EAST KENTUCKY POWER COOPERATIVE

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PUBLIC SERVICE
COMMISSION

August 1, 2007

HAND DELIVERED

Ms. Elizabeth O'Donnell
Executive Director
Public Service Commission
211 Sower Boulevard
Frankfort, KY 40602

Re: PSC Case No. ~~2005-00417~~ 2007-00375

Dear Ms. O'Donnell:

Please find enclosed for filing with the Commission in the above-referenced case, an original and ten copies of the Motion of East Kentucky Power Cooperative, Inc. to Amend the Certificate of Public Convenience and Necessity granted in this case on April 18, 2006.

Very truly yours,

Charles A. Lile
Senior Corporate Counsel

Enclosures

4775 Lexington Road 40391
P.O. Box 707, Winchester,
Kentucky 40392-0707

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http://www.ekpc.coop

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PUBLIC SERVICE
COMMISSION

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF EAST KENTUCKY POWER COOPERATIVE, INC FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION OF A FLUE GAS DESULFURIZATION SYSTEM ON SPURLOCK POWER STATION UNIT 2	)	2007-00375 **CASE NO.** ~~**2005-00417**~~

MOTION OF EAST KENTUCKY POWER COOPERATIVE, INC., TO AMEND THE CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY ISSUED APRIL 18, 2006

East Kentucky Power Cooperative, Inc., ("EKPC") hereby moves the Kentucky Public Service Commission (the "Commission") for an amendment to the certificate of public convenience and necessity granted in this case on April 18, 2006, for the Spurlock Station Unit 2 ("Spurlock 2") Flue Gas Desufurization ("FGD" or "Scrubber") system. As grounds for this Motion, EKPC states as follows:

1. At the time that EKPC filed its Application in this case, on October 7, 2005, EKPC believed that the existing Spurlock 2 chimney would be suitable for use with the Spurlock 2 Flue Gas Scrubber system. Since the Commission granted the certificate of public convenience and necessity for that system, studies conducted by EKPC's consultants determined that the existing chimney would not be compatible with the wet operating conditions associated with the new Spurlock 2 Scrubber. Evaluations of all possible alternatives to the construction of a new Spurlock 2 chimney showed that the construction of the new chimney was the best and most economical alternative. The attached Prepared Testimony of Gary Crawford (EKPC Motion Exhibit 1) explains these

evaluations regarding the Spurlock 2 Scrubber system and EKPC's decision in regard to the new stack.

2. Also attached in support of this Motion are the Prepared Testimony of Kyle Shadoan (EKPC Motion Exhibit 2), which explains the attached studies performed in regard to the need for the new Spurlock 2 chimney (Shadoan Exhibit A) and describes the construction and location of the new chimney (Shadoan Exhibit B); and the Supplemental Prepared Testimony of Frank Oliva (EKPC Motion Exhibit 3), which explains EKPC's economic evaluation of the updated cost of the Spurlock 2 Scrubber project (Oliva Exhibit A).

3. The construction of the new Spurlock 2 chimney is required as an essential functional part of the Spurlock 2 Flue Gas Scrubber system, and represents the most economical engineering alternative for that component of the system. The addition of the new Spurlock 2 chimney does not significantly change EKPC's justification for the Spurlock 2 Flue Gas Scrubber, and will have no significant adverse effect on the schedule for the commercial operation of that system.

WHEREFORE, EKPC respectfully moves the Commission for an amendment of the subject certificate of public convenience and necessity to add the new Spurlock 2 chimney, and to incorporate the updated estimated costs for the project.

Respectfully submitted,

DAVID A. SMART

CHARLES A. LILE

ATTORNEYS FOR EAST
KENTUCKY
POWER COOPERATIVE, INC.
P. O. BOX 707
WINCHESTER, KY 40392-0707
(859) 744-4812

CERTIFICATE OF SERVICE

This is to certify that an original and ten copies of the foregoing Motion of East Kentucky Power Cooperative, Inc. to Amend the Certificate of Public Convenience and Necessity in the above-referenced case were delivered to Elizabeth O'Donnell, Executive Director, Kentucky Public Service Commission, 211 Sower Boulevard, Frankfort, Kentucky 40601, on this 1st day of August, 2007.

CHARLES A. LILE

EKPC Motion Exhibit 1

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF EAST KENTUCKY POWER	)	
COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC	)	
CONVENIENCE AND NECESSITY FOR THE	)	**CASE NO. 2005-00417**
CONSTRUCTION OF A FLUE GAS DESULFURIZATION	)	
SYSTEM ON SPURLOCK POWER STATION UNIT 2	)	

PREPARED TESTIMONY OF GARY T. CRAWFORD
ON BEHALF OF
EAST KENTUCKY POWER COOPERATIVE, INC.

Q1. Please state your name and address.

A1. My name is Gary T. Crawford, and my work address is PO Box 707, Winchester, Kentucky 40392-0707.

Q2. By whom are you employed and in what capacity?

A2. I am employed by East Kentucky Power Cooperative, Inc. ("EKPC"), as Vice President, Construction.

Q3. What functional areas of EKPC operations are you responsible for in that position?

A3. I am responsible for generation construction and major plant improvement projects.

Q4. When did you assume your responsibilities for EKPC's Flue Gas Desulfurization ("FGD") Projects?

A4. I assumed responsibility for the FGD Projects on May 11, 2007

Q5. What is the purpose of your testimony?

A5. The purpose of my testimony is to explain and support the background of EKPC's request for an amendment to the certificate of public convenience and necessity granted in this case for the Spurlock Station Unit 2 ("Spurlock 2") Flue Gas Scrubber system.

Q6. Why is EKPC requesting the amendment to the certificate granted in this case?

A6. Since the issuance of the certificate of public convenience and necessity for the Spurlock 2 Flue Gas Scrubber system, EKPC has determined that the existing unit chimney is not suitable for use with the Scrubber, and that a new chimney will be required.

Q7. How did EKPC determine that a new chimney for Spurlock 2 is required, in connection with the Spurlock 2 Scrubber system?

A7. Engineering studies performed after the original decision to build a new Scrubber on Spurlock 2 concluded that the existing chimney would not be able to function acceptably without emitting an acid plume due to high gas velocities in the chimney liner. This detail is further explained in the testimony of Kyle Shadoan and the exhibits and appendices attached thereto. The necessity to include a new chimney in the Spurlock 2 Scrubber project scope was the result of detailed economic and technical analyses as referenced above. The project cost addition for the chimney is $18,995,000 and includes a new 650 foot high concrete shell with a carbon steel borosilicate lined flue.

Q8. Have there been any other changes to the scope or cost of the Spurlock 2 FGD Scrubber project?

A8. Yes, the Scrubber project cost has increased due to a number of factors, and the amounts are listed below:

Demolition Work to clear the site:	$2,600,000

Engineering:	1,900,000
Foundations for Chimney; ETC.	1,100,000
Piling for Chimney and Scrubbers:	5,900,000
Material Handling	2,500,000
IDC	15,400,000
TOTAL INCREASE (Not Including Chimney)	$ 29,400,000

The total estimated cost of the Spurlock 2 Scrubber is now $207.4 Million, including the above listed changes and the new chimney.

Q9. Have there been any other developments which have impacts on the Spurlock 2 Scrubber Project?

A9. Since the original Order granting the certificate in this case, EKPC has entered into a Consent Decree with the Environmental Protection Administration ("EPA") which commits EKPC to have the Spurlock 2 Scrubber operational not later than October 2008. This is a condition of settlement of the EKPC New Source Review ("NSR") case which has been pending in federal court since early 2003.

Q10. Has EKPC done a new economic evaluation of the Spurlock 2 Scrubber project, in light of the cost escalations that you have discussed?

A10. Yes, a new economic analysis has been prepared, utilizing the updated cost estimates for the project. The economic analysis is explained in the Supplemental Prepared Testimony of Frank Oliva, and the results of the analysis are attached to that testimony.

Q11. Does the new analysis show that the project is still economically justified?

A11. The new analysis shows a long-term net present value savings to EKPC of approximately $311 million, based on the escalated project cost of $207 million.

Q12. Has EKPC evaluated the timing of the installation of the Spurlock 2 Scrubber, in light of the increase in project costs?

A12. Construction of the Spurlock 2 Scrubber began in early September, 2006, and is currently 20% complete, as originally designed. There is only approximately one year between the current scheduled commercial operation date, and the date by which EKPC would be required to install the Spurlock 2 Scrubber pursuant to EPA clean air compliance deadlines. The commitment to the current commercial operation date in the NSR Settlement Agreement with the EPA precludes any change in the current schedule. Even without the EPA commitment, delay of the project would certainly increase overall costs substantially, due to demobilization expenses, escalation of materials and other construction cost increases that would be involved. The new economic analysis shows an additional $1.8 million NPV cost from a one year delay in the project.

Q13. Does EKPC believe that the changes to the project are needed and that the project continues to be economically justified?

A13. EKPC has carefully evaluated the addition of the Spurlock 2 chimney to the Scrubber Project scope, and believes that the information included in this filing demonstrates that the new chimney is essential to the proper operation of the system. EKPC's analysis also shows that the Scrubber Project, at the new estimated cost, remains economically justified.

Q14. Does this conclude your testimony?

A14. Yes.

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

THE APPLICATION OF EAST KENTUCKY POWER COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION OF A FLUE GAS DESULFURIZATION SYSTEM ON SPURLOCK POWER STATION UNIT 2	)	**CASE NO. 2005-00417**

AFFIDAVIT

STATE OF KENTUCKY)
)
COUNTY OF CLARK)

Gary T. Crawford, being duly sworn, states that he has read the foregoing prepared testimony and that he would respond in the same manner to the questions if so asked upon taking the stand, and that the matters and things set forth therein are true and correct to the best of his knowledge, information and belief.

Gary T. Crawford

Subscribed and sworn before me on this 31st day of July, 2007.

Terri K. Isaacs (Combs)
Notary Public

My Commission expires: 12/20/08

EKPC Motion Exhibit 2

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF EAST KENTUCKY POWER COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION OF A FLUE GAS DESULFURIZATION SYSTEM ON SPURLOCK POWER STATION UNIT 2	)))))	**CASE NO. 2005-00417**

PREPARED TESTIMONY OF KYLE SHADOAN
ON BEHALF OF
EAST KENTUCKY POWER COOPERATIVE, INC.

Q1. Please state your name and address.

A1. My name is Kyle Shadoan, and my work address is P. O. Box 398, Maysville, Kentucky 41056.

Q2. By whom are you employed and in what capacity?

A2. I am employed by East Kentucky Power Cooperative, Inc. ("EKPC"), as a plant engineer at Spurlock Station. I am serving as the on-site project manager for the Spurlock Station Units #1 and #2 flue gas desulphurization ("FGD") Projects.

Q3. What functional areas of EKPC operations are you responsible for in that position?

A3. Construction project manager of the Unit #1 and Unit #2 FGD Projects.

Q4. When did you assume your responsibilities for EKPC's FGD Projects?

A4. I assumed the construction management responsibility for the FGD Projects in November 2005.

Q5. What is the purpose of your testimony?

A5. The purpose of my testimony is to explain and support EKPC's request for an amendment to the certificate of public convenience and necessity granted in this case for the Spurlock Station Unit 2 ("Spurlock 2") Flue Gas Scrubber system, to include a new Spurlock 2 chimney.

Q6. Why was a new chimney not included in the original application in this case?

A6. An FGD system had been constructed for Spurlock 2 in 1982, which operated for a short period before it was determined that the use of compliance coal was more economical. When the new FGD system was designed, the existing Spurlock 2 chimney was anticipated to be suitable for wet FGD operation. This initial determination was based on the chimney having an acid brick liner, and the fact that it had previously operated with the original Spurlock 2 FGD system.

Q7. How did EKPC subsequently determine that a new chimney for Spurlock 2 is now required, in connection with the Spurlock 2 Flue Gas Scrubber system?

A7. After the Spurlock 2 FGD system was designed, EKPC began to evaluate the addition of a scrubber system to Spurlock Station Unit 1 ("Spurlock 1"). Spurlock 1 had never operated with an FGD system, and therefore a more detailed evaluation of the Spurlock1 chimney was included in the design phase. During the design phase of the Spurlock 1 FGD system, it was discovered that the existing Spurlock 1 chimney was not acceptable for wet FGD operation, due to excessive gas velocities. At that time, an in-depth review of the Spurlock 2 chimney, and its ability to operate in a wet FGD environment, began. The attached report of Stanley Consultants, designated as Exhibit A, reflects the conclusions of that review.

Q8. Please explain the operational concerns with the Spurlock 2 chimney that were identified.

A8. Since the time EKPC began to use compliance coal in Spurlock 2, the original FGD system was bypassed. Due to the use of the original FGD system's bypass function, the flue gas temperature was above the dew point and the chimney operated as a dry stack. The wet FGD presently under construction is designed so that 100% of the flue gas will be scrubbed, and there is no bypass in the system. Due to the lack of bypass flue gas to raise the temperature of the gas in the chimney, considerable condensation will occur. Also, the flue gas velocity in the existing chimney is more than double the operational limit for a chimney with an acid brick liner and a wet stack. This means that condensation will not drain down the chimney's liner walls so that it can be collected and handled appropriately. Operating the existing chimney at a flue gas velocity above the recommended limit will result in re-entrainment of acidic water (pH 3-3.5), which will be discharged out the chimney into the atmosphere as "acid rain".

A significant amount of acidic condensation will reach the ground and have corrosive effects at Spurlock Station. The areas that would be adversely affected would be structural steel, outdoor equipment, vehicles, and switchyard equipment. Additional studies by NELS and Alden Research are referenced in the Stanley Study and are attached to that study as Appendices B and C, respectively. The NELS and Alden Research studies both state that the existing unit #2 chimney is not acceptable for wet operation, and that the design and construction of a new unit #2 chimney is the best option. The attached study (Exhibit A) performed by Stanley Consultants provides information on the various options that were considered during the chimney evaluation process. Using good engineering judgment, and an evaluation of the updated economics, Stanley and EKPC personnel concluded that the best option for EKPC was the design and construction of a new unit #2 chimney. This option avoids technical and operational concerns, and the impact of an extended outage on Spurlock 2 which would require the purchase of higher cost replacement power for a longer period of time.

Q9. Will the new chimney replace the existing Spurlock 2 chimney?

A9. Yes

Q10. Please describe the components of the new Spurlock 2 chimney.

A10. The Spurlock 2 Chimney will consist of a concrete shell that is 650 feet tall. It will have a carbon steel liner that is 27'-6" in diameter and protected with borosilicate block.

Q11. What is the estimated cost for the new Spurlock 2 chimney?

A11. The Spurlock 2 chimney is expected to cost $18,995,000, including installation.

Q12. Have there been any other changes to the capital or operating costs associated with the original facilities which were approved in this case?

A12. There have been escalations in the estimated capital costs for the Spurlock 2 Scrubber Project, and those cost increases are discussed in the Prepared Testimony of Gary T. Crawford (Motion Exhibit 1).

Q13. What are the estimated annual operating costs relating to the new Spurlock 2 chimney?

A13. The annual operating costs relating to the Spurlock 2 chimney are estimated to be $100,000 per year.

Q14. Is the location of the new chimney indicated on any maps which were included in the Application in this case?

A14. No, the location of the Spurlock 2 chimney is noted on site layout drawings that are attached to this testimony as Exhibit 4.

Q15. Will the addition of the Spurlock 2 chimney in any way change EKPC's plans for financing the Spurlock 2 Flue Gas Scrubber project?

A15. No. The Spurlock 2 chimney will eventually be funded by a loan from the Rural Utilities Services, along with the rest of the Spurlock 2 Flue Gas Scrubber project.

Q16. Will the addition of the Spurlock 2 chimney affect the schedule for the construction of the Spurlock 2 Flue Gas Scrubber?

A16. No. The Spurlock 2 chimney is expected to be completed by August 15, 2008, which will allow the Spurlock 2 Flue Gas Scrubber to be placed in service by its scheduled October 6, 2008 completion date.

Q17. Will the addition of the Spurlock 2 chimney require any additional permits in regard to the Spurlock 2 Flue Gas Scrubber, or affect the timing of any necessary permits or approvals?

A17. A review of permit requirements by our environmental staff indicates no new approvals are required, and the addition of the new chimney should not impact any other permits for the Spurlock 2 Scrubber Project.

Q18. Does this conclude your testimony?

A18. Yes.

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

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AFFIDAVIT

STATE OF KENTUCKY)
)
COUNTY OF CLARK)

Kyle Shadoan, being duly sworn, states that he has read the foregoing prepared testimony and that he would respond in the same manner to the questions if so asked upon taking the stand, and that the matters and things set forth therein are true and correct to the best of his knowledge, information and belief.

Kyle Shadoan
Kyle Shadoan

Subscribed and sworn before me on this 25th day of June, 2007.

Terry L Lang
Notary Public

My Commission expires: July 25, 2009

Shadoan Prepared Testimony
Exhibit A

Spurlock Station Unit 2
Chimney Suitability Study

East Kentucky Power Cooperative
Maysville, Kentucky

Draft
October 12, 2006

Stanley Consultants INC.

A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

Spurlock Station Unit 2 Chimney Suitability Study

Introduction and Scope

East Kentucky Power Cooperative (EKPC) is installing a wet flue gas desulfurization (FGD) system on Unit 2 at Spurlock Station. The original purpose of this study was to determine the suitability of the existing Unit 2 chimney for reuse with the new wet FGD system. Specific tasks include:

- Review of Alstom Power, Inc.'s stack study and initiation of an additional study if needed.
- Review the economic impacts of the stack reheat option.
- Establish the scope for a spring 2006 inspection of the existing Unit 2 chimney by others.
- Review the results of the Unit 2 chimney inspection report.
- Review design and operational data including gas velocity, gas volume, etc.
- Address regulatory issues.
- Review costs such as capital, operating, maintenance, and outage costs.
- Recommendation regarding the feasibility of reusing the existing Unit 2 chimney.

The complete scope of the study is contained in the request for proposal from East Kentucky Power Cooperative dated February 9, 2006. Refer to Appendix A.

The scope has since been expanded to include development of options and pricing for replacement of the Unit 2 chimney and to include the Spurlock Unit 1 chimney in the discussions. Spurlock Unit 1 is also being retrofitted with a wet FGD system.

The evaluation incorporates information from the Electric Power Research Institute (EPRI) Wet Stack Design Guide, TR-107099 9017, dated November 1996.

Description of the Existing Unit 2 Chimney and Liner

The existing Unit 2 Chimney is a tapered concrete shell with a pressurized annulus and acid brick liner. The overall height of the chimney is 805'. The brick liner consists of ASTM C980-82 Type II acid resistant brick with potassium silicate mortar. At periodic intervals, courses of brick are turned perpendicular to the face of the liner and project into the gas stream.

The liner consists of two tapered sections. The lower liner section starts above the inlet elbow and lower support ring. The internal diameter of this section tapers from 35' to 22' at the upper ring wall. The upper liner section starts at the upper support ring with an internal diameter of 26' and tapers to 22' at the chimney cap. Liner reinforcement consists of 3" wide stainless steel bands at 5' intervals. The chimney and liner were originally intended for operation with a wet FGD system.

With the original FGD system, a portion of the incoming flue gas was bypassed around the scrubber to reheat the saturated scrubber flue gas discharge above its dew point. After operation with a wet scrubber for approximately 1½ years, the scrubber was shut down. The chimney never operated as a "wet" stack. The chimney and liner system have since been operated with hot, dry un-scrubbed flue gas for more than 20 years.

Description of the Existing Unit 1 Chimney and Liner

The existing Unit 1 Chimney is a tapered concrete shell with a fiberglass reinforced plastic (FRP) liner. The overall height of the chimney is 805'. The FRP liner has a constant diameter of 15' and is integrated with the chimney cap at the top of the concrete shell. Approximately 1.3 million cubic feet per minute of flue gas passes up through the chimney. The flue gas velocity through the chimney is approximately 120 feet per second. This is well in excess of the recommended velocities for any of the various liner materials operating with a wet FGD system.

Thus it was realized at the beginning of the Unit 1 FGD project that the existing Unit 1 chimney was unsuitable for use with a wet FGD system due to the high flue gas velocity. The Unit 1 FGD project scope included a new chimney to replace the existing.

Unit 2 Wet FGD Flue Gas Design Parameters

Installation of a wet FGD will change the operating parameters of the flue gas entering the Unit 2 chimney, when compared with historical operation. Table 1 - Wet FGD Flue Gas Design Parameters, includes the Unit 2 full load values that have been used in this study. These values were obtained from the Alstom Power Inc. design data for the Unit 2 wet FGD system currently being installed under Contract 16000-D204. The velocities under the new flow conditions at various locations of interest in the chimney are shown in Table 2 - Full Load Chimney Velocities Under Wet FGD Flow Conditions.

Table 1 Unit 2 Wet FGD Flue Gas Design Parameters

Description	Quantity and Units
Flue gas from Unit 2 WESP, mass flow rate	6,929,252 lb/hr wet 6,248,436 lb/hr dry
Water vapor mass flow rate	680,768 lb/hr
Volume flow rate	1,769,178 acfm, wet
Flue gas temperature	131°F

Table 2 Full Load Chimney Velocities Under Wet FGD Flow Conditions

Location in Stack	Diameter	V, ft/min	V, ft/s
Mitered elbow at entrance into chimney	22'–4"	4,514	75.2
Upper ring liner transition and support	22'–0"	4,652	77.5
Bottom of upper liner	26'–0"	3,331	55.5
Exit of chimney	22'–0"	4,652	77.5

Unit 2 2006 Chimney Inspection

To determine the present condition of the Unit 2 chimney, EKPC commissioned International Chimney Corporation (ICC) to perform an inspection of the chimney during the 2006 spring maintenance outage. ICC reported the Unit 2 Chimney and all appurtenances are intact. The chimney and its brick liner are in good operating condition. Refer to the original inspection report for specific inspection findings. ICC made the following specific recommendations:

- Consideration should be given to reinstalling the two air terminals of the lightning protection system, which have been removed. These would be attached to the fiberglass hood.

- To assure that the concrete column remains structurally sound, consideration should be given to coating the exterior top portion, approximately 50', of the concrete shell.

It appears that flue gas from adjacent chimneys at times engulf the concrete column. This condition has caused minor wear to the concrete column, which has resulted in heavy aggregate within the concrete to become exposed.

- The pressurization system rubber tubes which extend through the lower concrete support ring within the annular space should be replaced entirely.

ICC stated the approximate cost to complete the repairs as described above would be in the range of $40,000 to $50,000. It is not known if any of the recommended repairs have been completed to date.

- ICC was asked to comment upon the reuse of the Unit 2 chimney for a wet FGD application, including any recommended changes or upgrades and the suitability of the existing brick liner. ICC provided the following comments:

  - The major item affected when operating with a wet FGD system is the brick liner. As previously stated, the brick liner is currently in structurally sound condition with no excessive wear points being noted. The brickwork and the mortar joints are intact and in very good condition. Since the shut down of the original wet FGD system, the flue gas into the chimney has been hot and dry and well above the saturation temperature. This is the preferred operating condition for this type of brick liner construction.

  - With the introduction of the new wet FGD system, the flue gas temperatures will decrease greatly and be at saturation. The brickwork will be exposed to wet, cool, flue gas. The brick itself can withstand these conditions. The main concern would be the mortar joints. The mortar utilized for this lining is a potassium silicate mortar, which when exposed to the wet saturated conditions, will deteriorate over time. The key to utilizing the existing brick liner is the annulus pressurization system. The increased pressure within the annular space will deter the migration of moisture through the mortar joints and slow deterioration.

Hot, dry operation is preferred over wet operation. Regular inspections and performing required maintenance become more important when operating the same stack in a wet versus dry condition.

Proper operation of the annulus pressurization system is necessary to slow wastage of the mortar. Potassium silicate mortars are more resistant to sulfation than other types of silicate based cements. Potassium silicate based mortar is the mortar of choice in new installations utilizing ASTM C980 brick.

The maintenance costs for a chimney operated under wet conditions will be higher than the same chimney operated under dry conditions. The recommended inspection interval is shorter, every two or three years in order to keep repairs at a manageable level. If inspections are only carried out every 7 or 8 years, the extent of necessary repairs will be much higher.

ICC did not address other design issues such as flue gas velocity in the chimney.

Regulatory Issues

The existing Unit 1 and 2 chimneys are 805' tall. Regulations in effect at the time of construction allowed for some dispersion of local emissions through increased chimney height. The current method of chimney height determination, "Good Engineering Practice", limits the height of a chimney to 2.5 times the adjacent building height. New chimneys if constructed would thus be limited to 650' in height, the same as the existing Unit 3 and future Unit 4 chimneys. This would not be expected to result in difficulty with regulatory agencies or affect existing air permits as the existing air models and permits already in place are based on an effective height of the Unit 1 and 2 chimneys of 650'. An Owner can not take credit for chimneys which exceed current height regulations.

Unit 2 Chimney Evaluation

EPRI Guidelines

The Electric Power Research Institute (EPRI) recommends a flue gas velocity range for a chimney with an acid resistant brick liner operating with a wet FGD system of 45 – 55 feet per second. At velocities above this level, water condensed within the chimney due to cooling of the flue gas will agglomerate into droplets, become entrained, and be carried out the top of the chimney. This condensate is acidic and will cause damage to surfaces of vehicles and building structures. At velocities below the EPRI guidelines, the water will flow by gravity down the walls of the liner where it can be collected, drained and treated. The allowable flue gas velocity range can vary due to the roughness of the surface. The permissible flue gas velocity without condensate carryover in a fiberglass lined chimney is much higher than a brick lined chimney since the fiberglass liner is smoother. A brick liner has variations in the surface due to offsets in the brick and mortar joints. This provides sites where moisture can collect and become entrained in the gas stream. The existing Unit 2 chimney liner is especially poor in this regard due to the periodic brick layers jutting into the gas stream.

Table 2 - Full Load Chimney Velocities Under Wet FGD Flow Conditions, shows the variability in flue gas velocity through the different sections of the Unit 2 chimney. At full load, the flue gas velocity is above EPRI's recommended range in all sections of the chimney.

Plume Downwash

A cross wind at the top of a chimney will deflect the plume from its vertical path. When the ratio of the vertical plume momentum to horizontal wind momentum falls below two (2.0), the plume may become partially entrained in the vortices that form on the downwind side of the chimney. Downwash increases the potential for deterioration of the chimney concrete shell. Downwash is most likely to occur during reduced load operation under high wind conditions and cold ambient temperatures. Estimates were made to predict when the downwash potential is the greatest for wet operations. These estimates are presented in Figures 1 and 2. Downwash is likely to occur at wind speeds in excess of 35 mph during full load operation and in excess of 30 mph at 80% load. The downwash wind speeds were compared to the wind direction and speed data as presented in the Unit 3 and Unit 4 Design Outlines. The cumulative frequency for a wind speed greater than 21 knots (24.17 mph) is only 0.00148 (0.148 %), or approximately one half day per year. This indicates downwash rarely will occur.

FIGURE 1. FULL LOAD MOMENTUM RATIO FLUE/WIND

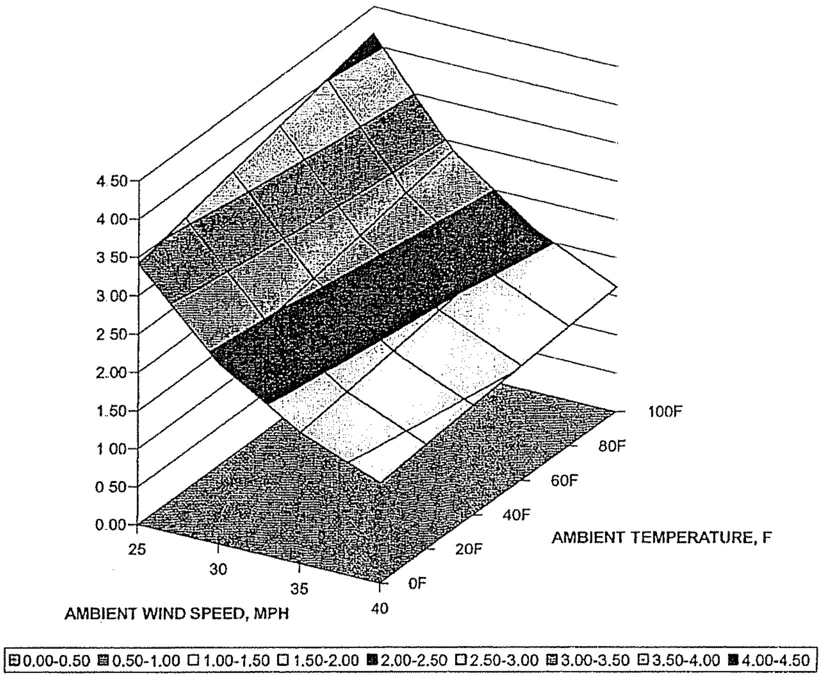
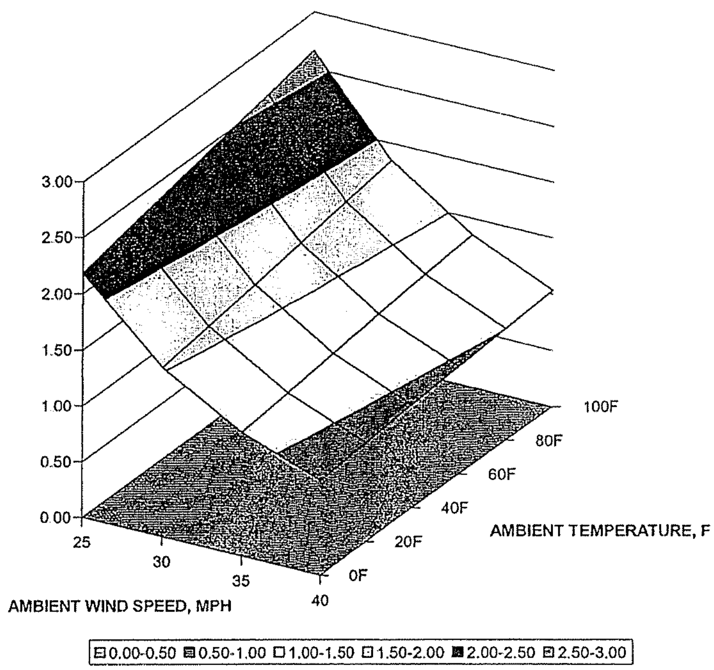


FIGURE 2. 80% LOAD MOMENTUM RATIO FLUE/WIND



NELS Study

A study of the Unit 2 chimney was commissioned by Alstom Power Inc. through NELS Consulting Services of St. Catharines, Ontario. The purpose of the report was to evaluate the existing Unit 2 chimney with respect to wet operation with a wet FGD system and the various options available to reduce droplet emissions. Stanley Consultants reviewed the preliminary report and concluded there was little depth and no detailed analyses of the existing Unit 2 design to reduce carryover of liquid. No support information was provided and there were multiple misapplications of EPRI recommendations. A copy of the report with Stanley Consultants' comments is included in Appendix B.

Alden Research Study

Alden Research (Alden), Holden Massachusetts, conducted the 1996 study and authored the EPRI guidelines for wet stack operation previously referenced. Subsequent to the NELS study, EKPC employed Alden to review the existing Unit 2 chimney design and future operating conditions to determine its suitability for wet stack operation. Mr. David Anderson of Alden presented the results of the study at a meeting on October 2, 2006. Highlights included:

- The existing brick chimney liner has a low tolerance for wet operation. The current recommended maximum velocity in a brick flue is 45 feet per second. This is a reduction from the original Alden study and EPRI guidelines published in 1996.
- Free moisture in the chimney flue gas stream is from carryover from the wet FGD system, cooling of the flue gas and condensation in the chimney, and from adiabatic effects from flue gas pressure losses.
- With an FRP or metal alloy liner such as C276, gravity downward forces and upward velocity (shear) forces are in balance at a velocity of 80 – 90 feet per second.
- Approximately 5 – 10 gallons per minute of condensate will be formed in the Unit 2 chimney, although not all would be emitted from the top of the chimney.
- Drop out of water carryover from the chimney normally occurs within 200' of the chimney.
- The existing brick chimney liner would have an expected flue gas velocity of 76 feet per second. This is not favorable for wet operation and is not recommended.

The existing brick offsets in the liner are an added problem. Mr. Anderson stated, "The brick liner just will not work."

- In response to a question, Mr. Anderson indicated that removing the narrower top section of brick liner to reduce the velocity would not be solution Moisture entrained in the flue gas in the lower section of the brick liner would still be carried out the chimney.

A copy of the Alden report is included in Appendix C.

Conclusions

Operating the existing Unit 2 chimney and liner under the proposed wet FGD conditions would result in flue gas velocities above those recommended for the brick liner. Entrainment of liquid condensate is expected to occur. This entrainment will result in carryover of liquid water and localized droplet fallout. The result of long term operations under this condition will be degradation of nearby structures caused by the acidic liquid. Discussion and evaluation of new chimney and liner configurations are discussed in subsequent sections.

Chimney Liner Material Options

Considerations

Multiple economic considerations play a role in the design of a chimney liner, including minimizing the diameter. The controlling parameter for effective wet stack operation is the liner gas velocity and the resulting effect on liquid collection. The various liner types and construction techniques have different velocities considered favorable for wet operation. The liner diameter should be selected so that the gas velocity is less than the critical re-entrainment velocity (with a desirable margin). This will allow liquid to be collected in the chimney rather than emitted with the gas stream. An estimate was made of the resulting stack internal diameters using the wet FGD flue gas flow rate and the EPRI velocity guidelines for the different available liner materials. These materials include:

- Acid Brick
- Borosilicate Glass Block

- Fiberglass Reinforced Plastic (FRP)
- Metal Alloys
- Coatings

This information is presented in Table 3 - Unit 2 Flue Diameter vs. EPRI Recommendations. Table 4 - Liner Summary contains qualitative information on the various liner materials.

Alden Research Laboratory Inc. was heavily involved in establishing the original EPRI recommendations. Since those recommendations where made many years of additional testing and industry experience have been accumulated. The recommended maximum flue gas velocities for some materials have been adjusted. Industry experience has shown the offset between brick layers has a greater effect on re-entrainment than originally predicted when establishing the EPRI guidelines. Alden has also done more testing and has more actual physical data on the borosilicate block liner system manufactured by Hadek. Alden now recommends 60 feet per second as the maximum flue gas velocity for the Hadek borosilicate block liner system.

Table 3 Unit 2 Flue Diameter vs. EPRI Recommendations

Liner Material	EPRI Recommended Velocity Ft/Sec	EPRI Recommended Velocity Ft/Min	Unit 2 Chimney Resulting Diameter
Acid Brick	45	2,700	28.9
Borosilicate Glass Block	50	3,000	27.4
Fiberglass Reinforced Plastic	50	3,000	27.4
Alloy	60	3,600	25.0
Coatings	60	3,600	25.0
Borosilicate Glass Block(1)	60	3,600	25.0
Fiberglass Reinforced Plastic(1)	55	3,300	26.1
Alloy(1)	55	3,300	26.1

(1) Alden Research Laboratory updated recommendations.

Table 4 Liner Summary

Liner and Material or Coating	Advantages	Disadvantages	Estimated Installed Cost Per Sq Ft, 1996$
Acid Resistant Brick	Good corrosion resistance.	Surface discontinuities re-entrain liquid.	$45 – $55

	Cost-effective. Liquid adheres to the porous surface.	Not recommended in high seismic areas. Maintenance of liner accessories. Annulus pressurization.	
Protective Coating on Carbon Steel	Fair corrosion resistance. Ability to retrofit to existing steel liner systems.	Surface preparation prior to placement. Very frequent repair and maintenance required. Limited acceptable selections.	$55 – $60
Borosilicate Foamed Glass Block on Carbon Steel	Good corrosion resistance. Good insulator (ductwork & liner should not be insulated). Ability to retrofit to existing steel liner systems. Good surface for liquid flow.	Cannot tolerate abrasion or physical and mechanical abuse. Limited source of supply. Care required to install properly.	$75 – $80
Fiberglass Reinforced Plastic	Good corrosion resistance. Easy to add liquid collectors.	Maximum 300°F gas temperature exposure. Quality control during fabrication and installation required. Limited sources of supply. Compressive strength limitations usually requires two support levels and expansion joint.	$85 – $90
Alloy C276	Excellent corrosion resistance.	Welding quality control. High material costs. Welding seams. Iron contamination. Acid cleaning.	$80 – $90 Wallpaper on carbon steel $110 – $120 Roll Clad $120 – $130 Solid
Titanium Grade 2 on Carbon Steel	Excellent corrosion resistance.	Welding process. Welding quality control High material costs.	$80 – $90 Wallpaper

Current 2006 costs provided by Jim Naylor, Pullman Power, are $125 per square foot installed for an FRP liner and Alloy C276 5/16" thick clad material, installed, $225 per square foot.

Chimney Option Evaluations

General

Numerous options for the Unit 1 and 2 chimneys were developed in conjunction with EKPC. These options as shown below include various plans for constructing new chimneys, dual flue chimneys, and reuse of existing chimneys.

- New individual chimneys for Units 1 and 2
- New single chimney with two internal flues to serve both Units 1 and 2
- Reuse existing Unit 2 chimney for Unit 1; New Unit 2 chimney
- Line existing Unit 2 chimney with borosilicate block; New Unit 1 chimney
- Reuse existing Unit 2 chimney shell. Remove brick liner and install new carbon steel flue with borosilicate glass liner system; New Unit 1 Chimney
- Shorten Unit 2 chimney to decrease flue gas velocity; New Unit 1 chimney
- New chimney adjacent to existing Unit 2 chimney to share Unit 2 gas flow; New Unit 1 chimney
- Unit 2 flue gas reheat system; New Unit 1 chimney
- Operation with existing Unit 2 chimney; New Unit 1 chimney

Conceptual cost estimates were developed for each of the options evaluated. The cost estimates include foundations and any additional duct work required. Unless stated otherwise, tie ins to existing systems could be accomplished in a normal three to four week outage window.

Costs of construction, materials, labor, etc. were developed from published data sources and industry references, vendor quotes, and previous work performed by Stanley Consultants. The costs are evaluated on a present value basis.

The costs include the categories of undeveloped design details, engineering design, contingency, and contractor's overhead and profit. Undeveloped design detail is a term used for items that are not included in the cost estimate but will need to be included in the final estimate. This includes items not known or not realized at the time of estimate preparation.

Engineering design covers the cost of executing the detailed design including the preparation of plans and specifications for bidding and construction purposes. Contingency is included in a cost estimate to allow for minor scope changes, variations in bidding climate, cost estimating inaccuracy, and unforeseen problems during construction.

The costs are conceptual in nature and are based on the information available at the time of the estimate. The final costs will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, and other variable factors. Thus the final project costs may vary somewhat from the estimates presented.

New Individual Chimneys for Unit 1 and Unit 2

The total estimated cost for new individual chimneys for Unit 1 and Unit 2 is $40.7 million. This includes a cost of $19.7 million for the Unit 1 chimney and $21 million for Unit 2. The chimneys would be 650' tall in accordance with EPA's "good engineering practice." The shells would include a concrete shell with independent alloy C276 clad flues. The main advantages of individual chimneys are operational and maintenance independence. Also each chimney would have the optimal design for the unit's operating conditions.

An FRP flue would cost approximately $3.4 million less per chimney to construct. However, FRP currently has a reported lead time of several years from the reputable FRP liner manufacturers due to the heavy demand. FRP also has additional issues with proper installation and requirements for maintenance.

New Individual Chimney with Two Flues

The estimated cost of a new chimney with two internal flues to serve both Unit 1 and Unit 2 is $43.1 million. Jim Naylor of Pullman Power reported that the cost of a dual flue chimney would only result in a savings of approximately $1 million when compared with the cost of individual chimneys. This savings would not actually be realized. The final cost is higher because a larger foundation is required and additional duct work is needed. Approximately 300' of duct work would be required for Unit 1 to the new chimney location. This ductwork is constructed of alloy 2205 for corrosion resistance to the wet, acidic flue gas and is very expensive, costing about $$11,000 per foot installed with foundations and supports. The new chimney would be located near the existing coal conveyors serving Units 1 and 2. The disadvantage of using a single chimney serving two units is reliability. The failure of a flue and the need for maintenance on either flue would be difficult and would require the shut down of both Units 1 and 2. Each flue would be designed for the individual unit operating conditions.

Reuse Existing Unit 1 and Unit 2 Chimneys for Unit 2 with New Unit 1 Chimney

This plan would reuse both the existing Unit 1 and Unit 2 chimneys. The flue gas flow from the Unit 2 scrubber would be split and ducted to the two chimneys. There would be significant flue gas flow issues that would have to be addressed during modeling and design. Approximately 400' of duct work would be required to access the Unit 1 chimney from the outlet of the Unit 2 scrubber. This represents a significant pressure loss. Additional fan horsepower would be expended to move the flue gas through the additional duct work. A control damper would be required in the flue duct to the existing Unit 2 chimney to equalize the duct losses to the Unit 1 chimney. Each inch of pressure drop needed to balance flow between the chimneys will result in approximately 0.25 MW of additional auxiliary power. Also, assuming the flue gas flowrate for the Unit 2 chimney is controlled to a velocity of 45 feet per second, the resulting velocity in the Unit 1 chimney will be 70 feet per second. The Unit 1 chimney flue velocity would be above the recommended Alden Research figure for FRP liner material of 55 feet per second.

The estimated cost of reusing the existing Unit 1 and Unit 2 chimneys for Unit 2 is $24 million. Of this amount, the new Unit 1 chimney represents $19.7 million of the total cost. On the surface, this seems to be an attractive solution to obtain continuing use from the existing chimneys. However, closer analysis reveals this plan does not solve the problem of stack liquid discharge as the resulting flue gas velocity in the chimneys still exceeds recommendations.

Line Existing Unit 2 Chimney with Borosilicate Block

Borosilicate glass block has been considered for attachment directly to the inside surface of the existing chimney's concrete shell to provide protection against wet flue gas. The estimated cost for this liner system and a new Unit 1 chimney is $33.6 million. Although glass block can provide an effective corrosion resistant barrier, there are risks involved. Damage to the concrete column is possible if leakage through the block and adhesive develops. The location of the leakage and the extent of damage to the concrete column would be difficult to detect and then evaluate.

Demolition of the existing liner would be required prior to installation of the glass block liner. The total outage time for demolition of the existing brick liner, construction of the chimney flue gas inlet structure to replace the existing mitered elbow, and surface prepation and installation of the glass block liner is estimated at 20 weeks. The existing platforms and

CEM equipment located within the annulus of the chimney would need to be removed. New platforms and CEM equipment would need to be installed on the outside of the chimney shell. Flanged ports would be added to the chimney shell to mount the CEM equipment.

Others have indicated a portion of the block could be applied to the chimney shell with the chimney in operation in order to reduce the total Unit 2 outage time. The working conditions would be very poor due to the heat and the presence of flue gas leaking through the existing liner. During demolition of the brick liner, the glass block would be very easily damaged, so extreme care would need to taken.

Potentially, the glass block could be applied to the inside of the existing brick liner. However this would reduce the internal diameter of the flue further and would exceed the recommended flue gas velocity for glass block.

Although the capital cost is low, the required outage time and resultant requirement to purchase power from other sources elevates the total cost.

Existing Unit 2 Chimney Shell with Carbon Steel Flue Lined with Borosilicate Block

In this plan, the existing Unit 2 chimney would be modified for continued use. The existing brick liner would be demolished. A new carbon steel flue would be installed, which in turn would be lined with borosilicate block. The carbon steel flue would be 25'-8" in diameter to meet gas velocity recommendations for borosilicate block. The total time to accomplish these tasks is estimated to be 32 weeks.

This scenario would eliminate some of the drawbacks of the previous plan. The existing annular CEM platforms could be maintained. It may be possible to reuse the existing CEM equipment. Inspection for leakage through the glass block liner and corrosion can be readily accomplished by inspecting the exterior of the carbon steel flue from the chimney annulus. The major problem with this proposal is the Unit 2 outage time required of 32 weeks. Purchase power costs during the unit outage would be very significant. The conceptual cost of this plan is $36.4 million

Shorten Existing Unit 2 Chimney to Decrease Flue Gas Velocity

The existing Unit 2 chimney could be shortened to 650' to correspond with the other new chimneys at Spurlock Station. Shortening the chimney would increase the brick liner diameter and the top of the chimney since the diameter tapers inward with increasing stack height. This would result in a flue gas velocity estimated to be 63 feet per second with this configuration. This velocity is still significantly higher than the recommended velocity for a brick liner. Also, Alden Research has stated that once moisture has been entrained, decreasing the velocity does not "resettle" the moisture and allow collection. The support ring on which the upper liner sits creates a choke point that increases the flow velocity and causes moisture to re-entrain.

The total cost of this plan with a new Unit 1 chimney is $23.4 million. Shortening the existing Unit 2 chimney is estimated to cost $3.7 million. The total outage time for demolition of the upper portion of the existing shell and brick liner is estimated at sixteen weeks.

New Chimney Adjacent to Unit 2 Chimney

A new chimney could be constructed to share the gas flow with the existing Unit 2 chimney. The flue gas velocity in the existing chimney could then be lowered to acceptable limits. The estimated cost of a new chimney to serve with the existing Unit 2 chimney is $16.8 million. This arrangement also has flue gas flow issues that would need to be addressed during modeling and design. Dampers would be required to control the flow to each chimney. There are advantages of this arrangement over utilizing the existing Unit 1 chimney. The main advantage is the new chimney would be located much closer to the Unit 2 wet FGD system, thus reducing the amount of additional duct required. The chimney could also be designed with the proper flue diameter. However the savings are low ($4.2 million) when compared to a new Unit 2 chimney designed for the total gas flow from the unit. The total cost of this plan with the new Unit 1 chimney included is $36.5 million.

Unit 2 Flue Gas Reheat System

The temperature of the flue gas from the Unit 2 wet FGD system will be at saturation. Cooling of the flue gas as it rises through the chimney results in condensation and the formation of liquid water. If the flue gas was heated above the saturation point, condensation in the chimney could be reduced.

An estimate was made of the energy necessary to reheat the flue gas. The source of the reheat energy would be auxiliary steam which is derived from the cold reheat steam system. The loss of turbine generator output resulting from extraction of the cold reheat steam, assuming 50 degrees of flue gas reheat, is estimated at 10.2 megawatts. The electrical output loss at $25/MWhr would result in approximately $2.2 million in lost revenue each year. The addition of a flue gas reheat heat exchanger in the FGD system outlet duct will also result in higher draft losses in the flue gas system. As previously stated, each inch of draft loss will result in approximately 0.25 MW of additional auxiliary power required. Inspection and maintenance costs are expected to be approximately $500,000 each year.

The estimated capital cost of the flue gas reheat system for Unit 2 is $5.8 million. The estimate is based on using alloy C276 material for construction of the heat exchanger due to the corrosive nature of the flue gas. With the addition of the new Unit 1 chimney, the total cost of this plan is $ 25.5 million.

Operation with Current Unit 2 Chimney

Table 5 - Stack Velocity vs. Load shows the flue gas velocity when utilizing the existing Unit 2 stack configuration. When operating below 60% boiler load, the flue gas velocity will be within the Alden Research guideline velocity of 45 feet per second for the existing brick liner. Downwash can be expected when wind speeds are greater than 25 mph. Down rating the unit and running at reduced load could alleviate the need for a new chimney, although at a substantial loss in generating capacity.

EPRI reported that based on their survey, stack liquid discharge effects, if seen, usually occur within 1/2 mile of the chimney. Alden Research reported the majority of the deposition will occur with 200 feet of the chimney. The new Unit 2 FGD system could be placed into operation with the existing chimney arrangement to determine if the effects are as predicted. If so, a new chimney could then be retrofitted. However this plan is not recommended.

Table 5 Stack Velocity vs. Load

% Unit Load	Flue Gas Flow Rate ACFM	Stack Exit Velocity Ft/Sec	Stack Exit Velocity Ft/Min
100%	1,768,517	77.5	4,652
95%	1,680,091	73.7	4,420
90%	1,591,665	69.8	4,187
85%	1,503,239	65.9	3,955
80%	1,414,814	62.0	3,722
75%	1,326,388	58.2	3,489
70%	1,237,962	54.3	3,257
65%	1,149,536	50.4	3,024
60%	1,061,110	46.5	2,791
55%	972,684	42.6	2,559
50%	884,259	38.8	2,326
55%	795,833	34.9	2,094

Exit Configuration

The existing Unit 2 chimney has a choke. A choke is the narrowing of the internal diameter of the stack at the outlet. This is usually done to assist dispersion. In stacks that have chokes, some of the fine droplets entrained in the gas flow will be deposited on the choke surface. The liquid collected on the choke will lead to stack liquid discharge if the local gas velocity is high. This can be expected for the Unit 2 stack exit when operating under wet conditions.

Summary and Conclusions

The plans for resolving the potential problems with the Unit 2 chimney and the resulting capital costs are summarized below:

Table 6 – Chimney Plans and Capital Costs

CHIMNEY PLAN	CAPITAL COST(2) (Millions $)	TECHNICAL FEASIBILITY(3)	UNIT 2 OUTAGE TIME
New Individual Chimneys for Units 1 and 2(1)	$40.7	Yes	4 weeks(4)
New Single Chimney to Serve Both Units 1 and 2	$43.1	Yes	4 weeks(4)
Reuse Existing Unit 1 and Unit 2 Chimneys for Unit 2; New Unit 1 Chimney(1)	**$26.9**	No	4 weeks(4)
Reuse Existing Unit 1 and Unit 2 Chimneys for Unit 1; New Unit 2 Chimney(5)	**$35.0**	**Yes**	**4 weeks(4)**
Line Existing Unit 2 Chimney Shell with Borosilicate Block; New Unit 1 Chimney(1)	**$27.7**	Yes	20 weeks
Existing Unit 2 Chimney Shell with Carbon Steel Flue with Borosilicate Block Liner; New Unit 1 Chimney(1)	**28.2**	Yes	**26 weeks**
Shorten Existing Unit 2 Chimney to Decrease Flue Gas Velocity; New Unit 1 Chimney(1)	$23.4	No	16 weeks
New Chimney Adjacent to Existing Unit 2 Chimney to Share Unit 2 Flue Gas Flow; New Unit 1 Chimney(1)	$36.5	Yes	4 weeks(4)
Unit 2 Flue Gas Reheat System; New Unit 1 Chimney(1)	$25.5	Yes	4 weeks(4)
Operation with Existing Unit 2 Chimney As Is; New Unit 1 Chimney(1)	$19.7	No	0 weeks

(1)Includes $19.7 million for new Unit 1 chimney

(2)Alloy C276 clad liner material assumed due to current availability. FRP material is estimated to be $3.4 million less
(3)Defined as meeting flue gas velocities as recommended by Alden Research in their report dated September 2006
(4)Unit outage time required for tie in
(5)Includes $21.0 million for new Unit 2 chimney

Other considerations must be taken into account in addition to those presented herein in making a determination as to how to proceed. The market for new chimneys is extremely tight. Many utilities are currently planning and constructing chimneys for new scrubbers and new generating units. The capacity of the industry to build new chimneys has been exceeded. The selection of the chimney option may be the one that can be built in the shortest period versus the least cost or technically optimal solution. If for example, only a single chimney construction slot is available to EKPC, the construction of the dual flue chimney may be best. It has also been reported that FRP chimney liner fabricators are busy for the next several years. It may be necessary to use a more expensive alloy liner in order to build a new chimney. Bids are due to be received for the new Unit 1 chimney on November 17, 2006. A determination of the availability of materials and the ability of chimney contractors to respond to the Unit 1 schedule can be made at that time based on the bids received.

Various economic factors must also be included in the selection. These include the costs of purchased power to offset power during unit outages for the chimney rebuild options and tie ins. Some of the plans require longer outages than others. Also, it may be better to delay start-up of the scrubbers and build chimneys when contractor schedules allow with optimal technical considerations rather than using more expensive materials at higher market costs in order to get the scrubbers on line sooner. The costs of sulfur dioxide emission allowances and low versus high sulfur fuel costs play a large role in these decisions.

All of these items need to be considered in the final solution.

APPENDIX A

SCOPE OF STUDY

EAST KENTUCKY POWER COOPERATIVE

February 9, 2006

Steve Schebler, P.E.
Senior Vice President
Stanley Consultants, Inc.
225 Iowa Avenue
Muscatine, IA 52761

Dear Steve:

Subject: Spurlock Station – Unit 2
Flue Gas Desulfurization (FGD) Systems
Existing Stack Suitability Request For Proposal

Please submit a cost estimate to provide the engineering required to determine the suitability of reuse of the exiting Unit No. 2 stack for the new FGD System and which includes, but is not limited to the following tasks:

Phase I—Identification of the Issues

- Review of Alstom's Stack Study and Initiation of Own Study if Needed
- Review of Economic Impact of Reheat Option
- Scope Definition for Unit No. 2 Stack Inspection for Spring 2006 Outage (March)

  Includes Condition Assessment of Liner

  Includes Condition Assessment of Rain Hood

  Includes Condition Assessment of Stack Pressurization System
- Review of Inspection Findings
- Review of Design/Operational Data, i.e. Gas Velocity, and Gas Volume
- Address any Regulatory Issues
- Review of Costs, i.e. Capital, Operating, Maintenance, and Outage
- Recommendation of Feasibility of Reuse of Existing Stack

4775 Lexington Road 40391
P.O. Box 707, Winchester,
Kentucky 40392-0707
Tel. (859) 744-4812
Fax: (859) 744-6008
http://www.ekpc.com

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February 9, 2006

Phase II—If Existing Stack cannot be Reused—Design Process of New Stack

- Preliminary Design - Engineer

  Address Regulatory Considerations

  Perform Component-by-Component Design

  Economic Analysis

- Preliminary Design Review – Engineer and Modeling Company

  Adjust Design for Suitability and Compatibility for Liquid Collection

- Fluid Dynamic Design – Modeling Company

  Perform Flow Model Study

- Preparation of Bid Specification - Engineer

- Final Design – Chimney Contractor

  Detailed Design for Chimney Construction

- Foundation Design – Engineer

Please reference EPRI Wet Stacks Design Guide.

If you have any question, please contact Jeff Brandt at 606/883-3166.

Sincerely,

Randy Dials /sg

Randy Dials, Vice President
Power Production

jmb:sg
c: Jeff Brandt
Diana Pulliam
Sam Holloway
Jim Shipp

APPENDIX B

NELS UNIT 2 CHIMNEY REPORT

ALSTOM POWER INC.

Knoxville, Tennessee

EAST KENTUCKY POWER CO-OPERATIVE
SPURLOCK STATION UNITS # 1&2
EVALUTAION OF EXISTING STACK LINERS
FOR WET OPERATION

Client Reference No.87002

NCS Project No. P022.06

NELS CONSULTING SERVICES INC.

ST. CATHARINES, ONTARIO, CANADA

(905) 682 2969

April 2006

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1 INTRODUCTION

The East Kentucky Power Co-Operative Spurlock power station for Units #1 & 2 are being equipped with Alstom Power Inc. WESP's & WFGD's. The addition of these two components will result in the operation of a wet stack liner in both cases. Currently the liners are operating dry with no moisture carryover issues. The conversion of the existing stack liners will result in non-ideal wet stack operating conditions for both units. This report present an evaluation of the existing stack liner with respect to wet operation and the various options available to reduce droplet emissions.

1.1 Unit #1 – Evaluation of Existing System

The existing Unit #1 stack liner is constructed of FRP at a constant diameter of 15 feet. The operating conditions are as follows:

<u>Existing operating conditions</u>

Stack Liner	FRP
Volume Flow	1,265,000 acfm at 330° F
Stack Diameter	15.0' diameter (176.6ft^2)
Stack Velocity	119.4 fps (7163 fpm)

<u>Proposed operating conditions</u>

Stack Liner	FRP
Volume Flow	1,020,000 acfm at 130° F
Stack Diameter	15.0' diameter (176.6ft^2)
Stack Velocity	96.3 fps (5776 fpm)

The recommended operating velocity for a FPR liner is 45 to 55 fps (2700 to 3300 fpm) according to the EPRI wet stack liner guidelines. Based on Nels previous experience with similar FRP wet stack liners the optimum liner velocity is approximately 50 fps with respect to droplet carryover and re-entrainment.

At the proposed liner velocities any liquid collection devices that project into the gas stream will be rendered ineffective due to the high gas velocities and upward liquid flow patterns. If an optimized liquid collection system were to be installed a maximum collection efficiency of approximately 20% would be obtained. Any condensation that will form in the liner will be re-entrained and exit the stack.

The mist eliminator (ME) carryover which is entrained in the gas flow would get partially removed from the gas stream in the absorber outlet ductwork, assuming that the ductwork velocities are in the range of 3000 fpm. The estimated collection efficiency for this section of ductwork could range from 50% to 80% assuming the ductwork velocities are in the correct range.

Despite the ability to remove some of the ME carryover the condensation rate will account for the majority of the liquid in the system. The estimated condensation rate for this liner would be 5.31 gpm for an ambient temperature of 25°F. The condensation rate does not include air infiltration, any amount of air infiltration will increase the condensation rate. Typically an FRP liner will have minimal air infiltration.

The plume downwash and wind interaction effects for the liner would be minimal due to the high exit velocity. This would allow for stable operation and flow patterns at the stack exit for a wide range of wind velocities. The estimated wind velocity at which plume downwash would occur would be 43 mph (62.6 fps).

The existing wet stack liner is not suitable for wet stack operation at the stated velocities without emitting an excessive amount of droplets. Any conventional liquid collection devices installed in the system would be rendered in-effective and the system would still emit excessive droplets.

1.2 Unit #2 – Evaluation of Existing System

The existing Unit #2 stack liner is constructed of acid resistant brick with a tapered liner with a bottom diameter of 35 feet and an exit diameter of 22 feet. The operating conditions are as follows:

Existing operating conditions

Stack Liner	Acid Resistant Brick
Volume Flow	2,325,076 acfm at 350° F
Stack Diameter	22.0' diameter at exit (379.9ft^2)
Stack Velocity	102.0 fps (6120 fpm)

Proposed operating conditions

Stack Liner	Acid Resistant Brick
Volume Flow	1,768,517 acfm at 131° F
Stack Diameter	22.0' diameter at exit (379.9ft^2)
Stack Velocity	77.6 fps (4655 fpm)

The recommended operating velocity for an Acid Brick liner is 55 to 65 fps (3300 to 3900 fpm for a ΔR of 0) and 25 to 35 fps (1500 to 2100 fpm for a ΔR of 1/8") according to the EPRI wet stack liner guidelines. Based on Nels previous experience with similar brick wet stack liners the optimum liner velocity is approximately 50 fps (ΔR=0) at the exit with respect to droplet carryover and re-entrainment.

At the proposed liner velocities any liquid collection devices that project into the gas stream will be rendered ineffective due to the high gas velocities and upward liquid flow patterns. If an optimized liquid collection system were to be installed a maximum collection efficiency of approximately 35% would be obtained. Any condensation that will form in the liner will be re-entrained and exit the stack.

The ME carryover which is entrained in the gas flow would get partially removed from the gas stream in the absorber outlet ductwork, assuming that the ductwork velocities are in the range of 3000 fpm. The estimated collection efficiency for this section of ductwork could range from 50% to 80% assuming the ductwork velocities are in the correct range.

Despite the ability to remove some of the ME carryover the condensation rate will account for the majority of the liquid in the system. The estimated condensation rate for this liner would be 4.82 gpm for an ambient temperature of 25°F. The condensation rate does not include air infiltration, any amount of air infiltration will increase the condensation rate. Typically a brick liner will have air infiltration especially if the stack has a pressurized annulus.

The plume downwash and wind interaction effects for the liner would be minimal due to the high exit velocity. This would allow for stable operation and flow patterns at the stack exit for a wide range of wind velocities. The estimated wind velocity at which plume downwash would occur would be 34 mph (50 fps).

The existing wet stack liner is not suitable for wet stack operation at the stated velocities without emitting an excessive amount of droplets. Any conventional liquid collection devices installed in the system would be rendered in-effective and the system would still emit excessive droplets.

2 Review of Potential Options for Reducing Droplet Emissions

The following is a review of potential options for reducing the droplet emissions for both units #1&2. The various options range from:

1. Completely replacing both liners
2. Partial liner replacement, Single New Stack
3. Installing a reheat system
4. Installing a mechanical moisture collector to remove the droplets from the system.

All of the proposed options have benefits to minimizing liquid droplet emissions with varying degrees of effect on the system in terms of system pressure loss, cost of installation and energy consumption.

2.1 Install New Wet Stack Liners for each Unit

Installing a new wet stack liner for each unit designed with an appropriate liner velocity and optimized liquid collection system. This option consists of high initial capital costs and extra space for the plant, but will have reduced maintenance cost compared to some other options.

The recommended design parameters for each stack would be as follows:

- Liner height kept the same as existing hot stacks (Ground Level Concentration (GLC) should be evaluated for wet operation)
- Can be constructed of FRP or C276 lined
- Liner velocity between 50 and 53 fps for FRP and 53 to 56 fps for C276.
- Optimized stack breeching geometry
- Optimized liquid collection system in the inlet ductwork and liner.

The above design parameters should increase the collection efficiency of the ME carryover to 80% and the proper liner velocities should reduce the condensate re-entrainment as the condensation will flow downwards and can be easily removed from the system. The ability of the gas flow to transport droplets over 200 micron in diameter will be reduced and the droplet emission from the stack liner will be minimized. The predicted condensation rate for this type of liner would be 4.19 gpm for Unit #1 and 5.09 gpm for Unit #2 for an ambient temperature of 25°F. The revised liners would also have a reduced system pressure drop as a result of the lower velocities in the system. The requirement for a choke at the exit of the stack would have to be reviewed to determine if the plume downwash and wind interaction will affect the stack exit. If a choke is used, the pressure savings will be reduced. The wind data for the plant location and the exit velocity for the liner would need to be evaluated.

The estimated total cost for each liner would be $30,000,000.00.

2.2 Existing Stacks With the Addition of a New Stack.

In this configuration the existing stack would be maintained and each would operate as follows:

Unit #1 561,588 acfm at 130°F (53 fps)

Unit #2 1,139,700 acfm at 131°F (50 fps) assuming a ΔR of 0

The remaining flow from both units would be ducted to a stack with a single liner designed to handle the following total excess flow from both units:

Excess 1,087,229 acfm at 130°F

FRP liner diameter of 20.9 ft at a liner velocity of 52.8 fps (3170 fpm).

Estimated Total Cost	Stack	$20,000,000.00
	Ductwork	$ 1,000,000.00
	Dampers	$ 1,000,000.00

The above option will allow the existing stacks to remain in operation and reduce the exit velocities to within tolerable levels and handle the excess gas flow from both units with a new separate stack liner. This option will have some capital cost savings compared to two new liners but maintenance costs for a third liner and the associated ductwork will be added. The complexity of the system will increase as well as the control logic for plant operation. Also when the one of the two units is offline and the gas flow in the third stack decreases, the wind interaction effects will become more predominant. Once again the evaluation of the wind data for the plant location would have to be reviewed with the various operating conditions and stack exit velocities.

Another variation of this option would be to use the existing Unit #2 stack liner for Unit #1 and construct a new liner for Unit #2. The overall cost would be similar but the maintenance of a third stack would not be present. The exit velocity for the existing Unit #2 stack with the gas flow from Unit #1 would be low and a choke may need to be added at the stack exit to reduce plume downwash and the wind interaction effects, based on GLC calculation.

2.3 Stack Reheat

In order to allow the existing stack to be reused it is proposed to reheat the scrubber outlet flow to 170°F using flue gas bypass. The various flow rates required will be as follows:

Unit #1

(a) Air Preheater Bypass (600°F)

Reheat Flow	165,000 at 600 °F (from air preheater)
Total Stack Exit Flow	1,152,248 acfm at 170.0°F
Stack Exit Velocity	108.7 fps (6525 fpm)
% Bypass	9.3% (Based on WESP Outlet)

(b) FGD Bypass (330°F)

Reheat Flow	330,500 at 330 °F (from FGD Inlet)
Total Stack Exit Flow	1,317,730 acfm at 170.0°F
Stack Exit Velocity	124.4 fps (7462 fpm)
% Bypass	21.7% (Based on WESP Outlet)

Unit #2

(a) Air Preheater Bypass (600°F)

Reheat Flow	278,200 at 600 °F (from air preheater)
Total Stack Exit Flow	1,988,532 acfm at 170.0°F
Stack Exit Velocity	87.2 fps (5234 fpm)
% Bypass	9.1% (Based on WESP Outlet)

(b) FGD Bypass (330°F)

Reheat Flow	507,800 at 350 °F (from FGD Inlet)

Total Stack Exit Flow	2,218,195 acfm at 170.0°F
Stack Exit Velocity	97.3 fps (5839 fpm)
% Bypass	21.7% (Based on WESP Outlet)

The above reheat rates are based on bypassing flue gas from either the air preheater or the inlet of the WFGD system. Reheating with this type of arrangement will cause unscrubbed flue gas to pass through the system increasing the SO_2 outlet emissions. It is anticipated that this would be an undesirable operating scenario and will reduce the overall scrubber efficiency. The other options for reheating the flue gas would be to use steam coil heaters, hot gas from clean fuel combustion or a heat exchanger. There are several problems with these options ranging from high energy costs to deposition and corrosion issues.

The reheat system will reduce the thin film condensation but it is difficult to evaporate the ME carryover that is entrained in the gas flow. The evaporation process is slow and requires a resonance time to be removed from the gas flow.

2.4 Stack Moisture Collector

A moisture removal system would be installed near the stack exit between the CEMS location and the exit to remove the liquid from the gas stream. The system would operate by installing a set of spin vanes in the stack to use centrifugal force to force all of the droplets to the surface of the liner. Downstream of the spin vanes a vacuum extraction system would be installed to remove the liquid from the liner surface. The extraction system would consist of a mist eliminator (ME) and a suction fan to remove the liquid. The collected liquid from the ME would then be returned to the absorber reaction tank.

An initial estimate is that this system will remove 90% of the moisture reaching the stack outlet (mist eliminator carryover and liner condensation).

Unit #1 Stack Exit Velocity 96.3 fps (5778 fpm) at 130°F.

Moisture Separator additional pressure loss is estimated to be between 3 to 8" of H_2O depending on the design of the system.

Unit #2 Stack Exit Velocity 77.6 fps (4656 fpm) at 131°F

Moisture Separator additional pressure loss is estimated to be between 2 to 5" of H_2O depending on the design of the system.

If the spin vane is installed in the 24' diameter elevation in the tapered stack the additional pressure loss is estimated to be between 1.5 to 3.5" of H_2O depending on the design of the system.

The estimated cost to install one of these systems is $1,000,000.00 per stack. The additional pressure loss in the system will result in higher operating costs due to the additional required fan power. The design of these systems can vary from 100% spin vane coverage to a reduced amount based on the available pressure capacity in the system. However, as the spin vane coverage is reduced, it's effectiveness is reduced since more droplets can pass through the spinner arrangement. The development of such a system has not been fully evaluated for high velocity applications.

Another variation of the system would be to install multiple levels of the extraction slots throughout the liner and eliminate the requirement for the spin vanes but the entrained droplets would be able to pass through the system. The performance of such a system is not known at this time and would require further development work.

3 DISCUSSIONS AND RECOMMENDATIONS

The existing stack liners are not suitable for 100% wet stack operation with respect to droplet emissions and liquid collection efficiency. An optimized liquid collection system could be installed in each existing liner but the high gas velocities will render it in-effective. The liquid flow patterns in the stack liners would be upwards throughout the majority of the liner making drainage almost impossible. The ability of a gutter to collect liquid that flows upwards is very difficult without an extraction system. The gas velocity in each liner would have to be reduced for a typical liquid collection system to operate correctly. To reduce the gas velocity in the system a secondary stack source would be the simplest option. The downside is that the relative location of the new stack could be difficult to locate and the ductwork to the stack breeching may be difficult to install. The additional stack could handle the excess gas from each unit but the extra capital cost, control system and space could be a concern.

Two new wet stack liners would result in the most expensive option but the end result would be the simplest system layout with the least amount of plant maintenance. The location of each stack could be close to the outlet of each unit limiting the amount of expensive alloy ductwork to connect each stack to the WESP outlet.

Rerouting the Unit #1 gas flow through the existing Unit #2 stack liner would save on some capital cost but the required alloy ductwork may be lengthy and difficult to layout. The resulting plant layout would be very complicated and potentially unorganized.

Typically reheat systems are not used due to high maintenance and operating costs. The initial capital cost to install such a system is lower but the operating costs are high. The input energy for the reheat system is high whether it is from a heat exchanger, steam coil heater or flue gas bypass. The flue gas bypass is undesirable due to the fact that the overall absorber efficiency will be compromised as a result of the bypass of un-scrubbed gas. If hotter gas is used then less bypass flow is required, but this still accounts to approximately 10% of flue gas bypass, which is a significant amount.

Insulating the liners will reduce the condensation rate slightly and would subsequently reduce the amount of required reheat. The cost of this option is not known at this time.

The mechanical moisture separator is an experimental device which has not typically been used in high velocity stack applications. This system currently has a high pressure loss and will result in violation of the EPA requirement for the CEMS location. The optimization of this device could be completed but the additional pressure loss may still be too high. A modified system with multiple extraction points may work with minimal costs but will have limited collection efficiency. This type of operating configuration would need to be evaluated and optimized prior to implementing in the field.

All of the costs included in this reported are estimated and should be verified with the appropriate vendors.

APPENDIX C

ALDEN RESEARCH UNIT 2 CHIMNEY REPORT

REVIEW OF THE LIQUID DISCHARGE POTENTIAL FROM THE WET DUCTS AND STACK AT EAST KENTUCKY POWER COOPERATIVE'S SPURLOCK GENERATING STATION UNIT NO.2

AGM-06-R-37

By

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Submitted to

EAST KENTUCKY POWER COOPERATIVE

SPURLOCK GENERATING STATION

MAYSVILLE, KY

September 2006

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REVIEW OF THE LIQUID DISCHARGE POTENTIAL FROM THE WET DUCTS AND STACK AT EAST KENTUCKY POWER COOPERATIVE'S SPURLOCK GENERATING STATION UNIT NO.2

INTRODUCTION

In support of an upcoming WFGD system installation at East Kentucky Power Cooperative's Spurlock Generating Station, Unit 2, Figure 1, the stack inlet ducting and existing stack liner design were reviewed by Alden Research Laboratory, Inc. (Alden) with respect to key design variables for favorable wet stack operation. The currently planned WFGD installation consists of an open spray tower followed by a two module wet electrostatic precipitator (WESP). The two WESP modules are stacked one on top of the other. The flow from each module is turned vertical into a common outlet hood which transitions from a rectangular outlet to a 23'6"diameter circular discharge duct. This discharge duct turns 90 degrees downward then 90 degrees horizontally towards the existing stack. The circular WESP outlet duct is then connected to the inlet of the existing 22'4"diameter three miter stack bottom entry elbow (R/D=1) through a reducing expansion joint. The stack bottom entry elbow turns vertical and immediately enters the bottom of the existing brick stack liner. The existing stack liner consists of two tapered sections stacked one on top of the other. The lower section is approximately 382" long and tapers from 35' diameter at the bottom to 22' diameter at the top. The liner second liner section is approximately 272' long and tapers from 26' diameter to 22' diameter. The connection between

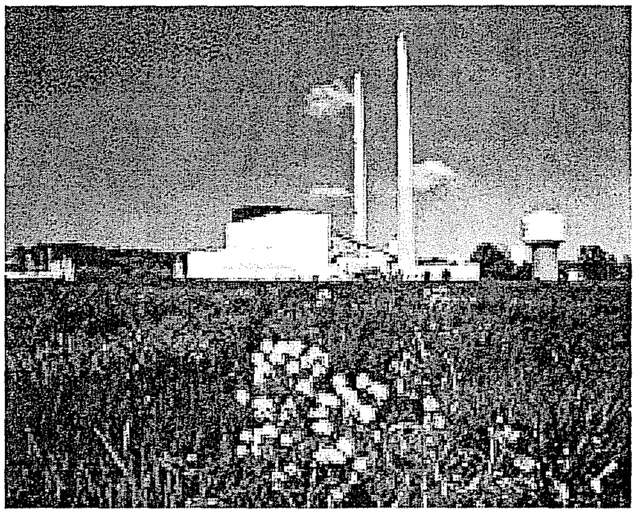


Figure 1: EKPC Spurlock Generation Station

the upper and lower liner sections consist of a rapid transition. Plan and isometric views of the proposed Absorber-WESP arrangement are presented in Figure 2 and 3.

A number of possible stack scenarios were reviewed as part of this study ranging from reuse of the existing stack and liner, modifications to the existing stack to increase it's favorability for wet operation and installation of a new stack. Potential problem areas were identified and recommendations made which should result in a duct-stack system favorable for wet operation.

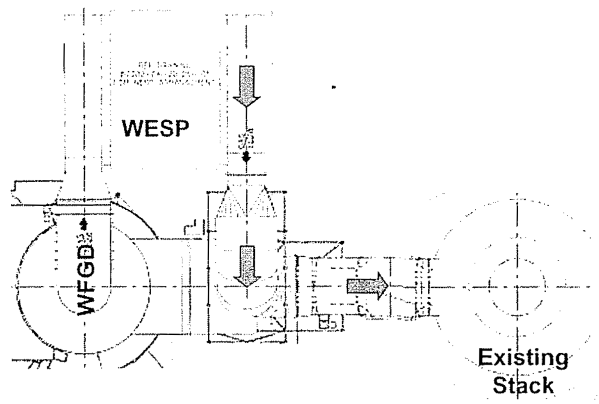


Figure 2 – Proposed Absorber-WESP Arrangement: Plan View

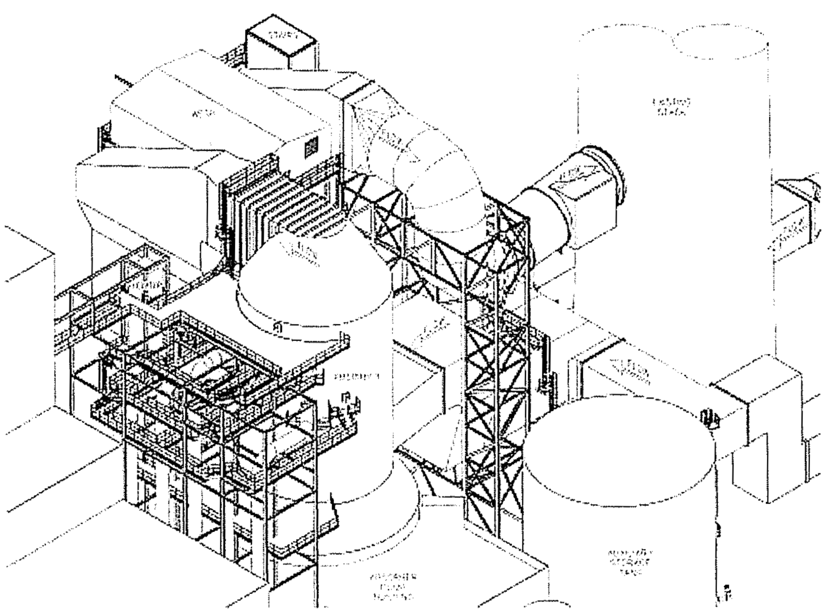


Figure 3 – Proposed Absorber-WESP Arrangement: Isometric View

PROCESS FLOW CONDITIONS

For this study the following process flow parameters were used:

Boiler Load: 100% MCR

Total flow to stack liner: 1,739,553 acfm, wet

Flue Gas Temperature: 130 degrees F

Flue Gas Density: 0.066 $\#/ft^3$

Entrained Moisture: 13 #/hr

Based on the drawings of the proposed duct arrangement and the process flow information provided, the expected gas velocities at key locations in the duct and stack liner were calculated. These locations, detailed in Figure 3 were:

A - WESP Outlet face

B - Duct between the lower and upper WESP outlet hoods

C - Horizontal inlet to WESP outlet transition

D - Vertical outlet of WESP outlet transition

E - Circular WESP outlet duct

F - Stack bottom entry inlet elbow

G - Bottom of lower brick liner section

H - Middle of lower brick liner section

I - Outlet of lower brick liner section

J - Inlet to upper brick liner section

K - Outlet of upper brick liner section

The dimension of the duct cross-sections and resulting gas velocities at these key cross-sections are detailed in Table 1 and Figure 4. As can be seen in this Figure a significant amount of the stack will be operating at a velocity greater that the maximum recommended value of 45 ft/s.

TABLE 1 – SYSTEM GAS VELOCITIES

FIELD UNIT AND MODEL SECTIONAL FLOW CALCULATIONS

Project: EKPC Spurlock Unit 2   Scale Factor: 1   Date: 9/16/2006

PLANE LOCATION (See Sketch)	CROSS SECTION SHAPE (C = cir) (R = rect)	MODEL CONDITIONS	PASSAGE DIMENSIONS H I.D. (IN) (FT)	x W - (IN) (FT)	FLOW AREA (IN^2) (FT^2)	VOLUME FLOWRATE (ACFM)	AVERAGE VELOCITY (FT/S)	AVERAGE VELOCITY HEAD (IN H_2O)
A Lower WESP Outlet	rect	FIELD	341 500 28'-05.50"	696 625 58'-00.63"	237897 438 1652.066	869 777	8 775	0 015
		MODEL	341.500 28'-05 50"	696.625 58'-00 63"	237897 438 1652 066			
		$V_m = V_f$				869777	8 775	0 017
		$V_m = V_f/(SF)^{1/2}$				869777	8.775	0.017
		$VH_m = VH_f$				815923	8 231	0.015
B Between WESPs	rect	FIELD	86 500 7'-02.50"	696.625 58'-00.63"	60258.063 418.459	869 777	34.642	0 237
		MODEL	86.500 7'-02.50"	696.625 58'-00.63"	60258.063 418 459			
		$V_m = V_f$				869777	34.642	0.269
		$V_m = V_f/(SF)^{1/2}$				869777	34 642	0 269
		$VH_m = VH_f$				815923	32.497	0.237
C WESP Outlet Horiz	rect	FIELD	173 000 14'-05.00"	696.625 58'-00.63"	120516 125 836.918	1 739 553	34.642	0 237
		MODEL	173 000 14'-05.00"	696 625 58'-00.63"	120516 125 836.918			
		$V_m = V_f$				1739553	34 642	0.269
		$V_m = V_f/(SF)^{1/2}$				1739553	34.642	0.269
		$VH_m = VH_f$				1631845	32.497	0.237
D WESP Outlet Vertical	rect	FIELD	324 000 27'-00.00"	173 000 14'-05 00"	56052 000 389.250	1 739 553	74.463	1 094
		MODEL	324.000 27'-00.00"	173.000 14'-05 00"	56052 000 389 250			
		$V_m = V_f$				1739553	74 463	1.243
		$V_m = V_f/(SF)^{1/2}$				1739553	74 463	1 243
		$VH_m = VH_f$				1631845	69.871	1.094
E WESP Outlet Duct	cir	FIELD	282 000 23'-06.00"	0 000 0'-00.00"	62458 004 433.736	1 739.553	66.844	0.881
		MODEL	282.000 23'-06.00"	0 000 0'-00 00"	62458 004 433.736			
		$V_m = V_f$				1739553	66 844	1 001
		$V_m = V_f/(SF)^{1/2}$				1739553	66 844	1 001
		$VH_m = VH_f$				1631845	62.705	0.881
F Stack Inlet Elbow	cir	FIELD	268 000 22'-04.00"	0.000 0'-00.00"	56410 438 391.739	1 739 553	74.010	1.060
		MODEL	268 000 22'-04.00"	0 000 0'-00 00"	56410 438 391 739			
		$V_m = V_f$				1739553	74 010	1 227
		$V_m = V_f/(SF)^{1/2}$				1739553	74 010	1.227
		$VH_m = VH_f$				1631845	69.427	1.060
G Lower Liner	cir	FIELD	420.000 35'-00.00"	0.000 0'-00.00"	138544.236 962.113	1 739.553	30 134	0 179
		MODEL	420.000 35'-00.00"	0.000 0'-00 00"	138544 236 962.113			
		$V_m = V_f$				1739553	30 134	0.203
		$V_m = V_f/(SF)^{1/2}$				1739553	30.134	0 203
		$VH_m = VH_f$				1631845	28 268	0.179
H Lower Liner Midpoint	cir	FIELD	312.000 26'-00.00"	0 000 0'-00.00"	76453.799 530.929	1 739 553	54.607	0 588
		MODEL	312.000 26'-00 00"	0.000 0'-00 00"	76453.799 530 929			
		$V_m = V_f$				1739553	54.607	0.668
		$V_m = V_f/(SF)^{1/2}$				1739553	54 607	0 668
		$VH_m = VH_f$				1631845	51.226	0.588
I Lower Liner Out	cir	FIELD	264 000 22'-00.00"	0 000 0'-00.00"	54739 110 380.133	1 739 553	76.270	1 147
		MODEL	264.000 22'-00 00"	0 000 0'-00.00"	54739 110 380 133			
		$V_m = V_f$				1739553	76.270	1.303
		$V_m = V_f/(SF)^{1/2}$				1739553	76.270	1 303
		$VH_m = VH_f$				1631845	71.547	1 147
J Upper Liner In	cir	FIELD	312 000 26'-00.00"	0.000 0'-00.00"	76453 799 530.929	1 739 553	54.607	0 588
		MODEL	312.000 26'-00 00"	0.000 0'-00.00"	76453 799 530.929			
		$V_m = V_f$				1739553	54 607	0.668
		$V_m = V_f/(SF)^{1/2}$				1739553	54 607	0.668
		$VH_m = VH_f$				1631845	51.226	0.588
K Upper Liner Out	cir	FIELD	264 000 22'-00.00"	0 000 0'-00.00"	54739 110 380.133	1 739 553	76.270	1 147
		MODEL	264.000 22'-00.00"	0 000 0'-00 00"	54739 110 380.133			
		$V_m = V_f$				1739553	76 270	1.303
		$V_m = V_f/(SF)^{1/2}$				1739553	76 270	1 303
		$VH_m = VH_f$				1631845	71.547	1.147

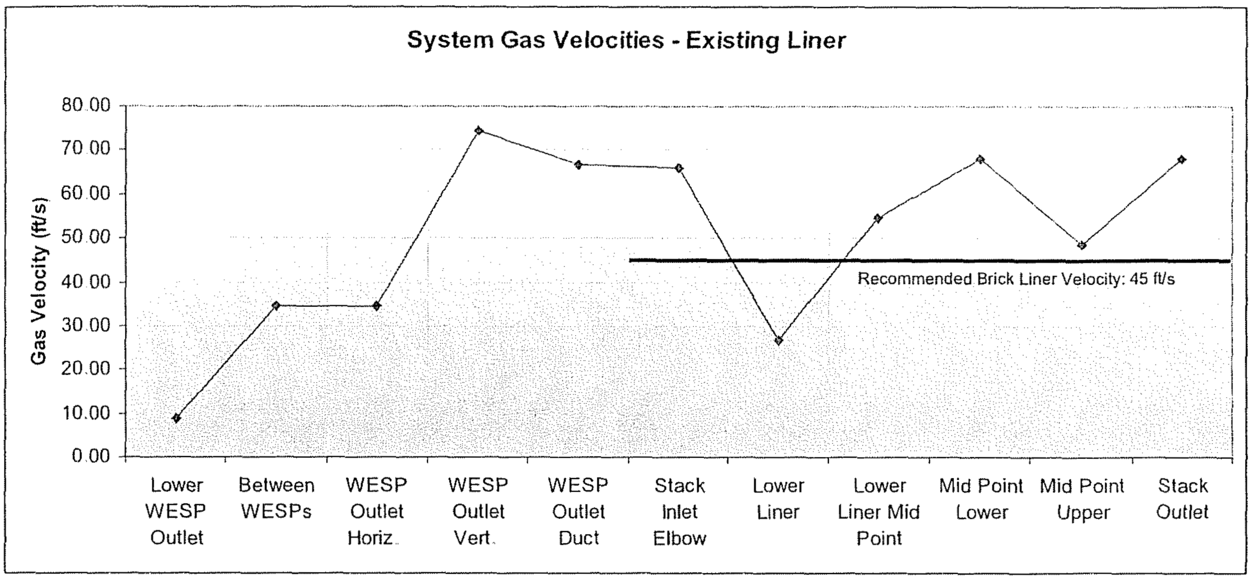


Figure 4 – Expected System Gas Velocities – Existing Liner

WESP OUTLET DUCT

For this study it was assumed that the flue gas flow profile exiting the WESP met ICAC EP-7 specifications and was therefore essentially uniform. The expected full load gas velocity at outlet face of the WESP collection fields is 8.7 ft/s, accelerating to 34.5 ft/s at the connection between the lower and upper WESP module outlet hoods. The outlet hood for the upper module is twice as wide as the lower hood to keep the gas velocities in the upper hood similar to those in the lower. 34.5 ft/s is generally considered to be favorable for wet operation as the liquid films collected on the duct walls from droplet deposition or condensation will be able to flow downward with low potential for re-entrainment from discontinuities on the duct surface. There are however numerous internal duct braces within these hoods which could act as sites for liquid deposition and droplet formation. The terminal velocities of 500 and 1000 micron droplets are 7 and 12 ft/s respectively which is significantly lower than the maximum gas velocity expected in the outlet hoods. Any droplets generated in this region could therefore potentially be re-entrained in the gas flow.

The gas velocity at the inlet to the WESP outlet transition is 34.5 ft/s accelerating to 74.5 ft/s at the inlet to the square to round transition leading to the circular outlet ducting. The gas is then decelerated to 67 ft/s within the circular outlet duct. Both 74.5 and 67 ft/s are higher than usual but is considered acceptable with the current duct arrangement. Some liquid re-entrainment should be expected from within the square to round transition but these droplets should re-deposit on the duct walls before reaching the stack liner.

There are two 90 degree elbows in the circular outlet ducting, one turning downward immediately after the WESP outlet hood, the second turning to horizontal upstream of the stack bottom entry elbow. Without flow controls or turning vanes in the elbows or straight sections of ducting, this geometry will generate a strong swirl leading into the liner inlet elbow which could persist into the liner. This swirl will result in an increase in the system pressure loss. It is highly recommended that this swirl be eliminated before the bottom entry elbow through the use of turning vanes in the middle elbow or a swirl suppressor in the form of a cross in the horizontal run upstream of the stack inlet elbow. To be effective, this cross will require a length to spacing ratio of 2 or greater and will require trailing edge liquid collectors to minimize the potential of droplet re-entrainment. Eliminating the swirl should also result in some pressure recovery.

On the positive side, gas swirl within the ducting will help deposit droplets entrained within the gas on to the duct walls. This liquid will need to be collected and removed from the ducting before entering the liner. A ring collector in the horizontal run leading the to the stack inlet elbow is recommended.

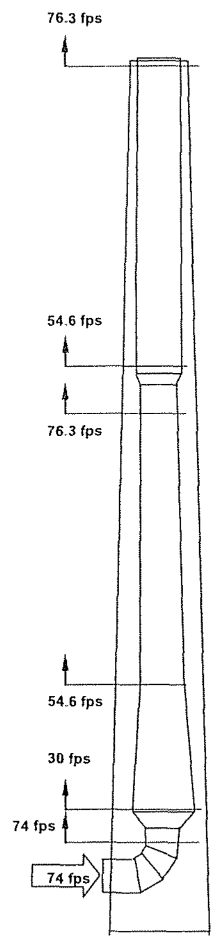


Figure 5 - Existing Stack

EXISTING STACK LINER ARRANGEMENT

The existing stack, Figure 5, utilizes a 22'4" in diameter brick lined three miter bottom entry elbow, operating at a full load gas velocity of 74 ft/s. The brick stack liner consists of three tapered liner sections and two sudden enlargements. The inside diameter of the liner at the discharge of the bottom entry elbow is 35' which results in an average gas velocity of 30 ft/s. In actuality, the incoming gas jet is not expected to full expand to the full liner width for some distance so the actual velocity in the center of the liner will be higher than this value. The average gas velocity in the liner varies between 30 and 76.3 ft/s. Most of the liquid deposition and condensation will re-entrain from the brick surface at velocities higher than about 45 ft/s. It is estimated that approximately 75% of the total existing liner surface will experience gas velocities equal to or greater than 45 ft/s and will therefore be susceptible to re-entrainment. For this reason, use of the existing stack liner is not recommended for wet operation.

The use of a stack outlet choke for the collection of the entrained droplets was considered but rejected because of the large amount of liquid which will potentially need to be captured and the significant increase in system pressure drop that would results with its installation.

MODIFICATION AND RE-USE OF THE EXISTING STACK

A major concern of the WFGD/WESP system installation is the re-use or partial re-use of the existing stack. For obvious reasons, re-use of all or even a portion of the existing stack will have less impact on the project's budget and schedule. Given that use of the existing brick liner is not recommended for wet operation, it has been suggested that the existing brick liner be removed and the inside surface of the concrete shell be lined with borosilicate block.

The diameter of the concrete shell at the outlet of the bottom entry elbow is approximately 61'. The gas velocity at this location during full load operation will be 9.9 ft/s. The flue gasses in the lined shell will accelerate to the stack outlet velocity of 40.1 ft/s. These velocities are favorable for wet operation for just about all liner materials. The resulting system gas velocities utilizing a borosilicate lined stack shell arrangement are presented in Figure 6.

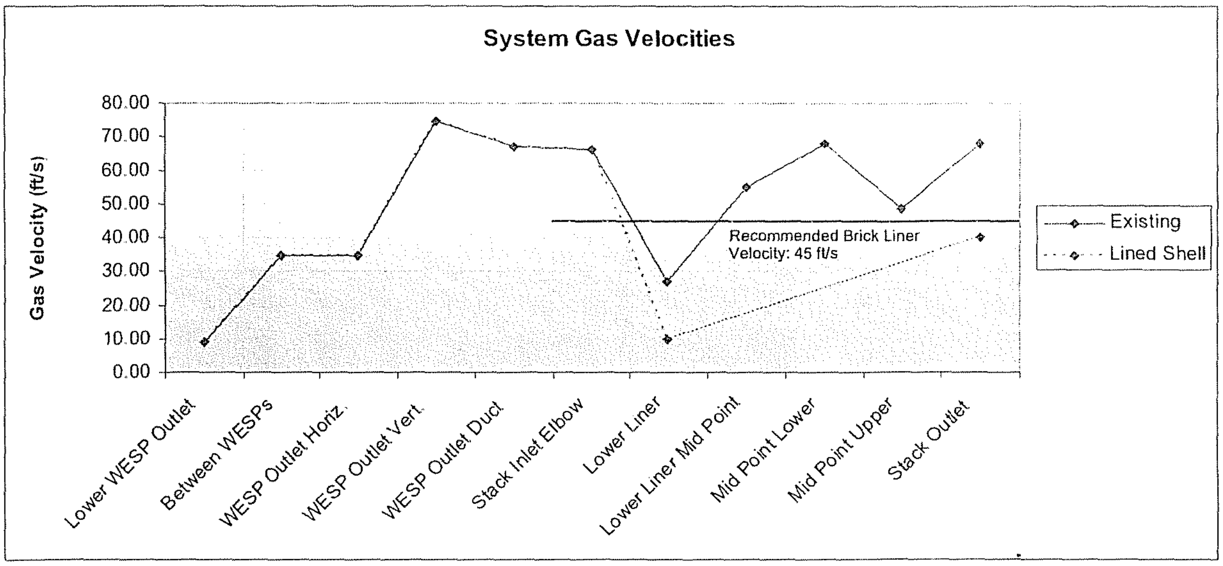


Figure 6 – Expected System Gas Velocities – Lined Stack Shell

The rapid expansion from the 22'4" diameter bottom entry elbow to the 61'diameter stack shell is not considered favorable for liquid collection as there is insufficient surface for the collection and drainage of liquid in the bottom entry elbow before the gas enters the liner and is rapidly decelerated. It is recommended that if the stack shell is used as the liner, that an extension or insert be added to outlet of the elbow with a length of approximately 44' to 56' (2 to 2.5 elbow diameters), Figure 7. This extended height will allow for the generation and dissipation of secondary flows within the elbow and the resulting droplet deposition and liquid film collection that occurs as a result of these secondary flows before the gas exits into the liner. The resulting 19' wide ring collector will collect any liquid flowing down the borosilicate block lined wall due to thermal and adiabatic condensation. A slight slope to either the inner or outer diameter of the flat floor can be incorporated to concentrate the collected liquid to multiple drainage points. All drains should incorporate a debris screen and must discharge into a

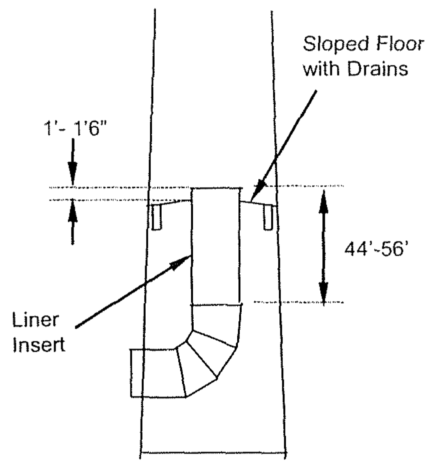


Figure 7: Liner Insert and Transition Ring Collector

seal pot to eliminate the potential for gas back flowing up the drain pipe. A physical flow model study will be required for the design and optimization of the of the liner insert, liquid collectors and drains.

Lining the stack shell with a borosilicate block lining system is a good choice. This material operates well at velocities up to 62ft/s and is a good thermal insulator. As with all liner construction techniques, care should be taken to ensure the surface is free of horizontal discontinuities such as misaligned blocks. Also, the height of the mastic joints between blocks should be minimized as the joints are where liquid re-entrainment typically starts as the liquid flows out of the nook and crannies of the block and is exposed to the gas flow as it passes downward over the joints.

Due to the favorable liner velocities over the entire height of the stack, no stack liquid discharge issues are expected. The stack will of course experience the white steam plume typical of wet stake operation but this is due to the very fine droplets generated due to adiabatic condensation as the gas passed up the liner. These droplets are typically 0.1 to 10 microns and will evaporate before reaching the ground.

Finally, the existing windscreen cap may not be not favorable for wet operation. Specifically, it could be susceptible to plume downwash which could corrode the stack top and during the winter months lead to icing. A plume downwash study should be performed to identify design changes necessary to achieve favorable wet operation.

<u>NEW STACK</u>

Another option under consideration is the installation of a new stack, Figure 8. Liquid collectors will be required in the WESP outlet hood and stack inlet ducting. The advantage of a new stack and liner is that it can be designed from the start to be very favorable for wet operation. Given a total gas flow rate of 1,739,553 acfm, a liner diameter of 25'11" is recommended for alloy and

FRP liners and 24'10" for a borosilicate lined liner. These diameters correspond to liner velocities of 55 ft/s and 60 ft/s respectively. Either a bottom entry elbow, Figure 8, or side entry breach can be utilized. A side entry breach in conjunction with a sloped liner floor, Figure 9, is generally preferred for wet operation because they generate ideal flow conditions for liquid collection and drainage and the design of the lower liner liquid collection system is simpler, easier to maintain and is generally less costly than it's counterparts in a bottom entry elbow.

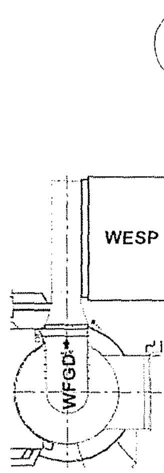


Figure 8 – Proposed New Stack Location

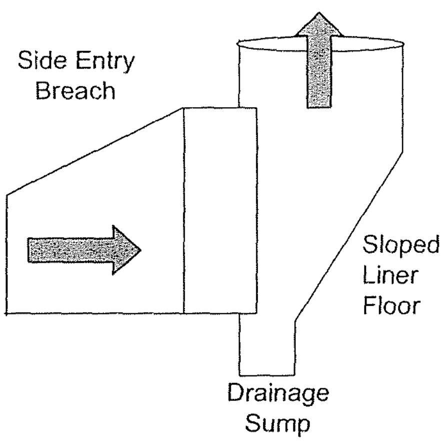


Figure 9 - Side Entry Breach

Care must be taken in the design of the side entry breach duct dimensions. The height to width ratio should be between 2 and 3 and the breach width to liner diameter ratio should be between 1.5 and 2. For an alloy or FRP liner of 25'11" diameter, the ideal breach dimensions would be 14'9.5" wide by 37'0" tall. These dimensions result in key ratios of 2.5 (height to width) and 1.75 (width to diameter). These dimensions will result in the formation of strong, well defined secondary flows in the lower liner which are needed for optimal liquid collection and drainage.

SUMMARY

1. The WESP outlet hoods operate at velocities favorable for wet operation. However, the numerous internal supports could act as sites for droplet formation and re-entrainment. It is recommended that even with favorable gas velocities that liquid collectors be utilized to keep liquid flowing down the hood walls away from surface discontinuities which could lead to liquid re-entrainment.

2. Some liquid re-entrainment should be expected from within the square to round transition but these droplets should re-deposit on the duct walls before reaching the stack liner.

3. The circular WESP outlet ducting operates at a velocity higher than what is generally considered favorable for wet operation. The multiple 90 degree turns will result in the generation swirl in the flow entering the liner. This swirling flow will aid in the collection of droplets within the ducting but should be corrected before entering the liner. Elimination the swirl could also result in some degree of system pressure recovery.

4. The existing brick stack liner is not acceptable for wet operation. Approximately 75% of the surface operates at a gas velocity above that recommended for brick liner operation. Therefore one could expect approximately 75% of the liquid deposited or condensed on the liner surface to be discharged for the existing liner in the form of droplets during full load operation.

5. The use of an outlet choke is not recommended to collect the re-entrained droplets because of the potentially large quantity of liquid which would need to be captured and the significant increase in system pressure drop that would result from its installation.

6. Removal of the existing brick liner and lining the stack shell with borosilicate block is a good alternative approach as it will result in velocities favorable for wet operation over the entire height of the liner. Partial removal of the existing brick liner is not recommended.

7. If the existing brick liner is removed and the shell lined with borosilicate block, an extension should be added to the outlet of the stack's existing bottom entry elbow extending 44 to 56ft above the current elbow outlet. This extension or insert is needed to allow for the development of secondary flows in the elbow which are necessary for liquid collection and liquid film drainage from the elbow. Without this extension, liquid flowing along the walls or suspended within the gas flowing through the circular WESP outlet duct will not have a chance to be properly collected and drained from the system before being discharged into the liner. A flow model study is recommended for the optimization of the liner insert height and its attendant liquid collection system.

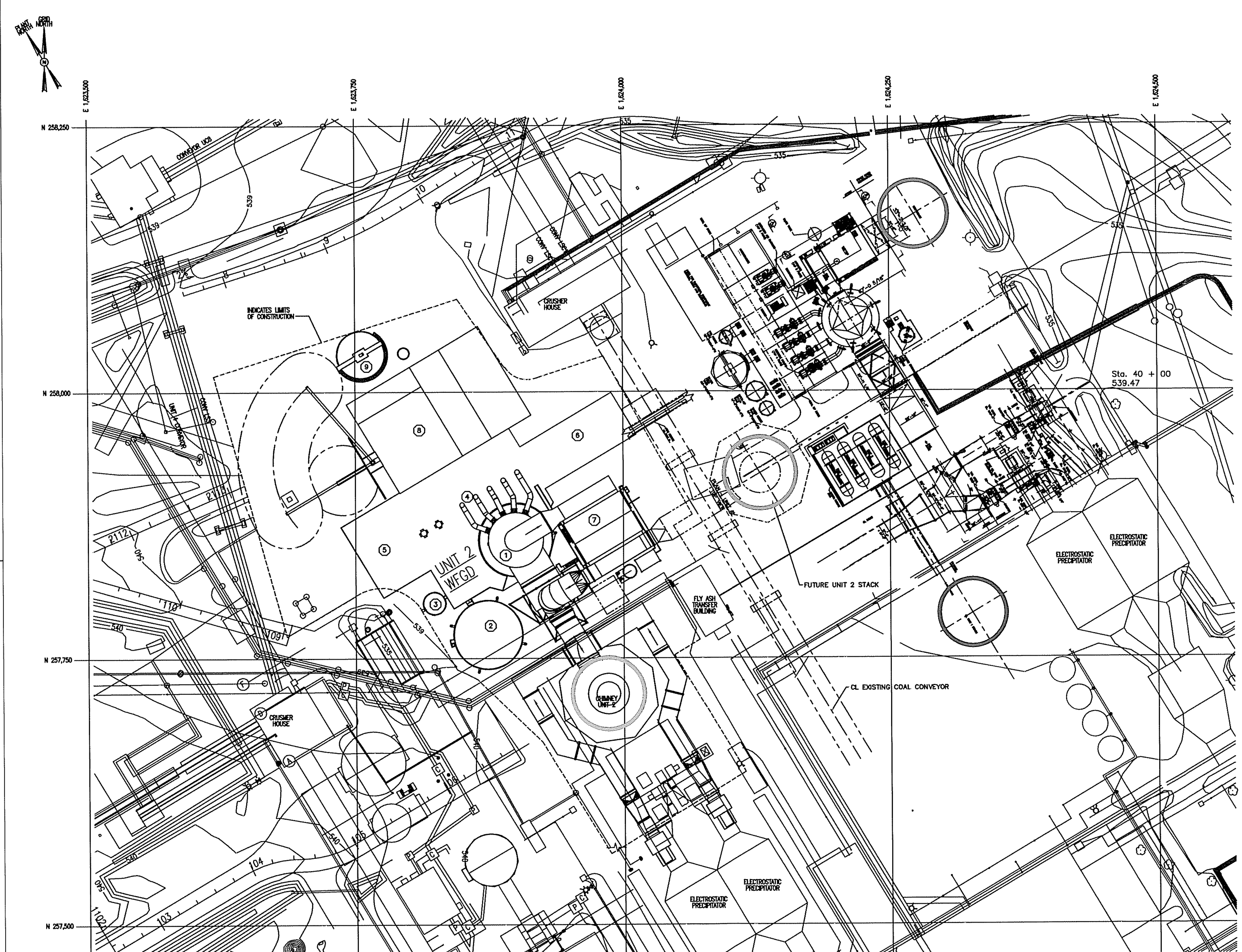
8. A ring collector will be required at the transition between the liner insert and the borosilicate lined stack shell. This collector must be drained to a seal pot to prevent the possibility of gas back flowing up the drain pipe.

9. A new stack is the ideal solution as it can be designed from the start to be favorable for wet operation.

10. If a new stack is planned, consideration should be given to the use of a side entry breach in conjunction with a sloped liner floor. This arrangement has been shown to be more favorable for wet operation than the bottom entry elbow.

11. The windscreen cap arrangement does not appear to be good for wet operation and should be replaced with one more suitable for wet operation and icing control.

Shadoan Prepared Testimony
Exhibit B



LEGEND

1. ABSORBER
2. AUXILIARY STORAGE TANK
3. MAKE-UP WATER TANK
4. ABSORBER PUMP BUILDING
5. ABSORBER MAINTENANCE BUILDING
6. WFGD ELECTRICAL/CONTROL BUILDING
7. WESP
8. REAGENT PREPARATION/DEWATERING BLDG
9. REAGENT FEED TANK

Existing Unit 1 Chimney
New Unit 1 Chimney

Distance (existing to new)
53'-3 7/16" W 373'-10 15/16 N

Existing Unit 2 Chimney
New Unit 2 Chimney

Distance (existing to new)
142'-8 9/16" E 206'-6/1/4" N

REV.	DESCRIPTION	DRAWN / APPR.	DATE

ALSTOM Power Inc.
An ISO 9001:2000 Certified Firm

EAST KENTUCKY POWER
UNITS 1 AND 2
MAYSVILLE, KENTUCKY
EKPC SPURLOCK UNITS 1 AND 2
SCRUBBER LAYOUTS

DWG. NO. 87004-SK-20105-001 REV. AA

FILE NO. 87004-SK-20105-001RAA

1/10" 1/8" - 1/4" 3/8" - 3/4" 1/2' -- 1"

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF EAST KENTUCKY POWER COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION OF A FLUE GAS DESULFURIZATION SYSTEM ON SPURLOCK POWER STATION UNIT 2	)))))	CASE NO. ~~2005-00417~~ 2007-00375

SUPPLEMENTAL PREPARED TESTIMONY OF FRANK OLIVA
ON BEHALF OF
EAST KENTUCKY POWER COOPERATIVE, INC.

Q1. Please state your name and address.

A1. My name is Frank Oliva, and my work address is P. O. Box 707, Winchester, Kentucky 40392-0707.

Q2. By whom are you employed and in what capacity?

A2. I am employed by East Kentucky Power Cooperative, Inc. ("EKPC"), as Manager of Finance and Risk Management.

Q3. Have you previously filed testimony in this case?

A3. Yes, my testimony was included as Exhibit 6 for this application filed on October 7, 2005.

Q4. Have you been asked to perform any updated analyses of the project?

A4. Yes, I have been asked to perform an updated long-term analysis of this project.

Q5. Could you briefly explain the nature of the new analyses of this project which were prepared by your staff.

A5. The nature of the new analysis of this project was to evaluate the continued viability of the Spurlock No. 2 scrubber based on revised capital costs of the limestone scrubber and a new chimney.

Q6. What factors were considered in the economic analysis of the project?

A6. The economic evaluation of the viability of the Spurlock Unit No. 2 scrubber focused on a comparison of the all-in cost of operating a scrubber burning high-sulfur coal versus burning low-sulfur compliance coal in the non-scrubbed unit. Factors considered included projected fuel costs, scrubber capital costs, SO2 allowance costs, maintenance costs, lime or limestone costs, ash landfill costs, and other operating costs. The economic analyses covered the years 2008-2036 with revised capital costs of $207 million including a new chimney. The only variable changed from the original evaluation submitted was the capital cost of the project.

Q7. What did the new economic analysis show?

A7. Over the evaluation period, the net present value (NPV) savings of operating a scrubber utilizing Northern Appalachian high-sulfur coal versus burning compliance coal in the Spurlock No. 2 unit is projected to be about $311 million. Operation of a scrubber on Spurlock Unit No. 2 appears to still be the least-cost compliance option when analyzed over the study period, even with the revised capital costs.

Q8. Does this conclude your testimony?

A8. Yes.

East Kentucky Power Cooperative
Limestone Scrubber #2 Study
Detailed Savings (Costs) Due to Scrubber Operation

	Year 2008 - 2036 NAP-WV - Pitts 6.0 lb.
Fuel Savings	$810,203,360
Emission Allowance Savings	138,927,516
Operation Labor & Benefits for Scrubber	(61,806,250)
Scrubber Maintenance	(84,071,000)
Fixed Costs Related to Scrubber Capital Expenditures	(367,584,751)
Limestone for Scrubber	(55,506,162)
Landfill Cost Including Ash Disposal	(7,032,327)
Energy Replacement	(61,712,000)
Total Savings (Costs) Due to Scrubber Operation	**$311,418,386**

Assumptions:

Fuel comparisons are between the scenarios of Compliance Coal (CAPP - Pike 1.2 lb.) without scrubber operation versus burning Non-compliance Coal (NAP-WV - Pitts 6.0 lb.) with scrubber operation.

Fuel prices and SO_2 allowance prices are from EVA projections.

East Kentucky Power Cooperative
Limestone Scrubber Study
Total Cost Analysis Including Net Present Value

Year		CAPP - Pike 1.2 lb.	NAP-WV Pitts 6.0 lb.
2008		$88,964,643	$88,523,171
2009		88,511,806	90,390,703
2010		91,517,515	92,310,509
2011		96,830,419	92,866,052
2012		100,946,250	93,603,614
2013		105,991,509	93,824,706
2014		106,273,300	94,400,872
2015		111,111,702	94,565,705
2016		113,550,182	95,048,249
2017		112,181,770	95,057,965
2018		111,476,062	95,153,064
2019		111,267,536	95,310,230
2020		111,473,437	95,517,990
2021		112,044,121	95,769,606
2022		112,880,282	96,030,526
2023		113,932,277	96,314,773
2024		115,183,569	96,599,646
2025		116,567,964	96,896,826
2026		118,085,480	97,186,003
2027		119,703,030	97,462,878
2028		121,553,069	97,726,088
2029		123,403,861	97,984,454
2030		125,255,430	98,196,972
2031		127,107,799	98,384,872
2032		128,960,991	98,527,920
2033		130,815,031	98,626,639
2034		132,669,946	98,681,565
2035		134,525,760	98,672,509
2036		136,382,502	98,620,784
Net Present Value	=	$2,138,229,111	$1,826,810,728
Savings in NPV	=		$311,418,383

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

THE APPLICATION OF EAST KENTUCKY POWER)
COOPERATIVE, INC. FOR A CERTIFICATE OF PUBLIC)
CONVENIENCE AND NECESSITY FOR THE) CASE NO. 2005-
CONSTRUCTION OF A FLUE GAS DESULFURIZATION) 00417
SYSTEM ON SPURLOCK POWER STATION UNIT 2)

AFFIDAVIT

STATE OF FLORIDA)
)
COUNTY OF LEE)

Frank Oliva, being duly sworn, states that he has read the foregoing prepared testimony and that he would respond in the same manner to the questions if so asked upon taking the stand, and that the matters and things set forth therein are true and correct to the best of his knowledge, information and belief.

NOTARY PUBLIC - STATE OF FLORIDA
Roberta Abelson
Commission #DD635366
Expires: FEB. 01, 2011
BONDED THRU ATLANTIC BONDING CO., INC.

Frank Oliva

Subscribed and sworn before me on this 31 day of July, 2007.

LISC # 095-253-302

Notary Public

My Commission expires: ______________