From: Straight, Scott
To: Voyles, John
Sent: 3/15/2011 9:16:48 AM
Subject: FW: EPA Regs Schedule 20110312.docx
Attachments: EPA Regs Schedule 20110312.docx

John,
Some edits for consideration.
Scott

-----Original Message-----
From: Voyles, John
Sent: Tuesday, March 15, 2011 8:04 AM
To: Straight, Scott
Subject: FW: EPA Regs Schedule 20110312.docx

Give me a call on this update.

JV

March 14, 2011

Key 2011 Dates for EPA Regulations Actions

Date	**Item**	**Input/Review**
Jan 14, 2011	Complete review of EPA's two alternate CATR allowance allocation methods	Env, Gen Planning
Jan 28, 2011	RFP responses for CR replacement capacity due	ES
Jan 31, 2011	Finalize content and timing of ECR filing	ES, RR, PE
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Input/Review: Env = Environmental; ES= Energy Services; RR = Rates and Regulatory

March 14, 2011

Jun 1, 2011	ECR and CCN filing for MC FGDs, BR landfill, GH SAM mitigation and EGU MACT response	ES, RR
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Oct-Dec, 2011	Prepare Transmission CCN for CR replacement	Trans, RR
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From: Straight, Scott
To: Saunders, Eileen
CC: Gregory, Ronald; Lively, Noel; Imber, Philip; Schetzel, Doug; Clements, Joe
Sent: 3/15/2011 9:22:07 AM
Subject: FW: EPA Regs Schedule 20110312.docx
Attachments: EPA Regs Schedule 20110312.docx

Keeping you in the loop.

-----Original Message-----
From: Straight, Scott
Sent: Tuesday, March 15, 2011 9:17 AM
To: Voyles, John
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March 14, 2011

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From:	Voyles, John
To:	Schram, Chuck; Straight, Scott
Sent:	3/15/2011 10:47:37 AM
Subject:	EPA Regs Schedule 20110312.docx
Attachments:	EPA Regs Schedule 20110312.docx

Here's the latest draft schedule with both of your comments include that I will share at Paul's staff meeting today.

Thanks,

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March 14, 2011

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From: Straight, Scott
To: Saunders, Eileen; Gregory, Ronald; Lively, Noel; Imber, Philip; Hance, Chuck; Clements, Joe
Sent: 3/15/2011 10:50:48 AM
Subject: FW: EPA Regs Schedule 20110312.docx
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Please share this with your engineering folks that are supporting these studies and planning activities.

Scott

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To: Schram, Chuck; Straight, Scott
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Input/Review: Env = Environmental; ES= Energy Services; RR = Rates and Regulatory; PE+ Project Engineering

From: Straight, Scott
To: Reed, Kathleen
Sent: 3/21/2011 10:00:34 AM
Subject:
Attachments: PE's Bi-Weekly Update of 3-18-11.docx

K,

Please put the latest version of the IC table in this file and send it back to me. It also needs to be better formatted to not run off the right side of the doc.

Scott Straight, P.E.
Director, Project Engineering
LG&E and KU Energy, LLC
(502) 627-2701
scott.straight@lge-ku.com

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
March 18, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent Elevators – Still in progress.
    - Brown FGD – Third party FGD Performance Testing on high sulfur coal is scheduled to begin 3/21/11.
    - Brown Coal Pile Modification – Complete enough to enable storage of the high sulfur coal for FGD Performance Testing.
    - Brown Elevators – Installation of the permanent cars is scheduled for May 2011.

- **TC2**
  - Safety – NTR
  - Schedule/Execution:
    - Bechtel EPC – The Group 3 Fuel test burns were completed 03/07/11 and the unit is schedule to be taken out of service for the burner inspection March 18-20, 2011. Indications are the burners have no significant damage from the Group 3 fuel burns; however there were some burner temperature excursions. Bechtel submitted their notice of Combustion System Completion. Data from both Group 2 and Group 3 tests burns will be reviewed by the station and PE before we review it together with Bechtel on 03/22/11. New ammonia forwarding pumps have been installed and commissioned by Bechtel and are operating satisfactorily. Bechtel continues work on the punchlist and April outage planning. The major outage activities are replacement of the AH baskets, installation of a baffle in the economizer to eliminate the vibration and completion of the furnace tube wall coating.
  - Contract Disputes/Resolution:
    - Bechtel LD's – Bechtel sent a letter reaffirming their LD position. Preparation with outside counsel in progress to prepare for a LD settlement meeting with Bechtel in April.
    - Bechtel Labor Claim – PE sent a letter requesting Bechtel resubmit a change order for remaining labor claim that terminates at Mechanical Completion of July 2010 instead of through October 2010 when the MC Certificate was issued. Bechtel has responded with a letter reaffirming their position.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification
    - Completion of punchlist

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – proceeding as planned to support the Spring 2012 in-service.

- Schedule/Execution – SCR ductwork and equipment deliveries continue well ahead of Zachry's needs. Zachry has completed demolition work in the Aux. Boiler area and has begun piling installation.
- Issues/Risk – NTR

- **Ohio Falls Rehabilitation**
  - Safety – NTR
  - Engineering
    - Voith Hydro proceeding with equipment orders and pre-mobilization issues for a restart of rehabilitation on Unit 5 in June 2011.
    - Bids due 3/16/11 on head gate modifications.
    - SOW for station auxiliary upgrade in internal review.
    - SOW developed for concrete façade and window repairs as part of the Historic Preservation Maintenance Plan.
    - SOW for parking and laydown expansion in process, ready for Commercial week of 03/21/11.
    - Dewatering pumps shipping off site on 3/16/11 for precautionary overhaul.
    - Spare set of wicket gates returned to Voith shop for overhaul.
    - Unit auxiliary transformers have been ordered.
    - Readiness Review meeting with Voith set for 04/13/11.
    - PE assisting plant on initial inquiry for new office building on site.

- **Mill Creek Limestone Project**
  - Safety - NTR
  - Schedule/Execution
    - Detailed Engineering - HDR is working with PE and the plant to develop specifications in support of bidding the General Contracting portion of the project.
    - The Limestone Conveyor Bid was issued on 03/15/11. A pre-bid meeting is scheduled at the site on 03/22/11.
    - HDR has issued the draft General Contracting specification to PE and the plant. A 50% review was held at the site with PE, Plant representatives and HDR on 03/10/11. Reviews are ongoing and the specification is scheduled to be issued the first week of April 2011.

- **Cane Run CCP Project**
  - Permitting
    - All permitting proceeding well. 401 and Flood Plain permits received in 2010.
    - Working on NOD #2 response which includes a door to door well survey of residents within 1-mile of the facility. Draft copy of NOD #2 response is currently under review.
  - Engineering
    - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall is nearing completion.
    - Finalization of construction drawings and specifications for the 5-year landfill will be completed by the end of March.

- **Trimble Co. Barge Loading/Holcim**
  - Finalized order with UCC to purchase pneumatic Fly Ash handling system.
  - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
  - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design.

- **TC CCP Project – BAP/GSP**
  - Safety – NTR
  - Schedule/Execution:
    - Setting of the GSP Raft began the week of 02/14/11.
    - All fill and mechanically stabilized earth wall work on the BAP is completed except for a small section of the South Dike. Work continues on erection of the new Pipe Rack, electrical duct banks to GSP Electrical Building and to Ash Pond Raft. Work is now being concentrated on raising the South Dike due to the high water level inside of the BAP.
  - Contract Disputes/Resolution
    - Minor issues to resolve with Riverside.
  - Issues/Risk
    - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill
  - Engineering
    - Detailed Engineering in progress with GAI.
  - Permitting:
    - The 401 Permit application was submitted to KYDOW in December 2010.
    - The 404 Permit application was submitted to the US Army Corps of Engineers in December, 2010. Additional requested field studies are being completed.
    - Development of the documents for the Division of Waste Management (DWM) Permit application continues. The application should occur in April 2011. A Private Water Well and Spring Survey continues by GAI Consultants for all residents within one-mile radius of the footprint of the landfill. This is required for the DWM permit.
    - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC on Thursday 03/03/11.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Issued RFQ for Civil/Mechanical Construction.
    - Bid for the new Security Fence around the Landfill Area have been received.
    - Major equipment packages for the Transport will be issued in March and April.
    - Reviewing Gypsum Dewatering, Fly Ash system, and Bottom Ash SFC's draft specifications.
  - Permitting:

        - All permit applications have been submitted. Moving forward as expected.
        - Working on response to NOD #2.
    - Issues/Risk:
        - Land Acquisition – Negotiations nearing completion with Deaton family in regards to pricing and terms of sale. The parties are close to a final settlement after resolution of terms and conditions of the sale. Work continues, however, on condemnation proceedings with the preparation of the drawings to delineate the actual "takings."

- **E.W. Brown Ash Pond Project**
    - Safety – NTR
    - Continue to work with Summit on contract settlement payout/resolution to avoid litigation.
    - Engineering – Detailed Engineering in progress by MACTEC.
    - Schedule/Execution:
        - All work in the field is currently related to the Aux. Pond Scope of Work.
        - Gypsum was placed in the South embankment. Gypsum placed and compacted is migrating through the filter fabric. A path forward is under development.
        - Continue to provide BR Landfill design information to MACTEC.
        - Currently developing RFQ for conceptual design engineering of Wet-to-Dry Ash Handling conversion as part of the BR Landfill project.
    - Issues/Risk:
        - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
        - Final settlement reached with Summit on all outstanding claims by Summit.

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
    - Safety – NTR
    - Schedule/Execution:–
        - Bids received for milling at Ghent from Nol-Tec, BCSI/Nalco, and UCC. Assessment is ongoing, review meeting with the plant scheduled for 3/21/11. On schedule for April Investment Committee meeting.
        - Permanent operation with mills at Ghent may be possible by November 2011. The bidding process will verify this assumption.
    - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal in progress. Unit 1 and Unit 2 SAM testing complete.
    - Considering the purchase of a new SAM CEMS at Ghent. Held technical discussion with SICK, the equipment manufacturer. The technology has open questions regarding performance.

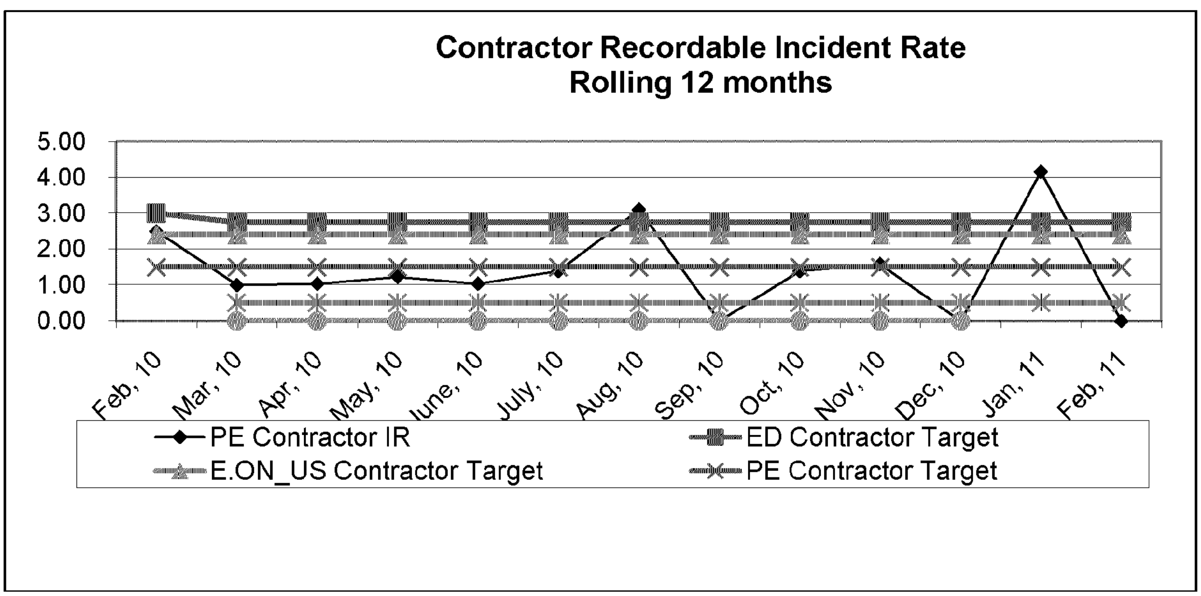
- **Cane Run CCGT**
    - Budget – NTR
    - Gas Pipe Line Routing – Bids received 3/16/11 from EMS, EN Engineering, and PAI for further NG Pipeline Engineering. This contract may also assess the new line for feed to Paddy's Run and for Gas Distribution system upgrades in the area.
    - Owner's Engineer –
        - Contract Award Document in routing for full release of OE
        - Cost Estimates updated and released to Generation Planning.

- Air Permitting – Trinity continuing netting analysis.
- Environmental Assessment – MacTec is on hold for until engineering deliverables are finalized for review. .

- **Other Generation Development**
  - Biomass – NTR
  - CCS 100 MW Project –
    - 3H reviewed NDA.
    - Division of Responsibility sent to 3H; working to get agreement they will support the Phase I activities pro-bono.
- FutureGen –NTR

- **General**
  - Environmental Scenario Planning:
    - All stations (MC, Ghent and Brown) are under review. The Mill Creek draft report was received on 03/14/11 as planned. The documents are under review.
    - Various meetings being held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
    - Babcock Power has been engaged to upgrade the MC Unit 4 SCR. Critical plant information as well as the design basis was transmitted to Balcke-Durr in Germany so preparations for dust model testing could proceed.
    - SCRs not in plan for Hg co-benefit. This will lead towards several (if not all but Ghent 2) SCRs not being needed, pending final allowance allocation by EPA.
  - 2011 MTP ECR/CCN Filings – working closely with Rates on PSC submittals and presentations/updates. **The filing date has been unofficially postponed with Rates for 06/01/11.**
  - Continue to work with Legal and EA on Ghent SAM compliance.
  - Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	FEB11	MAR11	APR11	MAY11	JUN11	JUL11	Aug11	Sep11	Oct11	Nov11	Dec11
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug											
Heun	GH CCR - Landfill Phase I - Construction	C		Dec											
Heun	GH CCR - Fines Mechanical - Construction	C		Apr											
Heun	GH CCR - Gypsum Dewatering Belts	C		Apr											
Heun	GH CCR - Dry Fly Ash System	C		Apr											
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		Apr											
Heun	GH CCR - Pipe Conveyor	C		Apr											
Heun	GH CCR - Transport EPC Contract	C		Aug											
Heun	CCR Storage Compliance	P		Pending											
Imber	BR 3 SAM Mitigation	C	8,000	May											
Imber	GH 1 -4 SAM Mitigation	P	8,000	Mar											
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P													
Lively	CCGT 2016 - Cane Run 7 Engineering/Development	P	5,650	Feb											
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep											
Saunders	MC Limestone Mill Construction Contract	C	12,000	Jun											
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	41,117	Pending											
Saunders	Environmental Air Compliance - BR 2 SCR	P	104,971	Pending											
Saunders	Environmental Air Compliance - GH 2 SCR	P	262,878	Pending											
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	97,229	Pending											
Saunders	Environmental Air Compliance - MC 2 FGD Upgrade	P	47,659	Pending											
Saunders	Environmental Air Compliance - MC 2 Electrostatic Precip	P	37,690	Pending											
Saunders	Environmental Air Compliance - MC4 FGD	P	271,994	Pending											
Saunders	Environmental Air Compliance - MC4 SCR	P	5,696	Pending											
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	159,453	Pending											
Straight	CCR Project Status Update	P		Feb											
Waterman	TC CCR - Landfill Phase I - Construction	C													
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jun											
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug											
Williams	BR CCR - Landfill Phase I - Construction	C		Jun											
Williams	BR CCR - Ash Handling Dry Conversion	C		Jun											

- **Staffing**
  - Headcount planning is in process to evaluate staffing needs to manage the 2011MTP projects.
  - Posting in progress for electrical engineer to replace Jason Finn.
  - PE Re-Organization implemented the week of 3/7/11.
  - Posting for Contract Administrator expected to be made the week of 3/21/11.
  - Posting for Business Analyst expected to be made the week of 3/21/11.

From:	Straight, Scott
To:	Straight, Scott; Thompson, Paul; Voyles, John; Bowling, Ralph; Hudson, Rusty; Hincker, Loren; Sinclair, David; Schetzel, Doug; Yussman, Eric; Jackson, Fred
CC:	Waterman, Bob; Imber, Philip; Lively, Noel; Saunders, Eileen; Gregory, Ronald; Heun, Jeff; Hance, Chuck; Clements, Joe; Cooper, David (Legal); Jones, Greg; Keeling, Chip; Hendricks, Claudia; Ray, Barry; O'brien, Dorothy (Dot); Bellar, Lonnie; Blake, Kent; Sturgeon, Allyson; Conroy, Robert; Cornett, Greg
Sent:	3/21/2011 11:10:29 AM
Subject:	Project Engineering's ES Bi-Weekly Report - March 18, 2011
Attachments:	PE's Bi-Weekly Update of 3-18-11.docx

Scott Straight, P.E.
Director, Project Engineering
LG&E and KU Energy, LLC
(502) 627-2701
scott.straight@lge-ku.com

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PROJECT ENGINEERING
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    - Bechtel EPC – The Group 3 Fuel test burns were completed 03/07/11 and the unit is schedule to be taken out of service for the burner inspection March 18-20, 2011. Indications are the burners have no significant damage from the Group 3 fuel burns; however there were some burner temperature excursions. <u>Bechtel submitted their notice of Combustion System Completion.</u> Data from both Group 2 and Group 3 tests burns will be reviewed by the station and PE before we review it together with Bechtel on 03/22/11. New ammonia forwarding pumps have been installed and commissioned by Bechtel and are operating satisfactorily. Bechtel continues work on the punchlist and April outage planning. The major outage activities are replacement of the AH baskets, installation of a baffle in the economizer to eliminate the vibration and completion of the furnace tube wall coating.
  - Contract Disputes/Resolution:
    - Bechtel LD's – Bechtel sent a letter reaffirming their LD position. Preparation with outside counsel in progress to prepare for a LD settlement meeting with Bechtel in April.
    - Bechtel Labor Claim – PE sent a letter requesting Bechtel resubmit a change order for remaining labor claim that terminates at Mechanical Completion of July 2010 instead of through October 2010 when the MC Certificate was issued. Bechtel has responded with a letter reaffirming their position.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification
    - Completion of punchlist

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – proceeding as planned to support the Spring 2012 in-service.

  - Schedule/Execution – SCR ductwork and equipment deliveries continue well ahead of Zachry's needs. Zachry has completed demolition work in the Aux. Boiler area and has begun piling installation.
  - Issues/Risk – NTR

- **Ohio Falls Rehabilitation**
  - Safety – NTR
  - Engineering
    - Voith Hydro proceeding with equipment orders and pre-mobilization issues for a restart of rehabilitation on Unit 5 in June 2011.
    - Bids due 3/16/11 on head gate modifications.
    - SOW for station auxiliary upgrade in internal review.
    - SOW developed for concrete façade and window repairs as part of the Historic Preservation Maintenance Plan.
    - SOW for parking and laydown expansion in process, ready for Commercial week of 03/21/11.
    - Dewatering pumps shipping off site on 3/16/11 for precautionary overhaul.
    - Spare set of wicket gates returned to Voith shop for overhaul.
    - Unit auxiliary transformers have been ordered.
    - Readiness Review meeting with Voith set for 04/13/11.
    - PE assisting plant on initial inquiry for new office building on site.

- **Mill Creek Limestone Project**
  - Safety - NTR
  - Schedule/Execution
    - Detailed Engineering - HDR is working with PE and the plant to develop specifications in support of bidding the General Contracting portion of the project.
    - The Limestone Conveyor Bid was issued on 03/15/11. A pre-bid meeting is scheduled at the site on 03/22/11.
    - HDR has issued the draft General Contracting specification to PE and the plant. A 50% review was held at the site with PE, Plant representatives and HDR on 03/10/11. Reviews are ongoing and the specification is scheduled to be issued the first week of April 2011.

- **Cane Run CCP Project**
  - Permitting
    - All permitting proceeding well. 401 and Flood Plain permits received in 2010.
    - Working on NOD #2 response which includes a door to door well survey of residents within 1-mile of the facility. Draft copy of NOD #2 response is currently under review.
  - Engineering
    - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall is nearing completion.
    - Finalization of construction drawings and specifications for the 5-year landfill will be completed by the end of March.

- **Trimble Co. Barge Loading/Holcim**
  - Finalized order with UCC to purchase pneumatic Fly Ash handling system.
  - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
  - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design.

- **TC CCP Project – BAP/GSP**
  - Safety – NTR
  - Schedule/Execution:
    - Setting of the GSP Raft began the week of 02/14/11.
    - All fill and mechanically stabilized earth wall work on the BAP is completed except for a small section of the South Dike. Work continues on erection of the new Pipe Rack, electrical duct banks to GSP Electrical Building and to Ash Pond Raft. Work is now being concentrated on raising the South Dike due to the high water level inside of the BAP.
  - Contract Disputes/Resolution
    - Minor issues to resolve with Riverside.
  - Issues/Risk
    - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill

- Engineering
  - Detailed Engineering in progress with GAI.
- Permitting:
  - The 401 Permit application was submitted to KYDOW in December 2010.
  - The 404 Permit application was submitted to the US Army Corps of Engineers in December, 2010. Additional requested field studies are being completed.
  - Development of the documents for the Division of Waste Management (DWM) Permit application continues. The application should occur in April 2011. A Private Water Well and Spring Survey continues by GAI Consultants for all residents within one-mile radius of the footprint of the landfill. This is required for the DWM permit.
  - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC on Thursday 03/03/11.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Issued RFQ for Civil/Mechanical Construction.
    - Bid for the new Security Fence around the Landfill Area have been received.
    - Major equipment packages for the Transport will be issued in March and April.
    - Reviewing Gypsum Dewatering, Fly Ash system, and Bottom Ash SFC's draft specifications.
  - Permitting:

    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – Negotiations nearing completion with Deaton family in regards to pricing and terms of sale. The parties are close to a final settlement after resolution of terms and conditions of the sale. Work continues, however, on condemnation proceedings with the preparation of the drawings to delineate the actual "takings."

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Continue to work with Summit on contract settlement payout/resolution to avoid litigation.
  - Engineering – Detailed Engineering in progress by MACTEC.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Gypsum was placed in the South embankment. Gypsum placed and compacted is migrating through the filter fabric. A path forward is under development.
    - Continue to provide BR Landfill design information to MACTEC.
    - Currently developing RFQ for conceptual design engineering of Wet-to-Dry Ash Handling conversion as part of the BR Landfill project.
  - Issues/Risk:
    - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
    - Final settlement reached with Summit on all outstanding claims by Summit.

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
  - Safety – NTR
  - Schedule/Execution:–
    - Bids received for milling at Ghent from Nol-Tec, BCSI/Nalco, and UCC. Assessment is ongoing, review meeting with the plant scheduled for 3/21/11. On schedule for April Investment Committee meeting.
    - Permanent operation with mills at Ghent may be possible by November 2011. The bidding process will verify this assumption.
  - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal in progress. Unit 1 and Unit 2 SAM testing complete.
  - Considering the purchase of a new SAM CEMS at Ghent. Held technical discussion with SICK, the equipment manufacturer. The technology has open questions regarding performance.

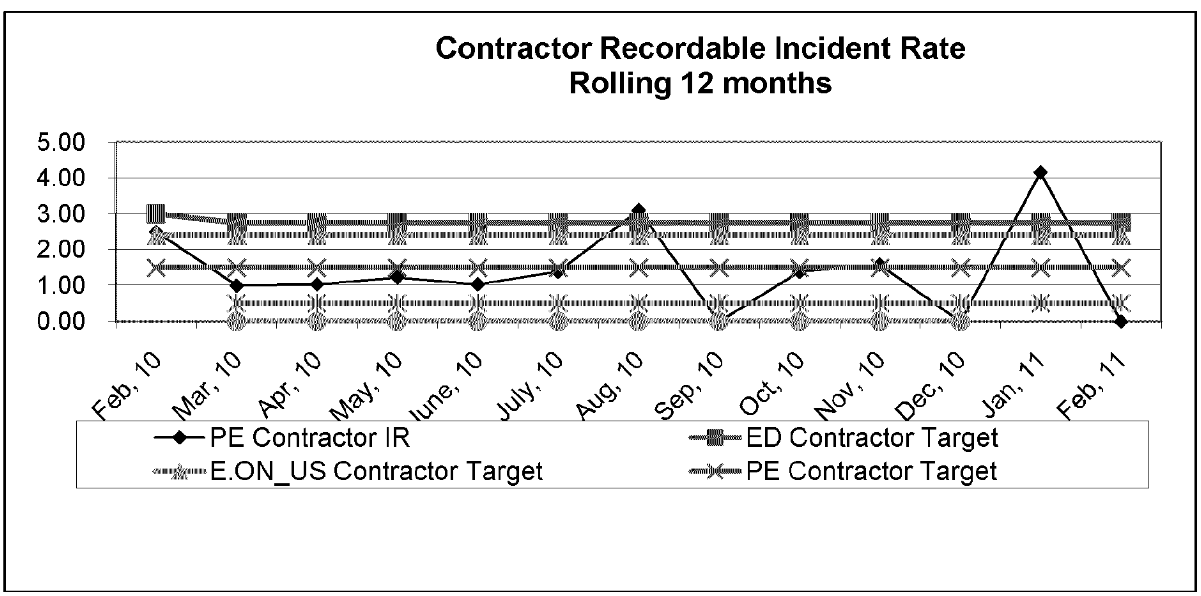
- **Cane Run CCGT**
  - Budget – NTR
  - Gas Pipe Line Routing – Bids received 3/16/11 from EMS, EN Engineering, and PAI for further NG Pipeline Engineering. This contract may also assess the new line for feed to Paddy's Run and for Gas Distribution system upgrades in the area.
  - Owner's Engineer –
    - Contract Award Document in routing for full release of OE
    - Cost Estimates updated and released to Generation Planning.

  - Air Permitting – Trinity continuing netting analysis.
  - Environmental Assessment – MacTec is on hold for until engineering deliverables are finalized for review. .

- **Other Generation Development**
  - Biomass – NTR
  - CCS 100 MW Project –
    - 3H reviewed NDA.
    - Division of Responsibility sent to 3H; working to get agreement they will support the Phase I activities pro-bono.
  - FutureGen –NTR

- **General**
  - Environmental Scenario Planning:
    - All stations (MC, Ghent and Brown) are under review. The Mill Creek draft report was received on 03/14/11 as planned. The documents are under review.
    - Various meetings being held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
    - Babcock Power has been engaged to upgrade the MC Unit 4 SCR. Critical plant information as well as the design basis was transmitted to Balcke-Durr in Germany so preparations for dust model testing could proceed.
    - SCRs not in plan for Hg co-benefit. This will lead towards several (if not all but Ghent 2) SCRs not being needed, pending final allowance allocation by EPA.
  - 2011 MTP ECR/CCN Filings – working closely with Rates on PSC submittals and presentations/updates. **The filing date has been unofficially postponed with Rates for 06/01/11.**
  - Continue to work with Legal and EA on Ghent SAM compliance.
  - Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAR11	APR11	MAY11	JUN11	JUL11	Aug11	Sep11	Oct11	Nov11	Dec11	Jan12	Feb12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C		May												
Heun	GH CCR - Gypsum Dewatering Belts	C		May												
Heun	GH CCR - Dry Fly Ash System	C		May												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		May												
Heun	GH CCR - Pipe Conveyor	C		May												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P		Pending												
Imber	BR 3 SAM Mitigation	C	8,000	May												
Imber	GH 1 -4 SAM Mitigation	P	8,000	Mar												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	MC Limestone Mill Construction Contract	C	12,000	Jun												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	41,117	Pending												
Saunders	Environmental Air Compliance - BR 2 SCR	P	104,971	Pending												
Saunders	Environmental Air Compliance - GH 2 SCR	P	262,878	Pending												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	97,229	Pending												
Saunders	Environmental Air Compliance - MC 2 FGD Upgrade	P	47,659	Pending												
Saunders	Environmental Air Compliance - MC 2 Electrostatic Precip	P	37,690	Pending												
Saunders	Environmental Air Compliance - MC4 FGD	P	271,994	Pending												
Saunders	Environmental Air Compliance - MC4 SCR	P	5,696	Pending												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	159,453	Pending												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jun												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Jun												
Williams	BR CCR - Ash Handling Dry Conversion	C		Jun												

- **Staffing**
  - Headcount planning is in process to evaluate staffing needs to manage the 2011MTP projects.
  - Posting in progress for electrical engineer to replace Jason Finn.
  - PE Re-Organization implemented the week of 3/7/11.
  - Posting for Contract Administrator expected to be made the week of 3/21/11.
  - Posting for Business Analyst expected to be made the week of 3/21/11.

From:	Williams, John
To:	Wilson, Stuart
CC:	Heun, Jeff; Schram, Chuck; Straight, Scott
Sent:	3/21/2011 2:21:36 PM
Subject:	RE: Brown Landfill Paper
Attachments:	BR Landfill Justification (08-Sep-10).pdf; BR Landfill Justification (08-Sep-10).pptx

Stuart,

See Attached:

Regards,

John

From: Wilson, Stuart
Sent: Monday, March 21, 2011 1:35 PM
To: Heun, Jeff
Cc: Williams, John
Subject: RE: Brown Landfill Paper

Great. Thanks.

From: Heun, Jeff
Sent: Monday, March 21, 2011 1:34 PM
To: Wilson, Stuart
Cc: Williams, John
Subject: RE: Brown Landfill Paper

Stuart,

As an FYI John Williams has taken over as Project Manager of the BR Landfill Project. I have forwarded your request on to him as I am not sure if he has made any changes to the paper.

JBH

From: Wilson, Stuart
Sent: Monday, March 21, 2011 1:26 PM
To: Heun, Jeff
Cc: Schram, Chuck; Straight, Scott
Subject: Brown Landfill Paper

Jeff,

To be sure we have the latest version, could you please forward me the most recent copy of the paper/analysis to justify the Brown landfill project.

Thanks.

Stuart

PROJECT ENGINEERING

E.W. Brown CCR Storage Evaluation
Continue Main Pond Project vs. Conversion to Landfill
September 08, 2010

Executive Summary

On June 21, 2010 the EPA issued a proposed Coal Combustion Residual (CCR) ruling that establishes federal guidelines for CCR storage. In light of the EPA's proposed CCR ruling, Project Engineering (PE) reviewed the CCR storage project (i.e., Main Ash Pond Project) at E.W. Brown (BR) that is under construction to evaluate what effects the EPA's proposed CCR rules potentially imposed on long-term wet storage of CCR at BR.

Significant work has been completed on the BR CCR Project, including detailed engineering and permitting for all phases of the project, as well as the physical work of relocating the transmission lines that cross the ash pond, ash handling upgrades and construction of the Auxiliary (Aux) Pond to elevation 880'. In addition to the completed tasks, construction of the Main Pond Starter Dike (elevation 902') is in progress but has been suspended by PE pending direction on the path forward for long-term CCR storage at BR.

As of June 2010, Phase I spend is \$53.3M of the approved \$73.1M sanction. Construction of Aux Pond elevation 900' (Phase II of II) is currently in progress and will proceed per the original plan or on an accelerated scheduled to support CCR storage requirements based on the path forward.

Project Engineering and the BR Station recommend the implementation of Case A to convert the Main Pond into a Landfill to meet the EPA's proposed CCP Ruling. This option has the lowest NPV and NPVRR of the Cases reviewed while maximizing the landfill footprint. Maximizing the landfill footprint also maximizes future vertical expansion opportunities and eliminates future cost and issues associated with Station operations while dewatering and closing the pond post-EPA CCR Ruling. It is important to note that both options proposed by the EPA for CCR storage are for long-term dry storage (i.e., landfill). Therefore, not converting the Main Pond Project to a dry landfill project now will not eliminate the requirement to convert all CCR storage to a dry landfill should either of the EPA proposed regulations become final.

Project Background

In 2005, PE was tasked with evaluating storage options to meet the future CCR storage requirements at BR to 2030. The evaluation process consisted of an Initial Siting study, Conceptual Design phase, and Detailed Design of the Main Pond and Aux Pond. The Initial Siting study evaluated potential storage options for BR Station and recommended an on-site storage facility as the least cost option.

The Conceptual Design was built upon the Initial Siting Study and focused on potential storage options available on-site. Options evaluated included ponds, landfills, and a combination of ponds and landfills; with the final evaluation considering three ponds and two landfill options. Pond Option #1 was a vertical upstream expansion of the existing Main Ash Pond, Pond Option #2 was a vertical upstream expansion of the existing Main Ash Pond and a new Gypsum Stack, and Pond Option #3 was a vertical upstream expansion of the existing Ash Pond and a new Bottom Ash Pond. The two landfill options were based on a common footprint; however Landfill Option #1 was based on conventional dry CCR handling and mechanical placement while Landfill Option #2 was based on wet CCR handling and dense slurry placement. Based on Net Present Value (NPV) evaluations of the (5) five options in 2005, the least-cost alternative was Pond Option #3 consisting of a new Aux Pond for bottom ash storage and the vertical upstream expansion of the existing Ash Pond for flyash and non-marketed gypsum storage. Option #3 capital costs (Phase I and II of five Phases) of $98M were approved for Environment Cost Recovery by the Kentucky Public Service Commission (KYPSC) in 2005 and again in 2009.

Upon completion of the Conceptual Design, Detailed Design of the new Aux Pond and vertical upstream expansion of the Main Pond was initiated. Detailed Design included engineering for the ponds, transmission line relocations, station mechanical upgrades, development & submittal of the Dam Safety and 404/401 permits, and several environmental studies to support the permitting process. Detailed Design for the Aux Pond was completed in 2006 followed by the Main Pond in 2007. The original design basis in 2006 was to provide 20-years (until year 2030) of CCR storage based on the following production rates:

CCR	Annual Production (yd^3)	20-Year Production (yd^3)
Gypsum	500,000	10,000,000
Fly Ash	221,000	4,420,000
Bottom Ash	55,000	1,100,000
Totals	**776,000**	**15,520,000**

Current Project Status

Phase I of Pond Option #3 CCR expansion began in 2006 with Detailed Design. The design consists of an expanded Main Ash Pond embankment, construction of an Aux Ash Pond, transmission line relocations, and ash handling upgrades. The Aux Pond is currently in operation at its initial height of elevation 880'. It provides an alternate location to treat bottom ash and fly ash in the area south of the existing Main Pond while the Main Pond Starter Dike (Starter Dike) is under construction. If the Pond Option #3 design progresses to final completion, the Main Pond will have been constructed to elevation 962' and the Aux Pond to elevation 900'.

Aux Pond

The construction sequence of the Aux Pond was designed with a two phase approach, separated by the construction duration of the Main Pond Starter Dike. Construction of the first phase, designated at Aux Pond elevation 880', commenced in October of 2006 and was placed into operation in June 2008. The second phase of construction, designated Aux Pond elevation 900', will expand the pond to the final design elevation. The second phase commenced in June 2010 and is currently planned to reach completion in mid-2013.

During the construction of Aux Pond elevation 880', the FGD facility was under construction and gypsum was not in production; therefore, the first phase of the Aux Pond was constructed of clay and rock sourced from on-site borrow. The 47-acre site was stripped and grubbed, karst features were investigated and treated, and a riser outfall structure was constructed to provide outlet control, and the facility's liner system was installed incorporating 60-mil reinforced polypropylene flexible membrane liner (FML). The FGD facility was placed into operation in June 2010, thereby adding gypsum to the by-product stream. The Aux Pond elevation 900' phase incorporates gypsum as the primary constructible fill material.

Main Pond

In June 2008, the Aux Pond was placed into operation at elevation 880'. Shortly thereafter, the Main Ash Pond was taken out of service. To date, excavation and pumping operations of the Main Pond have been performed to drain the low-lying areas allowing the existing ash surface to be stabilized and re-graded. A bi-axial geo-grid reinforced working platform and a starter dike were constructed utilizing shot rock that comprises the foundation for future phased elevation expansions. Also completed is the new riser structure, a storm water runoff system, clay borrow and bottom ash stockpiling, and liner system procurement.

In light of impending EPA regulations that were published in June of 2010, PE suspended most of the work on the Starter Dike contract in an effort to minimize construction of embankments that may not be required should the recommendation to convert the pond project to a landfill is approved. Only shared construction activities between the Starter Dike design and the projected design of a future landfill within the same footprint continue. In suspending the Starter Dike project, the liner system and embankment material can be utilized in the design of the landfill and also utilized to accelerate the construction of the Aux Pond elevation 900' Phase II, thus minimizing approximately $6.5 million of spend on construction that would be stranded.

Transmission Relocation

Early site construction included the relocation of approximately 13,000 linear feet of overhead electric transmission lines and associated poles and towers to accommodate the expansion of the Main Ash Pond and the construction of the Auxiliary Ash Pond. This phase of the construction effort was initiated in mid-2006 and was completed in 2007.

Ash Handling Upgrades

Multiple plant upgrades to the wet ash handling system resulted from the Main Pond expansion and Aux Pond construction. New higher capacity fly ash and bottom ash sluice pumps, servicing all three units, were required to overcome the added height of the Main Ash Pond embankment and the distance to the Aux Pond.

Phase I Financials

The following table depicts the Phase I expenditures to date verses the Phase I sanction amount.

Cost Through June '10 ($000)	
Engineering	$4,728
Transmission Line Relocation	$18,017
Ash Handling Upgrades	$5,947
Aux Pond 900'	$8,442
Main Pond Starter Dike	$13,202
E.ON U.S./Other	$2,947
Sub-Total	**$53,283**
ECR/Sanction Approved	$73,100
Remaining Budget	**$19,817**

EPA's Proposed CCR Ruling

As a result of the December 2008 ash pond failure at TVA's Kingston's Generating Station, the EPA issued a proposed CCR ruling on June 21, 2010 that would establish federal guidelines for CCR storage. The proposal had three options to govern the storage of CCR, Subtitle "C" – Hazardous, Subtitle "D" – Non-Hazardous, and Subtitle "D" Prime – Non-Hazardous.

Subtitle "C" – Hazardous

The Aux Pond and Main Pond at BR would not comply with the proposed ruling due to strict siting requirements and not having a composite liner. As a result the ponds would have to be closed per one of the two options below:

1. Prior to the ruling becoming effective, BR could cease operation of the ponds and close them under current KY Division of Waste Management regulations. Existing ponds would not be grandfathered in.
2. Once the ruling becomes effective, the ponds would have to stop receiving CCR within 5-years and close within 2-years thereafter. New Subtitle "C" permits would be required in addition to run-on & run-off controls, groundwater monitoring, corrective action plans, closure/post-closure care plan, and financial assurance per the ruling.

Subtitle "D" – Non-Hazardous

The Aux Pond could potentially comply with Subtitle "D" requirements but is highly unlikely as the liner consists of 18" of clay overtopped by an FML while the regulations calls for 24" of clay overtopped by an FML. Without changing our current design plans, the Main Pond at BR would not comply with the proposed ruling due to not having a composite liner and meeting strict siting requirements. As a result, the ponds would have to be closed per one of the two options below:

1. Prior to the ruling becoming effective, BR could cease operation of the ponds and close them under current KY Division of Waste Management regulations. Existing ponds would not be grandfathered in.
2. Once the ruling becomes effective, the ponds would have to stop receiving CCR within 5-years and close within 2-years thereafter. New Subtitle "D" permits would be required in addition to run-on & run-off controls, groundwater monitoring, corrective action plans, and closure/post-closure care plan per the ruling.

Subtitle "D" Prime – Non-Hazardous

Under Subtitle "D" Prime the current elevation of the Aux Pond and Main Pond at the effective date of the ruling would be grandfathered in and allowed to operate for their remaining useful life. However, any future vertical or horizontal expansion would fall under the new regulations and require a new permit, strict siting requirements, composite liner, run-on & run-off controls, groundwater monitoring, corrective action plan, and closure/post-closure care plan per the ruling. These requirements would preclude moving forward because the Main Pond (1) will not provide the required storage volume for CCR due to not being constructed to its final design elevation prior to the rules becoming effective because of both lack of gypsum or rock to construct the berm and insufficient time; and (2) the Main Pond, once placed into operation and filled with water, cannot be retrofitted with the required composite liner to comply with the strict siting requirements.

Under Subtitle "C" the EPA would effectively force the closure of all existing impoundments and eliminate impoundments for future CCR storage as a result of siting restriction, tighter water treatment standards, and cost to implement all technical requirements as set forth. Under Subtitle "D" existing impoundments that do not meet the proposed requirements would be forced to close. However, under Subtitle "D" new impoundments that are designed and constructed with a composite liner, groundwater monitoring, and in compliance with all performance standards would be allowed.

The EPA's proposed ruling will be considered in determining the path forward for the BR CCR project and its effects on the project will be discussed in later sections.

PROJECT ENGINEERING

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Design Basis Moving Forward

As a result of the EPA's proposed CCR Ruling, PE has reevaluated long-term CCR storage at BR as the current Main Pond design will no longer meet the 2030 storage requirement. The analyses are based on an assumption that the proposed ruling becomes effective on January 2012. The January 2012 effective date was based on the proposed ruling being approved in 2010, and accounted for one year of litigation before the ruling became effective. The 3 options available are summarized below:

- **Base Case** – Continue with construction of the Aux Pond to elevation 900' and the Main Pond to 962' per the original design.
- **Case A** – Stop construction of the Main Pond Starter Dike immediately and convert the Main Pond into a landfill prior to the effective date of the CCR Ruling and prior to placing wet CCR in the Main Pond. Complete construction of the Aux Pond 900' project utilizing rock in lieu of gypsum to accelerate construction completion prior to the rules becoming effective. The Aux Pond will eventually be closed per the new regulations once the landfill is placed into service.
- **Case B** – Continue construction of the Main Pond Starter Dike and Aux Pond 900' per the original design. Once the CCR Ruling becomes effective, take the Main Pond out of service, close and cap it per the new regulations, and then construct a landfill similar to Case A on top of the newly constructed Main Pond Starter Dike. As with Case A, once the landfill is placed into service the Aux Pond will be closed per the regulations.
- **Case C** – Modify the design of the Main Pond and install a composite liner per Subtitle "D" requirements. Complete the Aux Pond 900' project as originally designed.

Each case was evaluated based on the most recent forecast of CCR production rates as provided by Generation Planning. In the third quarter of 2009, Generation Planning issued updated CCR production rates based on the projected 2010 MTP generation plan. The CCR production rates for BR modeled in 2009 were significantly lower than the original production rates utilized in 2005. This is attributed to a significant reduction in the station's capacity factor from 77 percent to 54 percent due to shifting generation to other stations. Comparison of the average annual CCR production rates are provided below:

CCP	Average Annual Production Rates (yd^3)			
	2005 Design Basis	**2010 MTP**	**Δ**	**% Reduction**
Bottom Ash	55,000	35,879	(19,121)	35%
Fly Ash	221,000	143,516	(77,484)	35%
Gypsum	500,000	290,000	(210,000)	42%
Totals	**776,000**	**469,395**	**(306,605)**	**47%**

The required CCR storage capacity till 2030 using the 2010 MTP production rates is now 7M yd^3 based on an in-service date of January 2014. If utilizing the original 2005 design volume of

15.5M yd^3 the storage, the facility would have a design life of approximately 38-years (2048), well beyond BR's needs.

Moving forward, the CCR storage facility at BR for both viable Cases A and B will provide a minimum storage capacity of 7M yd^3 and will allow for future expansion if necessary. As described below, the Base Case of continuing to construct the Main Pond and utilize it until 2030 will not be allowed under either scenario in the proposed regulations. In other words, the CCR landfill for both Cases will be designed and permitted with the maximum footprint available and the height of the facility will be adjusted to meet potential changing capacity requirements.

Base Case

The Base Case is the plan currently being implemented and is in-line with the approved ECR & 2006-2010 MTP/LTP plans. Phase I included the design & permitting of the Aux Pond and Main Pond, relocation of the transmission lines, wet ash handling upgrades, Aux Pond 880' construction, and Main Pond Starter Dike construction. All items except the Main Pond Starter Dike construction (in suspension) have been completed. Phase II includes Aux Pond 900' (its final elevation) and Main Pond 912' construction utilizing gypsum. Under the EPA's proposed CCR Ruling, neither pond will meet either of the proposed requirements and will be required to close per the timeframe outlined in the ruling. As a result, moving forward with the Base Case based on the current plan and liner design will not provide BR the required storage through 2030, even at the lower 2009 model production rates.

Base Case Design Issues

The EPA has proposed three options to manage CCR. If the EPA moves forward with Subtitle "C", this option will effectively eliminate all wet CCR storage and would require all existing ponds to retroactively meet the design criteria or cease operation and close per the requirements set forth under Subtitle "C". The Main Pond at BR would not comply with the proposed ruling due to siting requirements, land disposal restrictions (waste treatment), and not having a composite liner & leachate collection system along with other minor issues. A composite liner and leachate collection system could be installed; however the siting requirements and land disposal restriction would remain an issue.

Under Subtitle "D", the EPA is more open to wet storage of CCR. However, several issues remain such as siting requirements (karst, seismic, proximity to wetland & adjacent property owners, etc), composite liner & leachate collection system, and requiring ponds to retroactively meet the design criteria or cease operation and close per the requirements set forth under Subtitle "D". Prior to the effective date of the EPA's ruling, the Main Pond could be constructed to its ultimate elevation of 928' using rock (if a source of sufficient rock quantity can be found) in-lieu of gypsum and include a composite liner with leachate collection. However, the Main Pond would still be subject to the siting requirements under Subtitle "D". By using rock in-lieu of gypsum, the design life of the pond will be reduced by 8 years as the gypsum eventually produced that would have been used to construct the dike would instead be stored in the pond. To complete construction prior to the effective date, embankment must be placed at 12,000 yd^3 per day when normal average construction is

3,000-5,000 yd^3 per day. In addition, close proximity land would have to be purchased to supply the quantity of clay required to construct the composite liner and to supply the rock necessary to construct the embankments. Compliant rock and clay currently sourced from the Houp Property is becoming limited. Based on production rates from the existing quarry, an additional 200 acres would be required to supply the 2.2M yd^3 of rock needed to complete the Aux Pond to an elevation of 900' and the Main Pond to an elevation of 928'. The purchase of 200 acres for additional borrow sources would add $2.0M (2010 dollars) to the project based on cost data gathered on the Ghent Landfill Project. Assuming the new quarry is located less than 5 miles from the plant and utilizing 40-ton articulated trucks, the additional hauling cost would be approximately $10.25M (2010 dollars) based on 2010 RS Means estimating manuals. These additional costs have not been included in the NPV or PVRR analysis.

Construction of the Main Pond could continue by modifying its design to comply with the proposed technical requirements at a significant cost increase and risk to the company. The technical requirements as proposed could change prior to the final ruling and the pond would no longer be in compliance. The EPA is trying to eliminate ponds and move towards dry landfills; therefore, constructing a new pond for long term CCR storage carries significant risk.

Under Subtitle "D" Prime the current elevation of the Main Pond, at the effective date of the ruling, would be grandfathered in and allowed to operate for the remainder of its useful life. However, any future vertical or horizontal expansion would fall under the new regulations and require a new permit, compliance with strict siting requirements, composite liner, run-on & run-off controls, groundwater monitoring, corrective action plan, and closure/post-closure care plan per the ruling. Prior to the effective date of the EPA's ruling the Main Pond could be constructed to its ultimate elevation of 928' as described above. However, there is significant risk as Subtitle "D" Prime is the least likely alternative to be approved as the EPA is trying to eliminate ponds and move towards dry landfills.

Based on the revised 2010 MTP CCR production rates requiring the reduced storage of 7M yd^3, the Main Pond's maximum elevation has been lowered from 962' to 928'. Moving forward, cost data provided for the Base Case will be based on a final elevation of 928'. The following table reflects the NPV, PVRR, and capital cost cash flows for the Base Case option as currently included in the 2011 MTP/LTP draft of July, 2010.

Base Case Capital Cost ($000) for 7M yd^3											
2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**NPV**	**PVRR**	**Total Project**
$19,300	$6,700	$4,153	$6,365	$3,424	$8,951	$2,637	$2,699	$3,813	$103,720	$127,799	$121,687

Case A

Case A consists of immediately terminating construction of the Main Pond Starter Dike (excluding site close out activities such as dust control and reclamation), accelerating the construction of the Aux Pond utilizing rock already blasted that has been recently placed in the Main Pond Starter Dike (thus reducing stranded investments), continued ash grading, Main Pond cap/closure, Landfill engineering and permitting, converting all station ash handling systems from wet to dry, and constructing the initial phase of a Landfill. Based on recent projects, the anticipated duration to perform these activities is 3.5 years with an in-service date of January 2014.

Design and construction of the Landfill would begin prior to final approval of the EPA's proposed CCR Ruling; however the Landfill liner requirements for both Subtitle "D" Non-Hazardous and "C" Hazardous options are the same and will become the basis of design. By terminating construction of the Main Pond Starter Dike, material already purchased and/or stockpiled, such as FML, Filter Fabric, Clay, Rock, and Bottom Ash, will be utilized in the construction of the Landfill thereby minimizing the cost impacts from the approximately $6.5 million stranded cost for the materials purchased or quarried. Additionally, by utilizing rock already blasted and placed in the Main Pond Starter Dike, the footprint of the landfill will be optimized to approximately 100 acres thereby reducing the final height of the landfill and maximizing the future vertical expansion opportunities up to approximately 18M yd^3.

All Plant effluents and CCR will continue to be directed to the Aux Pond during the design, permitting, and construction of the landfill for approximately 3.5 years in order to keep BR in operation. Based on a recent bathymetric survey conducted by MACTEC, and utilizing the 2010 CCR Production Rates, the Aux Pond has enough remaining capacity to store all the CCR generated through January 2015. This is a conservative estimate and provides one year of project float. The following table reflects the NPV, PVRR, and capital cost cash flows for Case A as reflected in the notes to the 2011 MTP/LTP as Landfill Option #1.

Case A Capital Cost ($000)											
2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**NPV**	**PVRR**	**Total Project**
$9,051	$14,262	$26,722	$24,064	$0	$0	$0	$0	$9,321	$126,322	$181,791	$154,939

Case B

Case B consists of completing the Main Pond Starter Dike and Aux Pond 900' projects as designed and permitted prior to final approval of the EPA's proposed CCR Ruling. Upon approval of the EPA's proposed CCR Ruling, the Main Pond would be taken out of service; the Main Pond would then be dewatered, followed by ash grading, Main Pond cap/closure, Landfill engineering, permitting, wet to dry ash handling conversion, and the initial phase of construction of the Landfill. Based on recent projects, the anticipated duration to perform these activities is 5.5 years with an in-service date of January 2016.

If the construction of the Main Pond Starter Dike were to continue to completion and the EPA's proposed ruling was approved, material already purchased and/or stockpiled such as FML, Filter Fabric, Clay, Rock, and Bottom Ash *cannot* be salvaged or otherwise made available for the construction of the Landfill resulting in the need to purchase additional land for approximately $2M to develop new borrow sources and liner material at future market values. Design and construction of a landfill would begin after final approval of the EPA's proposed CCR Ruling which would be the basis of design. By continuing with the construction of the Main Pond Starter Dike, the footprint of the landfill would be approximately 80 acres, some 20 acres less than Case A, thus reducing the potential for future vertical expansion, approximate maximum capacity 13.25M yd^3. Case B also would involve having to develop an operation plan for the Brown Station that would enable it to remain in operation while the recently constructed Main Pond was taken back out of service and dewatered to allow construction of the Landfill. **These operational costs are not included in the total project cost shown in the table below as they are difficult to estimate at the time of preparing this paper; however, they are expected to be significant**.

During the design and permitting of the landfill, both the Aux Pond and Main Pond will be used to store CCR material. During construction, a duration of approximately 2 years, all CCR generated will be stored in the existing Aux Pond. Based on a recent bathymetric survey conducted by MACTEC, and utilizing the 2010 CCR Production Rates, the Aux Pond has enough remaining capacity to store all the CCR generated for 2 years starting January 2014. The following table reflects the NPV, PVRR, and capital cost cash flows for Case A as reflected in the notes to the 2011 MTP/LTP as Landfill Option #2.

Case B Capital Cost ($000)											
2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**NPV**	**PVRR**	**Total Project**
$19,350	$2,907	$3,605	$10,786	$31,135	$31,387	$0	$0	$0	$143,980	$204,633	$193,567

NOTE: Case B values do not include the estimated $2.0M for land purchase for additional clay borrow source.

Case C

Case C consisted of completing the Aux Pond 900' project as designed and modifies the Main Pond Starter Dike to include a composite liner system. With the addition of 24" of clay the Main Pond could comply with Subtitle "D"; however, the Main Pond would not comply with Subtitle "C" and does not comply with the EPA intent to eliminate ponds for storage. Case C was eliminated because (1) it is not possible to source clay and rock from the existing station property in the quantities required; (2) it is not economically feasible to source clay from the surrounding area and the time required to locate and acquire a farm with sufficient quantities within the timeframe required is deemed marginal at best; and (3) to design and construct the composite liner will only allow compliance with subtitle "D" and not "C". Based on this no further consideration was given to Case C.

Schedule Impacts

If the decision is made to convert the Main Pond into a Landfill there are several items that will impact the schedule. They include engineering/design, permitting, a new or updated ECR/CPCN filing, and initial landfill construction. Based on experience from previous projects the engineering/design will take approximately 3-4-months and will include development of the landfill drawings, specifications, stability analysis, groundwater monitoring plan, and permit application.

Permitting will take approximately 18-months and should only include the KY Division of Waste Management permit as the remaining permits were obtained during the original Main

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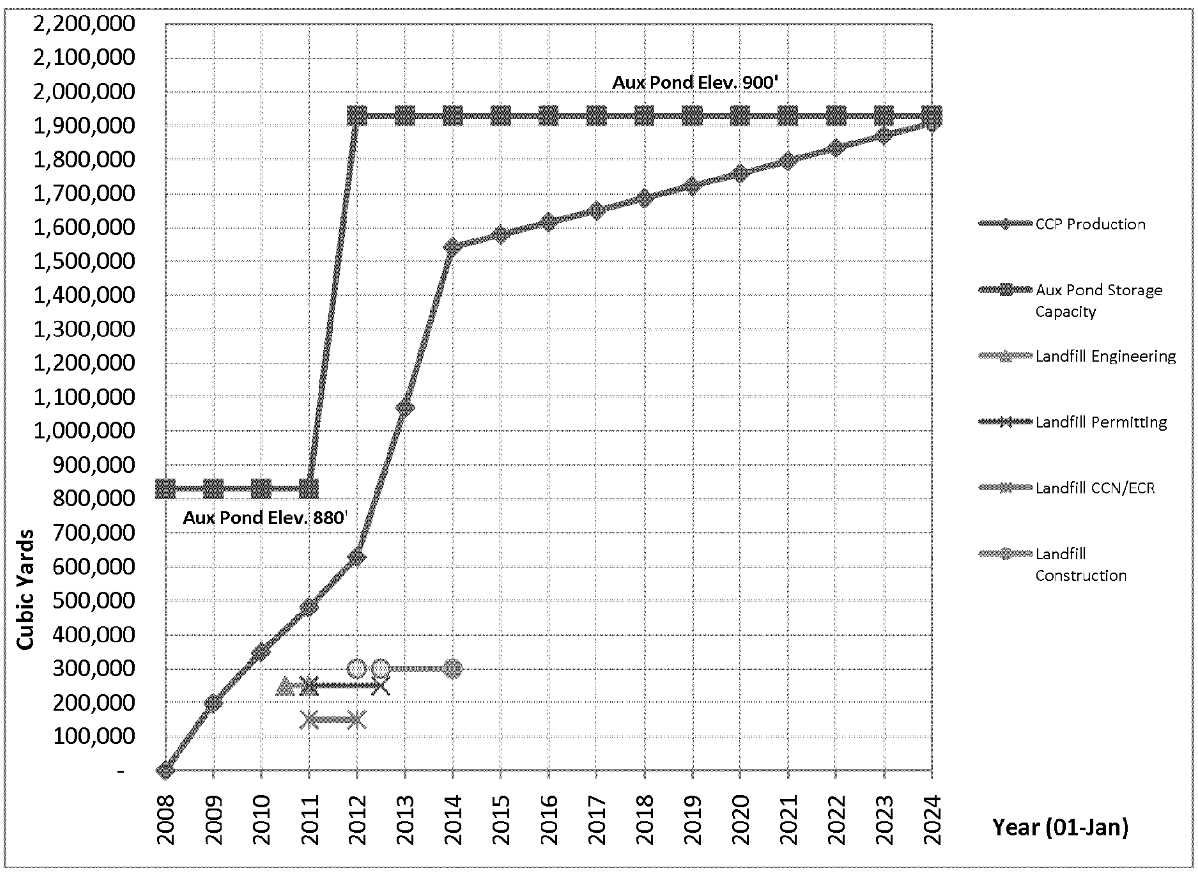
Pond project permitting. The updated or new ECR/CPCN filing will take approximately 6-months and would be submitted in parallel with the engineering/design and permitting process.

The initial landfill construction timeline will be dependent on the chosen option, but will take between 18-24 months to complete. Based on the above, PE performed an analysis to ensure the Aux Pond had enough storage capacity remaining to support the conversion of the Main Pond into a Landfill. Results of the storage analysis are provided below and indicate that the Aux Pond has enough capacity to support either Case A or Case B.

A summary of the schedule is shown below.

Project Timeline		
Task	**Date**	**Duration**
Informal Meeting w/the PSC	October 2010	1 Day
Engineering	September 2010	3-4 Months
File Permits	December 2010	18 Months
CPCN/ECR Filing	December 2010	6 Months
Construction	May 2012	18 Months

Aux Pond Stage Storage Graph (Case A) – Stop Main Pond Starter Dike & Accelerate Aux Pond 900' Construction



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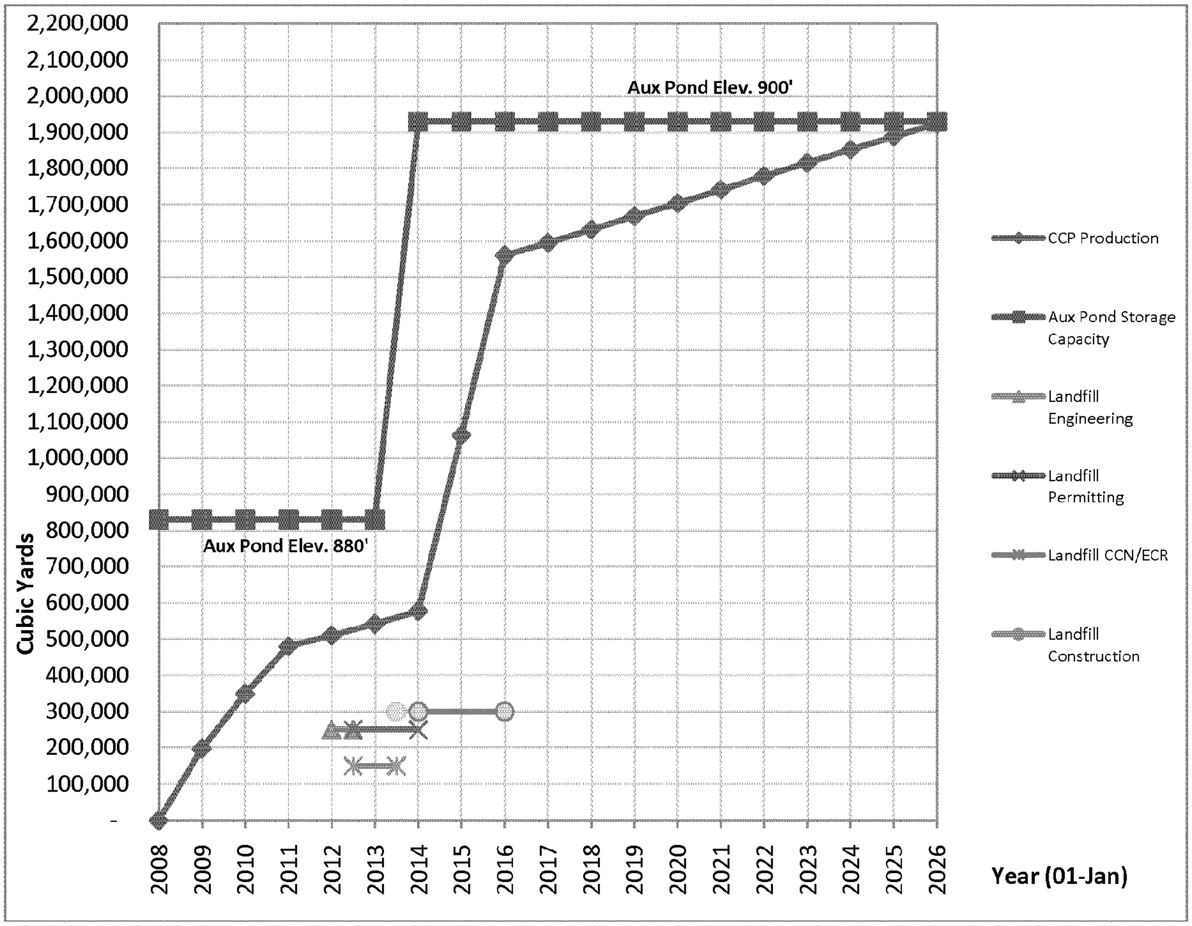
Aux Pond Stage Storage Graph (Case B) – Complete Main Pond Starter Dike & Aux Pond 900' per Original Schedule



Financials

Considering the factors referenced above, PE with the assistance of MACTEC, developed capital cost estimates for Case A and B which were based on a horizontal expansion of the landfill. Additional engineering is required to determine if a horizontal or vertical expansion approach is the best alternative. Timing of cash flows would be affected if a vertical expansion approach is chosen. The ECR approved cost estimate is the basis for the 2011 MTP/LTP and is provided for reference only. The Base Case is a modification of the ECR approved option which provides 7M yd^3 of storage and is no longer a viable long term solution for CCR storage as the current design of the Main Pond will not comply with the EPA's proposed CCR Ruling. *Case A or B are the only long term storage solutions.*

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Cost Estimate Comparison											
Option	**Life**	**Capacity**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**NPV**	**PVRR**	**Total Project**
ECR Approved	2054	15.5M yd^3	$25,233	$10,220	$8,777	$4,865	$5,463	$6,945	$143,394	$158,684	$200,132
Base Case	2030	7M yd^3	$19,300	$6,700	$4,153	$6,365	$3,424	$8,951	$103,720	$127,799	$121,687
Case A	2030	7M yd^3	$9,051	$14,262	$26,722	$24,064	$0	$0	$126,322	$181,791	$154,939
Case B	2030	7M yd^3	$19,350	$2,907	$3,605	$10,786	$31,135	$31,387	$143,980	$204,633	$193,567

NOTE: Case B values do not include the estimated $2.0M for land purchase for additional clay borrow source.

Recommendation

Project Engineering and the Brown Station recommend the immediate implementation of Case A to convert the Main Pond into a Landfill to meet the EPA's proposed CCP Ruling. This option has the lowest NPV & PVRR, is the least cost, maximizes the landfill footprint, maximizes future vertical expansion opportunities to accommodate changes in production, and eliminates the difficult and costly issues associated with maintaining station operations while dewatering and closing the pond post EPA CCR Ruling while the landfill is being constructed.

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EW Brown CCR Storage Evaluation

Continue Main Pond Project vs. Landfill Conversion

September 8, 2010

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Current Plan (Base Case – Modified ECR Approved Scope)

Scope

- Detailed engineering and permitting for all phases, completed 2006
- Relocation of transmission lines, completed 2007
- Ash handling upgrades, completed
- Construction of Aux Pond to elevation 880' (Phase I), completed June 2008

Schedule

- Aux Pond elevation 900' construction (Phase II of II), in progress
  - Will continue via original plan (completion mid-2013) or accelerated schedule to support CCR storage requirements to support landfill development.
- Construction of Main Pond Starter Dike, elevation 902', 75-80% complete
  - Currently suspended pending direction of path forward (Landfill or Pond)
- Accelerate construction of the Aux and Main Ponds based on working one shift, 7 days a week, at 4,000 yd^3 per day using rock and gypsum. Very aggressive schedule
  - Aux Pond constructed to final elevation of 900'
  - Main Pond constructed to an elevation of approximately 912'

Financials

- Phase I: $53.3M of approved $73.1M spent through June 2010
- Phase II: $24.9M approved

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Proposed CCR Rulings: Impact to Current Plan

Subtitle "C" (Hazardous)

- Aux Pond and Main Pond – as currently designed, they are not compliant due to lack of composite liner and may not meet siting requirements relative to Karst terrain.

- Result: Will required the closing of both ponds or retrofit with new liner design as grandfathering is not an option.

Subtitle "D" (Non-Hazardous)

- Aux Pond – compliance unlikely due to current 18" clay liner vs. required 24".
- Main Pond – as currently designed, not compliant due to lack of composite liner and may not meet siting requirements relative to Karst terrain.

- Result: Will require the closing of both ponds or retrofit with new liner system.

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Proposed CCR Rulings: Impact to Current Plan

Subtitle "D" Prime (Non-Hazardous)

- The Aux and Main Pond elevations at effective date of ruling will be grandfathered in; thus allowing the ponds to be operated for their remaining life.
- Any future vertical/horizontal expansion subject to new regulations which will require re-permitting, siting assessment, composite liner, run-on/off controls, groundwater monitoring, corrective action plans, and closure/post-closure care plans.

- Result: Effective date likely to result in lack of fully constructed Main Pond, thus new regulations will require closing Main Pond down and constructing new designed pond or landfill.

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Base Case – 20 Year Storage Capacity

- Based on the current ECR approved plan adjusted to provide storage until 2030

- Phase I – ECR approved 2005
  - Design & permitting of the Aux and Main Ponds - Completed
  - Transmission Line Relocation - Completed
  - Ash handling upgrades - Completed
  - Aux Pond 880' construction - Completed
  - Main Pond starter dike (902') construction – Construction has been suspended

- Phase II – ECR approved 2009
  - Aux Pond 900' construction – Under Construction
  - Main Pond 912' construction

- Phase III – future ECR filing
  - Original ECR scope reduced to match current CCR production rates
  - Main Pond 928' construction versus original 962'

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Landfill – Case A (Convert Now Prior to Placing Main Pond In-service)

Main Pond Starter Dike

- Stop construction immediately.
- EPA's proposed ruling used as the basis of design.
- Convert Main Pond to a Landfill prior to effective date of CCR Ruling and prior to placing wet CCR in Main Pond.
  - Landfill liner requirements same among Subtitle "D" and "C"
  - Utilize material already purchased and/or stockpiled for the intended Main Pond Starter Dike
  - Minimize costs from stranded materials purchased or quarried (~$6.5M)
  - Landfill footprint approximately 100 acres within Main Pond footprint, this reduces final height of landfill while maximizing future vertical expansion opportunities up to 18M yd^3.

Aux Pond 900'

- Accelerated completion of project utilizing rock and gypsum.
- After Landfill is placed into operation, close per regulations and modify with new design for management of process water.

Anticipated duration of activities

- 3.5 years, in service date of January 2014

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Landfill – Case B (Convert Pond to Landfill Post Regulations)

Main Pond Starter Dike

- Continue construction per original design.
  - Material used for pond liner will not be available for landfill construction.
  - Will require new off-site quarry at an estimated cost of $2.0M (due to consuming existing quarry for Main and Aux Pond construction), as well significant purchase of new liner material.
  - Landfill footprint approximately 80 acres, 20 acres smaller than Case A due to Main Pond utilization consuming space; thus reducing future storage to 13.25M yd^3 due to reduced vertical expansion.
- Once anticipated ruling becomes effective:
  - Main Pond required to be taken out of service
  - New Landfill will be required
  - Operation plan needed to maintain Brown Station's operation while Main Pond is taken out of service, dewatered , and landfill constructed. This is anticipated to be a significant impact on the station, a detailed plan of how to accomplish this has not been developed, nor included in the financial comparison.

Aux Pond 900'

- Continue construction per original design
- After Landfill is placed into operation, close per regulations and modify with new design for management of process water.

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Schedule

Project Timeline		
Task	**Start Date**	**Duration**
Informal Meeting with PSC	October 2010	1 Day
Engineering	September 2010	3-4 Months
File Permits	December 2010	18 Months
CPCN/ECR Filing	December 2010	6 Months
Construction	May 2012	18 Months

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Financial Comparison

Cost Estimate Comparison

Option	Life	Capacity	NPV	PVRR	Total Project
ECR Approved	2054*	15.5M yd^3	$135,467k	N/A	$272,831
Base Case	2030	7.0M yd^3	$100,966k	$127,799	$118,718
Case A	2030	7.0M yd^3	$126,322k	$181,791	$154,939
Case B	2030	7.0M yd^3	$143,980k	$204,633	$193,567k

NOTES:
1. If regulations become final for Hazardous or Non-Hazardous, Base Case will not be viable as the new regulations will require the closing of the newly constructed Ponds.
2. For ECR Approved Case, the original life was 2030 based on 2005 production models. The 2009 production models have shifted generation away from Brown, thus life extended to 2054 if Main Pond developed to original design height.
3. The interim operational and capital cost associated with Case B are not included in the number above. Given Case B is not least-cost in comparison to Case A, the estimate was not performed.
4. $2.0M to purchase additional land to establish clay borrow for Case B only is not included in the above financial analysis.

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Recommendation

Immediate implementation of Case A (convert to Landfill prior to Main Pond In-service)

- Lower NPV & PVRR than Case B
- Lower escalated capital cost than Case B
- Maximizes landfill footprint and future storage capacities than Case B
- Maximizes future vertical expansion opportunities than Case B
- Eliminates difficult and costly issues associated with maintaining station operations while dewatering and closing the Main Pond post-EPA CCR Ruling while landfill is being constructed.

- This recommendation will require modifying the approved ECR project.
- This recommendation will require Landfill permitting.
- This recommendation will require PSC notification.

From:	Straight, Scott
To:	Straight, Scott; Thompson, Paul; Voyles, John; Bowling, Ralph; Hudson, Rusty; Hincker, Loren; Sinclair, David; Schetzel, Doug; Yussman, Eric; Jackson, Fred
CC:	Waterman, Bob; Imber, Philip; Lively, Noel; Saunders, Eileen; Gregory, Ronald; Heun, Jeff; Hance, Chuck; Clements, Joe; Cooper, David (Legal); Jones, Greg; Keeling, Chip; Hendricks, Claudia; Ray, Barry; O'brien, Dorothy (Dot); Bellar, Lonnie; Blake, Kent; Sturgeon, Allyson; Conroy, Robert; Cornett, Greg
Sent:	4/1/2011 3:55:59 PM
Subject:	RE: Project Engineering's ES Bi-Weekly Report - April 1, 2011
Attachments:	PE's Bi-Weekly Update of 4-1-11.docx

Scott Straight, P.E.
Director, Project Engineering
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Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
April 1, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent Elevators – Still in progress.
    - Brown FGD – Third party FGD Performance Testing on high sulfur coal was completed on 3/25/11. Mist Eliminator warranty work and BR3 I.D. fan expansion joint replacement work is being completed in the upcoming outage.
    - Brown Coal Pile Modification – Plant pushed high sulfur coal onto the expanded footprint.
    - Brown Elevators – Installation of the permanent cars is scheduled for May 2011.

- **TC2**
  - Safety – Bechtel had a recordable from a hand injury.
  - Schedule/Execution:
    - Bechtel EPC – Bechtel has not responded to our rejection notice. Bechtel continues work on the punchlist and April outage planning. The major outage activities are replacement of the AH baskets, installation of a baffle in the economizer to eliminate the vibration and completion of the furnace tube wall coating.
  - Contract Disputes/Resolution:
    - Bechtel LD's – Owner's response to Bechtel's LD position letter was sent to Bechtel on 4/1/11 showing a balance owed of ~$11m.
    - Bechtel Labor Claim – PE sent a letter requesting Bechtel resubmit a change order for remaining labor claim that terminates at Mechanical Completion of July 2010 instead of through October 2010 when the MC Certificate was issued. Bechtel has responded with a letter reaffirming their position.
    - Planning to meet with Brightman around April 15th to try to move the LD, Labor Claim, Mechanical Completion and Combustion System Completion disputes closer to settlement.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification.
    - Completion of punchlist.

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – Proceeding as planned.
  - Schedule/Execution –Proceeding to plan. Agreed on weld detail modification of the SCR vessel with BPEI and Zachry.
  - Issues/Risk – NTR

- **Ohio Falls Rehabilitation**
  - Safety – NTR
  - Engineering

        - Orientation meeting held 3/31/11 with underwater repair contractor.
        - Award made on head gate modifications.
        - Award pending on tail gate modifications.
        - SOW for station auxiliary upgrade review held with plant, ready to submit to Commercial this week.
        - SOW for concrete façade repairs, component of Historic Preservation Maintenance Plan, moved from engineering to procurement.
        - SOW for parking and lay-down expansion completed, as well as the pre-bid held with contractors.
        - Meeting held with Corp of Engineers to discuss some of the site work that might about their property.
        - Dewatering pumps purchased in 2008 are being overhauled to repair seals damaged during long storage.
        - Readiness Review meeting with Voith moved to 05/01/11.
        - Plant requesting new office building.
        - Assisted Plant with turbine room OH crane test weight location.

- **Mill Creek Limestone Project**
    - Safety - NTR
    - Schedule/Execution
        - Detailed Engineering - HDR is working with PE and the plant to develop specifications in support of bidding the General Contracting portion of the project.
        - The Limestone Conveyor Bid was issued on 03/15/11. Pre-bid meeting was held at the site on 03/22/11.
        - HDR has issued the draft General Contracting specification to PE and the plant. Reviews are ongoing and the specification is scheduled to be issued to LG&E the first week of April 2011.

- **Cane Run CCP Project**
    - Permitting
        - All permitting proceeding well. 401 and Flood Plain permits received in 2010.
        - Working on NOD #2 response which includes a door to door well survey of residents within 1-mile of the facility. Draft copy of NOD #2 response is currently under review.
    - Engineering
        - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall is nearing completion.
        - Finalization of construction drawings and specifications for the 5-year landfill will be completed by the end of March.

- **Trimble Co. Barge Loading/Holcim**
    - Finalized order with UCC to purchase pneumatic Fly Ash handling system.
    - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
    - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design.

- **TC CCP Project – BAP/GSP**
  - Safety – NTR
  - Schedule/Execution:
    - Setting of the GSP Raft in progress.
    - All fill and mechanically stabilized earth wall work on the BAP is completed except for a small section of the South Dike.
    - Work continues on erection of the new Pipe Rack, electrical duct banks to GSP Electrical Building and to Ash Pond Raft.
    - Work is now being concentrated on raising the South Dike due to the high water level inside of the BAP.
  - Contract Disputes/Resolution
    - NTR
  - Issues/Risk
    - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill
  - Engineering
    - Detailed Engineering in progress with GAI.
  - Permitting:
    - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
    - The DWM Permit is currently being reviewed with submittal planned for late April 2011. A Private Water Well and Spring Survey continues by GAI Consultants for all residents within one-mile radius of the footprint of the landfill. This is required for the DWM permit.
    - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC on Thursday 03/03/11. Additional permit information is being completed by GAI.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Issued RFQ for Civil/Mechanical Construction.
    - Bid for the new Security Fence around the Landfill Area have been received.
    - Major equipment packages for the Transport will be issued in March and April.
    - Reviewing Gypsum Dewatering, Fly Ash system, and Bottom Ash SFC's draft specifications.
  - Permitting:
    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – Negotiations nearing completion with Deaton family in regards to pricing and terms of sale. The parties are close to a final settlement after resolution of terms and conditions of the sale. Work continues, however, on condemnation proceedings with the preparation of the drawings to delineate the actual "takings."

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Continue to work with Summit on contract settlement payout.
  - Engineering – Detailed Engineering by MACTEC continues.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Continued to place Type IIa-24 shot rock from the Starter Dike and Houp Property into the East embankment.
    - Gypsum was placed in the South embankment. Gypsum placed and compacted is migrating through the filter fabric. A path forward is under development.
    - Continue to provide BR Landfill design information to MACTEC.
    - Continuing development of RFQ for conceptual design engineering of Wet-to-Dry Ash Handling conversion as part of the BR Landfill project.
  - Issues/Risk:
    - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
    - <u>Final settlement reached with Summit on all outstanding claims by Summit.</u>

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
  - Safety – NTR
  - Schedule/Execution:
    - Bids meets for milling at Ghent held with Nol-Tec, BCSI/Nalco, and UCC.
    - Submitted clarification and BAFO request to each bidder with due date 04/08/11.
    - Permanent operation with mills at Ghent may be possible end of 2011.
  - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal complete. Reports pending.
  - Prepared sole source authorization to purchase a new SAM CEMS at Ghent.

- **Cane Run CCGT**
  - Budget – NTR
  - Gas Pipe Line Routing:

  EN Engineering is evaluated the preferred vendor for route survey, engineering, and environmental assessment. Working to release a contract.
  - Owner's Engineer:
    - Generated a draft EPC package for the LS Power Blue Grass conversion to combined cycle.
    - Updated the site layout, emissions analysis, and other documents for Air Permitting and Environmental Assessment work.
    - Updated the emissions
  - Air Permitting:
    - Trinity continuing netting analysis. Meeting set for week of April 4.
  - Environmental Assessment:
    - Submitted documents to MacTec for review. Meeting set for week of April 4.

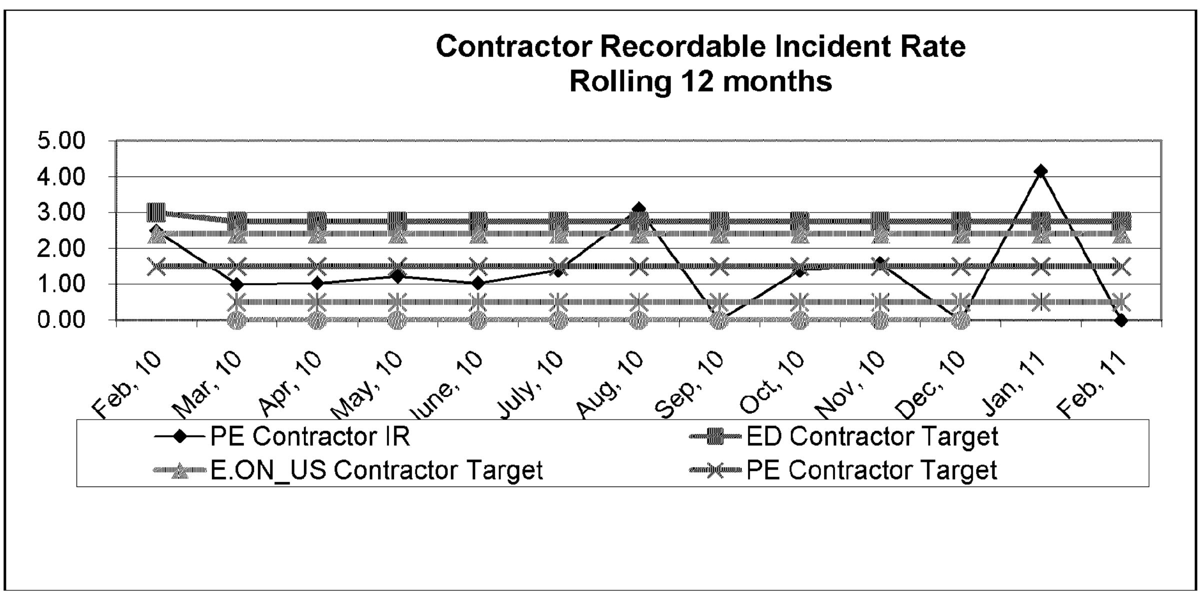
- **Other Generation Development**
  - Biomass – NTR
  - CCS 100 MW Project –

- 3H notified as chosen technology
- Engineering details based on a 50 MW CCS at EW Brown progressing

- FutureGen – NTR

- **General**
  - Environmental Scenario Planning:
    - All stations (MC, Ghent and Brown) are under review. A meeting was held at the site with PE and Plant Management as well as B&V to review FGD options for Units 1-2 and to examine overall site arrangements for the other units. A trip to B&V's offices has been planned to review the Mill Creek Report.
    - Fabric Filter vendor meetings held on 3/31/11 at LGE Building with attendance from Ghent, Mill Creek, Brown and EA.
    - ECR filing scope being modified to include new combined WFGD on Mill Creek 1 & 2 instead of significant upgrades to existing WFGDs.
    - Various meetings continue to be held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
    - BPEI flow modeling of MC4 planned in Germany in May.
    - The short review of existing ESPs by B&W reveal improvements can be made to existing ESPs; however, to meet proposed MACT standards, FF still required.
    - All SCRs taken out of the plan for ECR filing.
  - Continue to work with Legal and EA on Ghent SAM compliance. Prepared technical and economic assessment for meeting 5ppm SAM at each Ghent Unit. Draft term sheet/proposal in circulation for submittal to DOJ/EPA week of April 7.
  - Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics:



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAR11	APR11	MAY11	JUN11	JUL11	Aug11	Sep11	Oct11	Nov11	Dec11	Jan12	Feb12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C		May												
Heun	GH CCR - Gypsum Dewatering Belts	C		May												
Heun	GH CCR - Dry Fly Ash System	C		May												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		May												
Heun	GH CCR - Pipe Conveyor	C		May												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P		Pending												
Imber	BR 3 SAM Mitigation	C	8,000	May												
Imber	GH 1 -4 SAM Mitigation	P	8,000	Mar												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	MC Limestone Mill Construction Contract	C	12,000	Jun												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	41,117	Pending												
Saunders	Environmental Air Compliance - BR 2 SCR	P	104,971	Pending												
Saunders	Environmental Air Compliance - GH 2 SCR	P	262,878	Pending												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	97,229	Pending												
Saunders	Environmental Air Compliance - MC 2 FGD Upgrade	P	47,659	Pending												
Saunders	Environmental Air Compliance - MC 2 Electrostatic Precip	P	37,690	Pending												
Saunders	Environmental Air Compliance - MC4 FGD	P	271,994	Pending												
Saunders	Environmental Air Compliance - MC4 SCR	P	5,696	Pending												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	159,453	Pending												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jun												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Jun												
Williams	BR CCR - Ash Handling Dry Conversion	C		Jun												

- **Staffing**
  - Headcount planning is in process to evaluate staffing needs to manage the 2011MTP projects. Final draft will not be finalized until scope settles out for ECR filing.
  - Posting for Electrical Engineer to replace Jason Finn resulted in only one internal bid.
  - PE Re-Organization is now in the transition phase.
  - Requisition for Contract Administrator signed by RSS and JV on 3/31/11 and delivered to HR same day. This position is critical to fill given the significant commercial activities in PE for 2011, 2012 and 2013.
  - Posting for Business Analyst delayed by HR as Comp assigns pay range.

From:	Saunders, Eileen
To:	Straight, Scott; Kirkland, Mike; Buckner, Mike; Didelot, Joe; Bennett, Mike; Betz, Alex
CC:	Moehrke, William; Craigmyle, Kenny
Sent:	4/14/2011 1:32:31 PM
Subject:	FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll
Attachments:	Mill Creek U1-U2 Plan E 041111.pdf; Mill Creek U4 Plan C Paperdoll 041311.pdf

All,

Please see the attached sketch of the Mill Creek proposed plan C and the sketch for Mill Creek Units 1&2 Combined layout. Let me know if you have any comments. For those of us traveling next week, I am sure we will discuss these layouts in more detail during our meeting with B&V.

Thanks,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Wednesday, April 13, 2011 9:02 PM
To: Saunders, Eileen
Cc: 168908 E.ON-AQC; Hillman, Timothy M.; Wehrly, M. R.; Crabtree, Jonathan D.; Fields, Ron L.; Hintz, Monty E.; Goodlet, Roger F.; Mahabaleshwarkar, Anand
Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,
As requested we have developed a draft paperdoll for the Unit 4C scenario based on comments received during Anand's site visit on March 30th. Please review and let us know if you have any comments. Also, if you need to provide costs for this scenario for the budgeting process, I would offer you utilize the apportioned cost information provided on 4/4/11 for Unit 4B (i.e., total project costs of $188,833,524, and other applicable costs).

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
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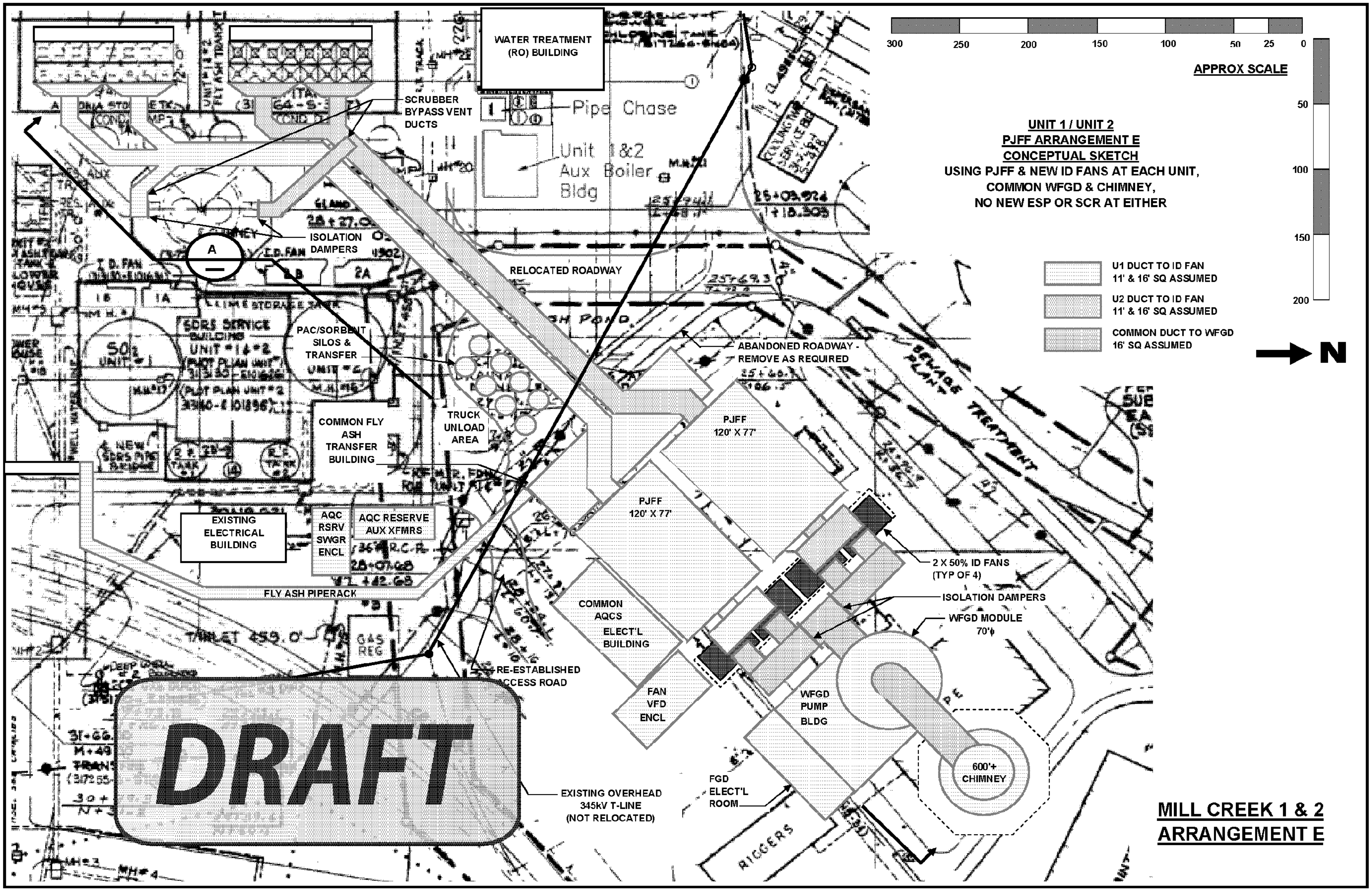
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ISOLATION DAMPERS
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FGD ELECT'L ROOM
WFGD PUMP BLDG
600'+ CHIMNEY
2 X 50% ID FANS (TYP OF 4)
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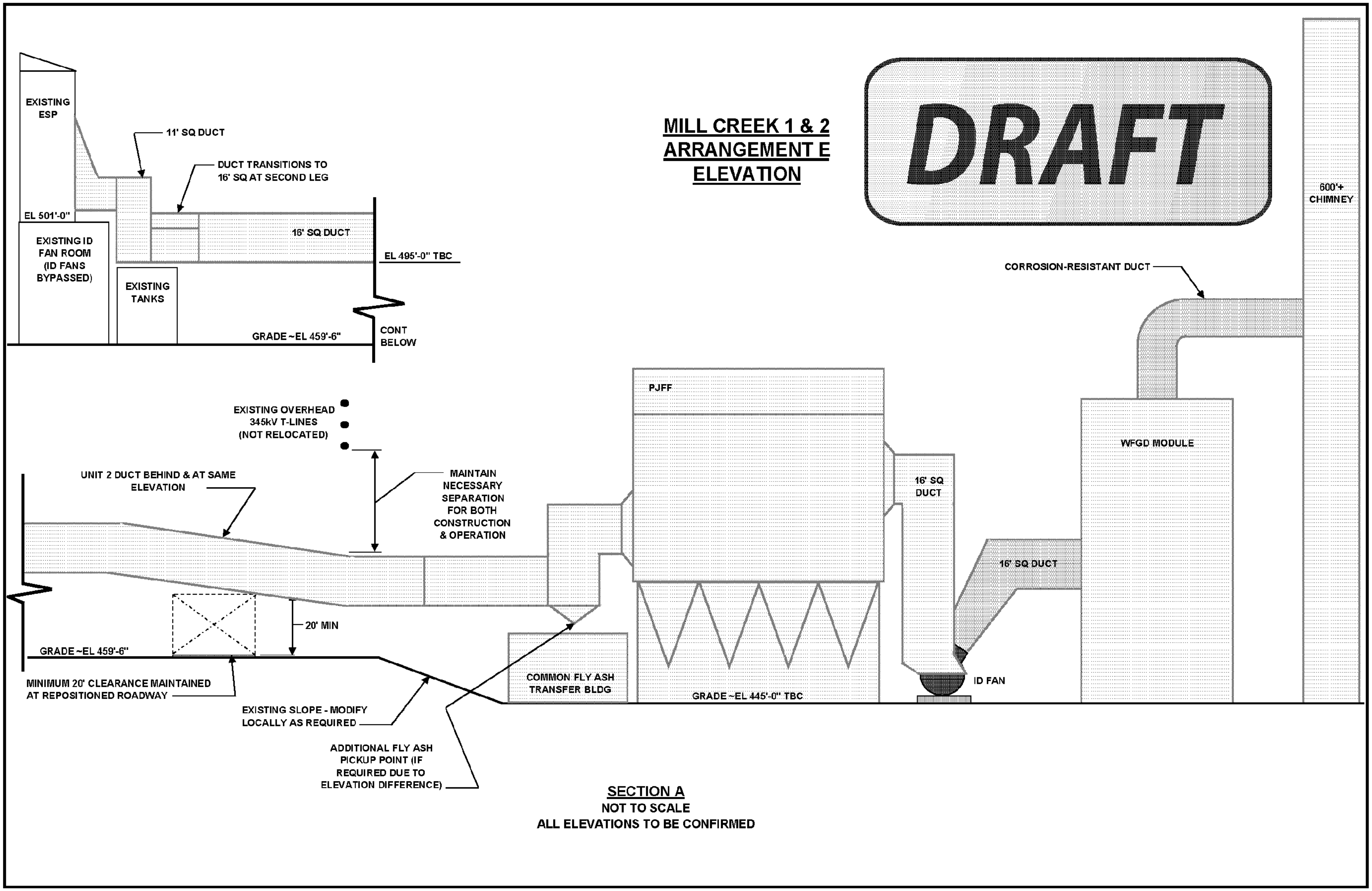
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EXISTING ESP
11' SQ DUCT
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GRADE ~EL 459'-6"
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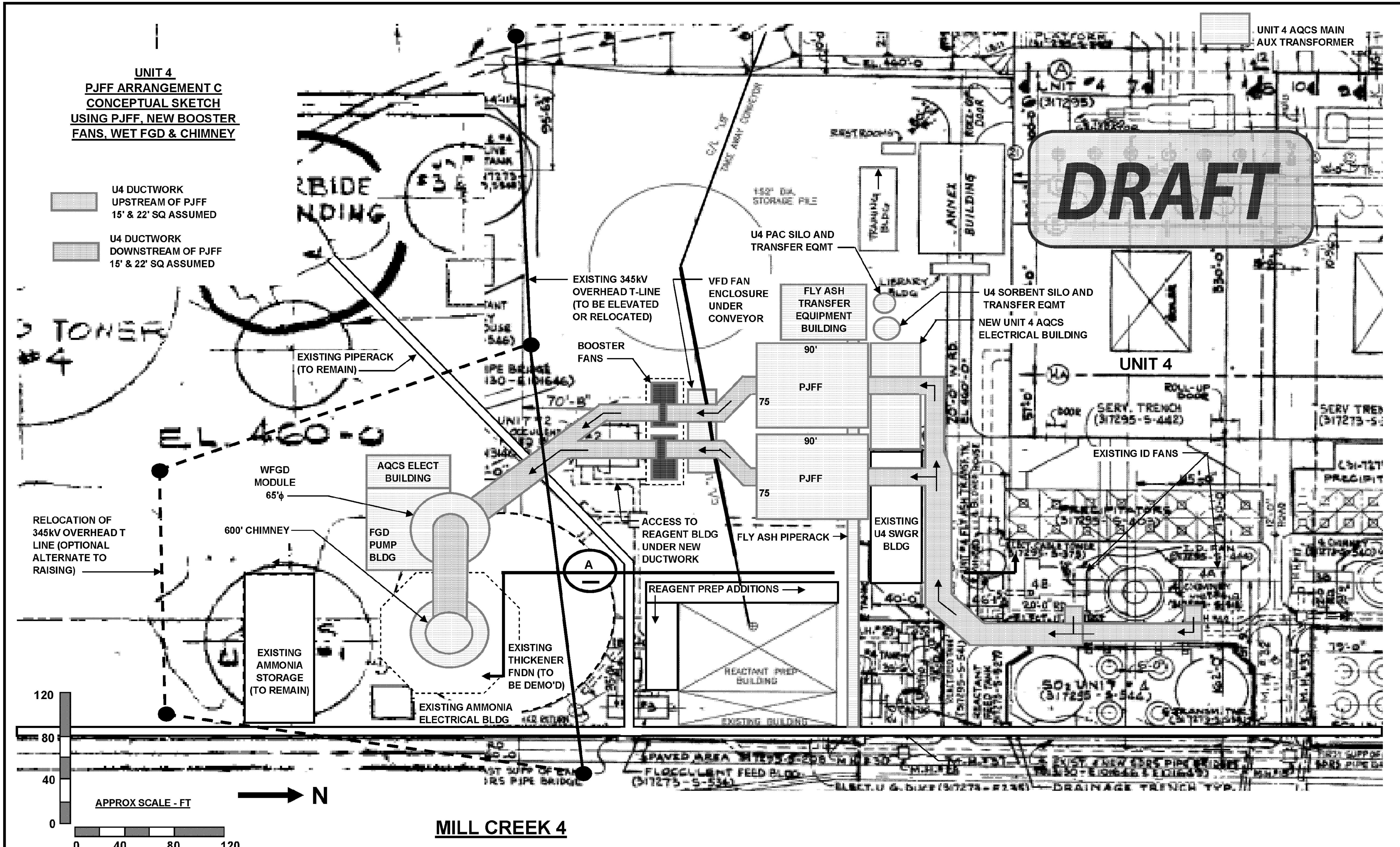
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U4 DUCTWORK DOWNSTREAM OF PJFF 15' & 22' SQ ASSUMED
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U4 PAC SILO AND TRANSFER EQMT
U4 SORBENT SILO AND TRANSFER EQMT
NEW UNIT 4 AQCS ELECTRICAL BUILDING
UNIT 4
EXISTING PIPERACK (TO REMAIN)
BOOSTER FANS
90'
PJFF
75
90'
PJFF
75
EXISTING ID FANS
AQCS ELECT BUILDING
WFGD MODULE 65'ϕ
FGD PUMP BLDG
600' CHIMNEY
RELOCATION OF 345kV OVERHEAD T LINE (OPTIONAL ALTERNATE TO RAISING)
ACCESS TO REAGENT BLDG UNDER NEW DUCTWORK
FLY ASH PIPERACK
EXISTING U4 SWGR BLDG
REAGENT PREP ADDITIONS
EXISTING THICKENER FNDN (TO BE DEMO'D)
EXISTING AMMONIA STORAGE (TO REMAIN)
EXISTING AMMONIA ELECTRICAL BLDG
A
120
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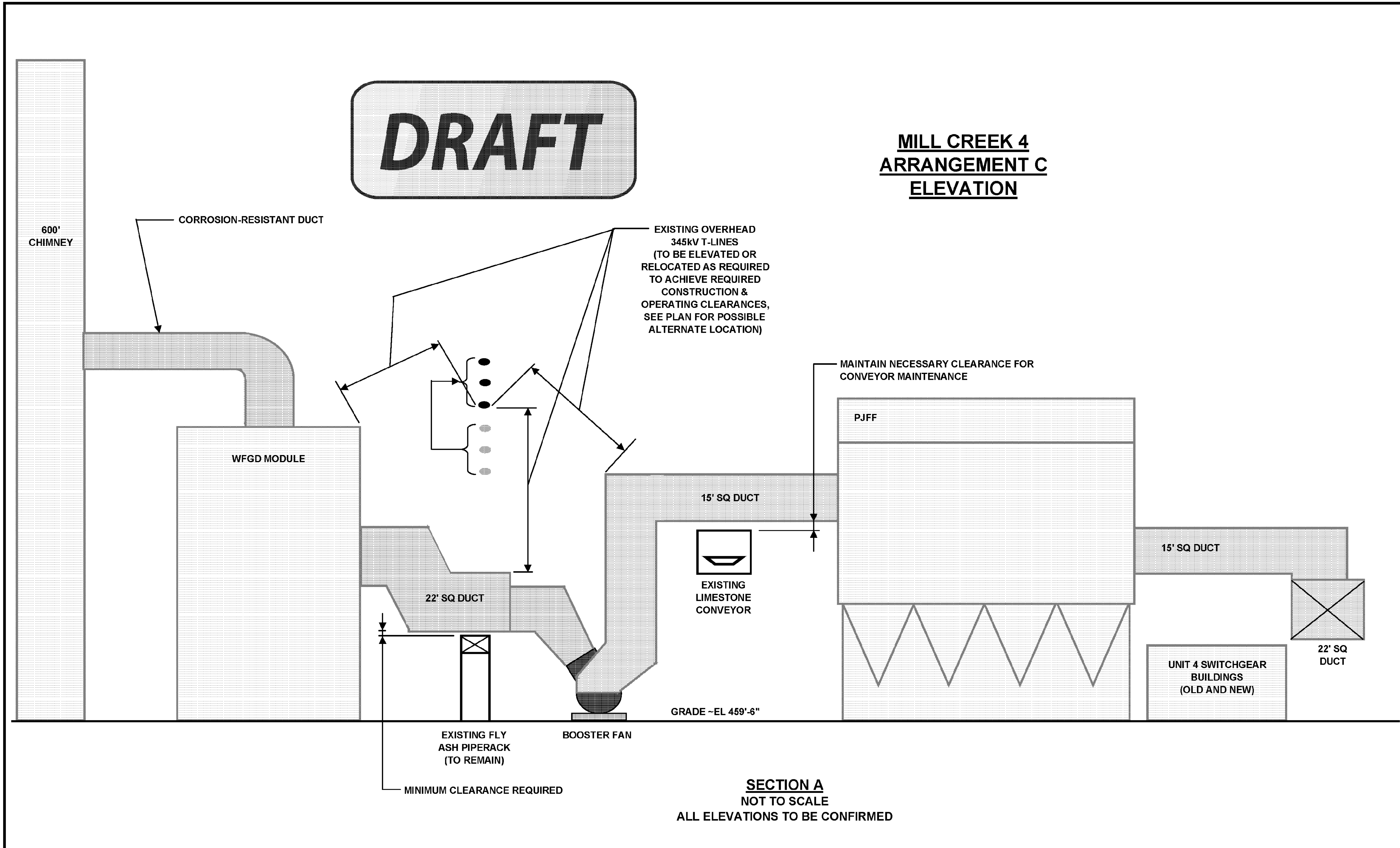
40
0
APPROX SCALE - FT
0
40
80
120
N
MILL CREEK 4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From:	Saunders, Eileen
To:	Schroeder, Andrea
CC:	Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/18/2011 9:36:40 AM
Subject:	FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll
Attachments:	Mill Creek U1-U2 Plan E 041111.pdf; Mill Creek U4 Plan C Paperdoll 041311.pdf

Andrea,

Please add these two proposed drawings to the list of diagrams for the ECR Filing. They are the latest arrangements for the Unit 4 FGD and the combined Units 1 and 2 FGDs.

Also, over the past few weeks, we have sent the following items to you and Gen Planning:

- Links to the Mill Creek Study (diagrams are included)
- Links to the Ghent Study (diagrams are included)
- Financial Data including O&M
- Scott's Contracting Summary
- Potential Asset Retirement to Property Accounting

Is there anything else related to the ***May 2, 2011*** public notification that Project Engineering needs to send at this point? I am traveling to work with Black and Veatch in Kansas City, MO tomorrow and will not be back in the office until Thursday. Please let me know if there is something else I need to send before I leave.

Thank you,

Eileen

From: Saunders, Eileen
Sent: Thursday, April 14, 2011 1:33 PM
To: Straight, Scott; Kirkland, Mike; Buckner, Mike; Didelot, Joe; Bennett, Mike; Betz, Alex
Cc: Moehrke, William; Craigmyle, Kenny
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Kyle

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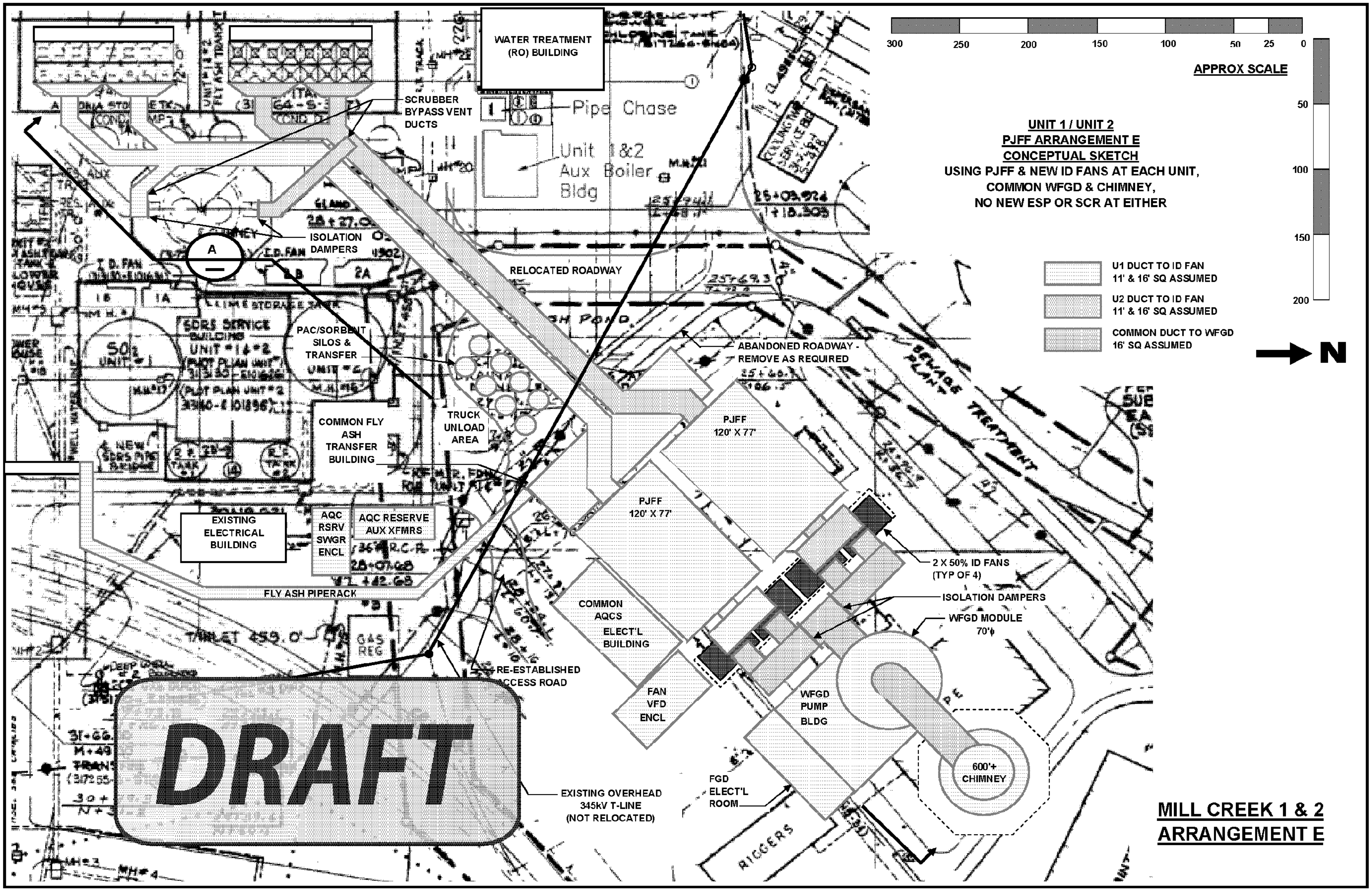
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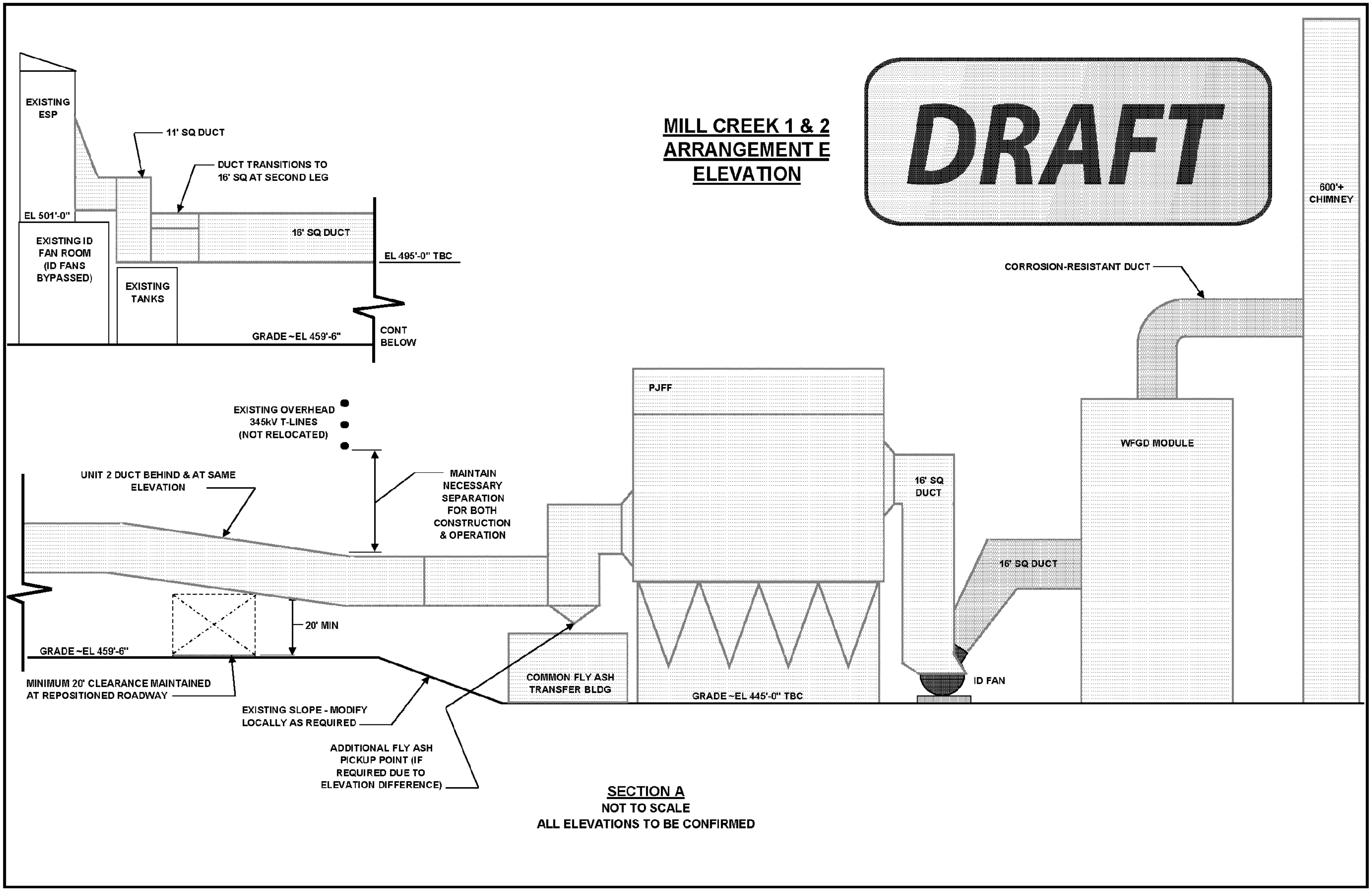
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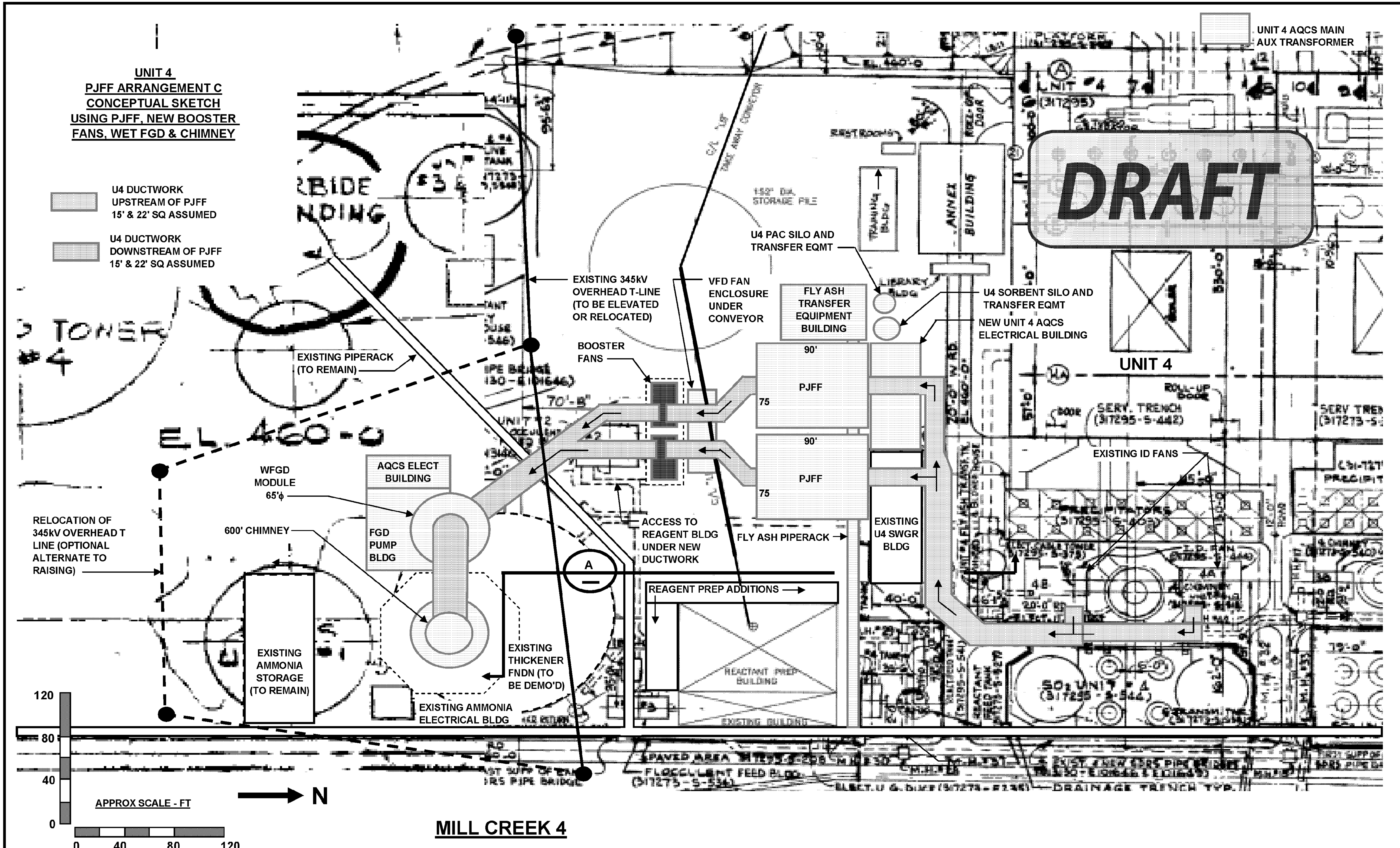
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120
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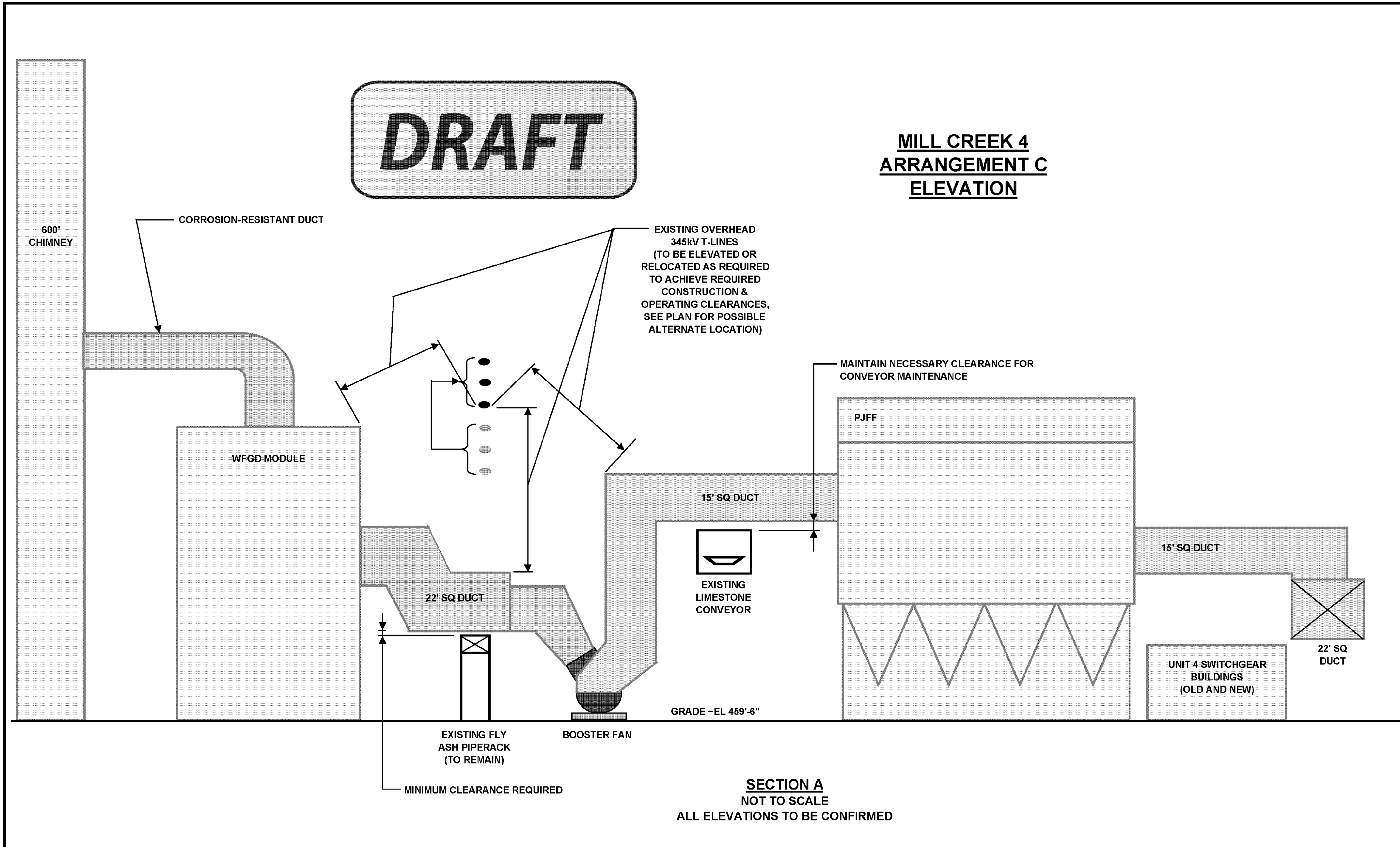
MILL CREEK 4



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From:	Hudson, Rusty
To:	Reed, Kathleen; Mooney, Mike (BOC 3)
CC:	Imber, Philip; Straight, Scott
Sent:	4/18/2011 9:38:41 AM
Subject:	Final Version of Ghent SAM Mitigation
Attachments:	PAI_GH SAM FINAL R2 (2).docx

Kathleen, the only change I made was to add a sentence in the executive summary that Ghent units 1, 3, and 4 utilize TRONA. I think it was implied in the paper but I could not find it actually stated. Rusty

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,500k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,500k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
April 2011	Contract Award
April - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.
6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:

1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	**GH1**	**GH3**	**GH4**	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$408	$223	$173	$804
Contingency (10%)	$78	$78	$90	$245
Total	$1,263	$1,078	$1,159	$3,500

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $804k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.5M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		**2011**	**2012**	**2013**	**Post 2013**	**Total**
Unit 1	#130905	$1,263				$1,263
Unit 3	#130907	$1,078				$1,078
Unit 4	#130909	$1,159				$1,159
Total		$3,500	$0	$0	$0	$3,500

EBIT		2011	2012	2013	Post 2013	Total
Unit 1	#130905	$89	$133	$127	$1,788	$2,138
Unit 3	#130907	$67	$114	$109	$1,526	$1,816
Unit 4	#130909	$79	$122	$117	$1,641	$1,960
Total		$236	$369	$353	$4,956	$5,913
ROCE		**2011**	**2012**	**2013**	**Post 2013**	**Average (39 Yr.)**
Unit 1	#130905	9.82%	10.84%	10.63%	8.54%	8.80%
Unit 3	#130907	10.26%	10.84%	10.63%	8.54%	8.81%
Unit 4	#130909	9.91%	10.84%	10.63%	8.54%	8.81%
Average		10.00%	10.84%	10.63%	8.54%	8.81%

Financial Detail by Year ($000s)	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	3,300				3,300
2. Cost of Removal Proposed	200				200
3. Total Capital and Removal Proposed (1+2)	3,500	-	-	-	3,500
4. Capital Investment 2011 MTP	16,050				16,050
5. Cost of Removal 2011 MTP					-
6. Total Capital and Removal 2011 MTP (4+5)	16,050	-	-	-	16,050
7. Capital Investment variance to MTP (4-1)	12,750	-	-	-	12,750
8. Cost of Removal variance to MTP (5-2)	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	12,550	-	-	-	12,550
10. Project O&M Proposed					-
11. Total Project Proposed (3+10)	3,500	-	-	-	3,500
12. EBIT *	$236	$369	$353	$4,956	$5,913
13. ROCE *	10.00%	10.84%	10.63%	8.54%	

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,263	$1,078	$1,159	$3,500
NPVRR	$1,543	$1,309	$1,415	$4,267
NPV	$7	$6	$6	$19
IRR	7%	7%	7%	7%
Discount Rate	6.9%	6.9%	6.9%	6.9%
ROCE (39yr.)	8.80%	8.81%	8.81%	8.81%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**			**Change in NPVRR**	**Change in NPV**
		2011	**2012**	**2013**		
Project Costs (capital +/-10%)						
Unit 1	#130905	$9	$13	$13	$154	$1
Unit 3	#130907	$7	$11	$11	$131	$1
Unit 4	#130909	$8	$12	$12	$141	$1
Totals	All Units	$24	$37	$35	$427	$2
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

  1. Lower capital cost (particularly with respect to the existing systems).
  2. Better contractual terms and conditions.
  3. Higher confidence in project execution.
  4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
  5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
  6. LG&E and KU have existing dry sorbent injection operating experience.
  7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,500k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F
1	**Financial Detail by Year ($000s)**	**2011**	**2012**	**2013**	**Post**	**Total**
2					**2013**	
3	1. Capital Investment Proposed	3,300				3,300
4	2. Cost of Removal Proposed	200				200
5	3. Total Capital and Removal Proposed (1+2)	3,500	-	-	-	3,500
6	4. Capital Investment 2011 MTP	16,050				16,050
7	5. Cost of Removal 2011 MTP					-
8	6. Total Capital and Removal 2011 MTP (4+5)	16,050	-	-	-	16,050
9	7. Capital Investment variance to MTP (4-1)	12,750	-	-	-	12,750
10	8. Cost of Removal variance to MTP (5-2)	(200)	-	-	-	(200)
11	9. Total Capital and Removal variance to MTP (6-3)	12,550	-	-	-	12,550
12	10. Project O&M Proposed					-
13	11. Total Project Proposed (3+10)	3,500	-	-	-	3,500
14						
15	12. EBIT *	$236	$369	$353	$4,956	$5,913
16	13. ROCE *	10.00%	10.84%	10.63%	8.54%	

From: Schroeder, Andrea
To: Saunders, Eileen
CC: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy; Conroy, Robert
Sent: 4/18/2011 9:47:18 AM
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,

Just a couple of follow-up items.

- Have you received the review of existing Precipitator facilities report? If so, please provide it.
- There are $1.26M in removal costs at Ghent. Have you been able to determine if there are retirements associated with those removal dollars?

Other than the annual incremental O&M that David and others are working through, that should be everything needed from Project Engineering.

Thanks,
Andrea
X3651

From: Saunders, Eileen
Sent: Monday, April 18, 2011 9:37 AM
To: Schroeder, Andrea
Cc: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Andrea,

Please add these two proposed drawings to the list of diagrams for the ECR Filing. They are the latest arrangements for the Unit 4 FGD and the combined Units 1 and 2 FGDs.

Also, over the past few weeks, we have sent the following items to you and Gen Planning:

- Links to the Mill Creek Study (diagrams are included)
- Links to the Ghent Study (diagrams are included)
- Financial Data including O&M
- Scott's Contracting Summary
- Potential Asset Retirement to Property Accounting

Is there anything else related to the ***May 2, 2011*** public notification that Project Engineering needs to send at this point? I am traveling to work with Black and Veatch in Kansas City, MO tomorrow and will not be back in the office until Thursday. Please let me know if there is something else I need to send before I leave.

Thank you,

Eileen

From: Saunders, Eileen
Sent: Thursday, April 14, 2011 1:33 PM
To: Straight, Scott; Kirkland, Mike; Buckner, Mike; Didelot, Joe; Bennett, Mike; Betz, Alex

Cc: Moehrke, William; Craigmyle, Kenny
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

All,

Please see the attached sketch of the Mill Creek proposed plan C and the sketch for Mill Creek Units 1&2 Combined layout. Let me know if you have any comments. For those of us traveling next week, I am sure we will discuss these layouts in more detail during our meeting with B&V.

Thanks,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Wednesday, April 13, 2011 9:02 PM
To: Saunders, Eileen
Cc: 168908 E.ON-AQC; Hillman, Timothy M.; Wehrly, M. R.; Crabtree, Jonathan D.; Fields, Ron L.; Hintz, Monty E.; Goodlet, Roger F.; Mahabaleshwarkar, Anand
Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,
As requested we have developed a draft paperdoll for the Unit 4C scenario based on comments received during Anand's site visit on March 30th. Please review and let us know if you have any comments. Also, if you need to provide costs for this scenario for the budgeting process, I would offer you utilize the apportioned cost information provided on 4/4/11 for Unit 4B (i.e., total project costs of $188,833,524, and other applicable costs).

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
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+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
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From: Straight, Scott
To: Saunders, Eileen; Schroeder, Andrea; Conroy, Robert
CC: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent: 4/18/2011 10:02:55 AM
Subject: Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

We have never included drawings in the filing that I can remember. Has this changed?

From: Saunders, Eileen
Sent: Monday, April 18, 2011 09:36 AM
To: Schroeder, Andrea
Cc: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
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Regards,
Kyle

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+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
Building a World of Difference.®

From:	Straight, Scott
To:	Schroeder, Andrea; Saunders, Eileen; Conroy, Robert
CC:	Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/18/2011 10:05:39 AM
Subject:	Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Did we do that on the SCR or FGD filings? I don't remember doing so.

From: Schroeder, Andrea
Sent: Monday, April 18, 2011 10:04 AM
To: Straight, Scott; Saunders, Eileen; Conroy, Robert
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

For the CPCN requirement, we have to provide a drawing of the site that shows the footprint of the new facilities.

From: Straight, Scott
Sent: Monday, April 18, 2011 10:03 AM
To: Saunders, Eileen; Schroeder, Andrea; Conroy, Robert
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
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+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
Building a World of Difference.®

From:	Straight, Scott
To:	Conroy, Robert; Schroeder, Andrea; Saunders, Eileen
CC:	Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/18/2011 10:08:20 AM
Subject:	Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Robert

Maybe a diagram, but including the entire reports is something we need to discuss. Maybe a meeting to discuss filing info instead of emails would be good. I'm put of town until Wed on business. W morning us fairly wide open.

Scott

From: Conroy, Robert
Sent: Monday, April 18, 2011 10:05 AM
To: Schroeder, Andrea; Straight, Scott; Saunders, Eileen
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Scott,

There have been no changes to what has been provided. We have always provided diagrams when a CPCN is required.

Robert M. Conroy
Director, Rates
LG&E and KU Services Company
(502) 627-3324 (phone)
(502) 627-3213 (fax)
(502) 741-4322 (mobile)
robert.conroy@lge-ku.com

From: Schroeder, Andrea
Sent: Monday, April 18, 2011 10:04 AM
To: Straight, Scott; Saunders, Eileen; Conroy, Robert
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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From: Straight, Scott
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Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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To: Schroeder, Andrea
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Cc: Moehrke, William; Craigmyle, Kenny
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy

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LucasKJ@BV.com
Building a World of Difference.®

From:	Saunders, Eileen
To:	Schroeder, Andrea
CC:	Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy; Conroy, Robert
Sent:	4/18/2011 11:13:15 AM
Subject:	RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll
Attachments:	DESP Study Summary Page with Tables (4-18-11).docx

Andrea,

I have attached the Dry ESP study. According to the B&V report for Ghent, here the cost assumed in the report for demolition:

- Unit 1 - Nothing
- Unit 2 - By-Pass Ductwork
- Unit 3 – Maintenance Shop and Axial ID Fan Removal
- Unit 4 – Warehouse and Axial ID Fan removal

Thanks,

Eileen

From: Schroeder, Andrea
Sent: Monday, April 18, 2011 9:47 AM
To: Saunders, Eileen
Cc: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy; Conroy, Robert
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,

Just a couple of follow-up items.

- Have you received the review of existing Precipitator facilities report? If so, please provide it.

- There are $1.26M in removal costs at Ghent. Have you been able to determine if there are retirements associated with those removal dollars?

Other than the annual incremental O&M that David and others are working through, that should be everything needed from Project Engineering.

Thanks,
Andrea
X3651

From: Saunders, Eileen
Sent: Monday, April 18, 2011 9:37 AM
To: Schroeder, Andrea
Cc: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Andrea,

Please add these two proposed drawings to the list of diagrams for the ECR Filing. They are the latest arrangements for the Unit 4 FGD and the combined Units 1 and 2 FGDs.

Also, over the past few weeks, we have sent the following items to you and Gen Planning:

- Links to the Mill Creek Study (diagrams are included)
- Links to the Ghent Study (diagrams are included)
- Financial Data including O&M
- Scott's Contracting Summary
- Potential Asset Retirement to Property Accounting

Is there anything else related to the ***May 2, 2011*** public notification that Project Engineering needs to send at this point? I am traveling to work with Black and Veatch in Kansas City, MO tomorrow and will not be back in the office until Thursday. Please let me know if there is something else I need to send before I leave.

Thank you,

Eileen

From: Saunders, Eileen
Sent: Thursday, April 14, 2011 1:33 PM
To: Straight, Scott; Kirkland, Mike; Buckner, Mike; Didelot, Joe; Bennett, Mike; Betz, Alex
Cc: Moehrke, William; Craigmyle, Kenny
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

All,

Please see the attached sketch of the Mill Creek proposed plan C and the sketch for Mill Creek Units 1&2 Combined layout. Let me know if you have any comments. For those of us traveling next week, I am sure we will discuss these layouts in more detail during our meeting with B&V.

Thanks,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Wednesday, April 13, 2011 9:02 PM
To: Saunders, Eileen
Cc: 168908 E.ON-AQC; Hillman, Timothy M.; Wehrly, M. R.; Crabtree, Jonathan D.; Fields, Ron L.; Hintz, Monty E.; Goodlet, Roger F.; Mahabaleshwarkar, Anand
Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,
As requested we have developed a draft paperdoll for the Unit 4C scenario based on comments received during Anand's site visit on March 30th. Please review and let us know if you have any comments. Also, if you need to provide costs for this scenario for the budgeting process, I would offer you utilize the apportioned cost information provided on 4/4/11 for Unit 4B (i.e., total project costs of $188,833,524, and other applicable costs).

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
Black & Veatch Corporation | 11401 Lamar Avenue, Overland Park, KS 66211
+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
Building a World of Difference.®

LGE-KU FLEETWIDE ESP STUDY

BACKGROUND

To investigate the potential for electrostatic precipitator (ESP) upgrades, we asked Babcock & Wilcox (B&W) to support us with their expertise. Our instructions to B&W were that we would meet with a plant representative to discuss the ESP design and upgrades and to walk around the ESPs for expansion potential, and a week later they would provide order of magnitude estimates for ESP expansion or conversion to a Pulse Jet Fabric Filter conversion (FFC). B&W met with the Project Engineering Dept. (PE) and a plant representative at Ghent (Ghent) and Trimble County (TC) Stations on March 9, 2011, Mill Creek Station (MC) on March 10, 2011, and at the E.W. Brown Station (Brown) on March 11, 2011. From PE were Larry VanGansbeke, Lead Engineer, Joe Strickland, Lead Engineer, and Kyle Roshberg, Co-op employee. The plant representatives were, Carla Piening, Ghent Sr. Scientist, Dave Anderson, TC Outage Coordinator, Tiffany Koller, MC Maintenance Supervisor, and Brian Sumner, Brown Manager - Maintenance.

SUMMARY

From our investigation, it appears that merely upgrading the ESPs does very little towards the goal of reducing HAPS emissions from the stack discharge. Any improvement in particulate emissions from an ESP upgrade may only serve to reduce the particulate removal in the FGD. The Fabric Filter conversions on certain units may approach or achieve the new PM and HAPS targets. To ascertain the potential removal efficiency and the cost/benefit of the FFC versus a new Pulse Jet Fabric Filter, further study will be necessary.

The limitations of this investigation into the potential for ESP expansion or conversion are:

- The study took place over the course of two weeks.
- The stations do not have ESP inlet or outlet PM data. All emissions data is at the stack.
- ESP modifications can only improve particulate matter (PM) emissions and will provide insignificant removal of HAP emissions.
- Potential ESP improvements may not improve stack emissions as downstream FGD performs significant removal of particulate matter.
- The costs shown are order of magnitude and do not include costs external to the ESP, such as duct modifications, new fans, power distribution, owner costs, contingency, etc.
- Order of magnitude costs for ESP modifications have an accuracy for material of ±20% and installation of ±40%.
- Ghent Units 2, 3, and 4 are hot side ESPs and cannot benefit from FFC due to fabric temperature restrictions.

Benefits and risks of conversion to Fabric Filters:

- Some improvement in HAPS emissions.
- Sub-optimal design due to existing structure. Efficiency may be less than new PJFF.
- Condition of existing ESP structure unknown, up to 40 years in service.
- Any ESP converted to a fabric filter will preclude fly ash sales from that unit.
- An FFC will save site footprint over a new Pulse Jet Fabric Filter.
- The outage time required for a conversion is about 10-12 weeks.

LGE-KU FLEETWIDE ESP STUDY

LG&E/Kentucky Utilities - Potential ESP Upgrades						
Station	**Unit #**	**Scenario #1**	**Scenario #2**	**Scenario #3**	**Scenario #4**	**Remarks**
EW Brown	1	Add 9ft outlet field: Materials: \$1.2m Installation: \$2.1m				DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.
EW Brown	2	Add 9ft inlet field: Materials: \$1.3m Installation: \$2.5m	FF Conversion: Materials: \$3.7m Installation: \$5.4m			DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
EW Brown	3 OLD	ESP tuning				DESP tuning will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.
EW Brown	3 NEW	Sectionalize inlet field: Materials: \$350k Installation: \$550k	Add 9ft outlet field: Materials: \$2.6m Installation: \$5m	Add 6ft height: Materials: \$4.6m Installation: \$8m	FF Conversion: Materials: \$10.8m Installation: \$18m	DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
Ghent	1	New AVC's: Materials: \$100k Installation: \$150k	Convert to SMPS: Materials: \$1.1m Installation: \$600k	Add 12ft outlet field: Materials: \$4m Installation: \$7m		DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.
Ghent	2	New AVC's: Materials: \$130k Installation: \$150k	Convert to SMPS: Materials: \$1.8m Installation: \$1m	Add 6ft height: Materials: \$8.5m Installation: \$13m		DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.
Ghent	3	New AVC's: Materials: \$210k Installation: \$280k	Convert to SMPS: Materials: \$3.4m Installation: \$2.5m	Add 6ft height: Materials: \$12.4m Installation: \$20m		DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.
Ghent	4	New AVC's: Materials: \$210k Installation: \$280k	Convert to SMPS: Materials: \$3.4m Installation: \$2.5m	Add 6ft height: Materials: \$12.4m Installation: \$20m		DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions.

Station	Unit #	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Remarks
Mill Creek	1	Add 5ft height: Materials: $3.6m Installation: $8m	FF Conversion: Materials: $8m Installation: $12m (feasible?)			DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
Mill Creek	2	Add 5ft height: Materials: $3.6m Installation: $8m	FF Conversion: Materials: $8m Installation: $12m (feasible?)			DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
Mill Creek	3	Add 12ft outlet field: Materials: $3.3m Installation: $7m	FF Conversion: Materials: $11m Installation: $13m			DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
Mill Creek	4	Add 9ft outlet field: Materials: $4.2m Installation: $7m	Add 6ft height: Materials: $8.4m Installation: $14m	FF Conversion: Materials: $13m Installation: $15m		DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.
Trimble	1	Outlet field top rap conversion + purge air for all fields: Materials: $1.8m Installation: $3m	FF Conversion: Materials: $16m Installation: $19m			DESP mods will improve PM, but will not improve HCl, SO_2, Hg, CO or Dioxin emissions. FFC will improve PM, HCl, SO_2, Hg, CO and Dioxin emissions.

NOTES:

1. Sectionalize - Add conventional T/R sets to increase the number of electrical fields.
2. New AVC's - Replace the existing voltage controls with B&W SQ-300i AVC's. Reuse cabinets.
3. Convert to SMPS - Replace existing conventional T/R sets with high frequency power supplies (one for one swap). New controls and bus/guard.
4. Add Height - Remove existing roof beams and add height to ESP. Rebuild at 400mm spacing with rigid discharge electrodes and new T/R sets.
5. Add Field - Add an additional mechanical field to existing ESP. New field at 400mm spacing with rigid discharge electrodes and new T/R sets.
6. Add Field - Rebuild at 400mm spacing with rigid discharge electrodes and new T/R sets. Convert to roof mounted EGR rappers.
7. FF Conversion - Remove ESP internals and convert to a pulse jet fabric filter. All ESPs will need to increase in height. Only on cold sides.
8. Budget prices (above) are provided as order of magnitude values: Materials +/- 20%, Installation +/- 40%.
9. Budget prices do not include costs external to the DESP, such as ductwork modifications.
10. Budget prices do not include Owner costs.
11. This limited study did not assess power distribution issues.
12. Costs provided by B&W. Remarks are by LGE-KU PE Dept.

From:	Reed, Kathleen
To:	Imber, Philip; Straight, Scott
Sent:	4/18/2011 11:43:31 AM
Subject:	FW: PAI_GH SAM FINAL 4-18-11 (2).docx
Attachments:	PAI_GH SAM FINAL 4-18-11 (2).docx

Final version below.

Kathleen Reed
LG&E and KU Energy, LLC
kathleen.reed@lge-ku.com
502-627-2957

From: Reed, Kathleen
Sent: Monday, April 18, 2011 11:40 AM
To: Hudson, Rusty
Cc: Mooney, Mike (BOC 3)
Subject: PAI_GH SAM FINAL 4-18-11 (2).docx

Last sentence in last paragraph of Executive Summary changed. Numbers confirmed by Mike. Thank you.

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,500k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,500k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. At the present time, Ghent Unit 1 uses both TRONA and Hydrated Lime, while Units 3 and 4 use only TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
April 2011	Contract Award
April - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.

6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:

1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	**GH1**	**GH3**	**GH4**	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$408	$223	$173	$804
Contingency (10%)	$78	$78	$90	$245
Total	$1,263	$1,078	$1,159	$3,500

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $804k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.5M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		**2011**	**2012**	**2013**	**Post 2013**	**Total**
Unit 1	#130905	$1,263				$1,263
Unit 3	#130907	$1,078				$1,078
Unit 4	#130909	$1,159				$1,159
Total		$3,500	$0	$0	$0	$3,500

EBIT		2011	2012	2013	Post 2013	Total
Unit 1	#130905	$89	$133	$127	$1,789	$2,138
Unit 3	#130907	$67	$114	$109	$1,527	$1,817
Unit 4	#130909	$80	$122	$117	$1,642	$1,961
Total		$236	$369	$353	$4,958	$5,916

Financial Detail by Year ($000s)	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	3,300				3,300
2. Cost of Removal Proposed	200				200
3. Total Capital and Removal Proposed (1+2)	3,500	-	-	-	3,500
4. Capital Investment 2011 MTP	16,050				16,050
5. Cost of Removal 2011 MTP					-
6. Total Capital and Removal 2011 MTP (4+5)	16,050	-	-	-	16,050
7. Capital Investment variance to MTP (4-1)	12,750	-	-	-	12,750
8. Cost of Removal variance to MTP (5-2)	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	12,550	-	-	-	12,550
10. Project O&M Proposed					-
11. Total Project Proposed (3+10)	3,500	-	-	-	3,500
12. EBIT *	$236	$369	$353	$4,958	$5,916

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,263	$1,078	$1,159	$3,500
NPVRR	$1,574	$1,335	$1,443	$4,352
NPV	$29	$24	$26	$79
IRR	7%	7%	7%	7%
Discount Rate	6.68%	6.68%	6.68%	6.68%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**			**Change in NPVRR**	**Change in NPV**
		2011	**2012**	**2013**		
Project Costs (capital +/-10%)						
Unit 1	#130905	$9	$13	$13	$157	$3
Unit 3	#130907	$7	$11	$11	$134	$2
Unit 4	#130909	$8	$12	$12	$144	$3
Totals	All Units	$24	$37	$35	$435	$3
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

  1. Lower capital cost (particularly with respect to the existing systems).
  2. Better contractual terms and conditions.
  3. Higher confidence in project execution.
  4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
  5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
  6. LG&E and KU have existing dry sorbent injection operating experience.
  7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,500k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F
1	**Financial Detail by Year ($000s)**	**2011**	**2012**	**2013**	**Post**	**Total**
2					**2013**	
3	1. Capital Investment Proposed	3,300				3,300
4	2. Cost of Removal Proposed	200				200
5	3. Total Capital and Removal Proposed (1+2)	3,500	-	-	-	3,500
6	4. Capital Investment 2011 MTP	16,050				16,050
7	5. Cost of Removal 2011 MTP					-
8	6. Total Capital and Removal 2011 MTP (4+5)	16,050	-	-	-	16,050
9	7. Capital Investment variance to MTP (4-1)	12,750	-	-	-	12,750
10	8. Cost of Removal variance to MTP (5-2)	(200)	-	-	-	(200)
11	9. Total Capital and Removal variance to MTP (6-3)	12,550	-	-	-	12,550
12	10. Project O&M Proposed					-
13	11. Total Project Proposed (3+10)	3,500	-	-	-	3,500
14						
15	12. EBIT *	$236	$369	$353	$4,958	$5,916
16						

From: Straight, Scott
To: Sturgeon, Allyson
Sent: 4/20/2011 8:19:06 AM
Subject: Accepted: ECR Testimony Review-Voyles

From:	Straight, Scott
To:	Sturgeon, Allyson
CC:	Saunders, Eileen; Voyles, John
Sent:	4/20/2011 8:26:22 AM
Subject:	Declined: General Comments/Discussion on First Draft of ECR Applications and Testimony

I will be on vacation all week.

From:	Conroy, Robert
To:	Schroeder, Andrea; Straight, Scott; Saunders, Eileen
CC:	Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/18/2011 10:05:31 AM
Subject:	RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Scott,

There have been no changes to what has been provided. We have always provided diagrams when a CPCN is required.

Robert M. Conroy
Director, Rates
LG&E and KU Services Company
(502) 627-3324 (phone)
(502) 627-3213 (fax)
(502) 741-4322 (mobile)
robert.conroy@lge-ku.com

From: Schroeder, Andrea
Sent: Monday, April 18, 2011 10:04 AM
To: Straight, Scott; Saunders, Eileen; Conroy, Robert
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

For the CPCN requirement, we have to provide a drawing of the site that shows the footprint of the new facilities.

From: Straight, Scott
Sent: Monday, April 18, 2011 10:03 AM
To: Saunders, Eileen; Schroeder, Andrea; Conroy, Robert
Cc: Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: Re: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

We have never included drawings in the filing that I can remember. Has this changed?

From: Saunders, Eileen
Sent: Monday, April 18, 2011 09:36 AM
To: Schroeder, Andrea
Cc: Straight, Scott; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Andrea,

Please add these two proposed drawings to the list of diagrams for the ECR Filing. They are the latest arrangements for the Unit 4 FGD and the combined Units 1 and 2 FGDs.

Also, over the past few weeks, we have sent the following items to you and Gen Planning:

- Links to the Mill Creek Study (diagrams are included)
- Links to the Ghent Study (diagrams are included)
- Financial Data including O&M
- Scott's Contracting Summary

- Potential Asset Retirement to Property Accounting

Is there anything else related to the ***May 2, 2011*** public notification that Project Engineering needs to send at this point? I am traveling to work with Black and Veatch in Kansas City, MO tomorrow and will not be back in the office until Thursday. Please let me know if there is something else I need to send before I leave.

Thank you,

Eileen

From: Saunders, Eileen
Sent: Thursday, April 14, 2011 1:33 PM
To: Straight, Scott; Kirkland, Mike; Buckner, Mike; Didelot, Joe; Bennett, Mike; Betz, Alex
Cc: Moehrke, William; Craigmyle, Kenny
Subject: FW: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

All,

Please see the attached sketch of the Mill Creek proposed plan C and the sketch for Mill Creek Units 1&2 Combined layout. Let me know if you have any comments. For those of us traveling next week, I am sure we will discuss these layouts in more detail during our meeting with B&V.

Thanks,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Wednesday, April 13, 2011 9:02 PM
To: Saunders, Eileen
Cc: 168908 E.ON-AQC; Hillman, Timothy M.; Wehrly, M. R.; Crabtree, Jonathan D.; Fields, Ron L.; Hintz, Monty E.; Goodlet, Roger F.; Mahabaleshwarkar, Anand
Subject: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

Eileen,
As requested we have developed a draft paperdoll for the Unit 4C scenario based on comments received during Anand's site visit on March 30th. Please review and let us know if you have any comments. Also, if you need to provide costs for this scenario for the budgeting process, I would offer you utilize the apportioned cost information provided on 4/4/11 for Unit 4B (i.e., total project costs of $188,833,524, and other applicable costs).

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
Black & Veatch Corporation | 11401 Lamar Avenue, Overland Park, KS 66211
+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
Building a World of Difference.®

From:	Schroeder, Andrea
To:	Straight, Scott; Saunders, Eileen; Conroy, Robert
CC:	Wilson, Stuart; Karavayev, Louanne; Cosby, David; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/18/2011 10:04:03 AM
Subject:	RE: 168908.14.4100 110413 Mill Creek - Unit 4C Paperdoll

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Kyle

Kyle Lucas | Environmental Permitting Manager, Energy
Black & Veatch Corporation | 11401 Lamar Avenue, Overland Park, KS 66211
+ 1 913-458-9062 P | +1 913-458-9062 F
LucasKJ@BV.com
Building a World of Difference.®

From:	Schroeder, Andrea </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=E026206>
Sent:	4/27/2011 11:36:12 AM
To:	Schroeder, Andrea <Andrea.Schroeder@lge-ku.com>; Conroy, Robert; Bellar, Lonnie; Straight, Scott; Saunders, Eileen; Voyles, John; Sturgeon, Allyson; Kendrick Riggs; 'Crosby, W. Duncan'
Subject:	Copy: Discuss supporting documents for Voyles ECR Testimony
Location:	LGEC12 North 1 (Cap 15)
Start:	Tue 5/3/2011 8:30:00 AM
End:	Tue 5/3/2011 10:00:00 AM
Recurrence:	(none)
Meeting Status:	Not yet responded
Required Attendees:	Schroeder, Andrea; Conroy, Robert; Bellar, Lonnie; Straight, Scott; Saunders, Eileen; Voyles, John; Sturgeon, Allyson; Kendrick Riggs; 'Crosby, W. Duncan'

The purpose of the meeting is to finalize the documents to be provided as support to John Voyles's testimony in the 2011 ECR Plan filings.

From: Saunders, Eileen
To: 'Hillman, Timothy M.'
CC: 168908 E.ON-AQC; King, Michael L. (Mike); Wehrly, M. R.; Lucas, Kyle J.; Crabtree, Jonathan D.; Upchurch, David E. (Dave); Dimitry, James E. (Ed); Jackson, Audrey; Fischer, Diane M.; Johnson, Joshua S. (Josh); Straight, Scott; Clements, Joe
Sent: 4/27/2011 2:05:47 PM
Subject: RE: 168908.11.1400 110426 Proposal and Change Order for Additional Cost Estimate Tasks

Tim,

Please proceed. I understand that the plan is to complete this work within the authorized budget. However, I also understand that B&V may present a request for additional funds if the work strays outside of the scope described below or the tasks within the original scope changes.

Lastly, Scott is out of the office. He may have some comment on the schedule but that should not stop you from proceeding.

Sincerely,

Eileen

From: Hillman, Timothy M. [mailto:HillmanTM@bv.com]
Sent: Tuesday, April 26, 2011 6:57 PM
To: Saunders, Eileen
Cc: Hillman, Timothy M.; 168908 E.ON-AQC; King, Michael L. (Mike); Wehrly, M. R.; Lucas, Kyle J.; Crabtree, Jonathan D.; Upchurch, David E. (Dave); Dimitry, James E. (Ed); Jackson, Audrey; Fischer, Diane M.; Johnson, Joshua S. (Josh)
Subject: 168908.11.1400 110426 Proposal and Change Order for Additional Cost Estimate Tasks

Eileen,

ADDITIONAL WORK PROPOSAL
As we discussed Wednesday (4/20) during our breakout session in Kansas City, please find attached a proposed scope of work, milestone schedule, and cost estimate to complete the following additional tasks requested by LG&E/KU:

- Task 1 - Mill Creek Units 1 & 2 Combined WFGD Cost Estimate
- Task 2 - Mill Creek Units 1& 2 Lifecycle Analysis and Comparison
- Task 3 - Mill Creek Unit 4 Cost Estimate for New Arrangement "C"
- Task 4 - Brown Units 1 & 2 Combined PJFF Cost Estimate

SCHEDULE
We can begin this additional work immediately after delivery of the Brown Phase II report scheduled for May 2nd. I've constructed the schedule to complete the Mill Creek related tasks first, followed by Brown. For Mill Creek, we will need to complete the Phase II budgetary cost estimate for the Units 1 & 2 combined WFGD (Task 1) before we can complete the lifecycle analysis and comparison described in Task 2. The Mill Creek Unit 4 Arrangement "C" Phase II cost estimate can be done in parallel with Units 1 & 2, and thus shares the same milestone delivery date as Task 1. We can begin (with about a week overlap with the completion of the Mill Creek work) the Brown Units 1 & 2 combined PJFF cost estimate as presented in the milestone schedule in the proposal.

RELATIONSHIP TO SPECIFICATION DEVELOPMENT PROPOSAL
It is also important to note that the conceptual design data required to feed the Phase II budgetary cost estimates for the aforementioned tasks are also needed as a starting basis for the PJFF, WFGD, and fan specification development work being proposed under separate contract. This additional conceptual design and cost estimate work will have an impact on the specification development schedule, which we are accounting for in the specification schedule. This is particularly true for Mill Creek and Brown, as the AQC equipment (WFGDs and PJFFs), arrangements, and fan sizing/locations are all potentially being revised with this additional work authorization to as we discussed last week.

BUDGET
As our current Phase II project and deliverables stand now, I estimate that we will have enough remaining authorized budget to

complete these additional tasks under our current contract authorization. I base this assumption on our conversations last week where we agreed that B&V would not be issuing second "final" round or version of the Phase II reports for each facility. Rather, as described in the attached proposal, B&V will issue addendums to the draft reports, as we have already done for the "no SCR" cases.

AUTHORIZATION
As you are aware, we have been able to accommodate several out of scope activities over this course of the project (see attached email), and as I explained above, I believe we will have enough remaining authorized budget to complete the additional tasks described in the attached proposal. However, as we are approaching the balance of the authorized budget, and because we have yet to complete all the deliverables authorized under the original contract, **I request LG&E/KU's email approval to proceed with the additional tasks described herein, as well as your agreement that additional budget authorization may be necessary in the future depending on the extent of the current out of scope tasks, and the remaining deliverables associated with the original contract.**

Best regards,

TIM HILLMAN | Project Manager, Energy
Black & Veatch Corporation | 11401 Lamar Ave., Overland Park, KS 66211
+ 1 913-458-7928 P |HillmanTM@BV.com
Building a World of Difference.®

From:	Imber, Philip
To:	Hudson, Rusty; Kuhl, Megan; Reed, Kathleen
CC:	Straight, Scott; Clements, Joe; Mooney, Mike (BOC 3); Ritchey, Stacy
Sent:	4/28/2011 2:45:24 PM
Subject:	PAI_GH SAM FINAL_042811 pai.docx
Attachments:	PAI_GH SAM FINAL_042811 pai.docx

Rusty, Megan,
Attached is the revised SAM Milling Paper.

Kathleen,
Please update the electronic file with this latest version.

Philip

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,926k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,926k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems. This figure accounts for $426k spent prior to 2011, with $3,500k to be spent in 2011.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station. Future sanction requests regarding enhanced mixing/injection technology and boiler outlet temperature control are expected.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with

the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
May 2011	Contract Award
May - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best particle size milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.

6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:
1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	GH1	GH3	GH4	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$597	$307	$326	$1,230
Contingency (10%)	$78	$78	$90	$245
Total	$1,452	$1,162	$1,312	$3,926

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $1,230k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.9M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$189	$1,263				$1,452
Unit 3	#130907	$84	$1,078				$1,162
Unit 4	#130909	$153	$1,159				$1,312
Total		$426	$3,500	$0	$0	$0	$3,926

EBIT		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$10	$89	$153	$146	$2,056	$2,455
Unit 3	#130907	$5	$67	$123	$117	$1,645	$1,957
Unit 4	#130909	$8	$79	$138	$132	$1,858	$2,217
Total		$24	$235	$414	$396	$5,560	$6,629

Financial Detail by Year ($000s)	Pre 2011	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	426	3,300				3,726
2. Cost of Removal Proposed	0	200				200
3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
4. Capital Investment 2011 MTP	875	16,050				16,925
5. Cost of Removal 2011 MTP	0	-				-
6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
10. Project O&M Proposed	0	-				-
11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
12. EBIT *	$24	$235	$414	$396	$5,560	6,629

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,452	$1,162	$1,312	$3,926
NPVRR	$1,543	$1,309	$1,415	$4,267
NPV	$7	$6	$6	$19
IRR	7%	7%	7%	7%
Discount Rate	6.9%	6.9%	6.9%	6.9%
ROCE (39yr.)	8.80%	8.81%	8.81%	8.81%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**				**Change in**	**Change in**
		Pre 2011	**2011**	**2012**	**2013**	**NPVRR**	**NPV**
Project Costs (capital +/-10%)							
Unit 1	#130905	$1	$9	$15	$15	$181	$3
Unit 3	#130907	$0	$7	$12	$12	$144	$3
Unit 4	#130909	$1	$8	$14	$13	$163	$3
Totals	All Units	$2	$24	$41	$40	$488	$9
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

  1. Lower capital cost (particularly with respect to the existing systems).
  2. Better contractual terms and conditions.
  3. Higher confidence in project execution.
  4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
  5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
  6. LG&E and KU have existing dry sorbent injection operating experience.
  7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,926k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F	G
1	**Financial Detail by Year ($000s)**	**Pre**	**2011**	**2012**	**2013**	**Post**	**Total**
2		**2011**				**2013**	
3	1. Capital Investment Proposed	426	3,300				3,726
4	2. Cost of Removal Proposed	0	200				200
5	3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
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11	9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
12	10. Project O&M Proposed	0	-				-
13	11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
14							
15	12. EBIT *	$24	$235	$414	$396	$5,560	6,629
16							

From: Mooney, Mike (BOC 3)
To: Hudson, Rusty; Kuhl, Megan; Reed, Kathleen; Imber, Philip
CC: Straight, Scott; Clements, Joe; Ritchey, Stacy
Sent: 4/28/2011 3:33:13 PM
Subject: Ghent SAM Final Paper Revision 2
Attachments: PAI_GH SAM FINAL_042811 V2docx.docx

All,

The original copy of the paper had a chart that did not save correctly. It has been fixed and should now be good to go.

<<...>>

Mike Mooney
Budget Analyst III, Project Engineering
BOC 3
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E-mail: Mike.Mooney@lge-ku.com

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,926k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,926k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems. This figure accounts for $426k spent prior to 2011, with $3,500k to be spent in 2011.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
May 2011	Contract Award
April - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.
6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:

1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	GH1	GH3	GH4	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$597	$307	$326	$1,230
Contingency (10%)	$78	$78	$90	$245
Total	$1,452	$1,162	$1,312	$3,926

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $1,230k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.9M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		**Pre-2011**	**2011**	**2012**	**2013**	**Post 2013**	**Total**
Unit 1	#130905	$189	$1,263				$1,452
Unit 3	#130907	$84	$1,078				$1,162
Unit 4	#130909	$153	$1,159				$1,312
Total		$426	$3,500	$0	$0	$0	$3,926

EBIT		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$10	$89	$153	$146	$2,056	$2,455
Unit 3	#130907	$5	$67	$123	$117	$1,645	$1,957
Unit 4	#130909	$8	$79	$138	$132	$1,858	$2,217
Total		$24	$235	$414	$396	$5,560	$6,629

Financial Detail by Year ($000s)	Pre 2011	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	426	3,300				3,726
2. Cost of Removal Proposed	0	200				200
3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
4. Capital Investment 2011 MTP	875	16,050				16,925
5. Cost of Removal 2011 MTP	0	-				-
6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
10. Project O&M Proposed	0	-				-
11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
12. EBIT *	$24	$235	$414	$396	$5,560	6,629

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,452	$1,162	$1,312	$3,926
NPVRR	$1,807	$1,438	$1,631	$4,876
NPV	$33	$26	$30	$89
IRR	7%	7%	7%	7%
Discount Rate	6.68%	6.68%	6.68%	6.68%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**				**Change in NPVRR**	**Change in NPV**
		Pre 2011	**2011**	**2012**	**2013**		
Project Costs (capital +/-10%)							
Unit 1	#130905	$1	$9	$15	$15	$181	$3
Unit 3	#130907	$0	$7	$12	$12	$144	$3
Unit 4	#130909	$1	$8	$14	$13	$163	$3
Totals	All Units	$2	$24	$41	$40	$488	$9
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

  1. Lower capital cost (particularly with respect to the existing systems).
  2. Better contractual terms and conditions.
  3. Higher confidence in project execution.
  4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
  5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
  6. LG&E and KU have existing dry sorbent injection operating experience.
  7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,926k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F	G
1	**Financial Detail by Year ($000s)**	**Pre**	**2011**	**2012**	**2013**	**Post**	**Total**
2		**2011**				**2013**	
3	1. Capital Investment Proposed	426	3,300				3,726
4	2. Cost of Removal Proposed	0	200				200
5	3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
6	4. Capital Investment 2011 MTP	875	16,050				16,925
7	5. Cost of Removal 2011 MTP	0	-				-
8	6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
9	7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
10	8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
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12	10. Project O&M Proposed	0	-				-
13	11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
14							
15	12. EBIT *	$24	$235	$414	$396	$5,560	6,629
16							

From:	Straight, Scott
To:	Thompson, Paul; Voyles, John; Bowling, Ralph; Hudson, Rusty; Hincker, Loren; Sinclair, David; Schetzel, Doug; Jackson, Fred; Sebourn, Michael
CC:	Waterman, Bob; Imber, Philip; Lively, Noel; Saunders, Eileen; Gregory, Ronald; Heun, Jeff; Hance, Chuck; Clements, Joe; Cooper, David (Legal); Jones, Greg; Keeling, Chip; Hendricks, Claudia; Ray, Barry; O'brien, Dorothy (Dot); Bellar, Lonnie; Blake, Kent; Sturgeon, Allyson; Conroy, Robert; Cornett, Greg
Sent:	5/3/2011 8:07:59 AM
Subject:	Project Engineering's ES Bi-Weekly Report - April 30, 2011
Attachments:	PE's Bi-Weekly Update of 4-30-11.docx

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
April 30, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent Elevators – Still in progress.
    - Brown FGD – Third party FGD Performance Testing on high sulfur coal was completed on 3/25/11. Mist Eliminator warranty work and BR3 I.D. fan expansion joint replacement work was completed during the scheduled FGD spring 2011 outage. Some failing/failed expansion joints were replaced on BR1 and BR3 during the scheduled outage. The station pulled a BR3 service water pump for inspection and found similar issues to the Goulds pumps at Ghent. The station is working with legal and Ghent to pursue the service water pump issues with the vendor as a warranty issue.
    - Brown Coal Pile Modification – Foundation and embankment placement is complete, except for the clay liner in the pond expansion. Clay placement is on hold for favorable weather conditions. Tie-in at the septic tank to occur within the next few weeks (waiting on favorable weather for clay backfill). KU has placed a few of the poles needed to relocate the RO building alarm line. Once the line is relocated, the breach into the existing coal pile runoff pond will occur.
    - Brown Elevators – Installation of the permanent cars is scheduled for May 2011.

- **TC2**
  - Safety – Bechtel had a recordable from a hand injury.
  - Schedule/Execution:
    - Bechtel EPC – Outage work was completed with the major known repair activities completed along with significant progress on punch list items. Independent inspections of the WESP and DESP revealed problem areas that will be captured as warranty items and addressed in the future since time did not allow for correction of all items.
  - Contract Disputes/Resolution:
    - Bechtel LD's – Meeting held with Brightman to review Owner's position on LDs.
    - Bechtel Labor Claim – NTR
    - Bechtel has agreed verbally to extend the date of Material Change notice from 05/01/11 to 05/15/11 or later, depending on the final date of a technical meeting with Doosan at the site.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification.
    - Completion of punchlist.

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – Proceeding as planned.
  - Schedule/Execution – Proceeding to plan. Agreed on weld detail modification of the SCR vessel with BPEI and Zachry.

- Completed multiple activities as reflected in the planned outage schedule, with minimal issues/concerns.
- Issues/Risk – Drilling contractor encountered diesel smell while drilling one of the foundation piles. Work was paused, soil and water samples were taken and analyzed and the path forward was determined with assistance of EA – no ongoing concerns.

- **Ohio Falls Rehabilitation**
  - Safety – NTR
  - Engineering
    - Dewatering pumps purchased in 2008 are being overhauled to repair seals damaged during long storage.
    - Readiness Review meeting with Voith moved to 05/01/11.
    - Plant requesting new office building.

- **Mill Creek Limestone Project**
  - Safety - NTR
  - Schedule/Execution
    - Detailed Engineering - The specification for the General Contractor was issued and bids are due back 05/02/11. A pre-bid meeting was held at the site on 04/14/11.
    - The award recommendation for the limestone conveyor work has been signed. Contractual negotiations are underway with Dearborn Mid-West.

- **Cane Run CCP Project**
  - Permitting
    - All permitting proceeding well. 401 and Flood Plain permits received in 2010.
    - Issued NOD #2 response to the KYDWM.
  - Engineering
    - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall is nearing completion and a recommendation from the Plant and PE will be presented in the next few weeks
    - Finalization of construction drawings and specifications for the 5-year landfill are nearing completion.

- **Trimble Co. Barge Loading/Holcim**
  - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
  - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design. B&V currently reviewing the scope of work and submitted a proposal.
  - Looking at potential scope changes as a result of lessons learned at Ghent on the Transport project.

- **TC CCP Project – BAP/GSP**
  - Safety – NTR
  - Schedule/Execution:
    - Setting of the GSP Raft in progress.

        - All fill and mechanically stabilized earth wall work on the BAP is completed except for a small section of the South Dike.
        - Work continues on erection of the new Pipe Rack, electrical duct banks to GSP Electrical Building and to Ash Pond Raft.
        - Work is now being concentrated on raising the South Dike due to the high water level inside of the BAP. Eight of the ten (10) piping systems have been switched-over from the existing system to the new system. The work continues to track to the schedule established in early March. All systems to be completed by 02May11, weather permitting.
    - Contract Disputes/Resolution
    - Project Engineering continues to work with Riverside on resolution on claims due to weather and engineering delays.
    - Issues/Risk
        - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill

- Engineering
    - Detailed Engineering in progress with GAI.
- Permitting:
    - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
    - The DWM Permit is currently being reviewed with submittal planned for late April 2011. Final revisions are being made to the DWM permit documents with plans to submit the application within the next one to two weeks. .
    - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC on Thursday 03/03/11. Additional permit information is being completed by GAI. The next set of information will be the geotechnical report for the bridge piers and abutment, which will be submitted to KTC by the end of April.

- **Ghent CCP Projects - Landfill**
    - Safety – NTR
    - Engineering:
        - Detailed Engineering of gypsum fines nearing completion with B&V.
            - Tank foundations are under construction.
            - Working on the 0-2 and 2-1 tank modifications.
            - Installation of the new 0-2 tank agitator
            - Bids received and under review for Civil/Mechanical Construction.
        - Security Fence was awarded to Riverside/Nationwide and is currently under construction. Approximately ½ of the poles have been set.
        - Have issued all four major equipment RFQ packages and held meeting with the vendors.
        - Reviewing the EPC scope of work.
    - Permitting:
        - All permit applications have been submitted. Moving forward as expected.
        - Working on response to NOD #2.
    - Issues/Risk:

- Land Acquisition – Negotiations nearing completion with Deaton family in regards to pricing and terms of sale. The parties are close to a final settlement after resolution of terms and conditions of the sale. Work continues, however, on condemnation proceedings with the preparation of the drawings to delineate the actual "takings."

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Continue to work with Summit on contract settlement payout.
  - Engineering – Detailed Engineering by MACTEC continues.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Continued to place Type IIa-24 shot rock from the Starter Dike and Houp Property into the East embankment.
    - Gypsum was placed in the South embankment. Gypsum placed and compacted is migrating through the filter fabric. A path forward is under development.
    - Continue to provide BR Landfill design information to MACTEC.
    - Continuing development of RFQ for conceptual design engineering of Wet-to-Dry Ash Handling conversion as part of the BR Landfill project.
    - Meeting with KYDWM held on 4/14 with follow-up held 4/17 to discuss hydrogeologic requirements specific to BR. Working on engineering change order as a result of unforeseen hydrogeologic requirements.
  - Issues/Risk:
    - Bathymetric Survey conducted on the Aux. Pond and preliminary results indicate construction schedule is attainable, but production rates are in excess of production rate forecast.
    - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
    - Final settlement reached with Summit on all outstanding claims by Summit.

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
  - Safety – NTR
  - Schedule/Execution:
    - Mills for Ghent to be presented at April 28 investment committee. Proposing Nol-Tec with Sturtevant mills for Ghent Units 1, 3, and 4. Project Cost is $3.5M.
    - .
    - Permanent operation with mills at Ghent may be possible end of 2011.
  - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal complete. Reports pending. Preparing BAFO RFQ for SAM Mitigation on all three Units at EWB. Expect release week of May 2.

- **Cane Run CCGT**
  - Budget – NTR
  - Gas Pipe Line Routing
    - EN Engineering kick off meeting held for route survey, engineering, and environmental assessment.
    - Site walk down with EN Engineering scheduled for May 2.
    - Preparing a letter to land owner's along the ROW for survey notification.

Owner's Engineer

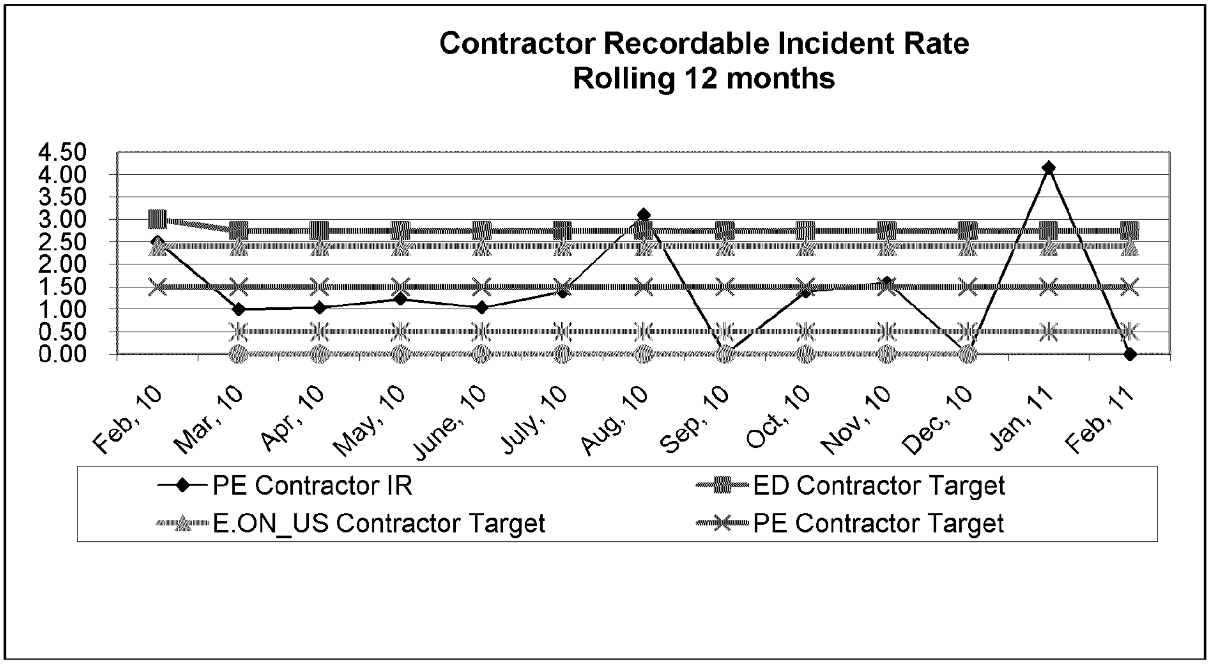
- Prepared a new LGIA for a 825 MW NGCC at EWB.
- Reviewed the draft Contracting Strategy with HDR.
- Met with CR staff to begin retirement planning activities that need to be accounted in the MTP. Agreed the planning/budget work for the 2011 MTP will be kept in house; O&M monies to be set aside for formal planning in 2012.

- Air Permitting
    - Held update meeting and transferred updated project data.
- Environmental Assessment
    - Held update meeting and transferred updated project data.

- **Other Generation Development**
    - Biomass – NTR
    - CCS 100 MW Project
        - KBR submitting draft documents for review.
        - Meeting set with KBR in Houston on May 5 to formally review draft Project Development Plan.
    - FutureGen – NTR

- **General**
    - Environmental Scenario Planning:
        - All stations (MC, Ghent and Brown) are under review. PE and the Mill Creek Management team traveled to Kansas to more thoroughly review the MC Report. ECR filing scope being modified to include new combined WFGD on Mill Creek 1 & 2 instead of significant upgrades to existing WFGDs.
        - Various meetings continue to be held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
        - BPEI flow modeling of MC4 planned in Germany in May.
        - The short review of existing ESPs by B&W reveal improvements can be made to existing ESPs; however, to meet proposed MACT standards, FF still required.
        - All SCRs taken out of the plan for ECR filing.
    - Continue to work with Legal and EA on Ghent SAM compliance. Prepared technical and economic assessment for meeting 5ppm SAM at each Ghent Unit. Draft term sheet/proposal in circulation for submittal to DOJ/EPA week of April 7.
    - Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics:



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAR11	APR11	MAY11	JUN11	JUL11	Aug11	Sep11	Oct11	Nov11	Dec11	Jan12	Feb12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C		May												
Heun	GH CCR - Gypsum Dewatering Belts	C		May												
Heun	GH CCR - Dry Fly Ash System	C		May												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		May												
Heun	GH CCR - Pipe Conveyor	C		May												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P		Pending												
Imber	BR 3 SAM Mitigation	C	8,000	May												
Imber	GH 1 -4 SAM Mitigation	P	8,000	Mar												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	MC Limestone Mill Construction Contract	C	12,000	Jun												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	41,117	Pending												
Saunders	Environmental Air Compliance - BR 2 SCR	P	104,971	Pending												
Saunders	Environmental Air Compliance - GH 2 SCR	P	262,878	Pending												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	97,229	Pending												
Saunders	Environmental Air Compliance - MC 2 FGD Upgrade	P	47,659	Pending												
Saunders	Environmental Air Compliance - MC 2 Electrostatic Precip	P	37,690	Pending												
Saunders	Environmental Air Compliance - MC4 FGD	P	271,994	Pending												
Saunders	Environmental Air Compliance - MC4 SCR	P	5,696	Pending												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	159,453	Pending												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jun												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Jun												
Williams	BR CCR - Ash Handling Dry Conversion	C		Jun												

- **Staffing**
  - Headcount planning is in process to evaluate staffing needs to manage the 2011MTP projects. Final draft will not be finalized until scope settles out for ECR filing.

- Posting for Electrical Engineer to replace Jason Finn resulted in only one internal bid.
- PE Re-Organization is now in the transition phase.
- Requisition for Contract Administrator signed by RSS and JV on 3/31/11 and delivered to HR same day. ***This position is critical*** to fill given the significant commercial activities in PE for 2011, 2012 and 2013.
- Posting for Business Analyst delayed by HR as Comp assigns pay range.

From:	Straight, Scott
To:	Sturgeon, Allyson
Sent:	5/9/2011 3:18:35 PM
Subject:	Accepted: Final ECR Application and Testimony Review

From:	MIKE.MOONEY@LGE-KU.COM
To:	Straight, Scott
Sent:	5/11/2011 2:00:58 PM
Subject:	AIP Project Approval - 130905 - REVISION
Attachments:	130905-27.pdf; PAI_GH SAM FINAL.docx; Pre 2011 GH SAM.docx

KU project number 130905 (GH1 SAM Mitigation) has been submitted for your approval. Please login to PowerPlant and respond to the items awaiting your approval.

login to powerplant

AUTHORIZATION FOR INVESTMENT PROPOSAL - REVISION

☐ LG&E and KU Services Co. ☐ Louisville Gas and Electric Co. ☒ Kentucky Utilities Company

Name of Project: GH1 SAM Mitigation	**Funding Project Type:** KU Steam Gen NonBlnk Exclude Land

Date Requested: 7/16/2010	**Project Number:** 130905	**Budgeted:** yes

Related Project Numbers: n/a	**If unbudgeted, list alternate budget ref. Number(s):** n/a

Expected Start Date: 1/1/2010	**Expected In Service Date:** 12/31/2012	**Expected Completion Date:** 12/31/2012

AIP Prepared by: Mooney, Michael Allen	**Phone:** 502/627-3671
Project Manager: Saunders, Eileen	**Phone:** 502/627-2431
Asset Location: Ghent Unit 1	**Environmental Code:** Air
Resp. Center: 015730-GENERATION SUPPORT - KU	**Product Code:** 111 - WHOLESALE GENERATION

REASONS AND DETAILED DESCRIPTION OF PROJECT

130905-GH1 SAM Mitigation

This AIP is being issued to authorize an additional expenditure of $1.263M (in addition to the 2010 spend of $189k) for the procurement and installation of a Milling System for the Ghent 1 SAM mitigation. This will bring the AIP up to $1.452M. Went before Invest Committee on 4-28-11.

Costs	Capital Investment	Cost of Removal/ Retirement	Capital Cost Subtotal	Inital O&M Cost	Lifetime Maintenance Cost	O&M Cost Subtotal	TOTAL INVESTMENT
	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Company Labor	$123,491.56	$0.00	$123,491.56	$0.00	$0.00	$0.00	$123,491.56
Contract Labor	$1,047,111.51	$200,000.00	$1,247,111.51	$0.00	$0.00	$0.00	$1,247,111.51
Other	$80,758.12	$0.00	$80,758.12	$0.00	$0.00	$0.00	$80,758.12
Local Engineering	$581.77	$0.00	$581.77	$0.00	$0.00	$0.00	$581.77
Subtotal - GAAP	$1,251,942.96	$200,000.00	$1,451,942.96	$0.00	$0.00	$0.00	$1,451,942.96
Net Expenditures - GAAP	$1,251,942.96	$200,000.00	$1,451,942.96	$0.00	$0.00	$0.00	$1,451,942.96
2010 Total	$188,912.33	$0.00	$188,912.33	$0.00	$0.00	$0.00	$188,912.33
2011 Total	$1,063,030.63	$200,000.00	$1,263,030.63	$0.00	$0.00	$0.00	$1,263,030.63
2012 Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Approval Type: Non-IT Projects

Authorized by	Amount	Name	Date Approved	Req'd
Supervisor	$25,000.00			N
Manager	$100,000.00	Imber, Phillip	5/11/2011	Y
Budget Coordinator	$0.00	Ritchey, Stacy	5/11/2011	Y
Budget Coordinator	$0.00	Mooney, Michael Allen	5/11/2011	Y
Director	$300,000.00	Straight, Ronald		Y
Vice President	$750,000.00	Voyles, John		Y
Investment Committee Coordinator	$0.00	Chapman, Laura		Y
Financial Planning Director	$0.00	Garrett, Christopher		Y
Senior Officer	$1,000,000.00	Thompson, Paul		Y
CFO	$1,000,001.00	Rives, Stephen		Y
CEO	$1,000,002.00	Staffieri, Victor		Y
Property Accounting	$0.00	Rose, Bruce		Y

INVESTMENT MATERIALS

UOP #	Utility Account Id		Quantity	Total Cost	
	131200	SO3 AIR COMPRESSOR SYSTEM - CC	0	$250,000.00	

RETIRED EQUIPEMENT (OR MATERIALS)

UOP #	Utility Account Id		Quantity	Vintage Year	Original Project Number

<u>AIP QUESTIONS</u>

Are there Related Project Numbers?
Provide related project numbers or indicate 'N/A'.
n/a

Is this an IT related project?
IT project is any project that requires IT involvement or the purchase of hardware and software.
no

Purchase/Sale of Real Estate?
Is this a transaction related to the sale/purchase of land or buildings?
no

Budgeted?
Is the project budgeted or unbudgeted?
yes

AIP QUESTIONS

Alternate Budget Numbers?
If the project is unbudgeted, list alternate budget reference numbers. Enter N/A, if none.
n/a

Legal Asset Retirement Obligation?
Is there a legal or environmental requirement governing disposal of this asset?
no

Leased Asset?
Does this project involve a leased asset?
no

Obsolete Inventory?
Will this project create obsolete inventory?
no

Environmental Project
Is this an Environmental Project?
yes

Environmental Cost Recovery
If an environmental project, is this an approved environmental cost recovery (ECR) project?
no

ECR Project Type
If this is an ECR project, indicate the project type.
Air

ECR Compliance Number
If this is an ECR project, provide the ECR compliance plan number (see the approved project list on the Rates and Regulatory intranet site).
To be in filing sometime during 2nd qtr 2011

Environmental Affairs
Does Environmental Affairs need to review this project for environmental permitting issues (based on responses to the six questions in the Investment Proposal)?
yes

Research and Experimental Credit
Is this an experimental project with the purpose of improving, enhancing, or adding to a current manufacturing process?
no

Sales Tax-Pollution Control
Is this project done for environmental regulations or statutes? (If yes, may qualify for the Pollution Control Exemption.)
no

Sales Tax-Manufacturing Integration
Is this project integrated in the Manufacturing Process? (Yes to this question and the following two questions may qualify for the New and Expanded Exemption.)
no

Sales Tax-State Equipment Use
Is this equipment used in the state for the first time?
no

Sales Tax-Upgrade or Improvement?
Is this project considered an upgrade or improvement? If yes, enter description on next line.
no

Sales Tax-Upgrade Description
Description of upgrade, if applicable (i.e., improved materials, increased capacity, longer life, etc.) from prior question. Enter N/A, if not applicable.
N/A

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,926k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,926k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems. This figure accounts for $426k spent prior to 2011, with $3,500k to be spent in 2011.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station. Future sanction requests regarding enhanced mixing/injection technology and boiler outlet temperature control are expected.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with

the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
May 2011	Contract Award
May - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best particle size milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.

6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:
1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	**GH1**	**GH3**	**GH4**	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$597	$307	$326	$1,230
Contingency (10%)	$78	$78	$90	$245
Total	$1,452	$1,162	$1,312	$3,926

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $1,230k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.9M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		**Pre-2011**	**2011**	**2012**	**2013**	**Post 2013**	**Total**
Unit 1	#130905	$189	$1,263				$1,452
Unit 3	#130907	$84	$1,078				$1,162
Unit 4	#130909	$153	$1,159				$1,312
Total		$426	$3,500	$0	$0	$0	$3,926

EBIT		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$10	$89	$153	$146	$2,056	$2,455
Unit 3	#130907	$5	$67	$123	$117	$1,645	$1,957
Unit 4	#130909	$8	$79	$138	$132	$1,858	$2,217
Total		$24	$235	$414	$396	$5,560	$6,629

Financial Detail by Year ($000s)	Pre 2011	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	426	3,300				3,726
2. Cost of Removal Proposed	0	200				200
3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
4. Capital Investment 2011 MTP	875	16,050				16,925
5. Cost of Removal 2011 MTP	0	-				-
6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
10. Project O&M Proposed	0	-				-
11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
12. EBIT *	$24	$235	$414	$396	$5,560	6,629

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,452	$1,162	$1,312	$3,926
NPVRR	$1,807	$1,438	$1,631	$4,876
NPV	$33	$26	$30	$89
IRR	7%	7%	7%	7%
Discount Rate	6.68%	6.68%	6.68%	6.68%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**				**Change in**	**Change in**
		Pre 2011	**2011**	**2012**	**2013**	**NPVRR**	**NPV**
Project Costs (capital +/-10%)							
Unit 1	#130905	$1	$9	$15	$15	$181	$3
Unit 3	#130907	$0	$7	$12	$12	$144	$3
Unit 4	#130909	$1	$8	$14	$13	$163	$3
Totals	All Units	$2	$24	$41	$40	$488	$9
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

1. Lower capital cost (particularly with respect to the existing systems).
2. Better contractual terms and conditions.
3. Higher confidence in project execution.
4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
6. LG&E and KU have existing dry sorbent injection operating experience.
7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,926k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F	G
1	**Financial Detail by Year ($000s)**	**Pre**	**2011**	**2012**	**2013**	**Post**	**Total**
2		**2011**				**2013**	
3	1. Capital Investment Proposed	426	3,300				3,726
4	2. Cost of Removal Proposed	0	200				200
5	3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
6	4. Capital Investment 2011 MTP	875	16,050				16,925
7	5. Cost of Removal 2011 MTP	0	-				-
8	6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
9	7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
10	8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
11	9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
12	10. Project O&M Proposed	0	-				-
13	11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
14							
15	12. EBIT *	$24	$235	$414	$396	$5,560	6,629
16							

This AIP request is for an additional $426k ($189k for GH1, $84k for GH3, and $153k for GH$) for a total of $3.926M. The Ghent SAM project went before the Investment Committee on 4-28-11 for $3.5M approval for 2011. The additional $426 was pre-2011 spend for Engineering was not included in the original paper. It was, however, to be discussed in the 4-28-11 investment Committee meeting.

From:	MIKE.MOONEY@LGE-KU.COM
To:	Straight, Scott
Sent:	5/11/2011 2:01:03 PM
Subject:	AIP Project Approval - 130909 - REVISION
Attachments:	130909-28.pdf; PAI_GH SAM FINAL.docx; Pre 2011 GH SAM.docx

KU project number 130909 (GH4 SAM Mitigation) has been submitted for your approval. Please login to PowerPlant and respond to the items awaiting your approval.

login to powerplant

AUTHORIZATION FOR INVESTMENT PROPOSAL - REVISION

☐ LG&E and KU Services Co. ☐ Louisville Gas and Electric Co. ☒ Kentucky Utilities Company

Name of Project: GH4 SAM Mitigation	**Funding Project Type:** KU Steam Gen NonBlnk Exclude Land

Date Requested: 7/16/2010	**Project Number:** 130909	**Budgeted:** yes

Related Project Numbers: n/a	**If unbudgeted, list alternate budget ref. Number(s):** n/a

Expected Start Date: 1/1/2010	**Expected In Service Date:** 12/31/2012	**Expected Completion Date:** 12/31/2012

AIP Prepared by: Mooney, Michael Allen	**Phone:** 502/627-3671
Project Manager: Saunders, Eileen	**Phone:** 502/627-2431
Asset Location: Ghent Unit 4	**Environmental Code:** Air
Resp. Center: 015730-GENERATION SUPPORT - KU	**Product Code:** 111 - WHOLESALE GENERATION

REASONS AND DETAILED DESCRIPTION OF PROJECT

130909-GH4 SAM Mitigation

The AIP is being issued to authorize the additional expenditure of $1.159M (in addition to the 2010 spend of $153k) for the procurement and installation of a Milling System of the Ghent 4 SAM mitigation. This brings the AIP up to $1,312M. Went before the Investment Committee on 4-28-11 and was approved.

Costs	Capital Investment	Cost of Removal/ Retirement	Capital Cost Subtotal	Inital O&M Cost	Lifetime Maintenance Cost	O&M Cost Subtotal	TOTAL INVESTMENT
	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Company Labor	$19,719.42	$0.00	$19,719.42	$0.00	$0.00	$0.00	$19,719.42
Contract Labor	$1,263,562.43	$0.00	$1,263,562.43	$0.00	$0.00	$0.00	$1,263,562.43
Materials	$5,587.89	$0.00	$5,587.89	$0.00	$0.00	$0.00	$5,587.89
Other	$23,151.93	$0.00	$23,151.93	$0.00	$0.00	$0.00	$23,151.93
Local Engineering	$359.30	$0.00	$359.30	$0.00	$0.00	$0.00	$359.30
Subtotal - GAAP	$1,312,380.97	$0.00	$1,312,380.97	$0.00	$0.00	$0.00	$1,312,380.97
Net Expenditures - GAAP	$1,312,380.97	$0.00	$1,312,380.97	$0.00	$0.00	$0.00	$1,312,380.97
2010 Total	$153,137.15	$0.00	$153,137.15	$0.00	$0.00	$0.00	$153,137.15
2011 Total	$1,159,243.82	$0.00	$1,159,243.82	$0.00	$0.00	$0.00	$1,159,243.82
2012 Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Approval Type: Non-IT Projects

Authorized by	Amount	Name	Date Approved	Req'd
Supervisor	$25,000.00			N
Manager	$100,000.00	Imber, Phillip	5/11/2011	Y
Budget Coordinator	$0.00	Ritchey, Stacy	5/11/2011	Y
Budget Coordinator	$0.00	Mooney, Michael Allen	5/11/2011	Y
Director	$300,000.00	Straight, Ronald		Y
Vice President	$750,000.00	Voyles, John		Y
Investment Committee Coordinator	$0.00	Chapman, Laura		Y
Financial Planning Director	$0.00	Garrett, Christopher		Y
Senior Officer	$1,000,000.00	Thompson, Paul		Y
CFO	$1,000,001.00	Rives, Stephen		Y
CEO	$1,000,002.00	Staffieri, Victor		Y
Property Accounting	$0.00	Rose, Bruce		Y

INVESTMENT MATERIALS

UOP #	Utility Account Id		Quantity	Total Cost	
	131200	SO3 AIR COMPRESSOR SYSTEM - CC	0	$250,000.00	

RETIRED EQUIPEMENT (OR MATERIALS)

UOP #	Utility Account Id		Quantity	Vintage Year	Original Project Number

AIP QUESTIONS

Are there Related Project Numbers?
Provide related project numbers or indicate 'N/A'.
n/a

Is this an IT related project?
IT project is any project that requires IT involvement or the purchase of hardware and software.
no

Purchase/Sale of Real Estate?
Is this a transaction related to the sale/purchase of land or buildings?
no

Budgeted?
Is the project budgeted or unbudgeted?
yes

AIP QUESTIONS

Alternate Budget Numbers?
If the project is unbudgeted, list alternate budget reference numbers. Enter N/A, if none.
n/a

Legal Asset Retirement Obligation?
Is there a legal or environmental requirement governing disposal of this asset?
no

Leased Asset?
Does this project involve a leased asset?
no

Obsolete Inventory?
Will this project create obsolete inventory?
no

Environmental Project
Is this an Environmental Project?
yes

Environmental Cost Recovery
If an environmental project, is this an approved environmental cost recovery (ECR) project?
no

ECR Project Type
If this is an ECR project, indicate the project type.
Air

ECR Compliance Number
If this is an ECR project, provide the ECR compliance plan number (see the approved project list on the Rates and Regulatory intranet site).
To be in filing in 2nd qtr 2011

Environmental Affairs
Does Environmental Affairs need to review this project for environmental permitting issues (based on responses to the six questions in the Investment Proposal)?
yes

Research and Experimental Credit
Is this an experimental project with the purpose of improving, enhancing, or adding to a current manufacturing process?
yes

Sales Tax-Pollution Control
Is this project done for environmental regulations or statutes? (If yes, may qualify for the Pollution Control Exemption.)
no

Sales Tax-Manufacturing Integration
Is this project integrated in the Manufacturing Process? (Yes to this question and the following two questions may qualify for the New and Expanded Exemption.)
no

Sales Tax-State Equipment Use
Is this equipment used in the state for the first time?
no

Sales Tax-Upgrade or Improvement?
Is this project considered an upgrade or improvement? If yes, enter description on next line.
no

Sales Tax-Upgrade Description
Description of upgrade, if applicable (i.e., improved materials, increased capacity, longer life, etc.) from prior question. Enter N/A, if not applicable.
N/A

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,926k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,926k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems. This figure accounts for $426k spent prior to 2011, with $3,500k to be spent in 2011.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station. Future sanction requests regarding enhanced mixing/injection technology and boiler outlet temperature control are expected.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with

the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
May 2011	Contract Award
May - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best particle size milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.

6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:
1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	GH1	GH3	GH4	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$597	$307	$326	$1,230
Contingency (10%)	$78	$78	$90	$245
Total	$1,452	$1,162	$1,312	$3,926

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $1,230k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.9M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$189	$1,263				$1,452
Unit 3	#130907	$84	$1,078				$1,162
Unit 4	#130909	$153	$1,159				$1,312
Total		$426	$3,500	$0	$0	$0	$3,926

EBIT		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$10	$89	$153	$146	$2,056	$2,455
Unit 3	#130907	$5	$67	$123	$117	$1,645	$1,957
Unit 4	#130909	$8	$79	$138	$132	$1,858	$2,217
Total		$24	$235	$414	$396	$5,560	$6,629

Financial Detail by Year ($000s)	Pre 2011	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	426	3,300				3,726
2. Cost of Removal Proposed	0	200				200
3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
4. Capital Investment 2011 MTP	875	16,050				16,925
5. Cost of Removal 2011 MTP	0	-				-
6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
10. Project O&M Proposed	0	-				-
11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
12. EBIT *	$24	$235	$414	$396	$5,560	6,629

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,452	$1,162	$1,312	$3,926
NPVRR	$1,807	$1,438	$1,631	$4,876
NPV	$33	$26	$30	$89
IRR	7%	7%	7%	7%
Discount Rate	6.68%	6.68%	6.68%	6.68%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**				**Change in NPVRR**	**Change in NPV**
		Pre 2011	**2011**	**2012**	**2013**		
Project Costs (capital +/-10%)							
Unit 1	#130905	$1	$9	$15	$15	$181	$3
Unit 3	#130907	$0	$7	$12	$12	$144	$3
Unit 4	#130909	$1	$8	$14	$13	$163	$3
Totals	All Units	$2	$24	$41	$40	$488	$9
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

1. Lower capital cost (particularly with respect to the existing systems).
2. Better contractual terms and conditions.
3. Higher confidence in project execution.
4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
6. LG&E and KU have existing dry sorbent injection operating experience.
7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,926k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F	G
1	**Financial Detail by Year ($000s)**	**Pre**	**2011**	**2012**	**2013**	**Post**	**Total**
2		**2011**				**2013**	
3	1. Capital Investment Proposed	426	3,300				3,726
4	2. Cost of Removal Proposed	0	200				200
5	3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
6	4. Capital Investment 2011 MTP	875	16,050				16,925
7	5. Cost of Removal 2011 MTP	0	-				-
8	6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
9	7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
10	8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
11	9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
12	10. Project O&M Proposed	0	-				-
13	11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
14							
15	12. EBIT *	$24	$235	$414	$396	$5,560	6,629
16							

This AIP request is for an additional $426k ($189k for GH1, $84k for GH3, and $153k for GH$) for a total of $3.926M. The Ghent SAM project went before the Investment Committee on 4-28-11 for $3.5M approval for 2011. The additional $426 was pre-2011 spend for Engineering was not included in the original paper. It was, however, to be discussed in the 4-28-11 investment Committee meeting.

From:	MIKE.MOONEY@LGE-KU.COM
To:	Straight, Scott
Sent:	5/11/2011 2:01:01 PM
Subject:	AIP Project Approval - 130907 - REVISION
Attachments:	130907-28.pdf; PAI_GH SAM FINAL.docx; Pre 2011 GH SAM.docx

KU project number 130907 (GH3 SAM Mitigation) has been submitted for your approval. Please login to PowerPlant and respond to the items awaiting your approval.

login to powerplant

AUTHORIZATION FOR INVESTMENT PROPOSAL - REVISION

☐ LG&E and KU Services Co. ☐ Louisville Gas and Electric Co. ☒ Kentucky Utilities Company

Name of Project: GH3 SAM Mitigation	**Funding Project Type:** KU Steam Gen NonBlnk Exclude Land

Date Requested: 7/16/2010	**Project Number:** 130907	**Budgeted:** yes

Related Project Numbers: n/a	**If unbudgeted, list alternate budget ref. Number(s):** n/a

Expected Start Date: 1/1/2010	**Expected In Service Date:** 12/31/2012	**Expected Completion Date:** 12/31/2012

AIP Prepared by: Mooney, Michael Allen	**Phone:** 502/627-3671
Project Manager: Saunders, Eileen	**Phone:** 502/627-2431

Asset Location: Ghent Unit 3	**Environmental Code:** Air
Resp. Center: 015730-GENERATION SUPPORT - KU	**Product Code:** 111 - WHOLESALE GENERATION

REASONS AND DETAILED DESCRIPTION OF PROJECT

130907-GH3 SAM Mitigation

The AIP is being issued to authorize the additional expenditure of $1.078M (in addition to the 2010 spend of $84k) for the procurement and installation of a Milling System of the Ghent 3 SAM mitigation. This brings the AIP up to $1,162M. Went before the Investment Committee on 4-28-11 and was approved.

Costs	Capital Investment	Cost of Removal/ Retirement	Capital Cost Subtotal	Inital O&M Cost	Lifetime Maintenance Cost	O&M Cost Subtotal	TOTAL INVESTMENT
	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Company Labor	$18,408.78	$0.00	$18,408.78	$0.00	$0.00	$0.00	$18,408.78
Contract Labor	$1,139,990.90	$0.00	$1,139,990.90	$0.00	$0.00	$0.00	$1,139,990.90
Other	$3,044.04	$0.00	$3,044.04	$0.00	$0.00	$0.00	$3,044.04
Local Engineering	$499.24	$0.00	$499.24	$0.00	$0.00	$0.00	$499.24
Subtotal - GAAP	$1,161,942.96	$0.00	$1,161,942.96	$0.00	$0.00	$0.00	$1,161,942.96
Net Expenditures - GAAP	$1,161,942.96	$0.00	$1,161,942.96	$0.00	$0.00	$0.00	$1,161,942.96
2010 Total	$83,715.89	$0.00	$83,715.89	$0.00	$0.00	$0.00	$83,715.89
2011 Total	$1,078,227.07	$0.00	$1,078,227.07	$0.00	$0.00	$0.00	$1,078,227.07
2012 Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Approval Type: Non-IT Projects

Authorized by	Amount	Name	Date Approved	Req'd
Supervisor	$25,000.00			N
Manager	$100,000.00	Imber, Phillip	5/11/2011	Y
Budget Coordinator	$0.00	Ritchey, Stacy	5/11/2011	Y
Budget Coordinator	$0.00	Mooney, Michael Allen	5/11/2011	Y
Director	$300,000.00	Straight, Ronald		Y
Vice President	$750,000.00	Voyles, John		Y
Investment Committee Coordinator	$0.00	Chapman, Laura		Y
Financial Planning Director	$0.00	Garrett, Christopher		Y
Senior Officer	$1,000,000.00	Thompson, Paul		Y
CFO	$1,000,001.00	Rives, Stephen		Y
CEO	$1,000,002.00	Staffieri, Victor		Y
Property Accounting	$0.00	Rose, Bruce		Y

INVESTMENT MATERIALS

UOP #	Utility Account Id		Quantity	Total Cost	
	131200	SO3 AIR COMPRESSOR SYSTEM - CC	0	$250,000.00	

RETIRED EQUIPEMENT (OR MATERIALS)

UOP #	Utility Account Id		Quantity	Vintage Year	Original Project Number

AIP QUESTIONS

Are there Related Project Numbers?
Provide related project numbers or indicate 'N/A'.
n/a

Is this an IT related project?
IT project is any project that requires IT involvement or the purchase of hardware and software.
no

Purchase/Sale of Real Estate?
Is this a transaction related to the sale/purchase of land or buildings?
no

Budgeted?
Is the project budgeted or unbudgeted?
yes

AIP QUESTIONS

Alternate Budget Numbers?
If the project is unbudgeted, list alternate budget reference numbers. Enter N/A, if none.
n/a

Legal Asset Retirement Obligation?
Is there a legal or environmental requirement governing disposal of this asset?
no

Leased Asset?
Does this project involve a leased asset?
no

Obsolete Inventory?
Will this project create obsolete inventory?
no

Environmental Project
Is this an Environmental Project?
yes

Environmental Cost Recovery
If an environmental project, is this an approved environmental cost recovery (ECR) project?
no

ECR Project Type
If this is an ECR project, indicate the project type.
Air

ECR Compliance Number
If this is an ECR project, provide the ECR compliance plan number (see the approved project list on the Rates and Regulatory intranet site).
To be in filing in 2nd qtr 2011.

Environmental Affairs
Does Environmental Affairs need to review this project for environmental permitting issues (based on responses to the six questions in the Investment Proposal)?
yes

Research and Experimental Credit
Is this an experimental project with the purpose of improving, enhancing, or adding to a current manufacturing process?
no

Sales Tax-Pollution Control
Is this project done for environmental regulations or statutes? (If yes, may qualify for the Pollution Control Exemption.)
no

Sales Tax-Manufacturing Integration
Is this project integrated in the Manufacturing Process? (Yes to this question and the following two questions may qualify for the New and Expanded Exemption.)
no

Sales Tax-State Equipment Use
Is this equipment used in the state for the first time?
no

Sales Tax-Upgrade or Improvement?
Is this project considered an upgrade or improvement? If yes, enter description on next line.
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Sales Tax-Upgrade Description
Description of upgrade, if applicable (i.e., improved materials, increased capacity, longer life, etc.) from prior question. Enter N/A, if not applicable.
N/A

Investment Proposal for Investment Committee Meeting on: April 28, 2011

Project Name: Ghent SAM Mitigation Mill Upgrades for Units 1, 3, and 4

Total Expenditures: $3,926k

Project Numbers: 130905 (U1), 130907 (U3) and 130909 (U4)

Business Unit/Line of Business: Project Engineering

Prepared/Presented By: Philip A. Imber, Manager Major Capital Projects

Executive Summary

This document seeks project approval of $3,926k to retrofit milling equipment on the existing Ghent Units 1, 3, and 4 Sulfuric Acid Mist (SAM) Mitigation Systems. This figure accounts for $426k spent prior to 2011, with $3,500k to be spent in 2011.

The addition of milling equipment to the SAM Mitigation Systems is anticipated to increase reagent utilization/effectiveness by generating smaller sorbent particles, higher sorbent surface area, and potentially improved in-flight sorbent mixing. This technology implementation is one step towards SAM Mitigation System improvements and plant betterment required to meet anticipated Unit specific SAM limits at the Ghent Station. Future sanction requests regarding enhanced mixing/injection technology and boiler outlet temperature control are expected.

The goal of this project is to progress dry sorbent injection technology effectiveness as the least cost technology and to meet a continuous goal of 5 ppm at the stack. To this end, there will be two mills installed per Unit with bypass capability for continued operation while maintenance is being performed. The milling equipment will enhance SAM Mitigation and potentially reduce operating cost and reagent usage if bag house equipment is installed.

Milling is not being installed on Unit 2 at this time. Ghent Unit 2 utilizes Hydrated Lime reagent via a temporary injection system. Milling will be reassessed on Unit 2 when a permanent reagent injection system is installed. Ghent Units 1, 3, and 4 utilize TRONA.

This project will be included in the June 1, 2011 ECR filing. This project is fully budgeted.

Background

In March 2009 the Ghent Station received a Notice of Violation (NOV) from the Environmental Protection Agency (EPA) and the Department of Justice (DOJ) regarding SAM emissions, a Potential for Significant Deterioration (PSD) criteria pollutant. The NOV, which Kentucky Utilities (KU) disputes, results from the addition of SCR (on Units 1, 3, and 4), the addition of FGD (on Units 2, 3, and 4), and switching to fuels with higher sulfur content (on Units 2, 3, and 4). In conjunction with

the FGD technology installation at Ghent, KU installed SAM Mitigation, dry sorbent injection systems, on Units 1, 3, and 4 due to the industry concerns of increased stack particulate matter, increased plume opacity, and concerns for plume "touchdown." These emission concerns are caused by increased SAM generated by SCR oxidation of SO_2 to SO_3 and its condensation to H_2SO_4 in the FGD. A temporary SAM Mitigation System was installed on Unit 2 in the summer of 2009 in response to the NOV. The SAM Mitigation Systems were installed with the expectation of SAM control to 5 ppm at the stack. The systems installed have not consistently controlled SAM to the 5 ppm expectation.

Utilizing milling technology on SAM Mitigation Systems is a new technology advancement. AES Somerset, Southern Company Plant Crist, Duke Zimmer, and Duke Gallagher plants have recently installed milling technology (AES having the longest service of over one year).

A Sturtevant mill was tested over a two week period on Ghent Unit 1 and Unit 4 in the summer of 2010 with positive reductions in visible opacity. A UCC mill was tested on Ghent Unit 4 in April of 2011 with positive reductions in visible opacity as well as reduced reagent consumption. A Hosokawa mill was tested at Ghent April of 2011; the Hosokawa mill experienced operational problems with bridging of material on the pins.

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

Project Description

- **Project Scope and Timeline**

  Project Engineering (PE) plans to mill the reagent for the two injection locations on Unit 1, 3, and 4. To this end, these units will get two mills with bypass capability such that the SAM Mitigation System can continue to feed un-milled reagent to the injection locations during maintenance cycles.

  The turnkey project will include civil, mechanical, electrical, and controls required to install permanent milling systems for all the Ghent Units. The milling equipment is anticipated to be skid mounted and pre-packaged for ease of installation.

March 2011	Bid Evaluation
May 2011	Contract Award
May - June 2011	Detail Engineering
June 2011	Site Mobilization
June – September 2011	Shop Fabrication
November 2011	Mechanical Completion
December 2011	Commercial Operation
January 2012	Turnover Packages Complete

Economic Analysis and Risks

- **Bid Summary**

Nol-Tec (marketing Sturtevant milling technology), BCSI/Nalco Mobotec (marketing Hosokawa milling technology), and UCC (marketing their own milling technology) bid on the installation of milling technology at Ghent.

The initial bids were received, assessed and technical meetings were held with each supplier. Best and Final Proposals were received following bid clarifications and technical meetings.

All three bidders have negotiated General Service Agreements on file or ready for execution.

The following table depicts the Best and Final Offer; a fully wrapped engineering, procurement and construction contract from the three vendors for milling at Units 1, 3, and 4:

	BCSI/Nalco Mobotec	UCC	Nol-Tec
MBE/WBE	No	No	No
Total Cost	*$2.5M*	*$2.1M*	*$2.5M*

The key mill performance indicator of a mill is the particle size after it is processed. Particle size is depicted by the percentage of material that is smaller than a stated micron; for example the "d50" term used in the table below means 50% of the material is smaller than the numerical micron value listed in the table. The milling performance guarantee for each vendor is depicted in the following table:

Milling Effectiveness	Nol-Tec	BCSI/Nalco	UCC
d50	10	12	15
d90	30	20	50

The technical team consisting of Project Engineering and Ghent Plant staff assessed each of the bids and each of the site milling tests. Nol-Tec was chosen as the preferred mill for the following reasons:

1. Best milling test performance. The Sturtevent mill did not surge during operation like the UCC and Hosokawa mills.
2. Best particle size milling performance guarantee
3. Nol-Tec defined the terminal points as required in the bid process. UCC did not define the terminal points in their proposal, generating concern for change orders.
4. Nol-Tec installed the existing SAM Mitigation systems and is best suited to dovetail the design, operation, and controls of the milling system with the existing SAM Mitigation systems.
5. Nol-Tec and their constructor UGS have continued to provide quality customer service and support on the existing SAM Mitigation systems.

6. Nol-Tec and their constructor UGS propose a strong Project Management and Construction team with past success at Ghent.

The low price bidder, UCC, was not chosen due to the following reasons:
1. The UCC mill amperage continuously surged during the testing period. This leads to concern for the robustness of design and the maximum throughput of reagent the equipment can handle.
2. Lack of detail in the proposal, particularly UCC did not define the terminal points in their proposal, generating concern for change orders.

- **Project Cost**

($000's)	**GH1**	**GH3**	**GH4**	TOTAL (all units)
Nol-Tec Cost	$777	$777	$897	$2,451
Owner's Cost	$597	$307	$326	$1,230
Contingency (10%)	$78	$78	$90	$245
Total	$1,452	$1,162	$1,312	$3,926

Owner's Costs including Project Management, Plant Support, Demolition Work, Abatement Work, Particle Size Testing Equipment and Spare Parts total $1,230k.

A 10% contingency is assessed to the contract price.

- **Assumptions**

Capital expenditures are based on $3.9M project cost estimate. Cash flow analysis is based on 39-year period. There is no O&M besides calculated Property Tax @ 0.15%.

- **Financial Summary ($000's)**

Summary by Unit

Capital Investment		**Pre-2011**	**2011**	**2012**	**2013**	**Post 2013**	**Total**
Unit 1	#130905	$189	$1,263				$1,452
Unit 3	#130907	$84	$1,078				$1,162
Unit 4	#130909	$153	$1,159				$1,312
Total		$426	$3,500	$0	$0	$0	$3,926

EBIT		Pre-2011	2011	2012	2013	Post 2013	Total
Unit 1	#130905	$10	$89	$153	$146	$2,056	$2,455
Unit 3	#130907	$5	$67	$123	$117	$1,645	$1,957
Unit 4	#130909	$8	$79	$138	$132	$1,858	$2,217
Total		$24	$235	$414	$396	$5,560	$6,629

Financial Detail by Year ($000s)	Pre 2011	2011	2012	2013	Post 2013	Total
1. Capital Investment Proposed	426	3,300				3,726
2. Cost of Removal Proposed	0	200				200
3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
4. Capital Investment 2011 MTP	875	16,050				16,925
5. Cost of Removal 2011 MTP	0	-				-
6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
7. Capital Investment variance to MTP (4-1)	449	12,750	-	-	-	13,199
8. Cost of Removal variance to MTP (5-2)	0	(200)	-	-	-	(200)
9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
10. Project O&M Proposed	0	-				-
11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
12. EBIT *	$24	$235	$414	$396	$5,560	6,629

*Refer to tables above and below for further details

Project Results By Unit:

	Unit 1 #130905	Unit 3 #130907	Unit 4 #130909	Total
Capital Expenditure	$1,452	$1,162	$1,312	$3,926
NPVRR	$1,807	$1,438	$1,631	$4,876
NPV	$33	$26	$30	$89
IRR	7%	7%	7%	7%
Discount Rate	6.68%	6.68%	6.68%	6.68%

- **Sensitivities**

SENSITIVITIES		**Change in EBIT**				**Change in NPVRR**	**Change in NPV**
		Pre 2011	**2011**	**2012**	**2013**		
Project Costs (capital +/-10%)							
Unit 1	#130905	$1	$9	$15	$15	$181	$3
Unit 3	#130907	$0	$7	$12	$12	$144	$3
Unit 4	#130909	$1	$8	$14	$13	$163	$3
Totals	All Units	$2	$24	$41	$40	$488	$9
Project Costs (O&M +/-10%)*		$0	$0	$0	$0	$0	$0
Availability Savings (+/-10%)*		$0	$0	$0	$0	$0	$0

*These lines include all units

- **Environmental**

New Source Review Evaluation, questions 1-6 (as applicable) must be completed on all investment proposals.		
1	Does the project include any new equipment or component with emissions, result in emissions not previously emitted or cause the unit to exceed any emission limit? If yes, Environmental Affairs is required to review this project. If no, go to Question #2.	NO
2	Question 2: Is the change a like-kind or functionally equivalent replacement under $500K? If yes, the project is not subject to NSR and no further evaluation is required. If no, go to Question #3.	NO
3	Question 3: Does the equipment change increase the emissions unit's maximum hourly heat input? If yes, Environmental Affairs is required to review this project. If no, go to Question #4.	NO
4	Question 4: Does the equipment change increase the emissions unit's electrical output? If yes, Environmental Affairs is required to review this project. If no, go to Question #5.	NO
5	Question 5: Has the equipment being repaired/replaced been repaired or replaced in the past at this unit or other units in the fleet? If no, Environmental Affairs is required to review this project. If yes, list any known projects and go to Question #6.	NO
6	Question 6: Have there been forced outages or unit de-rates in the past 5 years due to this component? If no, the project is not subject to NSR and no further evaluation is required; if the answer is yes, Environmental Affairs needs to review this project.	NO

- **Risks**

  This project sets out to reduce the risks associated with the NOV litigation from DOJ/EPA. Final terms on the SAM NOV have not been negotiated.

  Operational risks related to dry sorbent injection are low. The SAM Mitigation technology is in service under minor modifications to the existing Title V Operating Permit. Milling of TRONA has been performed at other utility sites with operational success. Milling of Hydrated Lime has not been performed at other operational sites. Hydrated Lime may react with CO_2 in air and plate on the milling equipment; this issue has not been observed with TRONA.

- **Other Alternatives Considered**

  An alternative to having mills installed for dry sorbent injection is to have a wet injection system. Wet and dry reagent injection systems are expected to have similar operations and maintenance labor requirements, however the wet injection system has higher water consumption and water treatment costs. Due to the following reasons, a dry sorbent injection is the recommended technology under the scenario of a 5 ppmvd SAM limit at the stack:

1. Lower capital cost (particularly with respect to the existing systems).
2. Better contractual terms and conditions.
3. Higher confidence in project execution.
4. Dry sorbent injection investment today will reduce equipment costs for the future CATR & NAAQS AQCS upgrades.
5. Reagent utilization is expected to improve with technology advancements on dry systems leveling the reagent cost (main factor in O&M cost) assessment between the two technologies.
6. LG&E and KU have existing dry sorbent injection operating experience.
7. PPL has negative experience with wet sorbent injection at the Montour Plant.

As part of meeting the anticipated Consent Decree SAM limits Project Engineering and the Ghent Plant have also considered:

1. Switch to lower sulfur fuels.
2. Install equipment to manage the boiler outlet temperature.
3. Install low conversion SCR catalyst.
4. Install in-duct mixing equipment to increase reagent utilization.

Conclusions and Recommendation

It is recommended that the Investment Committee approve the Ghent SAM Mitigation Mill Upgrades Project for Units 1, 3 and 4 for $3,926k. This project expenditure improves SAM Mitigation performance, generates goodwill with regulatory agencies, and provides a step toward sustaining a sub 5 ppm emission at the stack of each Unit.
Upon Investment Committee approval of this project a final contract will be prepared and released to Nol-Tec.

	A	B	C	D	E	F	G
1	**Financial Detail by Year ($000s)**	**Pre**	**2011**	**2012**	**2013**	**Post**	**Total**
2		**2011**				**2013**	
3	1. Capital Investment Proposed	426	3,300				3,726
4	2. Cost of Removal Proposed	0	200				200
5	3. Total Capital and Removal Proposed (1+2)	426	3,500	-	-	-	3,926
6	4. Capital Investment 2011 MTP	875	16,050				16,925
7	5. Cost of Removal 2011 MTP	0	-				-
8	6. Total Capital and Removal 2011 MTP (4+5)	875	16,050	-	-	-	16,925
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11	9. Total Capital and Removal variance to MTP (6-3)	449	12,550	-	-	-	12,999
12	10. Project O&M Proposed	0	-				-
13	11. Total Project Proposed (3+10)	426	3,500	-	-	-	3,926
14							
15	12. EBIT *	$24	$235	$414	$396	$5,560	6,629
16							

This AIP request is for an additional $426k ($189k for GH1, $84k for GH3, and $153k for GH$) for a total of $3.926M. The Ghent SAM project went before the Investment Committee on 4-28-11 for $3.5M approval for 2011. The additional $426 was pre-2011 spend for Engineering was not included in the original paper. It was, however, to be discussed in the 4-28-11 investment Committee meeting.

From:	Straight, Scott
To:	Reed, Kathleen
Sent:	5/13/2011 8:34:17 AM
Subject:	FW: PE's Bi-Weekly Update of 5-13-11.docx
Attachments:	PE's Bi-Weekly Update of 5-13-11.docx

From: Allgeier, Lana
Sent: Thursday, May 12, 2011 4:55 PM
To: Straight, Scott
Subject: PE's Bi-Weekly Update of 5-13-11.docx

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
May 13, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent Elevators – Inspections were completed by the State on Unit 1 and the Limestone Building. The last inspection is scheduled for 5/12/11.
    - Ghent Limestone Barge Modifications: Contractors are on site raising the cab of the limestone unloading barge and lowering the limestone unloading hopper. This work is being done to address safety and efficiency concerns raised by the plant.
    - Brown FGD – Third party FGD Performance Testing on high sulfur coal was completed on 3/25/11. Lab results have been received for Performance Testing samples and the report is being drafted by the testing company. A draft report is expected out this week. The station pulled a BR3 service water pump for inspection and found similar issues to the Goulds pumps at Ghent. The station is continuing to work with legal and Ghent to pursue the service water pump issues with the vendor as a warranty issue.
    - Brown Coal Pile Modification – Foundation and embankment placement is complete, except for the clay liner in the pond expansion. Clay placement is on hold for favorable weather conditions. Tie-in at the septic tank to occur within the next few weeks (waiting on favorable weather for clay backfill). KU has placed a few of the poles needed to relocate the RO building alarm line. Once the line is relocated, the breach into the existing coal pile runoff pond will occur.
    - Brown Elevators – Installation Nothing To Report (NTR)

- **TC2**
  - Safety – NTR
  - Schedule/Execution:
    - Bechtel EPC – There were difficulties with the startup centered around water quality and secondary air damper operation, the latter being the result of improperly insulated damper shaft bearings which caused overheating of the bearings and loss of lubrication Bechtel and the station are jointly reviewing the bearing design for this application. Bechtel has initiated an air flow verification program to address related operational issues within the combustion system.
  - Contract Disputes/Resolution:
    - Bechtel LD's – Meeting held with Brightman to review Owner's position on LDs.
    - Bechtel Labor Claim – NTR
    - The date of Material Change notice has been revised to May 20, 2011 to allow both parties more evaluation time of Test Burn results. A technical meeting with PE, the station, Bechtel, and Doosan is scheduled for May 12.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification.

        - Completion of punchlist.
- **Brown 3 SCR**
    - Safety – NTR
    - Engineering – Proceeding as planned.
    - Schedule/Execution – Proceeding to plan. Agreed on weld detail modification of the SCR vessel with BPEI and Zachry.
        - Completed multiple activities as reflected in the planned outage schedule, with minimal issues/concerns.
    - Issues/Risk – Drilling contractor encountered diesel smell while drilling one of the foundation piles. Work was paused, soil and water samples were taken and analyzed and the path forward was determined with assistance of EA – no ongoing concerns.

- **Ohio Falls Rehabilitation**
    - Schedule/Execution:
        - Continuing to coordinate with underwater repairs contractor regarding an alternate plan for work on gate slots; river level is dropping and is close to normal in the upper pool.
        - Voith has been instructed that the dewatered date of 06/06/11 for Unit 5 is in jeopardy and that PE will offer a new date for consideration.
        - Head gate modifications continue; upper gates are complete and ready for coating.
        - Tail gate modifications continue at a Louisville area river facility after the gates were relocated from an upriver site.
        - Proposals have been received and are being analyzed for the River Services work.
        - Bids have been received for station auxiliary upgrade and dewatering electrical work; the dewatering portion will be let 05/11/1.
        - Parking and laydown area expansion will begin 05/23/11 after a high water delay.
        - Readiness Review meeting with Voith was held on 05/04/11.
        - Asbestos abatement contractor began electrical demolition in the old fan/electrical room.
        - A Kingsbury thrust bearing rep will visit 05/11/11 to discuss their potential price increase; no orders committed yet.
        - Received quote for lease of office trailer for PE.
        - Received proposal from rigging contractor for design of rigging to handle the flood bulkhead, and a storage rack for inside storage.
    - Issues/Risk
        - Outstanding issue regarding Change of Law related international duty – potential $65k Change Order.
        - Standby costs may lead to Change Order based on not dewatering the Unit by 06/06/11.

- **Mill Creek Limestone Project**
    - Safety - NTR
    - Schedule/Execution

        - Detailed Engineering - General Contractor bids were received and are currently under review. Meetings with the top three bidders are being scheduled for the week of 5/16/11.

- **Cane Run CCP Project**
    - Permitting
        - All permitting proceeding well. 401 and Flood Plain permits received in 2010.
        - Continue to work with KYDWM on Landfill Permit application.
    - Engineering
        - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall has been completed and a recommendation from the Plant and PE will be presented shortly.

- **Trimble Co. Barge Loading/Holcim**
    - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
    - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design. B&V currently reviewing the scope of work and submitted a proposal.
    - Looking at potential scope changes as a result of lessons learned at Ghent on the Transport project.

- **TC CCP Project – BAP/GSP**
    - Safety – NTR
    - Schedule/Execution:
        - The setting of the GSP Raft has been substantially completed, except for resolution of issues regarding the mooring cables. .
        - All fill and mechanically stabilized earth wall work on the BAP
        - Work continues on, electrical duct banks to GSP Electrical Building. The duct bank from the Ash Pond Electrical Building to the Ash Pond Raft has been completed.
        - Work is now being concentrated on raising the South Dike due to the high water level inside of the BAP. All ten (10) piping systems have been switched-over from the existing system to the new system. The existing Southwest Pipe Culvert was demolished and fill has been completed to elevation 510 feet. With the completion to this elevation, the minimum freeboard distance from water elevation to dike has been reestablished. The work continues to track to the schedule established in early March.
        - Meeting was held on 05/10/11, to discuss raising of the BAP Raft to the next higher position.
    - Contract Disputes/Resolution
        - Project Engineering continues to work with Riverside on resolution on claims due to weather and engineering delays.

- Issues/Risk
  - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill

- Engineering
  - Detailed Engineering in progress with GAI.
  - LG&E Management met with Black & Veatch concerning the Final Conceptual Design of the CCR Treatment and Transportation Systems. The purpose of the meeting was to discuss alternatives.
- Permitting:
  - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
  - The review of the DWM Permit has been completed. The permit application was delivered on 05/06/11.
  - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC on 03/03/11. Additional permit information is being completed by GAI. The next set of information will be the geotechnical report for the bridge piers and abutment, which will be submitted to KTC by the end of April.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Working on the new 1-1 tanks.
      - Installation of the new 0-2 tank agitator has been completed
      - Bids have been reviewed for Civil/Mechanical Construction and a recommendation being sent to the IC.
    - Security Fence was awarded to Riverside/Nationwide and is currently under construction. Approximately 2/3 of the poles have been set.
    - Received the initial bids on the Gypsum Dewater belt package.
    - Reviewing the EPC scope of work with the Plant.
  - Permitting:
    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – Negotiations are complete with Deaton family in regards to pricing and terms of sale.

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Continue to work with Summit on contract settlement payout.

- Engineering – Detailed Engineering by MACTEC continues.
- Schedule/Execution:
  - All work in the field is currently related to the Aux. Pond Scope of Work.
  - Continued to place Type IIa-24 shot rock from the Starter Dike and Houp Property into the East embankment.
  - Gypsum placement on hold until density level in gypsum underflow tank reaches 45-50% after coming off the outage.
  - Continue to provide BR Landfill design information to MACTEC.
  - Continuing development of RFQ for conceptual design engineering of Wet-to-Dry Ash Handling conversion as part of the BR Landfill project.
  - Completed engineering change order as a result of unforeseen hydrogeologic requirements. Project continues to track within sanctioned amount. Mactec and drilling subcontractor on-site to begin dye-testing. Charah performed excavation to locate previously treated karst features to be used as dye injection sites. Mactec continues spring inventory and sampling.
- Issues/Risk:
  - Bathymetric Survey conducted on the Aux. Pond and preliminary results indicate construction schedule is attainable, but production rates are in excess of production rate forecast.
  - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
  - Final settlement reached with Summit on all outstanding claims by Summit.
  - Blasting suspended until third party blasting consultant evaluate alternatives to current blasting plan (neighborhood complaints). Blasting consultant on-site 5/10. Third party structural damage expert to evaluate surrounding property owners' claims. Interview of third party damage expert to be held week of 5/16.
  - Due to unforeseen hydrogeologic requirements, the landfill permit application submission to KYDWM will occur in late July/early Aug. instead of May.

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
  - Safety – NTR
  - Schedule/Execution:
    - Working on Contract with Nol-Tec for Mills.
    - Generated a Contract to demo the Ghent 1 Aux Boiler.
    - Contract prepared for B&W to perform Exit Gas Temperature Study.
    - New study proposal received from Alstom on 05/12/11. Performing review with expectation to release sole source contract week of 05/23/11.
    - EWB SAM calculations prepared for discussion on Fuel Switch capture requirements to meet rolling 12 month Title V requirements.
    - EWB SAM Mitigation BAFO due 05/13/11. URS is no bidding.
    - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal complete. Reports pending. Preparing BAFO RFQ for SAM Mitigation on all three Units at EWB. Expect release week of May 2.

- **Cane Run CCGT**
  - Budget – NTR
  - Gas Pipe Line Routing

- Site walk down with EN Engineering held May 2.
- ROW survey to begin 05/16/11. Affected owners notified.

Owner's Engineer

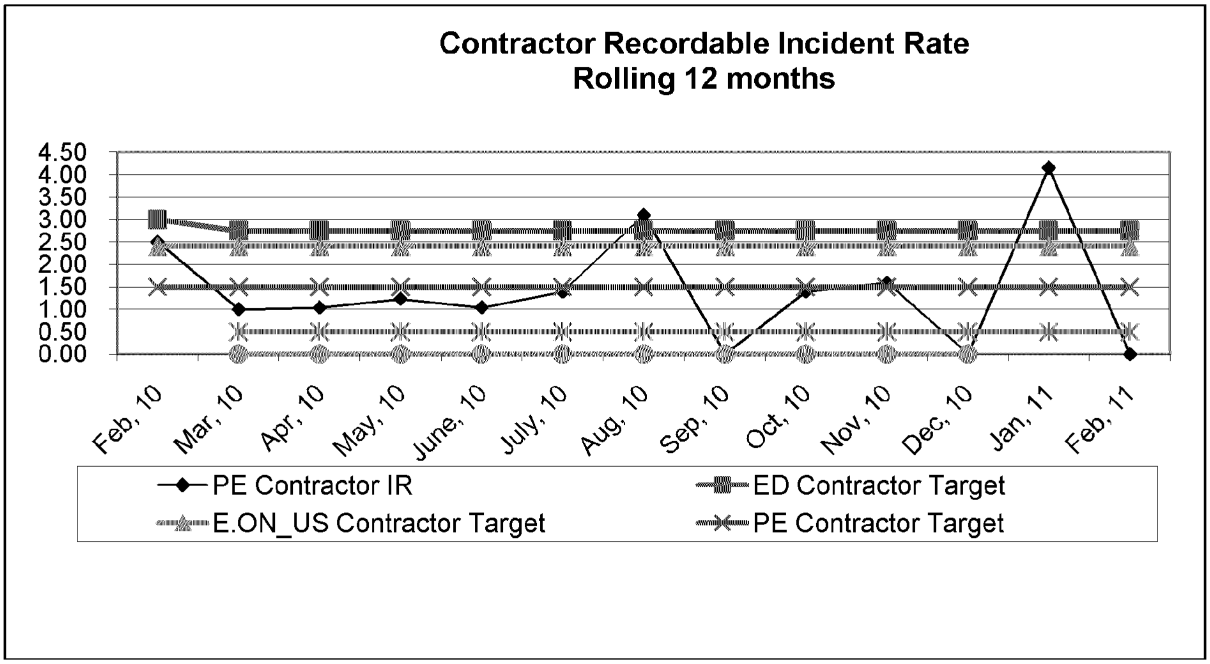
- Released EPRI document review work as part of the specification preparation.
- Site water routing drawings submitted.

- Prepared a new Vendor Prequalification schedule – Prequalification work to commence in September. Air Permitting
    - Completed information requests.
    - Next Meeting 05/17/11.
- Environmental Assessment
    - Completed information requests.
    - Delayed completion of work, no impact to project schedule.
- LS Power Purchase
    - Preparing SOW for Due Diligence for internal and external scopes – working towards a 06/01/11 due diligence start.

- **Other Generation Development**
    - Biomass – NTR
    - CCS 100 MW Project
        - Held Draft Report meeting in Houston on 05/05/11. Reviewed and commented on the Draft Report. Next draft due 05/20/11.
    - FutureGen – NTR

- **General**
    - Environmental Scenario Planning:
        - Various meetings continue to be held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
        - BPEI flow modeling of MC4 planned in Germany in May.
        - The short review of existing ESPs by B&W reveal improvements can be made to existing ESPs; however, to meet proposed MACT standards, FF still required.
        - All SCRs taken out of the plan for ECR filing.
    - Continue to work with Legal and EA on Ghent SAM compliance. Prepared technical and economic assessment for meeting 5ppm SAM at each Ghent Unit. Draft term sheet/proposal in circulation for submittal to DOJ/EPA week of April 7.
    - Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics:



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAY11	JUN11	JUL11	AUG11	SEP11	OCT11	NOV11	DEC11	Jan12	Feb12	Mar12	Apr12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C	6,000	May												
Heun	GH CCR - Gypsum Dewatering Belts	C		Jun												
Heun	GH CCR - Dry Fly Ash System	C		Jun												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		Jun												
Heun	GH CCR - Pipe Conveyor	C		Jun												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P														
Imber	BR 3 SAM Mitigation	C	8,000	Jun												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	Environmental Air Studies	P	3,250	May												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	105,123	Sep												
Saunders	Environmental Air Compliance - BR 2 Fabric Filter	P	113,602	Sep												
Saunders	Environmental Air Compliance - BR 3 Fabric Filter	P	117,196	Sep												
Saunders	Environmental Air Compliance - MC 1 & 2 Combined FGD	P	358,635	Sep												
Saunders	Environmental Air Compliance - MC 1 Fabric Filter	P	145,751	Sep												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	142,656	Sep												
Saunders	Environmental Air Compliance - MC 3 Fabric Filter	P	140,191	Sep												
Saunders	Environmental Air Compliance - MC4 FGD	P	218,431	Sep												
Saunders	Environmental Air Compliance - MC4 SCR Upgrade	P	5,606	Sep												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	151,643	Sep												
Saunders	Environmental Air Compliance - GH1 Fabric Filter	P	147,685	Sep												
Saunders	Environmental Air Compliance - GH2 Fabric Filter	P	156,808	Sep												
Saunders	Environmental Air Compliance - GH3 Fabric Filter	P	182,210	Sep												
Saunders	Environmental Air Compliance - GH4 Fabric Filter	P	168,587	Sep												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jul												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Mar												
Williams	BR CCR - Ash Handling Dry Conversion	C		Aug												

- **Staffing**
    - Headcount planning is in process to evaluate staffing needs to manage the 2011MTP projects. Final draft will not be finalized until scope settles out for ECR filing.
    - Phone screen interviews for Electrical Engineer to replace Jason Finn have been completed and first round of interviews is presently being arranged.
    - PE Re-Organization is now in the transition phase.
    - Requisition for Contract Administrator signed by RSS and JV on 3/31/11 and delivered to HR same day. ***This position is critical*** to fill given the significant commercial activities in PE for 2011, 2012 and 2013.
    - Posting for Business Analyst delayed by HR as Comp assigns pay range.

From:	Straight, Scott
To:	Reed, Kathleen
Sent:	5/13/2011 9:36:05 AM
Subject:	
Attachments:	PE's Bi-Weekly Update of 5-13-11.docx

Kathleen,

Make sure the project timeline is the latest in this. If not, please replace it and send the file back to me.

Scott Straight, P.E.
Director, Project Engineering
LG&E and KU Energy, LLC
(502) 627-2701
scott.straight@lge-ku.com

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
May 13, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent
      - Elevators – Inspections were completed by the State on Unit 1 and the Limestone Building. The last inspection is scheduled the week of May 13th.
      - Ghent Limestone Barge Modifications: Contractors are on site raising the cab of the limestone unloading barge and lowering the limestone unloading hopper. This work is being done to address safety and efficiency concerns.
    - Brown FGD
      - Performance Testing - Lab results have been received and the testing company's draft report is expected within a week.
      - SW Pumps - The station pulled a BR3 service water pump for inspection and found corrosion issues to the Goulds pumps similar to those at Ghent. The station is continuing to work with Legal and Ghent to pursue the service water pump issues with the vendor as a warranty issue.
      - Coal Pile Modification – Foundation and embankment placement is complete, except for the clay liner in the pond expansion. Clay placement is on hold for favorable weather conditions.
      - Elevators – NTR

- **TC2**
  - Safety – NTR
  - Schedule/Execution:
    - Bechtel EPC – There were difficulties with the startup centered around water quality and secondary air damper operation, the latter being the result of improperly insulated damper shaft bearings which caused overheating of the bearings and loss of lubrication. Bechtel and the station are jointly reviewing the bearing design for this application. Bechtel has initiated an air flow verification program to address related operational issues within the combustion system.
    - Punchlist – the station is managing the warranty punchlist and the closure of the remaining construction punchlist. PE to stay engaged to support the station and to manage the contractual issues.
  - Contract Disputes/Resolution:
    - Bechtel
      - LD's – Meeting held with Brightman to review Owner's position.
      - Bechtel Labor Claim – NTR
      - CSC - The date of Material Change notice has been revised to May 20, 2011 to allow both parties more evaluation time of Test Burn results.

A technical meeting with PE, the station, Bechtel, and Doosan was held on May 12.

- Issues/Risk:
  - Design of the DBEL burners for our coal specification.
  - Completion of punchlist.

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – Proceeding as planned.
  - Schedule/Execution – Proceeding to plan.
    - Agreed on weld detail modification of the SCR vessel with BPEI and Zachry.
    - Completed multiple activities as reflected in the planned outage schedule, with minimal issues/concerns.
  - Issues/Risk – Drilling contractor encountered diesel smell while drilling one of the foundation piles. Work was paused, soil and water samples were taken and analyzed and the path forward was determined with assistance of EA – no ongoing concerns.

- **Ohio Falls Rehabilitation**
  - Schedule/Execution:
    - Continuing to coordinate with underwater repairs contractor regarding an alternate plan for work on gate slots; river level is dropping and is close to normal in the upper pool.
    - Voith has been instructed that the dewatered date of 06/06/11 for Unit 5 is in jeopardy and that PE will offer a new date for consideration that is likely to be one month delay.
    - Head gate modifications continue; upper gates are complete and ready for coating.
    - Tail gate modifications continue at a Louisville area river facility after the gates were relocated from an upriver site.
    - Proposals have been received and are being analyzed for the River Services.
    - Bids have been received for station auxiliary upgrade and dewatering electrical work.
    - Parking and lay-down area expansion will begin after the high water delay.
    - Readiness Review meeting with Voith was held on 05/04/11.
    - Asbestos abatement contractor began electrical demolition in the old fan/electrical room.
    - Received proposal from rigging contractor for design of rigging to handle the flood bulkhead, and a storage rack for inside storage.
  - Issues/Risk
    - Outstanding issue regarding Change of Law related international duty – potential $65k Change Order.
    - Standby costs may lead to Change Order based on not dewatering the Unit by 06/06/11 due to high flood waters.

- **Mill Creek Limestone Project**
  - Safety - NTR
  - Schedule/Execution

        - Detailed Engineering - General Contractor bids were received and are currently under review. Meetings with the top three bidders are being scheduled for the week of 5/16/11.

- **Cane Run CCP Project**
    - Permitting
        - All permitting proceeding well.
        - Continue to work with KYDWM on Landfill Permit application.
    - Engineering
        - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall has been completed and a recommendation from the Plant and PE to continue to obtain the permit for the new landfill, apply for a permit modification of the existing landfill and raise the existing landfill to avoid constructing the new landfill was made to Bowling. Meeting to be arranged with PWT for final review of recommendation.

- **Trimble Co. Barge Loading/Holcim**
    - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
    - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design. B&V currently reviewing the scope of work and submitted a proposal.
    - Looking at potential scope changes as a result of lessons learned at Ghent on the Transport project.

- **TC CCP Project – BAP/GSP**
    - Safety – NTR
    - Schedule/Execution:
        - The setting of the GSP Raft has been substantially completed.
        - Work continues on the electrical duct banks to GSP Electrical Building. The duct bank from the Ash Pond Electrical Building to the Ash Pond Raft has been completed.
        - With the other dikes being raised to their final height, work is now being concentrated on raising the South Dike due to the high water level inside of the BAP. All ten (10) piping systems have been switched-over from the existing system to the new system. The existing Southwest Pipe Culvert was demolished and fill has been completed to elevation 510 feet. With the completion to this elevation, the minimum freeboard distance from water elevation to dike has been reestablished. The work continues to track to the schedule established in early March.
    - Contract Disputes/Resolution
        - Riverside claims due to weather and engineering delays are being addressed.
    - Issues/Risk
        - Weather remains the biggest risk to timing of completion and cost.

TC CCP Project – Landfill
- Engineering
  - Detailed Engineering in progress with GAI.
  - Meeting held with Black & Veatch concerning the Final Conceptual Design of the CCR Treatment and Transportation Systems.
- Permitting:
  - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
  - The review of the DWM Permit has been completed. The permit application was delivered on 05/06/11.
  - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC in April.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Working on the new 1-1 tanks.
      - Installation of the new 0-2 tank agitator has been completed
      - Bids have been reviewed for Civil/Mechanical Construction and a recommendation being sent to the IC.
    - The security fence around the perimeter of the land recently purchased was awarded to Riverside/Nationwide and is currently under construction.
    - Received the initial bids on the Gypsum Dewater belt package.
    - Reviewing the EPC scope of work with the Plant.
  - Permitting:
    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – A contract was signed with the Deatons. **This essentially concludes the purchase of land essential for the landfill project.**

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Engineering – Detailed Engineering by MACTEC continues.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Continue to place Type IIa-24 shot rock from the Starter Dike and Houp Property into the East embankment.
    - Gypsum placement on hold until density level in gypsum underflow tank reaches 45-50% after coming off the outage.
    - MACTEC and drilling subcontractor on-site to begin dye-testing. Charah performed excavation to locate previously treated karst features to be used as dye injection sites. Mactec continues spring inventory and sampling.

- Issues/Risk:
  - Bathymetric Survey conducted on the Aux. Pond and preliminary results indicate construction schedule is attainable, but production rates are in excess of production rate forecast.
  - Summit/Cook/PPMI pulled the North Wet Well Pumps for repair (possible gypsum erosion of the impellers).
  - **Final settlement reached with Summit on all outstanding claims by Summit.**
  - Blasting suspended until third party blasting consultant evaluates alternatives to current blasting plan (neighborhood complaints). PE supported the station's meeting with the neighbors. PE working with Risk Management to obtain a third party structural damage expert to evaluate surrounding property owners' claims.
  - Due to unforeseen hydrogeologic requirements, the landfill permit application submission to KYDWM will be deferred from May to late July/early Aug.

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
  - Safety – NTR
  - Schedule/Execution:
    - Working on Contract with Nol-Tec for Mills for Ghent.
    - Contract approved to demo the Ghent 1 Aux Boiler.
    - Contract prepared for B&W to perform Exit Gas Temperature Study.
    - New study proposal received from Alstom on 05/12/11. Performing review with expectation to release contract the week of 05/23/11.
    - EWB SAM calculations prepared for discussion on Fuel Switch capture requirements to meet rolling 12 month Title V requirements.
    - EWB SAM Mitigation BAFO due 05/13/11. URS is no bidding their wet system.
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  - Budget – NTR
  - Gas Pipe Line Routing
    - Site walk down with EN Engineering held May 2.
    - ROW survey to begin 05/16/11. Affected owners notified.

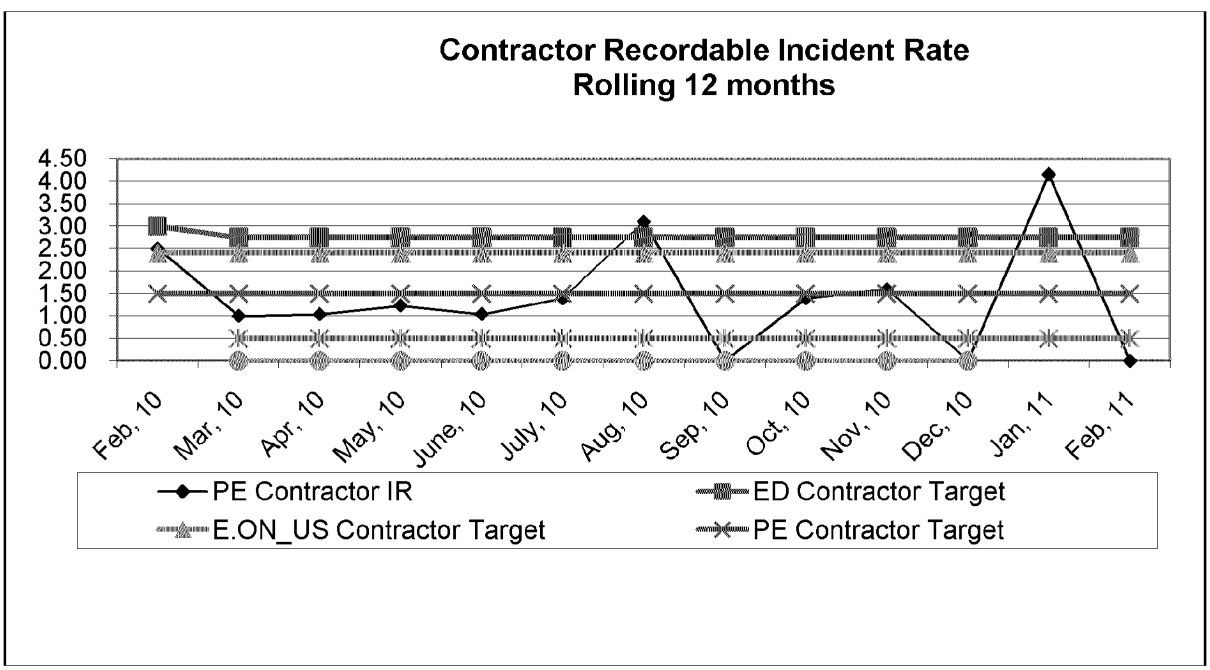
  Owner's Engineer
    - Released EPRI document review work as part of the specification preparation.
    - Site water routing drawings submitted.
  - Prepared a new Vendor Prequalification schedule – Prequalification work to commence in September. Air Permitting
    - Completed information requests.
    - Next Meeting 05/17/11.
  - Environmental Assessment
    - Completed information requests.
    - Delayed completion of work, no impact to project schedule.
  - LS Power Purchase

        - Preparing SOW for Due Diligence for internal and external scopes – working towards a 06/01/11 due diligence start.

- **Other Generation Development**
    - Biomass – NTR
    - CCS 100 MW Project
        - Held Draft Report meeting in Houston on 05/05/11. Reviewed and commented on the Draft Report. Next draft due 05/20/11.
    - FutureGen – NTR

- **General**
    - Environmental Scenario Planning:
        - Various meetings continue to be held with Gen Planning, Rates & Regulatory to continue honing the plan and various compliance scenarios.
        - BPEI flow modeling of MC4 planned in Germany in May.
        - The short review of existing ESPs by B&W reveal improvements can be made to existing ESPs; however, to meet proposed MACT standards, FF still required.
        - All SCRs taken out of the plan for ECR filing.
    - Continue to work with Legal and EA on Ghent SAM compliance. Prepared technical and economic assessment for meeting 5ppm SAM at each Ghent Unit. Draft term sheet/proposal in circulation for submittal to DOJ/EPA week of April 7.
    - Continue to work with Legal on asbestos litigation regarding construction of TC1.

<u>Metrics:</u>



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAY11	JUN11	JUL11	AUG11	SEP11	OCT11	NOV11	DEC11	Jan12	Feb12	Mar12	Apr12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C	6,000	May												
Heun	GH CCR - Gypsum Dewatering Belts	C		Jun												
Heun	GH CCR - Dry Fly Ash System	C		Jun												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		Jun												
Heun	GH CCR - Pipe Conveyor	C		Jun												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P														
Imber	BR 3 SAM Mitigation	C	8,000	Jun												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	Environmental Air Studies	P	3,250	May												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	105,123	Sep												
Saunders	Environmental Air Compliance - BR 2 Fabric Filter	P	113,602	Sep												
Saunders	Environmental Air Compliance - BR 3 Fabric Filter	P	117,196	Sep												
Saunders	Environmental Air Compliance - MC 1 & 2 Combined FGD	P	358,635	Sep												
Saunders	Environmental Air Compliance - MC 1 Fabric Filter	P	145,751	Sep												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	142,656	Sep												
Saunders	Environmental Air Compliance - MC 3 Fabric Filter	P	140,191	Sep												
Saunders	Environmental Air Compliance - MC4 FGD	P	218,431	Sep												
Saunders	Environmental Air Compliance - MC4 SCR Upgrade	P	5,606	Sep												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	151,643	Sep												
Saunders	Environmental Air Compliance - GH1 Fabric Filter	P	147,685	Sep												
Saunders	Environmental Air Compliance - GH2 Fabric Filter	P	156,808	Sep												
Saunders	Environmental Air Compliance - GH3 Fabric Filter	P	182,210	Sep												
Saunders	Environmental Air Compliance - GH4 Fabric Filter	P	168,587	Sep												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jul												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Mar												
Williams	BR CCR - Ash Handling Dry Conversion	C		Aug												

- **Staffing**
  - Headcount planning is nearly complete now that the projects are known for the 2011 ECR filing.
  - Phone screen interviews for Electrical Engineer to replace Jason Finn have been completed and first round of interviews is presently being arranged.
  - Requisition for Contract Administrator signed by RSS and JV on 3/31/11. The additional justification was approved by RSS, Voyles and Hincker and is awaiting approval from PWT. ***This position is critical*** to fill given the significant commercial activities in PE for 2011, 2012 and 2013.
  - Posting for Business Analyst delayed by HR as Comp assigns pay range.

From:	Straight, Scott
To:	Thompson, Paul; Voyles, John; Bowling, Ralph; Hudson, Rusty; Hincker, Loren; Sinclair, David; Schetzel, Doug; Jackson, Fred; Sebourn, Michael
CC:	Waterman, Bob; Imber, Philip; Lively, Noel; Saunders, Eileen; Gregory, Ronald; Heun, Jeff; Hance, Chuck; Clements, Joe; Jones, Greg; Keeling, Chip; Hendricks, Claudia; Ray, Barry; O'brien, Dorothy (Dot); Bellar, Lonnie; Blake, Kent; Sturgeon, Allyson; Conroy, Robert; Cornett, Greg; Huguenard, Jim
Sent:	5/13/2011 9:38:37 AM
Subject:	Project Engineering's ES Bi-Weekly Report - May 13, 2011
Attachments:	PE's Bi-Weekly Update of 5-13-11.docx

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
May 13, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent
      - Elevators – Inspections were completed by the State on Unit 1 and the Limestone Building. The last inspection is scheduled the week of May 13th.
      - Ghent Limestone Barge Modifications: Contractors are on site raising the cab of the limestone unloading barge and lowering the limestone unloading hopper. This work is being done to address safety and efficiency concerns.
    - Brown FGD
      - Performance Testing - Lab results have been received and the testing company's draft report is expected within a week.
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      - Coal Pile Modification – Foundation and embankment placement is complete, except for the clay liner in the pond expansion. Clay placement is on hold for favorable weather conditions.
      - Elevators – NTR

- **TC2**
  - Safety – NTR
  - Schedule/Execution:
    - Bechtel EPC – There were difficulties with the startup centered around water quality and secondary air damper operation, the latter being the result of improperly insulated damper shaft bearings which caused overheating of the bearings and loss of lubrication. Bechtel and the station are jointly reviewing the bearing design for this application. Bechtel has initiated an air flow verification program to address related operational issues within the combustion system.
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  - Contract Disputes/Resolution:
    - Bechtel
      - LD's – Meeting held with Brightman to review Owner's position.
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      - CSC - The date of Material Change notice has been revised to May 20, 2011 to allow both parties more evaluation time of Test Burn results.

A technical meeting with PE, the station, Bechtel, and Doosan was held on May 12.

- Issues/Risk:
    - Design of the DBEL burners for our coal specification.
    - Completion of punchlist.

- **Brown 3 SCR**
    - Safety – NTR
    - Engineering – Proceeding as planned.
    - Schedule/Execution – Proceeding to plan.
        - Agreed on weld detail modification of the SCR vessel with BPEI and Zachry.
        - Completed multiple activities as reflected in the planned outage schedule, with minimal issues/concerns.
    - Issues/Risk – Drilling contractor encountered diesel smell while drilling one of the foundation piles. Work was paused, soil and water samples were taken and analyzed and the path forward was determined with assistance of EA – no ongoing concerns.

- **Ohio Falls Rehabilitation**
    - Schedule/Execution:
        - Continuing to coordinate with underwater repairs contractor regarding an alternate plan for work on gate slots; river level is dropping and is close to normal in the upper pool.
        - Voith has been instructed that the dewatered date of 06/06/11 for Unit 5 is in jeopardy and that PE will offer a new date for consideration that is likely to be one month delay.
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        - Proposals have been received and are being analyzed for the River Services.
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        - Asbestos abatement contractor began electrical demolition in the old fan/electrical room.
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    - Issues/Risk
        - Outstanding issue regarding Change of Law related international duty – potential $65k Change Order.
        - Standby costs may lead to Change Order based on not dewatering the Unit by 06/06/11 due to high flood waters.

- **Mill Creek Limestone Project**
    - Safety - NTR
    - Schedule/Execution

        - Detailed Engineering - General Contractor bids were received and are currently under review. Meetings with the top three bidders are being scheduled for the week of 5/16/11.

- **Cane Run CCP Project**
    - Permitting
        - All permitting proceeding well.
        - Continue to work with KYDWM on Landfill Permit application.
    - Engineering
        - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall has been completed and a recommendation from the Plant and PE to continue to obtain the permit for the new landfill, apply for a permit modification of the existing landfill and raise the existing landfill to avoid constructing the new landfill was made to Bowling. Meeting to be arranged with PWT for final review of recommendation.

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    - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
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    - Looking at potential scope changes as a result of lessons learned at Ghent on the Transport project.

- **TC CCP Project – BAP/GSP**
    - Safety – NTR
    - Schedule/Execution:
        - The setting of the GSP Raft has been substantially completed.
        - Work continues on the electrical duct banks to GSP Electrical Building. The duct bank from the Ash Pond Electrical Building to the Ash Pond Raft has been completed.
        - With the other dikes being raised to their final height, work is now being concentrated on raising the South Dike due to the high water level inside of the BAP. All ten (10) piping systems have been switched-over from the existing system to the new system. The existing Southwest Pipe Culvert was demolished and fill has been completed to elevation 510 feet. With the completion to this elevation, the minimum freeboard distance from water elevation to dike has been reestablished. The work continues to track to the schedule established in early March.
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- Engineering
  - Detailed Engineering in progress with GAI.
  - Meeting held with Black & Veatch concerning the Final Conceptual Design of the CCR Treatment and Transportation Systems.
- Permitting:
  - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
  - The review of the DWM Permit has been completed. The permit application was delivered on 05/06/11.
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  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
      - Working on the new 1-1 tanks.
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      - Bids have been reviewed for Civil/Mechanical Construction and a recommendation being sent to the IC.
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    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – A contract was signed with the Deatons. **This essentially concludes the purchase of land essential for the landfill project.**

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  - Safety – NTR
  - Engineering – Detailed Engineering by MACTEC continues.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Continue to place Type IIa-24 shot rock from the Starter Dike and Houp Property into the East embankment.
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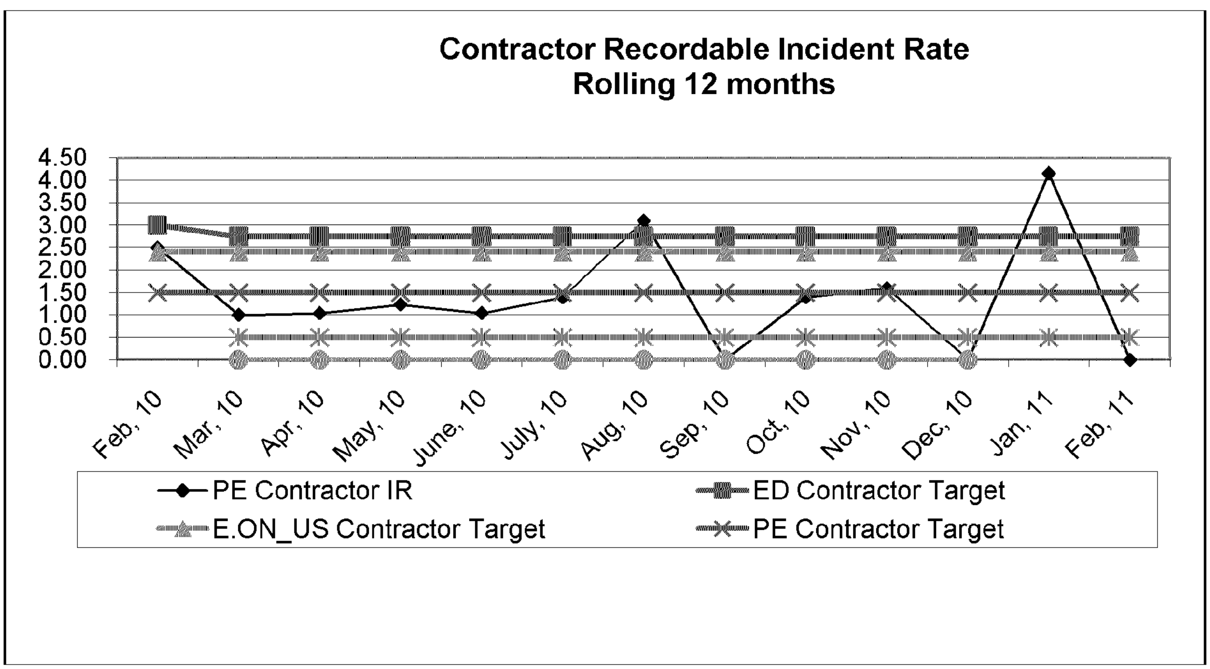
Metrics:



Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAY11	JUN11	JUL11	AUG11	SEP11	OCT11	NOV11	DEC11	Jan12	Feb12	Mar12	Apr12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C	6,000	May												
Heun	GH CCR - Gypsum Dewatering Belts	C		Jun												
Heun	GH CCR - Dry Fly Ash System	C		Jun												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		Jun												
Heun	GH CCR - Pipe Conveyor	C		Jun												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P														
Imber	BR 3 SAM Mitigation	C	8,000	Jun												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	Environmental Air Studies	P	3,250	May												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	105,123	Sep												
Saunders	Environmental Air Compliance - BR 2 Fabric Filter	P	113,602	Sep												
Saunders	Environmental Air Compliance - BR 3 Fabric Filter	P	117,196	Sep												
Saunders	Environmental Air Compliance - MC 1 & 2 Combined FGD	P	358,635	Sep												
Saunders	Environmental Air Compliance - MC 1 Fabric Filter	P	145,751	Sep												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	142,656	Sep												
Saunders	Environmental Air Compliance - MC 3 Fabric Filter	P	140,191	Sep												
Saunders	Environmental Air Compliance - MC4 FGD	P	218,431	Sep												
Saunders	Environmental Air Compliance - MC4 SCR Upgrade	P	5,606	Sep												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	151,643	Sep												
Saunders	Environmental Air Compliance - GH1 Fabric Filter	P	147,685	Sep												
Saunders	Environmental Air Compliance - GH2 Fabric Filter	P	156,808	Sep												
Saunders	Environmental Air Compliance - GH3 Fabric Filter	P	182,210	Sep												
Saunders	Environmental Air Compliance - GH4 Fabric Filter	P	168,587	Sep												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jul												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Mar												
Williams	BR CCR - Ash Handling Dry Conversion	C		Aug												

- **Staffing**
  - Headcount planning is nearly complete now that the projects are known for the 2011 ECR filing.
  - Phone screen interviews for Electrical Engineer to replace Jason Finn have been completed and first round of interviews is presently being arranged.
  - Requisition for Contract Administrator signed by RSS and JV on 3/31/11. The additional justification was approved by RSS, Voyles and Hincker and is awaiting approval from PWT. ***This position is critical*** to fill given the significant commercial activities in PE for 2011, 2012 and 2013.
  - Posting for Business Analyst delayed by HR as Comp assigns pay range.

From:	Saunders, Eileen
To:	Straight, Scott
CC:	Ritchey, Stacy; Reed, Kathleen
Sent:	5/16/2011 9:07:49 AM
Subject:	DRAFT - IC Additional Authorization Paper
Attachments:	[Untitled].pdf; Environmental Air additional funding request-SSA for B&V.doc

Scott,

I am moving as quickly as possible to get B&V on board to begin the specification development. Rusty said if I got the paper to him as soon as possible he would help me get an electronic vote of approval. Stacy has reviewed the financials. I am including the new request and the original request for reference. Feel free to use the "Straight" red pen!

Thanks,

Eileen

Original SSA that was approved in August.

Eileen Lamar Saunders
Manager, Major Capital Projects
LG&E and KU Services Company
820 W. Broadway (BOC)
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BOC: (502) 627-2431
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Russel A. Hudson
Director, Generation Acctg and Budgeting

220 West Main Street
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F (502) 627-2665
Rusty.hudson@eon-us.com

September 3, 2010

To: John Voyles
Ralph Bowling
Paul Thompson
Brad Rives
Vic Staffieri

Re: Sole Source Authorization – Black & Veatch

The Black & Veatch sole source authorization for $2.0m to continue advancing engineering on the 2011 MTP environmental air compliance was approved electronically by the Investment Committee on September 2, 2010. A copy of the approval notification is attached.

Please let me know of any questions that you have, and kindly return this to me after signing.

Rusty Hudson

Rusty Hudson

Attachment

Investment Proposal for IC:	August 31, 2010
Project Name:	MTP Engineering – Air Compliance Projects
Total Expenditures:	$2,000K
Project Number:	131693 – LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Generation
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, State and Federal air compliance regulations through 2016.

In addition to requesting approval of a new engineering project that will continue refining the 2011 MTP air compliance scope, this request also seeks approval of a sole source award to Black &Veatch (B&V) engineering firm. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Background

Starting this year and continuing for the next two years, the United States Environmental Protection Agency (USEPA) will be developing and implementing several new environmental regulations. These new regulations will significantly impact our coal-fired electric generating units and will affect all environmental areas of air, water and land. The pollutants targeted in three of the new air regulations are SO_2 and NO_x. There is a recent new 1-hour National Ambient Air Quality Standard (NAAQS) for SO_2 and NO_x that will require lower emission rates at several of the stations and the CAIR rule is proposed to be replace by a new Clean Air Transport Rule (CATR). Each will require additional reductions in SO_2 and NO_x. In 2011, the USEPA is expected to propose and finalize an Electric Utility Maximum Achievable Control Technology Rule (MACT). The MACT rule will require significant reductions in hazardous air pollutants such as mercury and acid gases (i.e., SO_3/H_2SO_4 emissions) which are also emitted from the LG&E and KU coal-fired electric generation fleet.

In May of 2010, Project Engineering was asked to investigate the technological and financial impacts of new environmental air regulations on the KU and LG&E coal-fired units. B&V was hired through a competitive bid process at a contract valued at $149K and given six weeks to provide a high level estimate based on site visits, data collection from the plants and industry experience. As a result of this Phase I effort, approximately $4 billion (escalated) of Air

Emissions Mitigation System additions and retrofits were identified as possible scenarios for bringing the fleet into compliance with the projected standards.

Through the approval of this investment/contract proposal, B&V will be contracted with to continue with Phase II of the engineering and estimating effort. This effort will provide a facility-specific project definition consisting of conceptual designs and budgetary cost estimates for selected air quality control technologies. This effort will result in a Level 1 Engineering assessment for Mill Creek, Ghent and EW Brown. The work for each facility will be staggered with the Mill Creek effort commencing first.

Award of the Phase II work to B&V will provide continuity to the initial study work. The contract will be on a time and material basis, not-to-exceed sole source contract, with a value of $1.6M. Black and Veatch will keep their original team in place to gain efficiencies for the Phase II work. The scope of their work will include activities/deliverables such as the following:

- Kick-Off Meetings at each facility
- Conceptual Design
- Building and Plant Arrangements
- Technology Screening
- Constructability Plans
- Project Cost Estimates including Cash Flows
- Refined Implementation Schedules

The remainder of the investment funding will cover costs of internal labor and expenses and the use of other external engineering /construction firms to review existing air pollution control technology performance enhancement options. Two examples of this would be hiring Riley Power (the original SCR technology firm) to review/model NOx emission reduction improvements on the existing Mill Creek 4 SCR that they originally design in 2002 and their review of improvements to the Mill Creek FGDs similar to the improvements they designed for TC1's FGD improvements as part of the TC2 Project.

Project timeline:

Level I Engineering	**Begin**	**Complete**
Mill Creek	August 2010	March 2011
Ghent	October 2010	April 2011
Brown	January 2011	May 2011

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only sanction to continue refining and developing the scopes, schedules and cost estimates for projects throughout the coal-fired fleet within LG&E and KU to comply with pending air regulations. Each project identified in this continuance of studies will seek sanction independent of this

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the Background section above.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2010 MTP/LTP	$0.0	$0.0	$0.0
Current Proposal	$.75	$1.25	$2.0

Sensitivities

None performed.

Risks

The 2011 draft MTP includes approximately $3 billion in air compliance projects identified with scope identification, schedules and cost estimates based on minimum (much less than Level I Engineering) engineering analyses. Disapproving this sanction will result in the continuance of generation planning for compliance with pending or proposed air regulations with scopes, schedules and estimates that have a significant margin of error.

Other Alternatives Considered

None

Conclusions and Recommendation

It is the recommendation of Project Engineering and Power Production to approve the continuance of studying and analyzing the scopes and options necessary to comply with pending or proposed air compliance regulations for the KU and LG&E coal-fired generating units. The continuance of these studies will lead to better definition of scopes, implementation schedules and cost estimates of major capital projects to comply with the air regulations that will be incorporated into the 2011 and 2012 MTP plans. Approval is also requested to award B&V a sole source award for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

sole source award on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

Eileen Saunders Manager Major Capital Projects	9/3/10 Scott Straight Director Project Engineering
9/7/10 John Voyles VP Transmission & Gen. Services	Ralph Bowling VP Power Production
for P. Thompson 9/7/10 Paul Thompson SVP Energy Services	9/9/10 Brad Rives Chief Financial Officer
Victor A. Staffieri Chief Executive Officer	

Hudson, Rusty

From: Kuhl, Megan
Sent: Thursday, September 02, 2010 9:28 AM
To: Hudson, Rusty
Subject: FW: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects
Attachments: 2011 MTP Level I Engineering - Air Compliance Projects.docx

The MTP Engineering proposal has been approved by the Investment Committee.

From: Kuhl, Megan
Sent: Friday, August 27, 2010 11:34 AM
To: Rives, Brad; Thompson, Paul; McCall, John; Hermann, Chris
Cc: Garrett, Chris; Neal, Susan; Blake, Kent; Kaiser, Pat
Subject: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, state and federal air compliance regulations through 2016.

Authority is also requested for a sole source award to Black & Veatch (B&V) engineering firm for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Please send your approval/rejection by COB Wednesday, September 1.

Thank you,

Megan Kuhl
Financial Analyst I, Financial Planning
E.ON U.S.
(502) 627-3716
megan.kuhl@eon-us.com

Investment Proposal for IC:	
Project Name:	MTP and 2011 ECR Engineering- Air Compliance Projects
Total Expenditures:	$3,250K
Project Number:	131693 LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Power Production
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks additional authorization of $1,000K to the existing Black & Veatch ("B&V") engineering contract to begin the project specification development and procurement efforts of major equipment necessary to support the Environmental Air Compliance implementation activities.

Previously, $2,000K was authorized to continue to refine the scopes, implementation schedules and cost estimates originally identified in the development of the 2011 MTP. BB&V engineering firm was retained and completed in their Phase I effort. This request also includes a sole source award recommendation to award B&V a change order of $413,000k to assist Project Engineering and the stations in the development of specifications for the 12 Pulse Jet Fabric Filters (baghouses) for E.W. Brown, Mill Creek, Ghent and Trimble County 1, as well as the development and bid supporting for the WFGD specifications for Mill Creek and fan specifications for all units listed in the 2011 ECR filing.

The remainder of the sanction will cover costs of internal labor and expenses, as well as the use of other engineering or construction firms asnecessary to support the specification development effort.

The Environmental Air Studies AIP was originally for $2,000K and was approved by the Investment Committee in September of 2010, but did not include the approved Mercury Study dollars. Mercury Compliance Study was approved by the Investment Committee in May 2009. These studies were conducted in 2009 and 2010. In Sept 2010, it was decided to combine the $250k Mercury Compliance Studies (125607 & 125609) with the newly approved Environmental Air Studies (131693 & 131694) for a total of $2.25M. All charges to the Mercury Compliance projects were moved to the Environmental Air Studies in Sept 2010.

Background

The background for this work is detailed in the original IC paper from August 31, 2010. Essentially, this authorization will give Project Engineering the ability to begin putting the procurement strategies in place that will enable us to react in a more timely fashion upon receipt of the ECR approvals and receipt of the EPA final ruling in November, 2011.

Project Description

The purpose of this scope of work is for B&V to support LG&E and KU with its Global Purchase Program of Air Quality Control Equipment at the Mill Creek, Ghent, Brown, and Trimble County facilities. B&V will assist LG&E KU with the following 3 Tasks:

Task 1 – WFGD Specification Development and Support through Award
Task 2 – PJFF Specification Development and Support through Award
Task 3 – Fan Specification Development and Support through Award

Project Timeline

Project	Begin	Complete
Phase I Engineering	May, 2010	April, 2010
Phase II Engineering	August, 2010	July, 2011
Specification Development	May, 2011	August, 2011

Procurement activities will take place through the end of 2011.

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only to sanction continuing to refine scopes in support of specification development.

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the background from the original authorization which is attached to this document.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2011 MTP/LTP	$1.25	$0.75	$2.00
Transfer Mercury Comp. Study	$0.25	$0.00	$0.25
Variance to 2011 MTP	($0.70)	$1.70	$1.00
Current Proposal	$0.80	$2.45	$3.25

Sensitivities

None performed.

Environmental

No permits required.

Risks

The implementation schedule associated with the new regulatory requirements is extremely challenging. Getting to the market place as soon as possible will decrease risk of equipment/material shortages in the market associated with most other coal-fired generators likely requiring the same technologies and equipment. Disapproving this sanction will result in delaying scope development and procurement strategy implementation which will negatively impact Project Engineering's ability to meet the construction schedule.

Other Alternatives Considered

None.

Conclusions and Recommendation

It is the recommendation of Project Engineering that the Investment Committee approve the additional sanction to the MTP Engineering- Air Compliance project to a total revised sanction of $3,520K. This will allow the continuance of the studying and analyzing of the scopes and options necessary to develop the specifications and procurement plan for the purchase of Pulse Jet Fabric Filters for twelve units, WFGDs for Mill Creek Units 1&2 and Fans for all units that require an upgrade.

From:	Straight, Scott
To:	Saunders, Eileen; Ritchey, Stacy; Reed, Kathleen
Sent:	5/16/2011 3:59:18 PM
Subject:	FW: DRAFT - IC Additional Authorization Paper
Attachments:	[Untitled].pdf; Environmental Air additional funding request-SSA for B&V.doc

My suggested edits.

From: Saunders, Eileen
Sent: Monday, May 16, 2011 9:08 AM
To: Straight, Scott
Cc: Ritchey, Stacy; Reed, Kathleen
Subject: DRAFT - IC Additional Authorization Paper
Importance: High

Scott,

I am moving as quickly as possible to get B&V on board to begin the specification development. Rusty said if I got the paper to him as soon as possible he would help me get an electronic vote of approval. Stacy has reviewed the financials. I am including the new request and the original request for reference. Feel free to use the "Straight" red pen!

Thanks,

Eileen

Original SSA that was approved in August.

Eileen Lamar Saunders
Manager, Major Capital Projects
LG&E and KU Services Company
820 W. Broadway (BOC)
Louisville, KY 40202
BOC: (502) 627-2431
Mill Creek Site: (502) 933-6558
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Russel A. Hudson
Director, Generation Acctg and Budgeting

220 West Main Street
Louisville, Kentucky 40202
T (502) 627-3661
F (502) 627-2665
Rusty.hudson@eon-us.com

September 3, 2010

To: John Voyles
Ralph Bowling
Paul Thompson
Brad Rives
Vic Staffieri

Re: Sole Source Authorization – Black & Veatch

The Black & Veatch sole source authorization for $2.0m to continue advancing engineering on the 2011 MTP environmental air compliance was approved electronically by the Investment Committee on September 2, 2010. A copy of the approval notification is attached.

Please let me know of any questions that you have, and kindly return this to me after signing.

Rusty Hudson
Rusty Hudson

Attachment

Investment Proposal for IC:	August 31, 2010
Project Name:	MTP Engineering – Air Compliance Projects
Total Expenditures:	$2,000K
Project Number:	131693 – LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Generation
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, State and Federal air compliance regulations through 2016.

In addition to requesting approval of a new engineering project that will continue refining the 2011 MTP air compliance scope, this request also seeks approval of a sole source award to Black &Veatch (B&V) engineering firm. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Background

Starting this year and continuing for the next two years, the United States Environmental Protection Agency (USEPA) will be developing and implementing several new environmental regulations. These new regulations will significantly impact our coal-fired electric generating units and will affect all environmental areas of air, water and land. The pollutants targeted in three of the new air regulations are SO_2 and NO_x. There is a recent new 1-hour National Ambient Air Quality Standard (NAAQS) for SO_2 and NO_x that will require lower emission rates at several of the stations and the CAIR rule is proposed to be replace by a new Clean Air Transport Rule (CATR). Each will require additional reductions in SO_2 and NO_x. In 2011, the USEPA is expected to propose and finalize an Electric Utility Maximum Achievable Control Technology Rule (MACT). The MACT rule will require significant reductions in hazardous air pollutants such as mercury and acid gases (i.e., SO_3/H_2SO_4 emissions) which are also emitted from the LG&E and KU coal-fired electric generation fleet.

In May of 2010, Project Engineering was asked to investigate the technological and financial impacts of new environmental air regulations on the KU and LG&E coal-fired units. B&V was hired through a competitive bid process at a contract valued at $149K and given six weeks to provide a high level estimate based on site visits, data collection from the plants and industry experience. As a result of this Phase I effort, approximately $4 billion (escalated) of Air

Emissions Mitigation System additions and retrofits were identified as possible scenarios for bringing the fleet into compliance with the projected standards.

Through the approval of this investment/contract proposal, B&V will be contracted with to continue with Phase II of the engineering and estimating effort. This effort will provide a facility-specific project definition consisting of conceptual designs and budgetary cost estimates for selected air quality control technologies. This effort will result in a Level 1 Engineering assessment for Mill Creek, Ghent and EW Brown. The work for each facility will be staggered with the Mill Creek effort commencing first.

Award of the Phase II work to B&V will provide continuity to the initial study work. The contract will be on a time and material basis, not-to-exceed sole source contract, with a value of $1.6M. Black and Veatch will keep their original team in place to gain efficiencies for the Phase II work. The scope of their work will include activities/deliverables such as the following:

- Kick-Off Meetings at each facility
- Conceptual Design
- Building and Plant Arrangements
- Technology Screening
- Constructability Plans
- Project Cost Estimates including Cash Flows
- Refined Implementation Schedules

The remainder of the investment funding will cover costs of internal labor and expenses and the use of other external engineering /construction firms to review existing air pollution control technology performance enhancement options. Two examples of this would be hiring Riley Power (the original SCR technology firm) to review/model NOx emission reduction improvements on the existing Mill Creek 4 SCR that they originally design in 2002 and their review of improvements to the Mill Creek FGDs similar to the improvements they designed for TC1's FGD improvements as part of the TC2 Project.

Project timeline:

Level I Engineering	**Begin**	**Complete**
Mill Creek	August 2010	March 2011
Ghent	October 2010	April 2011
Brown	January 2011	May 2011

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only sanction to continue refining and developing the scopes, schedules and cost estimates for projects throughout the coal-fired fleet within LG&E and KU to comply with pending air regulations. Each project identified in this continuance of studies will seek sanction independent of this

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the Background section above.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2010 MTP/LTP	$0.0	$0.0	$0.0
Current Proposal	$.75	$1.25	$2.0

Sensitivities

None performed.

Risks

The 2011 draft MTP includes approximately $3 billion in air compliance projects identified with scope identification, schedules and cost estimates based on minimum (much less than Level I Engineering) engineering analyses. Disapproving this sanction will result in the continuance of generation planning for compliance with pending or proposed air regulations with scopes, schedules and estimates that have a significant margin of error.

Other Alternatives Considered

None

Conclusions and Recommendation

It is the recommendation of Project Engineering and Power Production to approve the continuance of studying and analyzing the scopes and options necessary to comply with pending or proposed air compliance regulations for the KU and LG&E coal-fired generating units. The continuance of these studies will lead to better definition of scopes, implementation schedules and cost estimates of major capital projects to comply with the air regulations that will be incorporated into the 2011 and 2012 MTP plans. Approval is also requested to award B&V a sole source award for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

sole source award on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

Eileen Saunders
Manager Major Capital Projects

9/7/10
John Voyles
VP Transmission & Gen. Services

for P. Thompson
9/7/10
Paul Thompson
SVP Energy Services

Victor A. Staffieri
Chief Executive Officer

9/3/10
Scott Straight
Director Project Engineering

Ralph Bowling
VP Power Production

9/9/10
Brad Rives
Chief Financial Officer

Hudson, Rusty

From: Kuhl, Megan
Sent: Thursday, September 02, 2010 9:28 AM
To: Hudson, Rusty
Subject: FW: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects
Attachments: 2011 MTP Level I Engineering - Air Compliance Projects.docx

The MTP Engineering proposal has been approved by the Investment Committee.

From: Kuhl, Megan
Sent: Friday, August 27, 2010 11:34 AM
To: Rives, Brad; Thompson, Paul; McCall, John; Hermann, Chris
Cc: Garrett, Chris; Neal, Susan; Blake, Kent; Kaiser, Pat
Subject: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, state and federal air compliance regulations through 2016.

Authority is also requested for a sole source award to Black & Veatch (B&V) engineering firm for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Please send your approval/rejection by COB Wednesday, September 1.

Thank you,

Megan Kuhl
Financial Analyst I, Financial Planning
E.ON U.S.
(502) 627-3716
megan.kuhl@eon-us.com

Investment Proposal for IC:	
Project Name:	MTP and 2011 ECR Engineering- Air Compliance Projects
Total Expenditures:	$3,250K
Project Number:	131693 LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Power Production
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks additional authorization of $1,000K to the existing Black & Veatch ("B&V") engineering contract to begin the project specification development and procurement efforts of major equipment necessary to support the Environmental Air Compliance implementation activities.

Previously, $2,000K was authorized to continue to refine the scopes, implementation schedules and cost estimates originally identified in the development of the 2011 MTP. BB&V engineering firm was retained and completed in their Phase I effort. This request also includes a sole source award recommendation to award B&V a change order of $413,000k to assist Project Engineering and the stations in the development of specifications for the 12 Pulse Jet Fabric Filters (baghouses) for E.W. Brown, Mill Creek, Ghent and Trimble County 1, as well as the development and bid supporting for the WFGD specifications for Mill Creek and fan specifications for all units listed in the 2011 ECR filing.

The remainder of the sanction will cover costs of internal labor and expenses, as well as the use of other engineering or construction firms asnecessary to support the specification development effort.

The Environmental Air Studies AIP was originally for $2,000K and was approved by the Investment Committee in September of 2010, but did not include the approved Mercury Study dollars. Mercury Compliance Study was approved by the Investment Committee in May 2009. These studies were conducted in 2009 and 2010. In Sept 2010, it was decided to combine the $250k Mercury Compliance Studies (125607 & 125609) with the newly approved Environmental Air Studies (131693 & 131694) for a total of $2.25M. All charges to the Mercury Compliance projects were moved to the Environmental Air Studies in Sept 2010.

Background

The background for this work is detailed in the original IC paper from August 31, 2010. Essentially, this authorization will give Project Engineering the ability to begin putting the procurement strategies in place that will enable us to react in a more timely fashion upon receipt of the ECR approvals and receipt of the EPA final ruling in November, 2011.

Project Description

The purpose of this scope of work is for B&V to support LG&E and KU with its Global Purchase Program of Air Quality Control Equipment at the Mill Creek, Ghent, Brown, and Trimble County facilities. B&V will assist LG&E KU with the following 3 Tasks:

Task 1 – WFGD Specification Development and Support through Award
Task 2 – PJFF Specification Development and Support through Award
Task 3 – Fan Specification Development and Support through Award

Project Timeline

Project	**Begin**	**Complete**
Phase I Engineering	May, 2010	April, 2010
Phase II Engineering	August, 2010	July, 2011
Specification Development	May, 2011	August, 2011

Procurement activities will take place through the end of 2011.

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only to sanction continuing to refine scopes in support of specification development.

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the background from the original authorization which is attached to this document.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2011 MTP/LTP	$1.25	$0.75	$2.00
Transfer Mercury Comp. Study	$0.25	$0.00	$0.25
Variance to 2011 MTP	($0.70)	$1.70	$1.00
Current Proposal	$0.80	$2.45	$3.25

Sensitivities

None performed.

Environmental

No permits required.

Risks

The implementation schedule associated with the new regulatory requirements is extremely challenging. Getting to the market place as soon as possible will decrease risk of equipment/material shortages in the market associated with most other coal-fired generators likely requiring the same technologies and equipment. Disapproving this sanction will result in delaying scope development and procurement strategy implementation which will negatively impact Project Engineering's ability to meet the construction schedule.

Other Alternatives Considered

None.

Conclusions and Recommendation

It is the recommendation of Project Engineering that the Investment Committee approve the additional sanction to the MTP Engineering- Air Compliance project to a total revised sanction of $3,520K. This will allow the continuance of the studying and analyzing of the scopes and options necessary to develop the specifications and procurement plan for the purchase of Pulse Jet Fabric Filters for twelve units, WFGDs for Mill Creek Units 1&2 and Fans for all units that require an upgrade.

From: Saunders, Eileen
To: Hudson, Rusty
CC: Straight, Scott; Clements, Joe; Ritchey, Stacy; Mooney, Mike (BOC 3); Reed, Kathleen
Sent: 5/17/2011 7:43:54 AM
Subject: IC Paper for Electronic Vote
Attachments: [Untitled].pdf; Environmental Air additional funding request-SSA for BV (rev 3).docx

Rusty,

Please see the new IC paper and the original IC paper. I think both should be included in the electronic voting email since I reference the original in the new paper.

Thanks,

Eileen

Original SSA

Eileen Lamar Saunders
Manager, Major Capital Projects
LG&E and KU Services Company
820 W. Broadway (BOC)
Louisville, KY 40202
BOC: (502) 627-2431
Mill Creek Site: (502) 933-6558
eileen.saunders@lge-ku.com

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Russel A. Hudson
Director, Generation Acctg and Budgeting

220 West Main Street
Louisville, Kentucky 40202
T (502) 627-3661
F (502) 627-2665
Rusty.hudson@eon-us.com

September 3, 2010

To: John Voyles
Ralph Bowling
Paul Thompson
Brad Rives
Vic Staffieri

Re: Sole Source Authorization – Black & Veatch

The Black & Veatch sole source authorization for $2.0m to continue advancing engineering on the 2011 MTP environmental air compliance was approved electronically by the Investment Committee on September 2, 2010. A copy of the approval notification is attached.

Please let me know of any questions that you have, and kindly return this to me after signing.

Rusty Hudson
Rusty Hudson

Attachment

Investment Proposal for IC:	August 31, 2010
Project Name:	MTP Engineering – Air Compliance Projects
Total Expenditures:	$2,000K
Project Number:	131693 – LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Generation
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, State and Federal air compliance regulations through 2016.

In addition to requesting approval of a new engineering project that will continue refining the 2011 MTP air compliance scope, this request also seeks approval of a sole source award to Black &Veatch (B&V) engineering firm. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Background

Starting this year and continuing for the next two years, the United States Environmental Protection Agency (USEPA) will be developing and implementing several new environmental regulations. These new regulations will significantly impact our coal-fired electric generating units and will affect all environmental areas of air, water and land. The pollutants targeted in three of the new air regulations are SO_2 and NO_x. There is a recent new 1-hour National Ambient Air Quality Standard (NAAQS) for SO_2 and NO_x that will require lower emission rates at several of the stations and the CAIR rule is proposed to be replace by a new Clean Air Transport Rule (CATR). Each will require additional reductions in SO_2 and NO_x. In 2011, the USEPA is expected to propose and finalize an Electric Utility Maximum Achievable Control Technology Rule (MACT). The MACT rule will require significant reductions in hazardous air pollutants such as mercury and acid gases (i.e., SO_3/H_2SO_4 emissions) which are also emitted from the LG&E and KU coal-fired electric generation fleet.

In May of 2010, Project Engineering was asked to investigate the technological and financial impacts of new environmental air regulations on the KU and LG&E coal-fired units. B&V was hired through a competitive bid process at a contract valued at $149K and given six weeks to provide a high level estimate based on site visits, data collection from the plants and industry experience. As a result of this Phase I effort, approximately $4 billion (escalated) of Air

Emissions Mitigation System additions and retrofits were identified as possible scenarios for bringing the fleet into compliance with the projected standards.

Through the approval of this investment/contract proposal, B&V will be contracted with to continue with Phase II of the engineering and estimating effort. This effort will provide a facility-specific project definition consisting of conceptual designs and budgetary cost estimates for selected air quality control technologies. This effort will result in a Level 1 Engineering assessment for Mill Creek, Ghent and EW Brown. The work for each facility will be staggered with the Mill Creek effort commencing first.

Award of the Phase II work to B&V will provide continuity to the initial study work. The contract will be on a time and material basis, not-to-exceed sole source contract, with a value of $1.6M. Black and Veatch will keep their original team in place to gain efficiencies for the Phase II work. The scope of their work will include activities/deliverables such as the following:

- Kick-Off Meetings at each facility
- Conceptual Design
- Building and Plant Arrangements
- Technology Screening
- Constructability Plans
- Project Cost Estimates including Cash Flows
- Refined Implementation Schedules

The remainder of the investment funding will cover costs of internal labor and expenses and the use of other external engineering /construction firms to review existing air pollution control technology performance enhancement options. Two examples of this would be hiring Riley Power (the original SCR technology firm) to review/model NOx emission reduction improvements on the existing Mill Creek 4 SCR that they originally design in 2002 and their review of improvements to the Mill Creek FGDs similar to the improvements they designed for TC1's FGD improvements as part of the TC2 Project.

Project timeline:

Level I Engineering	Begin	Complete
Mill Creek	August 2010	March 2011
Ghent	October 2010	April 2011
Brown	January 2011	May 2011

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only sanction to continue refining and developing the scopes, schedules and cost estimates for projects throughout the coal-fired fleet within LG&E and KU to comply with pending air regulations. Each project identified in this continuance of studies will seek sanction independent of this

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the Background section above.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2010 MTP/LTP	$0.0	$0.0	$0.0
Current Proposal	$.75	$1.25	$2.0

Sensitivities

None performed.

Risks

The 2011 draft MTP includes approximately $3 billion in air compliance projects identified with scope identification, schedules and cost estimates based on minimum (much less than Level I Engineering) engineering analyses. Disapproving this sanction will result in the continuance of generation planning for compliance with pending or proposed air regulations with scopes, schedules and estimates that have a significant margin of error.

Other Alternatives Considered

None

Conclusions and Recommendation

It is the recommendation of Project Engineering and Power Production to approve the continuance of studying and analyzing the scopes and options necessary to comply with pending or proposed air compliance regulations for the KU and LG&E coal-fired generating units. The continuance of these studies will lead to better definition of scopes, implementation schedules and cost estimates of major capital projects to comply with the air regulations that will be incorporated into the 2011 and 2012 MTP plans. Approval is also requested to award B&V a sole source award for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

sole source award on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

Eileen Saunders
Manager Major Capital Projects

9/7/10
John Voyles
VP Transmission & Gen. Services

for P. Thompson
9/7/10
Paul Thompson
SVP Energy Services

Victor A. Staffieri
Chief Executive Officer

9/3/10
Scott Straight
Director Project Engineering

Ralph Bowling
VP Power Production

9/9/10
Brad Rives
Chief Financial Officer

Hudson, Rusty

From: Kuhl, Megan
Sent: Thursday, September 02, 2010 9:28 AM
To: Hudson, Rusty
Subject: FW: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects
Attachments: 2011 MTP Level I Engineering - Air Compliance Projects.docx

The MTP Engineering proposal has been approved by the Investment Committee.

From: Kuhl, Megan
Sent: Friday, August 27, 2010 11:34 AM
To: Rives, Brad; Thompson, Paul; McCall, John; Hermann, Chris
Cc: Garrett, Chris; Neal, Susan; Blake, Kent; Kaiser, Pat
Subject: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, state and federal air compliance regulations through 2016.

Authority is also requested for a sole source award to Black & Veatch (B&V) engineering firm for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Please send your approval/rejection by COB Wednesday, September 1.

Thank you,

Megan Kuhl
Financial Analyst I, Financial Planning
E.ON U.S.
(502) 627-3716
megan.kuhl@eon-us.com

Investment Proposal for IC:

Project Name:	MTP and 2011 ECR Engineering- Air Compliance Projects
Total Expenditures:	$3,250K
Project Number:	131693 LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Power Production
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks additional authorization of $1,000K to the existing Black & Veatch ("B&V") engineering contract to begin the project specification development and procurement efforts of major equipment necessary to support the Environmental Air Compliance implementation activities.

Previously, $2,000K was authorized to continue to refine the scopes, implementation schedules and cost estimates originally identified in the development of the 2011 MTP. BB&V engineering firm was retained and completed in their Phase I effort. This request also includes a sole source award recommendation to award B&V a change order of $413,000k to assist Project Engineering and the stations in the development of specifications for the 12 Pulse Jet Fabric Filters (baghouses) for E.W. Brown, Mill Creek, Ghent and Trimble County 1, as well as the development and bid supporting for the WFGD specifications for Mill Creek and fan specifications for all units listed in the 2011 ECR filing.

The remainder of the sanction will cover costs of internal labor and expenses, as well as the use of other engineering or construction firms as necessary to support the specification development effort.

The Environmental Air Studies AIP was originally for $2,000K and was approved by the Investment Committee in September of 2010, but did not include the approved Mercury Study dollars. Mercury Compliance Study was approved by the Investment Committee in May 2009. These studies were conducted in 2009 and 2010. In Sept 2010, it was decided to combine the $250k Mercury Compliance Studies (125607 & 125609) with the newly approved Environmental Air Studies (131693 & 131694) for a total of $2.25M. All charges to the Mercury Compliance projects were moved to the Environmental Air Studies in Sept 2010.

Background

The background for this work is detailed in the original IC paper from August 31, 2010. Essentially, this authorization will give Project Engineering the ability to begin putting the procurement strategies in place that will enable us to react in a more timely fashion upon receipt of the ECR approvals and receipt of the EPA final ruling in November, 2011.

Project Description

The purpose of this scope of work is for B&V to support LG&E and KU with its Global Purchase Program of Air Quality Control Equipment at the Mill Creek, Ghent, Brown, and Trimble County facilities. B&V will assist LG&E KU with the following 3 Tasks:

Task 1 – WFGD Specification Development and Support through Award
Task 2 – PJFF Specification Development and Support through Award
Task 3 – Fan Specification Development and Support through Award

Project Timeline

Project	Begin	Complete
Phase I Engineering	May, 2010	April, 2010
Phase II Engineering	August, 2010	July, 2011
Specification Development	May, 2011	August, 2011

Procurement activities will take place through the end of 2011.

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only to sanction continuing to refine scopes in support of specification development.

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the background from the original authorization which is attached to this document.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2011 MTP/LTP	$1.25	$0.75	$2.00
Transfer Mercury Comp. Study	$0.25	$0.00	$0.25
Variance to 2011 MTP	($0.70)	$1.70	$1.00
Current Proposal	$0.80	$2.45	$3.25

Sensitivities

None performed.

Environmental

No permits required.

Risks

The implementation schedule associated with the new regulatory requirements is extremely challenging. Getting to the market place as soon as possible will decrease risk of equipment/material shortages in the market associated with most other coal-fired generators likely requiring the same technologies and equipment. Disapproving this sanction will result in delaying scope development and procurement strategy implementation which will negatively impact Project Engineering's ability to meet the construction schedule.

Other Alternatives Considered

None.

Conclusions and Recommendation

It is the recommendation of Project Engineering that the Investment Committee approve the additional sanction to the MTP Engineering- Air Compliance project to a total revised sanction of $3,520K. This will allow the continuance of the studying and analyzing of the scopes and options necessary to develop the specifications and procurement plan for the purchase of Pulse Jet Fabric Filters for twelve units, WFGDs for Mill Creek Units 1&2 and Fans for all units that require an upgrade.

From:	Straight, Scott
To:	Voyles, John
CC:	Saunders, Eileen; Hudson, Rusty
Sent:	5/17/2011 12:17:57 PM
Subject:	IC Paper for Electronic Vote - B&V Air Studies
Attachments:	[Untitled].pdf; Environmental Air additional funding request-SSA for BV (rev 3).docx

John,

As an fyi, here is the paper for electronic IC vote that increases the contract authorization to B&V for the air compliance studies AND approves the sole source to B&V for the development of the fan, PJFF and WFGD specifications.

Scott

From: Saunders, Eileen
Sent: Tuesday, May 17, 2011 7:44 AM
To: Hudson, Rusty
Cc: Straight, Scott; Clements, Joe; Ritchey, Stacy; Mooney, Mike (BOC 3); Reed, Kathleen
Subject: IC Paper for Electronic Vote

Rusty,

Please see the new IC paper and the original IC paper. I think both should be included in the electronic voting email since I reference the original in the new paper.

Thanks,

Eileen

Original SSA

Eileen Lamar Saunders
Manager, Major Capital Projects
LG&E and KU Services Company
820 W. Broadway (BOC)
Louisville, KY 40202
BOC: (502) 627-2431
Mill Creek Site: (502) 933-6558
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Russel A. Hudson
Director, Generation Acctg and Budgeting

220 West Main Street
Louisville, Kentucky 40202
T (502) 627-3661
F (502) 627-2665
Rusty.hudson@eon-us.com

September 3, 2010

To: John Voyles
Ralph Bowling
Paul Thompson
Brad Rives
Vic Staffieri

Re: Sole Source Authorization – Black & Veatch

The Black & Veatch sole source authorization for $2.0m to continue advancing engineering on the 2011 MTP environmental air compliance was approved electronically by the Investment Committee on September 2, 2010. A copy of the approval notification is attached.

Please let me know of any questions that you have, and kindly return this to me after signing.

Rusty Hudson

Rusty Hudson

Attachment

Investment Proposal for IC:	August 31, 2010
Project Name:	MTP Engineering – Air Compliance Projects
Total Expenditures:	$2,000K
Project Number:	131693 – LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Generation
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, State and Federal air compliance regulations through 2016.

In addition to requesting approval of a new engineering project that will continue refining the 2011 MTP air compliance scope, this request also seeks approval of a sole source award to Black &Veatch (B&V) engineering firm. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Background

Starting this year and continuing for the next two years, the United States Environmental Protection Agency (USEPA) will be developing and implementing several new environmental regulations. These new regulations will significantly impact our coal-fired electric generating units and will affect all environmental areas of air, water and land. The pollutants targeted in three of the new air regulations are SO_2 and NO_x. There is a recent new 1-hour National Ambient Air Quality Standard (NAAQS) for SO_2 and NO_x that will require lower emission rates at several of the stations and the CAIR rule is proposed to be replace by a new Clean Air Transport Rule (CATR). Each will require additional reductions in SO_2 and NO_x. In 2011, the USEPA is expected to propose and finalize an Electric Utility Maximum Achievable Control Technology Rule (MACT). The MACT rule will require significant reductions in hazardous air pollutants such as mercury and acid gases (i.e., SO_3/H_2SO_4 emissions) which are also emitted from the LG&E and KU coal-fired electric generation fleet.

In May of 2010, Project Engineering was asked to investigate the technological and financial impacts of new environmental air regulations on the KU and LG&E coal-fired units. B&V was hired through a competitive bid process at a contract valued at $149K and given six weeks to provide a high level estimate based on site visits, data collection from the plants and industry experience. As a result of this Phase I effort, approximately $4 billion (escalated) of Air

Emissions Mitigation System additions and retrofits were identified as possible scenarios for bringing the fleet into compliance with the projected standards.

Through the approval of this investment/contract proposal, B&V will be contracted with to continue with Phase II of the engineering and estimating effort. This effort will provide a facility-specific project definition consisting of conceptual designs and budgetary cost estimates for selected air quality control technologies. This effort will result in a Level 1 Engineering assessment for Mill Creek, Ghent and EW Brown. The work for each facility will be staggered with the Mill Creek effort commencing first.

Award of the Phase II work to B&V will provide continuity to the initial study work. The contract will be on a time and material basis, not-to-exceed sole source contract, with a value of $1.6M. Black and Veatch will keep their original team in place to gain efficiencies for the Phase II work. The scope of their work will include activities/deliverables such as the following:

- Kick-Off Meetings at each facility
- Conceptual Design
- Building and Plant Arrangements
- Technology Screening
- Constructability Plans
- Project Cost Estimates including Cash Flows
- Refined Implementation Schedules

The remainder of the investment funding will cover costs of internal labor and expenses and the use of other external engineering /construction firms to review existing air pollution control technology performance enhancement options. Two examples of this would be hiring Riley Power (the original SCR technology firm) to review/model NOx emission reduction improvements on the existing Mill Creek 4 SCR that they originally design in 2002 and their review of improvements to the Mill Creek FGDs similar to the improvements they designed for TC1's FGD improvements as part of the TC2 Project.

Project timeline:

Level I Engineering	**Begin**	**Complete**
Mill Creek	August 2010	March 2011
Ghent	October 2010	April 2011
Brown	January 2011	May 2011

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only sanction to continue refining and developing the scopes, schedules and cost estimates for projects throughout the coal-fired fleet within LG&E and KU to comply with pending air regulations. Each project identified in this continuance of studies will seek sanction independent of this

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the Background section above.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2010 MTP/LTP	$0.0	$0.0	$0.0
Current Proposal	$.75	$1.25	$2.0

Sensitivities

None performed.

Risks

The 2011 draft MTP includes approximately $3 billion in air compliance projects identified with scope identification, schedules and cost estimates based on minimum (much less than Level I Engineering) engineering analyses. Disapproving this sanction will result in the continuance of generation planning for compliance with pending or proposed air regulations with scopes, schedules and estimates that have a significant margin of error.

Other Alternatives Considered

None

Conclusions and Recommendation

It is the recommendation of Project Engineering and Power Production to approve the continuance of studying and analyzing the scopes and options necessary to comply with pending or proposed air compliance regulations for the KU and LG&E coal-fired generating units. The continuance of these studies will lead to better definition of scopes, implementation schedules and cost estimates of major capital projects to comply with the air regulations that will be incorporated into the 2011 and 2012 MTP plans. Approval is also requested to award B&V a sole source award for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

sole source award on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP.

Eileen Saunders
Manager Major Capital Projects

9/3/10
Scott Straight
Director Project Engineering

9/7/10
John Voyles
VP Transmission & Gen. Services

Ralph Bowling
VP Power Production

for P. Thompson 9/7/10
Paul Thompson
SVP Energy Services

9/9/10
Brad Rives
Chief Financial Officer

Victor A. Staffieri
Chief Executive Officer

Hudson, Rusty

From: Kuhl, Megan
Sent: Thursday, September 02, 2010 9:28 AM
To: Hudson, Rusty
Subject: FW: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects
Attachments: 2011 MTP Level I Engineering - Air Compliance Projects.docx

The MTP Engineering proposal has been approved by the Investment Committee.

From: Kuhl, Megan
Sent: Friday, August 27, 2010 11:34 AM
To: Rives, Brad; Thompson, Paul; McCall, John; Hermann, Chris
Cc: Garrett, Chris; Neal, Susan; Blake, Kent; Kaiser, Pat
Subject: E-MAIL VOTE SOLICITED: MTP Engineering - Air Compliance Projects

This request seeks authorization of $2,000K to continue refining the scopes, implementation schedules and cost estimates of projects identified in the development of the 2011 MTP as necessary for compliance with proposed or final local, state and federal air compliance regulations through 2016.

Authority is also requested for a sole source award to Black & Veatch (B&V) engineering firm for $1.6 million on a time-and-material basis for Phase II of the Air Compliance portion of the 2011 MTP. B&V will perform the majority of studies included in the $2 million project sanction request; however, smaller valued contracts will be awarded to various technology firms to perform miscellaneous reviews of the LG&E and KU existing air pollution control technologies for potential upgrades to their performance.

Please send your approval/rejection by COB Wednesday, September 1.

Thank you,

Megan Kuhl
Financial Analyst I, Financial Planning
E.ON U.S.
(502) 627-3716
megan.kuhl@eon-us.com

Investment Proposal for IC:	
Project Name:	MTP and 2011 ECR Engineering- Air Compliance Projects
Total Expenditures:	$3,250K
Project Number:	131693 LG&E 131694 - KU
Business Unit/Line of Business:	LG&E and KU Coal-Fired Power Production
Prepared/Presented By:	Eileen Saunders/Scott Straight

Executive Summary

This request seeks additional authorization of $1,000K to the existing Black & Veatch ("B&V") engineering contract to begin the project specification development and procurement efforts of major equipment necessary to support the Environmental Air Compliance implementation activities.

Previously, $2,000K was authorized to continue to refine the scopes, implementation schedules and cost estimates originally identified in the development of the 2011 MTP. BB&V engineering firm was retained and completed in their Phase I effort. This request also includes a sole source award recommendation to award B&V a change order of $413,000k to assist Project Engineering and the stations in the development of specifications for the 12 Pulse Jet Fabric Filters (baghouses) for E.W. Brown, Mill Creek, Ghent and Trimble County 1, as well as the development and bid supporting for the WFGD specifications for Mill Creek and fan specifications for all units listed in the 2011 ECR filing.

The remainder of the sanction will cover costs of internal labor and expenses, as well as the use of other engineering or construction firms as necessary to support the specification development effort.

The Environmental Air Studies AIP was originally for $2,000K and was approved by the Investment Committee in September of 2010, but did not include the approved Mercury Study dollars. Mercury Compliance Study was approved by the Investment Committee in May 2009. These studies were conducted in 2009 and 2010. In Sept 2010, it was decided to combine the $250k Mercury Compliance Studies (125607 & 125609) with the newly approved Environmental Air Studies (131693 & 131694) for a total of $2.25M. All charges to the Mercury Compliance projects were moved to the Environmental Air Studies in Sept 2010.

Background

The background for this work is detailed in the original IC paper from August 31, 2010. Essentially, this authorization will give Project Engineering the ability to begin putting the procurement strategies in place that will enable us to react in a more timely fashion upon receipt of the ECR approvals and receipt of the EPA final ruling in November, 2011.

Project Description

The purpose of this scope of work is for B&V to support LG&E and KU with its Global Purchase Program of Air Quality Control Equipment at the Mill Creek, Ghent, Brown, and Trimble County facilities. B&V will assist LG&E KU with the following 3 Tasks:

Task 1 – WFGD Specification Development and Support through Award
Task 2 – PJFF Specification Development and Support through Award
Task 3 – Fan Specification Development and Support through Award

Project Timeline

Project	**Begin**	**Complete**
Phase I Engineering	May, 2010	April, 2010
Phase II Engineering	August, 2010	July, 2011
Specification Development	May, 2011	August, 2011

Procurement activities will take place through the end of 2011.

Economic Analysis and Risks

No economic or risk analyses have been performed as this request seeks only to sanction continuing to refine scopes in support of specification development.

Assumptions

Assumptions that will be used as a basis for the continuance of analyses performed within this sanction are the Energy Services 2011 MTP Assumptions. The primary assumptions are described in the background from the original authorization which is attached to this document.

Financial Summary ($000s)

None performed. This sanction will be capitalized and spread pro-rata across the air compliance projects that are sanctioned in the future.

Cash Flow Comparison ($000s)

Project Expenditures ($Millions)	2010	2011	Total
2011 MTP/LTP	$1.25	$0.75	$2.00
Transfer Mercury Comp. Study	$0.25	$0.00	$0.25
Variance to 2011 MTP	($0.70)	$1.70	$1.00
Current Proposal	$0.80	$2.45	$3.25

Sensitivities

None performed.

Environmental

No permits required.

Risks

The implementation schedule associated with the new regulatory requirements is extremely challenging. Getting to the market place as soon as possible will decrease risk of equipment/material shortages in the market associated with most other coal-fired generators likely requiring the same technologies and equipment. Disapproving this sanction will result in delaying scope development and procurement strategy implementation which will negatively impact Project Engineering's ability to meet the construction schedule.

Other Alternatives Considered

None.

Conclusions and Recommendation

It is the recommendation of Project Engineering that the Investment Committee approve the additional sanction to the MTP Engineering- Air Compliance project to a total revised sanction of $3,520K. This will allow the continuance of the studying and analyzing of the scopes and options necessary to develop the specifications and procurement plan for the purchase of Pulse Jet Fabric Filters for twelve units, WFGDs for Mill Creek Units 1&2 and Fans for all units that require an upgrade.

From: Sturgeon, Allyson </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=N093308>
Sent: 5/18/2011 7:58:50 AM
To: Voyles, John <John.Voyles@lge-ku.com>; Schram, Chuck <Chuck.Schram@lge-ku.com>; Charnas, Shannon <Shannon.Charnas@lge-ku.com>; Bellar, Lonnie <Lonnie.Bellar@lge-ku.com>; Conroy, Robert <Robert.Conroy@lge-ku.com>; Revlett, Gary <Gary.Revlett@lge-ku.com>; Straight, Scott <Scott.Straight@lge-ku.com>; Wilson, Stuart <Stuart.Wilson@lge-ku.com>; Saunders, Eileen <Eileen.Saunders@lge-ku.com>; Schroeder, Andrea <Andrea.Schroeder@lge-ku.com>; 'Riggs, Kendrick R.' <kendrick.riggs@skofirm.com>; 'Crosby, W. Duncan' <duncan.crosby@skofirm.com>; LGEC12 West 1202 (Cap 35) <EONUSC12WEST1202@lge-ku.com>; Sturgeon, Allyson <Allyson.Sturgeon@lge-ku.com>
Subject: Copy: Final ECR Application and Testimony Review (Updated with new location)
Location: LGEC 1202
Start: Wed 5/18/2011 1:00:00 PM
End: Wed 5/18/2011 3:00:00 PM
Recurrence: (none)
Meeting Status: Not yet responded

Required Attendees: Voyles, John; Schram, Chuck; Charnas, Shannon; Bellar, Lonnie; Conroy, Robert; Revlett, Gary; Straight, Scott; Wilson, Stuart; Saunders, Eileen; Schroeder, Andrea; 'Riggs, Kendrick R.'; 'Crosby, W. Duncan'; LGEC12 West 1202 (Cap 35); Sturgeon, Allyson

When: Wednesday, May 18, 2011 1:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: LGEC 1202

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

From:	Straight, Scott
To:	Sturgeon, Allyson
Sent:	5/18/2011 8:01:39 AM
Subject:	Accepted: Final ECR Application and Testimony Review (Updated with new location)

From:	Straight, Scott
To:	Thompson, Paul; Voyles, John; Bowling, Ralph; Hudson, Rusty; Hincker, Loren; Sinclair, David; Schetzel, Doug; Jackson, Fred; Sebourn, Michael
CC:	Waterman, Bob; Imber, Philip; Lively, Noel; Saunders, Eileen; Gregory, Ronald; Heun, Jeff; Hance, Chuck; Clements, Joe; Jones, Greg; Keeling, Chip; Hendricks, Claudia; Ray, Barry; O'brien, Dorothy (Dot); Bellar, Lonnie; Blake, Kent; Sturgeon, Allyson; Conroy, Robert; Huguenard, Jim
Sent:	5/27/2011 2:36:43 PM
Subject:	Project Engineering's ES Bi-Weekly Report - May27, 2011
Attachments:	PE's Bi-Weekly Update of 5-27-11.docx

Energy Services - Bi-Weekly Update
PROJECT ENGINEERING
May 27, 2011

- **KU SOx**
  - Safety – Nothing To Report (NTR)
  - Schedule/Execution:
    - Ghent
      - Elevators – Elevators are in service and the project has been completed.
      - Ghent Limestone Barge Modifications: Barge modifications are completed and hopper modifications begin the week of June 6, 2011.
    - Brown FGD
      - Performance Testing - The testing company's draft report has been received and returned with comments.
      - SW Pumps - The station pulled a BR3 service water pump for inspection and found corrosion issues to the Goulds pumps similar to those at Ghent. The station is continuing to work with Legal and Ghent to pursue the service water pump issues with the vendor as a warranty issue.
      - Coal Pile Modification – Foundation and embankment placement is complete, except for the clay liner in the pond expansion. Clay placement is on hold for favorable weather conditions.
      - Elevators – NTR
- **TC2**
  - Safety – NTR
  - Schedule/Execution:
    - Bechtel EPC – Bechtel/Doosan conducted a technical review meeting May 12 with the station and PE. Our primary technical concern now is that the data has revealed that the furnace outlet NOx level is significantly greater than Doosan's design point and the SCR may be under sized for this condition. PE issued a letter May 23 that continues our position that Bechtel has not achieved CS Completion. PE also issued Amendment 4 to the Agreement that extends the MCN to May 27 in an effort to allow a broader fuel range, within the Agreement, to be burned in the interim. There is a meeting scheduled for May 27 to go over the results of the recently completed air flow testing by Bechtel/Doosan and how they may affect the combustion system tuning.
  - Contract Disputes/Resolution:
    - Bechtel
      - LD's – NTR
      - Bechtel Labor Claim – NTR
  - Combustion System Completion - The date of Material Change Notice has been revised from May 20 to May 27th to allow both parties more evaluation time of Test Burn results. A technical meeting with PE, the station, Bechtel, and Doosan is scheduled for May 27.
  - Issues/Risk:
    - Design of the DBEL burners for our coal specification.

    - Completion of punchlist.

- **Brown 3 SCR**
  - Safety – NTR
  - Engineering – Proceeding as planned.
  - Schedule/Execution – Proceeding to plan.
  - Issues/Risk – NTR.

- **Ohio Falls Rehabilitation**
  - Schedule/Execution:
    - Continuing to coordinate with underwater repairs contractor regarding an alternate plan for work on gate slots; diving began but river level rose again and is fluctuating at the head-works.
    - Began preparations to clamshell out debris in stop log slots discovered by divers; river fluctuations affecting the work.
    - Voith has been informed that the original date of June 6 for Unit 5 dewatering has been moved to June 27.
    - Head gate modifications are complete and have been shipped to the coating vendor.
    - Tail gate modifications continue at a Louisville area river facility after the gates were relocated from an upriver site.
    - Proposals are being analyzed for the River Services work.
    - Both the station auxiliary electrical upgrade and dewatering electrical work have been awarded.
    - Temporary 480V construction power work to be done by Overhead Dept next week.
    - Parking and lay-down area expansion began but is in a rain delay; work should be complete June 6.
    - Asbestos abatement contractor continued electrical demolition in the old fan/electrical room.
    - Pre-bid for concrete façade repairs set for May 25.
    - Continued assistance to plant on possible new office building at parking plaza.
    - Worked with Rates and Regulatory Dept on documentation in an attempt to convince FERC that the plant road is not a dike nor component of the flood levee system
  - Issues/Risk
    - Outstanding issue regarding Change of Law related international duty – potential $65k Change Order.
    - Standby costs may lead to Change Order based on not dewatering the Unit by June 6 due to high flood waters.

- **Mill Creek Limestone Project**
  - Safety - NTR
  - Schedule/Execution
    - Detailed Engineering - Meetings with the top three bidders were held on May 17. A final review of the updated proposals will take place on May 31.

    - A kickoff meeting with the limestone conveyor contractor, Dearborn Midwest was held at the site on May 20 with participation from plant representatives, HDR and Project Engineering.

- **Cane Run CCP Project**
  - Permitting
    - All permitting proceeding well.
    - Continue to work with KYDWM on Landfill Permit application.
    - Meeting with the KYDWM to discuss the MSE wall option.
  - Engineering
    - The review of constructing the smaller landfill versus modifying the existing landfill, trucking balance of CCR to Mill Creek, and MSE Wall has been completed and a recommendation from the Plant and PE to continue to obtain the permit for the new landfill, apply for a permit modification of the existing landfill and raise the existing landfill to avoid constructing the new landfill was made to Bowling and Voyles. Meeting to be arranged by Bowling with PWT for final review of recommendation.

- **Trimble Co. Barge Loading/Holcim**
  - Permitting
    - The 404 permit has been issued by the USACE and received the 401 Stream Crossing permit in December 2010.
  - Engineering
    - Working to issue BOP engineering contract. Looking to award this work to B&V as part of the CCR Transport design.
    - Looking at potential scope changes as a result of lessons learned at Ghent on the Transport project.
  - Execution
    - This project is behind schedule. A coordination meeting was held with station management to discuss path forward and communication plans.

- **TC CCP Project – BAP/GSP**
  - Safety – NTR
  - Schedule/Execution:
    - Work continues on the electrical duct banks to GSP Electrical Building. The foundation is being prepared for the building after the duct banks are poured.
    - The duct bank from the Ash Pond Electrical Building to the Ash Pond Raft has been completed.
    - With the other dikes being raised to their final height, work is now being concentrated on raising the South Dike due to the high water level inside of the BAP. All ten (10) piping systems have been switched-over from the existing system to the new system. The existing Southwest Pipe Culvert was demolished and fill has been completed to elevation 510 feet. With the completion to this elevation, the minimum freeboard distance from water elevation to dike has been reestablished. The work continues to track to the schedule established in early March.
  - Contract Disputes/Resolution
    - Riverside claims due to weather and engineering delays are being addressed.

- Issues/Risk
  - Weather remains the biggest risk to timing of completion and cost.

- **TC CCP Project – Landfill**
  - Engineering
    - Detailed Engineering in progress with GAI.
    - Meeting held with Black & Veatch concerning the Final Conceptual Design of the CCR Treatment and Transportation Systems.
  - Permitting:
    - The 401 and 404 Permit applications submitted in December 2010. Additional requested field studies are being completed.
    - The review of the DWM Permit has been completed. The permit application was delivered on June 6.
    - GAI has completed the documents for the KTC Permit Application for the bridge crossing at State Road 1838. The permit application was delivered to the KTC in March. In follow-up conversations with KTC, the permit has been lost and preparations are being made to re-file the permit.

- **Ghent CCP Projects - Landfill**
  - Safety – NTR
  - Engineering:
    - Detailed Engineering of gypsum fines nearing completion with B&V.
      - Tank foundations are under construction.
  - Execution
    - Working on the new 1-1 tanks. Hydro of tank has been completed
    - The award for the civil/mechanical to Hall Contracting was approved on May 26th by the IC.
    - The security fence around the perimeter of the land recently purchased is currently under construction.
    - Received the initial bids on the Gypsum Dewater belt package.
    - Reviewing the EPC scope of work with the Plant.
  - Permitting:
    - All permit applications have been submitted. Moving forward as expected.
    - Working on response to NOD #2.
  - Issues/Risk:
    - Land Acquisition – all essential properties under contract with a few closings remaining.

- **E.W. Brown Ash Pond Project**
  - Safety – NTR
  - Engineering – Detailed Engineering by MACTEC continues.
  - Schedule/Execution:
    - All work in the field is currently related to the Aux. Pond Scope of Work.
    - Gypsum placement on hold until density level in gypsum underflow tank reaches 45-50% after coming off the outage.
    - MACTEC and drilling subcontractor on-site to begin dye-testing. Charah performed excavation to locate previously treated karst features to be used as dye injection sites. Mactec continues spring inventory and sampling.
  - Issues/Risk:

        - Bathymetric Survey conducted on the Aux. Pond and preliminary results indicate construction schedule is attainable, but production rates are in excess of production rate forecast.
        - <u>Due to unforeseen hydrogeologic requirements, the landfill permit application submission to KYDWM will be deferred from May to late July/early Aug.</u>

- **SO3 Mitigation (Mill Creek 3, Mill Creek 4, Brown 3, Ghent)**
    - Safety – NTR
    - Schedule/Execution:
        - Received EPA/DOJ proposal on Ghent NOV. Terms discussed at EPA offices on May 26. EPA requested we counter propose in their format (quite similar to ours). There is a gap between the existing proposals – us at 5 ppm, their proposal 2-3 ppm.
        - Mills contract for Ghent with Nol-Tec for signature.
        - Ghent 1 Aux Boiler Demo work kicked off with A&D Constructors.
        - Contract awaiting B&W signature to perform Exit Gas Temperature Study at Ghent.
        - Contract prepared for Alstom signature to perform Exit Gas Temperature Study at Ghent. SSA needs to be approved for this SOW.
        - EWB SAM Mitigation BAFO due received. URS is no bidding their wet system. Evaluating bids.
        - EW Brown SAM and FGD Performance Testing utilizing high sulfur coal draft reports received, however they need significant updating.

- **Cane Run CCGT**
    - Budget – NTR
    - Gas Pipe Line Routing
        - ROW survey to ongoing.
    - Owner's Engineer
        - Released EPRI document review work as part of the specification preparation.
        - Site water routing drawings submitted.
        - Prepared a new Vendor Prequalification schedule – Prequalification work to commence in September.
    - Environmental Assessment and Permitting
        - Draft Air Permit received from Trinity for review
        - EA work with Mac-Tec ongoing.
    - LS Power Purchase
        - Released Due Diligence Scope of Work for bid – expect proposals week of May 30.
- **Other Generation Development**
    - Biomass – NTR
    - CCS 100 MW Project
        - Report update and pro forma update received.
    - FutureGen – NTR from PE.
    - Paddys & Canal Demolition – NTR

- **General**
    - Environmental Scenario Planning:

- Numerous reviews made on ECR testimonies.
- BPEI flow modeling of MC4 SCR planned in Germany, now pushed from May to June.
- Continue to work with Legal and EA on Ghent SAM compliance. Prepared technical and economic assessment for meeting 5ppm SAM at each Ghent Unit. Draft term sheet/proposal in circulation for submittal to DOJ/EPA week of April 7.
- Continue to work with Legal on asbestos litigation regarding construction of TC1.

Metrics:

NTR

Upcoming PWT Approval Needs:

Project Manager	Description	Contract, Project, SSA	Amount $000s	Month of I/C Meeting	MAY11	JUN11	JUL11	AUG11	SEP11	OCT11	NOV11	DEC11	Jan12	Feb12	Mar12	Apr12
Heun	CR CCR - Landfill Phase I - Construction	C	15,000	Aug												
Heun	GH CCR - Landfill Phase I - Construction	C		Dec												
Heun	GH CCR - Fines Mechanical - Construction	C	6,000	May												
Heun	GH CCR - Gypsum Dewatering Belts	C		Jun												
Heun	GH CCR - Dry Fly Ash System	C		Jun												
Heun	GH CCR - Bottom Ash Scraper Conveyor	C		Jun												
Heun	GH CCR - Pipe Conveyor	C		Jun												
Heun	GH CCR - Transport EPC Contract	C		Aug												
Heun	CCR Storage Compliance	P														
Imber	BR 3 SAM Mitigation	C	8,000	Jun												
Imber	MC 3 and MC4 SAM Mitigation - **On Hold**	P														
Lively	CCGT 2016 - Cane Run 7	P	589,200	Sep												
Saunders	Environmental Air Studies	P	3,250	May												
Saunders	Environmental Air Compliance - BR 1 Fabric Filter	P	105,123	Sep												
Saunders	Environmental Air Compliance - BR 2 Fabric Filter	P	113,602	Sep												
Saunders	Environmental Air Compliance - BR 3 Fabric Filter	P	117,196	Sep												
Saunders	Environmental Air Compliance - MC 1 & 2 Combined FGD	P	358,635	Sep												
Saunders	Environmental Air Compliance - MC 1 Fabric Filter	P	145,751	Sep												
Saunders	Environmental Air Compliance - MC 2 Fabric Filter	P	142,656	Sep												
Saunders	Environmental Air Compliance - MC 3 Fabric Filter	P	140,191	Sep												
Saunders	Environmental Air Compliance - MC4 FGD	P	218,431	Sep												
Saunders	Environmental Air Compliance - MC4 SCR Upgrade	P	5,606	Sep												
Saunders	Environmental Air Compliance - MC4 Fabric Filter	P	151,643	Sep												
Saunders	Environmental Air Compliance - GH1 Fabric Filter	P	147,685	Sep												
Saunders	Environmental Air Compliance - GH2 Fabric Filter	P	156,808	Sep												
Saunders	Environmental Air Compliance - GH3 Fabric Filter	P	182,210	Sep												
Saunders	Environmental Air Compliance - GH4 Fabric Filter	P	168,587	Sep												
Waterman	TC CCR - Landfill Phase I - Construction	C														
Waterman	TC CCR - Transport and Treatment - Engineering	C		Jul												
Waterman	TC CCR - Transport and Treatment - Equipment/Construction	C		Aug												
Waterman	TC CCR - BAP/GSP Sanction	P		Jun												
Williams	BR CCR - Landfill Phase I - Construction	C		Mar												
Williams	BR CCR - Ash Handling Dry Conversion	C		Aug												

- **Staffing**
  - Headcount planning is complete now that the projects are known for the 2011 ECR filing. Currently working on the WFP document.
  - Interviews to replace the loss of Jason Finn are in progress.
  - Approval to post for Business Planning Coordinator to be requested the week of June 6th.

From: Saunders, Eileen
To: Voyles, John; Bowling, Ralph; Straight, Scott
Sent: 6/2/2010 3:41:30 PM
Subject: B&V Cost Estimate
Attachments: Environmental Summay (rev4 6-1-10).xlsx; Generation Future Environmental Requirements.xlsx

John, Ralph and Scott,

Enclosed, please find a summary of the costs provided by B&V as part of the Environmental Compliance Study. As you review this information, please note the following:

- The cost estimate does not meet the criteria for Level I Engineering. As Scott and I discussed, it may take 6-8 months to reach that level of Engineering.
- This estimate does not include the outage impact costs.
- The cost estimate does not include provisions for SO3 Mitigation Systems or Combined Cycle Costs. Both of those costs will be included in estimates provided by others.
- For Cane Run, Ghent, Trimble, Mill Creek and Green River, mercury technology solutions are included by Unit. The Brown Plant Management Team preferred to look at a mercury solution by plant. Environmental is unsure as to if the mercury regulations will be by plant or by unit so I supported their requests. If we believe that we should look at mercury by plant as the basis of what goes into the MTP, the costs may go down.
- A generic Neural Network number was used as a means of addressing CO.
- The second attachment, from Environmental Affair, has been updated to reflect the proper CO limits.

I will be reviewing this information with John and Scott tomorrow morning at 8:30 am.

Thank you,

Eileen

	A	B	C	D	E	F	G	H	I	J
1	Black & Veatch Study Cost Estimates									
2	$ in thousands									
3										
4										
5			**Capital Cost**		**O&M Cost**		**Total Capital and O&M**		**Levelized Annual Costs**	
6	**BROWN**									
7	Brown 1 - Low NOx Burners		$1,156		$0		$1,156		$141	
8	Brown 1 - Baghouse		$40,000		$1,477		$41,477		$6,345	
9	Brown 1 - PAC Injection		$1,599		$614		$2,213		$809	
10	Brown 1 - Neural Networks		$500		$50		$550		$111	
11	Brown 1 - Overfire Air		$767		$132		$899		$225	
12	Total Brown 1		**$44,022**		**$2,273**		**$46,295**		**$7,631**	
13										
14	Brown 2 - SCR		$92,000		$3,278		$95,278		$14,474	
15	Brown 2 - Baghouse		$51,000		$1,959		$52,959		$8,166	
16	Brown 2 - PAC Injection		$2,476		$1,090		$3,566		$1,391	
17	Brown 2 - Neural Networks		$500		$50		$550		$111	
18	Brown 2 - Lime Injection		$2,739		$1,155		$3,894		$1,488	
19	Total Brown 2		**$148,715**		**$7,532**		**$156,247**		**$25,630**	
20										
21	Brown 3 - Baghouse		$61,000		$3,321		$64,321		$10,745	
22	Brown 3 - PAC Injection		$5,426		$2,330		$7,756		$2,990	
23	Brown 3 - Neural Networks		$1,000		$100		$1,100		$222	
24	Total Brown 3		**$67,426**		**$5,751**		**$73,177**		**$13,957**	
25										
26	**Total Brown**		**$260,163**		**$15,556**		**$275,719**		**$47,218**	
27										
28										
29	**GHENT**									
30	Ghent 1 - Baghouse		$131,000		$5,888		$136,888		$21,831	
31	Ghent 1 - PAC Injection		$6,380		$4,208		$10,588		$4,984	
32	Ghent 1 - Neural Networks		$1,000		$100		$1,100		$222	
33	Total Ghent 1		**$138,380**		**$10,196**		**$148,576**		**$27,037**	
34										
35	Ghent 2 - SCR		$227,000		$7,078		$234,078		$34,704	
36	Ghent 2 - Baghouse		$120,000		$5,002		$125,002		$19,606	
37	Ghent 2 - PAC Injection		$6,109		$2,880		$8,989		$3,623	
38	Ghent 2 - Lime Injection		$5,483		$2,775		$8,258		$3,442	
39	Ghent 2 - Neural Networks		$1,000		$100		$1,100		$222	
40	Total Ghent 2		**$359,592**		**$17,835**		**$377,427**		**$61,597**	
41										
42	Ghent 3 - Baghouse		$138,000		$6,122		$144,122		$22,917	
43	Ghent 3 - PAC Injection		$6,173		$4,134		$10,307		$4,885	
44	Ghent 3 - Neural Networks		$1,000		$100		$1,100		$222	
45	Total Ghent 3		**$145,173**		**$10,356**		**$155,529**		**$28,024**	
46										

	A	B	C	D	E	F	G	H	I	J
47	Ghent 4 - Baghouse		$117,000		$5,363		$122,363		$19,602	
48	Ghent 4 - PAC Injection		$6,210		$3,896		$10,106		$4,652	
49	Ghent 4 - Neural Networks		$1,000		$100		$1,100		$222	
50	Total Ghent 4		$124,210		$9,359		$133,569		$24,476	
51										
52	**Total Ghent**		**$767,355**		**$47,746**		**$815,101**		**$141,134**	
53										
54										
55	**GREEN RIVER**									
56	Green River 3 - SCR		$29,000		$1,040		$30,040		$4,569	
57	Green River 3 - CDS-FF		$38,000		$6,874		$44,874		$11,499	
58	Green River 3 - PAC Injection		$1,112		$323		$1,435		$458	
59	Green River 3 - Neural Networks		$500		$50		$550		$111	
60	Total Green River 3		**$68,612**		**$8,287**		**$76,899**		**$16,637**	
61										
62	Green River 4 - SCR		$42,000		$1,442		$43,442		$6,553	
63	Green River 4 - CDS-FF		$54,000		$10,289		$64,289		$16,861	
64	Green River 4 - PAC Injection		$1,583		$515		$2,098		$708	
65	Green River 4 - Neural Networks		$500		$50		$550		$111	
66	Total Green River 4		**$98,083**		**$12,296**		**$110,379**		**$24,233**	
67										
68	**Total Green River**		**$166,695**		**$20,583**		**$187,278**		**$40,870**	
69										
70										
71	**CANE RUN**									
72	Cane Run 4 - FGD		$152,000		$8,428		$160,428		$26,926	
73	Cane Run 4 - SCR		$63,000		$2,219		$65,219		$9,886	
74	Cane Run 4 - Baghouse		$33,000		$1,924		$34,924		$5,940	
75	Cane Run 4 - PAC Injection		$2,326		$1,087		$3,413		$1,370	
76	Cane Run 4 - Lime Injection		$2,569		$983		$3,552		$1,296	
77	Cane Run 4 - Neural Networks		$500		$50		$550		$111	
78	Total Cane Run 4		**$253,395**		**$14,691**		**$268,086**		**$45,529**	
79										
80	Cane Run 5 - FGD		$159,000		$8,789		$167,789		$28,139	
81	Cane Run 5 - SCR		$66,000		$2,421		$68,421		$10,453	
82	Cane Run 5 - Baghouse		$35,000		$2,061		$37,061		$6,321	
83	Cane Run 5 - PAC Injection		$2,490		$1,120		$3,610		$1,423	
84	Cane Run 5 - Lime Injection		$2,752		$1,089		$3,841		$1,424	
85	Cane Run 5 - Neural Networks		$500		$50		$550		$111	
86	Total Cane Run 5		**$265,742**		**$15,530**		**$281,272**		**$47,871**	
87										
88	Cane Run 6 - FGD		$202,000		$10,431		$212,431		$35,014	
89	Cane Run 6 - SCR		$86,000		$2,793		$88,793		$13,259	
90	Can Rune 6 - Baghouse		$45,000		$2,672		$47,672		$8,149	
91	Cane Run 6 - PAC Injection		$3,490		$1,336		$4,826		$1,761	
92	Cane Run 6 - Lime Injection		$3,873		$1,367		$5,240		$1,838	

	A	B	C	D	E	F	G	H	I	J
93	Cane Run 6 - Neural Networks		$500		$50		$550		$111	
94	Total Can Run 6		$340,863		$18,649		$359,512		$60,132	
95										
96	**Total Cane Run**		**$860,000**		**$48,870**		**$908,870**		**$153,532**	
97										
98										
99	**Mill Creek**									
100	Mill Creek 1 - FGD		$297,000		$14,341		$311,341		$50,486	
101	Mill Creek 1 - SCR		$97,000		$3,366		$100,366		$15,171	
102	Mill Creek 1 - Baghouse		$81,000		$3,477		$84,477		$13,335	
103	Mill Creek 1 - Electrostatic Precipitator		$32,882		$3,581		$36,463		$7,583	
104	Mill Creek 1 - PAC Injection		$4,412		$2,213		$6,625		$2,750	
105	Mill Creek 1 - Lime Injection		$4,480		$2,024		$6,504		$2,569	
106	Mill Creek 1 - Neural Networks		$1,000		$100		$1,100		$222	
107	Total Mill Creek 1		**$517,774**		**$29,102**		**$546,876**		**$92,116**	
108										
109	Mill Creek 2 - FGD		$297,000		$14,604		$311,604		$50,749	
110	Mill Creek 2 - SCR		$97,000		$3,401		$100,401		$15,206	
111	Mill Creek 2 - Baghouse		$81,000		$3,518		$84,518		$13,376	
112	Mill Creek 2 - Electrostatic Precipitator		$32,882		$3,664		$36,546		$7,666	
113	Mill Creek 2 - PAC Injection		$4,412		$2,340		$6,752		$2,877	
114	Mill Creek 2 - Lime Injection		$4,480		$2,117		$6,597		$2,662	
115	Mill Creek 2 - Neural Networks		$1,000		$100		$1,100		$222	
116	Total Mill Creek 2		**$517,774**		**$29,744**		**$547,518**		**$92,758**	
117										
118	Mill Creek 3 - FGD		$392,000		$18,911		$410,911		$66,617	
119	Mill Creek 3 - Baghouse		$114,000		$4,923		$118,923		$18,797	
120	Mill Creek 3 - PAC Injection		$5,592		$3,213		$8,805		$3,894	
121	Mill Creek 3 - Neural Networks		$1,000		$100		$1,100		$222	
122	Total Mill Creek 3		**$512,592**		**$27,147**		**$539,739**		**$89,530**	
123										
124	Mill Creek 4 - FGD		$455,000		$21,775		$476,775		$77,149	
125	Mill Creek 4 - Baghouse		$133,000		$5,804		$138,804		$21,990	
126	Mill Creek 4 - PAC Injection		$6,890		$3,858		$10,748		$4,697	
127	Mill Creek 4 - Neural Networks		$1,000		$100		$1,100		$222	
128	Total Mill Creek 4		**$595,890**		**$31,537**		**$627,427**		**$104,058**	
129										
130	**Total Mill Creek**		**$2,144,030**		**$117,530**		**$2,261,560**		**$378,462**	
131										
132										
133	**TRIMBLE**									
134	Trimble 1 - Baghouse		$128,000		$5,782		$133,782		$21,360	
135	Trimble 1 - PAC Injection		$6,451		$4,413		$10,864		$5,198	
136	Trimble 1 - Neural Networks		$1,000		$100		$1,100		$222	
137	Total Trimble 1		$135,451		$10,295		$145,746		$26,780	
138										

	A	B	C	D	E	F	G	H	I	J
139	**Total Trimble**		**$135,451**		**$10,295**		**$145,746**		**$26,780**	
140										
141										
142	**Grand Total**		**$4,333,694**		**$260,580**		**$4,594,274**		**$787,996**	

	A	B	C	D	E
1	Black & Veatch Study Cost Estimates				
2					
3					
4					
5			**MW**		**$/kW**
6	**BROWN**				
7	Brown 1 - Low NOx Burners				$11
8	Brown 1 - Baghouse				$364
9	Brown 1 - PAC Injection				$15
10	Brown 1 - Neural Networks				$5
11	Brown 1 - Overfire Air				$7
12	Total Brown 1		110		**$400**
13					
14	Brown 2 - SCR				$511
15	Brown 2 - Baghouse				$283
16	Brown 2 - PAC Injection				$14
17	Brown 2 - Neural Networks				$3
18	Brown 2 - Lime Injection				$15
19	Total Brown 2		180		**$826**
20					
21	Brown 3 - Baghouse				$133
22	Brown 3 - PAC Injection				$12
23	Brown 3 - Neural Networks				$2
24	Total Brown 3		457		**$148**
25					
26	**Total Brown**		**747**		**$348**
27					
28					
29	**GHENT**				
30	Ghent 1 - Baghouse				$242
31	Ghent 1 - PAC Injection				$12
32	Ghent 1 - Neural Networks				$2
33	Total Ghent 1		541		**$256**
34					
35	Ghent 2 - SCR				$439
36	Ghent 2 - Baghouse				$232
37	Ghent 2 - PAC Injection				$12
38	Ghent 2 - Lime Injection				$11
39	Ghent 2 - Neural Networks				$2
40	Total Ghent 2		517		**$696**
41					
42	Ghent 3 - Baghouse				$264
43	Ghent 3 - PAC Injection				$12
44	Ghent 3 - Neural Networks				$2
45	Total Ghent 3		523		**$278**
46					

	A	B	C	D	E
47	Ghent 4 - Baghouse				$222
48	Ghent 4 - PAC Injection				$12
49	Ghent 4 - Neural Networks				$2
50	Total Ghent 4		526		$236
51					
52	**Total Ghent**		**2,107**		**$364**
53					
54					
55					
56	**GREEN RIVER**				
57	Green River 3 - SCR				$408
58	Green River 3 - CDS-FF				$535
59	Green River 3 - PAC Injection				$16
60	Green River 3 - Neural Networks				$7
61	Total Green River 3		71		**$966**
62					
63	Green River 4 - SCR				$385
64	Green River 4 - CDS-FF				$495
65	Green River 4 - PAC Injection				$15
66	Green River 4 - Neural Networks				$5
67	Total Green River 4		109		**$900**
68					
69	**Total Green River**		**180**		**$926**
70					
71					
72	**CANE RUN**				
73	Cane Run 4 - FGD				$905
74	Cane Run 4 - SCR				$375
75	Cane Run 4 - Baghouse				$196
76	Cane Run 4 - PAC Injection				$14
77	Cane Run 4 - Lime Injection				$15
78	Cane Run 4 - Neural Networks				$3
79	Total Cane Run 4		168		**$1,508**
80					
81	Cane Run 5 - FGD				$878
82	Cane Run 5 - SCR				$365
83	Cane Run 5 - Baghouse				$193
84	Cane Run 5 - PAC Injection				$14
85	Cane Run 5 - Lime Injection				$15
86	Cane Run 5 - Neural Networks				$3
87	Total Cane Run 5		181		**$1,468**
88					
89	Cane Run 6 - FGD				$774
90	Cane Run 6 - SCR				$330
91	Can Rune 6 - Baghouse				$172
92	Cane Run 6 - PAC Injection				$13

	A	B	C	D	E
93	Cane Run 6 - Lime Injection				$15
94	Cane Run 6 - Neural Networks				$2
95	Total Can Run 6		261		$1,306
96					
97	**Total Cane Run**		**610**		**$1,410**
98					
99					
100	**Mill Creek**				
101	Mill Creek 1 - FGD				$900
102	Mill Creek 1 - SCR				$294
103	Mill Creek 1 - Baghouse				$245
104	Mill Creek 1 - Electrostatic Precipitator				$100
105	Mill Creek 1 - PAC Injection				$13
106	Mill Creek 1 - Lime Injection				$14
107	Mill Creek 1 - Neural Networks				$3
108	Total Mill Creek 1		330		**$1,569**
109					
110	Mill Creek 2 - FGD				$900
111	Mill Creek 2 - SCR				$294
112	Mill Creek 2 - Baghouse				$245
113	Mill Creek 2 - Electrostatic Precipitator				$100
114	Mill Creek 2 - PAC Injection				$13
115	Mill Creek 2 - Lime Injection				$14
116	Mill Creek 2 - Neural Networks				$3
117	Total Mill Creek 2		330		**$1,569**
118					
119	Mill Creek 3 - FGD				$927
120	Mill Creek 3 - Baghouse				$270
121	Mill Creek 3 - PAC Injection				$13
122	Mill Creek 3 - Neural Networks				$2
123	Total Mill Creek 3		423		**$1,212**
124					
125	Mill Creek 4 - FGD				$867
126	Mill Creek 4 - Baghouse				$253
127	Mill Creek 4 - PAC Injection				$13
128	Mill Creek 4 - Neural Networks				$2
129	Total Mill Creek 4		525		**$1,135**
130					
131	**Total Mill Creek**		**1,608**		**$1,333**
132					
133					
134	**TRIMBLE**				
135	Trimble 1 - Baghouse				$234
136	Trimble 1 - PAC Injection				$12
137	Trimble 1 - Neural Networks				$2
138	Total Trimble 1		547		$248

	A	B	C	D	E
139					
140	**Total Trimble**		**547**		**$248**
141					
142					
143	**Grand Total**		**5,799**		**$747**

Estimated Requirements Under Future New Environmental Regulations

Task No.	Program Name	Regulated Pollutants: Pollutant	Limit	Units	Unit/Plant Averaging	Forcasted Date for Compliance
4.1	GHG Inventory	No additional limits			N/A	Spring - 2010
4.2	ing Engine NSPS and	PM	Horsepower. Certified to meet Tier		Unit	ting MACT & at insta
		NO_x				
		VOC				
		CO				
4.3	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
		MC4 - SAM	76.5	lbs/hour		
4.4	fferson Co. STAR Re	fuels (As) 20 - 50 ppm or ~$1x10^{-5}$ lbs/mmBtu emis			Plant	Spring - 2012
&	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	r, 2010 NO_x & SA
		SO_2	97%	Removal		
		NO_x	0.07 /0.08	lbs/mmBtu		
		SAM	110 -220	lbs/mmBtu		
4.7	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
4.8	GHG NSR	GHG	Energy Efficiency Projects		Unit/Plant	January, 2011
4.9	Revised CAIR	SO_2	0.25	lbs/mmBtu	Plant	Beginning in 2014
		NO_x	0.11	lbs/mmBtu		
4.10	New EGU MACT	Mercury	90% or	Removal	Plant	with 1-yr extension
			0.012	lbs/GWH		
		Acids (HCl)	0.002	lbs/mmBtu	Unit	
		Metals (PM)	0.03	lbs/mmBtu		
		Metals (As)	0.5×10^{-5}	lbs/mmBtu		
		Organics (CO)	0.10	lbs/mmBtu		
		Dioxin/Furan	15×10^{-18}	lbs/mmBtu		
4.11	n Co. Ozone Non-at	NO_x	5 - 10 % reductior	NOx emissions	County-wide	Spring - 2016
4.11	1-hour NAAQS for	NO_x	letermined based on m	lbs/hours	Plant	During - 2015
4.12	1-hour NAAQS for	SO_2	letermined based on m	lbs/hours	Plant	Spring - 2016
4.13	Reduction & Renew	GHG	letermined based on m	tons/year	Fleet	Beginning in 2014
Plan Risk	2.5 Emission Reduct	12.5 (Condensabl	letermined based on m	lbs/mmBtu	Unit/Plant	After 2013
4.14	CWA 316(a)	Thermal impacts	Biological Studies	N/A	Plant	Starting in 2010

	A	B	C	D	E	F	G
36	4.15	CWA 316(b)	Withdraw impacts	Biological Studies	N/A	Plant	Starting in 2012
37	4.16	ew Effluent Standa	etals, Chlorides, et	anaylsis is just begin	anaylsis is just begin	Plant	During - 2015
38	4.17	CCR Classification	Toxic Metals	landfill; possible closing existing ash por		Plant	Beginning in 2012;
39							
40		- New requirements have been finalized					

	A	B	C	D	E	F
1						
2	**Estimated Limits & Compliance Dates Under Future New Air Requirements**					
3	**(Current Estimated Implementation - Fast)**					
4						
5	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
6	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
7	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
8		MC4 - SAM	76.5	lbs/hour		
9	3rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	er, 2010 NO_x & SA
10		SO_2	97%	Removal		
11		NO_x	0.07 /0.08	lbs/mmBtu		
12		SAM	110 -220	lbs/mmBtu		
13	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
14	Revised CAIR	SO_2	0.25	lbs/mmBtu	Plant	e I in 2014; Limits in Phas
15		NO_x	0.11	lbs/mmBtu		
16	New EGU MACT	Mercury	90% or	Removal	Plant	with 1-yr extension -
17			0.012	lbs/GWH		
18		Acids (HCl)	0.002	lbs/mmBtu	Unit	
19		Metals (PM) or	0.03	lbs/mmBtu		
20		Metals (As)	0.5×10^{-5}	lbs/mmBtu		
21		Organics (CO)	0.10	lbs/mmBtu		
22		Dioxin/Furan	15×10^{-18}	lbs/mmBtu		
23	on Co. Ozone Non-att	NO_x	5 - 10 % reduction	NOx emissions	County-wide	Spring - 2016
24	w 1-hour NAAQS for N	NO_x	termined based on r	lbs/hours	Plant	During - 2015
25	w 1-hour NAAQS for S	SO_2	termined based on r	lbs/hours	Plant	Spring - 2016
26	$PM_{2.5}$ NAAQS	$_{2.5}$ or Condensable	termined based on r	lbs/hours	Plant	During 2016
27						
28		- New requirements have been finalized				

	A	B	C	D	E	F
1						
2	**Estimated Limits & Compliance Dates Under Future New Air Requirements**					
3	**(Slower Implementation)**					
4						
5	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
6	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
7	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
8		MC4 - SAM	76.5	lbs/hour		
9		PM	0.03	lbs/mmBtu		
10		SO_2	97%	Removal		
11	rown Consent Decre	NO_x	0.07 /0.08	lbs/mmBtu	Unit 3	ber, 2010 NO_x & SAM
12		SAM	110 -220	lbs/mmBtu		
13	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
14		SO_2	0.25	lbs/mmBtu		
15	Revised CAIR	NO_x	0.11	lbs/mmBtu	Plant	ase I in 2016; Limits in Phase I
16		Mercury	90% or	Removal	Plant	
17			0.012	lbs/GWH		
18		Acids (HCl)	0.002	lbs/mmBtu		
19	New EGU MACT	Metals (PM) or	0.03	lbs/mmBtu		2017 for high utilitization ur
20		Metals (As)	0.5×10^{-5}	lbs/mmBtu	Unit	
21		Organics (CO)	0.10	lbs/mmBtu		
22		Dioxin/Furan	15×10^{-18}	lbs/mmBtu		
23	n Co. Ozone Non-att	NO_x	5 - 10 % reduction	NOx emissions	County-wide	Spring - 2017
24	v 1-hour NAAQS for	NO_x	termined based on	lbs/hours	Plant	During - 2016
25	v 1-hour NAAQS for	SO_2	termined based on	lbs/hours	Plant	Spring - 2017
26	$PM_{2.5}$ NAAQS	$M_{2.5}$ or Condensable F	termined based on	lbs/hours	Plant	During 2017
27						
28		- New requirements have been finalized				

	A	B	C	D	E	F
1						
2	**Estimated Limits & Compliance Dates Under Future New Air Requirements**					
3	**(Slower Implementation and Higher Limits)**					
4						
5	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
6	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
7	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
8		MC4 - SAM	76.5	lbs/hour		
9	own Consent Decr	PM	0.03	lbs/mmBtu	Unit 3	nber, 2010 NO_x & SAM
10		SO_2	97%	Removal		
11		NO_x	0.07 /0.08	lbs/mmBtu		
12		SAM	110 -220	lbs/mmBtu		
13	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
14	Revised CAIR	SO_2	0.4	lbs/mmBtu	Plant	hase I in 2016; Limits in Phase II
15		NO_x	0.2	lbs/mmBtu		
16	New EGU MACT	Mercury	85% or	Removal	Plant	2017 for high utilitization un
17			0.021	lbs/GWH		
18		Acids (HCl)	0.02	lbs/mmBtu	Unit	
19		Metals (PM) or	0.04	lbs/mmBtu		
20		Metals (As)	$2. \times 10^{-5}$	lbs/mmBtu		
21		Organics (CO)	0.20	lbs/mmBtu		
22		Dioxin/Furan	50×10^{-18}	lbs/mmBtu		
23	Co. Ozone Non-at	NO_x	5 % reduction	NOx emissions	County-wide	Spring - 2017
24	1-hour NAAQS for	NO_x	etermined based on m	lbs/hours	Plant	During - 2016
25	1-hour NAAQS fo	SO_2	etermined based on m	lbs/hours	Plant	Spring - 2017
26	$PM_{2.5}$ NAAQS	$_{2.5}$ or Condensable	etermined based on m	lbs/hours	Plant	During 2017
27						
28		- New requirements have been finalized				

From:	Ritchey, Stacy
To:	Voyles, John; Bowling, Ralph; Straight, Scott
CC:	Saunders, Eileen
Sent:	6/3/2010 8:13:44 AM
Subject:	B&V Cost Estimates - Updated Per Eileen
Attachments:	Environmental Summay (rev5 6-3-10).xlsx

Stacy Ritchey
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	A	B	C	D	E	F	G	H
1	Black & Veatch Study Cost Estimates							
2	$ in thousands							
3								
4								
5			**Capital Cost**		**O&M Cost**		**Levelized Annual Costs**	
6	**BROWN**							
7	Brown 1 - Low NOx Burners		$1,156		$0		$141	
8	Brown 1 - Baghouse		$40,000		$1,477		$6,345	
9	Brown 1 - PAC Injection		$1,599		$614		$809	
10	Brown 1 - Neural Networks		$500		$50		$111	
11	Brown 1 - Overfire Air		$767		$132		$225	
12	Total Brown 1		**$44,022**		**$2,273**		**$7,631**	
13								
14	Brown 2 - SCR		$92,000		$3,278		$14,474	
15	Brown 2 - Baghouse		$51,000		$1,959		$8,166	
16	Brown 2 - PAC Injection		$2,476		$1,090		$1,391	
17	Brown 2 - Neural Networks		$500		$50		$111	
18	Brown 2 - Lime Injection		$2,739		$1,155		$1,488	
19	Total Brown 2		**$148,715**		**$7,532**		**$25,630**	
20								
21	Brown 3 - Baghouse		$61,000		$3,321		$10,745	
22	Brown 3 - PAC Injection		$5,426		$2,330		$2,990	
23	Brown 3 - Neural Networks		$1,000		$100		$222	
24	Total Brown 3		**$67,426**		**$5,751**		**$13,957**	
25								
26	**Total Brown**		**$260,163**		**$15,556**		**$47,218**	
27								
28								
29	**GHENT**							
30	Ghent 1 - Baghouse		$131,000		$5,888		$21,831	
31	Ghent 1 - PAC Injection		$6,380		$4,208		$4,984	
32	Ghent 1 - Neural Networks		$1,000		$100		$222	
33	Total Ghent 1		**$138,380**		**$10,196**		**$27,037**	
34								
35	Ghent 2 - SCR		$227,000		$7,078		$34,704	
36	Ghent 2 - Baghouse		$120,000		$5,002		$19,606	
37	Ghent 2 - PAC Injection		$6,109		$2,880		$3,623	
38	Ghent 2 - Lime Injection		$5,483		$2,775		$3,442	
39	Ghent 2 - Neural Networks		$1,000		$100		$222	
40	Total Ghent 2		**$359,592**		**$17,835**		**$61,597**	
41								
42	Ghent 3 - Baghouse		$138,000		$6,122		$22,917	
43	Ghent 3 - PAC Injection		$6,173		$4,134		$4,885	
44	Ghent 3 - Neural Networks		$1,000		$100		$222	
45	Total Ghent 3		**$145,173**		**$10,356**		**$28,024**	
46								

	A	B	C	D	E	F	G	H
47	Ghent 4 - Baghouse		$117,000		$5,363		$19,602	
48	Ghent 4 - PAC Injection		$6,210		$3,896		$4,652	
49	Ghent 4 - Neural Networks		$1,000		$100		$222	
50	Total Ghent 4		$124,210		$9,359		$24,476	
51								
52	**Total Ghent**		**$767,355**		**$47,746**		**$141,134**	
53								
54								
55	**GREEN RIVER**							
56	Green River 3 - SCR		$29,000		$1,040		$4,569	
57	Green River 3 - CDS-FF		$38,000		$6,874		$11,499	
58	Green River 3 - PAC Injection		$1,112		$323		$458	
59	Green River 3 - Neural Networks		$500		$50		$111	
60	Total Green River 3		**$68,612**		**$8,287**		**$16,637**	
61								
62	Green River 4 - SCR		$42,000		$1,442		$6,553	
63	Green River 4 - CDS-FF		$54,000		$10,289		$16,861	
64	Green River 4 - PAC Injection		$1,583		$515		$708	
65	Green River 4 - Neural Networks		$500		$50		$111	
66	Total Green River 4		**$98,083**		**$12,296**		**$24,233**	
67								
68	**Total Green River**		**$166,695**		**$20,583**		**$40,870**	
69								
70								
71	**CANE RUN**							
72	Cane Run 4 - FGD		$152,000		$8,428		$26,926	
73	Cane Run 4 - SCR		$63,000		$2,219		$9,886	
74	Cane Run 4 - Baghouse		$33,000		$1,924		$5,940	
75	Cane Run 4 - PAC Injection		$2,326		$1,087		$1,370	
76	Cane Run 4 - Lime Injection		$2,569		$983		$1,296	
77	Cane Run 4 - Neural Networks		$500		$50		$111	
78	Total Cane Run 4		**$253,395**		**$14,691**		**$45,529**	
79								
80	Cane Run 5 - FGD		$159,000		$8,789		$28,139	
81	Cane Run 5 - SCR		$66,000		$2,421		$10,453	
82	Cane Run 5 - Baghouse		$35,000		$2,061		$6,321	
83	Cane Run 5 - PAC Injection		$2,490		$1,120		$1,423	
84	Cane Run 5 - Lime Injection		$2,752		$1,089		$1,424	
85	Cane Run 5 - Neural Networks		$500		$50		$111	
86	Total Cane Run 5		**$265,742**		**$15,530**		**$47,871**	
87								
88	Cane Run 6 - FGD		$202,000		$10,431		$35,014	
89	Cane Run 6 - SCR		$86,000		$2,793		$13,259	
90	Can Rune 6 - Baghouse		$45,000		$2,672		$8,149	
91	Cane Run 6 - PAC Injection		$3,490		$1,336		$1,761	
92	Cane Run 6 - Lime Injection		$3,873		$1,367		$1,838	

	A	B	C	D	E	F	G	H
93	Cane Run 6 - Neural Networks		$500		$50		$111	
94	Total Can Run 6		$340,863		$18,649		$60,132	
95								
96	**Total Cane Run**		**$860,000**		**$48,870**		**$153,532**	
97								
98								
99	**Mill Creek**							
100	Mill Creek 1 - FGD		$297,000		$14,341		$50,486	
101	Mill Creek 1 - SCR		$97,000		$3,366		$15,171	
102	Mill Creek 1 - Baghouse		$81,000		$3,477		$13,335	
103	Mill Creek 1 - Electrostatic Precipitator		$32,882		$3,581		$7,583	
104	Mill Creek 1 - PAC Injection		$4,412		$2,213		$2,750	
105	Mill Creek 1 - Lime Injection		$4,480		$2,024		$2,569	
106	Mill Creek 1 - Neural Networks		$1,000		$100		$222	
107	Total Mill Creek 1		**$517,774**		**$29,102**		**$92,116**	
108								
109	Mill Creek 2 - FGD		$297,000		$14,604		$50,749	
110	Mill Creek 2 - SCR		$97,000		$3,401		$15,206	
111	Mill Creek 2 - Baghouse		$81,000		$3,518		$13,376	
112	Mill Creek 2 - Electrostatic Precipitator		$32,882		$3,664		$7,666	
113	Mill Creek 2 - PAC Injection		$4,412		$2,340		$2,877	
114	Mill Creek 2 - Lime Injection		$4,480		$2,117		$2,662	
115	Mill Creek 2 - Neural Networks		$1,000		$100		$222	
116	Total Mill Creek 2		**$517,774**		**$29,744**		**$92,758**	
117								
118	Mill Creek 3 - FGD		$392,000		$18,911		$66,617	
119	Mill Creek 3 - Baghouse		$114,000		$4,923		$18,797	
120	Mill Creek 3 - PAC Injection		$5,592		$3,213		$3,894	
121	Mill Creek 3 - Neural Networks		$1,000		$100		$222	
122	Total Mill Creek 3		**$512,592**		**$27,147**		**$89,530**	
123								
124	Mill Creek 4 - FGD		$455,000		$21,775		$77,149	
125	Mill Creek 4 - Baghouse		$133,000		$5,804		$21,990	
126	Mill Creek 4 - PAC Injection		$6,890		$3,858		$4,697	
127	Mill Creek 4 - Neural Networks		$1,000		$100		$222	
128	Total Mill Creek 4		**$595,890**		**$31,537**		**$104,058**	
129								
130	**Total Mill Creek**		**$2,144,030**		**$117,530**		**$378,462**	
131								
132								
133	**TRIMBLE**							
134	Trimble 1 - Baghouse		$128,000		$5,782		$21,360	
135	Trimble 1 - PAC Injection		$6,451		$4,413		$5,198	
136	Trimble 1 - Neural Networks		$1,000		$100		$222	
137	Total Trimble 1		$135,451		$10,295		$26,780	
138								

	A	B	C	D	E	F	G	H
139	**Total Trimble**		**$135,451**		**$10,295**		**$26,780**	
140								
141								
142	**Grand Total**		**$4,333,694**		**$260,580**		**$787,996**	

	A	B	C	D	E
1	Black & Veatch Study Cost Estimates				
2					
3					
4					
5			**MW**		**$/kW**
6	**BROWN**				
7	Brown 1 - Low NOx Burners				$11
8	Brown 1 - Baghouse				$364
9	Brown 1 - PAC Injection				$15
10	Brown 1 - Neural Networks				$5
11	Brown 1 - Overfire Air				$7
12	Total Brown 1		110		**$400**
13					
14	Brown 2 - SCR				$511
15	Brown 2 - Baghouse				$283
16	Brown 2 - PAC Injection				$14
17	Brown 2 - Neural Networks				$3
18	Brown 2 - Lime Injection				$15
19	Total Brown 2		180		**$826**
20					
21	Brown 3 - Baghouse				$133
22	Brown 3 - PAC Injection				$12
23	Brown 3 - Neural Networks				$2
24	Total Brown 3		457		**$148**
25					
26	**Total Brown**		**747**		**$348**
27					
28					
29	**GHENT**				
30	Ghent 1 - Baghouse				$242
31	Ghent 1 - PAC Injection				$12
32	Ghent 1 - Neural Networks				$2
33	Total Ghent 1		541		**$256**
34					
35	Ghent 2 - SCR				$439
36	Ghent 2 - Baghouse				$232
37	Ghent 2 - PAC Injection				$12
38	Ghent 2 - Lime Injection				$11
39	Ghent 2 - Neural Networks				$2
40	Total Ghent 2		517		**$696**
41					
42	Ghent 3 - Baghouse				$264
43	Ghent 3 - PAC Injection				$12
44	Ghent 3 - Neural Networks				$2
45	Total Ghent 3		523		**$278**
46					

	A	B	C	D	E
47	Ghent 4 - Baghouse				$222
48	Ghent 4 - PAC Injection				$12
49	Ghent 4 - Neural Networks				$2
50	Total Ghent 4		526		$236
51					
52	**Total Ghent**		**2,107**		**$364**
53					
54					
55					
56	**GREEN RIVER**				
57	Green River 3 - SCR				$408
58	Green River 3 - CDS-FF				$535
59	Green River 3 - PAC Injection				$16
60	Green River 3 - Neural Networks				$7
61	Total Green River 3		71		**$966**
62					
63	Green River 4 - SCR				$385
64	Green River 4 - CDS-FF				$495
65	Green River 4 - PAC Injection				$15
66	Green River 4 - Neural Networks				$5
67	Total Green River 4		109		**$900**
68					
69	**Total Green River**		**180**		**$926**
70					
71					
72	**CANE RUN**				
73	Cane Run 4 - FGD				$905
74	Cane Run 4 - SCR				$375
75	Cane Run 4 - Baghouse				$196
76	Cane Run 4 - PAC Injection				$14
77	Cane Run 4 - Lime Injection				$15
78	Cane Run 4 - Neural Networks				$3
79	Total Cane Run 4		168		**$1,508**
80					
81	Cane Run 5 - FGD				$878
82	Cane Run 5 - SCR				$365
83	Cane Run 5 - Baghouse				$193
84	Cane Run 5 - PAC Injection				$14
85	Cane Run 5 - Lime Injection				$15
86	Cane Run 5 - Neural Networks				$3
87	Total Cane Run 5		181		**$1,468**
88					
89	Cane Run 6 - FGD				$774
90	Cane Run 6 - SCR				$330
91	Can Rune 6 - Baghouse				$172
92	Cane Run 6 - PAC Injection				$13

	A	B	C	D	E
93	Cane Run 6 - Lime Injection				$15
94	Cane Run 6 - Neural Networks				$2
95	Total Can Run 6		261		$1,306
96					
97	**Total Cane Run**		**610**		**$1,410**
98					
99					
100	**Mill Creek**				
101	Mill Creek 1 - FGD				$900
102	Mill Creek 1 - SCR				$294
103	Mill Creek 1 - Baghouse				$245
104	Mill Creek 1 - Electrostatic Precipitator				$100
105	Mill Creek 1 - PAC Injection				$13
106	Mill Creek 1 - Lime Injection				$14
107	Mill Creek 1 - Neural Networks				$3
108	Total Mill Creek 1		330		**$1,569**
109					
110	Mill Creek 2 - FGD				$900
111	Mill Creek 2 - SCR				$294
112	Mill Creek 2 - Baghouse				$245
113	Mill Creek 2 - Electrostatic Precipitator				$100
114	Mill Creek 2 - PAC Injection				$13
115	Mill Creek 2 - Lime Injection				$14
116	Mill Creek 2 - Neural Networks				$3
117	Total Mill Creek 2		330		**$1,569**
118					
119	Mill Creek 3 - FGD				$927
120	Mill Creek 3 - Baghouse				$270
121	Mill Creek 3 - PAC Injection				$13
122	Mill Creek 3 - Neural Networks				$2
123	Total Mill Creek 3		423		**$1,212**
124					
125	Mill Creek 4 - FGD				$867
126	Mill Creek 4 - Baghouse				$253
127	Mill Creek 4 - PAC Injection				$13
128	Mill Creek 4 - Neural Networks				$2
129	Total Mill Creek 4		525		**$1,135**
130					
131	**Total Mill Creek**		**1,608**		**$1,333**
132					
133					
134	**TRIMBLE**				
135	Trimble 1 - Baghouse				$234
136	Trimble 1 - PAC Injection				$12
137	Trimble 1 - Neural Networks				$2
138	Total Trimble 1		547		$248

	A	B	C	D	E
139					
140	**Total Trimble**		**547**		**$248**
141					
142					
143	**Grand Total**		**5,799**		**$747**

From: Saunders, Eileen
To: Voyles, John; Bowling, Ralph; Crutcher, Tom; Turner, Haley; Fraley, Jeffrey; Pabian, Brad; Carman, Barry; Joyce, Jeff; Nix, Stephen; Piening, Carla; Kirkland, Mike; Koller, Tiffany; Stevens, Michael; Troost, Tom; Harper, Travis; Turner, Steven; Hensley, Mike; Wilson, Stuart; Karavayev, Louanne; Cosby, David; Hudson, Rusty; Raque, Gary; Revlett, Gary; Black, Greg; Imber, Philip
CC: Straight, Scott
Sent: 6/21/2010 11:30:09 AM
Subject: FW: 167987.26.0000 100617 - EON Draft AQC Technology Cost Report
Attachments: COMPLETE Draft EON AQC Cost Study 061710.pdf

All,

Enclosed, please find the draft report from B&V. Scott and I have just begun the review but I wanted to share the document with you as well. As discussed previously, this information does not meet the criteria for Level 1 Engineering, but it is a starting point for further analysis. If you have any comments, please send them to me by Friday, June 25, 2010.

Before you print this document, I want to warn you that it is roughly 400 pages.

Thanks,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, June 17, 2010 10:20 PM
To: Saunders, Eileen
Cc: Hillman, Timothy M.; Mahabaleshwarkar, Anand; Lawson, Stacy J.
Subject: 167987.26.0000 100617 - EON Draft AQC Technology Cost Report

Eileen,
Attached, please find the draft air quality control Technology Cost Report. Please review the document and provide one set of consolidated written comments by COB Thursday June 24, 2010. B&V will review the consolidated comments and incorporate, as appropriate, into the final report.

Additionally, Please confirm receipt of this document.

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-9062** | Fax: **(913) 458-9062**
Email: **lucaskj@bv.com**

E.ON US
Coal Fired Fleet Wide

Air Quality Control
Technology Cost Assessment

B&V Project: 167987
B&V File No.: 26.0000

Issue Date and Revision
June 2010
Rev. B

BLACK & VEATCH
Building a world of difference.

e·on

Table of Contents

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Table of Contents (Continued)
Tables
Summary of Plant AQC Technology Costs

Acronym List

AQC	Air Quality Control
BOP	Balance-of-Plant
CAIR	Clean Air Interstate Rule
CDS	Circulating Dry Scrubber
CO	Carbon Monoxide
EPA	Environmental Protection Agency
ESP	Electrostatic Precipitator
H_2SO_4	Sulfuric Acid
HCl	Hydrogen Chloride
Hg	Mercury
ID	Induced Draft
LNB	Low NO_x Burners
MACT	Maximum Achievable Control Technology
MBtu	Million British Thermal Unit
NN	Neural Network
NO_x	Nitrogen Oxides
O&M	Operation and Maintenance
OFA	Overfire Air
PAC	Powdered Activated Carbon
PJFF	Pulse Jet Fabric Filter
PM	Particulate Matter
SCR	Selective Catalytic Reduction
SO_2	Sulfur Dioxide

Executive Summary

The purpose of this study was to develop fleet-wide, high-level, capital and O&M costs for recommend air quality control equipment necessary to meet future environmental requirements at 18 coal-fired units located at 6 facilities (E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River) owned and operated by E.ON. The study was conducted at a high-level and under a tight schedule in order to meet E.ON's requirements.

To perform the study, Black &Veatch dispatched two teams of engineers to conduct site visits and walk-downs at each of the 6 facilities over the course of 3 days. Based on information gathered during these site visits, initial air quality control equipment recommendations were prepared for E.ON's review and approval before proceeding with the cost estimate. Following E.ON's approval, high-level capital and O&M costs were determined for each unit and air quality control technology. Table ES-1 summarizes the capital and O&M cost totals rolled up for each facility.

Table ES-1
Summary of Plant AQC Technology Costs

Plant	Capital Cost ($/1,000)	Operating Cost ($/kW)	O&M Cost ($/1,000)	Levelized Annual Cost ($/1,000)
E.W. Brown	260,163	1,374	15,556	47,218
Ghent	767,355	1,465	47,746	141,134
Cane Run	860,000	4,282	48,870	153,532
Mill Creek	2,144,030	5,485	117,530	378,462
Trimble County	135,451	248	10,295	26,780
Green River	166,695	1,866	20,583	40,870
Total	4,333,694	14,720	260,580	787,996

This report contains a breakdown of the aforementioned costs and summarizes the basis and supporting documentation used to develop them. The supporting documentation includes site visit notes, control technology recommendations, design basis, process flow diagrams, equipment layout drawings, and milestone implementation schedules for the selected technologies.

1.0 Introduction

Black & Veatch was tasked by E.ON to provide a high-level cost estimate of air quality compliance expenditures necessary to meet expected future regulatory requirements for budgetary purposes. The following coal fired units were considered in this study:

- E.W. Brown – Units 1, 2, and 3.
- Ghent – Units 1, 2, 3, and 4.
- Cane Run – Units 4, 5, and 6.
- Mill Creek – Units 1, 2, 3, and 4.
- Trimble County – Units 1 and 2.[1]
- Green River – Units 3 and 4.

To accomplish this objective, Black & Veatch personnel collected the necessary unit-specific data and performed onsite observations to prepare this AQC retrofit technology and cost assessment. Based on information gathered during these site visits, initial air quality control equipment recommendations were prepared for E.ON's review and approval before proceeding with the cost estimate. To support this process, design basis, process flow diagrams, equipment layout drawings, and milestone implementation schedules for the selected technologies were developed.

Based on B&V experience, technical and economic assumptions were made in order to facilitate rapid development of the technical calculations and costs estimates. Of special note, the capital cost estimates and annual operating cost data for the AQC equipment should be considered as high-level conceptual design estimates and should be confirmed with a more detailed follow-up assessment before initiating an implementation plan.

The assessment identifies AQC technologies for reducing unit-specific air emissions for pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), mercury (Hg), hydrogen chloride (HCl), and dioxin/furans. This report documents the assumptions and findings of the assessment, including the identification of retrofit AQC technologies to achieve compliance at each unit, as well as order-of-magnitude costs capital and operation and maintenance (O&M) cost estimates, process flow diagrams, summary plot plan drawings, and Level 1

[1]Unit 2 at Trimble County is a new unit currently in startup and tuning before becoming commercially operational and has new AQC equipment assumed to be sufficiently designed to meet the target emissions in this study. Therefore, this unit was excluded from further analyses.

summary schedules to engineer, procure, and install each recommended technology. Additionally, the report identifies potential impacts the AQC technologies may impose on balance-of-plant (BOP) systems as applicable, such as, electric systems, ash handling systems, water supply and wastewater treatment systems.

2.0 Pollutant Emission Targets

The potential impact of future regulations are the primary driver for both the timing and nature of environmental controls planned at the E.ON plants. Among the regulatory drivers are the Utility Maximum Achievable Control Technology (MACT) and the Transport Rule -- Clean Air Interstate Rule (CAIR) replacement to be proposed by the United States Environmental Protection Agency (USEPA) by March 2011 and summer 2010, respectively. These two regulatory drivers and their associated emission levels serve as the primary basis used by Black & Veatch to develop unit-by-unit AQC technology recommendations.

E.ON provided a matrix of estimated requirements under future new environmental regulations, as well as a summary implementation schedule of regulatory programs. This information is provided in Appendix A. From this information, E.ON developed specific pollutant emission limit targets with the intent that the limits would be applied to each unit individually to assess current compliance and the potential for additional AQC equipment. For the purposes of this study, compliance options beyond the addition of new AQC technology (such as fuel switching, shutdown of existing emission units, development of new power generation, and emissions averaging scenarios) were not considered. Table 2-1 summarizes the future pollution emission targets provided by E.ON for each unit.

Table 2-1
Future Pollution Emission Targets

Pollutant	Future Pollutant Emission Limit (lb/MBtu)
NO_x	0.11
SO_2	0.25
PM	0.03
CO	0.10[(a)]
Hg	0.000001[(b)]
HCl	0.002
Dioxin/Furan	15×10^{-18}

[(a)]E.ON's original emission matrix provided a CO emission level of 0.02 lb/MBtu. It was determined that there was not a feasible and proven control technology available for the type and size of unit being assessed. Therefore, on May 21, 2010, the future pollutant emission limit was modified to reflect 0.10 lb/MBtu, which is considered reflective of potentially achievable CO emissions from coal fired units.
[(b)]The emission matrix indicated 0.012 lb/GWh or 90 percent reduction.

3.0 Study Basis and Methodology

The following sections discuss the basis and methodology used to make the AQC technology recommendations and cost estimates presented herein. These activities included site visits, development of a design basis, costs estimate methodology development, and economic assumptions.

3.1 Site Visits

During the week of May 10, 2010, E.ON provided Black & Veatch personnel access to each plant site to review existing unit systems and components and discuss current operational issues with appropriate plant personnel. The discussions focused on plant-specific issues that could potentially impact the selection, installation, and operation of future AQC technologies, such as:

- Available space to locate new AQC equipment.
- Availability of auxiliary power.
- Condition assessment of major equipment.
- Identification of BOP issues.
- Constructability issues.

These discussions were followed by plant lead facility tours. Each plant site visit ended with an exit meeting, where the initial recommendations and findings were summarized with the plant team. A brief description of site visit observations and AQC considerations for E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble, and Green River are included in Sections 4.1.1, 4.2.1, 4.3.1, 4.4.1, 4.5.1, and 4.6.1, respectively. Table 3-1 identifies team personnel and facilities visited by each Black & Veatch team.

Table 3-1
Black & Veatch Team Members

Black & Veatch Team Member	Position
Team No. 1[a]	
Anand Mahabaleshwarkar	Air Quality Control Engineer
Richard Hooper	Mechanical Engineer
Mike Ballard	Civil/Structural Engineer
Team No. 2[b]	
Black & Veatch Team Member	**Position**
Pratik Mehta	Air Quality Control Engineer
Dave Muggli	Mechanical Engineer
Roger Goodlet	Civil/Structural Engineer

[a]Visited Cane Run, Mill Creek, and Green River Stations on May 11, May 12, and May 13, respectively.
[b]Visited Ghent, Trimble County, and E.W. Brown Stations on May 11, May 12, and May 13, respectively.

3.2 Design Basis

A design basis was established for each unit based on information provided by E.ON (included in Appendix B) and results from Black & Veatch's internal combustion calculations. Information in the design basis was used as the basis for estimating equipment sizes, performance calculations, cost estimates (capital, operating, and maintenance) and also for estimating resource consumption, auxiliary power requirements, and byproduct disposal volumes. The performance calculations developed were based on the established design basis parameters and served as the basis for estimating capital and annual O&M costs for proven and feasible AQC equipment. The design basis is provided in Appendix C.

3.3 Cost Methodology

Capital and annual O&M costs to procure, install, and operate the E.ON approved AQC technologies were developed for each of 17 units[2]. All cost information was produced for unit-specific combinations of new AQC technology components —

[2] Unit 2 at Trimble County is a new unit currently in startup and tuning before becoming commercially operational and has new AQC equipment assumed to be sufficiently designed to meet the target emissions in this study. Therefore, this unit was excluded from further analyses.

upgrades to existing AQC equipment were not considered. A brief description of the proven and feasible AQC technologies considered for this study is included in Appendix D.

To support the cost estimate, Black & Veatch performed a high-level fatal flaw analysis of the following for each selected emission control technology for each unit:

- Flue Gas Conditions. Based on design fuel analysis, boiler steaming capacity, and current operating characteristics, Black & Veatch determined the flue gas conditions to be used as the basis for the AQC equipment design basis.
- Draft Fan Analysis. Black & Veatch identified the new fan requirements with high-level approximations for the new or modified ID or booster fans.
- Simplified AQCS Mass Balance. Simplified mass balances for the AQC process was completed to determine the level of reagent use and the quantity of byproduct produced.
- Black & Veatch identified new auxiliary electric loads with approximate values for recommended technologies.
- Chimney Analysis. A high-level analysis was performed to evaluate, for each air pollution control equipment option identified, modifications or replacement of the existing chimney.
- Constructability Review. A high-level constructability review was performed to assure that each conceptual site layout considers necessary access for construction without disrupting existing plant and AQC equipment. Construction and schedule are key considerations in the success of any major capital plan.
- Conceptual Equipment Arrangements. Black & Veatch produced overlays of existing site layout drawings supplied by E.ON to identify potential equipment locations (AQC equipment footprint boxes) for the approved AQC technologies. These layouts approximate the footprints and the real estate constraints.
- Schedule. Black & Veatch developed a general high-level project schedule (Level 1) including construction and erection plan of recommended AQC technologies.

The capital cost estimates were factored from recent detailed studies of similar coal fired applications and previous in-house design/build projects, include direct and indirect costs, and are stated in 2010 dollars. These costs also include allowances for auxiliary electric, draft fan upgrades, control system upgrades and other required BOP system upgrades and high-level estimates of capital cost for new stacks, induced draft (ID) and booster fans, and ductwork. Likewise, O&M costs were also estimated for the aforementioned equipment and were similarly based on data from either in-house design/build projects or, as in most case, were estimated based on a factor. The capital and O&M represent order-of-magnitude costs. The following sections briefly describe these costs.

3.3.1 Capital Costs Estimate

Direct costs consist of purchased equipment, installation, and miscellaneous costs including foundation, handling equipment, electrical, demolition, buildings, relocation costs, etc. The purchased equipment costs are the costs for purchasing the equipment, including taxes and freight. An itemized list of key components of the direct capital cost has been included in the costs for each feasible control technology described later in this report. The installation costs include construction costs for installing the new controls. The installation costs take into account the retrofit difficulty of the existing site configuration and condition and the installation requirements of the evaluated technology. Finally, the costs of miscellaneous items such as site preparation, buildings, and other site structures needed to implement the control technology are included.

Indirect costs are those costs that are not related to the equipment purchased but are associated with any engineering project, such as the retrofit of an AQC technology. Indirect costs addressed in this evaluation include the following:

- Contingency.
- Engineering.
- Owner's Cost.
- Construction Management.
- Startup and Spare Parts.
- Performance Tests.

The following sections briefly describe the indirect capital costs considered for this study.

3.3.1.1 Contingency. Contingency accounts for unpredictable events and costs that could not be anticipated during the normal cost development of a project. Costs assumed to be included in the contingency cost category are items such as possible redesign and equipment modifications, errors in estimation, unforeseen weather-related delays, strikes and labor shortages, escalation increases in equipment costs, increases in labor costs, delays encountered in startup, etc.

3.3.1.2 Engineering. Engineering costs include any services provided by an architect/engineer or other consultant for support, design, and procurement of the AQC project.

3.3.1.3 Owner's Cost. Table 3-2 lists possible Owner's costs for this category. The Owner's costs are identified as indirect costs. Some of the categories are not applicable to all of the evaluated technologies, but are representative of the typical expenditures that an Owner would experience as part of an AQC retrofit project.

3.3.1.4 Construction Management. Construction management services include field management staff such as support personnel, field contract administration, field inspection and quality assurance, project controls, technical direction, and management of startup. It also includes cleanup expense for the portion not included in the direct-cost construction contracts, safety and medical services, guards and other security services, insurance premiums, other required labor-related insurance, performance bond, and liability insurance for equipment and tools.

3.3.1.5 Startup and Spare Parts. Startup services include the management of the startup planning and procedure and the training of personnel for the commissioning of the newly installed AQC technology. Also included are the general low-cost spare parts required for each AQC technology system. High-cost critical spare part components are kept only if recommended by the manufacturer; they are determined and accounted for on a case-by-case basis.

3.3.1.6 Performance Tests. Performance test services are typically required after every AQC technology addition to validate the performance of the emissions reduction system. The results of the performance tests are used to ensure compliance with performance guarantees and emissions limits.

Table 3-2
Typical Owner's Cost Categories

Project Development:

- Legal assistance
- Environmental permitting/offsets
- Public relations/community development
- Road modifications/upgrades

Financing:

- Debt service reserve fund
- Analyst and engineer

Owner's Project Management:

- Provide project management
- Perform engineering due diligence
- Prepare bid documents and select contractors and suppliers

Plant Startup/Construction Support:

- Owner's site mobilization
- O&M staff training
- Initial test fluids and lubricants
- Initial inventory of chemicals/reagents
- Consumables
- Construction all-risk insurance
- Auxiliary power purchase

Taxes/Advisory Fees/Legal:

- Taxes
- Market and environmental consultants
- Owner's legal expenses:
  - Power purchase agreement
  - Interconnect agreements
  - Contract--procurement and construction
  - Property transfer

3.3.2 Annual O&M Cost Estimate

Annual O&M costs typically consist of both fixed and variable O&M costs. The following cost categories are a few of the fixed and variable costs considered:

- Reagent costs.
- Electric power costs.
- Makeup water costs.
- Wastewater treatment and byproduct disposal costs.
- Operating labor costs.
- Maintenance materials and labor costs.

The costs of reagent, electric power, makeup water, wastewater, and byproduct disposal are variable annual costs and are dependent on the specific control technology. O&M materials and labor are fixed annual costs.

The following sections briefly discuss some of the fixed and variable O&M costs considered for this study.

3.2.2.1 Reagent Costs. Reagent costs include the costs for the material, delivery of the reagent to the facility, and reagent preparation. Reagent costs are a function of the quantity of the reagent used and the price of the reagent. The quantity of reagent used will vary with the quantity of pollutant removed. Reagent costs were defined for the following reagents:

- Anhydrous ammonia.
- Limestone.
- Lime.
- Trona.
- Powdered Activated Carbon (PAC).

3.2.2.2 Electric Power Costs. Additional auxiliary power will be required to run some of the new control technology systems. The power requirements of each system vary, depending on the type of technology and the complexity of the system. Electric power costs include an increase in fan power caused by the flue gas pressure losses through the new equipment. The additional fan power was estimated with a basis of 90 percent fan efficiency and 80 percent motor efficiency.

3.2.2.3 Makeup and Service Water Costs. Makeup water or service water is required for some of the processes in the new control technology systems. Examples of water consumption include water to support AQC activities for the SO_2 scrubber systems.

3.2.2.4 Wastewater and Byproduct Disposal Costs. Some control technologies generate wastewater and/or byproduct that will require treatment or disposal. Examples of wastewater and disposal to support the AQC activities include the SO_2 scrubber systems and the pulse jet fabric filter (PJFF) systems.

3.2.2.5 Operating Labor Costs. Operating labor costs are developed by estimating the number and type of employees that will be required to run the new AQC equipment. This estimate was based on common industry practices. The labor cost was based on a fully loaded labor rate and 40 hours per work week.

Typically, a complex emissions control technology will require a combination of the following personnel:

- Supervisor.
- Control Room Operator.
- Roving Operator.
- Relief Operator.
- Laboratory Technicians.
- Equipment Operators.

3.2.2.6 Maintenance Materials and Labor Costs. The annual maintenance materials and labor costs are typically estimated as a percentage of the total equipment costs of the system. Based on typical electrical utility industry experience, maintenance materials were estimated to be between 1 and 5 percent of the total direct capital costs. Some initial recommended spare parts were included (assumed) in the capital costs. An annual maintenance value of 3 percent of the total direct capital costs was used as the basis for the yearly maintenance materials and labor cost. For technologies that replace a similar existing technology at the current plant site, a determination of the additional maintenance requirements was performed. If the required maintenance materials and labor were similar to the existing technology, no additional maintenance costs were credited for the new control technology.

3.4 Economic Data and Assumptions

The following are the economic data and assumptions used in the cost analysis.

3.4.1 Economic Data

Economic data were provided by E.ON for use in development of the annual O&M costs. However, some economic data were not available for some units/plants. Therefore, Black & Veatch assumed the highest value provided by E.ON as representative of the equivalent variable for any plant with missing economic data. The economic data are presented in Table 3-3. The assumed cost data have been denoted in bold-italic font and are summarized below:

- The limestone cost for Cane Run and Green River is $11.54/ton.
- The lime cost for Cane Run and Green River plant is $132.19/ton.

Table 3-3
Economic Evaluation Parameters[a]

Economic Parameters	Economic Criteria																	
	E.W. Brown			**Ghent**				**Cane Run**			**Mill Creek**				**Trimble County**		**Green River**	
Unit Identification	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Remaining Plant Life (years)	30			30				20			30				30		30	
Capacity Factor (percent)	44.00	62.00	57.00	81.00	71.00	78.00	77.00	60.00	62.00	54.00	68.00	70.00	75.00	75.00	85.00	87.00	26.00	32.00
Auxiliary Power Cost ($/MWh)	42.66	36.46	36.24	24.87	24.59	25.44	24.9	28.88	28.35	30.18	21.56	21.69	23.31	22.35	23.25	21.49	34.33	31.87
Limestone Cost ($/ton)	11.54			8.22				***11.54***[b]			7.54				8.24		***11.54***[b]	
Lime Cost ($/ton)	132.19			131.78				***132.19***[b]			118.13				131.78		***132.19***[b]	
Ash Disposal Cost ($/tonne)	***15***[b]			***15***[b]				***15***[b]			***15***[b]				***15***[b]		***15***[b]	
SCR Catalyst Replacement Cost ($/m^3)	***6,500***[b]			***6,500***[b]				***6,500***[b]			***6,500***[b]				***6,500***[b]		***6,500***[b]	
Ammonia Cost for SCR ($/ton)	***530.03***[b]			517.55				***530.03***[b]			530.03				522.7		***530.03***[b]	
Trona Cost ($/ton)	200.42			200.42				***200.42***[b]			195				***200.42***[b]		***200.42***[b]	
Halogenated PAC Cost ($/lb)	***1.1***[b]			***1.1***[b]				***1.1***[b]			***1.1***[b]				***1.1***[b]		***1.1***[b]	
Water Cost ($/1,000 gal)	***2***[b]			***2***[b]				***2***[b]			***2***[b]				***2***[b]		***2***[b]	
Fully-Loaded Labor Rate ($/h)	123,325			121,000				126,882			132,901				132,491		121,547	
Capital Escalation Rate (percent)	2.5																	
O&M Escalation Rate (percent)	2																	
Levelized Fixed Charge Rate or Capital Recovery Factor (percent)	12.17																	
Interest During Construction (percent)	4.5																	

[a]Utilities costs are as delivered costs.
[b]Economic variable was not provided by E.ON and are assumed data based on similar economic data for other E.ON plants.

- The ash disposal cost for E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River is $15/ton.
- The selective catalytic reduction (SCR) catalyst replacement cost for E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River is $6,500/m^3.
- The anhydrous ammonia cost for E.W. Brown, Cane Run, and Green River is $530.03/ton.
- The trona cost for Cane Run, Trimble County and Green River is $200.42/ton.
- The halogenated PAC costs for E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River is $1.1/lb.
- The water costs for E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River is $2/1,000 gallons.

3.4.1 Economic Assumptions

Based on Black & Veatch's experience technical and economic assumptions were made to appropriately characterize costs for the study. These assumptions are briefly described, but are not limited to, the following:

1. The direct cost estimates reflect the following:
   - Costs for regulatory and environmental permitting were not included.
   - Costs for additional equipment studies were not included.
   - Regular supply of construction craft labor and equipment is available.
   - Normal lead-times for equipment deliveries are expected.
2. Compliance options beyond the addition of new AQC technology (such as fuel switching, shutdown of existing emission units, development of new power generation, and emissions averaging scenarios) and their associated cost were not considered.
3. Costs for loss of generation for construction outage were not included as part of the indirect costs.
4. Annual operating cost estimates are based on operation at full-load conditions utilizing E.ON supplied load factors.
5. Sizing of AQC components and estimates of flue gas flow and pressure drops are developed from calculations based on the coal composition as provided by E.ON.

6. Sizing of AQC components is based on the AQC equipment being capable of achieving Best Available Control Technology emission levels. However, O&M costs were based on achieving the identified pollutant emission rates.
7. The cost estimate includes calculated values for escalation and contingency.
8. Owner's costs (project development, financing, etc.) are estimated as a percentage of the total capital cost.
9. Annual O&M costs associated with the AQC retrofit equipment are differential O&M costs associated with the equipment, rather than with the entire plant O&M costs.
10. Common economic components of each AQC technology are apportioned to the technologies rather than identified separately.
11. Neural networks (NNs) were assumed for all units as the proven and feasible control technology to reduce emissions of CO from the coal fired units[3]. For units less than 300 MW, a capital and O&M cost of $500,000 and $50,000, respectively, was assumed. For units greater than 300 MW, a capital and O&M cost of $1,000,000 and $100,000, respectively, was assumed.
12. H_2SO_4 (SO_3) emissions were not an identified pollutant in E.ON's emission matrix. However, due to generation of sulfuric acid mist[4] (H_2SO_4) (SO_3) from SO_2 to SO_3 conversion across the SCR technology catalyst, Black & Veatch included costs for a H_2SO_4 (SO_3) mitigation system for units with approved SCR AQC technologies.
13. Costs estimates have been included in the unit specific AQC equipment costs for AQC equipment that requires new reagent preparation systems, dewatering systems, or byproduct handling systems.

[3] Neural networks are proven and feasible technologies to reduce CO emissions. However, CO emission reductions due to installation of NN vary from unit to unit based on each unit's specific equipment configuration and operation. It is recommended that detailed studies be performed to determine the potential benefit from NN installation.

[4] Emissions of H_2SO_4 (SO_3) were not included in the emission matrix as a primary pollutant requiring assessment for new AQC technology.

4.0 Control Cost Estimate (Capital and O&M)

The following sections describe the existing conditions, site visit observations, AQC recommendations, cost estimates, special considerations, and implementation schedules for each unit.

4.1 E.W. Brown - Units 1, 2, and 3

The E.W. Brown Station is located on Herrington Lake in Mercer County, Kentucky, between Shakertown and Burgin, off of Hwy 33. The station was constructed on the west side of Herrington Lake, the impoundment behind Dix Dam. The plant began commercial operation in 1957. The station includes three coal fired electric generating units with a total nameplate capacity of 747 MW gross. The electrical power from the E.W. Brown Station units is used to provide both load and voltage support for the 138 kV transmission systems.

Unit 1 has a gross capacity of 110 MW and is equipped with old generation LNBs and cold side dry ESP for NO_x and PM control, respectively. Unit 2 has a gross capacity of 180 MW and is equipped with LNBs, OFA, and cold-side dry ESP for NO_x and PM control. Unit 3 has a gross capacity of 457 MW and is equipped with LNBs, OFA, and cold-side dry ESP for NO_x and PM control. E.ON is in the process of installing an SCR (in-service date, 2012) on Unit 3 to control NO_x and a common wet FGD scrubber for Units 1, 2, and 3 (in-service date, late 2010).

4.1.1 Site Visit Observations and AQC Considerations

At the E.W. Brown Generating Station, the Black & Veatch team met Brad Pabian (Mechanical Engineer), Barry Carman (Results Coordinator), and Ronald Gregory (Plant Manager) from E.ON. The following text is a narrative summary of the site visit conducted on May 13, 2010.

The installation of SCR on Unit 1 will require significant demolition and relocation of the circulating water system, service water piping, and soot blower air compressors tanks and modification of secondary air heater duct in the boiler building. This would require a significant outage time and is generally thought to be a difficult and expensive alternative. In order to achieve plantwide NO_x emission compliance with future regulatory requirements, it was decided by E.ON to install new generation low NO_x burners (LNBs) and overfire air (OFA) instead of SCR on Unit 1[5].

Installing SCR on Unit 2 will require demolishing the abandoned Unit 2 chimney, relocation of the storage tank, relocation of auxiliary transformer, demolition of the dust collector and associated ductwork and support steel, and relocation of underground utilities. The new SCR duct tie-ins to the existing Unit 2 air heater inlet duct will require boiler building structural steel bracing and girts to be modified to accommodate ductwork. The existing coal conveyor and ductwork block crane access to the northeast side of Unit 2 boiler house. This will require Unit 2 SCR structures to be constructed using a large tonnage crane with extended reach capabilities, or by extending the structural support frame system to the east and using a pick and slide execution method to erect the SCR modules.

Installing individual PJFF on Unit 1 and Unit 2 will require some demolition of ductwork and structural steel and relocation of ductwork and associated support steel for tie-in. Crane access around the footprint of the ID fans for Unit 1 and Unit 2 is restricted, and it will be difficult to stage the construction equipment necessary to erect the ductwork support frame and associated foundations. There is no real estate available for construction of PJFF on Unit 2, and the PJFF on Unit 2 will be elevated above the grade level and constructed above (downstream) the existing cold-side dry electrostatic precipitators (ESPs). For Unit 3, the new PJFF will be installed downstream of the existing cold-side dry ESP.

Installing individual PJFF on Unit 3 will require some demolition of ductwork and structural steel and relocation of ductwork and associated support steel for tie-in. It will also require relocation of underground utility lines.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

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[5] It should be noted that Black & Veatch originally recommended an SCR for E.W. Brown Unit 1. However, on May 21, 2010, E.ON approved LNB and OFA technology in lieu of SCR. E.ON later requested costs for SCR, which were provided separately on June 14, 2010.

4.1.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit. The pollutants that require new control technologies to be installed that will meet target emission levels are NO_x, PM, CO, Hg, and dioxin/furan. New sorbent (lime) injection control technology may be required for H_2SO_4 abatement where SCR is installed.

To meet the identified pollutant emission limits, new AQC technologies are required for Brown Unit 1. These AQC technologies include installation of new generation LNBs, OFA, and PAC injection coupled with a new PJFF located downstream of the existing ESP. The new generation LNB and OFA system can reduce NO_x emissions to 0.30 lb/MBtu. The new PJFF will be installed downstream of the existing cold-side dry ESP. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

To meet the identified pollutant emission limits, new AQC technologies are required for Brown Unit 2. These AQC technologies include the installation of new SCR and PAC injection coupled with a new PJFF located downstream of the existing dry ESP. The new SCR system can reduce NO_x emissions to 0.11 lb/MBtu or lower. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New sorbent (lime) injection for H_2SO_4 abatement needs to be installed and will be into the new ductwork upstream of the PJFF. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

As previously noted, E.ON is in the process of installing an SCR (in-service date, 2012) on Unit 3 that will be capable of reducing NO_x emissions to 0.11 lb/MBtu or lower. To meet the identified pollutant emission limits, new AQC technologies are required for Brown Unit 3. These AQC technologies include installation of new PAC injection coupled with a new PJFF located downstream of the existing dry ESP. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

Also noted, a common wet FGD scrubber for Units 1, 2, and 3 is in the process of being built (in-service date, late 2010) at E.W. Brown. This wet FGD will serve to meet or exceed the SO_2 target emission of 0.25 lb/MBtu and the HCl target emission of 0.002 lb/MBtu. Therefore, no new SO_2 or HCl emission control technologies are proposed for these units.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.1.3 Capital and O&M Costs

The total estimated capital cost to upgrade E.W. Brown Unit 1, Unit 2, and Unit 3 with recommended technologies are \$44,000,000 (\$400/kW), \$149,000,000 (\$826/kW), and \$67,000,000 (\$148/kW), respectively. Capital, O&M, and levelized annual costs are shown in Tables 4-1, 4-2, and 4-3. Detailed cost summaries are included in Appendix H.

Table 4-1
Capital and O&M Cost Summary – E.W. Brown Unit 1

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Overfire Air	$767,000	$7	$132,000	$225,000
Low NO_x Burners	$1,156,000	$11	$0	$141,000
Fabric Filter	$40,000,000	$364	$1,477,000	$6,345,000
PAC Injection	$1,599,000	$15	$614,000	$809,000
Neural Networks	$500,000	$5	$50,000	$111,000
Total	**$44,022,000**	**$400**	**$2,273,000**	**$7,631,000**

Table 4-2
Capital and O&M Cost Summary – E.W. Brown Unit 2

AQC Equipment	Capital Cost, $	$/kW	O&M Cost,$	Levelized Annual Cost,$
SCR	$92,000,000	$511	$3,278,000	$14,474,000
Fabric Filter	$51,000,000	$283	$1,959,000	$8,166,000
Lime Injection	$2,739,000	$15	$1,155,000	$1,488,000
PAC Injection	$2,476,000	$14	$1,090,000	$1,391,000
Neural Networks	$500,000	$3	$50,000	$111,000
Total	**$148,715,000**	**$826**	**$7,532,000**	**$25,630,000**

Table 4-3
Capital and O&M Cost Summary – E.W. Brown Unit 3

AQC Equipment	Capital Cost, $	$/kW	O&M Cost,$	Levelized Annual Cost,$
Fabric Filter	$61,000,000	$133	$3,321,000	$10,745,000
PAC Injection	$5,426,000	$12	$2,330,000	$2,990,000
Neural Networks	$1,000,000	$2	$100,000	$222,000
Total	**$67,426,000**	**$148**	**$5,751,000**	**$13,957,000**

4.1.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirements will need to be considered for booster fan or upgraded ID fans to accommodate the additional pressure drop of the new AQC equipment.
- **Water**--New wet FGD is not required. No significant change in water supply is needed.
- **Wet FGD Byproduct Handling**--No new wet FGD byproduct handling system will be needed.
- **Ash Handling**--Additional new ash handling system will be needed for Units 1, 2, and 3 PJFF.
- **Ammonia Storage**--Ammonia storage for Unit 3 can be utilized to supply Unit 2 ammonia for new SCR.
- **H_2SO_4 (SO_3) Emissions**--Consideration was given to Unit 3's H_2SO_4 (SO_3) emissions although these emissions were not a primary focus for this study.
- **Footprint**:
  - There is very limited space to install a new SCR on Unit 2. Therefore, the SCR will be located between the existing plant wall and the original Unit 2 stack. To achieve this, it will be necessary to demolish the existing mechanical dust collector and demolish the abandoned Unit 2 stack.
  - Because of the limited available footprint, the PJFF on Unit 2 will be located above the existing dry ESP.
- **Constructability Challenges**:
  - The new SCR duct tie-ins to the existing Unit 2 air heater inlet duct will require boiler building structural steel bracing and girts to be modified to accommodate ductwork.
  - The new Unit 2 SCR support structure and reactor structure will require extensive relocation/demolition of existing plant components.
  - The relocation or protection of field fabricated tank located in base of abandoned Unit 2 chimney shell.
  - The demolition of Unit 2 chimney.

- The demolition of the dust collection ductwork located along the northeast exterior wall of Unit 2 boiler building.
- The relocation of Unit 2 auxiliary transformer located outside of the northeast exterior wall of Unit 2 boiler building.
- Extensive underground investigation will be required to identify operating utilities prior to installing new foundations for Unit 2 fabric filter structural steel support frame.
- The existing coal conveyor and ductwork block crane access to the northeast side of Unit 2 boiler house. This will require Unit 2 SCR and fabric filter structures to be constructed using a large tonnage crane with extended reach capabilities, or by extending the structural support frame system to the east and using a pick and slide execution method to erect the SCR and fabric filter modules.

4.1.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Unit 1

The Unit 1 arrangement (Appendix G) will allow for the majority of the construction of the PJFF to occur without taking a plant outage. The tie-in of the PJFF and the installation of the LNBs and OFA will require a plant outage.

Unit 2

Because of the tight space constraints, particularly for the installation sequencing of the SCR and somewhat for the PJFF, the construction efforts for Unit 2 will likely require an extended single outage or two shorter outages with the SCR being installed during the first outage. This allows for the major construction of the PJFFs with the plant in operation and requiring another shorter outage for the tie-in.

Unit 3

The Unit 3 arrangement shown on the drawing will allow for the majority of the construction of the PJFF to occur without taking a plant outage. The tie-in of the PJFF will require a plant outage.

4.1.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at E.W. Brown is nominally $260,000,000 ($1,400/kW). The O&M and levelized annual costs of new AQC equipment at E.W. Brown is nominally $15,600,000 and $47,000,000, respectively.

4.2 Ghent - Units 1, 2, 3, and 4

The Ghent Generating Station is located approximately 9 miles northeast of Carrolton, Kentucky. Ghent, which began commercial operations in February 1, 1974, is situated on approximately 1,670 acres.

The plant is a four unit pulverized coal fired electric power plant with gross capacity of 2,007 MW. Two of the boilers are manufactured by Combustion Engineering and two by Foster Wheeler. The Combustion Engineering boilers are tangential-fired, balanced draft forced circulation boilers, and Foster Wheeler boilers are balanced draft natural circulation boilers. Unit 1 has a gross capacity of 541 MW and is equipped with LNBs and SCR for NO_x control; cold-side dry ESP for PM control; wet FGD system for SO_2 control, and lime injection system for H_2SO_4 or SO_3 control. Unit 2 has a gross capacity of 517 MW and is equipped with LNBs, OFA for NO_x control; hot-side dry ESP for PM control; and wet FGD system for SO_2 control. Units 3 and 4 have a gross capacity of 523 MW and 526 MW, respectively, and are equipped with LNBs, OFA, and low-dust SCR for NO_x control; hot-side dry ESP for PM control; wet FGD system for SO_2 control, and trona injection system for H_2SO_4 (SO_3) control.

4.2.1 Site Visit Observations and AQC Considerations

At the Ghent Generating Station, the Black & Veatch team met David Pennybaker (Project Engineer), Carla Piening (Senior Scientist), Stephen Nix (Lead Engineer), and Jeff Joyce (Plant Manager) from E.ON. The following text is a narrative summary of the site visit conducted on May 11, 2010.

Installing PJFF for Units 1 and 2 requires significant site preparation and demolition. Crane access is difficult at Units 1 and 2 because of a low overhead piperack on the roadways around the cooling towers. Some piping bridges on the northeast side of the cooling tower and access roads to Unit 1 will need to be temporarily taken down or relocated. Lattice boom crawler crane booms will need to be final assembled and reeved at the working location. Access lanes around Units 1 and 2 are also the maintenance lanes for the cooling towers. Cranes and construction equipment will block access on these roads at various periods during project execution. Careful crane placement will be required in order to provide operations access to the cooling tower area. Current arrangement for Unit 2 fabric filters require a section of bypass ductwork to be installed in order to isolate/demolish existing ductwork/duct supports and provide the required footprint for the new equipment. Tie-in portions of this work scope must be accomplished during early plant outages. The new PJFF will be elevated aboveground. Erection of Unit 2 SCR will require construction material and equipment to be lifted over areas of high personnel traffic.

Installing PJFF on Units 3 and 4 requires removal of underground utility lines. Current arrangement for Unit 3 fabric filters requires an extensive length of inlet/outlet ductwork to be routed above and across the existing Unit 3 and 4 ESPs. Access around the footprint of the dry ESPs is restricted, and it will be difficult to stage the construction equipment necessary to erect the ductwork support frame and associated foundations. Existing underground electrical manholes, water wells, storm sewer boxes and piping, and circulating cooling water piping all run in the proposed footprint for Unit 4 fabric filter. The electrical manholes, water wells, and storm sewer piping will need to be relocated in order to install the foundations for the Unit 4 fabric filter structural frame.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

4.2.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit. The pollutants that require new control technologies to be installed that will meet target emission levels are NO_x, PM, CO, Hg, and dioxin/furan. New sorbent (lime) injection control technology may be required for H_2SO_4 abatement where SCR is installed.

To meet the identified pollutant emission limits, new AQC technologies are required for Ghent Unit 1. These AQC technologies include installation of a new PAC injection system coupled with a new PJFF located downstream of the existing dry ESP. The new PJFF will be elevated aboveground. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu. Unit 1 has an existing SCR to control NO_x emissions to the future NO_x emission target of 0.11 lb/MBtu or lower. No further new NO_x emission control technology is needed on this unit.

To meet the identified pollutant emission limits, new AQC technologies are required for Ghent Unit 2. These AQC technologies include installation of new SCR system, new PAC injection system coupled with a new PJFF located downstream of the existing ID fans. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New sorbent (lime/trona) injection for H_2SO_4 abatement needs to be installed and will be into the ductwork upstream of the hot-side dry ESP. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

To meet the identified pollutant emission limits, new AQC technologies are required for Ghent Units 3 and 4. These AQC technologies include installation of new PAC injection system coupled with a new PJFF located downstream of the existing ID fans of Units 3 and 4. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu. Units 3 and 4 have existing SCRs to control NO_x emissions to the future NO_x emission target of 0.11 lb/MBtu or lower. No further new NO_x emission control technology is needed on these units.

All four Ghent units have existing individual wet FGDs that will meet the SO_2 target emission of 0.25 lb/MBtu or lower and the HCl target emission of 0.002 lb/MBtu or lower. No new SO_2 or HCl emission controls are considered for this study, and there is no need to replace existing stacks.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.2.3 Capital and O&M Costs

The total estimated capital costs to upgrade Ghent Unit 1, Unit 2, Unit 3, and Unit 4 with recommended technologies are \$138,000,000 (\$256/kW), \$360,000,000

($696/kW), $145,000,000 ($278/kW), and $124,000,000 ($236/kW), respectively. Capital, O&M, and levelized annual costs are shown in Tables 4-4, 4-5, 4-6, and 4-7. Detailed cost summaries are included in Appendix H.

4.2.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirements will need to be considered for booster fan or upgraded ID fans to accommodate the additional pressure drop of the new AQC equipment.
- **Water**--New wet FGD is not required. No significant change in water supply is needed.
- **Wet FGD Byproduct Handling**--No new wet FGD byproduct handling system will be needed.

Table 4-4
Capital and O&M Cost Summary – Ghent Unit 1

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Fabric Filter	$131,000,000	$242	$5,888,000	$21,831,000
PAC Injection	$6,380,000	$12	$4,208,000	$4,984,000
Neural Networks	$1,000,000	$2	$100,000	$222,000
Total	**$138,380,000**	**$256**	**$10,196,000**	**$27,037,000**

Table 4-5
Capital and O&M Cost Summary – Ghent Unit 2

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$227,000,000	$439	$7,078,000	$34,704,000
Fabric Filter	$120,000,000	$232	$5,002,000	$19,606,000
Lime Injection	$5,483,000	$11	$2,775,000	$3,442,000
PAC Injection	$6,109,000	$12	$2,880,000	$3,623,000
Neural Networks	$1,000,000	$2	$100,000	$222,000
Total	**$359,592,000**	**$696**	**$17,835,000**	**$61,597,000**

Table 4-6
Capital and O&M Cost Summary – Ghent Unit 3

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Fabric Filter	$138,000,000	$264	$6,122,000	$22,917,000
PAC Injection	$6,173,000	$12	$4,134,000	$4,885,000
Neural Networks	$1,000,000	$2	$100,000	$222,000
Total	**$145,173,000**	**$278**	**$10,356,000**	**$28,024,000**

Table 4-7
Capital and O&M Cost Summary – Ghent Unit 4

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Fabric Filter	$117,000,000	$222	$5,363,000	$19,602,000
PAC Injection	$6,210,000	$12	$3,896,000	$4,652,000
Neural Networks	$1,000,000	$2	$100,000	$222,000
Total	**$124,210,000**	**$236**	**$9,359,000**	**$24,476,000**

- **Ash Handling**--Additional new ash handling system will be needed for Units 1, 2, 3, and 4 PJFF. It is understood that a new byproduct ash system is currently being studied at the plant. Contingent on the final determination of installed AQC technology, further investigation and coordination of ash handling systems will be required.
- **H_2SO_4 (SO_3) Emissions**-- Consideration was given to Unit 1, 2, 3, and 4 3's H_2SO_4 (SO_3) emissions although these emissions were not a primary focus for this study.
- **Ammonia Storage**--Ammonia storage for Unit 3 can be utilized to supply Unit 2 ammonia for new SCR.
- **Footprint**:
  - Unit 1 and Unit 2 PJFF do not have any real estate available on the grade elevation for construction. Hence these PJFF will be elevated above the ground level.
  - The Unit 3 PJFF could be installed between boilers of Units 2 and 3, adjacent to the new Unit 2 SCR. However, plant personnel want to keep this area clear for staging and equipment lay-down purposes. Hence, Unit 3 PJFF will be installed on the south side of the Unit 4 dry ESP, with booster fan or ID fan upgrades because there is very limited space available between the ID fan outlet and wet scrubber inlet on the west side.

- **Constructability Challenges**:
  - Crane access is difficult at Units 1 and 2 because of low overhead piperack on the roadways around the cooling towers. Some piping bridges on the northeast side of the cooling tower and access roads to Unit 1 will need to be temporarily taken down or relocated. Lattice boom crawler crane booms will need to be final assembled and reeved at the working location.
  - Erection of Unit 2 SCR will require construction material and equipment to be lifted over areas of high personnel traffic.
  - Access lanes around Units 1 and 2 are also the maintenance lanes for the cooling towers. Cranes and construction equipment will block access on these roads at various periods during project execution. Careful crane placement will be required in order to provide operations access to the cooling tower area.
  - The current arrangement for Unit 2 fabric filters requires a section of bypass ductwork to be installed in order to isolate/demolish existing ductwork/duct supports and provide the required footprint for the new equipment. Tie-in portions of this work scope must be accomplished during early plant outages.
  - The current arrangement for Unit 3 fabric filters requires an extensive length of inlet/outlet ductwork to be routed above and across the existing Unit 3 and 4 dry ESPs. Access around the footprint of the dry ESPs is restricted, and it will be difficult to stage the construction equipment necessary to erect the ductwork support frame and associated foundations.
  - Crane access will be restricted around the tie-in for Unit 3 fabric filter inlet/outlet ductwork.
  - Existing underground electrical manholes, water wells, storm sewer boxes and piping, and circulating cooling water piping all run in the proposed footprint for Unit 4 fabric filter. The electrical manholes, water wells, and storm sewer piping will need to be relocated in order to install the foundations for the Unit 4 fabric filter structural frame.

4.2.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Units 1, 2, 3, and 4

The arrangement shown on the drawing will allow for the majority of the construction of the PJFF to occur without taking a plant outage. The tie-in of the PJFF will require a plant outage. Unit 2 arrangements shown on the drawing will allow for the majority of the construction of the SCR to occur without taking a plant outage. The tie-in of the SCR will require a plant outage.

4.2.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at Plant Ghent is nominally $767,400,000 ($1,500/kW). The O&M and levelized annual costs of new AQC equipment at Ghent is nominally $47,800,000 and $141,000,000, respectively.

4.3 Cane Run - Units 4, 5, and 6

The Cane Run Generating Station is located at 5252 Cane Run Road (State Highway 1849), about 8 miles southwest of Louisville, Kentucky. The facility includes approximately 500 acres between Cane Run Road and the Ohio River. The pulverized coal fired electric power plant began commercial operation in 1954 in response to the demand for electricity by industries that were located in Louisville during World War II. Three of its six units are now retired. Units 4, 5, and 6 are currently active and have a gross capacity of 610 MW. Unit 4 was placed in service in 1962, Unit 5 in 1966, and Unit 6 in 1969.

Units 4, 5, and 6 have a gross capacity of 168 MW, 181 MW, and 261 MW, respectively, and are equipped with LNBs or OFA (Units 4 and 5 have LNBs but no OFA, Unit 6 has OFA but no LNBs) for NO_x control; cold-side dry ESP for PM control; and wet FGD system for SO_2 control.

4.3.1 Site Visit Observations and AQC Considerations

At the Cane Run Station, the Black & Veatch team met Keron Miller, Mike Hensley, and Chuck Hance from E.ON. The following text is a narrative summary of the site visit conducted on May 11, 2010.

Cane Run Units 4, 5, and 6 have existing LNBs and FGD emission control devices. Performance of the aging FGD scrubbers is sufficient to meet the current stack emission limit, and NO_x emissions are currently controllable to the existing limits using only LNBs. Current PM emissions are controlled by the combination of the efficient ESPs and FGD designs. In general, the plant is capable of maintaining the current emissions levels but requires new AQC technologies to meet the future pollutant emission limits and have operational flexibility. According to plant personnel, upgrades to the existing scrubber towers are currently being considered that would increase scrubbing efficiency to meet the future emission standards. However, due to space constraints, upstream control devices (e.g., SCR, fabric filter) require real estate that precludes use of the existing FGD vessels. Plant personnel also pointed out that maintenance of boiler tubes is considerably exacerbated because of lower oxygen combustion zone to minimize NO_x emissions.

New AQC technologies for each unit will be identical except for the sizing of components. Each unit will need new ID fans (2 x 50 percent) to overcome the added pressure drop of the new ductwork, SCR, PJFF, and wet FGD. A new single chimney will house three lined wet stacks; one liner for each unit. The SCR will increase the H_2SO_4 (SO_3) concentration in the flue gas and exacerbate the potential for corrosion on the cooler surfaces downstream of the air heater. Lime will be added downstream of the air heater (upstream of the PJFF) to minimize the impact of acid components in the flue gas on downstream surfaces. Injection of PAC is also recommended upstream of the PJFF.

Installation of SCR on Units 4, 5, and 6 would become a constraining factor from a construction perspective. There is not sufficient room to successfully install the connections from and back into the ductwork after the economizer section on any of the units. Any attempt to do so would compromise the performance of the SCR and would also be an operational challenge over the life of the plant. This decision alone leads to the difficult alternative of selectively demolishing the existing back end AQC equipment one unit at a time. This means that for an extended period of time only two of the three units would be operational. Scheduled outages on the remaining units will reduce plant availability even more.

Installation of SCR technology requires access to the hopper/ductwork exiting the economizer sections of each boiler. The hot fly ash laden flue gas must be transported to the SCR and ducted from the SCR to the air heater inlet. The existing equipment at this plant is too close-coupled in this area to allow adequate access for attaching these new ducts. The space required to install new AQC technologies is currently occupied by the existing wet FGD components and stacks. Any new technologies should be installed directly in lieu of the existing equipment. This requires a complete demolish and removal of existing equipment prior to installation of the new equipment. This will cause an extended outage as shown in the AQC replacement schedule in Subsection 4.3.5. Demolition of the existing and construction of new AQC equipment is planned in series for each unit. This lengthens the unit outage time and increases the cost associated to meet new emission standards.

Due to lack of available space to add the new equipment, the new AQC technologies required for the three units will need to use the existing footprint. Demolition of existing equipment will need to be completed prior to construction of new equipment to provide space for installation of the new equipment. Demolition of all existing AQC equipment one unit at a time from the economizer section back is proposed to minimize outage time (at least 24 month outages are estimated). Power lines above each unit will need to be moved for safe demolition and construction. There appear to be adequate areas available for equipment laydown during construction.

Demolition and construction of each unit will be in series. For example, Unit 5 could be taken out of service and demolished from the economizer to the FGD equipment. The common stack and other common equipment (ammonia storage area, common reaction tank) could be built prior to the outage. Moving of transmission lines could also be accomplished prior to the outage along with preparation of lay-down areas and moving of needed underground utilities.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

4.3.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit.

The pollutants that require new control technologies to be installed that will meet target emission levels are NO_x, SO_2, PM, CO, Hg, HCl and dioxin/furan. New sorbent (lime) injection control technology may be required for H_2SO_4 abatement where SCR is installed.

To meet the identified pollutant emission limits, new AQC technologies are required for Cane Run Units 4, 5, and 6. The AQC technologies identified for each of the three units are the same and include installation of a new SCR system to reducing NO_x to 0.11 lb/MBtu or lower, new PJFF to reduce PM emissions to 0.03 lb/MBtu or lower; a new wet FGD system to reduce SO_2 emissions to 0.25 lb/MBtu or lower and HCl emissions to 0.002 lb/MBtu or lower; a new halogenated PAC injection to reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu, new sorbent (lime) injection system for H_2SO_4 abatement, and New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.3.3 Capital and O&M Costs

The total estimated capital costs to upgrade Cane Run Unit 4, Unit 5, and Unit 6 with recommended technologies are \$253,000,000 (\$1,508/kW), \$266,000,000 (\$1,468/kW), and \$341,000,000 (\$1,306/kW), respectively. Capital, O&M, and levelized annual costs are shown in Tables 4-8, 4-9, and 4-10. Detailed cost summaries are included in Appendix H.

4.3.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirement will need to be considered for new ID fans to accommodate the additional pressure drop of the new AQC equipment.
- **Water**--A new wet FGD is required. There will be a significant change in the amount of wastewater produced by the wet FGD. A new or a possible upgrade in wastewater treatment facility is required.
- **Wet FGD Byproduct Handling**--There will be a significant change in the amount of byproduct produced by the wet FGD because of the high amount of sulfur removal from the coal. A new or a possible upgrade in byproduct handling system is required.
- **Wet FGD Reagent Preparation System**--There will be a significant change in the amount of reagent required by the wet FGD because of the high amount of sulfur removal from the coal. A new or a possible upgrade in reagent preparation system is required.
- **Ash Handling**--Cane Run has limited new space available for landfill of waste (ash and scrubber solids). Onsite landfill space is expected to be consumed in less than 20 years. Additional new ash handling system or a possible upgrade in the ash handling system will be required.
- **Ammonia Storage**--A new ammonia storage facility will be required for new SCRs. Detailed investigation or study will be required to identify the site location for ammonia storage and supply.

Table 4-8
Capital and O&M Cost Summary – Cane Run Unit 4

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$63,000,000	$375	$2,219,000	$9,886,000
Wet FGD	$152,000,000	$905	$8,428,000	$26,926,000
Fabric Filter	$33,000,000	$196	$1,924,000	$5,940,000
Lime Injection	$2,569,000	$15	$983,000	$1,296,000
PAC Injection	$2,326,000	$14	$1,087,000	$1,370,000
Neural Networks	$500,000	$3	$50,000	$111,000
Total	**$253,395,000**	**$1,508**	**$14,691,000**	**$45,529,000**

Table 4-9
Capital and O&M Cost Summary – Cane Run Unit 5

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$66,000,000	$365	$2,421,000	$10,453,000
Wet FGD	$159,000,000	$878	$8,789,000	$28,139,000
Fabric Filter	$35,000,000	$193	$2,061,000	$6,321,000
Lime Injection	$2,752,000	$15	$1,089,000	$1,424,000
PAC Injection	$2,490,000	$14	$1,120,000	$1,423,000
Neural Networks	$500,000	$3	$50,000	$111,000
Total	**$265,742,000**	**$1,468**	**$15,530,000**	**$47,871,000**

Table 4-10
Capital and O&M Cost Summary – Cane Run Unit 6

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$86,000,000	$330	$2,793,000	$13,259,000
Wet FGD	$202,000,000	$774	$10,431,000	$35,014,000
Fabric Filter	$45,000,000	$172	$2,672,000	$8,149,000
Lime Injection	$3,873,000	$15	$1,367,000	$1,838,000
PAC Injection	$3,490,000	$13	$1,336,000	$1,761,000
Neural Networks	$500,000	$2	$50,000	$111,000
Total	$340,863,000	$1,306	$18,649,000	$60,132,000

- **Footprint**--The new AQC equipment will be installed where the existing AQCS equipment is currently operating.
- **Constructability Challenges**:
  - Ingress from highways - Multiple power lines need to be raised to accommodate high loads.
  - Barge unloading is not economically feasible.
  - Existing overhead power lines are routed over each unit and must be relocated for crane access.
  - 4 kV building and CT switchyard needs to be relocated.
  - Entire Unit 5 "back-end" must be dismantled prior to starting any work on Unit 4.
  - There is a need for multiple mob/de-mob/outages for tie-ins and access to build new AQC equipment.
  - Underground utility interferences/relocations.
  - Aboveground utility interferences/relocations.
  - Need for areas to build ammonia storage, ash handling systems, limestone handling, reagent preparation dewatering (ancillary systems).
  - Extended outages (entire plant) needed to accommodate construction of new AQC systems.
  - Demolition must be performed in multiple phases followed by extensive earthwork activities to bring existing site up to proper elevation.
  - Soils must be tested and stabilized for heavy lift crane operations.
  - Space is very limited around units; the most efficient use of modularization will be compromised.

4.3.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Units 4, 5, and 6

Plant life is restricted at Cane Run because of the amount of available land required for landfill of waste products. Installation of new AQC equipment is made particularly difficult by the close-coupling of existing equipment. B&V proposes to demolish the existing dry ESP and FGD equipment one unit at a time to make room for the new equipment. B&V estimates that this will require an extended construction outage of approximately 24 months per unit. One time-saving benefit is provided by construction of a single chimney with three liners.

4.3.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at Cane Run is nominally $860,000,000 ($4,300/kW). The O&M and levelized annual costs of new AQC equipment at Cane Run is nominally $48,900,000 and $153,500,000, respectively.

4.4 Mill Creek - Units 1, 2, 3, and 4

The Mill Creek Station is located in southwestern Jefferson County, approximately 10.5 miles southwest of the city of Louisville, Kentucky, on a 509 acre site. Mill Creek Station includes four coal fired electric generating units with a gross total generating capacity of 1,608 MW. Mill Creek Station Unit 1 was placed in service in 1972, Mill Creek Station Unit 2 was placed in service in 1974, and Mill Creek Station Units 3 and 4 were each placed in service at 4 year intervals afterward in 1978 and 1982, respectively.

The Mill Creek Station consists of four coal fired electric generating units. All four boilers fire high sulfur bituminous coal. Each Mill Creek Station unit is composed of one GE reheat tandem compound, double-flow turbine with a condenser and hydrogen-cooled generator. Units 1 and 2 each consist of one Combustion Engineering subcritical, balanced draft boiler and have a gross capacity of 330 MW each and are equipped with LNBs and OFA for NO_x control; a cold-side dry ESP for PM control, and a wet FGD for SO_2 and HCl control. Units 3 and 4 each consist of one Babcock & Wilcox (B&W) balanced draft, Carolina type radiant boiler and have a gross capacity of 423 MW and 525 MW, respectively, and are equipped with LNBs and SCR for NO_x control; a cold-side dry ESP for PM control and a wet FGD for SO_2 and HCl control.

4.4.1 Site Visit Observations and AQC Considerations

At the Mill Creek Station, the Black & Veatch team met Mike Kirkland, Michael Buckner, Marc Blackwell, Alex Betz, Tiffany Koller, and Bill Moehrke from E.ON. The following text is a narrative summary of the site visit conducted on May 12, 2010.

Mill Creek Units 1 and 2 require a complete new set of AQC system equipment. Units 3 and 4 have existing SCR to control NO_x emissions to 0.11 lb/MBtu or lower. No further new NO_x emission control technology is needed on Units 3 and 4 based on the identified emission levels. Units 3 and 4 have an existing cold-side dry ESP which will be retained and used for pre-filtration and fly ash sales.

The option to modify the existing wet FGD equipment and use of additives was considered plausible to meet the new emission target. However, Black & Veatch concluded that new limestone scrubbing technology would provide a more reliable long-term emission control technology to meet and exceed the study's SO_2 emission target considering the current state of the existing scrubbers and also the impact on the wastewater treatment facility. Additionally, there is no need to replace the existing wet stacks, and these stacks will be reused for all the four units.

Installation of SCR on Units 1 and 2 would require demolition of the existing dry ESPs to allow space for installation of a new SCR reactor and ductwork. Black & Veatch engineers believe that there is not sufficient room to successfully install the connections from and back into the air heater after the economizer section on either of the units. The new pre-filter dry ESP could be designed for minimal efficiency (~ 90 percent) to reduce size and allow fly ash to help build cake on the downstream bags of the new PJFF. The new PJFF will be stacked above the pre-filter dry ESP. New sorbent (lime) injection for H_2SO_4 abatement needs to be installed and will be routed into the new ductwork upstream of the new cold-side dry ESP. The existing dry ESP will be demolished and a new cold-side dry ESP will be installed for pre-filtration and fly ash sales. These new components could be installed on-line prior to demolition of the existing dry ESP. Once the tie-in to the new PM control devices is completed (New ID fan required), the units can be brought back online for demolition of the existing dry ESP and installation of the new SCR. Segments of the new FGD could begin construction during this period. Tie-in of the new SCR, ductwork, and new FGD would then allow demolition of existing FGD components, if needed. Units 1 and 2 will require new ID fans (2 x 50 percent) to overcome the added pressure drop of the new ductwork, SCR, cold-side dry ESP, PJFF, and wet FGD. A phased construction approach as described above is necessary for Units 1 and 2 due to site real estate constraints and to reduce the 'loss of generation' aspect of the capital project.

Units 3 and 4 are particularly challenging with respect to finding a footprint for the new AQC equipment that did not require extremely long outages for demolition of existing equipment. Units 3 and 4 have limited space available for construction. The existing rail road tracks and the coal conveyors are the biggest challenges for these units. The new equipment will occupy land currently used as a roadway and historically used for rail. The roadway will need to be moved to provide future plant access. One set of inner tracks will remain for trains to continue to move coal throughout the plant.

Installation of AQC equipment for Units 1 and 2 requires phased installation and demolition activities. Installation of new PJFF and new Wet FGD on Units 3 and 4 will require the scrubber towers to be split to 2 x 50-60 percent capacity absorbers and the PJFFs be stacked and will be installed downstream of the existing cold-side dry ESP. This will avoid the expensive elevated construction option to create a tunnel over the road and rail. New sorbent (lime) injection for H_2SO_4 abatement needs to be installed and will be into the ductwork upstream of the existing cold-side dry ESP. The existing dry ESP will remain in service for pre-filtration and fly ash sales. Units 3 and 4 will require new booster fans (2 x 50 percent) to overcome the added pressure drop of the new ductwork, PJFF, and wet FGD systems. Existing power transmission lines would need to be moved for construction. There appears to be space available for addition of another tank to the existing ammonia tank farm if needed. It may be possible to simply increase the number of deliveries of anhydrous ammonia to account for the added demand of the new SCRs on Units 1 and 2.

The most imperative site constraint relating to the selection of post-combustion emission control technologies at Mill Creek is that greater than 80 percent of all solid waste is trucked offsite for use in other applications. Offsite transportation of solid waste minimizes onsite landfill needs and thereby helps extend plant life expectations. Therefore, because of the landfill issues, pre-filter dry ESPs are necessary for all units to mitigate the landfill challenge at Mill Creek as the collected ash will be disposed off to another location off site as a possible recycle material. Otherwise the use of a dry ESP for pre-filtration is not required for PM emissions control as new PJFFs are designed as full size PJFFs and not polishing filtration technology.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

4.4.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit. The pollutants that require new control technologies to be installed that will meet target emission levels are NO_x (only on Units 1 and 2), PM, SO_2, CO, Hg, HCl, and dioxin/furan. New sorbent (lime) injection control technology may be required for H_2SO_4 abatement where SCR is installed.

To meet the identified pollutant emission limits, new AQC technologies are required for Mill Creek Units 1 and 2. These AQC technologies include installation of new SCR and PAC injection coupled with a new PJFF located downstream of the new dry ESP. Also a new wet FGD system will be required. The new SCR system can reduce NO_x emissions to 0.11 lb/MBtu or lower. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. The new wet FGD system will reduce SO_2 emissions to 0.25 lb/MBtu or lower and HCl emissions to 0.002 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

To meet the identified pollutant emission limits, new AQC technologies are required for Mill Creek Units 3 and 4. These AQC technologies include installation of new PAC injection coupled with a new PJFF located downstream of the existing dry ESP. Also, a new wet FGD system will be required. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. The new wet FGD system will reduce SO_2 emissions to 0.25 lb/MBtu or lower and HCl emissions to 0.002 lb/MBtu or lower. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15 x 10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.4.3 Capital and O&M Costs

The total estimated capital cost to upgrade Mill Creek Units 1 and 2 with recommended technologies are is $518,000,000 ($1,569/kW) each. The total estimated capital costs to upgrade Mill Creek Units 3 and 4 with recommended technologies are $513,000,000 ($1,212/kW) and $596,000,000 ($1,135/kW), respectively. Capital, O&M, and levelized annual costs are shown in Tables 4-11, 4-12, 4-13, and 4-14. Detailed cost summaries are included in Appendix H.

Table 4-11
Capital and O&M Cost Summary – Mill Creek Unit 1

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$97,000,000	$294	$3,366,000	$15,171,000
Wet FGD	$297,000,000	$900	$14,341,000	$50,486,000
Fabric Filter	$81,000,000	$245	$3,477,000	$13,335,000
Electrostatic Precipitator	$32,882,000	$100	$3,581,000	$7,583,000
Lime Injection	$4,480,000	$14	$2,024,000	$2,569,000
PAC Injection	$4,412,000	$13	$2,213,000	$2,750,000
Neural Network	$1,000,000	$3	$100,000	$222,000
Total	**$517,774,000**	**$1,569**	**$29,102,000**	**$92,116,000**

Table 4-12
Capital and O&M Cost Summary – Mill Creek Unit 2

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
SCR	$97,000,000	$294	$3,401,000	$15,206,000
Wet FGD	$297,000,000	$900	$14,604,000	$50,749,000
Fabric Filter	$81,000,000	$245	$3,518,000	$13,376,000
Electrostatic Precipitator	$32,882,000	$100	$3,664,000	$7,666,000
Lime Injection	$4,480,000	$14	$2,117,000	$2,662,000
PAC Injection	$4,412,000	$13	$2,340,000	$2,877,000
Neural Network	$1,000,000	$3	$100,000	$222,000
Total	**$517,774,000**	**$1,569**	**$29,744,000**	**$92,758,000**

Table 4-13
Capital and O&M Cost Summary – Mill Creek Unit 3

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Wet FGD	$392,000,000	$927	$18,911,000	$66,617,000
Fabric Filter	$114,000,000	$270	$4,923,000	$18,797,000
PAC Injection	$5,592,000	$13	$3,213,000	$3,894,000
Neural Network	$1,000,000	$2	$100,000	$222,000
Total	**$512,592,000**	**$1,212**	**$27,147,000**	**$89,530,000**

Table 4-14
Capital and O&M Cost Summary – Mill Creek Unit 4

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Wet FGD	$455,000,000	$867	$21,775,000	$77,149,000
Fabric Filter	$133,000,000	$253	$5,804,000	$21,990,000
PAC Injection	$6,890,000	$13	$3,858,000	$4,697,000
Neural Network	$1,000,000	$2	$100,000	$222,000
Total	**$595,890,000**	**$1,135**	**$31,537,000**	**$104,058,000**

4.4.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirement will need to be considered for new ID/booster fans to accommodate the additional pressure drop of the new AQC equipment.
- **Water**--A new wet FGD is required for all the Units. There will be a significant change in the amount of waste water produced by the wet FGD. A new or a possible upgrade in wastewater treatment facility is required.

- **Wet FGD Byproduct Handling**--There will be a significant change in the amount of byproduct produced by the wet FGD because of the high amount of sulfur removal from the coal. A new or a possible upgrade in byproduct handling system is required.
- **Wet FGD Reagent Preparation System**--There will be a significant change in the amount of reagent required by the wet FGD because of the high amount of sulfur removal from the coal. A new or a possible upgrade in reagent preparation system is required.
- **Ash Handling**--Additional new ash handling system or a possible upgrade in the ash handling system will be required.
- **Ammonia Storage**--Detailed investigation or study will be required to identify if a new ammonia storage facility is required or an existing ammonia storage facility can be upgraded for accommodating Units 1 and 2 ammonia supply.
- **Biomass Utilization**--Black & Veatch is currently completing a biomass utilization study for Mill Creek. Should it be determined that biomass will be considered as a fuel source in one or more units at the plant, a detailed investigation or study will be required to identify potential affect to the approved AQC equipment and how these many affect the aforementioned costs.
- **Footprint**—For units 1 and 2 the SCR will be installed where the existing dry ESP equipment is currently operating. For units 1, 2, 3, and 4 existing scrubbers can be retired in place to save costs or demolished to create access.
- **Constructability Challenges**:
  - Barge unloading is not economically feasible.
  - Overhead power lines and at least two transmission towers must be moved.
  - Numerous underground utility interferences/relocations.
  - Numerous aboveground utility interferences/relocations.
  - Very limited access around units due to existing AQC systems.
  - Multiple mobilization/demobilization (very selective) dismantling operations are needed to ensure tie-in work is accomplished efficiently.
  - Building between Units 1 and 3 from Unit 1 work will present logistical problems for both plant work and construction.

- Access/height restrictions will dictate the magnitude of modularization that can be utilized.
- Warehouse and loading dock on Unit 2 side must be relocated.
- High complexity of ancillary systems routing to avoid interference with existing AQC systems.
- Ground stability will need to be verified and modified to accommodate heavy lift cranes.
- Multiple plant outages will be needed for tie-ins because of utilizing existing scrubbers, etc., throughout project.
- Ductwork routing is more extensive due to the layout of the existing plant and existing AQC systems in use.
- Space will be a premium for excavations/foundations/duct steel erection.
- Large existing concrete foundations will need to be removed to accommodate equipment.
- Outage windows are very short and limited.
- Site constraints due to the existing railroad and roadway exist.

4.4.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Units 1 and 2

The new dry ESP, PJFF, and ID fans on Units 1 and 2 can be installed with temporary ductwork to connect back to the air heater and to the existing wet FGD during a short outage. This will allow the existing dry ESPs to be demolished and the new SCRs and new wet FGD equipment to be constructed with the units remaining online. The remainder of the new equipment can then be tied into existing ductwork during a normal outage period.

Units 3 and 4

The new AQC equipment for these units can be installed without extensive off-line construction related outages. The tie-in of new ductwork can be scheduled to occur during planned unit outages.

4.4.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at Mill Creek is nominally $2,100,000,000 ($5,500/kW). The O&M and levelized annual costs of new AQC equipment at Mill Creek is nominally $117,500,000 and $378,500,000, respectively.

4.5 Trimble County - Units 1 and 2

Trimble County Generating Station Unit 1 is a pulverized coal fired power plant located approximately 5 miles west of Bedford, Kentucky. Unit 1 began commercial operation in December 23 1990. Unit 2, a 760 MW coal plant, is under construction on the site and is due to be completed on June 15, 2010. Unit 1 consists of one Combustion Engineering (CE) tangential balanced draft, forced circulation boiler and one General Electric (GE) reheat double-flow steam turbine with a hydrogen-cooled generator.

Unit 1 has a gross capacity of 547 MW and is equipped with LNBs, OFA, and SCR for NO_x control; a cold-side dry ESP for PM control and a wet FGD for SO_2 and HCl control. Unit 2 is a new coal fired unit, has a gross capacity of 750 MW, and is equipped with LNBs, OFA, and SCR for NO_x control; boiler combustion optimization and NNs for CO control; a cold-side dry ESP for PM control, a PJFF with PAC injection for Hg and dioxin/furan control, a wet FGD for SO_2 and HCl control and a wet ESP for H_2SO_4 (SO_3) control.

4.5.1 Site Visit Observations and AQC Considerations

At the Trimble County Station, the Black & Veatch team met Kenny Craigmyle (Project Engineer) and Haley Turner (Chemical Engineer) from E.ON. The following text is a narrative summary of the site visit conducted on May 12, 2010.

The Trimble County plant is the newest plant in the E.ON fleet and Unit 1 has AQC technologies already exceeding operation capabilities of other E.ON coal fired units. Unit 2 is a new unit currently in startup and tuning before becoming commercially operational and has new AQC equipment assumed to be sufficiently designed to meet the target emissions in this study. Thus, the Trimble County plant is already generally capable of meeting nearly all the defined pollutant emission targets. However, it has been determined that Unit 1 will need to add AQC technology to control emissions of Hg and dioxin/furan.

Installing a PJFF on Unit 1 will require demolition of an existing abandoned tower crane foundation and multiple runs of electrical duct bank which covers a large percentage of the area within the footprint proposed to install foundations for the Unit 1 fabric filter support frame. Extensive underground investigation will be required to identify operating utilities prior to installing new foundations.

Plant personnel indicated that the variable speed controller for the existing ID fans has been replaced and has additional capacity beyond what is currently required. This should be verified during any preliminary engineering for a PJFF installation project.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by

E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

4.5.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit.

To meet the identified pollutant emission limits, new AQC technologies are required for Trimble County Unit 1. These AQC technologies include installation of new PAC injection coupled with a new PJFF located downstream of the existing dry ESP. The existing cold-side dry ESP is capable of meeting the future PM emission limit of 0.03 lb/MBtu or lower; however, for Hg and dioxin/furan removal and to continue fly ash sales, a new PJFF would be required. The PJFF will reduce PM emissions to 0.03 lb/MBtu or lower. The new PJFF will be elevated above the grade level and will be installed downstream of the existing cold-side dry ESP. The existing dry ESP will be kept in service for pre-filtration and fly ash sales. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the new PJFF, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15×10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu.

As previously discussed, Unit 2 is currently in startup mode to test the unit's systems prior to becoming commercially operational. It has been assumed that this unit, and its existing AQC equipment, will meet the identified pollutant emission limits, and no new AQC technologies will be required.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.5.3 Capital and O&M Costs

The total estimated capital cost to upgrade Trimble County Unit 1 with recommended technologies is $136,000,000 ($248/kW). Capital, O&M, and levelized annual costs are shown in Table 4-15. Detailed cost summaries are included in Appendix H.

Table 4-15
Capital and O&M Cost Summary – Trimble County Unit 1

AQC Equipment	Capital Cost, $	$/kW	O&M Cost, $	Levelized Annual Cost, $
Fabric Filter	$128,000,000	$234	$5,782,000	$21,360,000
PAC Injection	$6,451,000	$12	$4,413,000	$5,198,000
Neural Network	$1,000,000	$2	$100,000	$222,000
Total	**$135,451,000**	**$248**	**$10,295,000**	**$26,780,000**

4.5.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirement will need to be considered for upgrading the ID fans to accommodate the additional pressure drop of the new PJFF.
- **Water**--New wet FGD is not required. No significant change in water supply is needed.
- **Wet FGD Byproduct Handling**--No new wet FGD byproduct handling system will be needed.
- **Ash Handling**--Additional new ash handling system will be needed for PJFF.
- **Ammonia Storage**--No new ammonia storage is required.
- **Footprint**--The new PJFF will be elevated and installed above the existing cold-side dry ESP.
- **Constructability Challenges**--An existing abandoned tower crane foundation and multiple runs of electrical duct bank cover a large percentage of the area within the footprint proposed to install foundations for the Unit 1 fabric filter support frame. Extensive underground investigation will be required to identify operating utilities prior to installing new foundations.

4.5.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Unit 1

The new PJFF can be installed without extensive construction related outages. The tie-in of new ductwork can be scheduled to occur during planned unit outages.

4.5.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at Trimble County is nominally $135,500,000 ($250/kW). The O&M and levelized annual costs of new AQC equipment at Trimble County are nominally $10,300,000 and $26,800,000, respectively.

4.6 Green River - Units 3 and 4

The Green River Generating Station is located 3 miles north of Central City in Muhlenberg County. The station is a four unit, coal fired electric generating station with a total nameplate capacity of 168 MW net. Units 3 and 4 are pulverized coal fired generating units. Units 1 and 2 were decommissioned in January 2002 and are, therefore, not included within this review. Units 3 and 4 have a gross capacity of 71 MW and 109 MW, respectively, and are equipped with LNBs for NO_x control; and dry ESP (cold-side dry ESP for Unit 3 and hot-side dry ESP for Unit 4) for PM control.

4.6.1 Site Visit Observations and AQC Considerations

At the Green River Station, the Black & Veatch team met Travis Harper, Jim Edelen, and Eileen Saunders from E.ON. The following text is a narrative summary of the site visit conducted on May 13, 2010.

The Green River plant is the oldest and most uncontrolled coal fired plant in the E.ON fleet. Green River Units 1 and 2 have been retired in place since 1948. Units 3 and 4 were put into service in 1954 and 1959, respectively. Both remaining Units 3 and 4 are load following. Low load is approximately 40 MW for each unit, and (according to plant personnel) it is not unusual for both units to sit at low loads for extended periods just to support line voltage drop.

This low load operating issue for Units 3 and 4 impacts the flue gas temperature at the economizer outlet of both units. To properly operate a new SCR, significant economizer bypass will be needed to keep the SCR inlet temperature from dropping below design limits. The Installation of new AQC systems on Units 3 and 4 would require relocation of overhead power lines and one tower for Unit 4 AQC Equipment. Underground and aboveground utility interferences need to be relocated for Unit 3 AQC equipment. The existing Unit 3 tubular air heater will be replaced with a new regenerative type air heater. Flue gas will be diverted from the economizer section to the SCR inlet duct and will flow vertically upward to the top of the SCR. The SCR will be located above the new air heater and will require economizer bypass to control the flue gas temperature to the SCR inlet. Flue gas flow from the new air heater to the bottom of the new CDS vessel where the bed will be kept fluidized across the load range using recirculated gas from the PJFF outlet. The scrubbed flue gas will be drawn through the CDS and PJFF with a new ID fan that will direct clean flue gas to the new Unit 3 carbon steel stack. Solids collected in the PJFF (fly ash + unreacted reagent) will be recycled back to the CDS inlet to optimize reagent utilization.

The existing Unit 3 cold-side dry ESP and Unit 4 hot-side dry ESP were put into service in 1974. The Unit 4 hot-side dry ESP outlet duct will be connected to the new

SCR by new ductwork. Flue gas will travel upward to the top of the SCR and be routed back to the existing regenerative air heater flue gas inlet. Flue gas will travel out from the air heater to the bottom of the CDS. Scrubbed gas will then travel into two new PJFF housings located on each side of the CDS vessel. New ID fans will draw flue gas through the PJFF housings and deliver the clean flue gas to the new Unit 4 stack located between the new AQC equipment and the existing building wall. The hardware and footprint for PAC injection equipment is minimal and will be located near the air heater outlet ductwork before it splits into two PJFF inlet ducts.

Green River Units 3 and 4 require a complete new set of AQC system equipment along with two new carbon steel dry stacks.

Following the site visits, Black & Veatch developed recommendations for specific AQC technology for each unit based on the air emission levels provided by E.ON. The AQC technology recommendations were provided to E.ON for review and approval. Following E.ON's approval of the recommended AQC technologies, costs estimates were developed. The approved AQC technology options selection sheets are provided in Appendix E. The following sections describe the recommended AQC technologies and associated costs.

4.6.2 Control Technology Summary

The following discussion summarizes the approved AQC technologies and considerations for installation of these technologies on each unit.

To meet the identified pollutant emission limits, new AQC technologies are required for Green River Units 3 and 4. These AQC technologies include installation of a new SCR and PAC injection coupled with a new circulating dry scrubber (CDS) and PJFF located downstream of the air heater. The new SCR system can reduce NO_x emissions to 0.11 lb/MBtu or lower. The CDS and PJFF will reduce PM emissions to 0.03 lb/MBtu or lower, SO_2 emissions to 0.25 lb/MBtu or lower, and HCl emissions to 0.002 lb/MBtu or lower. The existing cold-side dry ESP on Unit 3 will be retired in place/demolished and existing hot-side dry ESP on Unit 4 will be kept in service for pre-filtration of fly ash. Halogenated PAC injection for Hg and dioxin/furan removal will be into the new ductwork upstream of the CDS, and it will reduce Hg emissions to 1 lb/TBtu or lower and dioxin/furan emissions to 15×10^{-18} lb/MBtu. New NN systems are recommended as a technology option for consideration to meet the future CO compliance limit of 0.1 lb/MBtu. Units 3 and 4 will require new ID fans (2 x 50 percent) to overcome the added pressure drop of the new ductwork, SCR, CDS, and PJFF.

To support the costs analyses described in the next section, Black & Veatch developed process flow diagrams for the approved AQC technologies to illustrate the potential equipment locations and better understand the retrofit issues with the existing system, as well as potential constructability issues. Additionally, high-level control technology equipment arrangement drawings indicating one possible layout of new equipment for each plant were developed. The equipment arrangement drawings are preliminary and are not meant to replace a detailed engineering study. The drawings illustrate high-level box sketches indicating locations of new ductwork (noted in green) and new AQC equipment (noted in red). The drawings also indicate gas flow paths and include a brief description of the constructability issues considered. The process flow diagrams and equipment arrangements are included in Appendices F and G, respectively.

4.6.3 Capital and O&M Costs

The total estimated capital cost to upgrade Green River Units 3 and 4 with recommended technologies are $69,000,000 ($966/kW) and $98,000,000 ($900/kW) respectively. Capital, O&M, and levelized annual costs are shown in Tables 4-16 and 4-17. Detailed cost summaries are included in Appendix H.

Table 4-16 Capital and O&M Cost Summary – Green River Unit 3				
AQC Equipment	**Capital Cost, $**	**$/kW**	**O&M Cost, $**	**Levelized Annual Cost, $**
SCR	$29,000,000	$408	$1,040,000	$4,569,000
CDS-FF	$38,000,000	$535	$6,874,000	$11,499,000
PAC Injection	$1,112,000	$16	$323,000	$458,000
Neural Network	$500,000	$7	$50,000	$111,000
Total	**$68,612,000**	**$966**	**$8,287,000**	**$16,637,000**

Table 4-17 Capital and O&M Cost Summary – Green River Unit 4				
AQC Equipment	**Capital Cost, $**	**$/kW**	**O&M Cost, $**	**Levelized Annual Cost, $**
SCR	$42,000,000	$385	$1,442,000	$6,553,000
CDS-FF	$54,000,000	$495	$10,289,000	$16,861,000
PAC Injection	$1,583,000	$15	$515,000	$708,000
Neural Network	$500,000	$5	$50,000	$111,000
Total	**$98,083,000**	**$900**	**$12,296,000**	**$24,233,000**

4.6.4 Special Considerations

To arrive at the aforementioned cost estimates, BOP and ancillary operations, available space at the plant, and constructability issues were considered. The following highlight several of these issues considered for the development of the AQC equipment costs:

- **Auxiliary Power**--Additional auxiliary power requirement will need to be considered for new ID fans to accommodate the additional pressure drop of the new AQC equipment.
- **Water**--A new CDS-PJFF is required for all the Units. The makeup water system may require a possible upgrade.
- **CDS Byproduct Handling**--There will be a significant amount of byproduct produced by the CDS because of the high amount of sulfur removal from the coal. A new byproduct handling system is required.

- **CDS Reagent Preparation System**--There will be a significant amount of reagent required by the CDS because of the high amount of sulfur removal from the coal. A new reagent preparation system is required.
- **Ammonia Storage**--A new ammonia storage facility will be required for new SCRs. Detailed investigation or study will be required to identify the site location for ammonia storage and supply.
- **Footprint**--The new AQC equipment will be installed in the new location as shown on the equipment layout drawing included in Appendix G.
- **Constructability Challenges**:
  - Relocation of some existing transmission lines and one tower will be needed for safe installation of new AQC equipment.
  - Relocation of the existing generator set will be needed to make space available for the new AQC equipment.
  - Some underground utility interferences/relocations.
  - Some aboveground utility interferences/relocations.

4.6.5 AQC Equipment Implementation Schedule

AQC equipment implementation schedules for each unit are included in Appendix I. These schedules include milestones in months for the conceptual design, and construction and can help to identify critical path considerations for the approved AQC technologies. While these schedules represent a sequence of events to minimize site outages required for installation of the new AQC equipment, consideration of unit-specific outages outside the scope of this study, have not been included. The following highlight scheduling related issues that were considered in the development of the implementation schedules.

Unit 3 and 4

The plant has available space for the new AQC equipment, and the new AQC equipment can be installed without extensive off-line construction related outages.

4.6.6 Summary

The cost of new AQC equipment to meet or exceed defined future emission targets at Green River is nominally $167,000,000 ($1,900/kW). The O&M and levelized annual costs of new AQC equipment at Green River are nominally $20,600,000 and $40,900,000, respectively.

Appendix A
E.ON Environmental Matrix

Estimated Requirements Under Future New Environmental Regulations

Task No.	Program Name	Regulated Pollutants			Unit/Plant Averaging	Forcasted Date for Compliance
		Pollutant	Limit	Units		
4.1	GHG Inventory	No additional limits			N/A	Spring - 2010
4.2	New & Existing Engine NSPS and RICE MACT	PM NO_x VOC CO	Varies by Model Year and Horsepower. Certified to meet Tier III, Interim Tier IV or Tier IV		Unit	Spring 2013 for existing MACT & at installation for new NSPS
4.3	Mill Creek BART	MC3 - SAM MC4 - SAM	64.3 76.5	lbs/hour lbs/hour	Unit	During - 2011
4.4	Jefferson Co. STAR Reg.	metals in fuels (As) 20 - 50 ppm or ~$1x10^{-5}$ lbs/mmBtu emission rate			Plant	Spring - 2012
4.5 & 4.6	Brown Consent Decree	PM SO_2 NO_x SAM	0.03 97% 0.07 /0.08 110 -220	lbs/mmBtu Removal lbs/mmBtu lbs/mmBtu	Unit 3	SO_2 & PM - December, 2010 NO_x & SAM - December, 2012
4.7	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
4.8	GHG NSR	GHG	Energy Efficiency Projects		Unit/Plant	January, 2011
4.9	Revised CAIR	SO_2 NO_x	0.25 0.11	lbs/mmBtu lbs/mmBtu	Plant	Beginning in 2014
4.10	New EGU MACT	Mercury	90% or 0.012	Removal lbs/GWH	Plant	January, 2015; with 1-yr extension - January, 2016
		Acids (HCl) Metals (PM) Metals (As) Organics (CO) Dioxin/Furan	0.002 0.03 0.5×10^{-5} 0.02 15×10^{-18}	lbs/mmBtu lbs/mmBtu lbs/mmBtu lbs/mmBtu lbs/mmBtu	Unit	
4.11	Jefferson Co. Ozone Non-attainment	NO_x	5 - 10 % reduction	NOx emissions	County-wide	Spring - 2016
4.11	New 1-hour NAAQS for NO_x	NO_x	To be determined based on modeling	lbs/hours	Plant	During - 2015
4.12	New 1-hour NAAQS for SO_2	SO_2	To be determined based on modeling	lbs/hours	Plant	Spring - 2016
4.13	GHG Reduction & Renewables	GHG	To be determined based on modeling	tons/year	Fleet	Beginning in 2014
Plan Risk	$PM_{2.5}$ Emission Reductions	PM2.5 (Condensables)	To be determined based on modeling	lbs/mmBtu	Unit/Plant	After 2013
4.14	CWA 316(a)	Thermal impacts	Biological Studies	N/A	Plant	Starting in 2010
4.15	CWA 316(b)	Withdraw impacts	Biological Studies	N/A	Plant	Starting in 2012
4.16	New Effluent Standard	Metals, Chlorides, etc.	EPA anaylsis is just beginning	EPA anaylsis is just beginning	Plant	During - 2015
4.17	CCR Classification	Toxic Metals	Handle dry in landfill; possible closing existing ash ponds in 5 years		Plant	Beginning in 2012;

- New requirements have been finalized

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Major Assumptions (Air)

Generation
2011-2013 MTP

Air Related Environmental Regulatory Program Implementation

Year: 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2020

4.1 GHG Emission Inventory Implementation
4.2 IC and RICE Engine Compliance
4.8 GHG NSR Tailoring Rule | Development of GHG BACT for Boilers and CTs | GHG (CO_2)BACT Controls
4.9 Revised CAIR Regulation | Revised CAIR Implementation | Revised CAIR Phase II
4.10 EGU MACT Regulation | EGU MACT Implementation
4.11 Ozone Revised NAAQS (0.060 - 0.70 ppm) | Non-attainment Area Designation & NO_x Controls Required by SIP
4.12 New SO_2 NAAQS Standard (50 - 100 ppb for 1-hr) | Non-attainment Area Designation & SO_2 Controls Required by SIP
4.11 New NO_x NAAQS Standard (100 ppb for 1-hr) | Non-attainment Area Designation & NO_x Controls Required by SIP
4.13 GHG Reduction & Renewable Legislation and Regulation | Compliance Through the Purchase of Allowances and RECs

Plant-wide average of ~ 0.25 lbs/mmBtu for SO_2 and ~0.11 lbs/mmBtu for NO_x by post-2016

Controls for all HAPs with mercury between 0.015 - 0.020 lbs/GWH or 90% reduction

SIP requiring NOx reduction in ozone non-attainment areas

SIP requiring assessment of NAAQS near power plants. Determine SO_2 plant-wide emission ambient air impact using modeling

SIP requiring assessment of NAAQS near power plants. Determine NOx plant-wide emission ambient air impact using modeling.

Existing Air Related Environment Issues

Year: 2010 | 2011 | 2012 | 2013

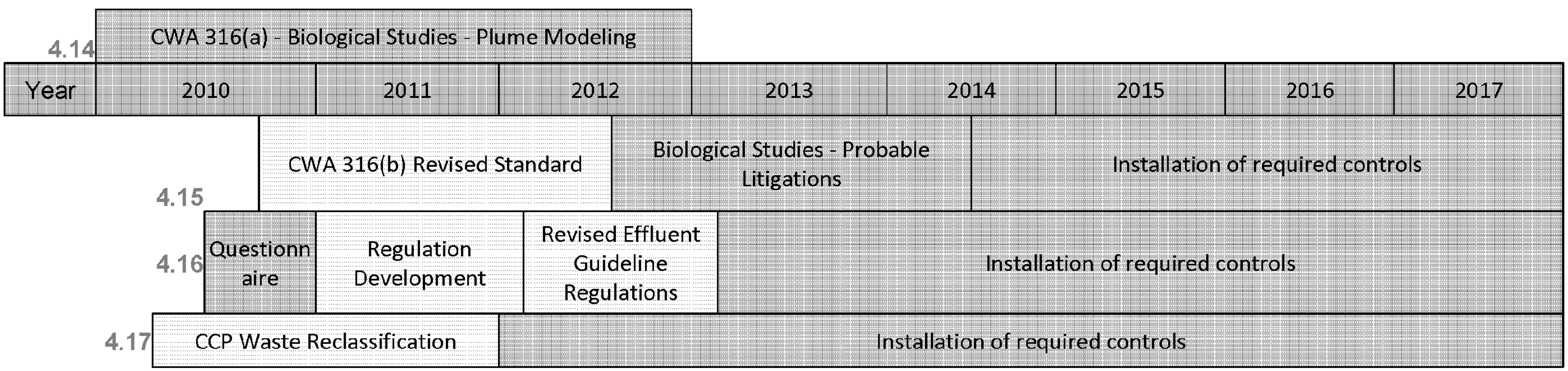
4.3 SO_3 mitigation at Mill Creek Units 3 & 4
4.4 New MC & CR Title V permits with STAR monitoring conditions | Implement new STAR monitoring conditions
4.5 / 4.6 Brown CD Requirements in the Title V air permit | Installation of Unit 3 SCR and Operation of the new FGD
4.7 Ghent SO_3 testing & resolution | Reduction in Ghent SO_3 and opacity (if necessary)

Note:
If the environmental action is above the "Year" row, then regulatory requirements are finalized.

- Year of occurrence
- Regulatory requirements are still being developed
- Requirements are still being developed, but an indication of major impact
- In the implementation phase (engineering design & equipment construction)

e·on | U.S. **Major Assumptions (Land & Water)** Generation 2011-2013 MTP

Land & Water Related Environmental Regulatory Program Implementation



- Year of occurrence
- Regulatory requirements are still being developed
- Requirements are still being developed, but an indication of major impact
- In the implementation phase (engineering design & equipment construction)

Appendix B
E.ON Unit Specific Data

E.W. Brown

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

References:

1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum		Notes
Carbon				%	
Hydrogen				%	
Sulfur				%	
Nitrogen				%	
Oxygen				%	
Chlorine				%	
Ash				%	
Moisture				%	
Total					
Higher Heating Value, Btu/lb (as received)				Btu/lb	
Ash Mineral Analysis (% by mass):					
Silica(SiO_2)				%	
Alumina (Al_2O_3)				%	
Titania (TiO_2)				%	
Phosphorous Pentoxide (P_2O_5)				%	
Calcium Oxide (CaO)				%	
Magnesium Oxide (MgO)				%	
Sodium Oxide (Na_2O)				%	
Iron Oxide (Fe_2O_3)				%	
Sulfur Trioxide (SO_3)				%	
Potassium Oxide (K_2O)				%	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)

Vanadium		%	
Arsenic		%	
Mercury		% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)			
Natural gas line (into the station) capacity (if applicable)			
Current Lost on Ignition (LOI)			
Start-up Fuel			
Ash Fusion Temperature			
Initial Deformation		°F	
Softening		°F	
Hemispherical		°F	
Hardgrove Grindability Index			

Black & Veatch AQCS Information Needs

Power Plant: ________ Owner: ________
Unit ________ Project: ________

Plant Size and Operation Data: (provide for each unit)		Unit 1	Unit 2	Unit 3	Unit X		Notes
Maximum (Design) Fuel Burn Rate		4 * 14.91 Tons/hr	4 * 22.6 Tons/hr	5 * 46.75 Tons		MBtu/hr	# Pulv * Pulv rating
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		Wall-Fired	Tangential Fired	Tangential Fired			
Boiler Manufacturer		B&W	CE	CE			
Net MW Rating (specify plant or turbine MW)		102	169	433		MW	Dispatch Generator Ratings
Gross MW Rating		110	180	457		MW	Dispatch Generator Ratings
Net Unit Heat Rate		9802	9855	9516		Btu/kWh	S&L Design Heat Balance
Net Turbine Heat Rate		8104	8149	8019		Btu/kWh	S&L Design Heat Balance
Boiler SO2 to SO3 Conversion Rate (if known)		na	na	na		%	
Fly Ash/Bottom Ash Split		80/20	80/20	80/20		%	Typical values used on other reports
Flue Gas Recirculation (FGR)							
Installed? (Y/N)		N	N	N			
In operation? (Y/N)							
Flue Gas Recirculation (if installed)						%	
Type of Air Heater		Ljungstrom	Ljungstrom	Ljungstrom			
Air Heater Configuration (horizontal or vertical flow or shaft)		Vertical	Vertical	Vertical			
Design Pressure/Vacuum Rating for Steam Generator	+/-					in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-					in wg.	
Electrical / Control							
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)							
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)							
Neural Network Installed? (Y/N)							
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)							
Extra Capacity available in DCS?							
Historian Manufacturer							
Additional Controls from DCS or local PLC w/tie-in							
Transformer Rating for Intermediate Voltage Switchgear							
(SUS's) and Ratings of Equipment in These Cubicles							
Auxiliary Electric Limited (Y/N)							
Operating Conditions							
Economizer Outlet Temperature		650	730	730		°F	Typical data from PI historian
Economizer Outlet Pressure		-8	-3.7	-5		in wg.	Typical data from PI historian
Excess Air or Oxygen at Economizer Outlet (full load/min load)		5/8 O2	3/4 O2	2.8/3.3		%	Typical data from PI historian
Economizer Outlet Gas Flow		na	na	na		acfm	
						lb/hr	
Air Heater Outlet Temperature		350	330	340		°F	Typical data from PI historian
Air Heater Outlet Pressure		-14	-8	-18		in wg.	Typical data from PI historian; Unit 1 has back pass dampers
Particulate Control Equipment Outlet Temperature		340	320	330		°F	Typical data from PI historian
Particulate Control Equipment Outlet Pressure		-18	-12	-19		in wg.	Typical data from PI historian
FGD Outlet Temperature (if applicable)		na	na	na		°F	Typical data from PI historian
FGD Outlet Pressure (if applicable)		na	na	na		in wg.	

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

NOx Emissions	**Unit X**	**Unit X**	**Unit X**	**Unit X**		**Notes**
Emissions Limit	0.5	0.45	0.07		lb/MBtu	Units 1 & 2 on averaging plan for Nox so this is target rather
Type of NOx Control (if any) - LNB, OFA, etc.	lnb	lnb, ofa	lnb, ofa			
Current NOx Reduction with existing controls	na	na	na		%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)						
Reagent Cost					$/ton	
Current Emissions					lb/hr	
					ton/yr	
					lb/MBtu	
Particulate Emissions						
Emissions Limit	0.254	0.162	0.03		lb/MBtu	Title V permit for 1 & 2, Consent Decree Unit 3
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF	Cold Side ESP	Cold Side ESP	Cold Side ESP			
Oxygen Content of Flue Gas @ Air Heater Outlet	na	na	na		%	
Oxygen Content of Flue Gas @ ESP/FF Outlet	na	na	na		%	
Current Emissions	0.241	0.068	0.07		lb/MBtu	Latest compliance PM testing
Fly Ash Sold (Y/N) - See Economic Section	n	n	n			
ESP						
Specific Collection Area (SCA)					ft^2/1000 acfm	
Discharge Electrode Type						
Supplier						
Efficiency					%	
No. of Electrical Sections						
% of Fly Ash Sold					%	
Fabric Filter						
Air to Cloth Ratio (net)					ft/min	
Number of Compartments						
Number of Bags per Compartments						
Efficiency					%	
% of Fly Ash Sold					%	
SO_2 Emissions						
Emissions Limit	5.15	5.15	.1 or 97%		lb/MBtu	Title V permit for 1 & 2, Consent Decree Unit 3
Type of Emission Control - wet or semi-dry FGD (if any)						
Current Emissions	2.5	2.5	2.5		lb/hr	Typical Value from CEMS (typically varies from 1.5 to 3.5 wit
					ton/yr	
					lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section						

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

ID Fan Information (at Full Load):	Unit X	Unit X	Unit X	Unit X		Notes
ID Fan Inlet Pressure	-14	-8	-18		in wg.	
ID Fan Discharge Pressure	0.5	0.5	0.5		in wg.	
ID Fan Inlet Temperature	340	320	330		F	
Oxygen Content of Flue Gas @ ID Fan Inlet	na	na	na		%	
ID Fan Motor Voltage (Rated)	13200	2300	13200		volts	
ID Fan Motor Amps (Operating)	na	400	na		A	
ID Fan Motor Amps (Rated)	see fan curve	see fan curve	see fan curve		A	
ID Fan Motor Power (Rated)	see fan curve	see fan curve	see fan curve		hp	
ID Fan Motor Service Factor (1.0 or 1.15)	see fan curve	see fan curve	see fan curve			

Chimney Information:						
Flue Liner Material						
Flue Diameter					ft	
Chimney Height					ft	
Number of Flues						

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)
Plant Arrangement Drawings (showing column row spacing)
CEM Quarterly and Annual Data (required if base emissions are to be verified)
Recent Particulate Emission Test Report (If available)
Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
Underground Utilities Drawings
Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________

Unit ____________ Project: ____________

Economic Evaluation Factors:	Unit X	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life					years	
Annual Capacity Factor (over life of study/plant)					%	
Contingency Margin (can be determined by B&V)					%	
Owner Indirects Cost Margin					%	
Interest During Construction					%	
Levelized Fixed Charge Rate or Capital Recovery Factor					%	
Present Worth Discount Rate					%	
Capital Escalation Rate					%	
O&M Escalation Rate					%	
Energy Cost (energy to run in-house equipment)					$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)					$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)					$/MBtu	
					$/ton	
Base Fuel Price					$/MBtu	
					$/ton	
Fuel Price Escalation Rate					%	
Water Cost					$/1,000 gal	
Limestone Cost					$/ton	
Lime Cost					$/ton	
Ammonia Cost					$/ton	
Fully Loaded Labor Rate (per person)					$/year	
Fly Ash Sales					$/ton	
Bottom Ash Sales					$/ton	
FGD Byproduct Sales					$/ton	
Waste Disposal Cost						
Fly Ash					$/ton	
Bottom Ash					$/ton	
Scrubber Waste					$/ton	

Ghent

Black & Veatch AQCS Information Needs

Power Plant: ______________ Owner: ______________
Unit ______________ Project: ______________

References:
1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum		Notes
Carbon				%	
Hydrogen				%	
Sulfur				%	
Nitrogen				%	
Oxygen				%	
Chlorine				%	
Ash				%	
Moisture				%	
Total					
Higher Heating Value, Btu/lb (as received)				Btu/lb	
Ash Mineral Analysis (% by mass):					
Silica(SiO_2)				%	
Alumina (Al_2O_3)				%	
Titania (TiO_2)				%	
Phosphorous Pentoxide (P_2O_5)				%	
Calcium Oxide (CaO)				%	
Magnesium Oxide (MgO)				%	
Sodium Oxide (Na_2O)				%	
Iron Oxide (Fe_2O_3)				%	
Sulfur Trioxide (SO_3)				%	
Potassium Oxide (K_2O)				%	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)			
Vanadium		%	
Arsenic		%	
Mercury		% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)	No		
Natural gas line (into the station) capacity (if applicable)	No		
Current Lost on Ignition (LOI)			
Start-up Fuel	# 2 Fuel Oil		
Ash Fusion Temperature			
Initial Deformation		°F	
Softening		°F	
Hemispherical		°F	
Hardgrove Grindability Index			

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Black & Veatch AQCS Information Needs

Power Plant: ______ Owner: ______
Unit ______ Project: ______

Plant Size and Operation Data: (provide for each unit)		Unit 1	Unit 2	Unit 3	Unit 4		Notes
Maximum (Design) Fuel Burn Rate		B&V can determine some values from previous VISTA				MBtu/hr	
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		tangential	tangential	ont/back wall fired	ont/back wall fired		
Boiler Manufacturer		CE	CE	FW	FW		
Net MW Rating (specify plant or turbine MW)						MW	
Gross MW Rating		541	517	523	526	MW	
Net Unit Heat Rate		10557	8904	11180	11070	Btu/kWh	
Net Turbine Heat Rate		8733	7565	8404	8439	Btu/kWh	
Boiler SO2 to SO3 Conversion Rate (if known)		1.50%		1.95%	2.20%	%	
Fly Ash/Bottom Ash Split						%	
Flue Gas Recirculation (FGR)							
Installed? (Y/N)		No	No	No	No		
In operation? (Y/N)		No	No	No	No		
Flue Gas Recirculation (if installed)		No	No	No	No	%	
Type of Air Heater		Lungstrom	Lungstrom	Lungstrom	Lungstrom		
Air Heater Configuration (horizontal or vertical flow or shaft)		vertical	vertical	vertical	vertical		
Design Pressure/Vacuum Rating for Steam Generator	+/-	35	26	35	35	in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-	35"V	30" V	30" V	30" V	in wg.	
Electrical / Control							
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)		Emerson	Emerson	Emerson	Emerson		
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)		Ovation	Ovation	Ovation	Ovation		
Neural Network Installed? (Y/N)		No	No	No	No		
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)		n/a	n/a	n/a	n/a		
Extra Capacity available in DCS?		yes	yes	yes	yes		
Historian Manufacturer		Emerson	Emerson	Emerson	Emerson		
Additional Controls from DCS or local PLC w/tie-in		yes	yes	yes	yes		
Transformer Rating for Intermediate Voltage Switchgear							
(SUS's) and Ratings of Equipment in These Cubicles							
Auxiliary Electric Limited (Y/N)							
Operating Conditions							
Economizer Outlet Temperature		729	610	731	791	°F	
Economizer Outlet Pressure		-323	-5.07	-5.12	-4.51	in wg.	
Excess Air or Oxygen at Economizer Outlet (full load/min load)		3	3.5	3.5	3.3	%	
Economizer Outlet Gas Flow		3775	4147	4506	4076	acfm	
						lb/hr	
Air Heater Outlet Temperature		345	309	315	309	°F	
Air Heater Outlet Pressure		-22.4	-18.6	-36.1	-29.4	in wg.	
Particulate Control Equipment Outlet Temperature		361	605	708	770	°F	
Particulate Control Equipment Outlet Pressure		-25.7	-10.8	-0.92	-0.82	in wg.	
FGD Outlet Temperature (if applicable)		125	83	130	128	°F	
FGD Outlet Pressure (if applicable)		1.65	1.45	2	1.56	in wg.	

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________

Unit ____________ Project: ____________

	Unit 1	Unit 2	Unit 3	Unit 4		Notes
NOx Emissions						
Emissions Limit	0.45	0.4	0.46	0.46	lb/MBtu	
Type of NOx Control (if any) - LNB, OFA etc.	LNB	LNB/OFA	LNB/OFA	LNB/OFA		
Current NOx Reduction with existing controls	SCR	SCR	SCR	SCR	%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)	anhydrous	anhydrous	anhydrous	anhydrous		
Reagent Cost					$/ton	
Current Emissions	330	1300	330	330	lb/hr	
	930	850	4800	850	ton/yr	
	0.04	0.35	0.04	0.04	lb/MBtu	
Particulate Emissions						
Emissions Limit					lb/MBtu	
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF	Cold side ESP	Hot side ESP	Hot side ESP	Hot side ESP		
Oxygen Content of Flue Gas @ Air Heater Outlet					%	
Oxygen Content of Flue Gas @ ESP/FF Outlet					%	
Current Emissions	0.02 to 0.045 lbs/r	0.02 to 0.045 lbs/r	0.02 to 0.045 lbs/r	0.025 lbs/mmbtu	lb/MBtu	
Fly Ash Sold (Y/N) - See Economic Section	No	No	No	No		
ESP						
Specific Collection Area (SCA)	153	223	328	328	ft^2/1000 acfm	
Discharge Electrode Type	rigid	wire	wire	wire		
Supplier	PECO	GE	GE	GE		
Efficiency	99.2	99			%	
No. of Electrical Sections	4 in series	4 in series	7 in series	7 in series		
% of Fly Ash Sold	0	0	0	0	%	
Fabric Filter						
Air to Cloth Ratio (net)	N/A				ft/min	
Number of Compartments						
Number of Bags per Compartments						
Efficiency					%	
% of Fly Ash Sold					%	
SO_2 Emissions						
Emissions Limit	5.67 lbs/mmbtu (24 Hr)	lbs/mmbtu (3 Hr)	lbs/mmbtu (3 Hr)	lbs/mmbtu (3 Hr)	lb/MBtu	
Type of Emission Control - wet or semi-dry FGD (if any)	wet FGD	wet FGD	wet FGD	wet FGD		
Current Emissions	600	600	1120	600	lb/hr	
	1400	2100	1400	1400	ton/yr	
	0.15	0.2	0.15	0.15	lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section	yes	yes	yes	yes		

Black & Veatch AQCS Information Needs

Power Plant: ______ Owner: ______
Unit ______ Project: ______

ID Fan Information (at Full Load):	Unit 1	Unit 2	Unit 3	Unit 4		Notes
ID Fan Inlet Pressure	-22.5	-18.7	-36	-28.9	in wg.	
ID Fan Discharge Pressure	6.08	11.4	5.94	14.6	in wg.	
ID Fan Inlet Temperature	358	309	322	309	F	
Oxygen Content of Flue Gas @ ID Fan Inlet	3	3.5	3.5	3.17	%	
ID Fan Motor Voltage (Rated)	4160	6600	13200	4000	volts	
ID Fan Motor Amps (Operating)	990	670	410	1385	A	
ID Fan Motor Amps (Rated)	1113	953	535	1020	A	
ID Fan Motor Power (Rated)	9000	12500	13600	8000	hp	
ID Fan Motor Service Factor (1.0 or 1.15)	1.15	1.15	1.15	1.15		
Chimney Information:						
Flue Liner Material	fiber glass	brick	brick	fiber glass		Ghent 2 and 3 share a common stack-each unit is mixed
Flue Diameter	29'6"	34'5"	34'5"	29'6"	ft	into a common exit flue
Chimney Height	660	580	580	660	ft	
Number of Flues	1	2	2	1		

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)
Plant Arrangement Drawings (showing column row spacing)
CEM Quarterly and Annual Data (required if base emissions are to be verified)
Recent Particulate Emission Test Report (If available)
Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
Underground Utilities Drawings
Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________

Unit ____________ Project: ____________

Economic Evaluation Factors:	Unit X	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life					years	
Annual Capacity Factor (over life of study/plant)					%	
Contingency Margin (can be determined by B&V)					%	
Owner Indirects Cost Margin					%	
Interest During Construction					%	
Levelized Fixed Charge Rate or Capital Recovery Factor					%	
Present Worth Discount Rate					%	
Capital Escalation Rate					%	
O&M Escalation Rate					%	
Energy Cost (energy to run in-house equipment)					$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)					$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)					$/MBtu	
					$/ton	
Base Fuel Price					$/MBtu	
					$/ton	
Fuel Price Escalation Rate					%	
Water Cost					$/1,000 gal	
Limestone Cost					$/ton	
Lime Cost					$/ton	
Ammonia Cost					$/ton	
Fully Loaded Labor Rate (per person)					$/year	
Fly Ash Sales					$/ton	
Bottom Ash Sales					$/ton	
FGD Byproduct Sales					$/ton	
Waste Disposal Cost						
Fly Ash					$/ton	
Bottom Ash					$/ton	
Scrubber Waste					$/ton	

Cane Run

Black & Veatch AQCS Information Needs

Power Plant: Cane Run Owner: Louisville Gas & Electric
Unit Project:

References:
1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum	Notes
Carbon	61.4	59.8	63.14	
Hydrogen	4.3	4.09	4.3	
Sulfur	3.2	2.23	3.2	
Nitrogen	1.3	1.26	1.5	
Oxygen	6.5	6.62	7.44	
Chlorine	0.1			
Ash	10.8	9.13	11.67	
Moisture	12.4	11.92	15.18	
Total	100	95.05	106.43	
Higher Heating Value, Btu/lb (as received)	10921.64	10391	11673	
Ash Mineral Analysis (% by mass):				
Silica(SiO_2)	46.02	42.41	49.07	
Alumina (Al_2O_3)	23.27	20.81	25.64	
Titania (TiO_2)	1.09	0.99	1.21	
Phosphorous Pentoxide (P_2O_5)	0.255	0.16	0.34	
Calcium Oxide (CaO)	1.211	0.88	1.89	
Magnesium Oxide (MgO)	0.98	0.87	1.14	
Sodium Oxide (Na_2O)	0.3	0.22	0.44	
Iron Oxide (Fe_2O_3)	22.97	17.48	27.84	
Sulfur Trioxide (SO_3)	0.95	0.52	1.7	
Potassium Oxide (K_2O)	2.6	2.24	2.93	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)

Vanadium	46.75	%	
Arsenic	15.47	%	
Mercury	0.09	% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)	Y		
Natural gas line (into the station) capacity (if applicable)			
Current Lost on Ignition (LOI)			
Start-up Fuel	Gas		
Ash Fusion Temperature			
Initial Deformation	2025.56	°F	
Softening	2211.44	°F	
Hemispherical	2332.11	°F	
Hardgrove Grindability Index	62		

Black & Veatch AQCS Information Needs

Power Plant: Cane Run   Owner: Louisville Gas & Electric
Unit: Project:

Plant Size and Operation Data: (provide for each unit)		CR4	CR5	CR6		Notes
Maximum (Design) Fuel Burn Rate		1601.9	1753.4	2395.7	MBtu/hr	
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		Wall	Wall	Wall		
Boiler Manufacturer		CE	Riley	CE		
Net MW Rating (specify plant or turbine MW)		155	168	240	MW	
Gross MW Rating		168	181	261	MW	
Net Unit Heat Rate		10340	10458	10789	Btu/kWh	
Net Turbine Heat Rate		8414	8429	8625	Btu/kWh	
Boiler SO2 to SO3 Conversion Rate (if known)		-	-	-	%	
Fly Ash/Bottom Ash Split		80/20	80/20	80/20	%	
Flue Gas Recirculation (FGR)						
Installed? (Y/N)		Y	N	N		
In operation? (Y/N)		Y	N	N		
Flue Gas Recirculation (if installed)					%	
Type of Air Heater		Ljungstrom	Ljungstrom	Ljungstrom		
Air Heater Configuration (horizontal or vertical flow or shaft)		Horizontal	Horizontal	Horizontal		
Design Pressure/Vacuum Rating for Steam Generator	+/-	1800/3.5	1800/1.5	2400/3.5	in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-	no data	20" H2O/-8.75	no data	in wg.	
Electrical / Control						
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)		Honeywell	Honeywell	Honeywell		
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)		TDC3000/Experion	TDC3000/Experion	TDC3000/Experion		
Neural Network Installed? (Y/N)		Y	Y	Y		
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)		Neuco	Neuco	Neuco		
Extra Capacity available in DCS?		Y	Y	Y		
Historian Manufacturer		Honeywell	Honeywell	Honeywell		
Additional Controls from DCS or local PLC w/tie-in						
Transformer Rating for Intermediate Voltage Switchgear (SUS's) and Ratings of Equipment in These Cubicles						
Auxiliary Electric Limited (Y/N)		N	N	N		
Operating Conditions						
Economizer Outlet Temperature		580.45	630.24	617.2	°F	
Economizer Outlet Pressure					in wg.	
Excess Air or Oxygen at Economizer Outlet (full load/min load)					%	
Economizer Outlet Gas Flow					acfm	
					lb/hr	
Air Heater Outlet Temperature		369.22	299.15	317.59	°F	
Air Heater Outlet Pressure					in wg.	
Particulate Control Equipment Outlet Temperature		132.6	128.4	132.8	°F	Summer design Temperature
Particulate Control Equipment Outlet Pressure					in wg.	ID Fan Suction Pressure
FGD Outlet Temperature (if applicable)		127			°F	
FGD Outlet Pressure (if applicable)					in wg.	

Black & Veatch AQCS Information Needs

Power Plant: Cane Run Owner: Louisville Gas & Electric
Unit: Project:

	CR4	CR5	CR6		Notes
NOx Emissions					
Emissions Limit	0.3372	0.3934	0.3276	lb/MBtu	
Type of NOx Control (if any) - LNB, OFA, etc.	LNB	LNB	OFA		
Current NOx Reduction with existing controls				%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)	N/A	N/A	N/A		
Reagent Cost				$/ton	
Current Emissions	0.337	0.384	0.286	lb/hr	
				ton/yr	
				lb/MBtu	
Particulate Emissions					
Emissions Limit	0.11	0.11	0.11	lb/MBtu	
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF					
Oxygen Content of Flue Gas @ Air Heater Outlet	5.78	5.82	4.53	%	
Oxygen Content of Flue Gas @ ESP/FF Outlet				%	
Current Emissions	0.041	0.034	0.024	lb/MBtu	
Fly Ash Sold (Y/N) - See Economic Section	N	N	N		
ESP					
Specific Collection Area (SCA)				ft^2/1000 acfm	
Discharge Electrode Type	0.109" Copper Bessemer	0.109" Copper Bessemer			
Supplier	Research-Cottrell	Research-Cottrell	Buell Engineering		Original supplier
Efficiency	99.1	96.1	99.2	%	
No. of Electrical Sections	48		49		
% of Fly Ash Sold	N/A	N/A	N/A	%	
Fabric Filter					
Air to Cloth Ratio (net)				ft/min	
Number of Compartments					
Number of Bags per Compartments					
Efficiency				%	
% of Fly Ash Sold	N/A	N/A	N/A	%	
SO_2 Emissions					
Emissions Limit	1.2	1.2	1.2	lb/MBtu	
Type of Emission Control - wet or semi-dry FGD (if any)	Wet	Wet	Wet		
Current Emissions	0.411	0.419	0.676	lb/hr	
				ton/yr	
				lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section	N	N	N		

Black & Veatch AQCS Information Needs

Power Plant: Cane Run Owner: Louisville Gas & Electric
Unit: Project:

ID Fan Information (at Full Load):	Unit X	Unit X	Unit X		Notes
ID Fan Inlet Pressure	-9.11	-6.82	-9.84	in wg.	
ID Fan Discharge Pressure	8	7	8	in wg.	
ID Fan Inlet Temperature				F	
Oxygen Content of Flue Gas @ ID Fan Inlet				%	
ID Fan Motor Voltage (Rated)	4160	4160	4000	volts	
ID Fan Motor Amps (Operating)	104.23	194.37	146.11	A	
ID Fan Motor Amps (Rated)	157	211	265	A	
ID Fan Motor Power (Rated)	1250	3000	2000	hp	
ID Fan Motor Service Factor (1.0 or 1.15)	1	1	1.15		
Chimney Information:					
Flue Liner Material	Pre-Krete	Hadite/Pre-krete	Hastalloy C276		
Flue Diameter	14'2"	15'6"	24'41/2"	ft	
Chimney Height	239	239	500	ft	
Number of Flues	1	1	1		

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)
Plant Arrangement Drawings (showing column row spacing)
CEM Quarterly and Annual Data (required if base emissions are to be verified)
Recent Particulate Emission Test Report (If available)
Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
Underground Utilities Drawings
Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
Specific burner and overfire air ports arrangement (single wall, opposed fired, total number of burners, number of burner levels, number of overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: Cane Run Owner: Louisville Gas & Electric
Unit Project:

Economic Evaluation Factors:	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life	20	20	20	years	
Annual Capacity Factor (over life of study/plant)	65	65	65	%	
Contingency Margin (can be determined by B&V)				%	
Owner Indirects Cost Margin				%	
Interest During Construction				%	
Levelized Fixed Charge Rate or Capital Recovery Factor				%	
Present Worth Discount Rate	6.4	6.4	6.4	%	
Capital Escalation Rate	4%	4%	4%	%	
O&M Escalation Rate	3%	3%	3%	%	
Energy Cost (energy to run in-house equipment)				$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)				$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)				$/MBtu	
				$/ton	
Base Fuel Price				$/MBtu	
				$/ton	
Fuel Price Escalation Rate				%	
Water Cost				$/1,000 gal	
Limestone Cost	N/A	N/A	N/A	$/ton	
Lime Cost	$112.54	$112.54	$112.54	$/ton	Total cost $773,013.3
Ammonia Cost	N/A	N/A	N/A	$/ton	
Fully Loaded Labor Rate (per person)				$/year	
Fly Ash Sales	N/A	N/A	N/A	$/ton	
Bottom Ash Sales	N/A	N/A	N/A	$/ton	
FGD Byproduct Sales	N/A	N/A	N/A	$/ton	
Waste Disposal Cost					
Fly Ash	$2.73			$/ton	Values represent total O&M cost for 2009. Plant Total
Bottom Ash	$8.40			$/ton	Values represent total O&M cost for 2009. Plant total
Scrubber Waste	$3,469.00	$4,989.00	$8,734.00	000$	Values represent total O&M cost for 2009.

Mill Creek

Black & Veatch AQCS Information Needs

Power Plant: ______ Owner: ______
Unit ______ Project: ______

References:
1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum		Notes
Carbon	64			%	
Hydrogen	4.5			%	
Sulfur	3.5			%	
Nitrogen	1.3			%	
Oxygen	4.62			%	
Chlorine	0.08			%	
Ash	12			%	
Moisture	10			%	
Total	100.00				
Higher Heating Value, Btu/lb (as received)	11471.82			Btu/lb	
Ash Mineral Analysis (% by mass):					
Silica(SiO_2)				%	
Alumina (Al_2O_3)				%	
Titania (TiO_2)				%	
Phosphorous Pentoxide (P_2O_5)				%	
Calcium Oxide (CaO)				%	
Magnesium Oxide (MgO)				%	
Sodium Oxide (Na_2O)				%	
Iron Oxide (Fe_2O_3)				%	
Sulfur Trioxide (SO_3)				%	
Potassium Oxide (K_2O)				%	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)

Vanadium		%	
Arsenic		%	
Mercury		% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)			
Natural gas line (into the station) capacity (if applicable)			
Current Lost on Ignition (LOI)			
Start-up Fuel			
Ash Fusion Temperature			
Initial Deformation		°F	
Softening		°F	
Hemispherical		°F	
Hardgrove Grindability Index			

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________

Unit ____________ Project: ____________

Plant Size and Operation Data: (provide for each unit)		Unit 1	Unit 2	Unit 3	Unit 4		Notes
Maximum (Design) Fuel Burn Rate		B&V can determine some values from previous VISTA				MBtu/hr	
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		Tangential fired	Tangential fired	opposed wall	opposed wall		
Boiler Manufacturer		CE	CE	B&W	B&W		
Net MW Rating (specify plant or turbine MW)	Winter ratings	303MW	303MW	397MW	492MW	MW	
Gross MW Rating	Winter ratings	330MW	330MW	423MW	525MW	MW	
Net Unit Heat Rate		10639	10929	10602	10410	Btu/kWh	
Net Turbine Heat Rate						Btu/kWh	
Boiler SO2 to SO3 Conversion Rate (if known)						%	
Fly Ash/Bottom Ash Split		80/20	80/20	80/20	80/20	%	
Flue Gas Recirculation (FGR)							
Installed? (Y/N)		N	N	N	N		
In operation? (Y/N)							
Flue Gas Recirculation (if installed)						%	
Type of Air Heater		Air Preheater Co.	Air Preheater Co.	Ljungstrom	Ljungstrom		
Air Heater Configuration (horizontal or vertical flow or shaft)		Vertical Flow	Vertical Flow	Vertical Flow	Vertical Flow		
Design Pressure/Vacuum Rating for Steam Generator	+/-					in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-					in wg.	
Electrical / Control							
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)		Honeywell	Honeywell	Honeywel	Honeywell		
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)		TC3000			Experion		
Neural Network Installed? (Y/N)		Y	Y	N	N		
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)		Neuco	Neuco				
Extra Capacity available in DCS?		minimal	minimal	minimal	minimal		
Historian Manufacturer		Honeywell	Honeywell	Honeywell	Honeywell		
Additional Controls from DCS or local PLC w/tie-in							
Transformer Rating for Intermediate Voltage Switchgear							
Capacity of Spare Electrical Cubicles in Existing MCC's and LCUS's (SUS's) and Ratings of Equipment in These Cubicles							
Auxiliary Electric Limited (Y/N)		N	N	N	N		
Operating Conditions							
Economizer Outlet Temperature		760	760	690	640	°F	
Economizer Outlet Pressure		-5	-5	-5	-5	in wg.	
Excess Air or Oxygen at Economizer Outlet (full load/min load)		5	5	5	5	%	
Economizer Outlet Gas Flow		1524804	1524804	1958726	2239453	acfm	
		2976508	2976508	4056287	4848440	lb/hr	
Air Heater Outlet Temperature		375	375	325	315	°F	
Air Heater Outlet Pressure		-10	-10	-18	-18	in wg.	
Particulate Control Equipment Outlet Temperature		375	375	325	315	°F	
Particulate Control Equipment Outlet Pressure		-14	-14	-23	-21	in wg.	
FGD Outlet Temperature (if applicable)		133	133	130	130	°F	
FGD Outlet Pressure (if applicable)		1	1	1	1	in wg.	

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Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

NOx Emissions	Unit 1	Unit 2	Unit 3	Unit 4		Notes
Emissions Limit			0.7	0.7	lb/MBtu	
Type of NOx Control (if any) - LNB, OFA etc.	LNB/OFA	LNB/OFA	LNB/SCR	LNB/SCR		
Current NOx Reduction with existing controls			90%	90%	%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)			Anhydrous	Anhydrous		
Reagent Cost			500	500	$/ton	
Current Emissions	0.32	0.32	0.05	0.05	lb/hr	
					ton/yr	
					lb/MBtu	
Particulate Emissions						
Emissions Limit	0.115	0.115	0.105	0.105	lb/MBtu	
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF	Cold Side ESP	Cold Side ESP	Cold Side ESP	Cold Side ESP		
Oxygen Content of Flue Gas @ Air Heater Outlet	4	4	4	4	%	
Oxygen Content of Flue Gas @ ESP/FF Outlet	4	4	4	4	%	
Current Emissions	0.36	0.48	0.05	0.04	lb/MBtu	
Fly Ash Sold (Y/N) - See Economic Section	Y	Y	Y	Y		Very minimal at this point in time
ESP						
Specific Collection Area (SCA)					ft^2/1000 acfm	
Discharge Electrode Type						
Supplier						
Efficiency					%	
No. of Electrical Sections						
% of Fly Ash Sold					%	
Fabric Filter						
Air to Cloth Ratio (net)					ft/min	
Number of Compartments						
Number of Bags per Compartments						
Efficiency					%	
% of Fly Ash Sold					%	
SO_2 Emissions						
Emissions Limit	1.2	1.2	1.2	1.2	lb/MBtu	
Type of Emission Control - wet or semi-dry FGD (if any)	Wet FGD	Wet FGD	Wet FDG	Wet FGD		
Current Emissions	0.47	0.47	0.58	0.47	lb/hr	
					ton/yr	
					lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section						

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

ID Fan Information (at Full Load):	Unit 1	Unit 2	Unit 3	Unit 4		Notes
ID Fan Inlet Pressure	-16	-16.5	-22	-23	in wg.	
ID Fan Discharge Pressure	-2	-1			in wg.	
ID Fan Inlet Temperature	340	340	330	330	F	
Oxygen Content of Flue Gas @ ID Fan Inlet	4	4	4	4	%	
ID Fan Motor Voltage (Rated)	4160	4160	4160	4160	volts	
ID Fan Motor Amps (Operating)	275	275	920	1115	A	
ID Fan Motor Amps (Rated)	320	320	1176		A	
ID Fan Motor Power (Rated)	2500	2500	9000	9500	hp	
ID Fan Motor Service Factor (1.0 or 1.15)	1.15	1.15	1	1.15		
Chimney Information:						
Flue Liner Material	C276	C276	C276	C276		
Flue Diameter	15' 6"	15' 6"	19' 6"	19' 6"	ft	top of liner
Chimney Height	623	623	630	630	ft	
Number of Flues	1	1	1	1		1&2 share a common stack

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)
Plant Arrangement Drawings (showing column row spacing)
CEM Quarterly and Annual Data (required if base emissions are to be verified)
Recent Particulate Emission Test Report (If available)
Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
Underground Utilities Drawings
Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: ____________ Owner: ____________
Unit ____________ Project: ____________

Economic Evaluation Factors:	Unit X	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life					years	
Annual Capacity Factor (over life of study/plant)					%	
Contingency Margin (can be determined by B&V)					%	
Owner Indirects Cost Margin					%	
Interest During Construction					%	
Levelized Fixed Charge Rate or Capital Recovery Factor					%	
Present Worth Discount Rate					%	
Capital Escalation Rate					%	
O&M Escalation Rate					%	
Energy Cost (energy to run in-house equipment)					$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)					$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)					$/MBtu	
					$/ton	
Base Fuel Price					$/MBtu	
					$/ton	
Fuel Price Escalation Rate					%	
Water Cost					$/1,000 gal	
Limestone Cost					$/ton	
Lime Cost					$/ton	
Ammonia Cost					$/ton	
Fully Loaded Labor Rate (per person)					$/year	
Fly Ash Sales					$/ton	
Bottom Ash Sales					$/ton	
FGD Byproduct Sales					$/ton	
Waste Disposal Cost						
Fly Ash					$/ton	
Bottom Ash					$/ton	
Scrubber Waste					$/ton	

Trimble County

Black & Veatch AQCS Information Needs

Power Plant:	Trimble	Owner:	
Unit	TC1 and TC2	Project:	

References:

1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum		Notes
Carbon				%	
Hydrogen				%	
Sulfur				%	
Nitrogen				%	
Oxygen				%	
Chlorine				%	
Ash				%	
Moisture				%	
Total					
Higher Heating Value, Btu/lb (as received)				Btu/lb	
Ash Mineral Analysis (% by mass):					
Silica(SiO_2)				%	
Alumina (Al_2O_3)				%	
Titania (TiO_2)				%	
Phosphorous Pentoxide (P_2O_5)				%	
Calcium Oxide (CaO)				%	
Magnesium Oxide (MgO)				%	
Sodium Oxide (Na_2O)				%	
Iron Oxide (Fe_2O_3)				%	
Sulfur Trioxide (SO_3)				%	
Potassium Oxide (K_2O)				%	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)

Vanadium		%	
Arsenic		%	
Mercury		% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)			
Natural gas line (into the station) capacity (if applicable)			
Current Lost on Ignition (LOI)			
Start-up Fuel			
Ash Fusion Temperature			
Initial Deformation		°F	
Softening		°F	
Hemispherical		°F	
Hardgrove Grindability Index			

Black & Veatch AQCS Information Needs

Power Plant: Trimble
Unit: TC1 and TC2
Owner:
Project:

Plant Size and Operation Data: (provide for each unit)		Unit 1	Unit 2	Unit X	Unit X		Notes
Maximum (Design) Fuel Burn Rate		B&V can determine some values from previous VISTA				MBtu/hr	
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		Tangential	Wallfired				
Boiler Manufacturer		Combustion Engineering	Doosan				
Net MW Rating (specify plant or turbine MW)		turbine 512	760			MW	
Gross MW Rating		547	509			MW	
Net Unit Heat Rate		10372	8662 guarentteed			Btu/kWh	
Net Turbine Heat Rate		gross 8362.53	7066 turbine guarenteed			Btu/kWh	
Boiler SO2 to SO3 Conversion Rate (if known)		NA	0.068 lb/MMBtu less than this at Econ outlet			%	
Fly Ash/Bottom Ash Split		80/20	80/20			%	
Flue Gas Recirculation (FGR)							
Installed? (Y/N)		N	N				
In operation? (Y/N)		N	NA				
Flue Gas Recirculation (if installed)		NA	NA			%	
Type of Air Heater		Regenerative	Regenerative				
Air Heater Configuration (horizontal or vertical flow or shaft)		Vertical 2 layer	Vertical 2 layer				
Design Pressure/Vacuum Rating for Steam Generator	+/-	26.5	24/35 +/- 24 on continuous +/-35 on transient basis			in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-	42 at 100%	25/-6 +/-35 for DESP, PJFF +25/-6			in wg.	
Electrical / Control							
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)		Emerson	Emerson				
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)		Ovation	Ovation				
Neural Network Installed? (Y/N)		N	N				
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)		N/A	N/A				
Extra Capacity available in DCS?		Y	Y				
Historian Manufacturer		Emerson	Emerson				
Additional Controls from DCS or local PLC w/tie-in		Y	Y				
Transformer Rating for Intermediate Voltage Switchgear		100.8 MVA? Need better definintion					
(SUS's) and Ratings of Equipment in These Cubicles		NA					
Auxiliary Electric Limited (Y/N)		N					
Operating Conditions							
Economizer Outlet Temperature		700	586			°F	
Economizer Outlet Pressure		-6				in wg.	
Excess Air or Oxygen at Economizer Outlet (full load/min load)		3	3.2/8.15 25%			%	
Economizer Outlet Gas Flow		N/A	3200333			acfm	
		N/A				lb/hr	
Air Heater Outlet Temperature		600	324			°F	
Air Heater Outlet Pressure		diff 6.5				in wg.	
Particulate Control Equipment Outlet Temperature		N/A	313			°F	
Particulate Control Equipment Outlet Pressure		-0.3				in wg.	
FGD Outlet Temperature (if applicable)		130	12.9 diff			°F	
FGD Outlet Pressure (if applicable)						in wg.	stack draft

Black & Veatch AQCS Information Needs

Power Plant: Trimble Owner:
Unit TC1 and TC2 Project:

	Unit 1	Unit 2	Unit X	Unit X		Notes
NOx Emissions						
Emissions Limit					lb/MBtu	
Type of NOx Control (if any) - LNB, OFA etc.						
Current NOx Reduction with existing controls					%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)						
Reagent Cost					$/ton	
Current Emissions					lb/hr	
					ton/yr	
					lb/MBtu	
Particulate Emissions						
Emissions Limit					lb/MBtu	
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF						
Oxygen Content of Flue Gas @ Air Heater Outlet					%	
Oxygen Content of Flue Gas @ ESP/FF Outlet					%	
Current Emissions					lb/MBtu	
Fly Ash Sold (Y/N) - See Economic Section						
ESP						
Specific Collection Area (SCA)					ft^2/1000 acfm	
Discharge Electrode Type						
Supplier						
Efficiency					%	
No. of Electrical Sections						
% of Fly Ash Sold					%	
Fabric Filter						
Air to Cloth Ratio (net)					ft/min	
Number of Compartments						
Number of Bags per Compartments						
Efficiency					%	
% of Fly Ash Sold					%	
SO_2 Emissions						
Emissions Limit					lb/MBtu	
Type of Emission Control - wet or semi-dry FGD (if any)						
Current Emissions					lb/hr	
					ton/yr	
					lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section						

Black & Veatch AQCS Information Needs

Power Plant: Trimble
Unit: TC1 and TC2
Owner:
Project:

ID Fan Information (at Full Load):	Unit 1	Unit 2	Unit X	Unit X		Notes
ID Fan Inlet Pressure	-0.3	-23.08			in wg.	
ID Fan Discharge Pressure	-0.3	15.77			in wg.	
ID Fan Inlet Temperature	300	313			F	
Oxygen Content of Flue Gas @ ID Fan Inlet	3-6%	4.2-9.2			%	
ID Fan Motor Voltage (Rated)	6600	13200			volts	
ID Fan Motor Amps (Operating)	535	NA			A	
ID Fan Motor Amps (Rated)	740	780			A	
ID Fan Motor Power (Rated)	9000	20241			hp	
ID Fan Motor Service Factor (1.0 or 1.15)	1.15	1.15				
Chimney Information:						
Flue Liner Material	FRP	FRP				
Flue Diameter	18'	18' & 10'			ft	
Chimney Height	754'	754'			ft	
Number of Flues	1	2				

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)
Plant Arrangement Drawings (showing column row spacing)
CEM Quarterly and Annual Data (required if base emissions are to be verified)
Recent Particulate Emission Test Report (If available)
Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
Underground Utilities Drawings
Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: Trimble   Owner:
Unit: TC1 and TC2   Project:

Economic Evaluation Factors:	Unit X	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life					years	
Annual Capacity Factor (over life of study/plant)					%	
Contingency Margin (can be determined by B&V)					%	
Owner Indirects Cost Margin					%	
Interest During Construction					%	
Levelized Fixed Charge Rate or Capital Recovery Factor					%	
Present Worth Discount Rate					%	
Capital Escalation Rate					%	
O&M Escalation Rate					%	
Energy Cost (energy to run in-house equipment)					$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)					$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)					$/MBtu	
					$/ton	
Base Fuel Price					$/MBtu	
					$/ton	
Fuel Price Escalation Rate					%	
Water Cost					$/1,000 gal	
Limestone Cost					$/ton	
Lime Cost					$/ton	
Ammonia Cost					$/ton	
Fully Loaded Labor Rate (per person)					$/year	
Fly Ash Sales					$/ton	
Bottom Ash Sales					$/ton	
FGD Byproduct Sales					$/ton	
Waste Disposal Cost						
Fly Ash					$/ton	
Bottom Ash					$/ton	
Scrubber Waste					$/ton	

Green River

Black & Veatch AQCS Information Needs

Power Plant: Green River Owner:
Unit Project:

References:
1)
2)
3)
4)

Yellow highlight denotes Critical Focus Needs.

Fuel Data

Ultimate Coal Analysis (% by mass as received):	Typical	Minimum	Maximum		Notes
Carbon				%	
Hydrogen				%	
Sulfur				%	
Nitrogen				%	
Oxygen				%	
Chlorine				%	
Ash				%	
Moisture				%	
Total					
Higher Heating Value, Btu/lb (as received)				Btu/lb	
Ash Mineral Analysis (% by mass):					
Silica(SiO_2)				%	
Alumina (Al_2O_3)				%	
Titania (TiO_2)				%	
Phosphorous Pentoxide (P_2O_5)				%	
Calcium Oxide (CaO)				%	
Magnesium Oxide (MgO)				%	
Sodium Oxide (Na_2O)				%	
Iron Oxide (Fe_2O_3)				%	
Sulfur Trioxide (SO_3)				%	
Potassium Oxide (K_2O)				%	

Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)

Vanadium		%	
Arsenic		%	
Mercury		% or ppm	
Other LOI		%	
Natural gas firing capability (if any at all)			
Natural gas line (into the station) capacity (if applicable)			
Current Lost on Ignition (LOI)			
Start-up Fuel			
Ash Fusion Temperature			
Initial Deformation		°F	
Softening		°F	
Hemispherical		°F	
Hardgrove Grindability Index			

Black & Veatch AQCS Information Needs

Power Plant: Green River Owner:
Unit Project:

Plant Size and Operation Data: (provide for each unit)		Unit 3	Unit 4	Unit X	Unit X		Notes
Maximum (Design) Fuel Burn Rate		880	1.2			MBtu/hr	Original Design
Boiler Type (e.g. wall-fired, tangential fired, cyclone)		Wall Fired	Wall Fired				
Boiler Manufacturer		B&W	B&W				
Net MW Rating (specify plant or turbine MW)		71	102			MW	
Gross MW Rating		75	109			MW	
Net Unit Heat Rate		11942	11278			Btu/kWh	
Net Turbine Heat Rate						Btu/kWh	
Boiler SO2 to SO3 Conversion Rate (if known)		Unknown	Unknown			%	
Fly Ash/Bottom Ash Split		80/20	80/20			%	
Flue Gas Recirculation (FGR)		NA	NA				
Installed? (Y/N)							
In operation? (Y/N)		NA	NA				
Flue Gas Recirculation (if installed)		NA	NA			%	
Type of Air Heater		Tubular	Lungstrom				
Air Heater Configuration (horizontal or vertical flow or shaft)		Vertical	Vertical				
Design Pressure/Vacuum Rating for Steam Generator	+/-	-18	-13.3			in wg.	
Design Pressure/Vacuum Rating for Particulate Control	+/-	-18	-13.3			in wg.	
Electrical / Control							
DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)		Honeywell	Honeywell				
Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 3000, etc.)		Experion	Experion				
Neural Network Installed? (Y/N)		N	N				
Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)		NA	NA				
Extra Capacity available in DCS?		Y	Y				
Historian Manufacturer		Honeywell	Honeywell				
Additional Controls from DCS or local PLC w/tie-in		Y Rockwell	Y Rockwell				
Transformer Rating for Intermediate Voltage Switchgear		7.5 MVA	9.375 MVA				
(SUS's) and Ratings of Equipment in These Cubicles		N/A	N/A				
Auxiliary Electric Limited (Y/N)		N	N				
Operating Conditions							
Economizer Outlet Temperature		475	610			°F	
Economizer Outlet Pressure		-5	-6			in wg.	
Excess Air or Oxygen at Economizer Outlet (full load/min load)		25%	25%			%	
Economizer Outlet Gas Flow						acfm	
		510	687			Klb/hr	
Air Heater Outlet Temperature		243	363			°F	
Air Heater Outlet Pressure		-9	-135			in wg.	
Particulate Control Equipment Outlet Temperature		230	600			°F	
Particulate Control Equipment Outlet Pressure		-11	-8.1			in wg.	
FGD Outlet Temperature (if applicable)		NA	NA			°F	
FGD Outlet Pressure (if applicable)		NA	NA			in wg.	

Black & Veatch AQCS Information Needs

Power Plant: Green River
Unit
Owner:
Project:

NOx Emissions	Unit 3	Unit 4	Unit X	Unit X		Notes
Emissions Limit	0.46	0.5			lb/MBtu	
Type of NOx Control (if any) - LNB, OFA, etc.	LNB	LNB				
Current NOx Reduction with existing controls	NA	NA			%	
Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)	NA	NA				
Reagent Cost	NA	NA			$/ton	
Current Emissions					lb/hr	
					ton/yr	
	0.398	0.384			lb/MBtu	

Particulate Emissions	Unit 3	Unit 4	Unit X	Unit X		Notes
Emissions Limit	0.29	0.14			lb/MBtu	
Type of Emission Control - Hot Side ESP, Cold Side ESP or FF	Cold side	Hot side				
Oxygen Content of Flue Gas @ Air Heater Outlet	~5%	~5%			%	
Oxygen Content of Flue Gas @ ESP/FF Outlet	~5%	~5%			%	
Current Emissions	Compliance	Compliance			lb/MBtu	Indirectly measured by Opacity
Fly Ash Sold (Y/N) - See Economic Section	N	N				
ESP						
Specific Collection Area (SCA)					ft^2/1000 acfm	
Discharge Electrode Type	Weighted Wire	Weighted Wire				
Supplier	Buell	Buell				
Efficiency	98.50%	99%			%	
No. of Electrical Sections	6	7				
% of Fly Ash Sold	0	0			%	
Fabric Filter						
Air to Cloth Ratio (net)	NA	NA			ft/min	
Number of Compartments	NA	NA				
Number of Bags per Compartments	NA	NA				
Efficiency	NA	NA			%	
% of Fly Ash Sold	NA	NA			%	

SO_2 Emissions	Unit 3	Unit 4	Unit X	Unit X		Notes
Emissions Limit	4.57	4.57			lb/MBtu	
Type of Emission Control - wet or semi-dry FGD (if any)	NA	NA				
Current Emissions					lb/hr	
	5448	9276			ton/yr	2009 data
					lb/MBtu	
Byproduct Sold (Y/N) - See Economic Section						

Black & Veatch AQCS Information Needs

Power Plant: Green River Owner:
Unit Project:

ID Fan Information (at Full Load):	Unit 3	Unit 4	Unit X	Unit X		Notes
ID Fan Inlet Pressure	-7	-15.5			in wg.	
ID Fan Discharge Pressure	0	-0.24			in wg.	
ID Fan Inlet Temperature	230	365			F	
Oxygen Content of Flue Gas @ ID Fan Inlet	~5%	~5%			%	
ID Fan Motor Voltage (Rated)	2300	2300			volts	
ID Fan Motor Amps (Operating)	105	230			A	
ID Fan Motor Amps (Rated)	98.3	224			A	
ID Fan Motor Power (Rated)	450	1000			hp	
ID Fan Motor Service Factor (1.0 or 1.15)	1	1				
Chimney Information:						
Flue Liner Material	Brick	Brick				
Flue Diameter	12	11			ft	
Chimney Height	198	247			ft	
Number of Flues	1	1				

Drawing and Other Information Needs:

Baseline pollutant emissions data for AQC analysis
Technical evaluations performed to support recent consent decree activity
Existing Plant/AQC system general design and performance issues
Full detailed boiler front, side, and rear elevation drawings
Boiler Design Data (Boiler Data Sheet)
Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)
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Current Mercury Testing Results (If available)
Current Site Arrangement Drawing
Foundation Drawings and/or Soils Report
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Plant One Line Electrical Drawing
Fan Curves for Existing ID Fans (including current system resistance curve)
Acceptable Fan Operating Margins
Plant Outage Schedule
overfire air ports, number of overfire air levels, etc.)

Black & Veatch AQCS Information Needs

Power Plant: Green River Owner: ____

Unit ____ Project: ____

Economic Evaluation Factors:	Unit X	Unit X	Unit X	Unit X		Notes
Remaining Plant Life/Economic Life					years	
Annual Capacity Factor (over life of study/plant)					%	
Contingency Margin (can be determined by B&V)					%	
Owner Indirects Cost Margin					%	
Interest During Construction					%	
Levelized Fixed Charge Rate or Capital Recovery Factor					%	
Present Worth Discount Rate					%	
Capital Escalation Rate					%	
O&M Escalation Rate					%	
Energy Cost (energy to run in-house equipment)					$/MWh	
Replacement Energy Cost (required to be purchased during unit outage)					$/MWh	
Year-by-Year Fuel Prices (over life of study/plant)					$/MBtu	
					$/ton	
Base Fuel Price					$/MBtu	
					$/ton	
Fuel Price Escalation Rate					%	
Water Cost					$/1,000 gal	
Limestone Cost					$/ton	
Lime Cost					$/ton	
Ammonia Cost					$/ton	
Fully Loaded Labor Rate (per person)					$/year	
Fly Ash Sales					$/ton	
Bottom Ash Sales					$/ton	
FGD Byproduct Sales					$/ton	
Waste Disposal Cost						
Fly Ash					$/ton	
Bottom Ash					$/ton	
Scrubber Waste					$/ton	

Appendix C
Project Design Memorandum (Design Basis)

EON
EW Brown, Ghent, Cane Run, Mill Creek, Trimble County, Green River
Design Basis
6/1/2010

Unit Designation	EW Brown			Ghent				Cane Run			Mill Creek				Trimble County		Green River		
	1	2	3	1	2	3	4	4	5	6	1	2	3	4	1	2	3	4	Reference
Ultimate Coal analysis, wet basis																			
Carbon, %	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	61.20	65.41	65.41	Data from E-ON
Hydrogen, %	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.46	4.46	Data from E-ON
Sulfur, %	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	2.60	2.60	Data from E-ON
Nitrogen, %	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.34	1.34	Data from E-ON
Chlorine, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Data from E-ON
Oxygen, %	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.69	6.69	Data from E-ON
Ash, %	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	9.00	9.00	Data from E-ON
Moisture, %	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	10.50	10.50	Data from E-ON
Higher Heating Value, Btu/lb	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,600	11,600	Data from E-ON
Trace Metal Analysis, ppm																			
Antimony (Sb)	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.07	1.07	Data from E-ON
Arsenic (As)	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	10.00	10.00	Data from E-ON
Barium (Ba)	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	49.00	49.00	Data from E-ON
Cadmium (Cd)	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.30	0.30	Data from E-ON
Chlorine (Cl)	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1845.00	1845.00	Data from E-ON
Chromium (Cr)	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	17.00	17.00	Data from E-ON
Fluorine (F)	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	71.00	71.00	Data from E-ON
Lead (Pb)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	Data from E-ON
Magnesium (Mg)	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	684.00	509.00	509.00	Data from E-ON
Mercury (Hg)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.10	Data from E-ON
Nickel (Ni)	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	14.00	14.00	Data from E-ON
Selenium (Se)	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	1.93	1.93	Data from E-ON
Strontium (Sr)	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00	30.00	30.00	Data from E-ON
Vanadium (V)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	Data from E-ON
Zinc (Zn)	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	50.00	50.00	Data from E-ON
Ash Analysis, % by mass																			
Alumina (Al2O3)	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	21.69	19.45	19.45	Data from E-ON
Barium Oxide (BaO)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	Data from E-ON
Lime (CaO)	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.89	2.89	Data from E-ON
Iron Oxide (Fe2O3)	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	21.80	19.90	19.90	Data from E-ON
Magnesia (MgO)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	Data from E-ON
Manganese Oxide (MnO)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	Data from E-ON
Phosphorous Pentoxide (P2O5)	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.21	0.21	Data from E-ON
Potassium Oxide (K2O)	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.41	2.41	Data from E-ON
Silica (SiO2)	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	45.88	49.65	49.05	Data from E-ON
Sodium Oxide (Na2O)	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.77	0.77	Data from E-ON
Strontium Oxide (SrO)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	Data from E-ON
Sulfur Trioxide (SO3)	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.47	2.47	Data from E-ON
Titania (TiO2)	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.08	1.08	Data from E-ON
Undetermined	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	Data from E-ON
Unit Characteristics																			
Gross Turbine Generator Load, MW	110	180	457	541	517	523	526	168	181	281	330	330	423	525	547	760	75	109	Data from E-ON
Boiler Efficiency, % (HHV)	85.32	86.73	86.53	85.74	86.83	86.31	86.77	85.12	87.14	87.09	85.40	85.40	86.51	86.51	86.88	86.92	89.02	85.25	Data from E-ON
Boiler Heat Input, MBtu/hr (HHV)	999.80	1,665.50	4,120.43	5,369	4,327	5,496	5,473	1,603	1,757	2,589	3,224	3,311	4,209	5,122	5,310	6,583	848	1,150	Data from E-ON
Coal Flow Rate, lb/hr	89,268	148,705	367,895	479,375	386,339	490,714	488,661	143,125	156,875	231,161	287,857	295,625	375,804	457,321	474,107	587,768	73,103	99,138	Data from E-ON
Capacity Factor, %	44.00	62.00	57.00	81.00	71.00	78.00	77.00	60.00	62.00	54.00	68.00	73.00	75.00	75.00	85.00	87.00	26.00	32.00	Data from E-ON
Fly Ash Portion of Total Ash, %	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	Data from E-ON
Air Heater Leakage, %	10.0	10.0	10.0	10.0	10.0	10.0	10.0	16.7	17.0	7.8	10.0	10.0	10.0	10.0	10.0	6.0	6.8	6.8	Data from E-ON
Excess Air, %	34.352	18.258	16.848	18.258	21.926	21.926	20.433	20.00	20.00	20.00	20.00	20.00	20.00	20.00	18.258	19.700	25.000	25.000	Data from E-ON
Economizer Outlet Conditions																			
Flue Gas Temperature, F	650	730	730	729	610	731	791	580	630	617	760	760	690	640	700	586	475	610	B&V Combustion Calculations
Flue Gas Pressure, in. w.g.	-8.0	-3.7	-5.0	-3.2	-5.1	-5.1	-4.5	-4.0	-3.0	-4.0	-5.0	-5.0	-5.0	-5.0	-6.0	-6.0	-5.0	-6.0	B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	1,090,927	1,615,221	3,952,267	5,206,933	4,316,060	5,482,104	5,397,559	1,575,668	1,727,042	2,544,856	3,169,029	3,254,545	4,137,234	5,034,667	5,149,714	6,455,853	886,785	1,202,598	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm	509,072	796,739	1,955,176	2,563,081	1,922,533	2,718,161	2,805,958	680,015	779,254	1,137,376	1,608,445	1,651,849	1,979,343	2,303,938	2,490,348	2,816,034	345,095	536,927	B&V Combustion Calculations
Uncontrolled Sulfur Dioxide Concentration, lb/MBtu	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	4.48	4.48	= % Sulfur in Coal x 20,000 / HHV
Uncontrolled Sulfur Dioxide Mass Flow Rate, lb/hr	5,993	9,983	24,697	32,161	25,936	32,942	32,805	9,608	10,531	15,518	19,324	19,846	25,228	30,701	31,828	39,459	3,798	5,150	B&V Combustion Calculations
Uncontrolled PM Concentration, lb/MBtu	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	8.746	6.334	6.334	B&V Combustion Calculations
Uncontrolled PM Mass Flow Rate, lb/hr	8,744	14,566	36,037	46,957	37,844	48,068	47,867	14,020	15,367	22,643	28,197	28,958	36,812	44,797	46,441	57,575	5,371	7,284	= Uncontrolled PM (lb/MBtu) x Heat Input (MBtu/hr)
Uncontrolled Mercury Concentration, lb/TBtu	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	8.62	8.62	= Hg in Coal (ppm) x Coal Flow Rate (lb/hr) / Heat Input (MBtu/hr)
Uncontrolled HCl Mass Flow Rate, lb/hr	147	244.63	605.21	789	636	807	804	235	258	380	474	486	618	752	780	967	139	188	= HCl in Coal (ppm) / 1,000,000 x Coal Flow Rate (lb/hr) x MW of HCl / MW of Cl
Uncontrolled HCl Concentration, lb/MBtu	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16	= HCl Flowrate (lb/hr) / Heat Input (MBtu/hr)
Hot-Side ESP Outlet Conditions																			
Flue Gas Temperature, F					605	708	770											600	B&V Combustion Calculations
Flue Gas Pressure, in. w.g.					-10.80	-10.90	-10.8											-8.1	B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	4,531,863	5,756,209	5,667,437	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	**No Hot-side ESP. Unit has a Cold-side ESP**	1,262,728	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm					2,041,027	2,843,960	2,947,083											562,236	B&V Combustion Calculations
Controlled PM Concentration, lb/MBtu					0.0565	0.0451	0.0248											0.08	B&V Combustion Calculations
Controlled PM Mass Flow Rate, lb/hr					244	248	135.73											92	= Controlled PM (lb/MBtu) x Heat Input (MBtu/hr)
Particulate Removal Efficiency, %					99.35	99.48	99.72											98.74	= { 1- Controlled PM (lb/MBtu) / Uncontrolled PM (lb/MBtu) } x 100
SCR Outlet Conditions																			
Flue Gas Temperature, F				729		708	770						690	640	700	586			B&V Combustion Calculations
Flue Gas Pressure, in. w.g.				-13.2		-20.90	-20.8						-13.0	-13.0	-16.0	-11.0			B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	**No SCR**	**No SCR**	**New SCR Planned for 2012**	5,311,071	**No SCR**	5,871,333	5,780,766	**No SCR**	**No SCR**	**No SCR**	**No SCR**	**No SCR**	4,219,979	5,135,360	5,252,708	6,584,970	**No SCR**	**No SCR**	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm				2,682,371		2,977,658	3,085,629						2,061,162	2,399,175	2,606,716	2,910,365			B&V Combustion Calculations
Controlled NOx Concentration, lb/MBtu				0.0639		0.0479	0.0627						0.0584	0.0589	0.076	0.076			Data from E-ON
Controlled NOx Mass Flow Rate, lb/hr				343		263	343						246	302	404	500			= Controlled NOx (lb/MBtu) x Heat Input (MBtu/hr)
Air Heater Outlet Conditions																			
Flue Gas Temperature, F	350	330	340	361	309	322	309	369	299	318	375	375	330	330	320	324	243	363	B&V Combustion Calculations
Flue Gas Pressure, in. w.g.	-14.00	-8.00	-16.00	-22.4	-18.60	-36.10	-29.4	-8.0	-6.0	-8.0	-10.0	-10.0	-18.0	-18.0	-22.5	-16.0	-9.0	-13.5	B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	1,200,020	1,776,743	4,347,494	5,842,179	4,985,049	6,458,467	6,358,865	1,839,262	2,021,310	2,744,081	3,485,932	3,580,000	4,641,976	5,648,896	5,777,979	6,380,068	947,426	1,349,377	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm	415,851	589,646	1,498,187	2,091,568	1,657,754	2,288,309	2,175,592	641,787	642,552	896,674	1,229,416	1,262,592	1,581,582	1,924,653	1,965,750	2,345,528	280,496	473,593	B&V Combustion Calculations
Cold-Side ESP Outlet Conditions																			
Flue Gas Temperature, F	340	320	330	358				369	299	318	340	340	330	330	320	324	230		B&V Combustion Calculations
Flue Gas Pressure, in. w.g.	-18.00	-12.00	-19.00	-25.7				-9.1	-6.8	-9.8	-14.0	-14.0	-23.0	-21.0	-25.5	-18.0	-11.0		B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	1,260,021	1,865,580	4,564,869	6,134,288	**No Cold-side ESP. Unit has a Hot-side ESP**	**No Cold-side ESP. Unit has a Hot-side ESP**	**No Cold-side ESP. Unit has a Hot-side ESP**	1,931,225	2,122,376	2,881,285	3,660,228	3,759,000	4,874,075	5,931,341	6,066,878	7,398,872	994,797	**No Cold-side ESP. Unit has a Hot-side ESP**	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm	436,197	618,296	1,559,510	2,209,920				676,568	676,855	947,034	1,250,977	1,284,735	1,684,442	2,039,199	2,082,968	2,502,995	290,916		B&V Combustion Calculations
Controlled PM Concentration, lb/MBtu	0.241	0.1	0.1	0.023				0.041	0.034	0.024	0.0385	0.0443	0.0517	0.0354	0.017	0.31	0.063		Data from E-ON
Controlled PM Mass Flow Rate, lb/hr	241	166.55	412.04	123				66	60	62	124	147	218	181	90	2041	53		= Controlled PM (lb/MBtu) x Heat Input (MBtu/hr)
Particulate Removal Efficiency, %	97.24	98.86	98.86	99.74				99.53	99.61	99.73	99.56	99.49	99.41	99.60	99.81	96.46	99.01		= { 1- Controlled PM (lb/MBtu) / Uncontrolled PM (lb/MBtu) } x 100
Fabric Filter Outlet Conditions																			
Flue Gas Temperature, F																313			B&V Combustion Calculations
Flue Gas Pressure, in. w.g.																-23.1			B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	**No Fabric Filter**	7,398,872	**No Fabric Filter**	**No Fabric Filter**	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm																2,500,664			B&V Combustion Calculations
Controlled PM Concentration, lb/MBtu																0.015			Data from E-ON
Controlled PM Mass Flow Rate, lb/hr																99			= Controlled PM from fabric Filter (lb/MBtu) x Heat Input (MBtu/hr)
Particulate Removal Efficiency, %																95.16			= { 1- FF Controlled PM (lb/MBtu) / ESP Controlled PM (lb/MBtu) } x 100
ID Fan Outlet Conditions																			
Flue Gas Temperature, F	356.05	332.17	346.44	376.94	325.52	346.34	333.60	379.03	306.39	327.81	354.85	355.15	348.83	348.83	340.08	334.60	235.91	371.55	B&V Combustion Calculations
Flue Gas Pressure, in. w.g.	10.00	10.00	10.00	6.10	11.40	5.90	14.60	8.00	7.00	8.00	10.00	10.00	10.00	10.00	10.00	15.77	1.00	1.00	B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	1,260,021	1,865,580	4,564,869	6,134,288	4,985,049	6,458,467	6,358,865	1,931,225	2,122,376	2,881,285	3,660,228	3,759,000	4,874,075	5,931,341	6,066,878	7,398,872	994,797	1,349,377	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm	415,059	594,805	1,481,211	2,086,965	1,571,913	2,119,437	2,010,799	656,526	660,654	917,824	1,200,841	1,233,697	1,598,066	1,932,543	1,954,644	2,334,113	284,775	461,503	B&V Combustion Calculations

EON
EW Brown, Ghent, Cane Run, Mill Creek, Trimble County, Green River
Design Basis
6/1/2010

Unit Designation	EW Brown			Ghent				Cane Run			Mill Creek				Trimble County		Green River		Reference
	1	2	3	1	2	3	4	4	5	6	1	2	3	4	1	2	3	4	
Scrubber Outlet Conditions	(For 3 units combined to a common/shared scrubber)																		
Flue Gas Temperature, F	129.64			131.74	128.04	129.28	128.50	131.19	125.96	128.80	130.30	130.32	129.60	129.60	129.24	129.43	No Scrubber	No Scrubber	B&V Combustion Calculations
Flue Gas Pressure, in. w.g.	2.00			1.70	1.50	2.00	1.60	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	6.00			B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr	8,136,097			6,534,149	5,252,980	6,834,132	6,711,801	2,056,206	2,226,116	3,036,144	3,879,298	3,984,228	5,157,618	6,277,442	6,413,722	7,813,543			B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm	2,029,766			1,643,977	1,306,064	1,705,743	1,671,656	517,157	550,120	754,452	972,502	998,878	1,291,025	1,571,359	1,598,535	1,927,087			B&V Combustion Calculations
Controlled Sulfur Dioxide Mass Flow Rate, lb/hr	679			805	865	824	821	659	736	1,750	1,515	1,556	2,441	2,407	441	546			B&V Combustion Calculations
Controlled Sulfur Dioxide Concentration, lb/MBtu	0.10			0.150	0.200	0.150	0.150	0.411	0.419	0.676	0.47	0.47	0.58	0.47	0.083	0.083			= Controlled SO_2 (lb/hr) / Heat Input (MBtu/hr)
Sulfur Dioxide Removal Efficiency, %	98.33			97.50	96.67	97.50	97.50	93.15	93.02	88.73	92.17	92.17	90.33	92.17	98.62	98.62			= { 1- Controlled SO_2 (lb/MBtu) / Uncontrolled SO_2 (lb/MBtu) } x 100
Wet ESP Outlet Conditions	No WESP			No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP	No WESP		No WESP	No WESP	
Flue Gas Temperature, F																129.43			B&V Combustion Calculations
Flue Gas Pressure, in. w.g.																2.00			B&V Combustion Calculations
Flue Gas Mass Flow Rate, lb/hr																7,813,543			B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm																1,945,943			B&V Combustion Calculations
Stack Outlet Emissions[1]																			
Sulfur Dioxide Emission Concentration, lb/MBtu	0.10	0.10	0.10	0.15	0.20	0.15	0.15	0.411	0.419	0.676	0.47	0.47	0.58	0.47	0.083	0.083	4.48	4.48	Data from E-ON
Sulfur Dioxide Emission Rate, lb/hr	100	167	412	805	865	824	821	659	736	1,750	1,515	1,556	2,441	2,407	441	546	3,798	5,150	= SO_2 Emission (lb/MBtu) x Heat Input (MBtu/hr)
PM Emission Concentration, lb/MBtu	0.241	0.1	0.1	0.023	0.0565	0.0451	0.0248	0.041	0.034	0.024	0.0385	0.0443	0.0517	0.0354	0.017	0.015	0.063	0.08	Data from E-ON
PM Emission Rate, lb/hr	241	167	412	123	244	248	136	66	60	62	124	147	218	181	90	99	53	92	= PM Emission (lb/MBtu) x Heat Input (MBtu/hr)
NOx Emission Concentration, lb/MBtu	0.4463	0.4374	0.3319	0.0639	0.276	0.0479	0.0627	0.3394	0.3843	0.272	0.3169	0.3139	0.0584	0.0589	0.076	0.076	0.4011	0.3864	Data from E-ON
NOx Emission Rate, lb/hr	446	728	1,368	343	1,194	263	343	544	675	704	1,022	1,039	246	302	404	500	340	444	= NOx Emission (lb/MBtu) x Heat Input (MBtu/hr)
Hg Emission Concentration, lb/TBtu	5.0	5.0	5.0	2.0	3.5	2.0	2.0	3.5	3.5	3.5	3.0	3.0	2.5	2.5	1.2	1.0	5.5	5.5	Data from E-ON
Hg Emission Rate, lb/hr	5.00E-03	8.33E-03	2.06E-02	1.07E-02	1.51E-02	1.10E-02	1.09E-02	5.61E-03	6.15E-03	9.06E-03	9.67E-03	9.93E-03	1.05E-02	1.28E-02	6.37E-03	6.58E-03	4.66E-03	6.33E-03	= Hg Emission (lb/TBtu) x Heat Input (MBtu/hr) / 1,000,000
HCl Emission Concentration, lb/MBtu	0.002	0.002	0.002	0.0015	0.0017	0.0015	0.0015	0.00095	0.00095	0.00095	0.0015	0.0015	0.0015	0.0015	0.00085	0.00085	0.017	0.017	Data from E-ON
HCl Emission Rate, lb/hr	2	3	8	8	7	8	8	2	2	2	5	5	6	8	5	6	14	20	= HCl Emission (lb/MBtu) x Heat Input (MBtu/hr)
CO Emission Concentration, lb/MBtu	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	CO Emissions are not known
CO Emission Rate, lb/hr	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	CO Emissions are not known
Dioxin/Furan Emission Concentration, lb/MBtu	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Dioxin/Furan Emissions are not known
Dioxin/Furan Emission Rate, lb/hr	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Dioxin/Furan Emissions are not known

Notes:
1. Current Outlet Emissions as noted in E-ON Matrix

Revision History:

Rev	Date	Description
0	5/21/2010	Initial Issue
1	6/1/2010	Final Issue

Appendix D
Air Quality Control Technology Descriptions

CONTROL TECHNOLOGY DESCRIPTIONS

NO_x Reduction Technologies

Low NO_x Burners (LNB)

The new-generation LNB have better NO_x removal performance than the first-generation LNB and are a fundamental component of the boiler design. The term ultra-low NO_x burners applies only to gas fired applications and does not apply to coal fired boilers.

LNB control the mixing of fuel and air in a pattern designed to minimize flame temperatures and quickly dissipate heat. These burners typically reduce NO_x by maintaining a reducing atmosphere at the coal nozzle and diverting additional combustion air (to complete combustion) to secondary air registers. This minimizes the reaction time at oxygen-rich, high-temperature conditions. Conventional burners, however, typically mix the secondary air with the primary air/fuel stream immediately following injection into the furnace, creating a high intensity combustion process.

Wall mounted LNB are typically a multiple-register (damper) type with two separate secondary airflow paths through the burner and into the furnace. Common features include dedicated total secondary airflow control dampers and separate dedicated dampers or vanes to control the flow and spin of the individual secondary airflows through the burner. The vanes that control spin or flame shape are typically set during initial startup and then locked in place.

Control and balancing of the secondary air, primary air, and coal distribution among the burners is a basic requirement of all manufacturers. Typical allowable flow deviations from the mean are 10 percent for individual burner air and coal flows. This requirement may necessitate changes in operating procedures related to individual burner level turn down at part load. Conversely, additional control provisions and flow monitoring capability is required to preserve the option to operate with unbalanced firing at part load.

The basic NO_x reduction principles for LNB are to control and balance the fuel and air flow to each burner, and to control the amount and position of secondary air in the burner zone so that fuel devolatization and high-temperature zones are not oxygen rich. Figure D-1 shows the low NOx burners

Low NO_X Burner Systems

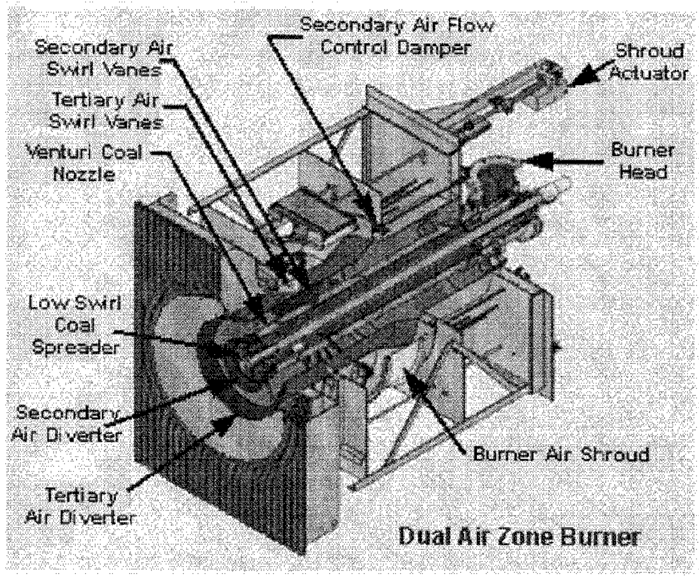

Figure D-1
Low NO_X Burners (Courtesy: DB Riley)

Overfire Air (OFA)

OFA is an air staging NO_X reduction technique that is based on withholding 15 to 20 percent of the total combustion air conventionally supplied to the high temperature zone of the furnace. OFA can be used in conjunction with the LNB system. Unburned carbon and combustible materials may increase as a result of the addition of OFA because of the staging of the combustion process.

With the installation of an OFA system, the main combustion burners are operated at or near stoichiometric ratio to limit available oxygen, flame temperature, and NO_X formation. The remainder of the combustion air is then injected through the OFA ports to complete combustion. The quantity of OFA introduced is sufficient to increase the overall excess air in the boiler to 15 to 20 percent to ensure complete combustion and maintain flue gas flow through the convective sections of the boiler.

OFA systems reduce NO_X formation by creating a fuel rich combustion zone. The OFA is introduced above the main combustion zone (fuel is introduced in an oxygen-starved environment) where fuel burnout can be completed at a lower temperature with fewer volatile nitrogen-bearing combustion products.

The OFA ports will be designed to allow adequate mixing of the combustion air and flue gas and with sufficient temperatures and residence times to ensure complete combustion to achieve optimum NO_x reductions. The location of the OFA ports is critical in achieving optimum NO_x reductions without affecting unburned carbon losses. Figure D-2 shows the overfire air

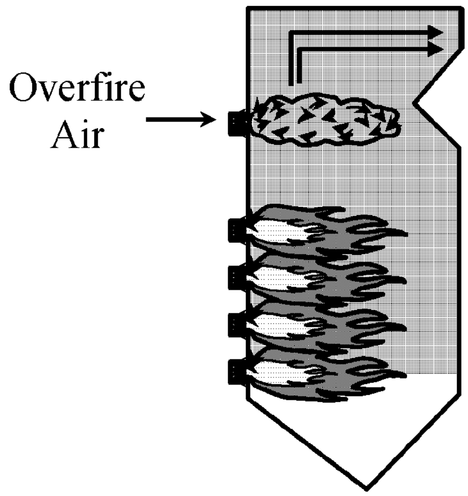

Figure D-2
Overfire Air System

Selective Noncatalytic Reduction System (SNCR)

Selective non-catalytic NO_x reduction systems rely on the appropriate reagent injection temperature and good reagent/gas mixing rather than a catalyst to achieve NO_x reductions. SNCR systems can use either ammonia (Thermal DeNO_x) or urea (NO_xOUT) as reagents.

The optimum temperature range for injection of ammonia or urea is 1,550 to 1,900° F. The NO_x reduction efficiency of an SNCR system decreases rapidly at temperatures outside this range. Injection of reagent below this temperature window results in excessive ammonia slip emissions. Injection of reagent above this temperature window results in increased NO_x emissions. A PC boiler operates at temperatures of between 2,500 and 3,000° F. Therefore, the optimum temperature window in a PC boiler occurs somewhere in the backpass of the boiler. To further complicate matters, this temperature location will change as a function of unit load. In addition, residence times in this temperature range are very limited, further detracting from optimum SNCR performance. Finally, there is no provision for feedforward control of reagent injection, relying only on feedback control. This results in over injection of reagent and high ammonia slip emissions.

SNCR systems are less efficient NO_x reduction systems than SCR systems. In general, SNCR systems on large PC-fired boilers will be capable of only up to 50 percent NO_x reduction. Figure D-3 shows a schematic of SNCR system.

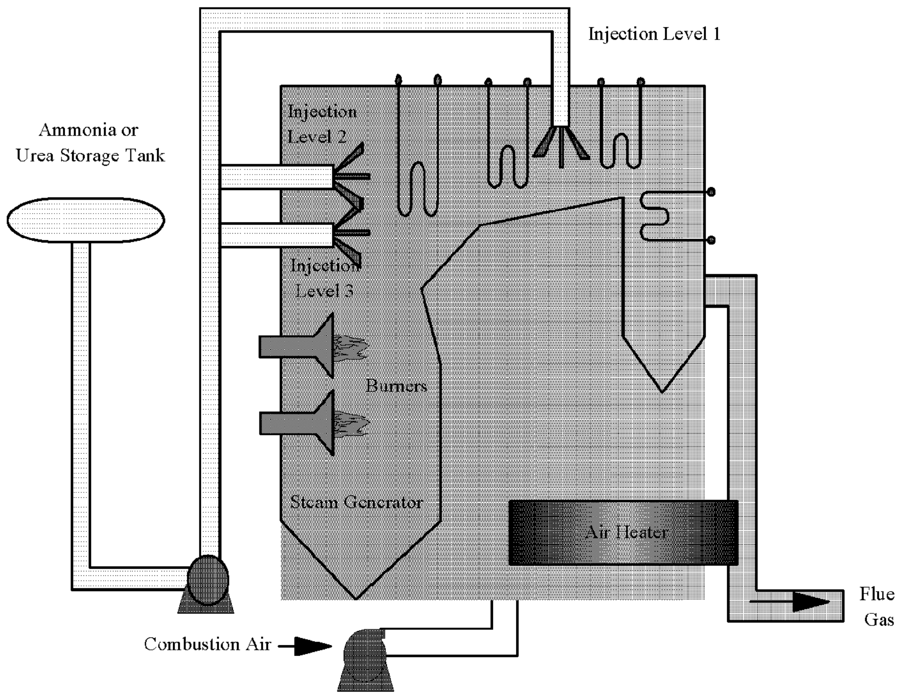

Figure D-3
Schematic of SNCR System with Multiple Injection Levels

Selective Catalytic Reduction System (SCR)

In an SCR system, ammonia is injected into the flue gas stream just upstream of a catalytic reactor. The ammonia molecules in the presence of the catalyst dissociate a significant portion of the NO_x into nitrogen and water.

The aqueous ammonia is received and stored as a liquid. The ammonia is vaporized and subsequently injected into the flue gas by compressed air or steam as a carrier. Injection of the ammonia must occur at temperatures above 600° F to avoid chemical reactions that are significant and operationally harmful. Catalyst and other considerations limit the maximum SCR system operating temperature to 840° F. Therefore, the system is typically located between the economizer outlet and the air heater inlet. The SCR catalyst is housed in a reactor vessel, which is separate from the boiler. The conventional SCR catalysts are either homogeneous ceramic or metal substrate coated. The catalyst composition is vanadium-based, with titanium included to disperse the vanadium catalyst and tungsten added to minimize adverse SO_2 and SO_3 oxidation reactions. An economizer bypass may be required to maintain the reactor temperature during low load operation. This will reduce boiler efficiency at lower loads.

The SCR process is a complex system. The SCR requires precise NO_x-to-ammonia distribution in the presence of the active catalyst site to achieve current BACT levels. In the past, removal efficiencies were the measure of catalyst systems because of extremely high inlet NO_x levels. Current technology SCR systems do not use removal efficiency as a primary metric because the current generation of LNB/OFA systems limits the amount of NO_x available for removal. Essentially, as NO_x is removed through the initial layers of catalyst, the remaining layers have difficulty sustaining the reaction.

A number of alkali metals and trace elements (especially arsenic) poison the catalyst, significantly affecting reactivity and life. Other elements such as sodium, potassium, and zinc can also poison the catalyst by neutralizing the active catalyst sites. Poisoning of the catalyst does not occur instantaneously, but is a continual steady process that occurs over the life of the catalyst. As the catalyst becomes deactivated, ammonia slip emissions increase, approaching design values. As a result, catalyst in a SCR system is consumable, requiring periodic replacement at a frequency dependent on the level of catalyst poisoning. However, effective catalyst management plans can be implemented that significantly reduce catalyst replacement requirements.

There are two SCR system configurations that can be considered for application on pulverized coal boilers: high dust and tail end. A high dust application locates the SCR system before the particulate collection equipment, typically between the economizer outlet and the air heater inlet. A tail end application locates the catalyst downstream of the particulate and FGD control equipment.

The high dust application requires the SCR system to be located between the economizer outlet and the air heater inlet in order to achieve the required optimum SCR operating temperature of approximately 600° to 800° F. This system is subject to high levels of trace elements and other flue gas constituents that poison the catalyst, as previously noted. The tail end application of SCR would locate the catalyst downstream of the particulate control and FGD equipment. Less catalyst volume is needed for the tail end application, since the majority of the particulate and SO_2 (including the trace elements that poison the catalyst) have been removed. However, a major disadvantage of this alternative is a requirement for a gas-to-gas reheater and supplemental fuel firing to achieve sufficient flue gas operating temperatures downstream of the FGD operating at approximately 125° F. The required gas-to-gas reheater and supplemental firing necessary to raise the flue gas to the sufficient operating temperature is costly. The higher front end capital costs and annual operating cost for the tail end systems present higher overall costs compared to the high dust SCR option with no established emissions control efficiency advantage. Figure D-4 shows a schematic diagram of SCR.

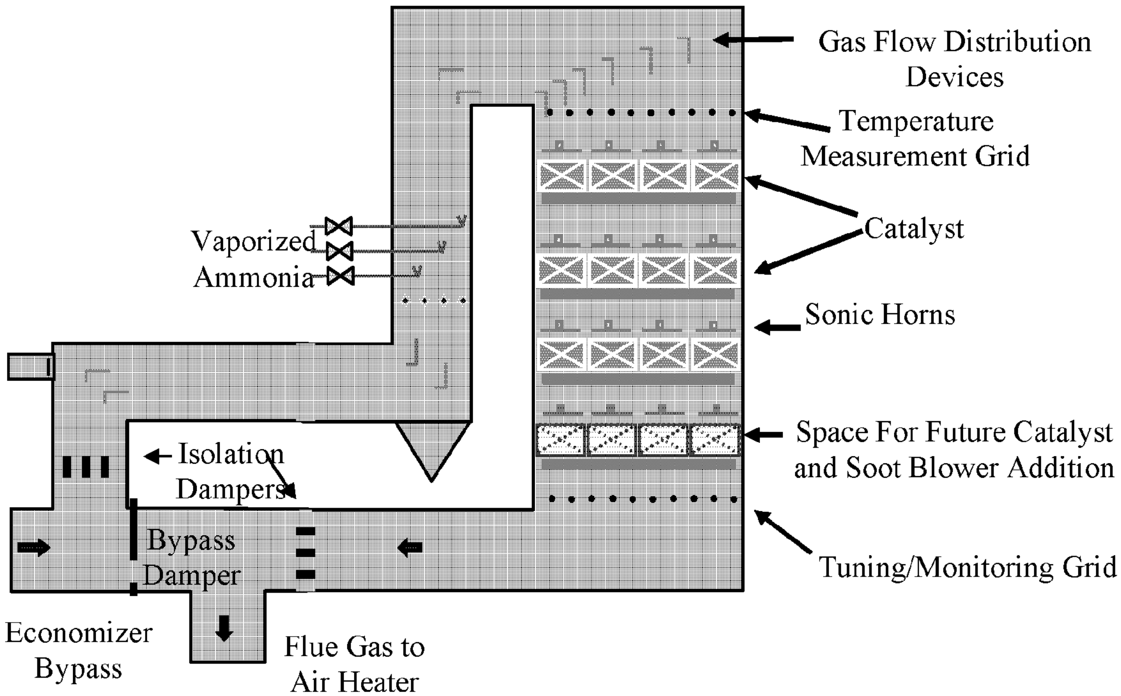

Figure D-4
Schematic Diagram of a Typical SCR Reactor

SNCR/SCR Hybrid System

The SNCR/SCR hybrid system uses components and operating characteristics of both SNCR and SCR systems. Hybrid systems were developed to combine the low capital cost and potential for high NH_3 slip associated with SNCR systems with the high reduction potential and low NH_3 slip inherent with catalyst based SCR systems. The result is an NO_x reduction alternative that can meet initial NO_x reduction requirements but can be upgraded to meet higher reductions at a future date, if required. Typically, installation of an SCR system with a single layer of in-duct catalyst is capable of reducing NO_x emissions from 40 to 70 percent, depending on the amount of NH_3 slip from the SCR and the volume of the single layer of catalyst.

The SNCR component of the hybrid system is identical to the SNCR system, except that the hybrid system may have more levels of multiple lance nozzles for reagent injection. This will increase the capital cost of the SNCR component of the hybrid system. During operation, the SNCR system would inject higher amounts of reagent into the flue gas. This increased reagent flow has a two-fold effect: NO_x reduction within the boiler is increased while NH_3 slip is also increased. The NH_3 that slips from the SNCR is then used as the reagent for the single layer of catalyst.

There are two design philosophies for using this excess NH_3 slip. The most conservative hybrid systems will use the catalyst simply as an NH_3 slip "scrubber" with some additional NO_x reduction. Similar to in-duct systems, the flue gas velocity through the catalyst is an important factor in design. Operating in this mode allows maximum NO_x reduction within the boiler by the SNCR while minimizing the catalyst volume requirement. While some NO_x reduction is achieved at the catalyst, the relatively small catalyst requirement of this design has the potential to fit all the catalyst in a true in-duct arrangement, with no significant ductwork changes, arrangement interference, or structural adaptations.

The second philosophy uses adequate catalyst volume to obtain significant levels of additional NO_x reduction. The additional reduction is a function of the quantity of NH_3 slip, the catalyst volume, and the distribution of NH_3 to NO_x within the flue gas. Using NH_3 slip that is produced by the SNCR system is not a high efficiency method of introducing reagent, due to the low reagent utilization. Therefore, even though the reaction at the catalyst requires 1 ppm of NH_3 to remove 1 ppm of NO_x, the SNCR must inject at least 3 ppm of NH_3 to generate 1 ppm of NH_3 at the catalyst.

Catalyst volume is strongly influenced by the NO_x reduction required and the NH_3 distribution. The impact of catalyst volume on the design of a hybrid system is on the size of the reactor required to hold the catalyst. If multiple levels of catalyst operating at low flue gas velocity are required, some modifications will be required to the typical ductwork. If widening the ductwork cannot provide for adequate catalyst volume, then a separate reactor is required, which quickly negates the capital cost advantage of a hybrid system. Figure D-5 represents a schematic diagram of a typical SNCR/SCR Hybrid system.

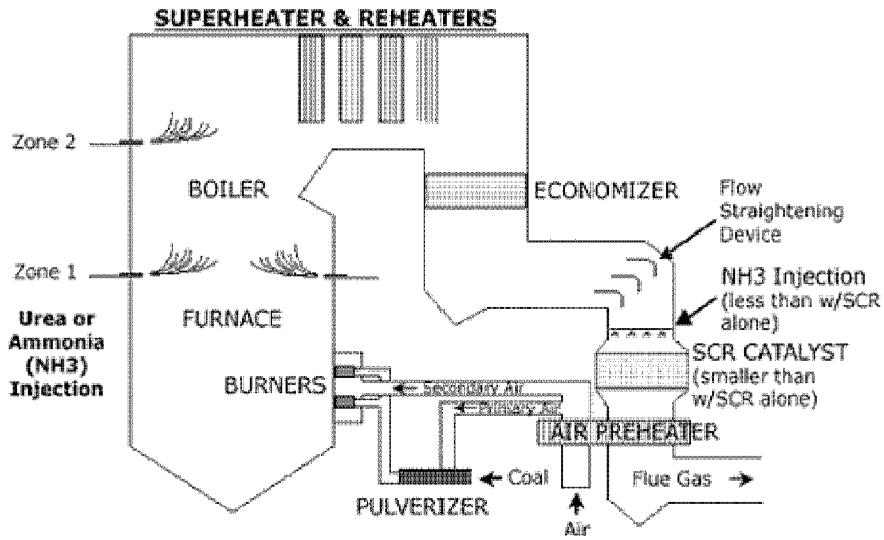

Figure D-5
Schematic Diagram of a Typical SNCR/SCR Hybrid System (Courtesy: Clean Environmental Protection Engineering Co. Ltd.)

SO_2 and HCl Reduction Technologies

Wet Flue Gas Desulfurization (FGD) System

Wet limestone-based FGD processes are frequently applied to pulverized coal fired boilers that burns medium-to-high sulfur eastern coals. All of the FGD systems installed in response to Phase I of the 1990 CAA were based on a wet FGD system using either lime or limestone as the reagent. Typically, the wet FGD processes on a pulverized coal facility are characterized by high efficiency (> 98 percent) and high reagent utilization (95 to 97 percent) when combined with a high sulfur fuel. The ability to realize high removal efficiencies on higher sulfur fuels is a major difference between wet scrubbers and semi-dry/dry FGD processes. It is well known that SO_2 removal efficiencies for wet FGD systems are generally higher for high sulfur coal applications than for low sulfur coal applications, for the fundamental physical reason that the chemical reactions that remove SO_2 are faster if the inlet SO_2 concentration is higher. The absolute emissions level becomes a limiting factor due to a reduction in the chemical driving forces of the reactions that are occurring. Thus, the calculated removal efficiency of the various types of wet scrubbers declines as the fuel sulfur content decreases; this is the case for low sulfur western and PRB coals.

In a wet FGD system, the absorber module is located downstream of the induced draft (ID) fans (or booster ID fans, if required). Flue gas enters the module and is contacted with a slurry containing reagent and byproduct solids. The SO_2 is absorbed into the slurry and reacts with the calcium to form $CaSO_3 \bullet 1/2H_2O$ and $CaSO_4 \bullet 2H_2O$. SO_2 reacts with limestone reagent through the following overall reactions:

$$SO_2 + CaCO_3 + \frac{1}{2}H_2O \rightarrow CaSO_3 \bullet \frac{1}{2}H_2O + CO_2$$

$$SO_2 + CaCO_3 + 2H_2O + \frac{1}{2}O_2 \rightarrow CaSO_4 \bullet 2H_2O + CO_2$$

The flue gas leaving the absorber will be saturated with water, and the stack will have a visible moisture plume. Because of the chlorides present in the mist carry-over from the absorber and the pools of low pH condensate that can develop, the conditions downstream of the absorber are highly corrosive to most materials of construction. Highly corrosion-resistant materials are required for the downstream ductwork and the flue stack. Careful design of the stack is needed to prevent the "rainout" from condensation that occurs in the downstream ductwork and stack. These factors contribute to the relatively high capital costs of the wet FGD SO_2 control alternative.

The reaction products are typically dewatered by a combination of hydrocyclones and vacuum filters. The resulting filter cake is suitable for landfill disposal. In early lime- and limestone-based FGD processes, the byproduct solids were primarily calcium sulfite hemihydrate ($CaSO_3 \bullet 1/2H_2O$), and the byproduct solids were mixed with fly ash (stabilization) or fly ash and lime (fixation) to produce a physically stable material. In the current generation of wet FGD systems, air is bubbled through the reaction tank (or in some cases, a separate vessel) to practically convert all of the $CaSO_3 \bullet 1/2H_2O$ into calcium sulfate dihydrate ($CaSO_4 \bullet 2H_2O$), which is commonly known as gypsum. This step is termed "forced oxidation" and has been applied to both lime- and limestone-based FGD processes. Compared to calcium sulfite hemihydrate, gypsum has much superior dewatering and physical properties, and forced oxidized FGD systems tend to have few internal scaling problems in the absorber and mist eliminators. Dewatered gypsum can be landfilled without stabilization or fixation. Many FGD systems in the United States are using the forced-oxidation process to produce a commercial grade of gypsum that can be used in the production of portland cement or wallboard. Marketing of the gypsum can eliminate or greatly reduce the need to landfill FGD byproducts.

The absorber vessels are fabricated from corrosion-resistant materials such as epoxy/vinyl ester-lined carbon steel, rubber-lined carbon steel, stainless steel, or fiberglass. The absorbers handle large volumes of abrasive slurries. The byproduct dewatering equipment is also relatively complex and expensive. These factors result in relatively higher initial capital costs. Wet FGD processes are also characterized by higher raw water usage than semi-dry FGD systems. This can be a significant disadvantage or even a fatal flaw in areas where raw water availability is in short supply.

A countercurrent spray tower has become one of the most widely used absorber types in wet limestone-based FGD service. Flue gas enters at the bottom of the absorber and flows upward. Slurry with 10 to 15 percent solids is sprayed downward from higher elevations in the absorber and is collected in a reaction tank at its base. The SO_2 in the flue gas is transferred from the flue gas to the recycle slurry. The hot flue gas is also cooled and saturated with water. Recycled slurry is pumped continuously from the reaction tank to the slurry spray headers. Each header has numerous individual spray nozzles that break the slurry flow into small droplets and distribute them evenly across the cross section of the absorber. Prior to leaving the absorber, the treated flue gas passes through a two-stage, chevron-type mist eliminator that removes entrained slurry droplets from the gas. The mist eliminator is periodically washed to keep it free of solids.

In the reaction tank, the SO_2 absorbed from the flue gas reacts with soluble calcium ions in the recycle slurry to form insoluble calcium sulfite and calcium sulfate solids. In forced-oxidization processes, air is bubbled through the slurry to convert all of the solids to calcium sulfate dihydrate (gypsum). A lime or limestone reagent slurry is added to the reaction tank to replace the calcium consumed.

To control the solids content of the recycle slurry, a portion of the slurry is discharged from the reaction tank to the byproduct dewatering equipment. Depending on the ultimate disposal of the byproduct solids, the dewatering equipment may include settling ponds, thickeners, hydrocyclones, vacuum filters, and centrifuges. The liquid that is separated from the byproduct solids slurry is stored in the reclaim water tank. Water in the reclaim water tank is returned to the absorber reaction tank as makeup water and used to prepare the reagent slurry.

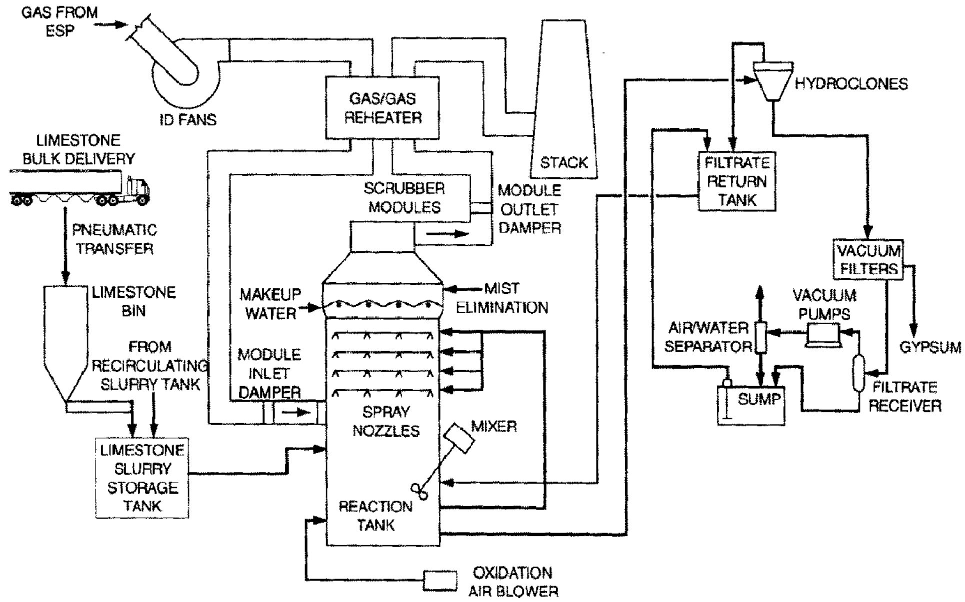

Figure D-6
Process Flow Diagram of FGD Process

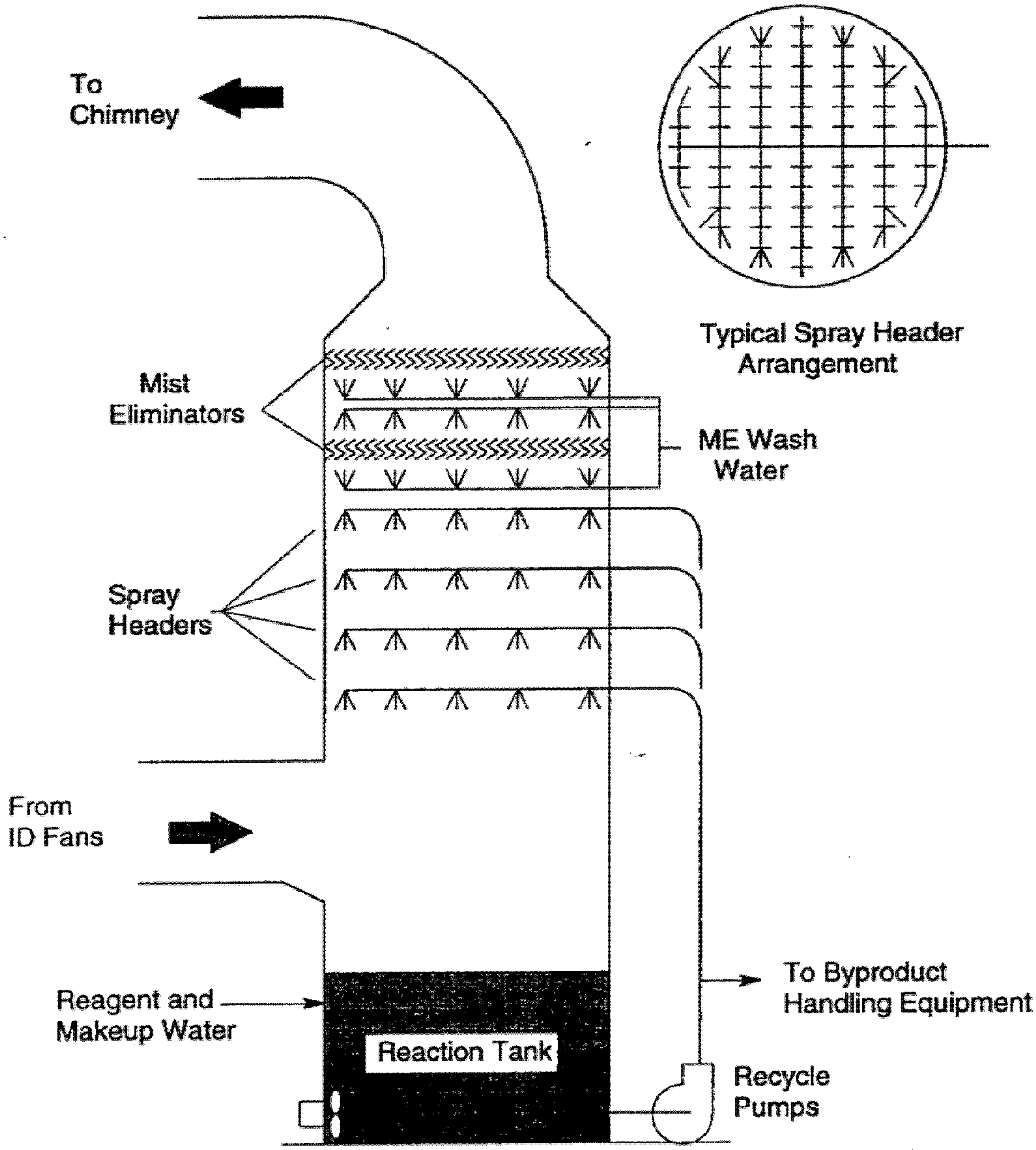

Figure D-7
Countercurrent Spray Tower FGD Process

Spray Dryer Absorber

Spray dryer absorber (SDA) FGD processes have been extensively used. US utilities have installed numerous SDA FGD systems on boilers using low sulfur fuels.

These installations, primarily located in the western United States, use either lignite or subbituminous coals such as PRB as the boiler fuel and generally have spray dryer systems designed for a maximum fuel sulfur content of less than 2 percent. The SDA lime-based FGD system has an inherent removal efficiency limitation of 94 percent from inlet concentration.

The SDA FGD process uses calcium hydroxide [$Ca(OH)_2$] produced from the lime reagent as either a slurry or as a dry powder to the flue gas in a reactor designed to provide good gas-reagent contact. The SO_2 in the flue gas reacts with the calcium in the reagent to produce primarily calcium sulfite hemihydrate ($CaSO_3 \bullet 1/2H_2O$) and a smaller amount of calcium sulfate dihydrate ($CaSO_4 \bullet 2H_2O$) through the following reactions:

$$SO_2 + Ca(OH)_2 \rightarrow CaSO_3 \bullet \tfrac{1}{2}H_2O + \tfrac{1}{2}H_2O$$
$$SO_2 + Ca(OH)_2 + \tfrac{1}{2}O_2 \rightarrow CaSO_4 \bullet 2H_2O$$

Water is also added to the reactor (either as part of the reagent slurry or as a separate stream) to cool and humidify the flue gas, which promotes the reaction and reagent utilization. The amount of water added is typically sufficient to cool the flue gas to within 30° to 40° F of the flue gas adiabatic saturation temperature. Significantly less water is used in these SDA FGD processes compared to wet FGD processes.

The reaction byproducts and excess reagent are dried by the flue gas and removed from the flue gas by a particulate control device (either fabric filter or DESP). Fabric filters are preferred for most systems, because the additional contact of the flue gas with the particulate on the filter bags provides additional SO_2 removal and higher reagent utilization. A portion of the reaction byproducts collected is recycled to the reagent preparation system in order to increase the utilization of the lime.

Because of the large amount of excess lime present in the FGD byproducts, the byproducts (and fly ash, if present) will experience pozzolanic (cementitious) reactions when wetted. When wetted and compacted, the byproduct makes a fill material with low permeability (low lengthening characteristics) and high bearing strength. However, other than as structural fill, this byproduct has limited commercial value and typically must be disposed of as a waste material.

The SDA FGD processes offer benefits in addition to SO_2 removal, including the lack of a visible vapor plume and SO_3 removal. Because the SDA FGD systems do not saturate the flue gas with water, there is no visible plume from the stack under most weather conditions. Environmental concerns with SO_3 emissions are also reduced with the SDA scrubber. SO_3 is formed during combustion and will react with the moisture in the flue gas to form sulfuric acid (H_2SO_4) mist in the atmosphere. An increase in H_2SO_4

emissions will increase PM_{10} emissions. The gas temperature leaving the reactor is lowered below the sulfuric acid dew point, and significant SO_3 removal will be attained as the condensed acid reacts with the alkaline reagent. By removing SO_3 in the flue gas, the condensable particulate matter emissions can be reduced. This will reduce the potential for any SO_3 plume that may cause opacity in stacks. Similar type of SO_3 removal is not achievable with a wet scrubber.

All current SDA designs use a vertical gas flow absorber. These absorbers are designed for co-current or a combination of co-current and countercurrent gas flow. In co-current applications, gas enters the cylindrical vessel near the top of the absorber and flows downward and outward. In combination-flow absorbers, a gas disperser located near the middle of the absorber directs a fraction of the total flue gas flow upward toward the slurry atomizers.

In both cases, the atomizers are located in the roof of the absorber. Both rotary and two-fluid nozzles have been applied to this approach. The atomizer produces an umbrella of atomized reagent slurry through which the flue gas passes. The SO_2 in the flue gas is absorbed into the atomized droplets and reacts with the calcium to form calcium sulfite and calcium sulfate. Before the slurry droplet can reach the absorber wall, the water in the droplet evaporates and a dry particulate is formed.

Some vendors base their designs on a single large rotary atomizer per absorber; others use up to three smaller rotary atomizers per absorber. Two-fluid atomizers are installed as an array of up to 16 nozzles per atomizer; all three approaches to spray atomizers have been successfully applied.

The flue gas, then containing fly ash and FGD byproduct solids, leaves the absorber and is directed to a fabric filter. The fly ash and byproduct solids collected in the fabric filter are pneumatically transferred to a silo for disposal. To improve both reagent utilization and spray solids drying efficiency, a large portion of the solids collected is directed to a recycle system, where it is slurried and re-injected into the spray dryer along with the fresh lime reagent.

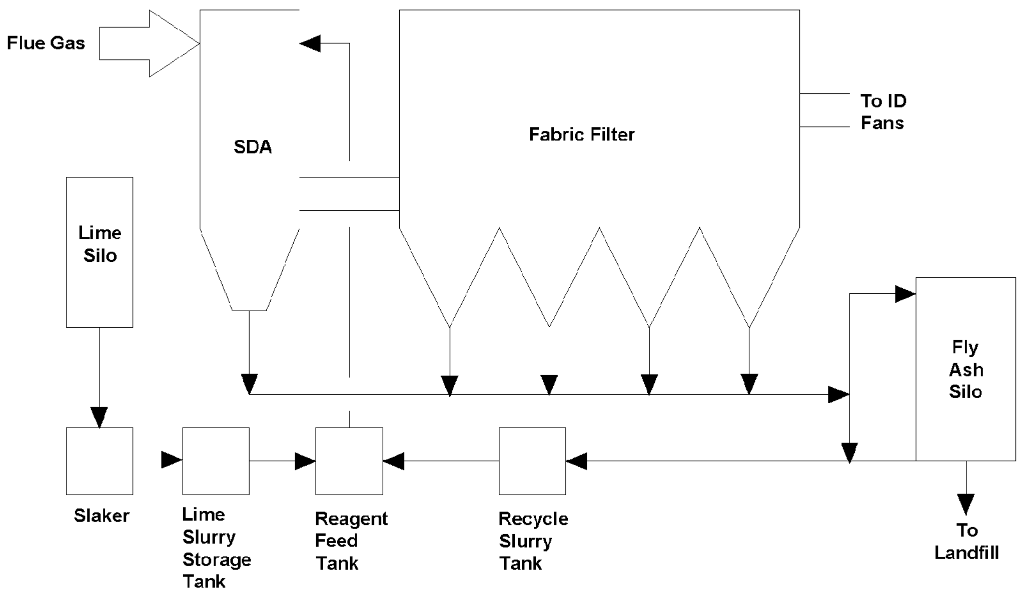

Figure D-8
SDA FGD Process

Circulating Dry Scrubber (CDS)

The CDS FGD process is a semi-dry, lime-based FGD process that uses a circulating fluid bed contactor rather than an SDA. The CDS absorber module is a vertical solid/gas reactor between the unit's air heater and its particulate control device. Water is sprayed into the reactor to reduce the flue gas temperature to the optimum temperature for reaction of SO_2 with the reagent. Hydrated lime [$Ca(OH)_2$] and recirculated dry solids from the particulate control device are injected cocurrently with the flue gas into the base of the reactor just above the water sprays. The gas velocity in the reactor is reduced and a suspended bed of reagent and fly ash is developed. The SO_2 in the flue gas reacts with the reagent to form predominately calcium sulfite. Fine particles of byproduct solids, excess reagent, and fly ash are carried out of the reactor and removed by the particulate removal device (either a fabric filter or electrostatic precipitator [ESP]). Over 90 percent of these solids are returned to the reactor to improve reagent utilization and increase the surface area for SO_2/reagent contact.

The CDS FGD system produces an extremely high solids load on the particulate removal device due to the recycling of the byproduct/fly ash mixture. For this reason, some CDS FGD system vendors prefer to use an ESP rather than a fabric filter. Most of the recycled material can be collected in the first field of an ESP with minimal effect on the overall ESP sizing. On the other hand, a fabric filter in this same service would require special design features to avoid reduced bag life associated with frequent bag cleaning. Figure D-9 provides an illustration of the CDS FGD system.

The CDS can be considered an acceptable FGD removal technology in some applications because of its ability to remove significant amounts of SO_2, the commercial status of the technology, and the use of conventional reagents. It has disadvantages relating to the downstream particulate load imposed on collectors but its implementation schedule and minimal impact on local communities adds to its acceptability.

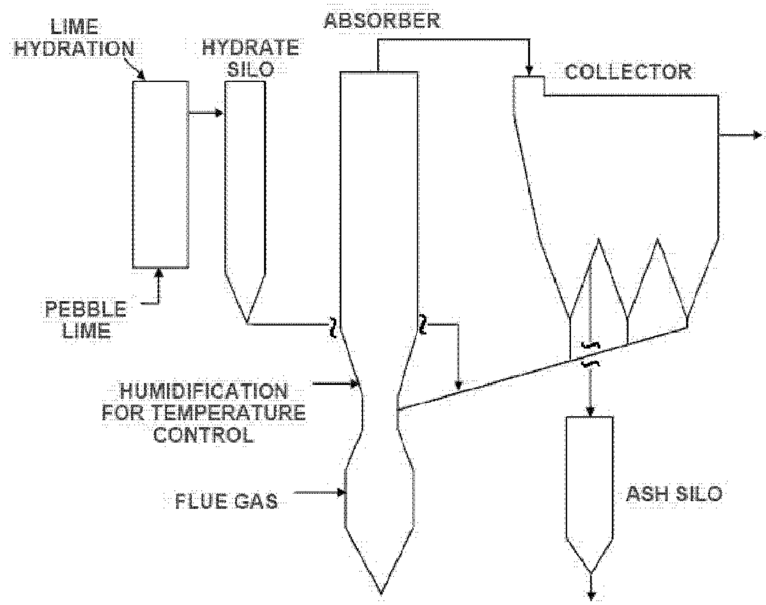

Figure D-9
Circulating Dry Scrubber System (Courtesy: Lurgi Lentjes North America)

Particulate Matter (PM) Reduction Technologies

Dry Electrostatic Precipitator (ESP)

ESPs are the most widely installed utility particulate matter (PM) removal technology. ESPs use transformer/rectifiers (TRs) to energize "discharge electrodes" and to produce a high voltage, direct current electrical field between the discharge electrodes and the grounded collecting plates. PM entering the electrical field acquires a negative charge and migrates to the grounded collecting plates. This migration can be expressed in engineering terms as an empirically determined effective migration velocity, but takes place in a turbulent flow regime with the particulate entrained within the turbulent gas patterns. Thus, the charged particles are actually captured when the combined effect of electrical attraction and gas flow patterns moves the PM close enough for it to attach to the collecting surfaces. A layer of collected particles forms on the collecting plates and is removed periodically by mechanically impacting or "rapping" the plates. The collected particulate matter drops into hoppers below the precipitator and is removed by the ash handling system. Some particulate is also re-entrained and either collected in subsequent electrical fields or emitted from the ESP. A graphic showing the sections of an ESP is shown on Figure D-10.

The required particulate removal efficiency, the expected electrical resistivity of the fly ash to be collected, and the expected electrical characteristics of the energization system determine the physical size of an ESP. Many parameters determine the ESP's capability for particulate collection including the following major items:

- The first parameter is the Specific Collection Area (SCA). ESP size is often measured in terms of SCA. SCA is defined as the total collecting area in square feet (ft^2) divided by the volumetric flue gas flow rate (1,000's of actual cubic feet per minute [acfm]).
- The treatment time of the flue gas within the electric collection fields of the ESP is an important aspect of particulate collection. High efficiency ESPs typically have treatment times between 7 and 20 seconds. Treatment time is becoming a major design parameter as lower particulate emissions are being mandated.
- Flue gas velocity, which is the speed at which the flue gas moves through the ESP, is important in the design and sizing of an ESP. Design gas velocities that range between 3 to 4 fps are common. The aspect ratio of the treatment length to the collection plate height is also important in the design and sizing of the ESP. As the aspect ratio increases, the re-entrainment losses from the ESP are minimized. Many existing ESPs have aspect ratios of approximately 0.8 to 1.2; newer ESPs, especially those meeting new particulate emission limits, have aspect ratios of approximately 1.2 to 2.0.
- The gas distribution for optimum particulate removal requires a uniform gas velocity throughout the entire ESP treatment volume, with minimal gas bypass around the discharge electrodes or collecting plates. If flue gas distribution is uneven, the particulate removal efficiency will decrease, and re-entrainment losses will increase in high velocity areas and reduce overall collection efficiency.
- Fly ash resistivity is a measure of how easily the ash or particulate acquires an electric charge. Typical coal fly ash resistivity values range from 1×10^8 ohm-cm to 1×10^{14} ohm-cm. The ideal resistivity range for electrostatic precipitation of fly ash is 5×10^9 to 5×10^{10} ohm-cm. Operating resistivity varies with flue gas moisture, SO_3 concentration, temperature, and ash chemical composition. As a result of fly ash resistivity being sensitive to these constituents, ESPs can be affected greatly by changes in fuel or operating conditions.

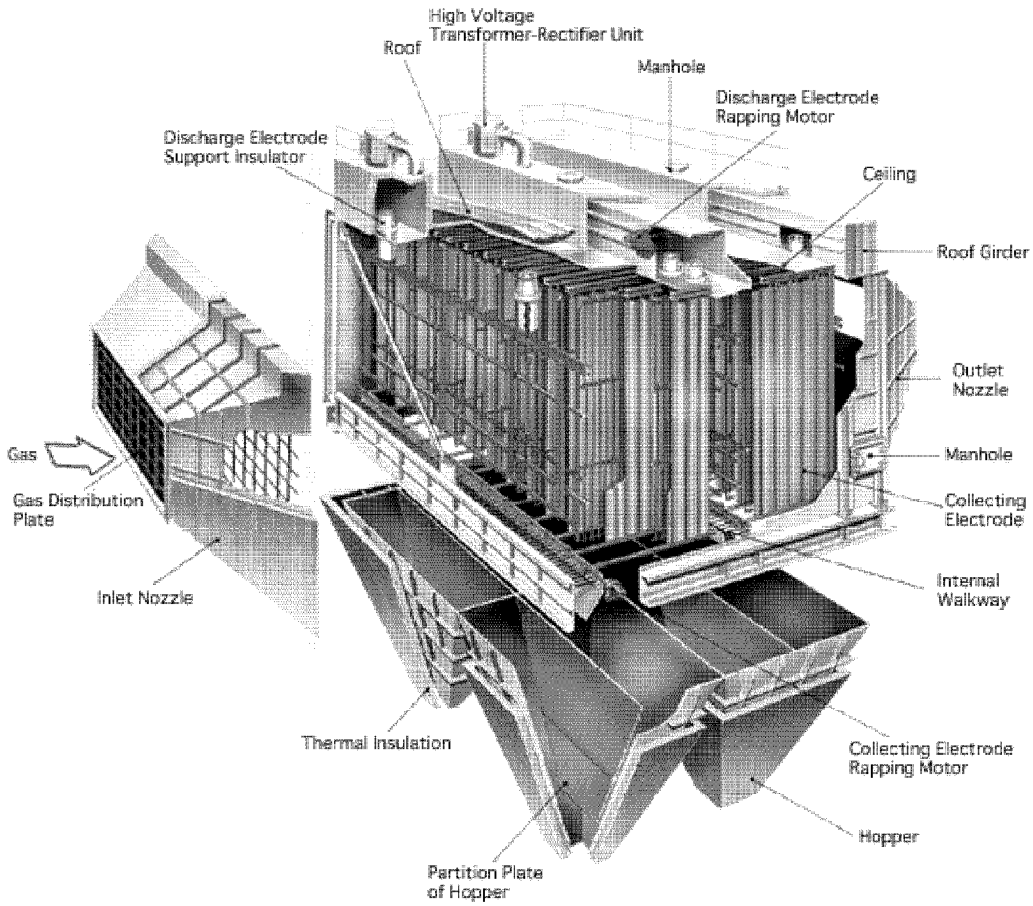

Figure D-10
Electrostatic Precipitator System (MHI)

Pulse Jet Fabric Filter (PJFF)

Fabric filters have been used for over 20 years on existing and new coal fired boilers and are media filters through which flue gas passes to remove the particulate. The success of FFs is predominately due to their ability to economically meet the low particulate emission limits for a wide range of particulate operations and fuel characteristics. Proper application of the FF technology can result in clear stacks (generally less than 5 percent opacity) for a full range of operations. In addition, the FF is relatively insensitive to ash loadings and various ash types, offering superb coal flexibility.

FFs are the current technology of choice when low outlet particulate emissions or Hg reduction is required for coal fired applications. FFs collect particle sizes ranging from submicron to 100 microns in diameter at high removal efficiencies. Provisions can be made for future addition of activated carbon injection to enhance gas phase elemental

Hg removal from coal fired plants. Some types of fly ash filter cakes will also absorb some elemental Hg.

FFs are generally categorized by type of cleaning. The two predominant cleaning methods for utility applications are reverse gas and pulsejet. Initially, utility experience in the United States was almost exclusively with Reverse Gas Fabric Filters (RGFF). Although they are a very reliable and effective emissions control technology, RGFFs have a relatively large footprint, which is particularly difficult for implementations. PJFFs can be operated at higher flue gas velocities and, as a result, have a smaller footprint. The PJFF usually has a lower capital cost than a RGFF and matches the performance and reliability of a RGFF. As a result, only PJFFs will be considered further.

Cloth filter media is typically sewn into cylindrical tubes called bags. Each FF may contain thousands of these filter bags. The filter unit is typically divided into compartments that allow on-line maintenance or bag replacement after a compartment is isolated. The number of compartments is determined by maximum economic compartment size, total gas volume rate, air-to-cloth ratio, and cleaning system design. Extra compartments for maintenance or off-line cleaning not only increase cost, but also increase reliability. Each compartment includes at least one hopper for temporary storage of the collected fly ash. A cutaway view of a PJFF compartment is illustrated on Figure D-11.

Fabric bags vary in composition, length, and cross section (diameter or shape). Bag selection characteristics vary with cleaning technology, emissions limits, flue gas and ash characteristics, desired bag life, capital cost, air-to-cloth ratio, and pressure differential. Fabric bags are typically guaranteed for 3 years but frequently last 5 years or more.

In PJFFs, the flue gas typically enters the compartment hopper and passes from the outside of the bag to the inside, depositing particulate on the outside of the bag. To prevent the collapse of the bag, a metal cage is installed on the inside of the bag. The flue gas passes up through the center of the bag into the outlet plenum. The bags and cages are suspended from a tubesheet.

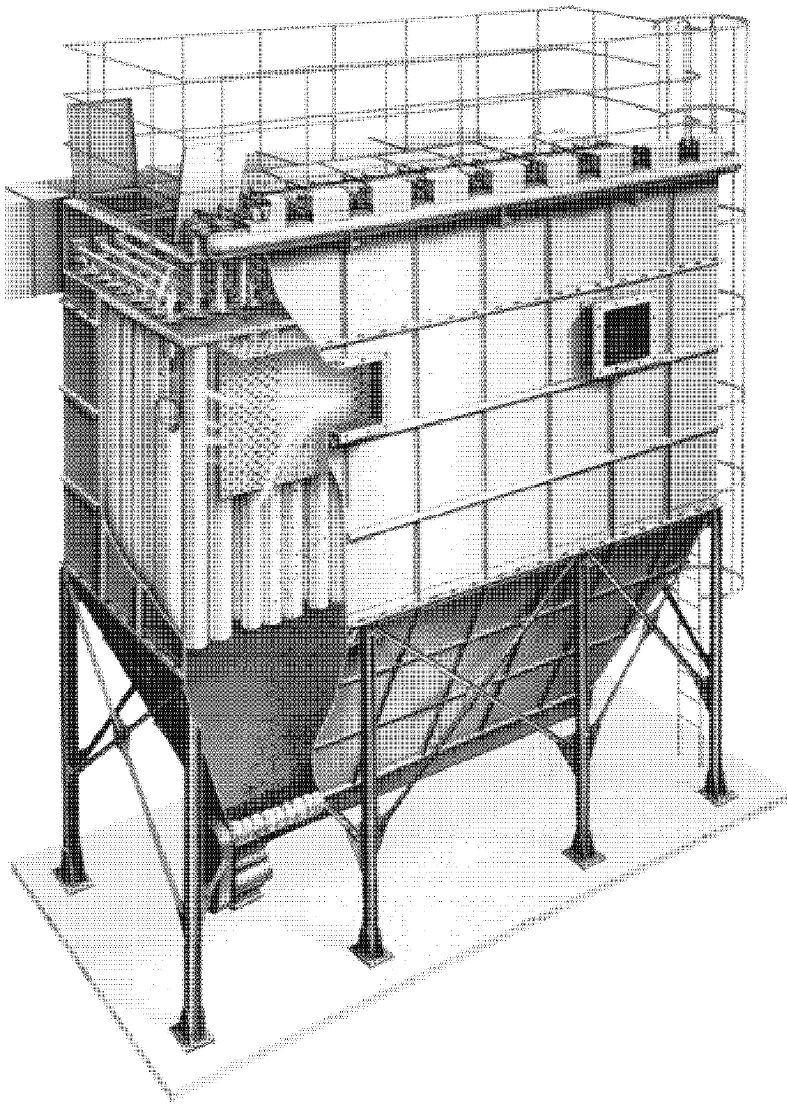

Figure D-11
Pulse Jet Fabric Filter Compartment

Cleaning is performed by initiating a downward pulse of air into the top of the bag. The pulse causes a ripple effect along the length of the bag. This dislodges the dust cake from the bag surface, and the dust falls into the hopper. This cleaning may occur with the compartment on line or off-line. Care must be taken during design to ensure that the upward velocity between bags is minimized so that particulate is not re-entrained during the cleaning process.

The PJFF cleans bags in sequential, usually staggered, rows. During on-line cleaning, part of the dust cake from the row that is being cleaned may be captured by the adjacent rows. Despite this apparent shortcoming, PJFFs have successfully implemented on-line cleaning on many large units.

The PJFF bags are typically made of felted materials that do not rely as heavily on the dust cake's filtering capability as woven fiberglass bags do. This allows the PJFF bags to be cleaned more vigorously. The felted materials also allow the PJFF to operate at a much higher cloth velocity, which significantly reduces the size of the unit and the space required for installation.

Compact Hybrid Particulate Collector (COHPAC™)

Another control technology that is effective in removing particulate matter is a high air-to-cloth ratio fabric filter installed after an existing cold-side ESP. Commonly referred to as a Compact Hybrid Particulate Collector (COHPAC™), this technology was developed and trademarked by the Electric Power Research Institute (EPRI). The COHPAC™ filter typically operates at air-to-cloth ratios ranging from 6 to 8 ft/min. compared to a conventional fabric filter that typically operate at air-to-cloth ratios of about 4 ft/min. For a COHPAC™ system, the majority of the particulate is collected in the upstream ESP. Therefore, the performance requirements of a high air-to-cloth ratio fabric filter is reduced allowing installation of this technology in a smaller footprint area, with less steel and filtration media to substantially lower both capital and operating costs compared to conventional fabric filters.

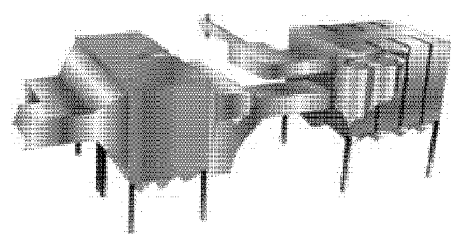

Figure D-12
COHPAC ™ I Arrangement (Courtesy: Hamon Research-Cottrell)

Mercury and Dioxin/Furan Reduction Technologies

Powdered Activated Carbon (PAC) Injection

With reported Hg removals of more than 90 percent for bituminous coal applications, PAC injection is an effective and mature technology in the control of Hg in Municipal Solid Waste (MSW) and Medical Waste Combustors (MWC). Its potential effectiveness on a wide range of coal fired power plant applications is gaining acceptance based on recent pilot and slipstream testing activities sponsored by the Department of

Energy (DOE), Environmental Protection Agency (EPA), Electric Power Research Institute (EPRI), and various research organizations and power generators. However, recent pilot scale test results indicate that the level of Hg control achieved with a PAC injection system is impacted by variables such as the type of fuel, the speciation of Hg in the fuel, operating temperature, fly ash properties, flue gas chloride content, and the mechanical collection device used in the removal of Hg.

PAC injection typically involves the use of a lignite based carbon compound that is injected into the flue gas upstream of a particulate control device as illustrated on Figure D-13. Elemental and oxidized forms of Hg are adsorbed into the carbon and are collected with the fly ash in the particulate control device.

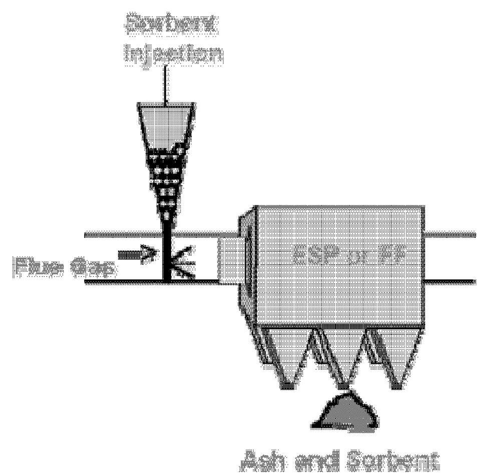

Figure D-13
Activated Carbon Injection System

PAC injection is generally added upstream of either PJFFs or ESPs. For ESPs, the Hg species in the flue gas are removed as they pass through a dust cake of unreacted carbon products on the surface of the collecting plates. Additionally, a significantly higher carbon injection rate is required for PAC injection upstream of a ESP than is required for PAC injection upstream of a high air-to-cloth ratio PJFF or a PJFF that is located downstream of a SDA FGD system. Literature indicates that PAC injection upstream of a cold ESP can reduce Hg emissions up to 60 percent for units that burn a sub-bituminous or lignite coal, and up to 80 percent for units that burn a bituminous coal. The addition of activated carbon does not directly affect the function of the ash handling system. The additional activated carbon in the fly ash does, however, affect the quality of the ash that is produced. For units that currently sell fly ash, this will negatively impact their continued ability to sell the ash.

Since the sale of fly ash depends on the carbon content of the ash, increasing the amount of carbon in the ash also makes it unsuitable for sale. To maintain the ash quality required for sale, the ash must either be removed upstream of the PAC injection system or the activated carbon should be injected into the flue gas so that it is not mixed with all the collected fly ash or is mixed with only a small portion of the total fly ash that is collected in the particulate control device. This can be accomplished by using a high air-to-cloth ratio PJFF downstream of cold ESP.

Numerous testing efforts and studies have shown that most of the Hg resulting from the combustion of coal leaves the boiler in the form of elemental Hg, and that the level of chlorine in the coal has a major impact on the efficiency of Hg removal with PAC injection and the particulate removal system. Low chlorine coals, such as sub-bituminous and lignite coals, typically demonstrate relatively low Hg removal efficiency. Sub-bituminous and lignite coals produce very low levels (approximately 100 parts per million [ppm]) of HCl during combustion and; therefore, normal PAC injection would be anticipated to achieve very low elemental Hg removal.

The removal efficiency that is attained by halogenated PAC injection can be significantly increased by the use of PAC that has been pretreated with halogens, such as iodine or bromine. Recent testing results indicate that halogenated PAC injection upstream of a cold ESP can reduce Hg emissions up to 80 percent for units that burn a sub-bituminous or lignite coal and up to 90 percent for units that burn a bituminous coal. Pretreated PAC is more expensive than untreated PAC: (approximately $5.00/lb of iodine, $1.00/lb of bromine, and $0.50/lb of PAC). However, less pretreated PAC is required to achieve significant removals, if such removal rates are dictated by more stringent Hg control regulations.

PAC can also be injected upstream of a PJFF located downstream of a semi-dry lime FGD. When a semi-dry lime FGD and a PJFF is injected with PAC upstream of the FGD, the activated carbon absorbs most of the oxidized Hg. This is a result of the additional residence time in the FGD and will basically allow greater contact between the Hg particles and the activated carbon. Because of the accumulated solids cake on the bags, the activated carbon is given another opportunity to interact with the Hg prior to disposal or recycle. Since the ash and reagent collected in the PJFF are already contaminated, the additional carbon collected in the PJFF will not affect ash sales or disposal. Recent literature indicates that PAC injection upstream of a semi-dry FGD and PJFF can reduce Hg emissions by 60 to 80 percent.

Halogenated PAC injection upstream of a semi-dry lime FGD and PJFF is basically similar in design to standard PAC, as described previously. Halogenated PAC includes halogens such as bromine or iodine. Literature indicates that halogenated sorbents require significantly lower injection rates (in some cases the difference is as much as a factor of 3) upstream of a semi-dry lime FGD and PJFF combination, as compared to an ESP, and can reduce Hg emissions of up to 95 percent.

CO Reduction Technologies

Good Combustion Controls

As products of incomplete combustion, CO and VOC emissions are very effectively controlled by ensuring the complete and efficient combustion of the fuel in the boiler (i.e., good combustion controls). Typically, measures taken to minimize the formation of NO_x during combustion inhibit complete combustion, which increases the emissions of CO and VOC. High combustion temperatures, adequate excess air, and good air/fuel mixing during combustion minimize CO and VOC emissions. These parameters also increase NO_x generation, in accordance with the conflicting goals of optimum combustion to limit CO and VOC, but lower combustion temperatures to limit NO_x. The products of incomplete combustion are substantially different and often less pronounced when the unit is firing high sulfur bituminous coals, which is the rationale for the slightly higher BACT emissions limits found on units permitted to burn low sulfur PRB subbituminous coals. In addition, depending on the manufacturer, good combustion controls vary in terms of meeting CO emissions limits.

Neural Networks

Neural networks utilize a DCS based computer system that obtains plant data such as load, firing rate, burner position, air flow, CO emissions, etc. The computer system analyzes the impact of various combustion parameters on CO emissions. The system then provides feedback to the control system to improve operation for lower CO emissions. With this combustion system performance monitoring equipment in place, it is expected that sufficient information would be available to maintain the performance of each burner at optimum conditions to enable operations personnel to maintain the most economical balance of peak fuel efficiency and emissions of NOx, and CO. In addition to burner performance these monitoring systems also allow continuous indication of pulverizer, classifier and fuel delivery system performance to provide early indication of impending component failures or maintenance requirements. This system is also used to improve heat rate and often provides operational cost savings along with CO control. It is commercially proven and has demonstrated CO reductions. However, CO emission reductions due to installation of NN vary from unit to unit based on each unit's specific equipment configuration and operation.

It is recommended that detailed studies be performed to determine the potential benefit from NN installation.

Appendix E
Approved Air Quality Control Technology Options

E.W. Brown

Comments on Brown AQC study by Black and Veatch
Brad Pabian

B&V recommended either a SNCR or SCR on Brown units 1 and 2 in their initial assessment of Brown station. This was due to their assertion that NOx limits would be imposed on a unit by unit basis. If this is the case, then their recommendations are valid. If, however, the NOx limits are imposed on a plant wide basis, then there may be a cheaper alternative. Brown 3 will be fitted with an SCR capable of 0.07 lbs/MMBTU NOx output. If Brown 2 was fitted with a similar SCR, Brown 1 may be able to come into compliance simply with better low NOx burners and over fired air. The rough calculations below show how this may be possible. These are not detailed and accurate numbers, only rough approximations.

Current Unit 3 Full Load Heat Input: ~4700 MMBTU/hr
Current Unit 2 Full Load Heat Input: ~1730 MMBTU/hr
Current Unit 1 Full Load Heat Input: ~1070 MMBTU/hr
Total Plant Full Load Heat Input: ~7500 MMBTU/hr
Maximum Plant Full Load NOx Emissions (at 0.11 lb/MMBTU): 825 lb/hr
Maximum Unit 3 NOx Emissions with 0.07 lb/MMBTU SCR in service: 329 lb/hr
Maximum Unit 2 NOx Emissions with 0.07 lb/MMBTU SCR in service: 121 lb/hr

Maximum allowable Unit 1 NOx Emissions with Unit 2 and 3 SCR in service: 375 lb/hr
Maximum allowable Unit 1 NOx Emission rate: 0.35 lb/MMBTU

Unit 1 currently runs between 0.4 and 0.5 lb/MMBTU, which is the reason that it seemed possible to attain 0.35 lb/MMBTU with less costly means. In addition, when capacity factor is considered, the allowable NOx emission rate on Unit 1 would be higher, since it has historically had a lower capacity factor than the other two units at Brown. I would suggest that capacity factor be treated as safety margin with respect to meeting the limits and that B&V propose a cost to upgrade burner equipment on Unit 1 to achieve approximately 0.3 to 0.32 lb/MMBTU emissions. The only time that this would not be a practical solution would be if the NOx limits were applied on a continuous basis, rather than by year. If so, then a Unit 3 outage would put the plant over the limit. This could be managed, possibly, with overlapping outages, etc. If the NOx regulations are applied on a unit by unit basis, NOx removal of 30-40% by an SNCR as described by B&V would not be capable of bringing Unit 1 into compliance, and a full SCR would be required.

The second major question I had was relative to disposal of material captured by a future baghouse, particularly considering heavy metals that would be captured. Please be sure B&V identifies costs that may be associated with construction of facilities to handle the waste. It should also be made clear in their final document that the potential baghouse requirements for Units 1 and 2 could be met by a single combined baghouse.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *1*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new NOx compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required****. Existing common WFGD to units 1, 2 and 3 can meet the new SO_2 compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available****. Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected****. Existing common WFGD to units 1, 2 and 3 can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15 x 10^{-18} lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***1***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

Please clarify if the PJFF is shared between Units 1&2. Also, the plant would prefer B&V to estimate the option of using low NOx burners and overfire air on Unit 1 and put the SCR on Unit 2 and 3 in order to achieve Plant compliance. According to the sheet titled, "Estimated Requirements Under Future New Environmental Regulations" provided to B&V by E.ON, the revised CAIR section 4.9 calls for Plant wide compliance. The Brown Team does not believe that an SCR should be the first option for compliance for this Unit. Please see the attached document prepared by Brad Pabian for further details.

Therefore, B&V should explore this option for the basis of the estimate. Eileen Saunders will discuss with management if E.ON would like B&V to provide costs associated with adding an SCR to Unit 1.

Is an SNCR feasible for the Brown Station? If not, please explain.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***1***

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***1***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NO_x compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NO_x emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NO_x emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NO_x emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NO_x reduction including future requirements.
- Likely require SO_3 mitigate system.
- New booster and/or ID fan installation as needed.
- Location: SCR would be located downstream of the existing economizer and upstream of the air heater.
- Real Estate Constraints – No space is available outside the boiler building on the north side to install the SCR. Therefore, the new SCR needs to be constructed on the east side of the boiler building. Potentially at an elevated level.
- Construction Issues – Tight space for tie-in and connection of ductwork between economizer outlet and SCR.
    - Soot blower air compressor tanks, service water piping and circulating water piping needs to be demolished and relocated.
    - Demineralization system building, which is currently not in use and is located on the north side of the boiler building, needs to be demolished.
    - Secondary air duct may need to be raised to clear the space.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with a shared/common wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *1*

Pollutant: Particulate (PM)

Feasible Control Options:

- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF)

Special Considerations:

- COHPAC may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 1 will be located downstream of the ductwork exiting the ID fans of Unit 1 and upstream of new booster fans for Unit 1.
- Real Estate Constraints – No space is available at grade level to install the new PJFF. Therefore the new PJFF will need to be constructed at an elevation above grade level, probably above the existing ESP with Booster fan or ID fan upgrades.
- Construction Issues – Heavy foundations and supports.
  - New PJFF will be installed at a higher elevation above the existing ESP, needing heavy support columns that need to be landing outside the existing ESP foundations.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *1*

Pollutant: Mercury (Hg)

Feasible Control Options:

- Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- Full size PJFF for Unit 1.
- *PAC to be injected downstream of the existing ESP but upstream of new full size PJFF for Unit 1.*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15 x 10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *2*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required****. Existing common WFGD to units 1, 2 and 3 can meet the new SO_2 compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing common WFGD to units 1, 2 and 3 can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***2***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

Please clarify if the PJFF is shared between Units 1&2. If so, B&V needs to make sure that the cost estimate only reflects one baghouse.

See comments on Unit 1 regarding the SCR estimate.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***2***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NO_x compliance limit of 0.11 lb/MBtu but not a long term solution for NO_x emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NO_x emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NO_x emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NOx reduction including future requirements.
- Likely require SO_3 mitigate system.
- New booster and/or ID fan installation as needed.
- Location: SCR would be required downstream of the existing economizer and upstream of the air heater.
- Real Estate Constraints – Limited space available at grade level outside the boiler building on the north side to install the SCR. Therefore the new SCR will need to be constructed at an elevation above grade level.
- Construction Issues – Unit 2 abandoned dry stack and main auxiliary transformer on the north side outside the boiler building.
  - Demolition and relocation of main auxiliary transformer of Unit 2.
  - Demolition of existing pre-dust collectors.
  - SCR will need to be constructed on a dance floor.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with a shared/common wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***2***

Pollutant: Particulate (PM)

Feasible Control Options:

- Compact Hybrid Particulate Collector (COHPAC^{TM}).
- Pulse Jet Fabric Filter (PJFF)

Special Considerations:

- COHPAC may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but not a long term solution for PM emissions less than 0.03 lb/MBtu.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 2 will be located downstream of the ductwork exiting the ID fans of Unit 2 and upstream of new booster fans for Unit 2.
- Real Estate Constraints – No space is available at grade level to install the new PJFF. Therefore the new PJFF will need to be constructed at an elevation above grade level, probably above the existing ESP with Booster fan or ID fan upgrades.
- Construction Issues – Heavy foundations and supports.
    - New PJFF will be installed at a higher elevation above the existing ESP, needing heavy support columns that need to be landing outside the existing ESP foundations.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***2***

Pollutant: Mercury (Hg)

Feasible Control Options:

- Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- Full size PJFF for Unit 2.
- *PAC to be injected downstream of the existing ESP but upstream of new full size PJFF for Unit 2.*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *3*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required***. *The new SCR which will be constructed in 2012 can meet the new* NO_x *compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required***. *Existing common WFGD to units 1, 2 and 3 can meet the new* SO_2 *compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing common WFGD to units 1, 2 and 3 can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of* 15×10^{-18} *lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

No additional comments

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

Pollutant: NO_x

Feasible Control Options:

- **No new NOx control technology is required**. The unit will be equipped with SCR in 2012 that can meet the future target NO_x emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

Pollutant: Particulate (PM)

Feasible Control Options:

- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF)

Special Considerations:

- COHPAC may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but not a long term solution for PM emissions less than 0.03 lb/MBtu.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 3 will be located downstream of the existing ID fans of Unit 3 and upstream of common wet FGD scrubber.
- Real Estate Constraints – No real estate constraints.
- Construction Issues – Possible underground service water pipelines interference.
    - May require relocation of underground service water pipelines

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

Pollutant: Mercury (Hg)

Feasible Control Options:

- Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- Full size PJFF for Unit 3.
- *PAC to be injected downstream of the existing ESP but upstream of new full size PJFF for Unit 3.*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *E.W. Brown*
Unit: *3*

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

Ghent

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Ghent***
Unit: ***1***

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required****. Existing SCR can meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required****. Existing WFGD can meet the new SO_2 compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***No new technology is required*** *for PM as current ESP is capable of meeting 0.03 lb/MBtu emissions.*	□ Yes □ No (See Qualifier in Comments Section)
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected****. Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No

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Plant: ***Ghent***
Unit: ***1***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

General Comments for ALL Units:

- In the document, where "South" is used for location, it should be "West"
- For Units 1, 3 and 4, under the section "Special Considerations", please use the phrase, "The plant currently uses an SO3 mitigation system" instead of saying they are "planning injection technology".
- For Unit 2, under the section "Special Considerations", please us the phrase, "The plant will be installing an SO3 mitigation system" instead of saying, "Likely require SO3 mitigation system".
- Please make it clear in the document that the PJFF system must be under negative pressure.
- For SO2, the existing technology can meet the new 0.25 requirements but if the limit becomes more stringent, modifications may have to be made to **consistently** meet the requirements. Please include this clarification in the descriptions of SO2 for all units.
- For various locations cited by B&V as potential locations for PJFF systems, another project run by B&V has plans to locate equipment in those locations (Ash Handling Project). B&V needs to coordinate discussions within their company to ensure that the basis of estimate is accurate. The other project has a 2013 date.

Unit 1 specific comments:

For PM: if this unit is required to meet a new PM limit of .03 lb/MBtu and the Hg Reg does not materialize, the ESP will need to be replaced or upgraded. It does not meet the limit of .03 lb/MBtu on a consistent basis. As long as a PAC/PJFF system is installed to take care of Hg and Dioxin/Furan, then PM will be fine. Please insert this comment on the

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Plant: ***Ghent***
Unit: ***1***

description on the first page. (And include estimate to replace/upgrade.

E.ON US
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Plant: ***Ghent***
Unit: ***1***

Pollutant: NO_x

Feasible Control Options:

- **No new NOx control technology is required**. The unit is currently equipped with SCR that can meet the future target NOx emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

Pollutant: Particulate (PM)

Feasible Control Options:

- **No new PM control technology is required.** The unit is currently equipped with an ESP technology that can meet the future target PM emission level of 0.03 lb/MBTU.

Special Considerations:

- A new PJFF will be required to meet mercury control using PAC. The existing ESP alone will not be capable of meeting the mercury compliance emissions using PAC.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

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Plant: ***Ghent***
Unit: ***1***

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- PJFF for Unit 1.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 1.*
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 1 will be located downstream of the existing ID fans of Unit 1 and upstream of the new booster fans for Unit 1.
- Real Estate Constraints – No space is available at grade level to install the new PJFF. Therefore the new PJFF will need to be constructed at an elevation above grade level, with Booster fan or ID fan upgrades.
- Construction Issues – Ductwork and abandoned stack interference. Access for heavy cranes may be a possible issue
  - Require demolition of ductwork
  - May require demolition of existing abandoned dry stack of Unit 1
  - Demolition and relocation of pipe rack for access

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

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Coal-Fired Fleet Wide
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Plant: ***Ghent***
Unit: ***1***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

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Plant: *Ghent*
Unit: *2*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required****. Existing WFGD can meet the new SO_2 compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected****. Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15 x 10^{-18} lb/MBtu.*	□ Yes □ No

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Plant: ***Ghent***
Unit: ***2***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

If the Mercury requirement ultimately is by plant and not unit, can Ghent meet the PM requirement without installing a PJFF system on Unit 2?

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Technology Options

Plant: ***Ghent***
Unit: ***2***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NO_x compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NO_x emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NO_x emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NO_x emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NO_x reduction including future requirements.
- Likely require SO_3 mitigate system.
- New booster and/or ID fan installation as needed.
- Location: SCR would be required downstream of the existing economizer and upstream of the air heater.
- Real Estate Constraints – Space is available outside the boiler building on the south side to install the SCR. The SCR will be elevated above grade.
- Construction Issues – Access for heavy equipment and cranes is not available.
  - Demolition and relocation of overhead walkway from Unit 2 to Unit 3 boiler building.
  - Demolition and relocation of some of the overhead power lines.
  - Tower cranes are required for access of heavy equipment and construction of SCR.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

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Plant: *Ghent*
Unit: *2*

Pollutant: Particulate (PM)

Feasible Control Options:

- Compact Hybrid Particulate Collector (COHPAC^{TM}).
- Pulse Jet Fabric Filter (PJFF)

Special Considerations:

- COHPAC may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 2 will be located downstream of the existing ID fans of Unit 2 and upstream of the new booster fans for Unit 2.
- Real Estate Constraints – No space is available at grade level to install the new PJFF. Therefore the new PJFF will need to be constructed at an elevation above grade level, with Booster fan or ID fan upgrades.
- Construction Issues – Ductwork interference. Access for heavy cranes may be a possible issue
  - Requires demolition of ductwork
  - Demolition and relocation of pipe rack for access

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

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Technology Options

Plant: *Ghent*
Unit: *2*

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing hot-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- Full size PJFF for Unit 2.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 2.*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

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Plant: *Ghent*
Unit: *3*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required***. *Existing SCR can meet the new* NO_x *compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required***. *Existing WFGD can meet the new* SO_2 *compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of* 15×10^{-18} *lb/MBtu.*	□ Yes □ No
Note: If E.ON does not approve a specific technology, an explanation can be included in		

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Plant: ***Ghent***
Unit: ***3***

the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

E.ON Comments:

For the Mercury section, page 4, under "Special Considerations", the wording should be changed to reflect this unit is a hot-side ESP not a cold-side ESP.

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Technology Options

Plant: *Ghent*
Unit: *3*

Pollutant: NO_x

Feasible Control Options:

- **No new NO_x control technology is required**. The unit is currently equipped with SCR that can meet the future target NOx emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

Pollutant: Particulate (PM)

Feasible Control Options:

- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF)

Special Considerations:

- COHPAC may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 3 will be located downstream of the existing ID fans of Unit 3 and upstream of the new booster fans for Unit 3.

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Plant: *Ghent*
Unit: *3*

- Real Estate Constraints – There is very limited space available between the ID fan outlet and wet scrubber inlet on the west side. The new PJFF will be installed on the south side of Unit 4 ESP, with Booster fan or ID fan upgrades.
- Construction Issues – Electrical manhole, electrical duct banks and circulating water and storm water drain piping running underground on the south side of Unit 4 ESP will need to be relocated to make real estate available.
    - Warehouse needs to be demolished
    - Well water pumps needs to be relocated

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- PJFF for Unit 3.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 3.*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

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Plant: ***Ghent***
Unit: ***3***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15 x 10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

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Plant: *Ghent*
Unit: *4*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required***. *Existing SCR can meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***No new technology is required***. *Existing WFGD can meet the new SO_2 compliance limit of 0.25 lb/MBtu*	□ Yes □ No
PM	***No new technology is required*** *for PM as current ESP is capable of meeting 0.03 lb/MBtu emissions.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBtu (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No
Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment		

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Plant: ***Ghent***
Unit: ***4***

and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

E.ON Comments:

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Plant: ***Ghent***
Unit: ***4***

Pollutant: NO_x

Feasible Control Options:

- **No new NOx control technology is required**. The unit is currently equipped with SCR that can meet the future target NOx emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- **No new SO_2 control technology is required**. The unit is currently equipped with wet FGD technology that can meet future target SO_2 emissions level of 0.25 lb/MBtu.

Pollutant: Particulate (PM)

Feasible Control Options:

- **No new PM control technology is required** to meet the 0.03 lb/MBTU emissions limit.

Special Considerations:

- A new PJFF will be required to meet mercury control using PAC. The existing ESP alone will not be capable of meeting the mercury compliance emissions using PAC.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.*

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Plant: ***Ghent***
Unit: ***4***

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction with new full size PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing hot-side dry ESP will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- PJFF for Unit 4.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 4.*
- New booster and/or ID fan installation as needed.
- Existing ESP to be kept for additional PM filtration.
- Location: A new PJFF for Unit 4 will be located downstream of the existing ID fans of Unit 4 and upstream of the new booster fans for Unit 4.
- Real Estate Constraints – There is very limited space available between the ID fan outlet and wet scrubber inlet on the west side. The new PJFF will be installed on the south side of Unit 4 ESP, with Booster fan or ID fan upgrades.
- Construction Issues – Electrical manhole, electrical duct banks and circulating water and storm water drain piping running underground on the south side of Unit 4 ESP will need to be relocated to make real estate available.
    - Warehouse needs to be demolished
    - Well water pumps needs to be relocated

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCL emissions with an existing Wet FGD.

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Plant: ***Ghent***
Unit: ***4***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

Cane Run

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Plant: *Cane Run*
Unit: *4*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new* NO_x *compliance limit of 0.11 lb/MBtu.*	□ Yes □ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new* SO_2 *compliance limit of 0.25 lb/MBtu.*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of* 15×10^{-18} *lb/MBtu.*	□ Yes □ No

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Plant: ***Cane Run***
Unit: ***4***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

Special Considerations Summary:

- Complete demolition of everything behind the boiler.
- Demolish and Build in Phases; requires ~20-30 month of construction outage for Unit 4.
- New ID Fans and wet liner/stack required for Unit 4 which will be a common concrete shell for units 4, 5 and 6 with separate wet flue liners.
- Relocate existing overhead power lines towards the backend equipment to minimize construction hazards.
- New common stack located near unit 5.
- Existing stacks demolished.
- Construction sequence starts with unit 5.

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Plant: ***Cane Run***
Unit: ***4***

E.ON Comments:

General Comments:

- During the site visits and in subsequent discussions with EON personnel, the outage timeframes were depicted in the 18-20 month range not 20-30 month range. Please explain the discrepancy.
- For the SCR's, an SO3 mitigation system is described as likely needed. To ultimately understand the total cost impact for Cane Run, EON will need to know those costs. Please contact Eileen Saunders regarding this item.

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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***4***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NO_x compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NO_x emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NO_x emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NO_x emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NOx reduction including future requirements.
- Likely require SO_3 mitigation system.
- New ID fan installation as needed.
- New air heater needed.
- Existing air heater demolished.
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Cane Run units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than

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Air Quality Control Technology Assessment
Technology Options

Plant: *Cane Run*
Unit: *4*

0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible and expandable control technology considered for SO_2 reduction including future requirements.

- New ID fan installation as needed.
- Existing WFGD will be demolished.
- Existing ID fans will be demolished
- Location: WFGD would be required downstream of the new ID fans and upstream of the new stack.
- To minimize outage time, Unit 4 Scrubbers will be installed in parallel with SCR. and installation of baghouse.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-side Dry ESP
- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF) .

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New ID fan installation as needed.
- Existing ESP will be demolished (no additional PM filtration proposed for ash sales).
- New air heater needed.
- Existing air heater demolished.
- Location: A new PJFF for Unit 4 will be located downstream of the new air heater and upstream of the new ID fans.
- Existing ID fans will be demolished.

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Air Quality Control Technology Assessment
Technology Options

Plant: *Cane Run*
Unit: *4*

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note* : Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A Full size PJFF in conjunction with PAC injection for Unit 4 is recommended to remove 90% mercury emissions.
- *PAC to be injected downstream of the new air heater but upstream of new full size PJFF for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and similarly it is expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD recommended.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Cane Run*
Unit: *4*

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

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Technology Options

Plant: *Cane Run*
Unit: *5*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new* NO_x *compliance limit of 0.11 lb/MBtu.*	□ Yes □ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new* SO_2 *compliance limit of 0.25 lb/MBtu.*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of* 15×10^{-18} *lb/MBtu.*	□ Yes □ No

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Technology Options

Plant: *Cane Run*
Unit: *5*

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

Special Considerations Summary:
- Complete demolition of everything behind the boiler.
- Demolish and Build in Phases; requires ~20-30 month of construction outage for Unit 5.
- New ID Fans and wet liner/stack required for Unit 5 which will be a common concrete shell for units 4, 5 and 6 with separate wet flue liners.
- Relocate existing overhead power lines towards the backend equipment to minimize construction hazards.
- New common stack located near unit 5.
- Existing stacks demolished.
- Construction sequence starts with unit 5.

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Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***5***

E.ON Comments:

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Air Quality Control Technology Assessment
Technology Options

Plant: *Cane Run*
Unit: *5*

Pollutant: NO_x

Feasible Control Options:
- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:
- SNCR/SCR Hybrid systems may be able to achieve the new NO_x compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NO_x emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NO_x emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NO_x emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NO_x reduction including future requirements.
- Likely require SO_3 mitigation system.
- New ID fan installation as needed.
- New air heater needed.
- Existing air heater demolished.
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater.

Pollutant: SO_2

Feasible Control Options:
- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:
- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Cane Run units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than

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Technology Options

Plant: *Cane Run*
Unit: *5*

0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible and expandable control technology considered for SO_2 reduction including future requirements.

- New ID fan installation as needed.
- Existing WFGD will be demolished.
- Existing ID fans will be demolished
- Location: WFGD would be required downstream of the new ID fans and upstream of the new stack.
- To minimize outage time, Unit 5 Scrubbers will be installed in parallel with SCR. and installation of baghouse.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-side Dry ESP
- Compact Hybrid Particulate Collector (COHPAC^{TM}).
- Pulse Jet Fabric Filter (PJFF) .

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New ID fan installation as needed.
- Existing ESP will be demolished (no additional PM filtration proposed for ash sales).
- New air heater needed.
- Existing air heater demolished.
- Location: A new PJFF for Unit 5 will be located downstream of the new air heater and upstream of the new ID fans.
- Existing ID fans will be demolished.

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Air Quality Control Technology Assessment
Technology Options

Plant: *Cane Run*
Unit: *5*

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note* : Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A Full size PJFF in conjunction with PAC injection for Unit 5 is recommended to remove 90% mercury emissions.
- *PAC to be injected downstream of the new air heater but upstream of new full size PJFF for Unit 5*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and similarly it is expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD recommended.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

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Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***5***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

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Technology Options

Plant: *Cane Run*
Unit: *6*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10^{th}, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new* NO_x *compliance limit of 0.11 lb/MBtu.*	☐ Yes ☐ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new* SO_2 *compliance limit of 0.25 lb/MBtu.*	☐ Yes ☐ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	☐ Yes ☐ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	☐ Yes ☐ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	☐ Yes ☐ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu*	☐ Yes ☐ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of* 15×10^{-18} *lb/MBtu.*	☐ Yes ☐ No

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Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***6***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

Special Considerations Summary:

- Complete demolition of everything behind the boiler.
- Demolish and Build in Phases; requires ~20-30 month of construction outage for Unit 6.
- New ID Fans and wet liner/stack required for Unit 6 which will be a common concrete shell for units 4, 5 and 6 with separate wet flue liners.
- Relocate existing overhead power lines towards the backend equipment to minimize construction hazards.
- New common stack located near unit 5.
- Existing stacks demolished.
- Construction sequence starts with unit 5.

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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***6***

E.ON Comments:

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Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***6***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NOx compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NOx emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NOx emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NOx emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NOx reduction including future requirements.
- Likely require SO_3 mitigation system.
- New ID fan installation as needed.
- New air heater needed.
- Existing air heater demolished.
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Cane Run units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than

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Technology Options

Plant: *Cane Run*
Unit: *6*

0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible and expandable control technology considered for SO_2 reduction including future requirements.

- New ID fan installation as needed.
- Existing WFGD will be demolished.
- Existing ID fans will be demolished
- Location: WFGD would be required downstream of the new ID fans and upstream of the new stack.
- To minimize outage time, Unit 6 Scrubbers will be installed in parallel with SCR. and installation of baghouse.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-side Dry ESP
- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF) .

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New ID fan installation as needed.
- Existing ESP will be demolished (no additional PM filtration proposed for ash sales).
- New air heater needed.
- Existing air heater demolished.
- Location: A new PJFF for Unit 6 will be located downstream of the new air heater and upstream of the new ID fans.
- Existing ID fans will be demolished.

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Technology Options

Plant: ***Cane Run***
Unit: ***6***

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note* : Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- **New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF** can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A Full size PJFF in conjunction with PAC injection for Unit 6 is recommended to remove 90% mercury emissions.
- *PAC to be injected downstream of the new air heater but upstream of new full size PJFF for Unit 6*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and similarly it is expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD recommended.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

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Technology Options

Plant: *Cane Run*
Unit: *6*

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

Mill Creek

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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *1*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new NO_x compliance limit of 0.11 lb/MBtu.*	☐ Yes ☐ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new SO_2 compliance limit of 0.25 lb/MBtu.*	☐ Yes ☐ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu. Plus, new cold-side dry ESP for pre-filtration for ash sales.*	☐ Yes ☐ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	☐ Yes ☐ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	☐ Yes ☐ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu.*	☐ Yes ☐ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	☐ Yes ☐ No

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Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *1*

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail.

E.ON to return written approval and comments sections to B&V.

Special Considerations Summary:

- Erection of new pre-filter ESP/ and new PJFF and ID fans prior to demolition of existing ESP required in meeting recommended phased approach to create real estate for new SCR.
- SCR will be installed in same physical location as existing ESP.
- Existing wet stack will be reused.
- Phased erection is required to minimize unit outage for tie-in to existing components.

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Technology Options

Plant: ***Mill Creek***
Unit: ***1***

E.ON Comments:

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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NOx compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NOx emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NOx emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NOx emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NOx reduction including future requirements.
- Likely require SO_3 mitigation system.
- New ID fan installation as needed.
- Existing air heater will be retained
- Existing ESP will be demolished.
- New economizer bypass will be provided
- Location: SCR would be required downstream of the existing economizer and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Mill Creek units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than 0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible

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Technology Options

Plant: *Mill Creek*
Unit: *1*

and expandable control technology considered for SO_2 reduction including future requirements.

- New ID fans installation is needed.
- Existing WFGD will be demolished in a phased approach.
- Existing ID fans will be demolished
- Location: WFGD would be required downstream of the new ID fans and upstream of the existing stack. The existing wet stack liner and breaching including the connecting ductwork will be reused as is.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-Side Dry ESP
- Compact Hybrid Particulate Collector (COHPAC^{TM}).
- Pulse Jet Fabric Filter (PJFF).

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New ID fans installation is needed.
- Existing ESP will be demolished.
- A new cold-side dry ESP will be used as a pre-filter to remove 80-85% fly ash that can be sold to the cement plant to lower the ash land filling liability. A new down stream full size PJFF will be used for mercury, acid and some PM control.
- Location: A new PJFF for Unit 1 will be located downstream of the existing air heater and upstream of the new ID fans. The PJFF will possibly be installed on the top of the pre-filter ESP due to site real estate constraints.
- Existing ID fans will be demolished.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note*: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF can meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP or new proposed cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A full size PJFF is recommended for Unit 1 in conjunction with PAC injection.
- *PAC to be injected downstream of the new pre-filter ESP but upstream of new full size PJFF for Unit 1*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and similarly it is expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD recommended.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *2*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***New Selective Catalytic Reduction (SCR) is required*** *to meet the new NO_x compliance limit of 0.11 lb/MBtu.*	□ Yes □ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new SO_2 compliance limit of 0.25 lb/MBtu.*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu. Plus, new cold-side dry ESP for pre-filtration for ash sales.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu.*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***2***

Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

Special Considerations Summary:

- Erection of new pre-filter ESP/ and new PJFF and ID fans prior to demolition of existing ESP required in meeting recommended phased approach to create real estate for new SCR.
- SCR will be installed in same physical location as existing ESP.
- Existing wet stack will be reused.
- Phased erection is required to minimize unit outage for tie-in to existing components.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***2***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *2*

Pollutant: NO_x

Feasible Control Options:

- Selective Non Catalytic Reduction (SNCR) / Selective Catalytic Reduction (SCR) Hybrid
- Selective Catalytic Reduction (SCR)

Special Considerations:

- SNCR/SCR Hybrid systems may be able to achieve the new NOx compliance limit of 0.11 lb/MBtu but it will not provide a long term consistent solution for NOx emissions less than 0.11 lb/MBtu.
- SCR can consistently achieve NOx emissions of 0.11 lb/MBtu on a continuous basis and has a capability to expand to meet the NOx emissions even lower than 0.11 lb/MBtu. Hence SCR is the most feasible and expandable control technology considered for NOx reduction including future requirements.
- Likely require SO_3 mitigation system.
- New ID fan installation as needed.
- Existing air heater will be retained
- Existing ESP will be demolished.
- New economizer bypass will be provided
- Location: SCR would be required downstream of the existing economizer and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Mill Creek units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than 0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *2*

and expandable control technology considered for SO_2 reduction including future requirements.

- New ID fans installation is needed.
- Existing WFGD will be demolished in a phased approach.
- Existing ID fans will be demolished
- Location: WFGD would be required downstream of the new ID fans and upstream of the existing stack. The existing wet stack liner and breaching including the connecting ductwork will be reused as is.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-Side Dry ESP
- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF).

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New ID fans installation is needed.
- Existing ESP will be demolished.
- A new cold-side dry ESP will be used as a pre-filter to remove 80-85% fly ash that can be sold to the cement plant to lower the ash land filling liability. A new down stream full size PJFF will be used for mercury, acid and some PM control.
- Location: A new PJFF for Unit 2 will be located downstream of the existing air heater and upstream of the new ID fans. The PJFF will possibly be installed on the top of the pre-filter ESP due to site real estate constraints.
- Existing ID fans will be demolished.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***2***

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note*: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF can meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- The existing cold-side dry ESP or new proposed cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A full size PJFF is recommended for Unit 2 in conjunction with PAC injection.
- *PAC to be injected downstream of the new pre-filter ESP but upstream of new full size PJFF for Unit 2*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and similarly it is expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD recommended.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***2***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *3*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required***. *Existing SCR can meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new SO_2 compliance limit of 0.25 lb/MBtu.*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu.*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No
Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment		

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***3***

and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

Special Considerations Summary:

- New booster fans required following PJFF.
- New ductwork will bypass existing FGD equipment that will be demolished following installation of new equipment.
- Existing stack can be reused with new FGD and PJFF elevated above existing road and rails.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***3***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***3***

Pollutant: NO_x

Feasible Control Options:

- **No new NOx control technology is required**. The unit is currently equipped with SCR that can meet the future target NOx emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Mill Creek units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than 0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible and expandable control technology considered for SO_2 reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing WFGD will be demolished.
- Location: WFGD would be required downstream of the new booster fans and upstream of the existing stack.
- New wet FGD absorber and reaction tank to be installed over the existing main access way on elevated steel supports and hence heavy duty steel support and foundations are expected. *Existing railroad tracks as well as pipe racks are kept intact by elevating the new PJFF and the WFGD absorber.*

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-Side Dry ESP

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *3*

- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF).

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation is needed.
- Existing ESP to be kept for additional PM filtration and lime injection for SO_3 mitigation to be located upstream of existing ESP.
- Location: A new PJFF for Unit 3 will be located over the main access way downstream of the existing ID fans and upstream of the new booster fans.
- Real Estate Constraints – No space is available at grade level to install the new PJFF because the existing access way is critical to plant operation. Therefore the new PJFF will need to be constructed at an elevation above grade level, with new Booster fans.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note*: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- **New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF** can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *3*

Special Considerations:

- The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF in conjunction with PAC injection is recommended for Unit 3.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 3*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *4*

The following AQC control technologies comprise the recommended technologies to control unit pollutant emissions to the targeted emission levels. As summarized on the following pages, the recommended technologies are based on the known technology limitations, future expanding capability, arrangement or site fatal flaws, constructability challenges, unit off-line schedule requirements or site-specific considerations developed or understood during the field work conducted during the week of May 10th, as well as information provided by E.ON. B&V will analyze costs for the one selected/approved technology for each applicable pollutant.

AQC Technology Recommendation		
Pollutant	AQC Equipment	E.ON Approval to Cost*
NO_x	***No new technology is required***. *Existing SCR can meet the new NO_x compliance limit of 0.11 lb/MBtu*	□ Yes □ No
SO_2	***New Wet Flue Gas Desulfurization (WFGD) is required*** *to meet the new SO_2 compliance limit of 0.25 lb/MBtu.*	□ Yes □ No
PM	***New full size Pulse Jet Fabric Filter (PJFF) is required*** *to meet the new PM compliance limit of 0.03 lb/MBtu.*	□ Yes □ No
CO	***No feasible and proven technology is available.*** *Existing combustion controls cannot meet the new CO compliance limit of 0.02 lb/MBTU (Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu)*	□ Yes □ No
Hg	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***No new technology selected.*** *Existing WFGD can meet the new HCl compliance limit of 0.002 lb/MBtu.*	□ Yes □ No
Dioxin/Furan	***New Powdered Activated Carbon (PAC) Injection required with new full size Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15×10^{-18} lb/MBtu.*	□ Yes □ No
Note: If E.ON does not approve a specific technology, an explanation can be included in the following section--comments by E.ON on specific issues regarding control equipment		

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***4***

and a decision to approve a technology should be described in detail. *E.ON to return written approval and comments sections to B&V.*

Special Considerations Summary:

- New booster fans required following PJFF.
- New ductwork will bypass existing FGD equipment that will be demolished following installation of new equipment.
- Existing stack can be reused with new FGD and PJFF elevated above existing road and rails.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***4***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***4***

Pollutant: NO_x

Feasible Control Options:

- **<u>No new NOx control technology is required</u>**. The unit is currently equipped with SCR that can meet the future target NOx emissions level of 0.11 lb/MBtu.

Special Considerations:

- Plant is currently planning injection technology to mitigate SO_3 from the SCR.

Pollutant: SO_2

Feasible Control Options:

- Semi-Dry Flue Gas Desulfurization (FGD)
- Wet Flue Gas Desulfurization (WFGD)

Special Considerations:

- Semi-Dry FGD systems may be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu but it will not provide a long term consistent solution for SO_2 emissions less than 0.25 lb/MBtu on high sulfur fuels. The O&M costs economics could favor use of a wet FGD technology when scrubbing high sulfur coals expected to be burned at Mill Creek units.
- WFGD can consistently achieve SO_2 emissions of 0.25 lb/MBtu on a continuous basis and has a capability to expand to meet the SO_2 emissions even lower than 0.25 lb/MBtu burning high sulfur content coals. Hence WFGD is the most feasible and expandable control technology considered for SO_2 reduction including future requirements.
- New booster and/or ID fan installation as needed.
- Existing WFGD will be demolished.
- <u>Location</u>: WFGD would be required downstream of the new booster fans and upstream of the existing stack.
- <u>New wet FGD absorber and reaction tank to be installed over the existing main access way on elevated steel supports and hence heavy duty steel support and foundations are expected</u>. *Existing railroad tracks as well as pipe racks are kept intact by elevating the new PJFF and the WFGD absorber.*

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold-Side Dry ESP

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *4*

- Compact Hybrid Particulate Collector (COHPAC™).
- Pulse Jet Fabric Filter (PJFF).

Special Considerations:

- Both dry cold-side ESP and COHPAC combination may be able to achieve the new PM compliance limit of 0.03 lb/MBtu but it is not considered a long term solution for PM emissions less than 0.03 lb/MBtu. However a full size PJFF offers more direct benefits or co-benefits of removing future multi-pollutants using some form of injection upstream when compared to dry ESPs. Hence either ESPs or COHPAC combination is not recommended.
- A full-size PJFF can consistently achieve PM emissions of less than 0.03 lb/MBtu on a continuous basis and has a capability to expand to meet the PM emissions lower than 0.03 lb/MBtu. Hence a full size PJFF is the most feasible and expandable control technology considered for PM reduction including future requirements.
- New booster and/or ID fan installation is needed.
- Existing ESP to be kept for additional PM filtration and lime injection for SO_3 mitigation to be located upstream of existing ESP.
- Location: A new PJFF for Unit 4 will be located over the main access way downstream of the existing ID fans and upstream of the new booster fans.
- Real Estate Constraints – No space is available at grade level to install the new PJFF because the existing access way is critical to plant operation. Therefore the new PJFF will need to be constructed at an elevation above grade level, with new Booster fans.

Pollutant: CO

Feasible Control Options:

- ***No feasible and proven technology is available for this type and size of unit*** to meet the 0.02 lb/MBtu emission limit.
- *Note*: Please confirm CO emission level is 0.02 and not 0.20 lb/MBtu.

Pollutant: Mercury (Hg)

Feasible Control Options:

- New Powdered Activated Carbon (PAC) Injection in conjunction new PJFF can meet the new Hg compliance limit of 1×10^{-6} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Mill Creek*
Unit: *4*

Special Considerations:

- The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF in conjunction with PAC injection is recommended for Unit 4.
- *PAC to be injected downstream of the existing ID fans but upstream of new full size PJFF for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- **No new control technology is required** as the unit is currently meeting target emission level of 0.002 lb/MBtu HCl emissions with an existing Wet FGD and expected to meet the same target emission level of 0.002 lb/MBtu with new Wet FGD.

Special Considerations:

- New WFGD proposed as control technology for SO_2 reduction for future requirements will also meet HCl target emission level.

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new PJFF considered for mercury control can meet the dioxin/furan compliance limit of 15×10^{-18} lb/MBtu or lower on a continuous basis and hence is the most feasible control technology.

Special Considerations:

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

Trimble County