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Prepared for

Mirant Potomac River Generating Station

PM2.5 Emissions Reduction Project

May 13, 2010

Phase II Presentation Agenda

Phase II:

- Project Background
- Approach to Technical Evaluation
- Existing Configuration
- Technology Options
- Description of Key Options
- Cost Estimate
- Recommendations
- Next Steps

Background (continued)

- Engineering Study Includes Evaluating:
  - PHASE I: Feasibility, cost and installation of fugitive dust controls for the Facility site.
  - PHASE II:
    - (a) Installing baghouse or other technologies in the current housings for the hot- and/or cold-side precipitators,
    - (b) Improving performance and reliability of existing hot- and/or cold-side precipitators, and
    - (c) Other commercially available PM2.5 technologies identified by the Engineer that may be applied at the Facility.

Phase II Goal and Objective

- Goal

  Identify and select the most cost effective PM Reduction Technology within the Phase II Budget (TIC of $32,000,000)

- Objective:

  Capital improvements at the Facility intended to lessen the Facility's impact on ambient air quality consistent with and fully protective of the NAAQS by reducing the PM2.5 emissions from each of the five (5) units (C1, C2, C3, C4 and C5) at the Facility.

Phase II - Objectives

- Approach
  - Identify and observe all existing PM reduction controls
  - Review past PM removal projects
  - Review past PM emission reports
  - Prepare screening matrix of commercially available technologies
  - Prepare matrix of screened technologies
    - Level of PM Reduction (Low, Medium & High)
    - Approximate Cost
  - With the consensus of the Evaluation Team, select and recommend most cost effective PM reduction technology within Phase II Budget

Phase II Approach
Technology Evaluation & Screening

- ## Technology Evaluation
  - Compile, screen and recommend the PM emissions reduction technology which provides the greatest benefit within budget;
  - Prepare a matrix of technologies to evaluate; and
  - Develop criteria to screen and rank the technologies. 25 technologies were ranked.
- ## Screening Criteria

Coarse Screening:

- Technical Feasibility
- Estimated Level of PM Reduction
- Rough Order of Magnitude Estimate of Implementation

Detailed Screeing:

- Operation Issues
- Maintenance Issues
- Advantages
- Disadvantages

Final Screening

- Relative Importance Ranking

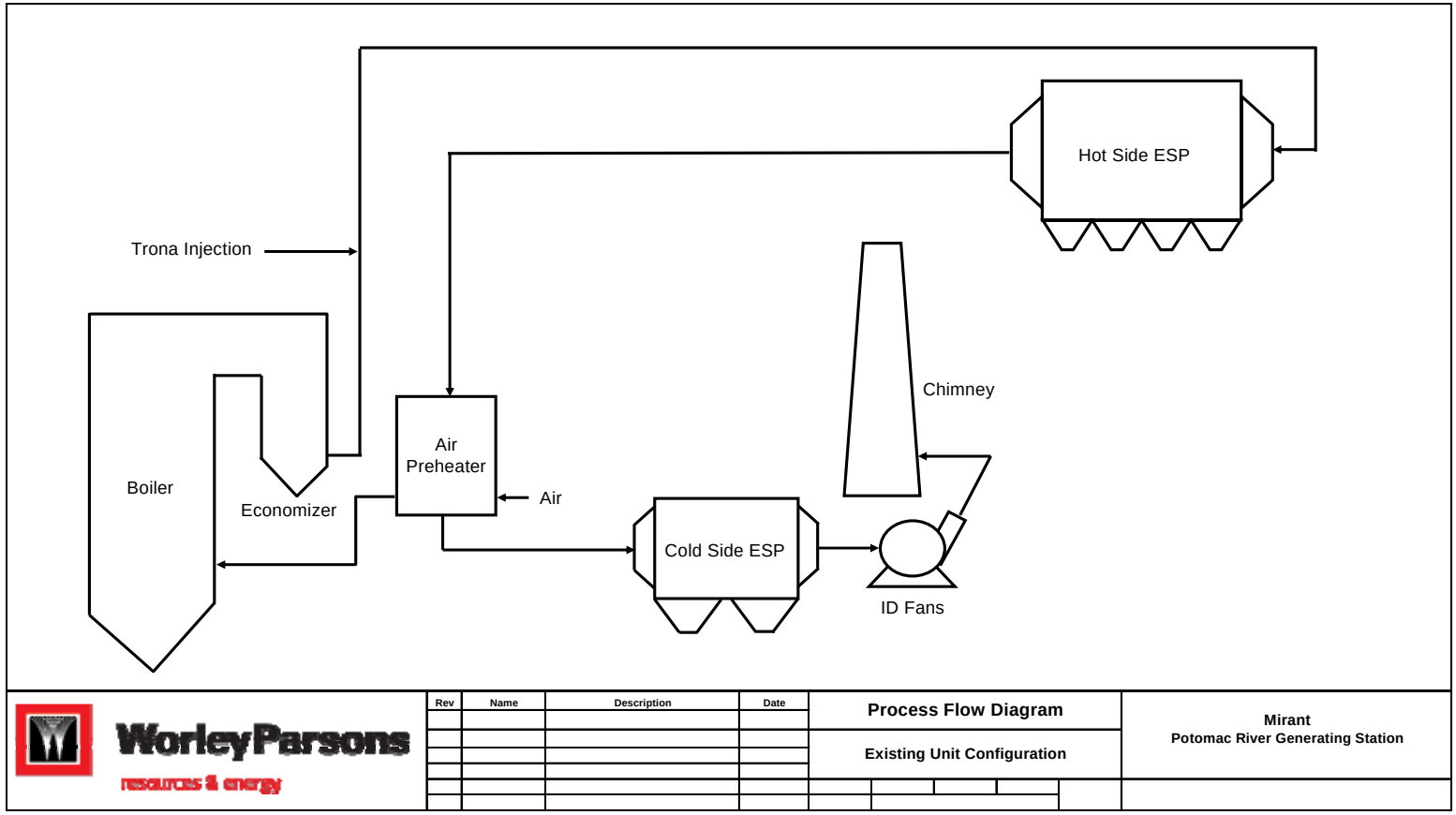
Existing Plant Equipment for PM Collection

AQC Technology used in all 5 units at Potomac River Generating Station:

- A Cold-Side Electrostatic Precipitator (CESP) which operates at the stack temperature of about 350°F.
  - Original Particulate Collection equipment installed in the early 1950s.
  - Design PM Removal Efficiency of CESP is about 95 %.
  - Recent Upgrades have included:
    - Rebuilds and Controls Upgrades
- A Hot-Side Electrostatic Precipitator (HESP) which operates at about 650°F
  - HESP Equipment added in 1978 to enhance the performance of the CESP
  - Design PM Removal Efficiency of HESP is about 99.1 %.
  - Recent Upgrades have included:
    - Rebuilds and Controls Upgrades

Existing Plant Equipment Configuration

Potomac River Generating Stations, Units 1 to 5:



Evaluated Technology Options

Option 1: HESP upgrade

1. HESP power supplies changed to high frequency units
2. ESPs performance varies

Option 2: CESP to PJFF conversion as **Primary** PM collector

1. HESP is bypassed
2. HESP power is saved, offset added fan power

Option 3: HESP to PJFF conversion

1. Extensive ductwork modifications required

Option 4: CESP to PJFF conversion as Polishing PM collector

1. HESP can remain in service

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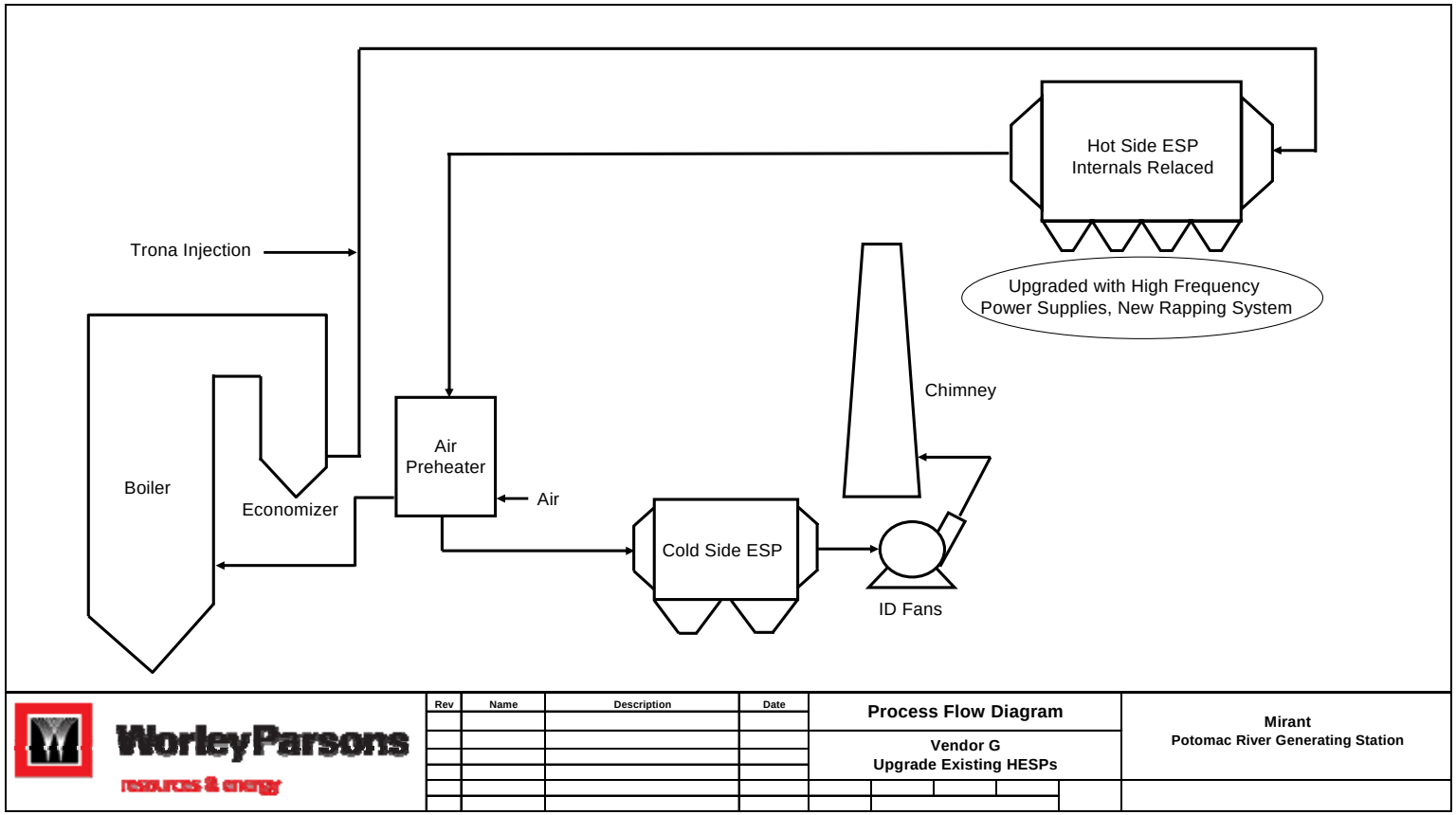
Option 1: HESP Upgrade



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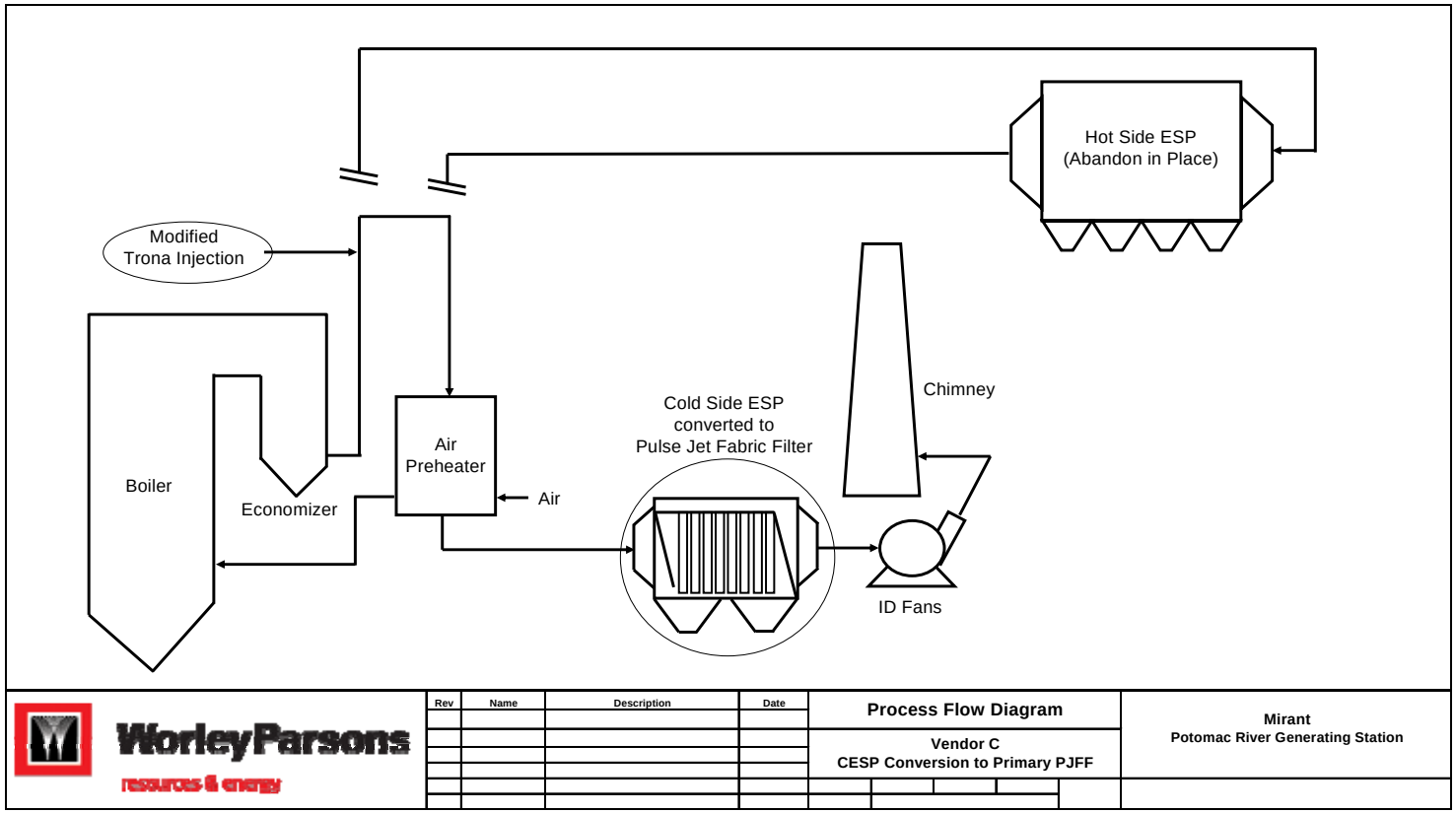
Option 2: Convert CESP to Primary PJFF



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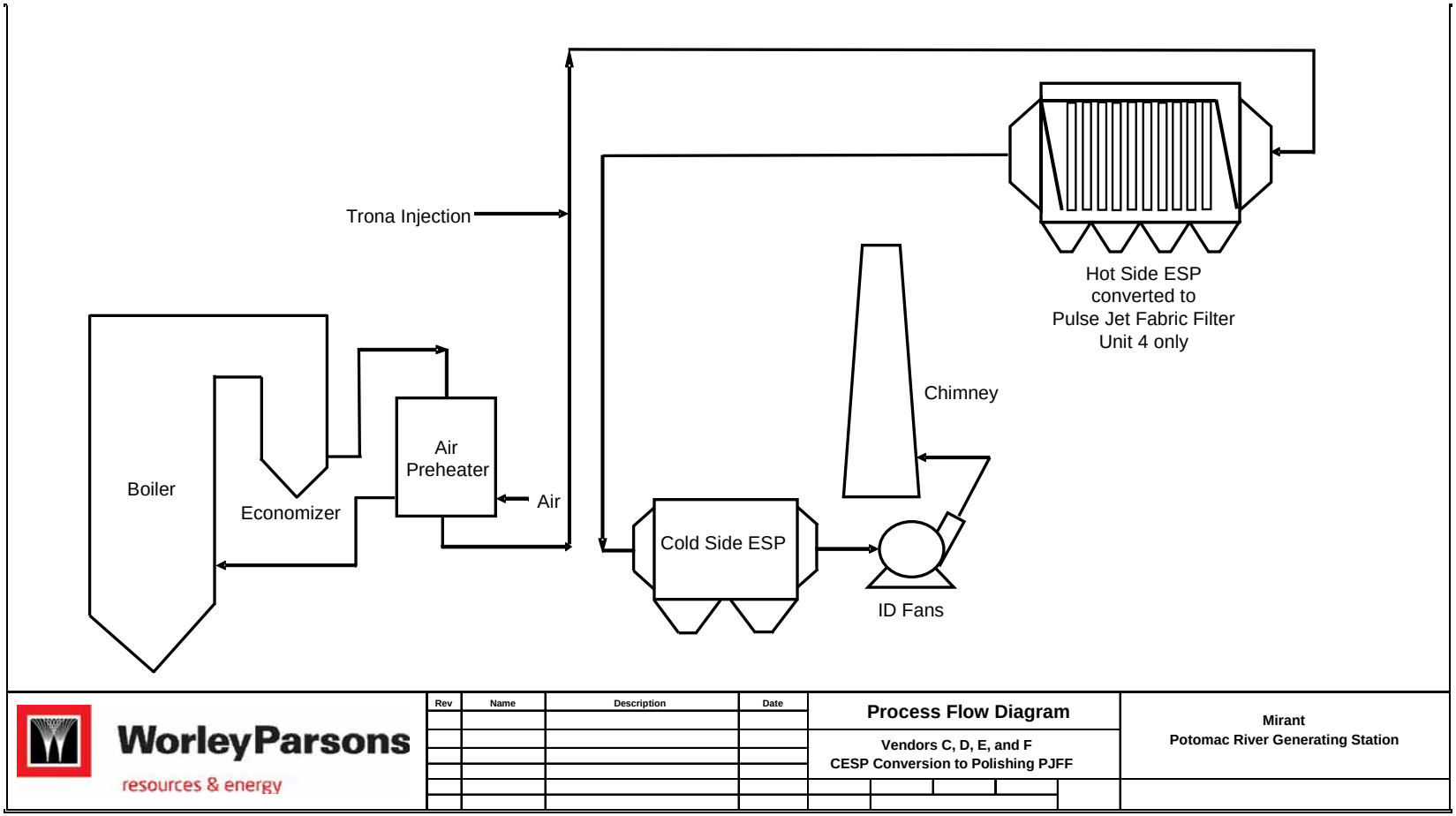
Option 3: HESP Conversion to PJFF



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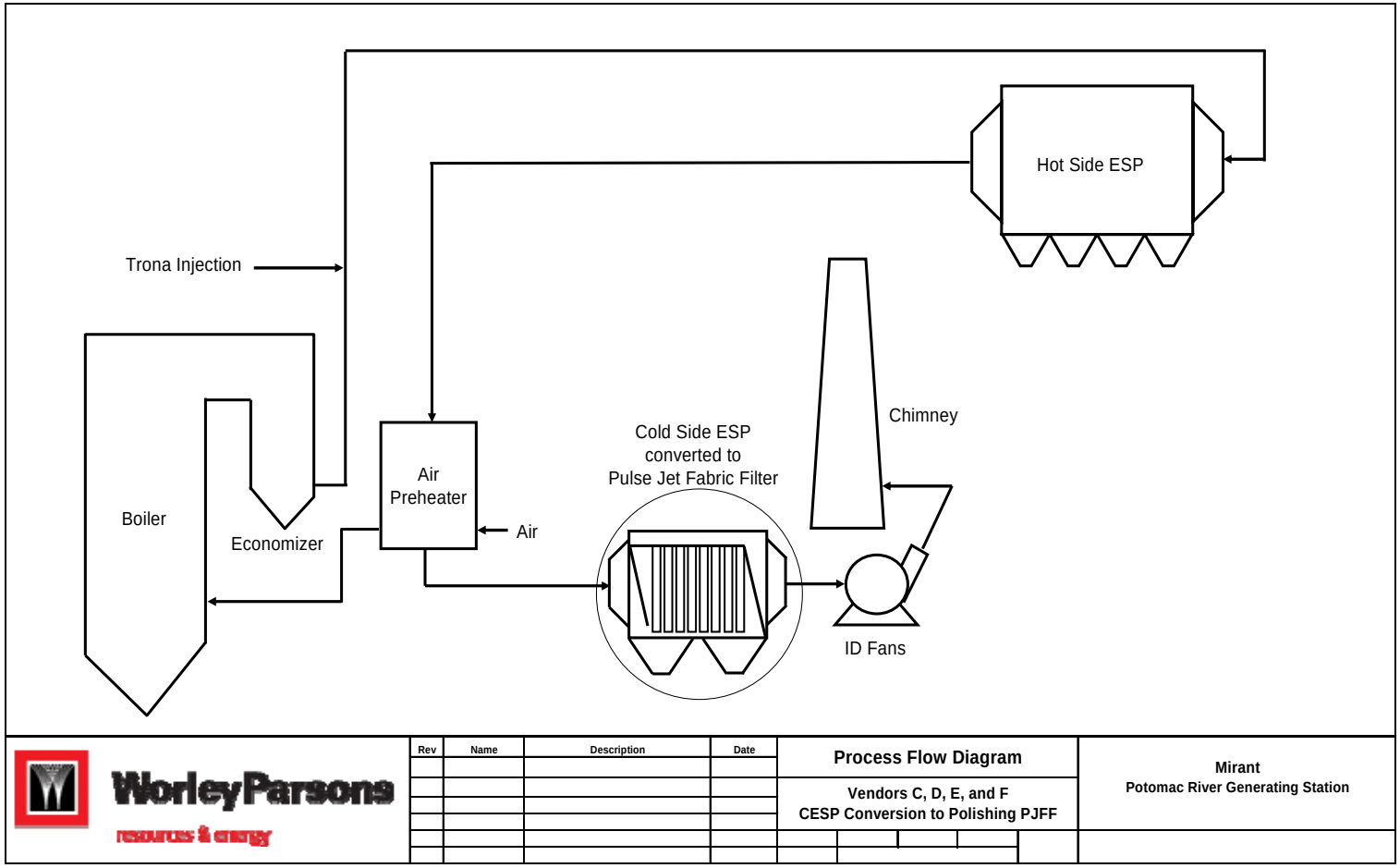
Option 4: Convert CESP to Polishing PJFF



CESP Conversion into PJFF as Polishing Collector

- This variation of converting the CESPs into PJFFs as a polishing collector keeps the HESP operating in the gas path.
- The HESP would continue to handle most of the particulate; the PJFF would remove PM2.5.
- Resolves Option 2 issue of small CESP hoppers and ash handling system.
- This solution is considered to have the best capability to minimize PM2.5 emissions.

BOP CONSIDERATIONS

All Balance-of-Plant issues have been addressed:

- **Current ID Fan Capacity Study**
  - The purpose of this study was to determine if the current ID Fans have additional capacity for future AQC equipment. This included PJFF on Units 3 to 5.
- **Electrical System Capacity**
  - Major electrical system expansion has been avoided by using the existing margin in the ID fans to cover the additional resistance added by the future PJFF installation
- **Transient Analysis of Draft Equipment**
  - A transient analysis has been conducted to determine the impact of a PJFF on Units 3 to 5 and will be made available to the successful bidder.
- **Trona System Impact**
  - As a future enhancement to the recommended concept, it should be possible to modify the Trona injection location by splitting the Trona flow to both the HESP and to the new PJFF. Trona consumption could be reduced, but Trona optimization is outside the scope of this project.

Conclusions of Technical Evaluation

Major Conclusions of the Technical Evaluation are:

- The WorleyParsons' PM Emission Reduction Study, based on good engineering judgment, has technically evaluated the control options and recommended the most beneficial control strategies for reducing the PM emissions at Mirant's PRGS.
- WorleyParsons recommends converting the existing CESPs into Polishing PJFFs on as many units as the budget will allow, and upgrade HESPs on units that won't get PJFF. This recommendation was unanimously supported by the Evaluation Team.
- PJFFs are known to provide excellent results in minimizing particulate matter and PM2.5 emissions – superior to that which can be achieved by the best ESP. Variations of this theme accounted for most of the recommendation from the vendors who responded to the RFP. The three variations on this theme are:

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Recommendations of Technical Evaluation

For the base-loaded Units 3, 4, and 5, recommendations are:

- WorleyParsons recommends conversion of the CESPs to PJFFs (polishing baghouses).
- The conversion provides the best opportunity for consistent PM reductions from these units.
- This is effectively putting the best technology onto the 3 units which operate the most at PRGS.
- It should also be noted that each PJFF polishing baghouse could also serve as the basis of a mercury capture system in the future.
- As a future enhancement, consider modifying the Trona injection points to split the Trona flow between its current location and a new location upstream of the converted PJFF.

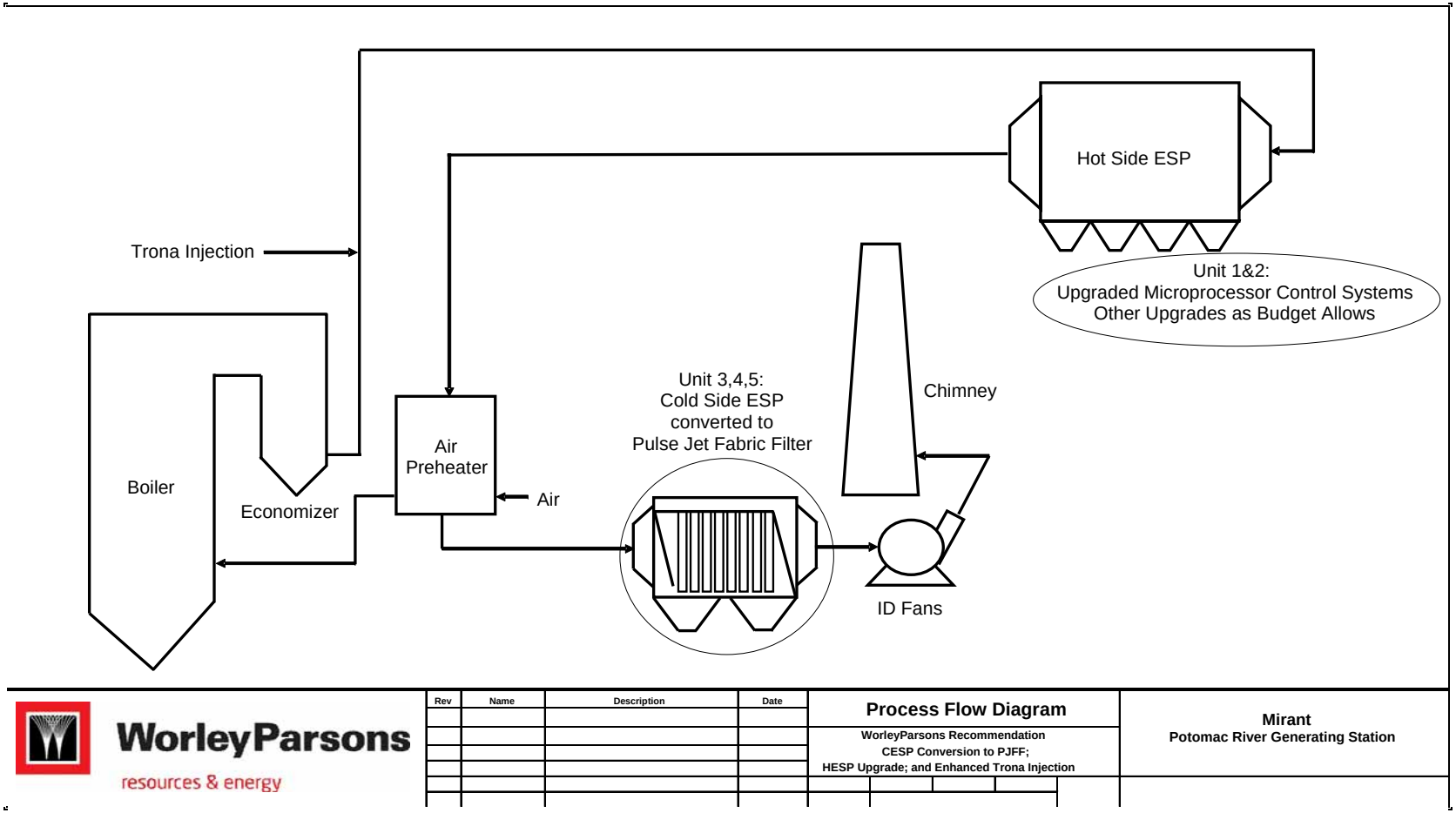
Recommendations (continued)

For the cycling Units 1 and 2, recommendations are:

- Conversion of the CESPs to PJFFs would remain the preferred technology; however, financial limitations appear to require a different solution.
- Therefore, for these cycling units, WorleyParsons recommends as a minimum to upgrade the HESPs controls to the current best control technology available.
- If sufficient funding is available, we would recommend other enhancements to the HESPs which could have a combination effect when added to the controls upgrade.
- While not as effective as the PJFF polishing baghouses, improved particulate performance can be achieved with the increases in applied power that the new power supplies can provide.

Recommended Plant Equipment Configuration

Potomac River Generating Stations, Units 1 to 5:



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Cost Estimate Comparison Option 4 – CESP as PJFF

	DESCRIPTION	MATERIAL COST	LABOR COST	TOTAL COST
Mechanical / Structural / Civil / Electrical / I&C				
	Convert existing CESP to PJFF (Units 3, 4 & 5) (incl. demolition of internals)	8,700,000	9,000,000	17,700,000
	General HESP upgrade to next generation of mircoprocessor controls Units 1 & 2	500,000	500,000	1,000,000
	Compressed Air System for PJFF, included w/1 (install only)	-	29,900	29,900
	Subtotal - Mechanical	9,200,000	9,529,900	18,729,900
BOP Costs				
	ID fan update for Units 3, 4 & 5 CESP (NOT APPLICABLE)	-	-	-
	In-duct silencers	103,200	1,160,100	1,263,300
	Turning vanes at base of Unit 4 stack	52,000	410,000	462,000
	Others	XXX	YYY	ZZZ
	Subtotal - BOP Costs	1,422,300	3,419,000	4,841,300
	Sub Total Construction	10,622,300	12,948,900	23,571,200
	GC Premium @ 4%			943,000
	Total Construction			24,514,200
Other Costs				
	Engineering & Procurement (incl Trips)			2,200,000
	Construction & Start-up Oversight			300,000
	Contingency (Quoted Items) - 10%			920,000
	Contingency (Services) -10%			250,000
	Contingency (Construction) - 20%			2,874,000
	Total Present day costs (April 2010 Dollars)			**31,060,000**

Phase II Next Steps

Current / Future Activities:

- Phase II Draft Report – 30 April 2010 (3 May with DEQ)
- Phase II Draft Report Reviews by the City, Mirant, and DEQ – 45 days
- Phase II Report Finalization – 60 days
- Phase II Preferred Technology Selection by the City
- City and Mirant Recommendation of Proposed Technology to Board and DEQ for agreement and issuance of any required permits or permit modifications
- Bid Package Preparation for turn-key, fixed price, firm bids with emission rate and customary commercial guarantees
- EPC Contractor Selection
- Contract Execution Phase

▶ Potential Schedule Impacts

- DEQ Permits
- PJM Requirements
- Contractor Availability

Estimated at $320,000 TIC (Total Installed Cost) ±30%

The breakdown was:

- Dust Suppression system – approximately $200,000
- Electrical system – approximately $40,000
- Engineering / Procurement / Construction & Start-up Oversight – approximately $80,000.

Currently:

- Dust Suppression system awarded for approximately $236,000
- Delivery / installation expected late summer
- Electrical system final bid received at approximately $48,000
- Engineering / Procurement / Construction & Start-up Oversight – on track for approximately $80,000

Final TIC Estimate $364,000

Estimated at $140,000 TIC (Total Installed Cost) ±30%

The breakdown was:

- Street Sweeper – approximately $105,000
- Engineering / Procurement / Attending Demos – approximately $35,000.

Currently:

- Street Sweeper performed poorly in demo – changed to different model with Dustless Filtration System
- Street Sweeper awarded for approximately $156,000
- Delivery expected this summer
- Engineering / Procurement / Attending Demos – approximately $35,000.

Final TIC Estimate $191,000

Phase I Update – Wind Screen

Estimated at $615,000 TIC (Total Installed Cost) ±30%

The breakdown was:

- Wind Screen – approximately $475,000
- Engineering / Procurement / Foundation Design Work / Construction Oversight – approximately $130,000.

Currently:

- Vendor has increased his bid approximately $405,000 due to change from wood poles to Corten steel, “escalation”, and foundation changes due to very weak soil.
- This control currently on hold (other that to investigate alternative foundation providers)
- Engineering / Procurement / Foundation Design Work / Construction Oversight – on track for approximately $130,000.

Final TIC Estimate $1,020,000

On hold until after Phase II costs better understood

Phase I Update – Other

Drip Pans

- Estimated at $400,000 TIC (Total Installed Cost) ±30%
- This control currently on hold (rated medium emission reduction – holding until wind screen and Phase II costs better known.)

Ash Conditioner (Ash Loader)

- Allocated $100,000 to complete installation
- Currently installed and operating on temporary power.

END

Backuup Slides

- FOLLOWING SLIDES ARE IN CASE QUESTION IS ASKED THAT COULD BENEFIT FROM THEIR USE.

Project Background

- Parties Involved:
  - Mirant
  - City of Alexandria
  - The “Engineer” (WorleyParsons)
  - City Engineering Consultant (EPSCO)
- TIC (Total Installed Cost) Budget:
  - Phase I - $2,000,000
  - Phase II - $32,000,000
- Current Work:
  - Two Phase Engineering Study

HESP Upgrade

- Completely upgrade and overhaul ESP internals
  - Replace the existing discharge electrodes with ELEX/RS Rigid Discharge Electrodes.
  - Add most recent ESP controls: Switch Mode Power Supply.
  - Modify the existing ESP design with wide (16”) collecting plate spacing.
- ESPs performance varies with load and conditions
- Provides increased ESP performance, but likely not as consistent performance as a fabric filter.
- Partial upgrades are possible, involving some of the items above. This option may be suitable for Units 1&2

CESP Conversion into PJFF as Primary Collector

- This variation of converting the CESPs into PJFFs as the primary collector involves removing the HESP from the gas path. The PJFF then becomes the only collector.
- There is no back-up collector if the PJFF has a problem.
- Saves significant power by not using the HESP.
- The original CESP fly ash hoppers do not have sufficient storage capacity when receiving the full fly ash and Trona loadings.
- There is not enough space available to install the required larger hoppers and larger flyash piping.

HESP conversion to PJFF

- None of the Bidders suggested this option due to the Complex ductwork modifications required to convert the hot-side ductwork to cold-side to enable the use of a conventional PJFF.
- The HESP casings are approximately 2.5 times the size of the CESP casings and the conversion of one HESP to a PJFF could possibly handle up to two boilers.
- This conversion would also require redirecting the gas flow from the economizer back through the airheater prior to entering a converted PJFF. WorleyParsons has investigated the potential to convert a HESP into a PJFF, including the feasibility to reroute the ductwork. We have concluded the following based on this analysis.
  - The required duct routing is not feasible in the extremely congested boilerhouse.
  - Any new ductwork that would put additional loads on the existing building structure is not acceptable.
  - The cost to re-route the ductwork would be prohibitive.

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Cost Estimate Comparison
Option 1 – HESP Upgrades

DESCRIPTION	MATERIAL COST	LABOR COST	TOTAL COST
Mechanical / Structural / Civil / Electrical / I&C			
Complete HESP upgrade - Units 3, 4 and 5	7,761,600	10,659,000	18,420,600
General HESP upgrade - Units 1 & 2	500,000	500,000	1,000,000
Subtotal - Mechanical	8,261,600	11,159,000	19,420,600
BOP Costs			
Electrical Distribution Changes to Units 1 & 2 HESP (ALLOWANCE)	150,000	149,400	299,400
Low voltage wiring - Power cables, conduit, raceways- units 3-4-5 (ALLOWANCE)	128,700	197,100	325,800
Start-up or commissioning (3 units - 21 days ea) (2 units - 7 days ea)	-	136,900	136,900
Subtotal - BOP Costs	278,700	483,400	762,100
Sub Total Construction	8,540,300	11,642,400	20,182,700
GC Premium @ 4%			807,300
Total Construction			20,990,000
Other Costs			
Engineering & Procurement (incl Trips)			2,100,000
Construction & Start-up Oversight			300,000
Contingency (Quoted Items) - 10%			826,200
Contingency (Services) - 10%			240,000
Contingency (Construction) - 20%			2,384,000
Total Present day costs (April 2010 Dollars)			**26,955,000**

Cost Estimates
Basis of Recommended Option

- The estimates are conceptual type with an accuracy of +/- 30 percent.
- Mechanical:
  - Budgetary vendor quote provided costs for converting Unit 3, 4, & 5 CESP to a PJFF – and for the full upgrades to the HESPs, including material and labor costs.
  - Upgrade of a HESP to a PJFF was estimated by WorleyParsons
  - An allowance was used for controller upgrades to HESPs.
  - Other costs were included with the vendor data, were estimated by WorleyParsons or were allowances
- BOP Costs:
  - Compressor foundations are based on preliminary sizes and quantities.
  - Piping and duct modification costs are based on preliminary engineering quantity information.
  - Asbestos abatement is based on preliminary calculated quantities & average rates for DC area.
  - Insulation costs are based on preliminary engineering quantity information.
  - Other costs were included as allowances.

Other Costs:

- Engineering and Procurement Services, Construction & Start-up Oversight - based on preliminary information.

Contingency:

- Contingency is developed using the following categories:
  - Quoted Items @ 10.0 percent
  - Services @ 10.0 percent
  - Construction @ 20.0 percent

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Cost Estimate Comparison
Option 2 – CESP as Primary PM

	DESCRIPTION	MATERIAL COST	LABOR COST	TOTAL COST
Mechanical / Structural / Civil / Electrical / I&C				
	General HESP upgrade to next generation of mircoprocessor controls (Units 1 & 2)	500,000	500,000	1,000,000
	Convert existing CESP to PJFF (Units 3, 4 & 5) (incl. demolition of internals)	8,700,000	9,000,000	17,700,000
	Subtotal - Mechanical	9,450,000	9,529,900	18,979,900
BOP Costs				
	Ash handling system modification - units 3 - 5	2,000,000	2,032,000	4,032,000
	In-duct silencer modifications (1 per fan - 6 total)	103,200	1,160,040	1,263,300
	Turning vanes at base of stack	52,000	409,920	462,000
	Others	XXX	YYY	ZZZ
	Subtotal - BOP Costs	4,308,800	6,097,660	10,406,600
	Sub Total Construction	13,758,800	15,627,560	29,386,500
	GC Premium @ 4%			1,175,500
	Total Construction			30,562,000
Other Costs				
	Engineering & Procurement (incl Trips)			2,500,000
	Construction & Start-up Oversight			300,000
	Contingency (Quoted Items) - 10%			945,000
	Contingency (Services) - 10%			280,000
	Contingency (Construction) - 20%			3,987,000
	Total Present day costs (April 2010 Dollars)			**38,574,000**

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Cost Estimate Comparison
Option 3 – HESP as PJFF (Unit 4)

	DESCRIPTION	MATERIAL COST	LABOR COST	TOTAL COST
Mechanical / Civil / Electrical / I&C				
	Convert (1) HESP to Baghouse (includes engineering and material) - Remove the ESP roof and internals. [Note WP labor - ALLOWANCE]	4,500,000	7,500,000	12,000,000
	Compressed air systems for 1 Baghouse units (scfm at 70 to 100 psig per Baghouse unit) Total of 2 compressors/dryers/receivers (1 operating + 1 spare).	526,600	114,400	641,000
	General HESP upgrade to next generation of mircoprocessor controls (Units 1, 2, 3 & 5)	1,000,000	1,000,000	2,000,000
	Subtotal - Mechanical	6,026,600	8,614,400	14,641,000
	Subtotal - Structural (Duct Modifications)	1,172,300	2,765,000	3,937,300
Subtotal - BOP Costs		1,141,300	691,900	1,833,200
	Sub Total Construction	8,340,200	12,071,300	20,411,500
	GC Premium @ 4%			816,000
	Total Construction			21,227,500
Other Costs				
	Engineering & Procurement (incl Trips)			2,100,000
	Construction & Start-up Oversight			300,000
	Contingency (Quoted Items) - 10%			603,000
	Contingency (Services) -10%			240,000
	Contingency (Construction) - 20%			2,643,000
	Total Present day costs (April 2010 Dollars)			**27,322,000**