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

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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^{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 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

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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.

Special Considerations:

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Plant: ***E.W. Brown***
Unit: ***3***

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

From:	Lucas, Kyle J.
To:	Saunders, Eileen
CC:	Mahabaleshwarkar, Anand; Hillman, Timothy M.
Sent:	5/20/2010 4:19:40 PM
Subject:	EON AQC Selection Sheets - Mill Creek
Attachments:	Mill Creek Unit 1 052010.doc; Mill Creek Unit 2 052010.doc; Mill Creek Unit 3 052010.doc; Mill Creek Unit 4 052010.doc

Eileen,
Attached please find the AQC technology selection sheets for Mill Creek Units 1-4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
Black & Veatch - Building a World of Difference™
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E.ON US
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

E.ON US
Coal-Fired Fleet Wide
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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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Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

E.ON Comments:

E.ON US
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
- <u>Location</u>: 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
- <u>Location</u>: 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.
- <u>Location</u>: 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.

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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 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 x10^{-18} lb/MBtu.*	□ Yes □ No

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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.

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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
- <u>Location</u>: 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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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.

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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.

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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.

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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		

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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.

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Plant: ***Mill Creek***
Unit: ***3***

E.ON Comments:

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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

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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.
- <u>Location</u>: 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.
- <u>Real Estate Constraints</u> – 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:

- ***<u>No feasible and proven technology is available for this type and size of unit</u>*** to meet the 0.02 lb/MBtu emission limit.
- <u>Note</u>: 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
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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.

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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		

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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.

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Technology Options

Plant: ***Mill Creek***
Unit: ***4***

E.ON Comments:

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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

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Plant: *Mill Creek*
Unit: *4*

- 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 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.
- <u>Location</u>: 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.
- <u>Real Estate Constraints</u> – 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:

- ***<u>No feasible and proven technology is available for this type and size of unit</u>*** to meet the 0.02 lb/MBtu emission limit.
- <u>*Note*</u>: 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.

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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.

From:	Saunders, Eileen
To:	Kirkland, Mike; Koller, Tiffany; Stevens, Michael
Sent:	5/20/2010 4:30:38 PM
Subject:	FW: EON AQC Selection Sheets - Mill Creek
Attachments:	Mill Creek Unit 1 052010.doc; Mill Creek Unit 2 052010.doc; Mill Creek Unit 3 052010.doc; Mill Creek Unit 4 052010.doc

All,

Please see the templates I just received for Mill Creek. I will check calendars and schedule a conference call to discuss. Please ignore the CO question below as I have already passed it along to Gary Revlett to answer.

Thank you,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, May 20, 2010 4:20 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheets - Mill Creek

Eileen,
Attached please find the AQC technology selection sheets for Mill Creek Units 1-4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
Black & Veatch - Building a World of Difference™
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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 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

E.ON US
Coal-Fired Fleet Wide
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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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

E.ON Comments:

E.ON US
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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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™).
- 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.

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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.

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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

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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.

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Technology Options

Plant: ***Mill Creek***
Unit: ***2***

E.ON Comments:

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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
- <u>Location</u>: 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.
- <u>Location</u>: 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

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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:

- **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: ***4***

- 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 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.

From:	Saunders, Eileen
To:	Straight, Scott
Sent:	5/20/2010 4:30:55 PM
Subject:	FW: EON AQC Selection Sheets - Mill Creek
Attachments:	Mill Creek Unit 1 052010.doc; Mill Creek Unit 2 052010.doc; Mill Creek Unit 3 052010.doc; Mill Creek Unit 4 052010.doc

Mill Creek data.

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, May 20, 2010 4:20 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheets - Mill Creek

Eileen,
Attached please find the AQC technology selection sheets for Mill Creek Units 1-4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

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 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

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

E.ON Comments:

E.ON US
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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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™).
- 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:

- **<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: *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 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: *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:

- **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: *4*

- 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 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.
- <u>Location</u>: 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.
- <u>Real Estate Constraints</u> – 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:

- ***<u>No feasible and proven technology is available for this type and size of unit</u>*** to meet the 0.02 lb/MBtu emission limit.
- <u>*Note*</u>: 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.

From:	Revlett, Gary
To:	Saunders, Eileen
Sent:	5/20/2010 5:01:48 PM
Subject:	RE: CO Emission Limit Question
Attachments:	Generation Future Environmental Requirements.xlsx

Hi Eileen,

The revised tables are attached.

Gary

From: Saunders, Eileen
Sent: Thursday, May 20, 2010 4:47 PM
To: Revlett, Gary; 'Hillman, Timothy M.'; 'Lucas, Kyle J.'; 'Mahabaleshwarkar, Anand'
Cc: Straight, Scott
Subject: RE: CO Emission Limit Question

Gary,

Please update the "Estimated Requirements Under Future New Environmental Regulations" document that was provided to the team and B&V as soon as possible. I need to make sure everyone receives the new limit for their records.

Thank you,

Eileen

From: Revlett, Gary
Sent: Thursday, May 20, 2010 3:33 PM
To: 'Hillman, Timothy M.'; Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Subject: RE: CO Emission Limit Question

Everyone,

I have reviewed my notes on the origin of the suggested Electric Generating Unit (EGU) MACT carbon monoxide limit of 0.02 lbs/mmBtu. This proposed CO MACT number came from some of our current emission inventories and was based on Table 1.1-3 of AP-42. The value in the table is 0.5 lbs per ton of coal burned, which is approximately 0.02 lbs/mmBtu. When providing this number, I didn't calculate the ppm value as a reality check. Since the ppm value would be less than 10, this does seem to be unrealistically low.

A key factor for the MACT CO will be the averaging time. I would now suggest using the proposed ICI boiler MACT for PC boilers, which is 90 ppm (corrected to 3% O_2) and the averaging time of 24-hours. For the typical operating conditions of 7% O_2, this would be equivalent to ~ 40 ppm or ~0.10 lbs/mmBtu.

Gary

From: Hillman, Timothy M. [mailto:HillmanTM@bv.com]
Sent: Thursday, May 20, 2010 9:54 AM
To: Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: RE: CO Emission Limit Question

Understood...thanks.

Tim Hillman | Senior Air Quality Scientist
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

From: Saunders, Eileen [mailto:Eileen.Saunders@eon-us.com]
Sent: Thursday, May 20, 2010 8:47 AM
To: Hillman, Timothy M.; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: CO Emission Limit Question

All,

Gary contacted me today regarding your question and he is in the process of researching the answer. As soon as I hear from him, I will pass along the information to you.

Thank you,

Eileen

	A	B	C	D	E	F	G
1							
2	**Estimated Requirements Under Future New Environmental Regulations**						
3							
4	**Task**	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
5	**No.**	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
6	4.1	GHG Inventory	No additional limits			N/A	Spring - 2010
7	4.2	ing Engine NSPS and	PM	Horsepower. Certified to meet Tier		Unit	ting MACT & at insta
8			NO_x				
9			VOC				
10			CO				
11	4.3	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
12			MC4 - SAM	76.5	lbs/hour		
13	4.4	fferson Co. STAR Re				Plant	Spring - 2012
14			fuels (As) 20 - 50 ppm	or $\sim 1x10^{-5}$ lbs/mmBtu emis			
15	&	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	er, 2010 NO_x & SA
16			SO_2	97%	Removal		
17			NO_x	0.07 /0.08	lbs/mmBtu		
18			SAM	110 -220	lbs/mmBtu		
19	4.7	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
20	4.8	GHG NSR	GHG	Energy Efficiency Projects		Unit/Plant	January, 2011
21	4.9	Revised CAIR	SO_2	0.25	lbs/mmBtu	Plant	Beginning in 2014
22			NO_x	0.11	lbs/mmBtu		
23	4.10	New EGU MACT	Mercury	90% or	Removal	Plant	with 1-yr extension
24				0.012	lbs/GWH		
25			Acids (HCl)	0.002	lbs/mmBtu	Unit	
26			Metals (PM)	0.03	lbs/mmBtu		
27			Metals (As)	0.5×10^{-5}	lbs/mmBtu		
28			Organics (CO)	0.10	lbs/mmBtu		
29			Dioxin/Furan	15×10^{-18}	lbs/mmBtu		
30	4.11	n Co. Ozone Non-at	NO_x	5 - 10 % reductior	NOx emissions	County-wide	Spring - 2016
31	4.11	v 1-hour NAAQS for	NO_x	letermined based on m	lbs/hours	Plant	During - 2015
32	4.12	v 1-hour NAAQS for	SO_2	letermined based on m	lbs/hours	Plant	Spring - 2016
33	4.13	Reduction & Renew	GHG	letermined based on m	tons/year	Fleet	Beginning in 2014
34	Plan Risk	2.5 Emission Reduct	12.5 (Condensabl	letermined based on m	lbs/mmBtu	Unit/Plant	After 2013
35	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	Brown Consent Decree	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 Name**	**Regulated Pollutants**			**Unit/Plant Averaging**	**Forcasted Date for Compliance**
6		**Pollutant**	**Limit**	**Units**		
7	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
8		MC4 - SAM	76.5	lbs/hour		
9	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	ber, 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	0.25	lbs/mmBtu	Plant	ase I in 2016; Limits in Phase I
15		NO_x	0.11	lbs/mmBtu		
16	New EGU MACT	Mercury	90% or	Removal	Plant	2017 for high utilitization u
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	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	$\Lambda_{2.5}$ 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	nase 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 for	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:	Lucas, Kyle J.
To:	Saunders, Eileen
CC:	Mahabaleshwarkar, Anand; Hillman, Timothy M.
Sent:	5/20/2010 5:50:21 PM
Subject:	EON AQC Selection Sheets - Green River
Attachments:	Green River Unit 3 052010.doc; Green River Unit 4 052010.doc

Eileen,
Attached please find the AQC technology selection sheets for Green River Units 3 & 4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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	***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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans, Air Heater and dry carbon steel Stack required for Unit 3.
- Underground aux electric duct banks need to be avoided during foundations for future AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

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 NOx 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 ID fan installation is needed.
- Existing air heater will be demolished and used as SCR ductwork.
- New air heater.
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater. New air heater to be located straight under the new SCR.

Pollutant: SO_2

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
Unit: *3*

gas recycle to maintain the lime bed during low load operations. Hence CDS is the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed.
- Existing ID fans will be demolished
- Location: CDS would be required downstream of the new air heater and upstream of the new ID fans.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed.
- Existing ESP will be retired in place. This will not be demolished. Exhaust gas stream will bypass the existing ESP.
- Location: A new PJFF for Unit 3 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be demolished.
- New Air Heater will be installed straight under the new SCR.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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:

- 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 will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF for Unit 3 is recommended in conjunction with PAC injection.
- PAC to be injected downstream of the new air heater but upstream of CDS FGD system for Unit 3

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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: *Green River*
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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans and dry carbon steel Stack required for Unit 4. Booster fans options to be evaluated.
- Relocate existing power lines and tower.
- Will require demolition of abandoned Unit 1 and Unit 2 ID fans, scrubber and stack to make room for Unit 4 new AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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 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 mitigate system.
- New ID fan installation is needed if booster fans do not make sense.
- Existing air heater will be used
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing hot-side ESP and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue gas recycle to maintain the lime bed during low load operations. Hence CDS is

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed if booster fans do not make sense.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.
- Location: CDS would be required downstream of the existing air heater and upstream of the new ID fans. Existing ID fans located at higher elevation will either be retired in place if new ID fans are selected or reused when new booster fans are added CDS with new dry carbon steel stack.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed if booster fans do not make sense.
- Existing hot side ESP to be kept to minimize the arrangement challenges for new SCR. The existing ESP will remain functional (energized) and used for additional PM filtration.
- Location: A new PJFF for Unit 4 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 x 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 4.
- *PAC to be injected downstream of the existing air heater but upstream of CDS FGD system for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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.

From: Saunders, Eileen
To: Troost, Tom; Harper, Travis
Sent: 5/20/2010 7:00:12 PM
Subject: Fw: EON AQC Selection Sheets - Green River
Attachments: Green River Unit 3 052010.doc; Green River Unit 4 052010.doc

Tom and Travis,

Here is the template for Green River. I will check calendars to set up a discussion time. Please ignore the CO question in the email. Gary Revlett is taking care of getting B&V the answer.

Thanks,

Eileen

From: Lucas, Kyle J. <LucasKJ@bv.com>
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand <MahabaleshwarkarA@bv.com>; Hillman, Timothy M. <HillmanTM@bv.com>
Sent: Thu May 20 17:50:21 2010
Subject: EON AQC Selection Sheets - Green River

Eileen,
Attached please find the AQC technology selection sheets for Green River Units 3 & 4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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	***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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans, Air Heater and dry carbon steel Stack required for Unit 3.
- Underground aux electric duct banks need to be avoided during foundations for future AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

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 NOx 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 ID fan installation is needed.
- Existing air heater will be demolished and used as SCR ductwork.
- New air heater.
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater. New air heater to be located straight under the new SCR.

Pollutant: SO_2

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

gas recycle to maintain the lime bed during low load operations. Hence CDS is the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed.
- Existing ID fans will be demolished
- Location: CDS would be required downstream of the new air heater and upstream of the new ID fans.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed.
- Existing ESP will be retired in place. This will not be demolished. Exhaust gas stream will bypass the existing ESP.
- Location: A new PJFF for Unit 3 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be demolished.
- New Air Heater will be installed straight under the new SCR.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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:
- 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 will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF for Unit 3 is recommended in conjunction with PAC injection.
- PAC to be injected downstream of the new air heater but upstream of CDS FGD system for Unit 3

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:
- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:
- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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: *Green River*
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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15 x10^{-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: *Green River*
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 ID Fans and dry carbon steel Stack required for Unit 4. Booster fans options to be evaluated.
- Relocate existing power lines and tower.
- Will require demolition of abandoned Unit 1 and Unit 2 ID fans, scrubber and stack to make room for Unit 4 new AQC equipment.

E.ON US
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Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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 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 mitigate system.
- New ID fan installation is needed if booster fans do not make sense.
- Existing air heater will be used
- New economizer bypass will be built
- <u>Location</u>: SCR would be required downstream of the existing hot-side ESP and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:
- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:
- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue gas recycle to maintain the lime bed during low load operations. Hence CDS is

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed if booster fans do not make sense.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.
- Location: CDS would be required downstream of the existing air heater and upstream of the new ID fans. Existing ID fans located at higher elevation will either be retired in place if new ID fans are selected or reused when new booster fans are added CDS with new dry carbon steel stack.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed if booster fans do not make sense.
- Existing hot side ESP to be kept to minimize the arrangement challenges for new SCR. The existing ESP will remain functional (energized) and used for additional PM filtration.
- Location: A new PJFF for Unit 4 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 x 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 4.
- *PAC to be injected downstream of the existing air heater but upstream of CDS FGD system for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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.

From:	Saunders, Eileen
To:	Straight, Scott
Sent:	5/20/2010 8:06:08 PM
Subject:	Fw: EON AQC Selection Sheets - Green River
Attachments:	Green River Unit 3 052010.doc; Green River Unit 4 052010.doc

Green River data.

From: Lucas, Kyle J. <LucasKJ@bv.com>
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand <MahabaleshwarkarA@bv.com>; Hillman, Timothy M. <HillmanTM@bv.com>
Sent: Thu May 20 17:50:21 2010
Subject: EON AQC Selection Sheets - Green River

Eileen,
Attached please find the AQC technology selection sheets for Green River Units 3 & 4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
Black & Veatch - Building a World of Difference™
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Overland Park, KS 66211
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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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	***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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans, Air Heater and dry carbon steel Stack required for Unit 3.
- Underground aux electric duct banks need to be avoided during foundations for future AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

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 NOx 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 ID fan installation is needed.
- Existing air heater will be demolished and used as SCR ductwork.
- New air heater.
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater. New air heater to be located straight under the new SCR.

Pollutant: SO_2

Feasible Control Options:
- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:
- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue

E.ON US
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Technology Options

Plant: *Green River*
Unit: *3*

gas recycle to maintain the lime bed during low load operations. Hence CDS is the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed.
- Existing ID fans will be demolished
- Location: CDS would be required downstream of the new air heater and upstream of the new ID fans.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed.
- Existing ESP will be retired in place. This will not be demolished. Exhaust gas stream will bypass the existing ESP.
- Location: A new PJFF for Unit 3 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be demolished.
- New Air Heater will be installed straight under the new SCR.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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:

- 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 will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF for Unit 3 is recommended in conjunction with PAC injection.
- PAC to be injected downstream of the new air heater but upstream of CDS FGD system for Unit 3

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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: *Green River*
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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for*** SO_2 ***removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of* 1×10^{-6} *lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans and dry carbon steel Stack required for Unit 4. Booster fans options to be evaluated.
- Relocate existing power lines and tower.
- Will require demolition of abandoned Unit 1 and Unit 2 ID fans, scrubber and stack to make room for Unit 4 new AQC equipment.

E.ON US
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Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 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 mitigate system.
- New ID fan installation is needed if booster fans do not make sense.
- Existing air heater will be used
- New economizer bypass will be built
- <u>Location</u>: SCR would be required downstream of the existing hot-side ESP and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue gas recycle to maintain the lime bed during low load operations. Hence CDS is

E.ON US
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Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
Unit: *4*

the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed if booster fans do not make sense.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.
- Location: CDS would be required downstream of the existing air heater and upstream of the new ID fans. Existing ID fans located at higher elevation will either be retired in place if new ID fans are selected or reused when new booster fans are added CDS with new dry carbon steel stack.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed if booster fans do not make sense.
- Existing hot side ESP to be kept to minimize the arrangement challenges for new SCR. The existing ESP will remain functional (energized) and used for additional PM filtration.
- Location: A new PJFF for Unit 4 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 x 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 4.
- *PAC to be injected downstream of the existing air heater but upstream of CDS FGD system for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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.

From: Revlett, Gary
To: Straight, Scott
Sent: 5/21/2010 7:03:47 AM
Subject: FW: CO Emission Limit Question
Attachments: Generation Future Environmental Requirements.xlsx

FYI

From: Revlett, Gary
Sent: Thursday, May 20, 2010 5:02 PM
To: Saunders, Eileen
Subject: RE: CO Emission Limit Question

Hi Eileen,

The revised tables are attached.

Gary

From: Saunders, Eileen
Sent: Thursday, May 20, 2010 4:47 PM
To: Revlett, Gary; 'Hillman, Timothy M.'; 'Lucas, Kyle J.'; 'Mahabaleshwarkar, Anand'
Cc: Straight, Scott
Subject: RE: CO Emission Limit Question

Gary,

Please update the "Estimated Requirements Under Future New Environmental Regulations" document that was provided to the team and B&V as soon as possible. I need to make sure everyone receives the new limit for their records.

Thank you,

Eileen

From: Revlett, Gary
Sent: Thursday, May 20, 2010 3:33 PM
To: 'Hillman, Timothy M.'; Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Subject: RE: CO Emission Limit Question

Everyone,

I have reviewed my notes on the origin of the suggested Electric Generating Unit (EGU) MACT carbon monoxide limit of 0.02 lbs/mmBtu. This proposed CO MACT number came from some of our current emission inventories and was based on Table 1.1-3 of AP-42. The value in the table is 0.5 lbs per ton of coal burned, which is approximately 0.02 lbs/mmBtu. When providing this number, I didn't calculate the ppm value as a reality check. Since the ppm value would be less than 10, this does seem to be unrealistically low.

A key factor for the MACT CO will be the averaging time. I would now suggest using the proposed ICI boiler MACT for PC boilers, which is 90 ppm (corrected to 3% O_2) and the averaging time of 24-hours. For the typical operating conditions of 7% O_2, this would be equivalent to ~ 40 ppm or ~0.10 lbs/mmBtu.

Gary

From: Hillman, Timothy M. [mailto:HillmanTM@bv.com]

Sent: Thursday, May 20, 2010 9:54 AM
To: Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: RE: CO Emission Limit Question

Understood...thanks.

Tim Hillman | Senior Air Quality Scientist
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

From: Saunders, Eileen [mailto:Eileen.Saunders@eon-us.com]
Sent: Thursday, May 20, 2010 8:47 AM
To: Hillman, Timothy M.; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: CO Emission Limit Question

All,

Gary contacted me today regarding your question and he is in the process of researching the answer. As soon as I hear from him, I will pass along the information to you.

Thank you,

Eileen

	A	B	C	D	E	F	G
1							
2	**Estimated Requirements Under Future New Environmental Regulations**						
3							
4	**Task**	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
5	**No.**	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
6	4.1	GHG Inventory	No additional limits			N/A	Spring - 2010
7	4.2	ing Engine NSPS and	PM	lorsepower. Certified to meet Tier		Unit	ting MACT & at insta
8			NO_x				
9			VOC				
10			CO				
11	4.3	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
12			MC4 - SAM	76.5	lbs/hour		
13	4.4	fferson Co. STAR Re				Plant	Spring - 2012
14			fuels (As) 20 - 50 ppm or ~1x10^{-5} lbs/mmBtu emis				
15	&	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	er, 2010 NO_x & SA
16			SO_2	97%	Removal		
17			NO_x	0.07 /0.08	lbs/mmBtu		
18			SAM	110 -220	lbs/mmBtu		
19	4.7	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
20	4.8	GHG NSR	GHG	Energy Efficiency Projects		Unit/Plant	January, 2011
21	4.9	Revised CAIR	SO_2	0.25	lbs/mmBtu	Plant	Beginning in 2014
22			NO_x	0.11	lbs/mmBtu		
23	4.10	New EGU MACT	Mercury	90% or	Removal	Plant	with 1-yr extension
24				0.012	lbs/GWH		
25			Acids (HCl)	0.002	lbs/mmBtu	Unit	
26			Metals (PM)	0.03	lbs/mmBtu		
27			Metals (As)	0.5 x 10^{-5}	lbs/mmBtu		
28			Organics (CO)	0.10	lbs/mmBtu		
29			Dioxin/Furan	15 x 10^{-18}	lbs/mmBtu		
30	4.11	n Co. Ozone Non-at	NO_x	5 - 10 % reductior	NOx emissions	County-wide	Spring - 2016
31	4.11	1-hour NAAQS for	NO_x	letermined based on m	lbs/hours	Plant	During - 2015
32	4.12	1-hour NAAQS for	SO_2	letermined based on m	lbs/hours	Plant	Spring - 2016
33	4.13	Reduction & Renew	GHG	letermined based on m	tons/year	Fleet	Beginning in 2014
34	Plan Risk	$_{2.5}$ Emission Reduct	12.5 (Condensabl	letermined based on m	lbs/mmBtu	Unit/Plant	After 2013
35	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 begi	anaylsis is just begi	Plant	During - 2015
38	4.17	CCR Classification	Toxic Metals	landfill; possible closing existing ash po		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	Brown 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	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	ber, 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	0.25	lbs/mmBtu	Plant	ase I in 2016; Limits in Phase I
15		NO_x	0.11	lbs/mmBtu		
16	New EGU MACT	Mercury	90% or	Removal	Plant	2017 for high utilitization u
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	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	$I_{2.5}$ 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 n	lbs/hours	Plant	During - 2016
25	1-hour NAAQS fo	SO_2	etermined based on n	lbs/hours	Plant	Spring - 2017
26	$PM_{2.5}$ NAAQS	$_{2.5}$ or Condensable	etermined based on n	lbs/hours	Plant	During 2017
27						
28		- New requirements have been finalized				

From:	Saunders, Eileen
To:	Jackson, Audrey
Sent:	5/21/2010 8:25:11 AM
Subject:	FW: EON AQC Selection Sheets - Mill Creek
Attachments:	Mill Creek Unit 1 052010.doc; Mill Creek Unit 2 052010.doc; Mill Creek Unit 3 052010.doc; Mill Creek Unit 4 052010.doc

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, May 20, 2010 4:20 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheets - Mill Creek

Eileen,
Attached please find the AQC technology selection sheets for Mill Creek Units 1-4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
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E.ON US
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 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 x10^{-18} lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Mill Creek***
Unit: ***1***

E.ON Comments:

E.ON US
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
- <u>Location</u>: 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: *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
- <u>Location</u>: 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:
- **<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: ***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^{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 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.

From: Saunders, Eileen
To: Jackson, Audrey
Sent: 5/21/2010 8:25:25 AM
Subject: FW: EON AQC Selection Sheets - Green River
Attachments: Green River Unit 3 052010.doc; Green River Unit 4 052010.doc

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, May 20, 2010 5:50 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheets - Green River

Eileen,
Attached please find the AQC technology selection sheets for Green River Units 3 & 4. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
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	***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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1 x 10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new dioxin/furan compliance limit of 15 x10^{-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: *Green River*
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 ID Fans, Air Heater and dry carbon steel Stack required for Unit 3.
- Underground aux electric duct banks need to be avoided during foundations for future AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

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 NOx 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 ID fan installation is needed.
- Existing air heater will be demolished and used as SCR ductwork.
- New air heater.
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing economizer and upstream of the new air heater. New air heater to be located straight under the new SCR.

Pollutant: SO_2

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

gas recycle to maintain the lime bed during low load operations. Hence CDS is the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed.
- Existing ID fans will be demolished
- Location: CDS would be required downstream of the new air heater and upstream of the new ID fans.

Pollutant: Particulate (PM)

Feasible Control Options:
- Cold Side Dry ESP
- 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 is needed.
- Existing ESP will be retired in place. This will not be demolished. Exhaust gas stream will bypass the existing ESP.
- Location: A new PJFF for Unit 3 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be demolished.
- New Air Heater will be installed straight under the new SCR.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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:
- 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 will not be capable of removing 90% mercury with PAC injection and hence not recommended for cost considerations.
- A new full size PJFF for Unit 3 is recommended in conjunction with PAC injection.
- PAC to be injected downstream of the new air heater but upstream of CDS FGD system for Unit 3

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:
- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:
- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***3***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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: *Green River*
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 Circulating Dry Scrubber (CDS) Desulfurization 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) which is part of the CDS technology for SO_2 removal 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 CDS and Pulse Jet Fabric Filter (PJFF)*** *to meet the new Hg compliance limit of 1×10^{-6} lb/MBtu.*	□ Yes □ No
HCl	***New CDS technology*** *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 CDS and 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: *Green River*
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 ID Fans and dry carbon steel Stack required for Unit 4. Booster fans options to be evaluated.
- Relocate existing power lines and tower.
- Will require demolition of abandoned Unit 1 and Unit 2 ID fans, scrubber and stack to make room for Unit 4 new AQC equipment.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 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 mitigate system.
- New ID fan installation is needed if booster fans do not make sense.
- Existing air heater will be used
- New economizer bypass will be built
- Location: SCR would be required downstream of the existing hot-side ESP and upstream of the existing air heater.

Pollutant: SO_2

Feasible Control Options:
- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:
- Both WFGD and Semi-Dry FGD systems will be able to achieve the new SO_2 compliance limit of 0.25 lb/MBtu on a continuous basis on high sulfur fuels. However for small size boilers like Unit 3, it would be economically feasible to build a semi-dry FGD or CDS system than Wet FGD system. The CDS system will offer more operational flexibility compared to the two other technologies when load flexibility is an issue. The CDS technology will incorporate an internal flue gas recycle to maintain the lime bed during low load operations. Hence CDS is

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Green River*
Unit: *4*

the most feasible control technology considered for SO_2 reduction based on the size of the unit.

- New ID fan installation is needed if booster fans do not make sense.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.
- Location: CDS would be required downstream of the existing air heater and upstream of the new ID fans. Existing ID fans located at higher elevation will either be retired in place if new ID fans are selected or reused when new booster fans are added CDS with new dry carbon steel stack.

Pollutant: Particulate (PM)

Feasible Control Options:

- Cold Side Dry ESP
- 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 is needed if booster fans do not make sense.
- Existing hot side ESP to be kept to minimize the arrangement challenges for new SCR. The existing ESP will remain functional (energized) and used for additional PM filtration.
- Location: A new PJFF for Unit 4 will be located downstream of the new CDS and upstream of the new ID fans.
- Existing ID fans will be retired in place if new ID fans are used in lieu of booster fans.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
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 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 4.
- *PAC to be injected downstream of the existing air heater but upstream of CDS FGD system for Unit 4*

Pollutant: Hydrogen Chloride (HCl)

Feasible Control Options:

- Wet Flue Gas Desulfurization (WFGD)
- Semi-Dry Flue Gas Desulfurization (FGD)
- Circulating Dry Scrubber (CDS)

Special Considerations:

- WFGD, Semi-Dry FGD, and CDS systems will be able to achieve the new HCl compliance limit of 0.002 lb/MBtu on a continuous basis.
- However, since a new CDS system will be installed for SO_2 control, it will also control HCl. Therefore, no new HCl control technology is required beyond the proposed CDS. The new CDS technology with PJFF will remove the HCl to the compliance levels of 0.002 lb/MBtu.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Green River***
Unit: ***4***

Pollutant: Dioxin/Furan

Feasible Control Options:

- PAC injection with new CDS and 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.

From: Saunders, Eileen
To: Jackson, Audrey
Sent: 5/21/2010 8:25:41 AM
Subject: FW: EON AQC Selection Sheet - Trimble County
Attachments: Trimble County Unit 1 051810.doc

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Tuesday, May 18, 2010 7:03 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheet - Trimble County

Eileen,
Attached please find the AQC technology selection sheet for Trimble County Unit 1. At this time, we believe that Unit 2 has a full suite of AQC technologies that may meet the target emission levels and will be determined later when the unit is operational. Thus, we have not included an AQC technology selection sheet for this unit. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, please confirm the CO targeted emission level noted in the matrix is 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

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**
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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Trimble County*
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 NOx 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 PJFF.***	□ 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*** *and new Pulse Jet Fabric Filter (PJFF) required to meet the compliance requirements.*	□ 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 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 US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Trimble County***
Unit: ***1***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Trimble County***
Unit: ***1***

Pollutant: NO_x

Feasible Control Options:

- **No new NO_x control technology is required**. The unit is currently equipped with state of the art SCR that can meet future target NOx emissions level of 0.11 lb/MBtu.

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 SO2 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.*

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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Trimble County***
Unit: ***1***

continuous basis and hence is the most feasible control technology. The existing cold-side dry ESP will not be capable to removing 90% mercury with PAC injection and hence not recommended for cost considerations.

Special Considerations:

- Full size PJFF.
- *PAC to be injected downstream of the existing ESP but upstream of new PJFF.*
- Location: A PJFF would be required downstream of the PAC injection system.
- 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 – Electrical manhole and electrical duct banks running underground between the existing ID fans and scrubber inlet duct will need to be avoided or relocated to make real estate available.
    - Array of I-beam structures (currently supporting no equipment) located between the existing ID fans and scrubber inlet needs to be demolished.
    - New PJFF will be installed at a higher elevation needing heavy support columns that need to be landing outside the existing ESP foundations.

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:

- The **new 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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: *Trimble County*
Unit: *1*

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.

From:	Saunders, Eileen
To:	Jackson, Audrey
Sent:	5/21/2010 8:25:52 AM
Subject:	FW: EON AQC Selection Sheets - Cane Run
Attachments:	Cane Run Unit 4 052010.doc; Cane Run Unit 5 052010.doc; Cane Run Unit 6 052010.doc

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Thursday, May 20, 2010 3:13 PM
To: Saunders, Eileen
Cc: Mahabaleshwarkar, Anand; Hillman, Timothy M.
Subject: EON AQC Selection Sheets - Cane Run

Eileen,
Attached please find the AQC technology selection sheets for Cane Run Units 4-6. Please review this information and provide your approval for the recommended technologies. If E.ON chooses not to approve any of recommended technologies, please provide a detailed description of the alternative approach.

Additionally, we understand you are confirming the CO targeted emission level noted in the matrix of 0.02 lb/MBtu (for each of the 18 coal-fired units). We have assumed that this value is correct and was developed from the recent boiler MACT. However, B&V does not know of any feasible and proven CO control technology for units of this type and size.

Please feel free to contact us if you have any questions,

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
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E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

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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Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***4***

E.ON Comments:

E.ON US
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

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
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 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 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.

E.ON US
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***5***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
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.
- <u>Location</u>: 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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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™).
- 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.

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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 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 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 x10^{-18} lb/MBtu.*	□ Yes □ No

E.ON US
Coal-Fired Fleet Wide
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***Cane Run***
Unit: ***6***

E.ON Comments:

E.ON US
Coal-Fired Fleet Wide
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

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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.

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
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.

From:	Lucas, Kyle J.
To:	Saunders, Eileen
CC:	Hillman, Timothy M.; Mahabaleshwarkar, Anand; Mehta, Pratik D.
Sent:	5/21/2010 10:52:23 AM
Subject:	E.ON AQC - Design Basis
Attachments:	Design Basis for E-ON 052110b.pdf

Eileen,
Attached is the design basis we have quickly developed for each unit based on the noted fuels and other information provided by E.ON. The design basis is reflects the estimate of boiler and equipment operation based using the current unit emissions from the Matrix. B&V will use this information as the baseline for each unit and from this point the approved AQC technologies will be added and costs developed. Again, this is just one point/step of the overall costing process and can be revised in later phases of the project.
Please review this information and feel free to provide comments by Monday morning for consideration.

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
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Overland Park, KS 66211
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EON
EW Brown, Ghent, Cane Run, Mill Creek, Trimble County, Green River
Design Basis
5/21/2010

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	
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	49.65	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	261	330	330	423	525	547	760	75	109	B&V Combustion Calculations
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	86.02	85.25	B&V Combustion Calculations
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	B&V Combustion Calculations
Coal Flow Rate, lb/hr	89,266	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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	-8.0	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	9,963	24,697	32,161	25,936	32,942	32,805	9,608	10,531	15,516	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	6,584,670	No SCR	No SCR	B&V Combustion Calculations
Volumetric Flue Gas Flow Rate, acfm				2,682,371		2,977,658	3,085,629						2,081,162	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	-18.00	-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	296,916		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	680,654	917,824	1,200,841	1,233,697	1,588,066	1,832,543	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
5/21/2010

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																			
Flue Gas Temperature, F	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	129.43	No WESP	No WESP	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

From:	Saunders, Eileen
To:	Turner, Steven; Hensley, Mike; Kirkland, Mike; Koller, Tiffany; Turner, Steven; Fraley, Jeffrey; Pabian, Brad; Carman, Barry; Troost, Tom; Harper, Travis; Crutcher, Tom; Turner, Haley; Wilson, Stuart; Karavayev, Louanne; Black, Greg; Revlett, Gary; Imber, Philip; Billiter, Delbert
CC:	Straight, Scott
Sent:	5/21/2010 11:04:17 AM
Subject:	FW: E.ON AQC - Design Basis
Attachments:	Design Basis for E-ON 052110b.pdf

All,

Please see the design basis B&V plans to use for the cost estimate based on the data E.ON has provided as well as their internal data and calculations. If you have any comments or questions, please let me know by Monday.

As you are looking at the spreadsheet, please see the last column, titled "Reference" for details on the build-up of each line of data.

Thank you,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Friday, May 21, 2010 10:52 AM
To: Saunders, Eileen
Cc: Hillman, Timothy M.; Mahabaleshwarkar, Anand; Mehta, Pratik D.
Subject: E.ON AQC - Design Basis

Eileen,
Attached is the design basis we have quickly developed for each unit based on the noted fuels and other information provided by E.ON. The design basis is reflects the estimate of boiler and equipment operation based using the current unit emissions from the Matrix. B&V will use this information as the baseline for each unit and from this point the approved AQC technologies will be added and costs developed. Again, this is just one point/step of the overall costing process and can be revised in later phases of the project.
Please review this information and feel free to provide comments by Monday morning for consideration.

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
Black & Veatch - Building a World of Difference™
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Overland Park, KS 66211
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EON
EW Brown, Ghent, Cane Run, Mill Creek, Trimble County, Green River
Design Basis
5/21/2010

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	
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	49.65	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	261	330	330	423	525	547	760	75	109	B&V Combustion Calculations
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	B&V Combustion Calculations
Boiler Heat Input, MBtu/hr (HHV)	999.80	1,865.50	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	B&V Combustion Calculations
Coal Flow Rate, lb/hr	89,266	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	B&V Combustion Calculations
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	83.0	80.0	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	-18.00	-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	6,980,068	947,426	1,349,077	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	1,349,077	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	1,588,066	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
5/21/2010

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

From: Saunders, Eileen
To: Crutcher, Tom; Turner, Haley
Sent: 5/21/2010 1:15:18 PM
Subject: FW: CO Emission Limit Question
Attachments: Generation Future Environmental Requirements.xlsx

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From: Revlett, Gary
Sent: Thursday, May 20, 2010 5:02 PM
To: Saunders, Eileen
Subject: RE: CO Emission Limit Question

Hi Eileen,

The revised tables are attached.

Gary

From: Saunders, Eileen
Sent: Thursday, May 20, 2010 4:47 PM
To: Revlett, Gary; 'Hillman, Timothy M.'; 'Lucas, Kyle J.'; 'Mahabaleshwarkar, Anand'
Cc: Straight, Scott
Subject: RE: CO Emission Limit Question

Gary,

Please update the "Estimated Requirements Under Future New Environmental Regulations" document that was provided to the team and B&V as soon as possible. I need to make sure everyone receives the new limit for their records.

Thank you,

Eileen

From: Revlett, Gary
Sent: Thursday, May 20, 2010 3:33 PM
To: 'Hillman, Timothy M.'; Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Subject: RE: CO Emission Limit Question

Everyone,

I have reviewed my notes on the origin of the suggested Electric Generating Unit (EGU) MACT carbon monoxide limit of 0.02 lbs/mmBtu. This proposed CO MACT number came from some of our current emission inventories and was based on Table 1.1-3 of AP-42. The value in the table is 0.5 lbs per ton of coal burned, which is approximately 0.02 lbs/mmBtu. When providing this number, I didn't calculate the ppm value as a reality check. Since the ppm value would be less than 10, this does seem to be unrealistically low.

A key factor for the MACT CO will be the averaging time. I would now suggest using the proposed ICI boiler MACT for PC boilers, which is 90 ppm (corrected to 3% O_2) and the averaging time of 24-hours. For the typical operating conditions of 7% O_2, this would be equivalent to ~ 40 ppm or ~0.10 lbs/mmBtu.

Gary

From: Hillman, Timothy M. [mailto:HillmanTM@bv.com]

Sent: Thursday, May 20, 2010 9:54 AM
To: Saunders, Eileen; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: RE: CO Emission Limit Question

Understood...thanks.

Tim Hillman | Senior Air Quality Scientist
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

From: Saunders, Eileen [mailto:Eileen.Saunders@eon-us.com]
Sent: Thursday, May 20, 2010 8:47 AM
To: Hillman, Timothy M.; Lucas, Kyle J.; Mahabaleshwarkar, Anand
Cc: Revlett, Gary
Subject: CO Emission Limit Question

All,

Gary contacted me today regarding your question and he is in the process of researching the answer. As soon as I hear from him, I will pass along the information to you.

Thank you,

Eileen

	A	B	C	D	E	F	G
1							
2	**Estimated Requirements Under Future New Environmental Regulations**						
3							
4	**Task**	**Program**	**Regulated Pollutants**			**Unit/Plant**	**Forcasted Date**
5	**No.**	**Name**	**Pollutant**	**Limit**	**Units**	**Averaging**	**for Compliance**
6	4.1	GHG Inventory	No additional limits			N/A	Spring - 2010
7			PM				
8	4.2	ing Engine NSPS and	NO_x	Iorsepower. Certified to meet Tier		Unit	ting MACT & at insta
9			VOC				
10			CO				
11	4.3	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
12			MC4 - SAM	76.5	lbs/hour		
13	4.4	fferson Co. STAR Re				Plant	Spring - 2012
14			fuels (As) 20 - 50 ppm or ~1x10^{-5} lbs/mmBtu emis				
15			PM	0.03	lbs/mmBtu		
16			SO_2	97%	Removal		
17	&	rown Consent Decre	NO_x	0.07 /0.08	lbs/mmBtu	Unit 3	er, 2010 NO_x & SA
18			SAM	110 -220	lbs/mmBtu		
19	4.7	Ghent NOVs	SAM	3.5 - 10	ppm	Unit	During - 2012
20	4.8	GHG NSR	GHG	Energy Efficiency Projects		Unit/Plant	January, 2011
21	4.9	Revised CAIR	SO_2	0.25	lbs/mmBtu	Plant	Beginning in 2014
22			NO_x	0.11	lbs/mmBtu		
23			Mercury	90% or	Removal	Plant	
24				0.012	lbs/GWH		
25			Acids (HCl)	0.002	lbs/mmBtu		
26	4.10	New EGU MACT	Metals (PM)	0.03	lbs/mmBtu		with 1-yr extension
27			Metals (As)	0.5 x 10^{-5}	lbs/mmBtu	Unit	
28			Organics (CO)	0.10	lbs/mmBtu		
29			Dioxin/Furan	15 x 10^{-18}	lbs/mmBtu		
30	4.11	n Co. Ozone Non-at	NO_x	5 - 10 % reductior	NOx emissions	County-wide	Spring - 2016
31	4.11	v 1-hour NAAQS for	NO_x	letermined based on m	lbs/hours	Plant	During - 2015
32	4.12	v 1-hour NAAQS for	SO_2	letermined based on m	lbs/hours	Plant	Spring - 2016
33	4.13	Reduction & Renew	GHG	letermined based on m	tons/year	Fleet	Beginning in 2014
34	Plan Risk	$_{2.5}$ Emission Reduct	12.5 (Condensabl	letermined based on m	lbs/mmBtu	Unit/Plant	After 2013
35	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 begi	anaylsis is just begi	Plant	During - 2015
38	4.17	CCR Classification	Toxic Metals	landfill; possible closing existing ash po		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 Name**	**Regulated Pollutants**			**Unit/Plant Averaging**	**Forcasted Date for Compliance**
6		**Pollutant**	**Limit**	**Units**		
7	Mill Creek BART	MC3 - SAM	64.3	lbs/hour	Unit	During - 2011
8		MC4 - SAM	76.5	lbs/hour		
9	rown Consent Decre	PM	0.03	lbs/mmBtu	Unit 3	ber, 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	0.25	lbs/mmBtu	Plant	ase I in 2016; Limits in Phase I
15		NO_x	0.11	lbs/mmBtu		
16	New EGU MACT	Mercury	90% or	Removal	Plant	2017 for high utilitization u
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	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	$I_{2.5}$ 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 for	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:	Saunders, Eileen
To:	Hillman, Timothy M.; 'Lucas, Kyle J.'; Mahabaleshwarkar, Anand
CC:	Fraley, Jeffrey; Pabian, Brad; Carman, Barry
Sent:	5/21/2010 2:52:28 PM
Subject:	FW: AQCS Response - Brown Station
Attachments:	Brown AQC Comments.docx; E W Brown Unit 1 051910 eon response.doc; E W Brown Unit 2 051910 eon response.docx; E W Brown Unit 3 051910 eon response.docx

All,

Please see the response from the Brown Team. You will notice that I have attached a separate document with comments regarding their preference for controlling NOx for the **station**. As you review the document, please refer to the previously forwarded document titled, “Estimated Requirements Under Future New Environmental Regulations” developed by Gary Revlett for guidance.

If you have any questions, please contact me as soon as possible.

Thank you,

Eileen

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* 1×10^{-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: ***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^{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 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 1×10^{-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 15×10^{-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™).
- 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^{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 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.

Special Considerations:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

From: Saunders, Eileen
To: Straight, Scott
Sent: 5/21/2010 4:39:36 PM
Subject: FW: AQCS Response - Brown Station
Attachments: Brown AQC Comments.docx; E W Brown Unit 1 051910 eon response.doc; E W Brown Unit 2 051910 eon response.docx; E W Brown Unit 3 051910 eon response.docx

FYI

From: Saunders, Eileen
Sent: Friday, May 21, 2010 2:52 PM
To: Hillman, Timothy M.; 'Lucas, Kyle J.'; Mahabaleshwarkar, Anand
Cc: Fraley, Jeffrey; Pabian, Brad; Carman, Barry
Subject: FW: AQCS Response - Brown Station

All,

Please see the response from the Brown Team. You will notice that I have attached a separate document with comments regarding their preference for controlling NOx for the **station**. As you review the document, please refer to the previously forwarded document titled, "Estimated Requirements Under Future New Environmental Regulations" developed by Gary Revlett for guidance.

If you have any questions, please contact me as soon as possible.

Thank you,

Eileen

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 1×10^{-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: ***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™).
- 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 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 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 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: *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.

Special Considerations:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

From:	Saunders, Eileen
To:	Gregory, Ronald
Sent:	5/21/2010 5:03:30 PM
Subject:	FW: E.ON AQC - Design Basis
Attachments:	Design Basis for E-ON 052110b.pdf

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Friday, May 21, 2010 10:52 AM
To: Saunders, Eileen
Cc: Hillman, Timothy M.; Mahabaleshwarkar, Anand; Mehta, Pratik D.
Subject: E.ON AQC - Design Basis

Eileen,
Attached is the design basis we have quickly developed for each unit based on the noted fuels and other information provided by E.ON. The design basis is reflects the estimate of boiler and equipment operation based using the current unit emissions from the Matrix. B&V will use this information as the baseline for each unit and from this point the approved AQC technologies will be added and costs developed. Again, this is just one point/step of the overall costing process and can be revised in later phases of the project.
Please review this information and feel free to provide comments by Monday morning for consideration.

Regards,
Kyle

Kyle Lucas | Environmental Permitting Manager
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Overland Park, KS 66211
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EON
EW Brown, Ghent, Cane Run, Mill Creek, Trimble County, Green River
Design Basis
5/21/2010

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	
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	49.65	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	261	330	330	423	525	547	760	75	109	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
Coal Flow Rate, lb/hr	89,266	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	B&V Combustion Calculations
Capacity Factor, %	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	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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	B&V Combustion Calculations
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	39,458	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	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	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		
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					4,531,863	5,756,209	5,667,437											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	No SCR	No SCR	New SCR Planned for 2012		No SCR			No SCR	No SCR	No SCR	No SCR	No SCR					No SCR	No SCR	
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				5,311,071		5,871,333	5,780,786						4,219,979	5,135,360	5,252,708	6,584,970			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	-18.00	-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	6,980,068	947,426	1,349,077	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					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											No Cold-side ESP. Unit has a Hot-side ESP	
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				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		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	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		No Fabric Filter	No Fabric Filter	
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																7,398,872			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	1,349,077	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	1,588,066	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
5/21/2010

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																			
Flue Gas Temperature, F	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	129.43	No WESP	No WESP	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

From:	Hillman, Timothy M.
To:	Saunders, Eileen
CC:	Mahabaleshwarkar, Anand; Lucas, Kyle J.
Sent:	5/24/2010 4:23:22 PM
Subject:	167987.28.0600 EON AQC Project - Action Item List from 052410 Project Conference Call
Attachments:	EON ACTION ITEM LIST 052410.xls

Eileen,

Please find attached an updated action item list from our conference call this afternoon.

Best regards,

Tim Hillman | Senior Air Quality Scientist
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

	A	B	C	D	E	F	G	I	J	K
1	**ACTION ITEM LIST - EON AIR QUALITY CONTROL STUDY**									
2										
3	ITEM #	SOURCE		DESCRIPTION	FILE NO.	RESPONSIBILITY		ATE ADDE	RIG DUE DAT	RR DUE D
4		DOC/MTNG	DATE			CO.	INITIAL			
5	1	Conf Call	5/3/10	Send template for environmental requirements matrix		BV	AM	05/03/10	05/03/10	05/03/10
6	2	Conf Call	5/3/10	Establish a "General" folder in the IBackup document manager		BV	BO	05/03/10	05/04/10	05/03/10
7	3	Conf Call	5/3/10	Set up weekly project status conference call and action item list		BV	TH	05/03/10	05/07/10	05/12/10
8	4	Conf Call	5/3/10	Prepare draft agenda for May 10 kickoff meeting		BV	TH	05/03/10	05/04/10	05/05/10
9	5	Conf Call	5/3/10	Send EON names and disciplines of AQC site teams		BV	AM	05/03/10	05/04/10	05/03/10
10	6	Conf Call	5/3/10	Send previous project invoice format to EON for review		BV	MK/TH	05/03/10	05/06/10	05/05/10
11	7	Conf Call	5/3/10	Prepare a more detailed/specific data request		BV	AM	05/03/10	05/03/10	05/03/10
12	8	Conf Call	5/3/10	Email suggestions for coordination and order of site visits		EON	ES	05/03/10	05/04/10	05/05/10
13	9	Conf Call	5/3/10	Set up contact with EON Fuels		EON	ES	05/03/10	05/04/10	05/04/10
14	10	Conf Call	5/3/10	Determine financial model input requirements (i.e., owner's cost, etc)		EON	ES	05/03/10	05/07/10	
15	11	Kick-Off Mtng	5/10/10	Prepare Meeting Minutes from Kick-off Meeting		BV	KL	05/10/10	05/13/10	05/17/10
16	12	Project Call	5/17/10	Review Kickoff Meeting Minutes		EON	ES	05/17/10	05/18/10	
17	13	Project Call	5/17/10	Issue AQC Recommendation Summaries		BV	KL	5/17/10	05/18-05/20	
18	14	Project Call	5/17/10	Issue Design Basis		BV	KL	5/17/10	05/20/10	05/21/10
19	15	Project Call	5/17/10	Review and Approve AQC Recommendations		EON	ES	5/17/10	05/21/10	05/24/10
20	16	Project Call	5/24/10	Update Design Basis Memo with Revised Data References		BV	AM	05/24/10	05/25/10	
21	17	Project Call and S	5/24/10	Issue Capital and O&M Cost Data		BV	KL	05/24/10	COB 06/01/10	
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	A	B	C	D	E
1	EON	E.ON U.S. SERVICES INC. COMPANY			
2	ES	Eileen Saunders			
3	GB	Greg Black			
4	GR	Gary Revlett			
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15	BV	Black & Veatch (B&V)			
16	TH	Tim Hillman			
17	KL	Kyle Lucas			
18	AM	Anand Mahabaleshwarker			
19	MK	Mike King			
20	BO	Brian O'Neal			

From:	Saunders, Eileen
To:	Jackson, Audrey
Sent:	5/26/2010 8:36:13 AM
Subject:	FW: AQCS Response - Brown Station
Attachments:	Brown AQC Comments.docx; E W Brown Unit 1 051910 eon response.doc; E W Brown Unit 2 051910 eon response.docx; E W Brown Unit 3 051910 eon response.docx

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From: Saunders, Eileen
Sent: Friday, May 21, 2010 2:52 PM
To: Hillman, Timothy M.; 'Lucas, Kyle J.'; Mahabaleshwarkar, Anand
Cc: Fraley, Jeffrey; Pabian, Brad; Carman, Barry
Subject: FW: AQCS Response - Brown Station

All,

Please see the response from the Brown Team. You will notice that I have attached a separate document with comments regarding their preference for controlling NOx for the **station**. As you review the document, please refer to the previously forwarded document titled, "Estimated Requirements Under Future New Environmental Regulations" developed by Gary Revlett for guidance.

If you have any questions, please contact me as soon as possible.

Thank you,

Eileen

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 1×10^{-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: ***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^{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 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 1×10^{-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 15×10^{-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™).
- 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.

Special Considerations:

E.ON US
Coal-Fired Fleet Wide
Air Quality Control Technology Assessment
Technology Options

Plant: ***E.W. Brown***
Unit: ***3***

- Dioxin and Furan removal will be a co-benefit with targeted mercury emissions removal and additional PAC consumption beyond mercury removal will be required.

From:	Hillman, Timothy M.
To:	Saunders, Eileen
CC:	O'Neal, Brian D.; King, Michael L. (Mike); Mahabaleshwarkar, Anand; Lucas, Kyle J.
Sent:	5/3/2010 6:16:43 PM
Subject:	EON AQC Project - Initial Action Items from 5/3/10 Pre-Kickoff Conference Call
Attachments:	AQCS Fleetwide Compliance Matrix B&V May 3 2010.xls; Black & Veatch Site Visit Teams May 3 2010.xls; EON Power Plant AQCS Information Data Request May 3 2010.xls

Eileen,

As we discussed in our conference call this afternoon, please find attached a few of the initial action items.

- Draft template for the Environmental Requirements Matrix. The green highlighted columns will be calculated and estimated by B&V. EON's input is requested in the other columns.
- Data Request Information Sheet. The yellow highlighted items denote the most critical information.
- Names and disciplines of the site visit personnel.

Regards,

Tim Hillman | Senior Air Quality Scientist

Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

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1													EON Fleetwide AQCS Co
2													
3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW Net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		E. W. Brown											
5	1			1					NOx				
6	2								SO2				
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3	Current Controlled	Future Required En	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections if applicable		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Er**	**Removal %**
4		Ghent											
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Cane Run											
5	1			4					NOx				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Er**	**Removal %**
4		Mill Creek											
5	1			1					NOx				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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1													**EON Fleetwide AQCS Co**
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled En**	**Removal %**
4		Trimble County											
5	1			1					NOx				
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1	**ɔmpliance Analysis and High Level Capital and O&M Cost Estimation**									
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Em**	**Removal %**
4		Green River											
5	1			3					NOx				
6	2								SO2				
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23									SO2				
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1	**EON Environmental AQC Assessment Project**						
2	**Item**	**Name of the Professional**	**Discipline**	**Team #**	**Sites Visiting**	**Dates**	**Contact Cell**
3							
4	1	Anand Mahabaleshwarkar	AQC.Mech	1			913 558-7003
5							
6	2	Richard Hooper	AQC/Mech	1			
7							
8	3	Mike Ballard	Civil Constriction	1			
9							
10							
11							
12	1	Dave Muggli	AQC/Mech	2			
13							
14	2	Pratik Mehta	AQC/Chem	2			
15							
16	3	Roger Goodlet	Civil Construction	2			
17							

	A	B	C	D	E	F	G	H	I
1			Black & Veatch AQCS Information Needs						
2									
3	Power Plant:				Owner:				
4	Unit				Project:				
5									
6		References:							
7	1)								
8	2)								
9	3)								
10	4)								
11		Yellow highlight denotes Critical Focus Needs.							
12		Fuel Data							
13		Ultimate Coal Analysis (% by mass as received):				Typical	Minimum	Maximum	
14		Carbon							%
15		Hydrogen							%
16		Sulfur							%
17		Nitrogen							%
18		Oxygen							%
19		Chlorine							%
20		Ash							%
21		Moisture							%
22		Total							
23		Higher Heating Value, Btu/lb (as received)							Btu/lb
24		Ash Mineral Analysis (% by mass):							
25		Silica(SiO_2)							%
26		Alumina (Al_2O_3)							%
27		Titania (TiO_2)							%
28		Phosphorous Pentoxide (P_2O_5)							%
29		Calcium Oxide (CaO)							%
30		Magnesium Oxide (MgO)							%
31		Sodium Oxide (Na_2O)							%
32		Iron Oxide (Fe_2O_3)							%
33		Sulfur Trioxide (SO_3)							%
34		Potassium Oxide (K_2O)							%
35		Coal Trace Element Analysis (mercury and especially arsenic if fly ash is returned to boiler)							

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13	**Notes**	
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	A	B	C	D	E	F	G	H	I
36		Vanadium					%		
37		Arsenic					%		
38		Mercury					% or ppm		
39		Other	LOI				%		
40		Natural gas firing capability (if any at all)							
41		Natural gas line (into the station) capacity (if applicable)							
42		Current Lost on Ignition (LOI)							
43		Start-up Fuel							
44		Ash Fusion Temperature							
45		Initial Deformation					°F		
46		Softening					°F		
47		Hemispherical					°F		
48		Hardgrove Grindability Index							

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	A	B	C	D	E	F	G	H	I
49		**Plant Size and Operation Data: (provide for each unit)**				**Unit X**	**Unit X**	**Unit X**	**Unit X**
50		Maximum (Design) Fuel Burn Rate				B&V can determine some values from previous VISTA			
51		Boiler Type (e.g. wall-fired, tangential fired, cyclone)							
52		Boiler Manufacturer							
53		Net MW Rating (specify plant or turbine MW)							
54		Gross MW Rating							
55		Net Unit Heat Rate							
56		Net Turbine Heat Rate							
57		Boiler SO2 to SO3 Conversion Rate (if known)							
58		Fly Ash/Bottom Ash Split							
59		Flue Gas Recirculation (FGR)							
60			Installed? (Y/N)						
61			In operation? (Y/N)						
62		Flue Gas Recirculation (if installed)							
63		Type of Air Heater							
64		Air Heater Configuration (horizontal or vertical flow or shaft)							
65		Design Pressure/Vacuum Rating for Steam Generator			+/-				
66		Design Pressure/Vacuum Rating for Particulate Control			+/-				
67									
68		**Electrical / Control**							
69		DCS Manufacturer (e.g. Westinghouse, Foxboro, Honeywell, etc.)							
70		Type of DCS (e.g. WDPF, Ovation, Net 90, Infi 90, Symphony, TDC 30							
71		Neural Network Installed? (Y/N)							
72		Neural Network Manufacturer (e.g. Pegasus, Westinghouse, etc.)							
73		Extra Capacity available in DCS?							
74		Historian Manufacturer							
75		Additional Controls from DCS or local PLC w/tie-in							
76		Transformer Rating for Intermediate Voltage Switchgear							
77		Capacity of Spare Electrical Cubicles in Existing MCC's and LCUS's (S							
78		Auxiliary Electric Limited (Y/N)							
79									
80		**Operating Conditions**							
81		Economizer Outlet Temperature							

	J	K
49		**Notes**
50	MBtu/hr	
51		
52		
53	MW	
54	MW	
55	Btu/kWh	
56	Btu/kWh	
57	%	
58	%	
59		
60		
61		
62	%	
63		
64		
65	in wg.	
66	in wg.	
67		
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79		
80		
81	°F	

	A	B	C	D	E	F	G	H	I
82		Economizer Outlet Pressure							
83		Excess Air or Oxygen at Economizer Outlet (full load/min load)							
84		Economizer Outlet Gas Flow							
85									
86		Air Heater Outlet Temperature							
87		Air Heater Outlet Pressure							
88		Particulate Control Equipment Outlet Temperature							
89		Particulate Control Equipment Outlet Pressure							
90		FGD Outlet Temperature (if applicable)							
91		FGD Outlet Pressure (if applicable)							

	J	K
82	in wg.	
83	%	
84	acfm	
85	lb/hr	
86	^{o}F	
87	in wg.	
88	^{o}F	
89	in wg.	
90	^{o}F	
91	in wg.	

	A	B	C	D	E	F	G	H	I
92		**NOx Emissions**				**Unit X**	**Unit X**	**Unit X**	**Unit X**
93		Emissions Limit							
94		Type of NOx Control (if any) - LNB, OFA, etc.							
95		Current NOx Reduction with existing controls							
96		Type of Ammonia Reagent Used (Anhydrous or % H_2O or Urea)							
97		Reagent Cost							
98		Current Emissions							
99									
100									
101									
102		**Particulate Emissions**							
103		Emissions Limit							
104		Type of Emission Control - Hot Side ESP, Cold Side ESP or FF							
105		Oxygen Content of Flue Gas @ Air Heater Outlet							
106		Oxygen Content of Flue Gas @ ESP/FF Outlet							
107		Current Emissions							
108		Fly Ash Sold (Y/N) - See Economic Section							
109									
110			**ESP**						
111			Specific Collection Area (SCA)						
112			Discharge Electrode Type						
113			Supplier						
114			Efficiency						
115			No. of Electrical Sections						
116			% of Fly Ash Sold						
117									
118			**Fabric Filter**						
119			Air to Cloth Ratio (net)						
120			Number of Compartments						
121			Number of Bags per Compartments						
122			Efficiency						
123			% of Fly Ash Sold						
124									
125		**SO_2 Emissions**							
126		Emissions Limit							

	J	K
92		**Notes**
93	lb/MBtu	
94		
95	%	
96		
97	$/ton	
98	lb/hr	
99	ton/yr	
100	lb/MBtu	
101		
102		
103	lb/MBtu	
104		
105	%	
106	%	
107	lb/MBtu	
108		
109		
110		
111	ft^2/1000 acfm	
112		
113		
114	%	
115		
116	%	
117		
118		
119	ft/min	
120		
121		
122	%	
123	%	
124		
125		
126	lb/MBtu	

	A	B	C	D	E	F	G	H	I
127		Type of Emission Control - wet or semi-dry FGD (if any)							
128		Current Emissions							
129									
130									
131		Byproduct Sold (Y/N) - See Economic Section							
132									

	J	K
127		
128	lb/hr	
129	ton/yr	
130	lb/MBtu	
131		
132		

	A	B	C	D	E	F	G	H	I
133		**ID Fan Information (at Full Load):**				**Unit X**	**Unit X**	**Unit X**	**Unit X**
134		ID Fan Inlet Pressure							
135		ID Fan Discharge Pressure							
136		ID Fan Inlet Temperature							
137		Oxygen Content of Flue Gas @ ID Fan Inlet							
138		ID Fan Motor Voltage (Rated)							
139		ID Fan Motor Amps (Operating)							
140		ID Fan Motor Amps (Rated)							
141		ID Fan Motor Power (Rated)							
142		ID Fan Motor Service Factor (1.0 or 1.15)							
143									
144		**Chimney Information:**							
145		Flue Liner Material							
146		Flue Diameter							
147		Chimney Height							
148		Number of Flues							
149									
150		**Drawing and Other Information Needs:**							
151		Baseline pollutant emissions data for AQC analysis							
152		Technical evaluations performed to support recent consent decree activity							
153		Existing Plant/AQC system general design and performance issues							
154		Full detailed boiler front, side, and rear elevation drawings							
155		Boiler Design Data (Boiler Data Sheet)							
156		Ductwork Arrangement Drawing (emphasis from economizer outlet to air heater inlet)							
157		Ductwork Arrangement Drawing (emphasis from air heater outlet to stack)							
158		Plant Arrangement Drawings (showing column row spacing)							
159		CEM Quarterly and Annual Data (required if base emissions are to be verified)							
160		Recent Particulate Emission Test Report (If available)							
161		Current Mercury Testing Results (If available)							
162		Current Site Arrangement Drawing							
163		Foundation Drawings and/or Soils Report							
164		Underground Utilities Drawings							
165		Plant One Line Electrical Drawing							
166		Fan Curves for Existing ID Fans (including current system resistance curve)							
167		Acceptable Fan Operating Margins							

	J	K
133		**Notes**
134	in wg.	
135	in wg.	
136	F	
137	%	
138	volts	
139	A	
140	A	
141	hp	
142		
143		
144		
145		
146	ft	
147	ft	
148		
149		
150		
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	A	B	C	D	E	F	G	H	I
168		Plant Outage Schedule							
169		Specific burner and overfire air ports arrangement (single wall, opposed fired, total number of burners, number of burner levels, number of over							
170									

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	A	B	C	D	E	F	G	H	I
171		**Economic Evaluation Factors:**				**Unit X**	**Unit X**	**Unit X**	**Unit X**
172		Remaining Plant Life/Economic Life							
173		Annual Capacity Factor (over life of study/plant)							
174		Contingency Margin (can be determined by B&V)							
175		Owner Indirects Cost Margin							
176		Interest During Construction							
177		Levelized Fixed Charge Rate or Capital Recovery Factor							
178		Present Worth Discount Rate							
179		Capital Escalation Rate							
180		O&M Escalation Rate							
181		Energy Cost (energy to run in-house equipment)							
182		Replacement Energy Cost (required to be							
183		purchased during unit outage)							
184		Year-by-Year Fuel Prices (over life of study/plant)							
185									
186		Base Fuel Price							
187									
188		Fuel Price Escalation Rate							
189		Water Cost							
190		Limestone Cost							
191		Lime Cost							
192		Ammonia Cost							
193		Fully Loaded Labor Rate (per person)							
194		Fly Ash Sales							
195		Bottom Ash Sales							
196		FGD Byproduct Sales							
197		Waste Disposal Cost							
198		Fly Ash							
199		Bottom Ash							
200		Scrubber Waste							

	J	K
171		**Notes**
172	years	
173	%	
174	%	
175	%	
176	%	
177	%	
178	%	
179	%	
180	%	
181	$/MWh	
182		
183	$/MWh	
184	$/MBtu	
185	$/ton	
186	$/MBtu	
187	$/ton	
188	%	
189	$/1,000 gal	
190	$/ton	
191	$/ton	
192	$/ton	
193	$/year	
194	$/ton	
195	$/ton	
196	$/ton	
197		
198	$/ton	
199	$/ton	
200	$/ton	

	A	B	C	D	E	F
1						
2	Project - Document & Drawing List					
3						
4		**Item**	**Document Type**	**Document/Drawing No.**	**Description**	**Date**
5		1	Drawing			
6		2	Drawing			
7		3	Drawing			
8		4	Drawing			
9		5	Document			
10		6	Drawing			
11		7	Document			
12		8	Document			
13		9	Document			
14		10	Document			
15		11	Document			
16		12	Document			
17		13	Document			
18		14	Document			
19		15	Document			
20		16	Document			
21		17	Drawing			
22		18	Drawing			
23		19	Drawing			
24		20	Drawing			
25		21	Drawing			
26		22	Drawing			
27		23	Drawing			
28		24	Drawing			
29		25	Drawing			
30		26	Document			
31		27	Document			
32		28	Drawing			
33		29	Drawing			
34		30	Drawing			
35		31	Drawing			
36		32	Document			
37		33	Document			
38		34	Drawing			
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40		36	Drawing			
41		37	Drawing			
42		38	Drawing			
43		39	Drawing			
44		40	Document			

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4	**Notes**
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47		43	Drawing			
48		44	Drawing			
49		45	Document			
50		46	Drawing			
51		47	Document			
52		48	Document			

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From: Saunders, Eileen
To: Revlett, Gary; Black, Greg
Sent: 5/4/2010 1:44:33 PM
Subject: Compliance Matrix
Attachments: AQCS Fleetwide Compliance Matrix B&V May 3 2010.xls

Gary and Greg,

My apologies for not sending this earlier today. I did not realize it was attached to an email Tim sent me last night. Please take a look at this matrix and then we can discuss.

Thanks,

Eileen

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													**EON Fleetwide AQCS Co**
2													
3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW Net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Em	Removal %
4		E. W. Brown											
5	1			1					NOx				
6	2								SO2				
7	3								PM				
8	4								PM				
9	5												
10	6								CO				
11	7								VOC				
12	8								Hg				
13	9								HAPs				
14	10								H2SO4				
15	11								SO3-SAM				
16	12								HCL				
17	13								HF				
18													
19													
20													
21													
22				2					NOx				
23									SO2				
24									PM				
25									PM				
26													
27									CO				
28									VOC				
29									Hg				
30									HAPs				
31									H2SO4				
32									SO3-SAM				
33									HCL				
34									HF				
35													
36													
37													
38													
39				3					NOx				
40									SO2				
41									PM				
42									PM				
43													
44									CO				
45									VOC				
46									Hg				

	N	O	P	Q	R	S	T	U	V	W
1	**ompliance Analysis and High Level Capital and O&M Cost Estimation**									
2										
3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections if applicable		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
5										
6										
7										
8										
9										
10										
11										
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	X	Y	Z
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3	**Levelized Annu**	**Remarks**	**Revision**
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47									HAPs				
48									H2SO4				
49									SO3-SAM				
50									HCL				
51									HF				
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56													
57		Revision #											
58		Date of Revision											
59		Notes											
60													
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	A	B	C	D	E	F	G	H	I	J	K	L	M
1													EON Fleetwide AQCS Co
2													
3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Ghent											
5	1			1					NOx				
6	2								SO2				
7	3								PM				
8	4								PM				
9	5												
10	6								CO				
11	7								VOC				
12	8								Hg				
13	9								HAPs				
14	10								H2SO4				
15	11								SO3-SAM				
16	12								HCL				
17	13								HF				
18													
19													
20													
21													
22				2					NOx				
23									SO2				
24									PM				
25									PM				
26													
27									CO				
28									VOC				
29									Hg				
30									HAPs				
31									H2SO4				
32									SO3-SAM				
33									HCL				
34									HF				
35													
36													
37													
38													
39				3					NOx				
40									SO2				
41									PM				
42									PM				
43													
44									CO				
45									VOC				
46									Hg				
47									HAPs				

	N	O	P	Q	R	S	T	U	V	W
1	**mpliance Analysis and High Level Capital and O&M Cost Estimation**									
2										
3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
5										
6										
7										
8										
9										
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3	**Levelized Annu**	**Remarks**	**Revision**
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48									H2SO4				
49									SO3-SAM				
50									HCL				
51									HF				
52													
53													
54													
55													
56				4					NOx				
57									SO2				
58									PM				
59									PM				
60													
61									CO				
62									VOC				
63									Hg				
64									HAPs				
65									H2SO4				
66									SO3-SAM				
67									HCL				
68									HF				
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73													
74		Revision #											
75		Date of Revision											
76		Notes											
77													
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	A	B	C	D	E	F	G	H	I	J	K	L	M
1													**EON Fleetwide AQCS Co**
2													
3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Cane Run											
5	1			4					NOx				
6	2								SO2				
7	3								PM				
8	4								PM				
9	5												
10	6								CO				
11	7								VOC				
12	8								Hg				
13	9								HAPs				
14	10								H2SO4				
15	11								SO3-SAM				
16	12								HCL				
17	13								HF				
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22				5					NOx				
23									SO2				
24									PM				
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39				6					NOx				
40									SO2				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Mill Creek											
5	1			1					NOx				
6	2								SO2				
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39				3					NOx				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled En	Removal %
4		Trimble County											
5	1			1					NOx				
6	2								SO2				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled En	Removal %
4		Green River											
5	1			3					NOx				
6	2								SO2				
7	3								PM				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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From:	Hillman, Timothy M.
To:	Saunders, Eileen
CC:	Mahabaleshwarkar, Anand; Lawson, Stacy J.; Lucas, Kyle J.; O'Neal, Brian D.
Sent:	5/5/2010 11:07:05 AM
Subject:	RE: EON site layout and major underground utilities identification
Attachments:	Kickoff Meeting Agenda 051010.doc

Eileen,

I spoke with Anand, and here's some guidance from our discussion and his email below:

For obvious cost consideration reasons, we do not want to locate any new AQC equipment on existing underground utilities/structures, unless no other option presents itself. For this high level evaluation, we are not looking for more than 1 or 2 underground utility drawings per unit. In fact, in some cases, the drawing may even be a hand-marked sketch of the underground utilities on a facility plot plan, identifying utilities like circulating water pipes or duct banks. The site teams also plan to make sketches of underground interferences during the site visits based on discussions with knowledgeable site personnel.

Additionally, please find attached a draft agenda for Monday's Kickoff Meeting for your review and comment.
Best regards,

Tim Hillman | Senior Air Quality Scientist
Black & Veatch - Building a World of Difference™
11401 Lamar Avenue
Overland Park, KS 66211
Phone: **(913) 458-7928**
Email: **hillmantm@bv.com**

From: Mahabaleshwarkar, Anand
Sent: Wednesday, May 05, 2010 9:24 AM
To: Hillman, Timothy M.
Subject: EON site layout and major underground utilities identification

Tim:
When we visit the sites our intent is that we have latest site plot plans or layouts in our hands for each unit and the major underground utilities like circulating water pipe or a ductbank is marked or shown on some site plan drawing. This will help us in preliminarily sketching future AQC equipment while on the site. It is expected that the site people will be able to guide us in identifying major underground utilities using this site plot plan.

We are not looking for more than 2 underground utility drawings per unit. In some cases they can even handmark the underground utilities on a unit/site plot plan and that will suffice our needs in this high level evaluation. The objective is that we do not want to land our new AQC equipment on existing underground utilities, unless we have no other option. Then in that case we will add cost for relocation of underground utilities.

Thanks

Anand

AGENDA

Kick-Off Meeting

E.ON
Environmental Compliance
Air Quality Control Study

Monday May 10, 2010 @ 1:00 p.m.
BOC – Lower Level Assembly Room
Louisville, KY

I. Introductions

II. Project Objective
  a. Project Overview (E.ON)
  b. Review Scope of Work (BV)
  c. Schedule

III. Information Exchange and Discussion
  a. Status of Data Requests
  b. Environmental Compliance Limits
  c. Unit Specific Strategic Plans

IV. Site Visits
  a. Purpose and Plan
  b. Site Coordination
  c. Safety and Logistics

V. Project Administration
  a. Communication
  b. Deliverables (Format and Schedule)
  c. Invoicing

VI. Adjournment

From: Saunders, Eileen
To: Revlett, Gary; Black, Greg
Sent: 5/5/2010 11:36:54 AM
Subject: FW: Compliance Matrix
Attachments: AQCS Fleetwide Compliance Matrix B&V May 3 2010.xls

Gary and Greg,

From checking your calendars, I see you are both in training until Friday. Can you please assign someone from your group to help complete sections J-P of this compliance matrix? Please let me know who will be working on it so I can ensure that the matrix gets populated by close of business on Friday.

Thank you,

Eileen

From: Saunders, Eileen
Sent: Tuesday, May 04, 2010 1:45 PM
To: Revlett, Gary; Black, Greg
Subject: Compliance Matrix

Gary and Greg,

My apologies for not sending this earlier today. I did not realize it was attached to an email Tim sent me last night. Please take a look at this matrix and then we can discuss.

Thanks,

Eileen

	A	B	C	D	E	F	G	H	I	J	K	L	M
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW Net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled En	Removal %
4		E. W. Brown											
5	1			1					NOx				
6	2								SO2				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections if applicable		O&M Costs
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Cane Run											
5	1			4					NOx				
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Mill Creek											
5	1			1					NOx				
6	2								SO2				
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13	9								HAPs				
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22				2					NOx				
23									SO2				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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1													**EON Fleetwide AQCS Co**
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Em**	**Removal %**
4		Trimble County											
5	1			1					NOx				
6	2								SO2				
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31									H2SO4				
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1	ɔmpliance Analysis and High Level Capital and O&M Cost Estimation									
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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1													EON Fleetwide AQCS Co
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Green River											
5	1			3					NOx				
6	2								SO2				
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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From:	Saunders, Eileen
To:	'Hillman, Timothy M.'
Sent:	5/5/2010 3:42:22 PM
Subject:	Kickoff Meeting Agenda 051010 Rev 1 (els).docx
Attachments:	Kickoff Meeting Agenda 051010 Rev 1 (els).docx

Tim,

I made a few minor changes. Please review and if you are in agreement, we will go with this version.

Thank you,

Eileen

AGENDA

Kick-Off Meeting

E.ON US
Environmental Compliance
Air Quality Control Study

Monday May 10, 2010 @ 1:00 p.m.
BOC – Lower Level Assembly Room
Louisville, KY

I. Welcome (E.ON US)
   a. Introductions
   b. Team Expectations

II. Project Objective
   a. Project Overview (E.ON US)
   b. Review Scope of Work (BV)
   c. Schedule

III. Information Exchange and Discussion
   a. Status of Data Requests
      i. Review of AQCS Information Data Sheets
      ii. Review of Compliance Matrix
   b. Environmental Compliance Limits
   c. Unit Specific Strategic Plans

IV. Site Visits
   a. Purpose and Plan
   b. Site Coordination
   c. Safety and Logistics

V. Project Administration
   a. Communication
   b. Action Item Lists
   c. Deliverables (Format and Schedule)
   d. Invoicing

VI. Adjournment

From:	Saunders, Eileen
To:	Hensley, Mike; Nix, Stephen; Piening, Carla; Stevens, Michael; Koller, Tiffany; Turner, Haley; Crutcher, Tom; Troost, Tom; Harper, Travis; Pabian, Brad; Carman, Barry; Wilson, Stuart; Karavayev, Louanne; Revlett, Gary; Black, Greg; Imber, Philip; Vaughn, Deborah (BOC); Hance, Chuck; Whitworth, Wayne; Billiter, Delbert; Cosby, David; Wilson, Dan; Raque, Gary; Fraley, Jeffrey
CC:	Voyles, John; Bowling, Ralph; Straight, Scott
Sent:	5/7/2010 10:52:14 AM
Subject:	Kickoff Meeting Agenda 051010 Rev 2 (els).docx
Attachments:	Kickoff Meeting Agenda 051010 Rev 2 (els).docx

All,

Enclosed is the Agenda for the Kickoff meeting on Monday. Lunch will be served at 12:15pm.

Thank you,

Eileen

AGENDA

Kick-Off Meeting

E.ON US
Environmental Compliance
Air Quality Control Study

Monday May 10, 2010 @ 1:00 p.m.
BOC – Lower Level Assembly Room
Louisville, KY

I. **Welcome (E.ON US)**
   a. Introductions
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   a. Communication
   b. Action Item Lists
   c. Deliverables (Format and Schedule)
   d. Invoicing

VI. **Adjournment**

From: Saunders, Eileen
To: Jackson, Audrey
Sent: 5/7/2010 1:04:34 PM
Subject: FW: Kickoff Meeting Agenda 051010 Rev 2 (els).docx
Attachments: Kickoff Meeting Agenda 051010 Rev 2 (els).docx

Here is the agenda. Please make copies for the participants.

Thanks,

Eileen

From: Saunders, Eileen
Sent: Friday, May 07, 2010 10:52 AM
To: Hensley, Mike; Nix, Stephen; Piening, Carla; Stevens, Michael; Koller, Tiffany; Turner, Haley; Crutcher, Tom; Troost, Tom; Harper, Travis; Pabian, Brad; Carman, Barry; Wilson, Stuart; Karavayev, Louanne; Revlett, Gary; Black, Greg; Imber, Philip; Vaughn, Deborah (BOC); Hance, Chuck; Whitworth, Wayne; Billiter, Delbert; Cosby, David; Wilson, Dan; Raque, Gary; Fraley, Jeffrey
Cc: Voyles, John; Bowling, Ralph; Straight, Scott
Subject: Kickoff Meeting Agenda 051010 Rev 2 (els).docx

All,

Enclosed is the Agenda for the Kickoff meeting on Monday. Lunch will be served at 12:15pm.

Thank you,

Eileen

AGENDA

Kick-Off Meeting

E.ON US
Environmental Compliance
Air Quality Control Study

Monday May 10, 2010 @ 1:00 p.m.
BOC – Lower Level Assembly Room
Louisville, KY

I. Welcome (E.ON US)
  a. Introductions
  b. Team Expectations

II. Project Objective
  a. Project Overview (E.ON US)
  b. Review Scope of Work (BV)
  c. Schedule

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  a. Status of Data Requests
    i. Review of AQCS Information Data Sheets
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  a. Purpose and Plan
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V. Project Administration
  a. Communication
  b. Action Item Lists
  c. Deliverables (Format and Schedule)
  d. Invoicing

VI. Adjournment

From: Lucas, Kyle J.
To: Revlett, Gary
Sent: 11/1/2010 4:32:03 PM
Subject: EW Brown Kick-off

Gary,
Do you have your presentation ready for the Brown plant's AQC kick-off meeting next week. I would like to get a copy and blend in the emissions requirements into the our presentation.

Please let me know if you would like to discuss.

Thanks,
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**

From: Lucas, Kyle J.
To: Revlett, Gary
Sent: 10/6/2010 8:57:11 AM
Subject: RE: 168908.14.4000 101004 - E.ON MC & Ghent Regulatory Briefing

Gary,
The PPT was still for Ghent. The Excel sheet was MC.

Regards,

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**

From: Revlett, Gary [mailto:Gary.Revlett@eon-us.com]
Sent: Wednesday, October 06, 2010 7:53 AM
To: Lucas, Kyle J.
Subject: FW: 168908.14.4000 101004 - E.ON MC & Ghent Regulatory Briefing

Kyle,
Attached are two additional Mill Creek.
Gary

From: Revlett, Gary
Sent: Wednesday, October 06, 2010 7:09 AM
To: 'Lucas, Kyle J.'
Cc: Hillman, Timothy M.; Wehrly, M. R.; Lawson, Stacy J.; 168908 E.ON-AQC; Jackson, Audrey; Saunders, Eileen
Subject: RE: 168908.14.4000 101004 - E.ON MC & Ghent Regulatory Briefing

Hi Kyle,

Attached to this email is a copy of the Ghent PowerPoint presentation that I will use at Ghent's Phase II Air Quality Control Study Kickoff Meeting. The first part of the Ghent presentation is the same as used at Mill Creek meeting to described the regulatory drivers. I have also included the Mill Creek specific environmental requirements and information on CATR.

Gary

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Monday, October 04, 2010 5:43 PM
To: Revlett, Gary

Cc: Hillman, Timothy M.; Wehrly, M. R.; Lawson, Stacy J.; 168908 E.ON-AQC; Jackson, Audrey; Saunders, Eileen
Subject: 168908.14.4000 101004 - E.ON MC & Ghent Regulatory Briefing

Gary,
For our project records we would like to obtain a copy of your PowerPoint presentation summarizing the regulatory drivers for the Mill Creek plant (from 9/15/10). Likewise, we would like to get an electronic copy of this week's presentation at Ghent.

Thanks for your assistance,

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**

From:	Gibian, Glenn
To:	Revlett, Gary
Sent:	4/30/2010 3:49:17 PM
Subject:	RE: EON AQC Project - Monday Conference Call

Thanks... sounds like Kyle: "pending issuance of the contract, we can talk."

From: Revlett, Gary
Sent: Friday, April 30, 2010 3:41 PM
To: Gibian, Glenn; Pardee, Marlene; Scheetz, Sarah; Smith, Dave; Wilkerson, Jason
Subject: FW: EON AQC Project - Monday Conference Call

FYI

From: Saunders, Eileen
Sent: Friday, April 30, 2010 3:37 PM
To: 'Lucas, Kyle J.'
Cc: O'Neal, Brian D.; Hillman, Timothy M.; King, Michael L. (Mike); Mahabaleshwarkar, Anand; Revlett, Gary; Black, Greg
Subject: RE: EON AQC Project - Monday Conference Call

Kyle,

This time works for me. I will extend an invitation to a few others from our Environmental Affairs (Gary Revlett) and Environmental Compliance (Greg Black) department. Enclosed, please find the matrix and informational document you refer to in your email. We can discuss any questions you may have regarding the documents as well.

Thank you,

Eileen

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Friday, April 30, 2010 3:13 PM
To: Saunders, Eileen
Cc: O'Neal, Brian D.; Hillman, Timothy M.; King, Michael L. (Mike); Mahabaleshwarkar, Anand
Subject: EON AQC Project - Monday Conference Call

Eileen,
Based on our conversation this morning, I have set up a conference call with a few members of the team for you to discuss the scope, data request, upcoming kick-off meeting, and site visits.

Pending issuance of the contract, the call for Monday 5/3 can be held at 1 pm eastern (noon central). This was the time that the several of the group were available for a quick call on Monday. If this works for you B&V will initiate the call. If please let Brian O'Neal or Tim Hillman know and they'll coordinate another time during the week.

Also, it is critical that we receive EON's unit specific future regulation and emission compliance matrix. Also, we need an indication from you as to which plants you feel have critical AQC and constructability issues against this matrix so that we can appropriately schedule our staff for the site visits. It would also be helpful, based on your understanding of each plant's location, the most efficient order of plants to send the two teams for the visits.

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**

From: Revlett, Gary
To: 'grevlett@insightbb.com'
Sent: 5/4/2010 1:48:33 PM
Subject: Fw: Compliance Matrix
Attachments: AQCS Fleetwide Compliance Matrix B&V May 3 2010.xls

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From: Saunders, Eileen
To: Revlett, Gary; Black, Greg
Sent: Tue May 04 13:44:32 2010
Subject: Compliance Matrix

Gary and Greg,

My apologies for not sending this earlier today. I did not realize it was attached to an email Tim sent me last night. Please take a look at this matrix and then we can discuss.

Thanks,

Eileen

<<AQCS Fleetwide Compliance Matrix B&V May 3 2010.xls>>

	A	B	C	D	E	F	G	H	I	J	K	L	M
1												**EON Fleetwide AQCS Co**	
2													
3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW Net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled En	Removal %
4		E. W. Brown											
5	1			1					NOx				
6	2								SO2				
7	3								PM				
8	4								PM				
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10	6								CO				
11	7								VOC				
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13	9								HAPs				
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15	11								SO3-SAM				
16	12								HCL				
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23									SO2				
24									PM				
25									PM				
26													
27									CO				
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39				3					NOx				
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1	**ompliance Analysis and High Level Capital and O&M Cost Estimation**									
2										
3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections if applicable		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
5										
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1												**EON Fleetwide AQCS Co**	
2													
3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Er**	**Removal %**
4		Ghent											
5	1			1					NOx				
6	2								SO2				
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13	9								HAPs				
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15	11								SO3-SAM				
16	12								HCL				
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23									SO2				
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1	**ompliance Analysis and High Level Capital and O&M Cost Estimation**									
2										
3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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1												**EON Fleetwide AQCS Co**	
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Cane Run											
5	1			4					NOx				
6	2								SO2				
7	3								PM				
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23									SO2				
24									PM				
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1	**ɔmpliance Analysis and High Level Capital and O&M Cost Estimation**									
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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1													**EON Fleetwide AQCS Co**
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled Er**	**Removal %**
4		Mill Creek											
5	1			1					NOx				
6	2								SO2				
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15	11								SO3-SAM				
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39				3					NOx				
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1	**ɔmpliance Analysis and High Level Capital and O&M Cost Estimation**									
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
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3	Item #	Plant/Site	Vintage	Unit	Unit rating MWg	MW net	Priority	Fuel Burned	Pollutant	Compliance D	AQC Control	Uncontrolled Er	Removal %
4		Trimble County											
5	1			1					NOx				
6	2								SO2				
7	3								PM				
8	4								PM				
9	5												
10	6								CO				
11	7								VOC				
12	8								Hg				
13	9								HAPs				
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16	12								HCL				
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22				2					NOx				
23									SO2				
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1	**mpliance Analysis and High Level Capital and O&M Cost Estimation**									
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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1													**EON Fleetwide AQCS Co**
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3	**Item #**	**Plant/Site**	**Vintage**	**Unit**	**Unit rating MWg**	**MW net**	**Priority**	**Fuel Burned**	**Pollutant**	**Compliance D**	**AQC Control**	**Uncontrolled En**	**Removal %**
4		Green River											
5	1			3					NOx				
6	2								SO2				
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22				4					NOx				
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1	**ompliance Analysis and High Level Capital and O&M Cost Estimation**									
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3	Current Controlled	Future Required Er	Future Regulatory D	Tons removed with (	Tons removed with	Capital costs		Cost Corrections		O&M Costs
4						*$/ton removed*	*$/kW*	*$/ton removed*	*$/kW*	*$*
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From:	Saunders, Eileen </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=SAUNDERE>
Sent:	4/30/2010 1:13:49 PM
To:	Harper, Travis <Travis.Harper@eon-us.com>; Hensley, Mike <Mike.Hensley@eon-us.com>; Stevens, Michael <Michael.Stevens@eon-us.com>; Koller, Tiffany <Tiffany.Koller@eon-us.com>; Piening, Carla <Carla.Piening@eon-us.com>; Nix, Stephen <Stephen.Nix@eon-us.com>; Pabian, Brad <Brad.Pabian@eon-us.com>; Carman, Barry <Barry.Carman@eon-us.com>; Black, Greg <Black@eon-us.com>; Revlett, Gary <Gary.Revlett@eon-us.com>; Wilson, Stuart <Stuart.Wilson@eon-us.com>; Karavayev, Louanne <Louanne.Karavayev@eon-us.com>; Imber, Philip <Philip.Imber@eon-us.com>; Hance, Chuck <Chuck.Hance@eon-us.com>; Whitworth, Wayne <Wayne.Whitworth@eon-us.com>; Fraley, Jeffrey <Jeffrey.Fraley@eon-us.com>; Crutcher, Tom <Tom.Crutcher@eon-us.com>; Billiter, Delbert <Delbert.Billiter@eon-us.com>; Cosby, David <David.Cosby@eon-us.com>; Straight, Scott <Scott.Straight@eon-us.com>; Troost, Tom <Tom.Troost@eon-us.com>; Wilson, Dan <Dan.Wilson@eon-us.com>; Vaughn, Deborah (BOC) <Deborah.Vaughn@eon-us.com>; Jackson, Audrey <Audrey.Jackson@eon-us.com>; Saunders, Eileen <Eileen.Saunders@eon-us.com>
Subject:	Copy: Environmental Compliance Project Kickoff Meeting
Location:	BOC- Lower Level Assembly Room
Start:	Mon 5/10/2010 12:00:00 PM
End:	Mon 5/10/2010 5:00:00 PM
Recurrence:	(none)
Meeting Status:	Not yet responded
Required Attendees:	Harper, Travis; Hensley, Mike; Stevens, Michael; Koller, Tiffany; Piening, Carla; Nix, Stephen; Pabian, Brad; Carman, Barry; Black, Greg; Revlett, Gary; Wilson, Stuart; Karavayev, Louanne; Imber, Philip; Hance, Chuck; Whitworth, Wayne; Fraley, Jeffrey; Crutcher, Tom; Billiter, Delbert; Cosby, David; Straight, Scott; Troost, Tom; Wilson, Dan; Vaughn, Deborah (BOC); Jackson, Audrey; Saunders, Eileen
Categories:	Travel Required

When: Monday, May 10, 2010 12:00 PM-5:00 PM (GMT-05:00) Eastern Time (US & Canada).
Where: BOC- Lower Level Assembly Room

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

All,

Please note the change in the kickoff date. The contractor (Black and Veatch) and I discussed the schedule and agreed that the best use of our time would be to collect data the week of May 3, 2010 and follow up with a more focused kickoff on May, 10th. The next few days, May 11-14 will be used for parallel site visits to all of the plants for additional data collection.

This changes means that you have until May 7, 2010 for us to collect and send in the initial data that was requested in my previous emails. I will send out our data collection strategy next week.

An agenda will be developed and sent out next week. It is possible that some participants may only be needed for part of the meeting. Lunch will be provided from 12:15 until 1pm. The meeting will begin promptly at 1pm.

Thank you for your patience as we work to get this project moving.

Sincerely,

Eileen

From:	Sturgeon, Allyson </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=N093308>
Sent:	4/19/2011 2:53:46 PM
To:	Sturgeon, Allyson <Allyson.Sturgeon@lge-ku.com>; Schroeder, Andrea <Andrea.Schroeder@lge-ku.com>; Schram, Chuck <Chuck.Schram@lge-ku.com>; Conroy, Robert <Robert.Conroy@lge-ku.com>; 'Kendrick Riggs' <kendrick.riggs@skofirm.com>; Bellar, Lonnie <Lonnie.Bellar@lge-ku.com>; Charnas, Shannon <Shannon.Charnas@lge-ku.com>; Revlett, Gary <Gary.Revlett@lge-ku.com>; Voyles, John <John.Voyles@lge-ku.com>; Straight, Scott <Scott.Straight@lge-ku.com>; Saunders, Eileen <Eileen.Saunders@lge-ku.com>; Wilson, Stuart <Stuart.Wilson@lge-ku.com>; Winkler, Michael <Michael.Winkler@lge-ku.com>; Ehrler, Bob <Bob.Ehrler@lge-ku.com>
Subject:	Copy: General Comments/Discussion on First Draft of ECR Applications and Testimony
Location:	LGEC12 North 2 (Cap 15)
Start:	Tue 4/26/2011 9:00:00 AM
End:	Tue 4/26/2011 10:00:00 AM
Show Time As:	Tentative
Recurrence:	(none)
Meeting Status:	Not yet responded
Required Attendees:	Sturgeon, Allyson; Schroeder, Andrea; Schram, Chuck; Conroy, Robert; 'Kendrick Riggs'; Bellar, Lonnie; Charnas, Shannon; Revlett, Gary; Voyles, John; Straight, Scott; Saunders, Eileen; Wilson, Stuart; Winkler, Michael; Ehrler, Bob

I realize that not everyone is available, but if you can make it, please try to do so. Thanks.

From:	Sturgeon, Allyson
To:	Schroeder, Andrea; Schram, Chuck; Conroy, Robert; Kendrick Riggs; Bellar, Lonnie; Charnas, Shannon; Revlett, Gary; Voyles, John; Straight, Scott; Saunders, Eileen; Wilson, Stuart; Winkler, Michael; Ehrler, Bob
Sent:	4/19/2011 2:53:46 PM
Subject:	General Comments/Discussion on First Draft of ECR Applications and Testimony

When: Tuesday, April 26, 2011 9:00 AM-10:00 AM (GMT-05:00) Eastern Time (US & Canada).
Where: LGEC12 North 2 (Cap 15)

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

I realize that not everyone is available, but if you can make it, please try to do so. Thanks.

From:	Revlett, Gary
To:	Sturgeon, Allyson
Sent:	4/19/2011 3:02:12 PM
Subject:	Tentative: General Comments/Discussion on First Draft of ECR Applications and Testimony

From:	Walters, Kim </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=E010358>
Sent:	4/20/2011 8:03:41 AM
To:	Sturgeon, Allyson <Allyson.Sturgeon@lge-ku.com>; 'Riggs, Kendrick R.' <kendrick.riggs@skofirm.com>; Conroy, Robert <Robert.Conroy@lge-ku.com>; Schroeder, Andrea <Andrea.Schroeder@lge-ku.com>; Bellar, Lonnie <Lonnie.Bellar@lge-ku.com>; Revlett, Gary <Gary.Revlett@lge-ku.com>; LGEC12 West 1201 (Cap 20) <LGEC12West1201Cap20@lge-ku.com>
Subject:	Copy: ECR Testimony Review-Revlett
Location:	LGEC1201
Start:	Fri 5/13/2011 2:00:00 PM
End:	Fri 5/13/2011 3:30:00 PM
Recurrence:	(none)
Meeting Status:	Not yet responded
Required Attendees:	Sturgeon, Allyson; 'Riggs, Kendrick R.'; Conroy, Robert; Schroeder, Andrea; Bellar, Lonnie; Revlett, Gary; LGEC12 West 1201 (Cap 20)

From: Walters, Kim
To: 'Riggs, Kendrick R.'; Conroy, Robert; Schroeder, Andrea; Bellar, Lonnie; Revlett, Gary; LGEC12 West 1201 (Cap 20)
Sent: 4/20/2011 8:03:41 AM
Subject: ECR Testimony Review-Revlett

When: Friday, May 13, 2011 2:00 PM-3:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: LGEC1201

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

From:	Revlett, Gary
To:	Sturgeon, Allyson
Sent:	4/20/2011 8:03:59 AM
Subject:	Accepted: ECR Testimony Review-Revlett

From:	Reed, Kathleen
To:	Revlett, Gary; Joyce, Jeff
Sent:	4/20/2011 1:28:09 PM
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: Imber, Philip
To: Revlett, Gary; Conroy, Robert
Sent: 4/25/2011 12:12:02 PM
Subject: FW: GH SAM Mitigation Milling proposal
Attachments: PAI_GH SAM FINAL 4-18-11 (2).docx

Gary, Robert,

I was asked if you are in agreement to the Ghent SAM Milling proposal.

Gary and I have discussed numerous times and I believe we are on the same page.

I believe Rates/Regulatory and I are on the same page - as this is planned for the June ECR filing.

Please respond with your agreement and I can "check my box".

Philip

From: Hudson, Rusty
Sent: Monday, April 25, 2011 11:31 AM
To: Imber, Philip; Mooney, Mike (BOC 3)
Cc: Straight, Scott
Subject: FW: GH SAM Mitigation proposal

Attached are the questions from Financial Planning (first three for Philip, fourth one for Mike) on the Ghent SAM mitigation proposal. Mike, I'm thinking we decided not to show the 2012 amounts (from the 2011 MTP) since there could be other work down the road, but I'm not sure on the 2011 difference. If you can respond back by mid-day tomorrow, Megan will try to send the proposals out later tomorrow. Rusty

---

From: Kuhl, Megan
Sent: Monday, April 25, 2011 11:27 AM
To: Hudson, Rusty
Subject: GH SAM Mitigation proposal

Rusty,

We have the following questions/comments:

- Has environmental affairs agreed to this?
- Has rates and regulatory agreed to this?
- Was UCC asked for details on their proposal since there was concern?
- I'm having trouble tying the MTP to what is in the financial details table. I am showing $8.7m for 2011 and $15.4m for 2012. Are there other project numbers?

Thanks,

Megan Kuhl
Financial Analyst II, Financial Planning
LG&E and KU Services Company
(502) 627-3716

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					-
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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:	Sturgeon, Allyson
To:	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'
Sent:	5/9/2011 3:06:07 PM
Subject:	Final ECR Application and Testimony Review

When: Wednesday, May 18, 2011 1:00 PM-3:00 PM (GMT-05:00) Eastern Time (US & Canada).
Where: LGEC12 North 1 (Cap 15)

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

From: Revlett, Gary
To: Sturgeon, Allyson
Sent: 5/9/2011 5:46:16 PM
Subject: Accepted: Final ECR Application and Testimony Review

Hi Allyson,

I will be at Trimble Co Station in morning of the 18th, so I may be a little late arriving to this 1:00 pm meeting.

From:	Walters, Kim </O=LGE/OU=LOUISVILLE/CN=RECIPIENTS/CN=E010358>
Sent:	5/18/2011 7:58:08 AM
To:	Sturgeon, Allyson <Allyson.Sturgeon@lge-ku.com>; 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>
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:	Sturgeon, Allyson; 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)

From:	Walters, Kim
To:	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)
Sent:	5/18/2011 7:58:08 AM
Subject:	Final ECR Application and Testimony Review (Updated with new location)

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:	Revlett, Gary
To:	Sturgeon, Allyson
Sent:	5/18/2011 8:46:54 AM
Subject:	Accepted: Final ECR Application and Testimony Review (Updated with new location)

From: Clements, Joe
To: Straight, Scott; Saunders, Eileen; Imber, Philip
Sent: 4/23/2010 7:27:15 PM
Subject: Fw: E.ON Air Quality Control Study
Attachments: ArchiveInfo.htm

Joe Clements
EON U.S.
Project Engineering
502 724 9101

From: Lucas, Kyle J. <LucasKJ@bv.com>
To: Clements, Joe
Cc: King, Michael L. (Mike) <kingml@bv.com>; Hillman, Timothy M. <HillmanTM@bv.com>; Mahabaleshwarkar, Anand <MahabaleshwarkarA@bv.com>
Sent: Fri Apr 23 17:10:31 2010
Subject: E.ON Air Quality Control Study

Joe,
Based on our telephone conversation on Wednesday April 21, attached please find the proposal for the requested air quality control services. We understand that E.ON requires this study to be completed by June 18 and we are available to start this project immediately to meet this deadline. Additionally, we have completed a similar study for Ameren UE and have included a Letter of Recommendation for your consideration.

Please feel free to contact Mike King at (734) 622-8516 or myself should you have any questions.

Regards,
Kyle Lucas

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**

This message and its attachments have been archived. To retrieve, double click the message in the message list.

The following attachments were archived from this message:

- Letter of Recommendation.pdf
- PROPOSAL E.ON.pdf

From: Clements, Joe
To: 'Lucas, Kyle J.'
CC: King, Michael L. (Mike); Hillman, Timothy M.; Mahabaleshwarkar, Anand; Saunders, Eileen; Imber, Philip; Straight, Scott; Whitworth, Wayne
Sent: 4/26/2010 9:21:33 AM
Subject: RE: E.ON Air Quality Control Study
Attachments: ArchiveInfo.htm

Kyle,

Please provide a native format copy of your proposal. Please include an excel worksheet of your estimate with it as well. We would like to see resource x hours x billing rate by task by COB today.

I am out of my office all day today at the Trimble County Station, with spotty cell phone coverage. If you need to speak with me directly, drop me an email and I will phone you when I am available.

Thanks

Joe Clements
Project Engineering
Mgr. Contracts
Major Capital Projects
Mobile 502-724-9101
Work 502-627-2760
EON U.S.
820 West Broadway
Louisville, Ky 40202

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Friday, April 23, 2010 5:11 PM
To: Clements, Joe
Cc: King, Michael L. (Mike); Hillman, Timothy M.; Mahabaleshwarkar, Anand
Subject: E.ON Air Quality Control Study

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This message and its attachments have been archived. To retrieve, double click the message in the message list.

The following attachments were archived from this message:
- Clements, Joe.vcf

From: Clements, Joe
To: Whitworth, Wayne
CC: Ransdell, Charles; Imber, Philip; Saunders, Eileen; Straight, Scott
Sent: 4/26/2010 9:25:10 AM
Subject: FW: E.ON Air Quality Control Study
Attachments: ArchiveInfo.htm

Wayne-I want you to draft a contract for this work this week, so start familiarizing yourself with this proposal. We will be receiving an additional proposal today from Burns & McDonnell for comparison purposes which will help us decide on a negotiation/contracting strategy.

Joe C

From: Lucas, Kyle J. [mailto:LucasKJ@bv.com]
Sent: Friday, April 23, 2010 5:11 PM
To: Clements, Joe
Cc: King, Michael L. (Mike); Hillman, Timothy M.; Mahabaleshwarkar, Anand
Subject: E.ON Air Quality Control Study

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From: Lucas, Kyle J.
To: Clements, Joe
CC: King, Michael L. (Mike); Hillman, Timothy M.; Mahabaleshwarkar, Anand; Saunders, Eileen; Imber, Philip; Straight, Scott; Whitworth, Wayne
Sent: 4/26/2010 4:39:51 PM
Subject: RE: E.ON Air Quality Control Study
Attachments: ArchiveInfo.htm

Joe,
As requested, please find attached the Word version of the proposal and the Excel worksheet with the estimate.

Please let me know if you require any additional information.

Regards,
Kyle Lucas

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**

From: Clements, Joe [mailto:Joe.Clements@eon-us.com]
Sent: Monday, April 26, 2010 8:22 AM
To: Lucas, Kyle J.
Cc: King, Michael L. (Mike); Hillman, Timothy M.; Mahabaleshwarkar, Anand; Saunders, Eileen; Imber, Philip; Straight, Scott; Whitworth, Wayne
Subject: RE: E.ON Air Quality Control Study

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Thanks

Joe Clements
Project Engineering
Mgr. Contracts