING AIR HEATER	PRI/SEC	555/555	575/596	579/601
RESISTANCE, IN. OF WATER — GAS — FURNACE & CONVECTION BANKS		1.7	3.5	3.9
GAS — FLUES TO AH OUTLET		0.4	0.9	1.1
GAS — AIR HEATER		1.7	3.6	4.1
TOTAL FURN. TO AH OUTLET		3.8	8.0	9.1
AIR — FUEL BURNERS & WINDBOX		1.0	2.5	2.9
AIR — DUCTS & FLOW METER		1.2	3.3	3.8
AIR — AIR HEATER		1.7	4.0	4.6
TOT. FROM	AH INLET TO FURN	3.9	9.8	11.3
HEAT LOSS, % — DRY GAS		4.23	4.34	4.43
H_2 & H_2O IN FUEL		5.80	5.89	5.91
MOISTURE IN AIR		0.11	0.11	0.11
UNBURNED COMBUSTIBLE		0.30	0.30	0.30
RADIATION		0.31	0.17	0.15
UNACC. FOR & MFRS. MARGIN		1.50	1.50	1.50
TOTAL HEAT LOSS		12.25	12.31	12.40
EFFICIENCY OF UNIT, %		87.75	87.69	87.60
PULVERIZER — NO. IN USE PER BOILER		5	6	5 6
TOTAL POWER, KW HR/TON MOTOR OUTPUT				
% THRU 200 U.S.S. SIEVE		74	69	65 68

PREDICTED PERFORMANCE IS BASED ON COMBUSTION AIR ENTERING UNIT WITH 0.013 LB MOISTURE/LB DRY AIR, ON 29.92 IN. HG. BAROMETRIC PRESSURE, ON CONDITIONS & EQUIPMENT GIVEN ON THIS SUMMARY SHEET & ON ARRANGEMENT SHOWN ON DRAWING P12-4657-16Y0

C — EQUIPMENT PER UNIT

TYPE	RADIANT
SIZE	RBC 57 79/HB
DESIGN PRESSURE - 2,975 PSIG	
FURNACE — WATER COOLED SCREEN (CIRCUMFERENTIAL)	
FURNACE — WATER COOLED (PROJECTED)	48,736
FURNACE — SUPERHEATER (CIRCUMFERENTIAL)	
FURNACE — SUPERHEATER (PROJECTED)	46,442
	-
TOTAL FURNACE HEATING SURFACE	95,178
CONVECTION — SATURATED (CIRCUMFERENTIAL)	10,586
CONVECTION — SUPERHEATER (CIRCUMFERENTIAL)	243,015
CONVECTION — REHEATER 1 (CIRCUMFERENTIAL	333,919
CONVECTION — REHEATER 2 (CIRCUMFERENTIAL)	
CONVECTION — ECONOMIZER	46,519
TOTAL CONVECTION HEATING SURFACE	634,039
TOTAL FURN. & CONV. PRESSURE PART. HTG. SURF.	729,217
FLAT PROJECTED FURNACE HEATING SURFACE	
TO FACE OF PLATENS (24" CTR)	73,581
TO FACE OF CONVECTION SURFACE	101,501
FURNACE VOLUME, CU FT	734,185
AIR HEATER — TYPE ROTHEMUHLE REGENERATIVE	NO. 1-PRI. 2-SEC.
AIR HEATER — TOTAL HEATING SURFACE, SQ FT	PRI.-250,522
	SEC.-824,850
PRI.SIZE-10.6 Vu 56	
SEC.SIZE-12.5 Vu 68	
FUEL BURNER — TYPE DUAL REGISTER	
FUEL BURNER — NO. 54	
PULVERIZER — TYPE MPS SIZE 89G NO. 6	
CAPACITY OF 5 PULV. IS 5239 M LB STEAM/HR BASED ON 48 GRIND	
10,285 BTU COAL AT 65 % THRU 200 U.S.S. SIEVE	
FOR 109.7 M LB COAL/PULV.-HR AT 65% THRU 200 U.S.S. SIEVE MIN. GRIND	
IS 42 MAXIMUM TOTAL MOISTURE IS 18% REQUIRING 570 F AIR	
STEAM TEMP. CONTROL — MAIN STEAM BY SPRAY ATTEMPERATION	
STEAM TEMP. CONTROL — REHEAT BY GAS RECIRCULATION	
UNIT CONSTRUCTION FEATURES — MEMBRANE WALLS	
UNIT CONSTRUCTION FEATURES — BALANCE DRAFT	

REVISIONS NO.	DESCRIPTION	BY	DATE

FLORIDA POWER CORP.
CRYSTAL RIVER, UNIT 5

UTILITY BOILER PERFORMANCE SUMMARY
BY RLG APPD. [illegible] DATE

THE BABCOCK & WILCOX COMPANY

P12-4657-16Y0-1S0

Progress Energy
Crystal River Units 4 and 5

Powder River Basin Coal Conversion Study

Project No. 11888-001

October 14, 2005

SL Report 008575

Sargent & Lundy LLC

Prepared by
Sargent & Lundy, LLC

Sargent & Lundy

Progress Energy
Crystal River Units 4 & 5

October 14, 2005
Project No. 11888-001

POWDER RIVER BASIN COAL CONVERSION STUDY

EXECUTIVE SUMMARY

Progress Energy authorized Sargent & Lundy (S&L) to evaluate the burning of various blends of Powder River Basin (PRB) and Illinois coal at Crystal River Units 4 and 5. On-site blending was not considered. The blending would be done off-site. The study was identified as a high level assessment that would assist Progress Energy in the performance of a "first cut" evaluation to determine if PRB coal will provide an economic benefit.

The assessments focused on two major areas, safety and performance. In all blend cases the objective was to continue to maintain the current unit maximum operating capability at valves wide open and 5% overpressure. Also, all modifications required to maintain safe operating conditions were to be included.

The assessments were based on burning blends of PRB coal and Illinois coal. Progress Energy provided coal analyses of coal blends from 0% to 100% PRB in increments with PRB coal increasing by 10%. The two base scenarios identified for the study were the burning of less than 30% PRB and 100% PRB. The other scenario to be considered was a blend with PRB coal between 30% and 90% where a major performance and/or cost impact would occur.

For coal blends less than 30% PRB, the following modifications are recommended:

Performance

- Implement repairs as required so that all existing furnace and convective pass sootblowers are in proper operating condition.
- Improve pulverizer throughput and performance by making changes, such as new rotating vane wheels, dynamic classifiers, hydraulic roll tensioning devices.
- Replace all chutework at TP-3.
- Add crusher by-pass screens.
- Install belt scales on Conveyors 35A, 35B, 401, 403, 501 and 502.
- Replace chutework at TP-26 and TP-27.
- Modify discharge chutes for Conveyors 501 and 502.

Safety

- Replace the four existing non-functioning dust collectors with wet type dust collectors for silo ventilation.
- Add fogging dust suppression systems for all transfer points from surge bin to cascade conveyor system to maintain the same level of coverage provided by the existing dust collectors.

- Modify/upgrade the existing pulverizer steam mill inerting and water spray system as much as practical so that a functional system is available.

For both units the total estimated order of magnitude costs for these modifications is $[redacted] including engineering and contingency. Additional personnel will be required for housekeeping purposes primarily in the coal handling areas. The actual number of additional personnel required is dependent on the current operating practices of the owner. Due to the characteristics of PRB coal and its impact on equipment performance, equipment will need to be maintained in proper operating condition. Therefore, maintenance costs can be expected to increase.

It should be noted that coal blends with PRB coal less than 30% exhibit characteristics of bituminous coal and many of the safety modifications required for PRB coal are not necessary. However, above 30% PRB coal the blended coal acts like PRB coal. All the modifications required to maintain safety with PRB coal are required.

For coal blends with 70% PRB coal, the following modifications are recommended:

<u>Performance</u>

- Add four water cannons to each unit to clean the furnace water walls.
- Add/modify sootblowers to clean the convective pass heat transfer surface areas.
- Install new pulverizer for each unit, including motor drive, cascade conveyor, silo, feeder, coal piping, pyrites removal equipment, controls, burner piping, electrical feeds and auxiliary power modifications.
- Increase the skirt height for the cascade conveyors.
- Replace the existing 18 in. coal piping with 24 in. piping and modify the coal feeders.
- Replace all chutework at TP-3.
- Add crusher by-pass screens.
- Increase the capacity of conveyors 35A/B and 36A/B by installing 45 degree idlers.
- Increase the belt speed of the conveyors from the surge bin to the cascade conveyors and replace the drives and pulleys.
- Install belt scales on Conveyors 35A, 35B, 401, 403, 501 and 502.
- Replace chutework at TP-26 and TP-27.
- Replace the crusher vibratory feeders with belt feeders.
- Replace the surge bin vibratory feeders with belt feeders.
- Modify discharge chutes for Conveyors 501 and 502.

<u>Safety</u>

- Add washdown hoses and floor drains for the in-plant surge bin area and for the cascade conveyor rooms.
- Install sloping surfaces on beams for the in-plant surge bin area and the cascade conveyor room ceiling.
- Replace the existing four dust collectors with wet type dust collectors for silo ventilation.
- Add water sprays and residual effect dust suppression at the train unloading hopper.
- Add wind screen, water sprays and residual effect dust suppression at the barge unloading hopper.
- Add fogging dust suppression systems for all the transfer chutes in the reclaim system.

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- Replace the existing non-functional pulverizer inerting system with a new steam inerting and water suppression system designed to current industry standards.
- Add CO monitoring system.
- Purchase a Fire Aid 2000 system to extinguish coal silo fires.
- Add explosion venting for the in-plant surge bin area and the cascade conveyor room area.

For both units the total estimated order of magnitude costs for these modifications is $[redacted] including engineering and contingency. Additional personnel will be required for housekeeping purposes primarily in the coal handling areas. The actual number of additional personnel required is dependent on the current operating practices of the owner. Due to the characteristics of PRB coal and its impact on equipment performance, equipment will need to be maintained in proper operating condition. Therefore, maintenance costs can be expected to increase. Variable O&M costs could increase by up to $0.04/MWhr.

For burning 100% PRB coal, the following modifications are recommended:

<u>Performance</u>

- Add four water cannons to each unit to clean the furnace water walls.
- Add/modify sootblowers to clean the convective pass heat transfer surface areas.
- Modify burners and controls to handle a greater PRB coal flow and to optimize combustion to maintain low unburned carbon.
- Install cyclone separator dampers and a bypass duct for the gas recirculation system. Also, modify the fans for greater fly ash erosion resistance.
- Install new pulverizer for each unit, including motor drive, cascade conveyor, silo, feeder, coal piping, pyrites removal equipment, controls, burner piping, electrical feeds and auxiliary power modifications.
- Increase the skirt height for the cascade conveyors.
- Replace the existing 18 in. coal piping with 24 in. piping and modify the coal feeders.
- Replace all chutework at TP-3.
- Add crusher by-pass screens.
- Increase the capacity of conveyors 35A/B and 36A/B by installing 45 degree idlers.
- Increase the belt speed of the conveyors from the surge bin to the cascade conveyors and replace the drives and pulleys.
- Install belt scales on Conveyors 35A, 35B, 401, 403, 501 and 502.
- Replace chutework at TP-26 and TP-27.
- Replace the crusher vibratory feeders with belt feeders.
- Replace the surge bin vibratory feeders with belt feeders.
- Modify discharge chutes for Conveyors 501 and 502.

<u>Safety</u>

- Add washdown hoses and floor drains for the in-plant surge bin area and for the cascade conveyor rooms.
- Install sloping surfaces on beams for the in-plant surge bin area and the cascade conveyor room ceiling.
- Replace the existing four dust collectors with wet type dust collectors for silo ventilation.
- Add water sprays and residual effect dust suppression at the train unloading hopper.

- Add wind screen, water sprays and residual effect dust suppression at the barge unloading hopper.
- Add fogging dust suppression systems for all the transfer chutes in the reclaim system.
- Replace the existing non-functional pulverizer inerting system with a new steam inerting and water suppression system designed to current industry standards.
- Add CO monitoring system.
- Purchase a Fire Aid 2000 system to extinguish coal silo fires.
- Add explosion venting for the in-plant surge bin area and the cascade conveyor room area.

For both units the total estimated order of magnitude costs for these modifications is $[redacted] including engineering and contingency. Additional personnel will be required for housekeeping purposes primarily in the coal handling areas. The actual number of additional personnel required is dependent on the current operating practices of the owner. Due to the characteristics of PRB coal and its impact on equipment performance, equipment will need to be maintained in proper operating condition. Therefore, maintenance costs can be expected to increase. Variable O&M costs could increase by up to $0.04/MWhr.

I. INTRODUCTION

Progress Energy authorized Sargent & Lundy (S&L) to evaluate the burning of various blends of Powder River Basin (PRB) and Illinois coal at Crystal River Units 4 and 5. On-site blending was not to be considered. The blending would be done off-site. The study was identified as a high level assessment that would assist Progress Energy in the performance of a "first cut" evaluation to determine if PRB coal will provide an economic benefit.

II. SCOPE OF WORK

S&L visited the Crystal River site on July 28 and 29, 2005. During the visit the study objectives and criteria, scope of work, methodologies to be used and schedule were reviewed with Progress Energy personnel. Walkdowns were performed to review the existing equipment. Available design and operating information required as input to the study were collected. Discussions were held with Progress Energy operating and engineering personnel to ensure an understanding of current plant operations and conditions. Based on these activities, engineering assessments were performed to determine the impacts of various blends of PRB coal on the two units. The assessments focused on two major areas, safety and performance. For all blend cases the objective was to continue to maintain the current unit maximum operating capability at valves wide open and 5% overpressure. Also, all modifications required to maintain safe operating conditions were to be included. The general listing of equipment included in Exhibit B was used as a guide for the equipment review.

The assessments were based on burning blends of PRB coal and Illinois coal. Progress Energy stated that it is more likely that blending would be done with PRB coal and a higher heating value Central Appalachian coal. The use of Illinois coal for this study was deemed to be a more conservative approach. Progress Energy provided coal analyses of coal blends from 0% to 100% PRB in increments with PRB coal increasing by 10%. The analyses are included in Exhibit C. The two base scenarios identified for the study were the burning of less than 30% PRB and 100% PRB. The other scenario to be considered was a blend with PRB coal between 30% and 90% where a major performance and/or cost impact would occur. For this study this break point turned out to be 70% PRB.

The assessments focused on specific components and subsystems affected by burning PRB coal. The effects of PRB coal were identified and recommendations were included for equipment repair, upgrade, replacement, or no change required to maintain safe operating conditions or to overcome operational limitations due to burning PRB coal. S&L developed order of magnitude cost estimates for these changes. The estimates were based primarily on our assessment of current equipment performance, station reports on existing O&M practices and S&L past experience on similar PRB coal conversion applications at other units. The recommended modifications and associated order of magnitude cost estimates are summarized in Exhibit A.

Since this study is a high level assessment, a detailed review of the condition of the existing equipment was not performed. In general, it was assumed that all of the existing equipment is in proper operating condition unless otherwise noted by station personnel or observed during the station walkdowns. Costs for making the existing equipment operational have only been included where a need was identified.

III. TECHNICAL DISCUSSION

Crystal River Units 4 and 5 are the same utilizing the same boiler design and a shared coal handling system. Accordingly, the following discussion applies equally to both units unless otherwise noted.

Boiler - General Description

The boiler was manufactured by Babcock & Wilcox and was originally designed for 50% Illinois and 50% PRB coal. The boiler has a maximum rating of 5,329,600 lbs/hr main steam at 2640 psig and 1005°F, and 4,344,700 lbs/hr reheat steam at 520 psig (cold reheat inlet) and 1005°F. There are six pulverizers with space available to add a seventh. There are two Rothemule regenerative secondary air heaters and one Rothemule regenerative primary air heater. The gas recirculation system is operational and in use. The boiler has a balanced draft furnace with two FD Fans, two primary air fans and four ID Fans.

Furnace Size

A large furnace size is very important in successfully firing PRB coal because the ash accumulation on the furnace walls from this coal is usually sticky and highly reflective, which significantly reduces water wall heat transfer rates. Furnaces properly sized for PRB coal will operate with furnace exit gas temperatures (FEGT's) that are below the ash fusion temperature so that excessive superheater and reheater slagging and fouling does not occur.

An often used criteria for assessing furnace size is the coal fuel heat release rate per square foot. New furnaces designed for PRB coal usually have heat release rates in the range of 1.6 to 1.8 MM Btu/hr/sq.ft. The Crystal River Unit 4 and 5 furnace has a design heat release rate of approximately 1.5 MM Btu/hr/sq.ft. In addition, the furnace volume heat release rate is approximately 9,000 Btu / cu. ft., which is lower than many other boilers that are successfully firing PRB. Therefore, this boiler's furnace size should readily accept 100% PRB coal.

The furnace has a nose of reasonable size, which promotes equal gas flow rates through the platen and final superheater assemblies. Equal flow through these surfaces will mitigate slagging and fouling problems. There are no wing walls or other furnace surfaces that might hinder PRB firing.

The burners are positioned at a fairly wide spacing, with the position of the top burners being somewhat higher than optimum. However, this situation should not pose an impediment to PRB coal firing.

In summary, the furnace size and configuration appear to be consistent with new boilers designed for PRB coal firing. However, as discussed below the installation of furnace water cannons may be needed.

Convection Pass

The convection pass arrangement and spacing is quite similar to what is being offered by boiler suppliers for new PRB coal boiler designs. Spacing of the final reheater could be slightly wider. During our meeting at the plant, major convection pass issues were not identified. The boiler has a bare tube economizer, which is preferred. As discussed below the installation of additional sootblowers will be needed.

In the report on the 2004 PRB test burn, it was concluded that the use of superheater spray flow experienced "was not very significant". Therefore, there will not be a need to increase the maximum flow rate capability of the superheater and reheater attemperators.

Furnace and Convection Pass Cleaning

Water cannons and soot blowers are the first line of defense in maintaining boiler cleanliness, performance and in achieving optimum FEGT. The addition of water cannons to clean the furnace water walls is recommended for PRB coal blends 70% and above. It is also recommended that more sootblowers be installed and some existing sootblowers modified to incorporate the latest tube cleaning technology in the boiler convective pass area for PRB blends 70% and above. This will provide optimum cleaning capabilities in the convective pass of the boiler. In some cases there are existing boiler openings reserved for future use that could be used with new sootblowers. For PRB coal blends less than 30%, the existing furnace and convective pass sootblowers should be repaired so they are all in proper operating condition.

Pulverizers

Per the B&W Performance Summary data page, there are six MPS 89G pulverizers installed. Each pulverizer has a capacity of 109,000 lbs/hr with 42 HGI coal. Plant operating personnel advised that all six pulverizers are needed when operating at the full load overpressure condition with the current coal. With five pulverizers in operation each unit can achieve about 650 to 680 MW depending on coal conditions, the condition of the pulverizers, etc.

Based on the April 26 - 28, 2004 PRB test burn report, with a 22% PRB blend and with all six pulverizers operating, the pulverizer coal flow rates were about 90,000 lbs/hr. However, this rate actually seems lower than what is needed based on B&W data. Probably the coal feeders have more capacity than the pulverizers so percent of feeder speed may not be correctly indicating the pulverizer coal flow capability.

It is probabale that full load can be achieved at PRB coal blends less than 30% PRB with all six pulverizers in operation. However, we recommend some pulverizer changes be implemented to improve pulverizer throughput and performance, such as new rotating vane wheels, dynamic classifiers, hydraulic roll tensioning devices, etc. It is our understanding that rotating throats have been installed.

For PRB coal blends at 70% PRB and above the installation of a seventh mill will be required. The layout for these units includes provisions for another pulverizer. This includes space for the pulverizer, silo and feeder. Therefore, a new pulverizer could be added to these units much more easily than almost any other unit. This modification would also require modifications or additions for coal piping, pyrites removal, controls, cascade conveyors, electrical feeds and auxiliary power system. The modification for coal piping might be complicated because space for a spare burner row was not provided. One option would require removing one burner from each of the existing feeders to provide the coal feed from the new pulverizer.

One issue with PRB coal firing is unburned carbon and pulverizer operation. It is noted that essentially all of the fly ash is sold from this unit. This is contingent on ash unburned carbon being at 5 to 6% per the April 2004 report. The large furnace should be an advantage for low unburned carbon. Burner modifications discussed below also need to be considered.

Primary and Secondary Air Heaters

Recent tests have not been conducted, but it was estimated by station personnel that the existing primary and secondary air heaters are experiencing about 40 to 50% and 20 to 25% leakage, respectively. It will be important to control these leakage rates because primary airflow will need to increase compared to what is currently required so that the pulverizers can evaporate the increased amount of moisture contained in PRB coal. Also, precipitator collection efficiency is adversely impacted by higher gas flow rates caused by air heater leakage.

Rothemule air heaters generally have high leakage rates. We recently studied replacing a primary air heater for another owner and it was determined that the cost was excessive even though the ongoing maintenance costs are high. Including these costs in the cost estimate for PRB firing does not seem valid because the expenditures for the required maintenance is not fuel dependent. Firing PRB coal may actually reduce maintenance costs because some of the current maintenance costs may be due to erosion that would be reduced with the lower abrasion that is usually experienced with PRB ash.

Mill Inerting and Water Fire Suppression System

The plant has indicated that the existing mill inerting system is not operable. The addition of a completely new system for PRB coal blends below 30% is not economically justifiable. However, having an operable system available is recommended. Therefore, it is recommended that the existing pulverizer steam mill inerting and water spray system be modified/upgraded as much as practical so that a functional system is available.

To maintain safe conditions during transients and to extinguish a fire should one occur, for PRB coal blends at 30% PRB coal and higher a state-of-the-art steam inerting and water fire suppression systems should be installed on each pulverizer.

The low inerting flow maintains an inert atmosphere inside an off-line pulverizer during hazardous conditions. The higher inerting or clearing flow transports the contents of the pulverizer to the pyrites system, while maintaining an inert atmosphere in the pulverizer during potentially hazardous conditions or when restarting a tripped pulverizer full of fuel.

For both systems, the installation would include piping, valves, seal air dampers and actuators, fogging and wash headers, a fully automatic control system with the ability to also operate the valves and actuators locally, manually.

Burners

The current burners are an early B&W low NO_x design. It is probable that newer, improved burners will be needed to produce sufficiently low fly ash unburned carbon, maintain precipitator performance and maintain low NO_x emissions at blends above 70% PRB coal. At 70% PRB and less, we are of the opinion that the existing burners are adequate. An option remains to upgrade these burners at the time when major maintenance is needed.

Forced Draft, Primary Air and Induced Draft Fans and Air Preheating System

During our meetings at the plant and based on our engineering assessments the capacities of the FD, PA and ID fans have sufficient capability for PBR coal firing. This seems reasonable based on the original design coal being a 50% PRB coal blend and the usual margins included in the fan specifications. The Air Preheating System is operating properly for maintaining adequate average cold end temperatures. Cold end corrosion concerns will be reduced with increasing amounts of PRB coal due to the reduced sulfur content of the PRB coal.

Silos, Coal Feeders and Coal Piping

The silos have stainless steel outlet cones that will facilitate coal flow. The coal feeders have sufficient additional needed capacity for PRB coal. However, the coal piping may be undersized. It appears that the piping between the silo and the feeder is 18 in. It is our experience that this pipe should be at least 24 in to maintain good coal flow and prevent coal pluggage. In some cases 36 in. is needed. For coal blends with PRB coal at 30% or higher, we have included the cost for larger pipes in the attached cost estimates.

During our brief visit to this unit, provisions for emergency emptying of the each of silos was found to be in place.

Gas Recirculation System

Some units with gas recirculation sytems have experienced excessive cyclone separator plugging with PRB ash. This seems to occur because of the higher moisture in the PRB coal and an ash that tends to stick to the cyclone internals. At blends above 70% PRB, installing a bypass duct around the existing separator with shutoff dampers is recommended so flow could be directed either through or around the separator as necessary. Modifying the Gas Recirculating Fans with new blades and types of blade liners that are more resistant to erosion is also recommended.

Miscellaneous

One of the comments in the April 2004 PRB firing report is that the controls did not track properly. This is not a specific PRB coal issue, but should be reviewed further.

Boiler Summary

As described above, for blends with less than 30% PRB coal we recommend installing pulverizer upgrades to increase throughput and performance. For coal blends above 30% PRB, we recommend the addition of pulverizer inerting and fire suppression system. It is reasonable to expect that minimal modifications are needed up to about a 70% PRB coal blend since the original design was for 50% PRB firing and the design margins that typically, but not always, are provided extend the PRB firing capability another 10% to 20%.

However, above 70% PRB coal modifications and/or additions are required to the pulverizers, convection pass sootblowers, furnace water cannons, mill inerting and fire suppression, silo coal outlet piping, and Gas Recirculation Fans.

The large furnace size on this boiler greatly facilitates 100% PRB firing.

Coal Handling

Equipment Design and Current Performance

The north plant coal handling system consists of stockout and reclaim sub-systems. Coal is brought to either one of these sub-systems from train or barge unloading facilities located in the south coal yard. Coal is unloaded by a barge unloader and transported to an active storage pile by Conveyors 1, 2 and 3 via transfer houses TP-2 and TP-3. Conveyor 3 is equipped with a bucket wheel stacker reclaimer. The coal can also be delivered by rail cars (bottom dump rapid discharge cars) and then transported to the active pile by conveyors 11, 13A, 29B and 1 via transfer houses TP-22, TP-24 and TP-3.

Coal unloaded in the south coal yard is transported to the north coal yard at 2200 tph via conveyor 31B. At transfer house TP-26, all or some of the incoming coal can either be sent to the coal yard stacker/reclaimer S-R#2 (via reversible conveyor 32) or to conveyor 33A. Splitter gate #26 located in the transfer tower is used to split the incoming coal between conveyors 32 and 33A

Conveyor 33A transports the incoming coal to transfer house TP-27 where again all or some of the incoming coal can be sent to the coal yard stacker/reclaimer S-R#3 (via reversible conveyor 34) or to conveyors 35A/35B. Splitter gates #27A and #27B are located in this transfer tower. Splitter gate #27A is used to split the incoming coal between conveyors 34 and 35A/B. Splitter gate #27B is used to split the coal flow between conveyors 35A and 35B. Conveyors 35A and 35B transport coal to the crusher building where coal is first discharged into a surge bin and then fed into crushers by vibrating feeders. From the crusher building, conveyors 36A and 36B transport the crushed coal to the in-plant surge bin.

From the in-plant surge bin three vibrating feeders discharge the coal on to conveyors 401, 501 and 502. These conveyors and a fourth vibrating feeder transport the coal to cascade conveyors 403, 404, 503 and 504 for storage in the in-plant silos.

At the crusher building a sampling system is provided for collecting as fired coal samples.

To remove tramp iron from the incoming coal, self cleaning inline magnetic separators are mounted at the head end of conveyors 35A and 35B. In addition to the magnetic separators, metal detectors are installed on conveyors 36A and 36B.

Belt scales are installed for controlling or monitoring coal flow at the following locations:

- Stacker/Reclaimer S-R#2 boom conveyor
- Stacker/Reclaimer S-R#3 boom conveyor
- Conveyor 31B
- Conveyor 33A
- Conveyor 35A
- Conveyor 35B
- Conveyor 401
- Conveyor 402

- Conveyor 501
- Conveyor 502

Load cells are provided for monitoring or controlling the coal level in the crusher house surge bin, in-plant surge bin and in the twelve in-plant silos.

Four bag type dust collectors are located in the boiler building. These dust collectors collect dust at the head ends of conveyors 36A/36B, the surge bin, the vibrating feeders, the transfer conveyors and the cascade conveyors. In addition to collecting dust at various transfer points, these dust collectors also vent the coal storage silos. Augers (screw conveyors) located under each of the dust collector hoppers return the collected dust to the coal silos. Each auger has two discharge openings that permit return of the collected dust to alternate silos. These dust collectors have not been operated for the last five years.

Coal Consumption

As described above, coal is delivered to Crystal River via barges or rail cars. The system was designed to handle bituminous coals. With sub-bituminous coal (PRB coal) the existing system components will operate differently than originally designed. This is because of the greater quantity of PRB coal that will have to be handled and the poor handling characteristics of the PRB coal.

Following is a summary comparing the coal-handling system operating parameters for blends of 30% and 70% PRB coal and for firing 100% PRB coal.

Full Load Hourly Coal Burn Rates

	Unit 4	Unit 5	Total
0% PRB coal	280 tph	280 tph	560 tph
30% PRB coal	300 tph	300 tph	600 tph
70% PRB coal	350 tph	350 tph	700 tph
100% PRB coal	410 tph	410 tph	820 tph

Full Load Daily Coal Consumption

	Current Coal	PRB Coal	Total
0% PRB coal	13,400 tpd	0 tpd	13,400 tpd
30% PRB coal	10,080 tpd	4,320 tpd	14,400 tpd
70% PRB coal	5,040 tpd	11,760 tpd	16,800 tpd
100% PRB coal	0 tpd	19,680 tpd	19,680 tpd

Annual Coal Consumption @ 90% Capacity Factor

	Current Coal	PRB Coal	Total
0% PRB coal	4,400,000 tpy	0 tpy	4,400,000 tpy
30% PRB coal	3,300,000 tpy	1,400,000 tpy	4,700,000 tpy
70% PRB coal	1,660,000 tpy	3,840,000 tpy	5,500,000 tpy
100% PRB coal	0 tpy	6,500,000 tpy	6,500,000 tpy

Conveyors

The lower bulk density and lower angle of surcharge (15 degrees for sub-bituminous coals versus 25 degrees for the current coal) reduces the carrying capacity of the belt conveyors. Surcharge is the coal pile angle to horizontal surface as it rides on the conveyor belt. Coal blends containing less than 30% PRB coal have the handling characteristics of bituminous coal. However, blends containing more than 30% PRB coal have the handling characteristics of PRB coal. The comparison of conveyor volumetric capacities for bituminous and PRB coals is tabulated below:

Coal Delivery System

Conveyor No.	Belt Width, Inches	Current Belt Speed, fpm	Rated Capacity, tph	Calculated Belt Cross-Sectional Capacity, tph			
				0% PRB	30%PRB	70%PRB	100%PRB
1	54	750	2500	2600	2520	2270	2150
2	54	750	2500	2600	2520	2270	2150
3	54	750	2500	2600	2520	2270	2150
11	54	750	2500	2600	2520	2270	2150
29A	54	750	2500	2600	2520	2270	2150
29B	54	750	2500	2600	2520	2270	2150
30	54	725	2500	2510	2430	2200	2080
31	54	725	2500	2510	2430	2200	2080
32	54	725	2500	2510	2430	2200	2080
33	54	725	2500	2510	2430	2200	2080

Reclaim System

Conveyor No.	Belt Width, Inches	Current Belt Speed, fpm	Rated Capacity, tph	Calculated Belt Cross-Sectional Capacity, tph			
				0% PRB	30%PRB	70%PRB	100%PRB
35A/ 35B	36	550	800	875	850	710	670
36A/ 36B	36	550	800	875	850	710	670
401	30	450	400	485	470	390	370
403	30	450	400	485	470	390	370
404	30	450	400	485	470	390	370
501	30	450	400	485	470	390	370
502	30	450	400	485	470	390	370
503	30	450	400	485	470	390	370
504	30	450	400	485	470	390	370

The belt volumetric capacity review indicates the following:

- The barge or the train unloading conveyor capacity for 30% PRB coal will be reduced from the current 2500 tph to 2430 tph. The barge or the train unloading conveyor capacity for 70% PRB coal will be reduced from the current 2500 tph to 2200 tph. The barge or the train unloading conveyor capacity for 100% PRB coal will be reduced from the current 2500 tph to 2080 tph

- The reclaim rate for blends with 70% PRB coal will be reduced from the current 800 tph to 710 tph. The reclaim rate for 100% PRB coal will be reduced from the current 800 tph to 670 tph.

Conveyor Modifications

Unloading

The average barge-unloading conveyor system capacity is estimated to drop from 2500 tph to 2080 tph. However, conveyor capacity is still higher than the existing maximum barge unloader capacity of 1400 tph. Therefore, no conveyor modifications are required.

Reclaim System

Reclaim System Operation Per Day, @ Full Load

	0% PRB coal	30% PRB coal	70% PRB coal	100% PRB coal
Reclaim Rate	800 tph	800 tph	710 tph	670 tph
Operating Time, one reclaim conveyor in operation	17.0 hours	18.0 hours	24.0 hours	29.4 hours
Operating time, both reclaim conveyors in operation	8.5 hours	9.0 hours	12.0 hours	14.7 hours

The operating hours summarized above assume the conveyor system can operate at the peak rate with no interruptions. However, in real operating conditions there would be times when the amount of coal on the belt may be reduced or there may be no coal on the belt for short durations. These situations could be caused by a reduced reclaim rate at the yard reclaimer or by wet coal conditions affecting the performance of the crushers, vibratory feeders or transfer chutes. Therefore, the existing system capacity is only adequate for fueling up to 30% PRB coal with only one conveyor system in operation. Above 30% PRB coal, both reclaim conveyor systems would have to operate simultaneously to meet the fueling needs for the two units.

In order to provide increased conveyor capacity for fueling higher than 30% PRB coal blends, the following modifications should be implemented for increasing system capacity.

Modifications for 70% PRB Coal Blend

The reclaim system capacity would be increased while handling PRB coal by replacing all the existing 35-degree troughing idlers with 45-degree idlers for conveyors 35A /35B and 36A/36B. The belt speed of the cascade conveyor system would remain unchanged. All the drives and pulleys would be reused.

The following table summarizes the impact of these changes on the daily reclaim system operation.

	0% PRB coal	30% PRB coal	70% PRB coal	100% PRB coal
Reclaim Rate	800 tph	800 tph	800 tph	730 tph
Operating Time, one reclaim conveyor in operation	17.0 hours	18.0 hours	21.0 hours	27.0 hours
Operating time, both reclaim conveyors in operation	8.5 hours	9.0 hours	10.5 hours	13.5 hours

Modifications for 100% PRB Coal

The reclaim system capacity should be increased for PRB coal blends greater than 30% PRB. The existing 35-degree troughing idlers would be replaced with 45-degree idlers for conveyors 35A /35B and 36A/36B, the belt speed of the cascade conveyor system would be increased to 500 fpm and the conveyor loading skirt height would be increased to accommodate the increased coal volume. All the drives and pulleys would be replaced for the new design conditions.

The following table summarizes the impact of these changes on the daily reclaim system operation.

	70% PRB coal	100% PRB coal
Reclaim Rate	800 tph	800 tph
Operating Time, one reclaim conveyor in operation	19.2 hours	24.6 hours
Operating Time, both reclaim conveyors in operation	9.6 hours	12.3 hours

Vibratory Feeders

The vibratory feeders are unable to provide a consistent reclaim rate while handling PRB coal with varying quantities of moisture and fines. Therefore, it is recommended that for PRB coal blends greater than 30% PRB all the vibratory feeders (two at the crusher house and four at the in-plant surge bin) be replaced with variable speed belt feeders.

Whether the crusher feeders are replaced or if the existing ones are retained, the installation of new belt scales on conveyors 36A/36B is required to provide flow rate feed back to the control system. This feedback will be used to control the feeder output. The lack of feed rate indication may be the major reason that the existing reclaim system is presently operating at reduced capacity and for extended periods of time, up to 22 hours per day. Similarly, conveyors 401, 404, 501 and 502 require feed back from the belt scales to control feeder output.

Chutework

Cascade conveyors 403, 404, 503 and 504 are equipped with continuous loading skirts for the entire length of the conveyor. The cross section of the loading skirt at the present belt speed permits a maximum conveyor capacity of 400 tph. Any fluctuations of coal flow on the conveyor above 420 tph would result in coal spillage. Therefore, it is important that the feeder flow rate at the surge bin be controlled as noted above.

Also, the conveyor to conveyor transfer chutes at the discharges of conveyors 501 and 502 have restricted height inside the chutework and will only permit 300 tph coal to pass through the transfer point. A higher tonnage than 300 tph will back-up the coal flow inside the chutework resulting in a coal spill at the head end of the conveyors. The transfer point chutes need to be modified to handle the rated capacity of 400 tph.

Belt Scales

Belt scales are installed for controlling or monitoring coal flow at the following locations:

- Conveyor 31B
- Conveyor 33A
- Conveyor 35A
- Conveyor 35B
- Conveyor 401
- Conveyor 403
- Conveyor 501
- Conveyor 502

The belt scales on conveyors 35A and 35B ("Thayer" Scales) are certified scales. These scales operate satisfactorily. As mentioned in the capacity review section above, two new scales will have to be added on conveyors 36A/36B for monitoring and controlling the crusher feeders.

Safety Considerations

The following modifications are required to safely handle blends of PRB coal greater than 30%. At PRB coal blends less than 30% the coal blend exhibits properties of bituminous coal and generally the existing safety provisions should continue to be adequate. However, these provisions need to be in proper operation condition.

Dust Control

The primary purpose of any coal dust control system design is to contain fugitive dust concentrations in a controlled environment. Due to the higher dust loading of PRB coal, dust control is required at locations where excessive amounts of dust generation are expected; specifically coal conveyor transfer points that discharge onto other conveyors, crusher houses, track hoppers, ship unloading hoppers, bunkers/silos and coal piles. Two different methods are currently used to control fugitive dust emissions from coal-handling systems: dust collection and dust suppression. Dust collection can utilize ducted dry-type baghouse systems or wet scrubbing type systems. Dust suppression systems include those using wet sprays of water, chemicals or foam and those using water and air foggers.

Another means for dust control is the use of chutework at coal transfer points that minimizes the generation of dust by controlling the distance that the coal falls and its angle/trajectory. The application of this type of chutework is limited for retrofit applications due to space limitations, but could be installed where existing chutework needs to be replaced and the required space is available.

Dust control systems were evaluated for all the coal-handling facilities that contain coal unloading, transferring, or processing equipment. The following modifications are recommended.

- Install a residual dust suppression system at the barge unloader conveyor BC-1 discharge. This system will not only control dust at the unloading conveyor but also at subsequent transfer points and the coal pile. Although the dust suppression system will be designed to operate year round, the dust suppression system may not be effective in extreme cold weather conditions.
- Install a fog type dust suppression system for the reclaim system transfer points.
- For coal blends greater than 30% PRB, replace the existing inoperative/unused dust collectors with new wet type dust collectors for venting the silos.
- The existing dust collectors have not been operational for some time. These dust collectors should be in operation even when firing the current bituminous coal and with PRB coal blends less than 30%. Therefore, it is recommended that the existing dust collectors be replaced with new wet type dust collectors for silo ventilation. Also, add fogging dust suppression systems for all the transfer points from the surge bin to the cascade conveyors to maintain the same level of coverage provided by the existing dust collectors.

Ventilation

Adequate ventilation systems are required in various locations when handling PRB coals for the following reasons:

- Provide continuous makeup outdoor air to offset dust collector exhaust.
- Provide fresh air ventilation for all year long for personnel safe occupancy.
- Pressurize areas such as electrical equipment rooms to minimize dust infiltration.
- Reduce and dilute explosive dust concentrations, methane gas buildup and products of combustion, such as carbon monoxide from enclosed conveyor rooms, bunkers, silos, surge bins, crusher houses, other coal-handling buildings, or underground facilities.

Based on S&L's evaluation of the existing ventilation systems, no changes are recommended.

Housekeeping

The increased dustiness of PRB coal necessitates diligent housekeeping of the coal-handling areas. Manual washdown and the use of vacuum cleaning systems are two approaches to performing the required cleaning. Vacuum cleaning systems require permanent piping with mechanical groove-type couplings and vacuum connection fittings for attachment to either a truck-mounted vacuum machine that can be a permanent installation or a portable trailer-mounted vacuum machine.

Horizontal surfaces (support beams and girts) in coal-handling structures provide areas for dust accumulation. The collection of dust on these surfaces increases the risk of spontaneous combustion. Increased attention must be paid to these areas, and frequent housekeeping, water washdown and/or vacuuming must be performed. The installation of lightweight concrete or metal caps on the top of girt steel is an option that will help facilitate washdown and reduce the potential for dust buildup.

Based on S&L's evaluation of the existing areas, the following changes are recommended for coal blends with PRB coal at 30% and higher:

- Install sloping surfaces to eliminate ledges where dust could accumulate in the crusher surge bin building, breaker house, sample house and the conveyor room above the silos to facilitate housekeeping.

- Install wash down piping / hoses / floor drains in the surge bin area, conveyors 501 and 502, and the conveyor rooms above the silos. Since the plant is located in a warm weather location where water washdown can be performed year round, the addition of vacuum cleaning piping is not required. Vacuum piping has an advantage in that vacuum cleaning could be used to clean up large coal spills that can not be readily handled with water washdown.

Fire Protection

The increased fire/explosion potential of sub-bituminous coal necessitates a higher level of fire protection compared to most bituminous coals. The following fire protection modifications are recommended for coal blends with PRB coal at 30% and higher:

- Provide explosion-venting panels in the surge bin area, conveyors 501 and 502 and in the conveyor rooms above the silos. These panels would minimize the extent of damage should an explosion occur.

- Provide a Fire Aid 2000 system for controlling spontaneous combustion of coal in a silo should an extended plant or silo outage occur.

- Provide a CO detecting system for the cascade conveyor room (included in the silo ventilation dust collector intake ductwork).

- Provide a pulverizer inerting system/ water suppression system as described in the boiler section of this report.

- All the silos should have provisions for being emptied in the event of an unexpected mill or plant outage of longer duration. Based on our site visit, these provisions already exist.

Electrical Code Modifications

Based on a cursory review of the existing electrical equipment located in the coal handling areas indicates this equipment is up to code. Therefore, no major changes are required. However, for coal blends with 30% PRB and higher a more detailed and thorough walkdown should be performed to make sure all the existing electrical devices in the coal handling areas comply with the current code requirements.

Electrostatic Precipitator (ESP)

Due to the reduced sulfur content of PRB coal compared to bituminous coal, the resistivity of PRB coal fly ash is higher than bituminous coal ash. This reduces the effectiveness of the ESP.

The precipitator gas flow, plate area and overall configuration were reviewed.

1. The SCA (square foot per cu. ft. of flue gas flow through the precipitator) is approximately 680. This is better than many recent vintage precipitators that have been installed with SCAs in the 300 to 400 SCA range.
2. The precipitator face velocity (the average velocity based on the total flue gas flow divided by the height and width of the precipitator) is about 4.16 ft/sec. This is a mid-range velocity that is usually consistent with "good" precipitator collection efficiency.
3. There are five fields, which is another feature that leads to "good" precipitator collection efficiency.
4. The treatment time, average time for an ash particle to pass through the precipitator is about 21 seconds. This is much longer than most precipitators, which should result in excellent collection efficiency.

The above assessment is based on design gas flows and data from the CE Power Systems Environmental Division General Description of Installation. This precipitator being quite large should provide adequate collection efficiency with a blend or 100% PRB coal.

During our meetings at Crystal River, problems with failure of the plate rappers were described. This should be studied in more detail to determine the needed solution and to ensure that PRB firing will not result in particulate emission problems. From discussions with operations personnel it seems that hammer rapper failures are typical with this precipitator. To the best of our knowledge there are other precipitators with hammer rappers that are working properly. Therefore, it seems that this problem could be corrected.

The Unit 4 April 26-28, 2004 Initial PRB Test Burn Report states the following: "Unit 4 has recently experienced some difficulties with their ESP. Nominal base levels of 10% opacity rose to 12% with the 15% PRB blend and 14% when the 22% PRB material burned. A short-term peak (10 minutes) of 19% occurred when a presumed spike occurred in the blend towards the end of the 22% material burn." The reason for high opacity was not determined during this study, except for the possibility of rapper problems. Also, during the test burn the coals that were fired had a very low sulfur content, lower than the 100% PRB case considered for this study. This may also have contributed to the higher opacity experienced during the test burn. However, it seems reasonable to expect that the

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problem(s) could be corrected and proper opacity would result with PRB based on the large size of this precipitator.

IV. OTHER ISSUES

Based on past experience it is recommended that operation at a coal blend near 50% Illinois / 50% PRB coal should be avoided. Boiler control difficulties have been encountered operating at a 50/50 blend. Better boiler operation and control can be achieved when one of the two coals is predominant.

With PRB coal many factors will tend to increase plant O&M costs. Additional motor driven equipment may be required and existing motor driven equipment may run for longer periods of time increasing auxiliary power usage. The modifications requiring additional power usage are minimal for blends with PRB coal less than 30%. Therefore, the auxiliary power usage impact is expected to be minimal. However, for PRB coal blends with 70% PRB coal and higher the impact on auxiliary power usage will be significant due to the addition of a new pulverizer and other associated equipment. Due to the characteristics of PRB coal and its impact on equipment performance, equipment will need to be maintained in proper operating condition. Therefore, maintenance costs can be expected to increase. At higher blends of PRB coal, the usage of chemicals (dust suppression) will increase. This could result in a variable O&M cost increase of up to $0.04/MWhr. With increasing amounts of PRB coal, boiler efficiency will be reduced. This is caused by the high amount of moisture in the coal. The reduction in boiler efficiency can range from 1.0 to 1.5%. Due to the additional equipment and the higher amounts of coal being handled the equivalent availability for the units may be reduced by up to 0.5%. Additional personnel will be required for housekeeping purposes primarily in the coal handling areas. The actual number of additional personnel required is dependent on the current operating practices of the owner.

SO_2 and NO_X emissions will be reduced. SO_2 emissions will go down due to the reduced sulfur content of PRB coal compared to bituminous coal. NO_X emissions will go down due to the high moisture content in PRB coal which will tend to reduce the generation of thermal NO_X.

V. EXHIBITS

Exhibit A	Summary of Recommended Modifications and Estimated Costs
Exhibit B	List of Equipment
Exhibit C	Coal Analyses

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Systems and Equipment Requiring Evaluation for Coal Switching

Exhibit B

Component/System	Check for	Areas to be Investigated	Remarks
Steam Generator			
• Furnace	Performance Slagging/fouling Volume	Fuel moisture Fuel ash content Volatile matter Heating value Ash constituents	
• Superheater	Performance Slagging/fouling Tube spacing	Ash content Ash constituents Gas velocities FEGT	
• Reheater	Performance Slagging/fouling Tube spacing	Ash content Ash constituents Gas velocities FEGT	
• Economizer	Performance fouling Slagging/fouling Tube spacing	Ash content Ash constituents Gas velocities FEGT	Finned or bare tube
• Cyclones	Capacity	Fuel velocity Air distribution Heating value Volatile matter Fuel ash Particle size T_{250}	Flame stability Slag tapping capability Carbon carryover
Boiler Auxiliaries			
• Pulverizers	Capacity upgrading Exit temperature limitations	Fuel characteristics including moisture, volatile matter, grindability and ash constituents Internal material upgrades	Non-original equipment manufacturer equipment replacement parts
• Coal piping	Capacity	Fuel velocity, wear points	
• Burners	Capacity	Fuel velocity Air distribution Fuel heating valve Fuel volatile matter	
• Forced draft fan	Capacity	Fuel characteristics	
• Primary air fan	Capacity	Fuel characteristics	
• Induced draft fan	Capacity	Fuel characteristics	

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Systems and Equipment Requiring Evaluation for Coal Switching

Exhibit B

Component/System	Check for	Areas to be Investigated	Remarks
• Air preheating	Capacity Air temperature	Fuel characteristics, moisture	
• Air heater	Performance Air temperature	Cold end temperature Pressure drop Basket spacing Fuel charecteristics, moisture, ash content	
• Sootblowers	System capacity placement	Fouling tendencies of fuel ash, furnace configuration, expansion of system, controls, ash content, ash constituents	Air, steam or water Furnace water walls Convective pass Air heater
Coal Handling			
• Transportation	Access to plant Availability	Railroad Barge Ship Truck Associated costs	Spot market considerations, existing coal transfer facilities, long-term commitments
• Receiving equipment	Capacity Flow characteristics Dusting	Original design capacity, current condition, upgrade requirements, vibrators, dust suppression and elimination systems, multiple fuel storage, hours to receive	Frozen coal consideration
• Onsite storage	Capacity Fugitive dust	Land available, dust suppression systems, fire protection systems	Blending consideration multiple fuels
• Reclaiming	Capacity Blending capability	Existing reclaim hoppers, feeders, feeder controls, vibrators, system expansion	Blending considerations Multiple fuels
• Conveyors	Capacity	Conveyor belt sizes, conveyor speed, idler troughing angle	
• Transfer points	Dusting Flow characteristics	Chutes, skirt boards, flow control chutes, dust elimination system, vibrators	Belt loading hoods
• Crushers	Capacity	Inlet and outlet, type of crusher, product size	

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Systems and Equipment Requiring Evaluation for Coal Switching

Exhibit B

Component/System	Check for	Areas to be Investigated	Remarks
• Coal crackers	Frozen coal crackers	Point of shipment, capacity	Frozen coal consideration
• Bunker/silo	Flow characteristics Capacity	Sloped walls, liners, dead spots, vibrators	
• Tripper	Capacity Bunker seals	Belt speed, belt characteristics, dust control	
• Coal feeders	Capacity	Controls, belt speed, emergency unloading	
Safety			
• Fire protection	Additional protection	System capability, expansion requirements, detectors	Sprinkler systems CO, methane detectors
• Dust elimination	Capacity Transfer points Coal piles	Higher dusting patterns	Lower belt speeds Belt cleaners Belt misalignment switches Loading skirts Dust curtains Coal pile management Chutework changes
• Dust control	Adequacy of existing provisions Capacity	Higher dusting patterns	Collection (dry, wet) Suppression (spray, fogging, foam, surfactant) Dry dust conditioning
• Housekeeping	Existing plan	Expand existing plan to account for higher fire potential Removal of increased volumes	Water washdown Vacuum cleaning Vacuum truck Sumps and pumps
• Electrical equipment	Dusting Washdown	Code compliant components	Code classification
• Pulverizer inerting	Explosive conditiond	Isolation, inerting, fire suppression	Steam, N_2, CO_2
• Ventilation	Dusting	Makeup air Fresh air ventilation for personnel Pressurize electrical equipment rooms Exhaust smoke and gas	Methane, CO

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Systems and Equipment Requiring Evaluation for Coal Switching

Exhibit B

Component/System	Check for	Areas to be Investigated	Remarks
• Coal handling buildings/ structures	Dusting Housekeeping Explosions	Dust ledges Explosion venting Fire breaks	
• Bunker/silo	Dusting Fires Ventilation Gas	Emergency unloading Existing ventilation system Fire suppression Inerting Dust removal	
Other Plant Systems			
• Auxiliary power equipment	Capacity	Electric load may increase	
• Makeup water treating equipment	Capacity	Increased water usage (steam sootblowing)	
• Wastewater treating	Existing provisions	Coal pile runoff, ash pond	
• Air compressors	Capacity	Increased air usage (sootblowing)	
• Precipitator	Collection efficiency	Ash characteristics, ash resistivity, helper precipitator, SCA, chemical injection systems, additional field	
• Ash handling	Capacity Wet versus dry	Ash characteristics, ash in fuel, calcium content in ash, disposal	Storage capacity Marketability

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EXHIBIT C

COAL ANALYSES