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PUBLIC SERVICE
COMMISSION

Mr. Jeff DeRouen
Executive Director
Kentucky Public Service Commission
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Frankfort, KY 40602

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July 11, 2011

RE: *VERIFIED APPLICATION OF LOUISVILLE GAS AND ELECTRIC COMPANY FOR AN ORDER PURSUANT TO KRS 278.300 AND FOR APPROVAL OF LONG-TERM PURCHASE CONTRACT* - CASE NO. 2011-00099

Dear Mr. DeRouen:

Please find enclosed and accept for filing the original and ten (10) copies of the Supplemental Response of Louisville Gas and Electric Company to the Supplemental Information Request, Question No. 1 of Commission Staff to Louisville Gas and Electric Company and Kentucky Utilities Company dated June 14, 2011, in the above-referenced matter. The Supplemental Response to Question No. 1 provides the draft URS report the Commission Staff requested. The report indicates that the Ohio Valley Electric Corporation ("OVEC") and Indiana-Kentucky Electric Corporation ("IKEC") generating units at issue in this proceeding should be physically capable of operating through 2040.

Because time is of the essence in this matter, Louisville Gas and Electric Company ("LG&E") respectfully asks the Commission to issue a final order in this proceeding by August 9, 2011. LG&E asks the Commission to issue a final order in this proceeding by August 9, 2011 because it is the date by which the Virginia State Corporation Commission has indicated it will issue a final order in its proceeding concerning the same contract filed by another OVEC owner. Moreover, part of what makes the proposed contract at issue in this proceeding valuable to LG&E's customers is the contemplated refinancing of OVEC and IKEC's debt at a favorable interest rate. Because it cannot be known how long such favorable rates will be available, obtaining this Commission's approval in the near future should benefit LG&E's customers.

Should you have any questions concerning the enclosed, please contact me at your convenience.

Sincerely,

Robert M. Conroy

Enclosure

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) SS:
COUNTY OF JEFFERSON)

The undersigned, **Lonnie E. Bellar**, being duly sworn, deposes and says that he is Vice President, State Regulation and Rates for Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Lonnie E. Bellar

Lonnie E. Bellar

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 8th day of July 2011.

Tammy J. Elzy (SEAL)
Notary Public

My Commission Expires:

November 9, 2014

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

VERIFIED APPLICATION OF LOUISVILLE GAS AND	)	
ELECTRIC COMPANY FOR AN ORDER PURSUANT	)	CASE NO.
TO KRS 278.300 AND FOR APPROVAL OF LONG	)	2011-00099
TERM PURCHASE CONTRACT	)	

JULY 11, 2011 SUPPLEMENTAL RESPONSE OF LOUISVILLE GAS AND ELECTRIC COMPANY TO THE SUPPLEMENTAL INFORMATION REQUEST OF COMMISSION STAFF DATED JUNE 14, 2011

FILED: July 11, 2011

LOUISVILLE GAS AND ELECTRIC COMPANY

July 11, 2011 Supplemental Response to the Supplemental Information Request of Commission Staff Dated June 14, 2011

Case No. 2011-00099

Question No. 1

Witness: Lonnie E. Bellar

Q-1. Refer to the second paragraph of the response to Item 2.a of the Initial Request for Information of Commission Staff ("Staff's First Request"). As soon as it becomes available, provide the draft report being prepared by URS Corporation ("URS") for the Ohio Valley Electric Corporation ("OVEC") on the remaining life and production capabilities of the OVEC generating assets.

A-1. **Original response:**

The URS draft will be provided when it becomes available.

Supplemental response:

Please see the attached draft URS report. The report indicates that the OVEC generating assets should be physically capable of operating through 2040.

INDEPENDENT TECHNICAL REVIEW

KYGER CREEK
&
CLIFTY CREEK PLANTS

OHIO VALLEY ELECTRIC CORPORATION
INDIANA-KENTUCKY ELECTRIC CORPORATION

By

URS Corporation

Rev. 0
June 27, 2011

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EXECUTIVE SUMMARY

Ohio Valley Electric Corporation / Indiana Kentucky Electric Corporation (OVEC/IKEC hereinafter referred to as "OVEC") contracted URS Corporation (URS) to provide an independent technical review of the current condition and the operational and maintenance plans of their Kyger Creek (Kyger) and Clifty Creek (Clifty) Plants, to assess the potential for successful operation of the plants through the year 2040. URS reviewed OVEC supplied data and visited both plants in April 2011. Following are the major conclusions of the review:

Ability of Plants to Operate As Planned

Each unit has been operating primarily in a base loaded mode with recent forced outage rates of less than 5% to 11% at Kyger and 5% to 9.2% at Clifty. Forced outage rates are trending downward and it is reasonable to expect the downward trend to continue as there are major boiler tube replacements being performed. The overall system produced a low of 15.84 GW hours in 2010 of electrical output to a maximum of 17.92 GWhours in 2006. Twenty (20) year budget projections are based on 15.6 to 15.8 GWhours per year. As the flue gas desulfurization (FGD) Scrubbers are brought on line in 2011 through 2013, there will be an increase in auxiliary power usage of 4% or more, plus the scrubbers might cause more forced outages. At a minimum there will be a "shake down" period as the scrubbers are operated and the fuel is switched to primarily Eastern Coal. The OVEC system appears capable of producing to the planned production levels.

Adequacy Of Projected Capital and Operating Costs

Through 2015, projected plant performance appears reasonable and the budget projections appear capable of supporting this continued operation. The bulk of the capital expenditures will be on the boiler and scrubbers. After 2015 or 2016 the boiler capital costs should decrease with the end of the major re-tubing and partial header replacement projects. There should be no additional capital cost for the scrubbers after 2015 for the forseeable future.

These budgets assume very little capital spending on the turbogenerator units and accessory electric equipment through 2015. These low capital expense budget numbers for the turbogenerator and other electric equipment will almost certainly increase after 2015.

The total installed scrubber cost of $1,334.8mm is included in the budget, as well as an increase in maintenance costs for the scrubbers. Of this total scrubber cost, $988.5mm was already spent through 2010, and the remainder will be paid from 2011 through 2015.

With the installation and operation of the scrubbers in 2011 through 2013, the long term projections of generation output, operations and maintenance costs, and capital equipment costs appear realistic. However, as the scrubbers are major plant additions, there is some cost uncertainty to its effect on maintenance and operations.

Environmental Compliance, Present and Future

The installation of the selective catalytic reduction units (SCR's) in 2002 and 2003 has reduced NOx emissions to less than required levels.

Wet Flue Gas Desulphurization (FGD) units are planned for installation on all eleven (11) units from 2011 through 2013. Modifications are in progress or already completed to the ash ponds, stacks and ID fans.

With the Electrostatic Precipitators (ESP) installed on each unit in the 1970's and the current stack performance, particulate emissions are also less than regulatory limits. No significant changes are anticipated except as may be related to the installation of the FGD systems.

OVEC anticipates that all units having SCR and FGD systems should comply with the proposed Utility Maximum Achievable Control Technology (MACT) and Transport rules without the need for additional controls. OVEC believes that the co-benefit of the FGD and SCR systems will achieve the anticipated regulatory requirements for mercury control, since the SCR system will oxidize the mercury for more effective removal by the FGD system. Both systems are expected to be able to meet control requirements for other pollutants (e.g., particulate matter, acid gases) covered under both rules. OVEC is currently conducting preliminary engineering for retrofitting an SCR system on only one boiler (Unit 6 at Clifty Creek), which is the only boiler not equipped with this control. A decision on whether SCR would be retrofitted would be made once these rules become final.

The ammonia on demand system (AOD) is working adequately.

OVEC is complying with all federal and state regulations on water quality. OVEC was proactive and successful in negotiating a settlement with Ohio EPA regarding a non-routine ammonia release from the Kyger Creek plant in July 2009. This release resulted in a fish kill in Kyger Creek. Upgrades have been completed for installing a new landfill at Clifty Creek and new ash pond and landfill at Kyger Creek for meeting anticipated regulations related to NPDES and Coal Combustion Residues or Products.

OVEC has minimized its use and generation of hazardous wastes, and no significant cost impacts are expected due to hazardous wastes. OVEC believes that EPA likely would not regulate coal combustion products or residues as a special waste subject to regulation under Subtitle C of Resource Conservation and Recovery Act (RCRA). Therefore, OVEC does not expect any future significant increases in the generation of hazardous wastes.

OVEC has no underground fuel oil storage tanks.

URS believes that OVEC is doing an excellent job in their existing and planned environmental compliance strategy.

Good Management / Engineering Practices

OVEC actively monitors their plant production, operations, maintenance, forced outages, emissions and costs. Management uses this data to identify trends and developing problems. With the advantage of eleven (11) units of the same age and nearly identical design, when degradation at one unit is observed and corrected, evaluation is performed of the need for modifications at the other ten (10) units. Based on observations and plant production, URS believes that Kyger and Clifty plants are managed well for long term operation.

Expected Life Of Physical Assets And Major Risks To Life Expectancy

If the Clifty Creek and Kyger Creek plants operate to 2040, they will be 85 years old. This is an unusually long service life for generating facilities. Traditionally the old facilities have been retired based upon efficiency compared to new units, excessive maintenance costs, low availability, new technology, or difficulty in achieving new environmental requirements. Any of these driving forces could develop and push unit retirement prior to 2040. However, it is URS' opinion that it is a reasonable expectation that the six (6) units at Clifty Creek and five (5) units at Kyger Creek can be expected to operate through 2040. This opinion is based upon the following observations:

1. The original design was robust with an unusual amount of redundancy.
2. The operation over the first 48 years was nearly always base loaded with limited thermal cycles on the equipment.
3. Since 2003, some limited load following operation has been performed, but the thermal cycling is limited by the requirement to maintain operation of the SCR's.
4. Appropriate maintenance and inspection of equipment has nearly always been a high priority, and critical equipment has been maintained properly.
5. The plants run at or below pressure and temperature design conditions.
6. Management is continuing to work towards improvement of maintenance, operation and inspection practices.
7. There appears to be a very strong sense of "ownership" by the plant employees that they are working to assure the plants' long term operation.
8. Management appears to be focused on long term plant operation, not on a short term profit.
9. Major equipment repairs have been implemented in the last four (4) years, with major events planned through 2015. The major focus is boiler tube and header replacement.
10. Cost of electricity is competitive with neighboring utilities.
11. Major environmental upgrades have been made and will be completed by second quarter of 2013. This will complete the scrubber installation. At this time, all known regulatory requirements will be achieved.
12. At both Clifty and Kyger, sophisticated simulators has been installed to train new operators, and to refresh training of experienced operators. This training emphasis should reduce the potential for catastrophic operator error.
13. Work force is experienced at the plant. Management is aware of likely turnover due to retirement, and is working to assure younger personnel are trained and ready to move into more responsible positions.
14. There is a true focus on water chemistry, including on-site chemists and functional laboratories. This is unusual compared to other plants that have shut down their in-house chemical laboratories.

Recognized risks that exist for OVEC, as well as most other United States coal fired electric generating plants include:

- Scrubber integration may be more difficult than expected. This is not expected to be an issue, as the plant personnel appear realistic about the challenges and several possible operational and maintenance issues have been considered.

- Major unexpected equipment failures may occur that are too expensive to repair. This includes minor damage that can cause major fires, such as a lube oil system failure.
- Units are converted to cyclic or load following operational mode. This would adversely affect remaining life of high temperature equipment, and risk more operational events that could damage equipment.
- Serious operational error that causes direct and collateral damage.
- Major new environmental or other regulatory requirements, such as an enhanced "new source review".
- Major shift in fuel prices and technologies, particularly in combination with onerous new environmental regulations.

1.0 INTRODUCTION

1.1 SCOPE OF WORK

URS Corporation (URS) was retained to perform an independent technical review of the current condition and the operational and maintenance plans at the Ohio Valley Electric Corporation / Indiana – Kentucky Electric Corporation (OVEC) Kyger Creek Plant ("Kyger") Units 1 through 5, and Clifty Creek Plant Units 1 through 6. This review has been conducted to assess the financial viability of the plants through the year 2040.

A Life Expectancy Study was conducted by URS, Sirois Engineering & Consulting, Inc. and Stone & Webster, Inc. *resulting in the Kyger Creek Life Expectancy Study Report*, Rev. 2 issued March 26, 2004 and the Clifty Creek Life Expectancy Report, Rev. 2 issued March 26, 2004. The data for these reports was complete through November 30, 2002. URS performed a follow up study through July 31, 2005. This new study is intended to assess the actual operations, maintenance and capital improvements experience from Dec. 1, 2002 to December 31, 2011 in comparison to the 2005 report assumptions. A physical assessment has been made in 2011 of the condition of the units to confirm the quality of the previous assumptions. Lastly, expected changes in fuel, operations, regulations or other factors that would affect the long term physical and financial viability of the plant are discussed.

This report contains the following sections:
Section 1, Introduction, including Scope of Work, Methodology, Assumptions and References.

Section 2, Kyger Creek Plant Description, Review of Operations and Assessment of Plant Conditions with special attention paid to changes since 2005.

Section 3, Clifty Creek, Plant Description, Review of Operations and Assessment of Plant Conditions with special attention paid to changes since 2005.

Section 4, Environmental Compliance, reviews the system's compliance with current regulations, and the modifications that will be required to comply with scheduled changes in regulations.

Section 5, Review of System Operations Plans, reviews OVEC plans in critical operational areas as they may affect the reliability and financial performance of the plant over the next 29 years. Specific review areas include coal supply, equipment upgrades, performance goals, transmission adequacy, planned capital improvements and planned O&M

Section 6, Projected Life Expectancy provides a qualitative assessment of the condition of the plants compared with the assumptions based on the 2005 data.

Section 7, Conclusions compiles the information from all of the above sections to evaluate adequacy of OVEC's plans to successfully operate the plants over the next 30 years. These include environmental compliance, implementation of good engineering, operational and maintenance practices, expected remaining life of critical equipment, and major risks to life expectancy.

1.2 METHODOLOGY

This report summarizes major capital expenditures, operational and maintenance history, and environmental history from 2000 through February 2011, as supplied by OVEC. URS consultants visited Clifty and Kyger Plants to clarify the OVEC data and perform a high level evaluation of the plant condition. Data and observations are compared to the information available from the 2005 report to assess the plant performance versus the expected performance in the previous report. In addition, expected changes in fuel, known environmental regulation revisions, and other expected changes affecting plant performance are noted.

This report also provides a summary of our review and opinions regarding the following:

- Condition of Plant Equipment
- Remaining Life Projection (physical and operational life)
- Operations & Maintenance Life Projection Requirement
- Capital Expenditure Projections through 2015
- Environmental issues
- OVEC's Budget Projections

The Technical Review is limited to the scope of work described above and does not include review of the following:

- FERC Requirements and State Ratemaking Requirements
- Debt parameters, IRR targets, capitalization, insurance, or tax issues.
- OVEC management and personnel issues
- Legal issues relating to contracts and power sales agreements
- Power market issues, regulatory (non-environmental) issues, credit issues
- Unknown future laws related to power plant operations and environmental regulations

URS conducted this analysis and prepared the report utilizing reasonable care and skill and applied methods consistent with normal industry practice. Our opinions are based on our experience and documentation provided to us by OVEC. The documents URS has relied upon are listed in Section 1.4.

The participants in this review are:

Mike Damian, URS Project Manager
George Warriner, URS Manager, Power Projects
Gerry May, URS Manager of Mechanical Integrity
Gunseli Shareef, URS Vice President, Power Sector
John Martinez, URS Environmental Specialist

1.3 ASSUMPTIONS

In the preparation of this report and in formulating the expressed opinions, URS has made certain assumptions with respect to physical condition of components that may exist or events that may occur in the future. If events or circumstances are different than currently forecast then the budgets may be impacted. The O&M and capital expense projections, maintenance plans, and equipment inspection reports were developed by OVEC and reviewed by URS. Assessment of legal issues, such as assignment of contractual rights, and procedural issues related to permits and permit waivers is outside of URS's scope of work as Independent Technical Reviewer.

URS personnel conducted a site visit on April 26, 2011 at Kyger Creek plant and April 27, 2011 at the Clifty Creek plant. The plants were visually inspected for general condition and to understand the history and future operational plans. The information gathered was used to verify the condition of the major equipment as represented in the maintenance reports.

The following assumptions pertain to this study and its results:

a. The report, "Independent Technical Review Kyger Creek & Clifty Creek Plants," Rev. 1, September 15, 2005 provides the baseline data and analysis for this 2011 report.

b. OVEC provided operation, maintenance, environmental and financial data; representing 2000 through 2010.

c. OVEC provided limited budget information for maintenance and capital equipment through 2015, and preliminary plans to 2020.

d. This review is based on operation through the year 2040.

e. OVEC operating and maintenance practices will continue as reported previously and are represented in OVEC's expected reliability and expected expenses over the next 30 years.

f. Major overhaul intervals will continue at ten (10) years for the HP turbine sections and 20 years for the LP turbine sections.

g. Feedwater heaters will generally be replaced or retubed when tube pluggage exceeds ten percent, except as noted.

h. Balance of plant equipment will be "replaced-in-kind" except as noted.

i. Major replacements are timed to correspond with scheduled major overhauls.

j. All costs are estimated in nominal 2011 dollars.

j. For the boiler, the planned outages for inspection and routine maintenance will continue on an annual basis or perhaps be extended up to three (3) years.

k. All eleven (11) Kyger and Clifty units are similar in design, equipment manufacturer, performance, operation and maintenance. Any known significant differences are noted throughout this report.

l. All five (5) Kyger Units are typical, except Unit 1 turbine generator, which is a GE, similar to turbine generators at Clifty Creek plant.

m. All six (6) Clifty Units are typical, except Unit 6 has a hot side precipitator and no SCR, compared to the other units having a cold side precipitator and SCR.

n. All of the units will continue to operate as base load units, and not converted to load following or cycling operation. Some load following in the evening and weekend hours is expected to be limited by the need to keep the SCR's operational.

o. Balance of plant equipment including, but not limited to, heat exchangers, condensers, pumps, valves, intake structures, outflow structures, condensers, conveyors, barge unloading facility, stacks, SCRs, instrumentation, transformers, fire protection systems, ash ponds and critical piping at both plants will continue to be inspected periodically and maintained.

1.4 REFERENCES

Clifty Creek & Kyger Creek Data and Industry Data:

1. OVEC-IKEC Generating Availability Statistics, 2010, Updated February 7, 2011
2. OVEC-IKEC 2010 Maintenance Planning Package May 19, 2010.
3. Kyger Creek Unit 2, Annual Maintenance Outage, Scheduled Outage April 09, 2010.
4. Kyger Creek Operating Plan 2011-2015. (Power Point Presentation)
5. Clifty Creek Operating Plan 2011-2015. (Power Point Presentation)
6. Clifty Creek Plant Maintenance Dept. Misc Data Sheet, Turbine Generators, 5 April 2011.
7. Use Factor-Available Power Sales to Sponsors, July 2010 to December 2010.
8. OVEC Operations December 24 to December 30, 2010.
9. Clifty Creek Unit #1 Outage Report, Maintenance Department, January 10, 2011; Planned Outage 3-27-10 to 6-1-10.
10. Gross and Net Real Power Capability Verification Form, all 11 units, Summer 2010.
11. Performance Measures Reports, MicroGads, Jaunary 2005 to February 2011.
12. Event Summary Report, Microgads, January 2005 to February 2011.
13. Generation Summary Report, Microgads, January 2005 to February 2011.
14. Independent Technical Review, Kyger Creek & Clifty Creek Plants, Ohio Valley Electric Corporation, by URS, September 15, 2005.

2.0 KYGER CREEK PLANT

2.1 PLANT DESCRIPTION

Kyger Creek Plant consists of five pulverized coal-fired steam electric generating units, each designed to produce a total of approximately 217 MWe guaranteed output. The units were commissioned in 1954 and 1955. Each unit consists of one (1) boiler and one (1) steam turbine generator. Each unit shares common facilities such as water treatment, fuel handling and ash disposal facilities, main powerhouse building, maintenance shops, service building, warehouse, and the wastewater treatment facilities.

2.1.1 Boiler System

The five (5) boilers are replicate units designed and manufactured by Babcock & Wilcox Company (B&W). See **Figure 2-1** for a typical side elevation of the Kyger Creek and Clifty Creek boilers. The boilers are natural circulation, balanced draft (converted after initial commissioning), wet bottom furnace, open-pass, single reheat type steam generators. **Table 2-1-1** provides additional boiler data. They were originally designed for operation with high sulfur Midwest bituminous coal; currently the fuel supply is a blend of mid-sulfur bituminous coal and low-sulfur western sub-bituminous coal from the Powder River Basin (PRB).

The Plant has no auxiliary boilers available for start-up purposes. Auxiliary electric power is available from the grid for starting one unit during a plant black-start condition. Once one unit has been started, the other units can then be started.

Boiler draft fans are provided on a 2 x 60 percent capacity basis for the forced draft and 1 x 100 percent for the induced draft systems, respectively. Adjustable speed drives were added to all FD and ID fans when the SCRs were installed. The FD fans have a great deal of over capacity. The ID fans are sufficient, but there is no excess capacity.

The boiler water chemistry is achieved using softened water with an RO unit per current ASME guidelines. Oxygen scavenging has been discontinued.

Since commissioning, the units were converted from pressurized operation to balanced draft. The flue gas recirculation system has been removed and electrostatic precipitators (ESP) have been installed on each unit. In 2002 and 2003, NOx reduction methods have been installed that are comprised of overfire air, and retrofit of SCR systems on each unit. Low NOx burners have not been installed.

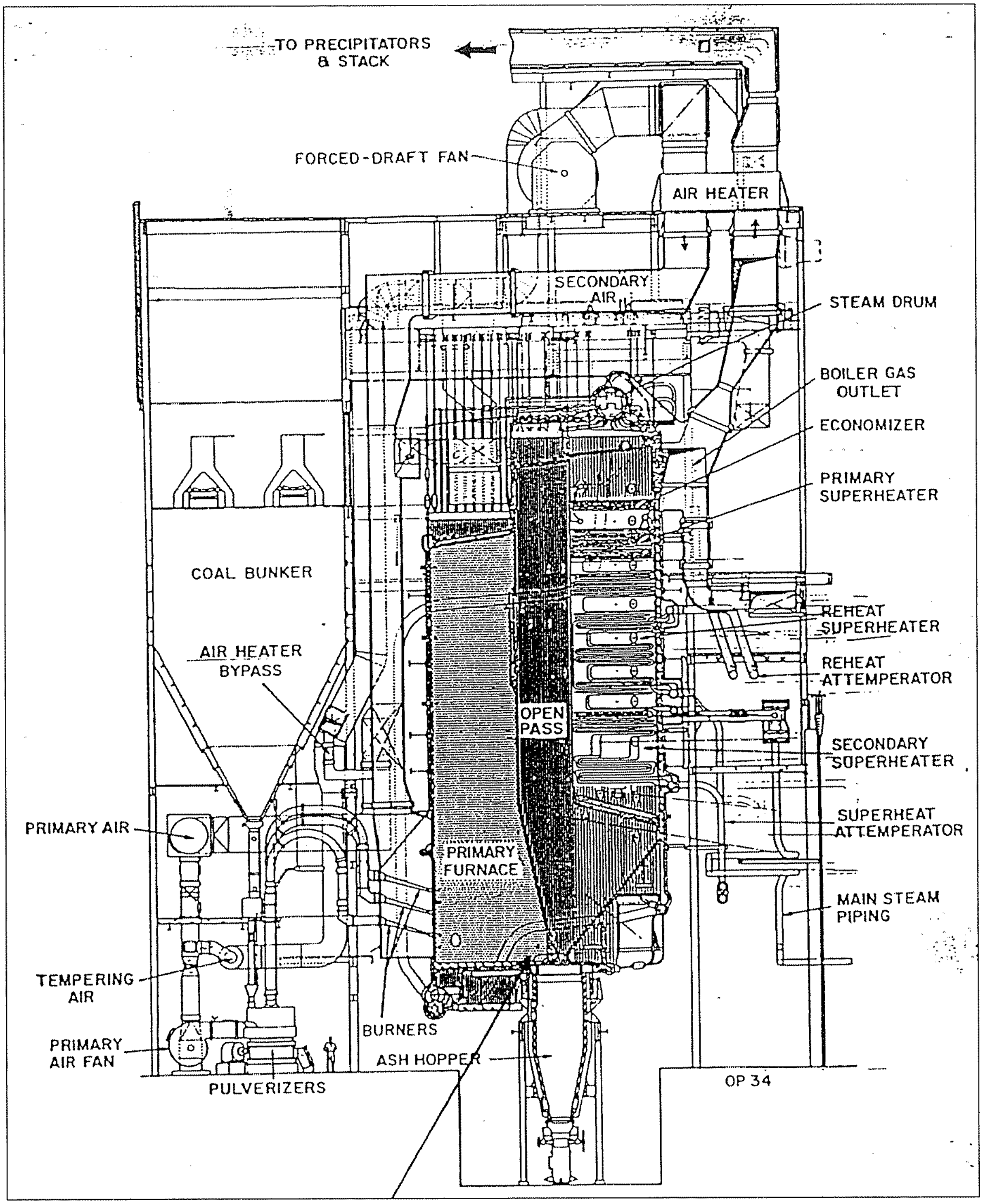

Figure 2-1 Kyger Creek & Clifty Creek Plants Boiler Side View

URS

Table 2-1-1
Kyger Creek Plant Boiler Data

Item	Unit No. 1-5
Commercial Operation Year	1954 – 1955
Manufacturer	Babcock & Wilcox Corp.
Type	Front Fired – Wet Bottom Furnace
Main Steam Temp (ºF)	1,050
Reheat Steam Temp (ºF)	1,050
Operating Pressure at SHO (psig)*	2,075
Design Pressure Rating (psig)	2,400
Main Steam Flow (lbs/hr)	1,336,000
Reheat Steam Flow (lbs/hr)	1,194,000
Circulation Type	Natural
Air Heater	Three Regenerative (Bisector Design)
Furnace Type	Single, wet bottom with open pass.
Pulverizer Type	7 – Babcock & Wilcox Model EL 70 Ball & Race Pulverizers
Primary Air	7 – centrifugal type motor driven hot PA fans
Additive System	Coal slag viscosity control done with magnetite injection
Burners	Directional flame burners on three rows on the front waterwall. No. 2 oil ignition.
Slag Blowers	31-Diamond Power with steam blowing medium
Furnace Draft	Balanced Draft
Forced Draft Fan	Two fans with original casings and new wheels, blades and adjustable speed drives installed in 2002 and 2003.
Induced Draft Fan	One fan with original casing and new wheel, blade and Robicon adjustable speed drive installed in 2002 and 2003...
NO_x Control	All 5 units retrofitted with SCR system in 2002 and 2003.

* Unit operated at 2,000-psig throttle pressure

2.1.2 Emission Control Systems

2.1.2.1 General

The emission control system at Kyger Creek Plant consists of electrostatic precipitators for particulate emission control with the new SCR system for NO_x control. Two (2) scrubbers are currently under construction and expected to be operational in the fourth quarter of 2011 and first quarter of 2012.

2.1.2.2 Electrostatic Precipitators

The units were originally equipped with mechanical collectors. They were retrofitted with cold side electrostatic precipitators from Flakt Inc. during 1978-1980. Salient features of the precipitators are:

• Supplier	Flakt Inc.
• Flue Gas Flow Rate	925,000 CFM
• Flue gas Inlet Temperature	350°F
• Inlet Dust Loading	0.5 – 3.5 grains/acf at 350°F
• Specific Collection Area. (SCA)	336 (sq. ft./1000 acfm)
• Effective Collecting Area	310,439 sq.ft.
• Length of Discharge Wire	236,652 ft.
• T/R Sets Rating	700 mA/55 kV/61 kVA
• Guaranteed Collection Efficiency	99%
• Guaranteed Emission	0.035 grain/acf (Maximum)

A flue gas conditioning (FGC) system was added in 1999 to augment precipitator performance. The FGC system was supplied by Wahlco Inc., and consists of sulfur burner, catalytic oxidation and sulfur trioxide injection grid and attendant controls. The overall ESP control system was upgraded in 2001.

2.1.2.3 SCRs

The SCR systems were installed on all five (5) units in 2002 and 2003 over the top of turbine roof. ID fans were modified, and turbine bay structural columns were reinforced to support the additional weight.

• Supplier	Riley
• Catalyst Manufacturer	Argillon
• Catalyst Type	Plate
• Catalyst Specific Surface Area (m^2/m^3)	353

• Plate Pitch (mm)	5.6
• Plate Thickness (mm)	0.8
• Plate Height (mm)	625
• Catalyst Volume Per Unit (m^3)	
o Initial	378.4
o Full	504.5
• Design Temperature (^0F)	700
• Design Flow Rate (scfm)	481,507
• Removal Efficiency	90%

2.1.2.4 Stack

The original stacks were replaced with a single stack in 1980. All five (5) units discharge through this approximately 990-ft. single stack. The stack consists of a concrete shell and a steel liner with attendant standard appurtenances such as rain hood (stainless steel), CEMS, access platforms, navigational lights and personnel elevator. This stack will be replaced with a new stack downstream of the new scrubbers. The old stack will be left in place and converted to other use later.

2.1.2.5 Scrubbers

Units 1 & 2 will be serviced by one Jet Bubble Reactor (JBR) and Units 3, 4 & 5 by a second JBR. Scrubbers are Chiyoda design with Black & Veatch as AE for auxiliary equipment and design. SO2 emissions are estimated to decline from the current 124 tons per year for all five (5) units burning Powder River Basin (PRB) blended coal, to 5 tons per year using Eastern coal at 6.5 to 7 lbs sulfur per ton. This will achieve reductions as required by EPA and state regulations.

The use of Eastern coal at approximately 80% and PRB 20% will reduce transportation costs. While there is a possibility of additional savings for the cost of the coal at the mine, this is dependent upon market forces at the time of purchase.

A new dock and barge off-loading facility is complete for receipt of the limestone. Conveyors are installed from the storage area to the scrubbers.

The gypsum output of the scrubbers is not commercial grade and will be de-watered, conveyed approximately one (1) mile, and then trucked to the nearby OVEC landfill. The bottom ash that is being dewatered and sent to the landfill will use this same conveyor. As the conveyor is used, it is anticipated that there will be some issues with dust and maintenance.

The scrubbers were originally planned to be operational by January 1, 2010. However, Chiyoda and American Electric Power (AEP) discovered problems with corrosion of the scrubber tank, and the strength of the PVC pipe. The extruded PVC pipe is being replaced with fiber reinforced pipe

(FRP) for additional strength. The tank is being lined with a high alloy steel on the walls and bottom to minimize corrosion.

There is expected to be a learning curve in operation of the scrubbers and interface with the existing plant and new coal. Extensive analysis has been performed on the operation, including the possible interaction between units since multiple boilers feed one scrubber. The control room has already been upgraded with the links to the equipment and instruments.

Maintenance of the scrubbers will require adaptation as it is learned how long the scrubbers can operate without shutting down. The tanks can operate with 3 of 4 agitator blades operational. If a second blade fails, then all units connected to the scrubber must be shutdown. There is no by-pass, or cross-tie between units and scrubbers. It is estimated it will require 10 days to 2 weeks for a scrubber shutdown to clean out the tank and perform routine maintenance and inspection inside the tank. This will affect short outage plans, as work on 2 or 3 units may need to be performed simultaneously on multiple units and the scrubber.

2.1.2.6 Ash Disposal

As was planned in 2005, the fly ash pond has been de-commissioned and a new pond opened closer to the plant. The new pond has been filling in. A long term program has been implemented to remove fly ash by dredging, dewatering it, and conveying and trucking it to the Kyger Creek landfill.

Most of the bottom ash is sold for industrial use. Only a small percentage is trucked to the landfill.

2.1.3 Turbine Generators

The Kyger Creek Plant includes one (1) General Electric and four (4) Westinghouse turbine generators with the following characteristics:

Table 2-1-2
Kyger Creek Turbine Generator Details

Plant	Manufacture	Nom. Size	Type	Steam Conditions	Age
Kyger Creek 1	GE	217,260 KWe	CC2F38	2,000 psig – 1050°/1050°F	55
Kyger Creek 2 – 5	Westinghouse	217,260 KWe	CC2F40	2,000 psig – 1050°/1050°F	55

The Unit 1 turbine-generator manufactured by General Electric is a cross-compound unit with the HP-IP (high-pressure and intermediate-pressure) turbine-generator operating at 3,600 RPM and the LP (low-pressure) turbine-generator consisting of two (2) separate low-pressure turbines with 38-inch last stage blades operating at 1,800 RPM. The HP/IP and LP rotors are configured in opposed flow configuration.

This turbine was placed into service in 1955 and has a nominal rating of 217 MWe. Turbine design throttle conditions are 2,000 psig, 1,050°F main steam and 1,050°F reheat. Control valves are integral to the upper and lower half shells. The control valves are controlled by a mechanical hydraulic system (MHC). The unit control system is designed to operate in a combination of partial arc admission and full arc admission depending on whether the unit is in a startup mode, partial load or full load condition. During startup, the control valves are full open and steam is controlled by one upstream stop valve with a by-pass valve for admitting sufficient steam to carry approximately 20 percent load. The control valves then take control for partial arc admission mode. The units operate with sliding pressure down to approximately 1800 psig, in a load following mode. Main steam and reheat stop and intercept valves are separate from the turbine shells.

The unit 2-5 turbine-generators, manufactured by Westinghouse, are in a cross-compound arrangement. Separate HP (high-pressure) and IP (intermediate-pressure) turbines are arranged in a tandem compound arrangement and drive a generator at 3,600 RPM. The LP (low-pressure) turbine-generator consists of low-pressure turbine with 40-inch last stage blades. The LP turbine is an opposed flow configuration operating at 1,800 RPM. The HP, IP and LP rotors are opposed flow configuration to balance thrust.

The unit 2-5 turbine generators were placed into service in 1955 and have a nominal rating of 217 MWe. Turbine design throttle conditions are 2,000 psig, 1,050°F main steam and 1,050°F reheat. Plant personnel report the current main steam and reheat operating temperature is nominally 1050°F or less. Control valves, main steam and reheat stop and reheat intercept valves are separate from the turbine cylinders. The control valves are controlled by a mechanical hydraulic system (MHC). The unit control system is designed to operate in a combination of partial arc admission and full arc admission depending on whether the unit is in a startup mode, partial load or full load condition. During startup, the control valves are fully open and steam is controlled by one upstream stop valve with a by-pass valve for admitting sufficient steam to carry approximately 20 percent load. The control valves then take control for partial arc admission mode. The units can operate in sliding pressure mode down to approximately 500 psig in a load following mode. In fact, in reduced load operation the pressure is reduced to about 1800 psig and any additional load reduction is by valves so that adequate temperature is maintained in the SCR's for continued operation.

The turbines have not been upgraded with higher efficiency rotors or other efficiency upgrades. Such installation might require a New Source Review.

There are system spares in OVEC for the turbine rotors, both the HP/IP and LP rotors. Since units are identical, rotors have been moved between units and the spares used over the years.

2.1.4 Balance of Plant

The regenerative feedwater heating system consists of three (3) LP heaters (1, 2, 3) arranged in series feeding a direct contact deaerating heater. The HP heater configuration consists of two parallel heater trains, each including three (3) HP heaters (5 E&W, 6 E&W, 7 E&W). The condensate and feedwater pumps are horizontal, single speed motor driven type. There are 3 – 50% feedwater pumps and 2 – 100% condensate pumps.

The condensers are single pressure, with Arsenical Copper tubes, directly cooled by Ohio River water provided by horizontal scroll case, low speed circulating water pumps. Two pumps and a condenser are provided for each unit.

The main steam piping is seamless P22 and the hot reheat system piping was originally seamless P11 with welded elbows and a welded WYE fitting. Since 2005, all original seam welded hot reheat components have been replaced with forged seamless components. This greatly reduces the risk of a catastrophic steam failure.

Each unit has three (3), single phase, three (3) winding generator step up transformers. A winding is provided in each transformer for the HP generator, the LP generator and the high voltage.

2.2 REVIEW OF OPERATIONS

2.2.1 Operation Characteristics

Historically, the units are operated essentially in a base-load mode. However, in 2002 and part of 2003 the units operated in a daily load following mode. Since 2003, the units have been base loaded again. There is some load following on weekends and nights, but the temperature cycling is limited to assure that the SCR's continually operate.

The load is reduced by sliding pressure to 1800 psig. Additional reduction to approximately 85 MWe net is by throttling. Current operation with the coal blends and auxiliary equipment results in full generation at 1050^{0}F or less on the main steam and hot reheat systems, which does not exceed the 1050^{0}F design temperature.

Planned outages, forced outages, de-rating for equipment repairs, and occasional environmental issues have caused less than full generation.

With the addition of the scrubbers, the net additional parasitic load is expected to be 4 to 8 MWe per unit. Current Auxiliary Power Requirements are 16 to 17 MWe per unit. With the change to a higher blend of Eastern Coal, there is no anticipation of major changes to the plant operating characteristics. There will be some optimization work required to settle on the best fuel mix, soot blowing methods, and other boiler operations.

2.2.2 Operating Capability and Reliability

The Kyger units historically have, and presently each is, operated in approximately the same fashion and for the same duration. **Table 2-2-1** shows the total generation for each unit from 2001 through 2010. Note that the total generation was greatest in 2004 through 2006 and has been relatively consistent prior to 2004 and post 2006.

Table 2-2-2 contains annual plant production data. Given the relatively similar operational characteristics of the individual units, URS determined that it was not necessary to analyze each unit for purposes of this evaluation. Plant use is about 7% of gross generation. Load, Capacity and Capability Factors increased in 2004 and 2005 over the previous two years while the heat rate improved. However, in 2006 through 2010, the heat rate increased, while the load, capacity and capability factors decreased to levels similar to 2002 and 2003.

Except for long outages attributed to SCR installation, the Kyger units availability factor from 2000 to 2006 was not less than 85 percent, and routinely well over 90 percent. See **Table 2-2-3**. Since 2007, the availability factor is generally 83% to 87%, with some lower factors in years with major planned outages.

The units are tested annually for gross and net capability. **Table 2-2-4** shows the values in Net Generation since 2000 through 2005, except for 2002, and for 2010. There are some differences in the test methods over the years. The 2010 data is based upon summer tests that are adjusted for ambient conditions. For clarification and comparison, both the summer and winter adjusted values are provided. There is no indication of any reduction in capability in any of the units.

Plant actual production data indicates that the Kyger units can generate approximately 235 to 240 gross MWe each during the winter months and about 215 to 220 gross MWe during the summer months. Auxiliary loss is about 17 MWe per unit, and is consistent throughout the year.

Forced outages are an indicator of the unit condition. **Table 2-2-5** shows the annual equivalent forced outage rate for the Kyger Plant. The values were compiled by URS for each unit based on OVEC supplied GADS data.

The average forced outage rate for the overall plant was less than 5.5% each year through 2005. In 2006 through 2008 it increased to a maximum of 11.17%, and then has been decreasing since. Each of the forced outages has been analyzed by the plant. It shows the vast majority of these forced outages are for boiler tube leaks and other boiler related problems. For example, in 2010, 74% of all EFOR's are attributed to boiler tube failures. Another 13% were related to other boiler issues, including fouling, boiler ash hoppers, mills, PA Fans and Feeders. Of great significance is that electrical transformers, turbine-generators and aging plant auxiliary equipment are performing extremely well with very few failures and with limited down times when there is a failure.

Units 1, 2 & 3 have had the largest forced outage rates, particularly in 2008 & 2009 on Unit 1, 2007, 2008 & 2009 on Unit 2 and 2006, 2008 & 2009 on Unit 3. On these three (3) units, the forced outages in 2010 were reduced significantly.

These statistics led to the major tube replacement program that is being performed through 2014 on the Kyger boilers. With reduced likelihood of boiler tube leakage, it is expected that the EFOR's for the Kyger units will continue to trend downward over the next few years.

2.2.3 Fuel Sourcing

Since original commissioning, Kyger's fuel source has changed from high sulfur bituminous to a combination of bituminous and PRB sub-bituminous coals to meet operational requirements and air emission limits.

With the expected commissioning of the scrubbers in 2011 & 2012, the coal sources and blends will be re-constituted. The expected blend is about 80% Eastern coal with 6.5 to 7 #/ ton sulfur, with 20% PRB. There will be changes to the performance of the units, as the BTU content of the coal should be greater than has been burned in the last few years. Slagging, coal handling and ash handling are all expected to change, particularly since the scrubbers will change unit operation. These changes are planned for as much as possible, and personnel are realistic that evaluations and adjustments must be made after the scrubbers are operational.

At Kyger, there are no fly ash sales. The ash goes to a settling pond, is dredged out, de-watered, and then conveyed to trucks that take it about 2 miles to a landfill. The furnace bottom ash is used for various purposes off-site and is mined from the pond by a local company.

In 2005, the amount of coal in the coal yard was very low. In 2010, reasonable reserves of Eastern Coal and PRB are now in the coal yard. With the move to Eastern Coal, on-time availability and delivery of coal is expected to be routine.

2.3 OBSERVATIONS OF PLANT CONDITIONS

2.3.1 Summary of Plant Conditions

URS Consultants walked-down Kyger Unit 1 from the top to the basement floor, and observed the scrubber installation, coal yard, screens, stacks, conveyors, ash ponds and other plant equipment from the roof of Unit 1. In general the plant was found to be well maintained with most of the boiler components in a condition above average compared to other coal fired units of this vintage inspected by URS. The Kyger Creek Plant's conservative design and configuration is typical of a multi-unit pulverized coal-fired configuration. This includes a semi-indoor plant fueled through a common, covered coal gallery for the five units. The building is considered a common facility. Given its physical age, the visual condition of Kyger appeared to be very good for this vintage of power plant. There were no obvious signs of deteriorating structures, decking, support steel, piping, pipe supports, thermal insulation, cable trays, etc.

The SCR and precipitator additions, plus the on-going scrubber additions make for a relatively compact arrangement on the site. Space has been well utilized. Based upon observations and discussions with plant personnel, the plant modifications have been well enough designed that they have not created significant maintenance problems for existing equipment due to access limitations. When the SCR's were added, existing steel had to be reinforced, and this process assured all existing steel was carefully examined.

The new scrubbers will force the retirement of the stack now in operation. Future use will be for maintenance.

Tanks have been installed to inject Trona for control of "blue plume". This has been a relatively rare occurrence and should not be needed often. After the scrubbers are operational it is likely that trona will need to be injected more often.

The fly ash pond is nearly full. A long term program has been instituted to dredge the bottom of the pond, de-water the fly-ash, and convey and truck the ash to the Kyger Creek landfill. The same conveyor and trucking system will be used for the gypsum from the scrubbers.

The dock and unloading facility for the limestone is operational. The scrubbers are still several months away from completion.

There is a staffed chemistry lab performing water chemistry evaluations on site. This is unusual at plants today, but URS considers this an example of a commitment by management to assure the plant is well maintained.

While URS did not see the training simulator at Kyger, we did observe a similar one at Clifty Creek. The facility is another commitment by management to assure that operators are well trained and will be ready to react properly when unusual events occur. This facility also is used by controls personnel to assure that planned changes to the controls logic function properly.

There are about 350 people on staff at Kyger Creek. Management is planning for possible retirement of up to 25% of the people in the next 4 years. Since the plant appears to be one of the respected employers in the area, plant jobs are considered desirable, and the turnover is manageable. If the primary turnover is retirement, with the remaining people at the plant there should be adequate managers and senior people to train the replacement personnel.

The plant personnel that URS met were knowledgeable, and focused on the long term viability of the plant. This is extremely important in that decisions should be made based upon long term plant production and availability, not upon short term least cost solutions.

Outages are well planned through a five (5) year rolling schedule. There are preliminary "place holder" outage schedules from 5 to 10 years. There is probably more uncertainty in these schedules right now than in the past because of the addition of the scrubbers. Since scrubber maintenance forces a shutdown of 2 or 3 units for days or weeks, there will have to be adjustments to attempt to perform as many of the standard maintenance and inspection items during each scrubber shutdown. Probably scrubber shutdowns will be timed on the beginning or end of one of the unit major outages, if at all possible.

There are safety committees and other groups that meet regularly representing Kyger Creek and Clifty Creek. This provides good feedback to each plant on which improvements have worked the best. AEP, as the largest sponsor provides extensive technical support and planning. AEP also provides document control services for the plant drawings.

OVEC/IKEC maintains well-documented programs for both capital and maintenance projects done at Kyger. Records were provided that showed all major maintenance on the boilers, turbine generators and other equipment since original plant commissioning. This is impressive record keeping, and is one more example of the long term commitment of management to the maintenance of Kyger Creek.

2.3.2 Capital Improvements, Maintenance & Inspection History Since 2000

Table 2-3-1 tabulates the Capital Improvements and Maintenance expenditure levels from January 2000 through June 2010, and the budgeted expenditures through 2015. The capital expenses are dominated by the SCR installation in 2002 and 2003 and the scrubber installation since 2005.There is a $44mm Boiler Plant Equipment capital expense in 2006, which is much greater than average. This one time charge includes the coal yard upgrades.

With the major cycle of refurbishments of the boiler to be completed in 2014 at Kyger Creek, the projected boiler capital expenses are greatly reduced in 2015. Based on today's known problems, this is reasonable. Also, the basic re-tubing of major sections of the boilers is a significant expense that should lower maintenance costs and forced outages for several years.

Capital costs for the Turbogenerator and Accessory Electric Equipment are budgeted at less than historic averages through 2015. Given the current condition of the equipment this is reasonable through 2015. In later years it would be expected that this equipment capital expense would return to near its historic average.

The maintenance costs were consistent from 2000 to 2006. In 2007 on and through the budgeted period to 2015, the boiler maintenance expenses increased 50% to 100% over the 2005 values. This reflects the increase in tube failures and other boiler related work necessary to keep the plants functional. Note that the boiler plant equipment capital budget is increased dramatically from 2010 to 2014 in an attempt to bring the boilers into good working order with minimum outage time in future operating years.

The maintenance expense / budget include the full time maintenance staff, and thus there is a base cost of about 100 people that is relatively stable. The perturbations in maintenance levels are generally a function of the outage schedules and forced outages. Long outages, such as when the SCR's were installed, provide opportunity for more extensive maintenance of the boiler and turbines. There is expected to be some increased staff with the commissioning of the scrubbers, but with the boiler improvements there is expected to be some minimal cost savings to boiler maintenance.

Overall, **Table 2-3-1** indicates a commitment by OVEC to maintain and improve the plants to meet the long term operational requirements.

The following sections summarize of the significant improvements, repairs and inspections represented by the above expenditures.

2.3.2.1 Boiler

Boilers are chemically cleaned every three (3) years. Typically the cleaning results in "uncovering" some tube leaks and additional repairs are required.

Each boiler is inspected and repaired annually during a 14 day outage. Typical inspections include visual inspection of steam drum headers, tubes and supports, magnetic particle inspection of selected locations, replication, inspection for ligament cracking, and other standard NDE. Inspections are performed on a schedule and not all inspections are performed annually. Indications are consistently repaired at the time they are found.

Major tube replacements on the primary furnace were performed on the side wall, first baffle wall and roof in the 1979 through 1982 outages. Similar replacements are being performed now through 2014. The sloping floors are also being replaced on each unit through 2014.

The reheat tubes and the reheater outlet headers are to be replaced on each unit in 2012 through 2014.

SCR units were installed in 2002 and 2003 on all five units. These units are located above the turbine roof.

All five units' lower front tubes of the primary furnace were replaced 2002 and 2003.

All five (5) units' lower bank and outlet legs of the secondary superheater were replaced 2000 to 2003.

Secondary Superheater Upper bank last replaced in 1978 through 1980, although selected SSH platens have been replaced since then.

Unit 3 lower left, lower right side walls and lower water wall headers replaced in 2010.

Unit 3 Sloping floor tubes and lower screen tubes replaced in 2010.

Unit 1, replaced 30 Sloping floor tubes in 2007.

2.3.2.2 Turbine Generator

As noted above, the H.P. turbine components are on a ten (10) year major overhaul schedule and the L.P. sections on a 20 year major overhaul schedule. Examinations are made annually during the boiler shutdowns. No unusual problems reported since 2002.

A spare HP, LP and IP rotor exists on site for the Westinghouse turbine generators. The General Electric spare rotors are maintained and stored at Clifty Creek since they have six GE units.

Some of the significant turbine generator maintenance accomplishments since 2005 include:

- Unit 2, HP Turbine inner cylinder replaced
- Unit 3, HP Turbine 1st Stage Curtis blades replaced

2.3.2.3 Emissions Control System

Selective Catalytic Reduction (SCR) systems were installed on all five (5) boilers at Kyger in 2003. These systems are capable of continuous operation and this mode of operation would result only in the additional variable operating costs associated with increased consumption of ammonia and catalyst. All associated SCR equipment maintenance increases proportionally to SCR operating hours.

Electrostatic Precipitators (ESP) were installed on all 5 Kyger units in the late 1970's. All five (5) units are fitted with "cold side" ESP's. These units are located downstream of the air preheater. The ESP systems were originally designed for operation with eastern bituminous coals or western sub-bituminous coals. Particulate control on all five (5) units has consistently operated well below the current emission limit.

Flue Gas Desulphurization units (FGD, also referred to as "Scrubbers" and "Jet Bubble Reactor" (JBR)) are not currently installed at Kyger. OVEC originally planned to install FGDs on all five (5) units by January 1, 2010. Construction was nearly done, when problems were found at other units with corrosion of the tank, and strength of the PVC pipe. Re-design has been performed and construction is now continuing for tie-in during late 2011 and first quarter 2012.

No mercury reduction systems are currently installed on any of the Kyger units.

During each available opportunity, forced or planned outage, the SCR is inspected for fly ash accumulation and cleaned if necessary.

CEMS and other monitoring systems are calibrated and maintained as necessary.

2.3.2.4 Stack

The existing Kyger stack will be taken out of service when the scrubbers are tied-in. There is a new stack installed downstream of the scrubbers. The old stack may be used for maintenance.

2.3.2.5 Balance of Plant

All steel, concrete foundations, turbine generator pedestal and other structural components appear to be in good condition. When the SCRs were installed, columns in the T-G building were reinforced to support the increased loads.

Intake and outflow structures are periodically inspected and no significant deterioration has been found. Since there is only one in-take and outflow structure, it is difficult to perform maintenance with five units.

Critical pipe and pipe supports are inspected bi-annually and adjusted or replaced, as needed.

Asbestos pipe insulation has been nearly completely replaced with non-asbestos insulation. Insulators are nearly continuously on site assuring the insulation is in good repair.

Electrical cable deterioration has not been a problem.

Instrumentation and controls are continually being maintained and upgraded. The major upgrade in the control rooms to the Ovation system has been accepted by plant operators and the system is working properly.

Some other equipment that has been repaired since 2005 include:
- Retubed a total of six (6) feedwater heaters in various units.
- Changed out the Ash hopper skirt and weir on Units 2 and 5
- Replaced air heater baskets on Units 1 & 4
- Retubed Units 2 and 3 Condensers
- Repaired traveling screens on units 1 & 2
- Rebuilt the air compressors on Units 1, 2, 4 & 5
- Overlayed primary furnace tubes with 309 stainless steel on all five units.
- Replaced reheat seam welded reheat line elbows and WYE fittings with seamless components.
- Underground fuel oil storage tanks have been replaced with aboveground storage tanks.

2.3.2.6 Coal Supply

Coal supply will change significantly later in 2011 from primarily PRB to primarily Eastern coal. This conversion has a high level of attention by the plant personnel to manage this properly. On-time delivery of coal to the plant should not be any problem.

2.3.2.7 Transportation

Coal is delivered to plant by barge. Docks are well maintained, as are the conveyor systems from the coal yard to the tripper.

2.3.2.8 Electricity Transmission

No recent changes have been made to the electrical transmission system from the plant to sponsoring companies. The system has been adequate, and sponsoring companies have the responsibility for the transmission system.

3.0 CLIFTY CREEK PLANT

3.1 PLANT DESCRIPTION

Clifty Creek Plant consists of six pulverized coal-fired steam electric generating units, each designed to produce a total of approximately 217 MWe guaranteed output. The units were commissioned in the mid-1950s. Each unit consists of one boiler and one steam turbine generator. Each unit shares common facilities such as water treatment, fuel handling, ash disposal facilities, main powerhouse building, maintenance shops, service building, warehouse, and the wastewater treatment facilities.

3.1.1 Boiler System

The six (6) boilers are replicate units designed and manufactured by Babcock & Wilcox Company (B&W). See **Figure 2-1** for a typical side elevation of the Clifty Creek boilers. The boilers are natural circulation, balanced draft (converted after initial commissioning), wet bottom furnace, open-pass, single reheat type steam generators. **Table 3-1-1** provides additional boiler data. They were originally designed for operation with high sulfur Midwest bituminous coal; now the fuel supply is a blend of mid-sulfur bituminous coal and low-sulfur western sub-bituminous coal from the Powder River Basin (PRB). In 2012 & 2013, with the commissioning of the scrubbers, the coal supply will be changed.

The Plant has no auxiliary boilers available for start-up purposes. Auxiliary electric power is available from the grid for starting one unit during a plant black-start condition. Once one unit has been started, the other units can then be started.

Boiler draft fans are provided on a 2 x 60 percent capacity basis for the forced draft and 1 x 100 percent for the induced draft systems, respectively. Adjustable speed drives were added to all FD and ID fans when the SCRs were installed. The FD fans have a great deal of over capacity. The ID fans are sufficient, but there is no excess capacity.

The boiler water chemistry is achieved using softened water with a double RO unit per current ASME recommendation. Oxygen scavenging has been discontinued.

Since commissioning, the units were converted from pressurized operation to balanced draft, the flue gas recirculation system has been removed and electrostatic precipitators (ESP) have been installed on each unit. In 2002 and 2003, NOx reduction methods were installed that are comprised of overfire air, burner modifications and retrofit of SCR systems on units 1 through 5. The low NOx burner modifications were found to not be totally effective, and were retrofitted back.

Table 3-1-1
Clifty Creek Plant Boiler Data

Item	**Unit No. 1-6**
Commercial Operation Year	1954 – 1955
Manufacturer	Babcock & Wilcox Corp.
Type	Front Fired – Wet Bottom Furnace
Main Steam Temp (ºF)	1,050
Reheat Steam Temp (ºF)	1,050
Operating Pressure at SHO (psig)*	2,075
Design Pressure Rating (psig)	2,400
Main Steam Flow (lbs/hr)	1,336,000
Reheat Steam Flow (lbs/hr)	1,194,000
Circulation Type	Natural
Air Heater	Three Regenerative (Bisector Design)
Furnace Type	Single, wet bottom with open pass.
Pulverizer Type	7 – Babcock & Wilcox Model EL 70 Ball & Race Pulverizers
Primary Air	7 – centrifugal type motor driven hot PA fans
Additive System	Coal slag viscosity control done with magnetite injection
Burners	Directional flame burners on three rows on the front waterwall. No. 2 oil ignition.
Slag Blowers	31-Diamond Power with steam blowing medium
Furnace Draft	Balanced Draft
Forced Draft Fan	Two fans with original casings and new wheels, blades and adjustable speed drives installed in 2002 and 2003.
Induced Draft Fan	One fan with original casing and new wheel, blade and Robicon adjustable speed drive installed in 2002 and 2003...
NO_x Control	Units 1 through 5 retrofitted with SCR system in 2002 and 2003.

* Unit operated at 2,000-psig throttle pressure

3.1.2 Emission Control Systems

3.1.2.1 General

The emission control system at Clifty Creek Plant consists of electrostatic precipitators for particulate emission control with the SCR system for NO_x control. At this time, the plant does not have a flue gas desulphurization system for sulfur dioxide emission control, although it is under construction.

3.1.2.2 Electrostatic Precipitators

The units were originally equipped with mechanical collectors. Units 1 through 5 were retrofitted with cold side electrostatic precipitators from Lodge Cottrell in 1977 & 1978. Unit 6 was retrofitted with a hot –side precipitator from Western Precipitator in 1976. Salient features of the precipitators are:

Cold-Side Precipitators (Units 1 through 5)

- Supplier — Lodge Cottrell
- Flue Gas Flow Rate — Design 925,000 CFM
- Flue gas Inlet Temperature — 350°F
- Inlet Dust Loading — 0.27 – 3.7 grains/acf at 350°F
- Specific Collection Area. (SCA) — 532 (sq. ft./1000 acfm)
- Effective Collecting Area — 492,480 sq.ft.
- Length of Discharge Wire — 316,000 ft.
- T/R Sets Rating — 1000 mA/55 kV/61 kVA
- Guaranteed Collection Efficiency 98.41%
- Guaranteed Emission — 0.05 grain/acf (Maximum)

Hot-Side Precipitator (Unit 6)

- Supplier — Western Precipitators
- Gas Flow Rate — 1,303,000 acfm
- Flue Gas Inlet Temperature — 760°F
- Inlet Dust Loading — 0.37 to 3.4 grains/acf
- Specific Collection Area (SCA) — 371 (sq. ft./1,000 acfm)
- Effective Collection Area — 483,413 sq. ft.
- T/R Sets Rating — 1,000 mA/45 kV DC
- Guaranteed Collection Efficiency — 99.4%
- Emission — 0.0045 grain/acf

A flue gas conditioning (FGC) system was added in 1999 on units 1 through 5 to augment precipitator performance. The FGC system was supplied by Wahlco Inc., and consists of sulfur burner, catalytic oxidation and sulfur trioxide injection grid and attendant controls. The overall ESP control system was upgraded in 1997 & 1998.

3.1.2.3 SCR

The SCR systems were installed on units 1 through 5 in 2002 and 2003 over the top of turbine roof. ID fans were modified, and turbine bay structural columns were reinforced to support the additional weight.

- Supplier — Riley
- Catalyst Manufacturer — Argillon
- Catalyst Type — Plate
- Catalyst Specific Surface Area (m^2/m^3) — 353
- Plate Pitch (mm) — 5.6
- Plate Thickness (mm) — 0.8
- Plate Height (mm) — 625
- Catalyst Volume Per Unit (m^3)
  - Initial — 378.4
  - Full — 504.5
- Design Temperature (^0F) — 725
- Design Flow Rate (scfm) — 443,617
- Removal Efficiency — 90%

3.1.2.4 Stack

The original stacks were replaced with two (2) stacks in 1976. Units 1 through 3 discharge through one stack and units 4 through 6 discharge through the other. The stacks consist of a concrete shell and a steel liner with attendant standard appurtenances such as rain hood (stainless steel), CEMS, access platforms, navigational lights and personnel elevator. Both these stacks will be abandoned in place when the scrubbers are commissioned in 2012 & 2013. A new single stack has been built to replace the existing two stacks.

3.1.2.5 Scrubbers

Units 1, 2 & 3 will be serviced by one Jet Bubble Reactor (JBR) and Units 4, 5 & 6 by a second JBR. Scrubbers are Chiyoda design with Black & Veatch as AE for auxiliary equipment and design. SO2 removal is estimated that from the current approximately 70 tons per year for all 6 units burning PRB blended coal, to 4 tons per year using Eastern coal at 6.5 to 7 lbs sulfur per ton. This will achieve reductions as required by EPA and state regulations.

The use of Eastern coal at approximately 80% and PRB 20% will reduce transportation costs. While there is a possibility of additional savings for the cost of the coal at the mine, this is dependent upon market forces at the time of purchase.

A new dock and barge off-loading facility is complete for receipt of the limestone. Conveyors are installed from the storage area to the scrubbers.

The gypsum output of the scrubbers is not commercial grade and will be trucked to the nearby Clifty landfill.

The scrubbers were originally planned to be operational by January 1, 2010. However, Chiyoda and American Electric Power (AEP) discovered problems with corrosion of the scrubber tank, and the strength of the PVC pipe. The extruded PVC pipe is being replaced with FRP pipe for additional strength. The tank is being lined with a high alloy on the walls and bottom to minimize corrosion.

There is anticipated to be a learning curve in operation of the scrubbers and interface with the existing plant and new coal. Extensive analysis has been performed on the operation, including the possible interaction between units since multiple boilers feed one scrubber. The control room has already been upgraded with the links to the equipment and instruments. Some benefit may be obtained in lessons learned on the scrubber operation from Kyger Creek, since it will be operational at least 1 year prior to Clifty Creek. However, it is recognized that the coal and other operations will not be identical at the two plants.

Maintenance of the scrubbers will require adaptation as it is learned how long the scrubbers can operate without shutting down. The tanks can operate with 3 of 4 agitator blades operational. If a second blade fails, then all units connected to the scrubber must be shutdown. There is no by-pass, or cross-tie between units and scrubbers. It is estimated it will require 10 days to 2 weeks for a scrubber shutdown to clean out the tank and perform routine maintenance and inspection inside the tank. This will cause an effect on short outage plans, as work on units may need to be performed simultaneously on multiple units and the scrubber.

3.1.2.6 Ash Disposal

The bottom ash has significant slag and is used as a liner for the landfill. The fly ash is dry, and is trucked to the landfill. Some fly ash is sold to contractors for filler, if possible.

3.1.3 Turbine Generators

The Clifty Creek plant includes six (6) General Electric turbine generators with the following characteristics:

Table 3-1-2
Clifty Creek Plant Turbine Generator Details

Units	Manufacture	Nom. Size	Type	Steam Conditions	Age
Units 1 through 6	GE	217,260 KWe	CC2F38	2,000 psig - 1050°/1050°F	50

These turbine-generators manufactured by General Electric are cross-compound units with the HP-IP (high-pressure and intermediate-pressure) turbine-generator operating at 3,600 RPM and the LP (low-pressure) turbine-generator consisting of two (2) separate low-pressure turbines with 38-inch last stage blades operating at 1,800 RPM. The HP/IP and LP rotors are configured in opposed flow configuration.

The turbines were placed into service in 1955 and have a nominal rating of 217 MWe. Turbine design throttle conditions are 2,000 psig, 1,050°F main steam and 1,050°F reheat. Control valves are integral to the upper and lower half shells. The control valves are controlled by a mechanical hydraulic system (MHC). The unit control system is designed to operate in a combination of partial arc admission and full arc admission depending on whether the unit is in a startup mode, partial load or full load condition. During startup, the control valves are full open and steam is controlled by one upstream stop valve with a by-pass valve for admitting sufficient steam to carry approximately 20 percent load. The control valves then take control for partial arc admission mode. The units operate with sliding pressure down to approximately 1800 psig in a load following mode. Further reduction to 85MWe net power output is achieved by throttling. Main steam and reheat stop and intercept valves are separate from the turbine shells.

3.1.4 Balance of Plant

The regenerative feedwater heating system consists of three LP heaters (1, 2 & 3) arranged in series feeding a direct contact deaerating heater. The HP heater configuration consists of two parallel heater trains, each including three (3) HP heaters (5 E&W, 6 E&W, 7 E&W). The condensate and feedwater pumps are horizontal, single speed motor driven. There are three (3) - 50% boiler feed pumps, and two (2) – 100% condensate pumps.

The condensers are single pressure, with arsenical copper tubes, directly cooled by Ohio River water provided by horizontal scroll case, low speed circulating water pumps. Two (2) pumps and a condenser are provided for each unit.

The main steam piping is seamless P22 and the hot reheat system piping is seamless P11. None of this pipe, fittings or headers is seam welded.

Each unit has three (3), single phase, three (3) winding generator step up transformers. A winding is provided in each transformer for the HP generator, the LP generator and the high voltage.

3.2 REVIEW OF OPERATIONS

3.2.1 Operation Characteristics

Historically, the units are operated essentially in a base-load mode. However, in 2002 and part of 2003 the units operated in a daily load following mode. Since 2003, the units have been base loaded again. Planned outages, forced outages, de-rating for equipment repairs, and occasional environmental issues have caused less than full generation. There is some limited load following in the evenings and weekends to about 85MWe, net generation. Reduction below this level is rarely done because it forces the SCR's out of service and the financial penalties are significant. This limitation in load following limits the temperature swings that the equipment experiences.

The load is reduced by sliding pressure to 1800 psig and the remainder by throttling. Current operation with the coal blends and auxiliary equipment results in full generation at 1040^{0}F to 1050^{0}F on the main steam and hot reheat systems, at or slightly less than the 1050^{0}F design temperature.

3.2.2 Operating Capability and Reliability

The Clifty units historically have, and presently each is, operated in approximately the same fashion and for the same duration. **Table 3-2-1** shows the total generation for each unit from 2001 through June 2010. It is noted that all seven pulverizers must be operating to burn 80% PRB coal. Test burns of the expected blended coal after the scrubbers are operational indicate that at most six pulverizers will be required for full load, and possibly only five.

Peak generation was in 2005 and 2006, with relatively consistent generation at the plant in the other years.

Table 3-2-2 contains annual plant production data. Given the relatively similar operational characteristics of the individual units, URS determined that it was not necessary to analyze each unit for purposes of this evaluation. Plant electrical use is about 7.5% of gross generation. Load, Capacity and Capability Factors were greatest in 2004 and 2005 and since then have been consistent with the pre-2004 levels.

At Clifty Creek, the annual plant availability factor has varied from 80.5% to 89.0% from 200 to 2010. See **Table 3-2-3. T**he low availability in 2003 is attributed to installation of SCR's and some forced outages on Units 1 and 3. The overall plant availability in 2009 and 2010 is in the upper portion of the range, at 85.6% to 87% availability.

The units are tested annually for gross and net capability. **Table 3-2-4** shows the values in Net Generation since 2000, 2001, 2003, 2004, 2005 and 2010. There are some differences in the test methods over the years. The 2010 data is based upon summer tests that are adjusted for ambient conditions. For clarification and comparison both the summer and winter adjusted values are provided. There is no indication of any reduction in capability in any of the units.

Plant actual production data indicates that the Clifty units can generate approximately 225 to 235 gross MWe each during the winter months and about 217 to 227 gross MWe during the summer months. Auxiliary loss is about 17 MWe per unit, and is consistent throughout the year.

Forced outages are an indicator of the unit condition. **Table 3-2-5** shows the annual forced outage rate for the Clifty Plant.

The average forced outage rate for the overall plant peaked at 9.54% in 2007 and has been steadily decreasing ever since. The 2010 rate is 5.11%. The vast majority of forced outage (FO) events and down time at Clifty is attributed to boiler problems, primarily tube failures. Of the forced outages in 2010, 70% were attributed to boiler tube failures. Only 3% were attributed to the turbine generator. From 2006 through 2010, the top five (5) causes of forced outages were

1. Boiler tube leaks, 1,688,000 MWh
2. Slagging or fouling, 991,000 MWh
3. Air and gas systems, 486,000 MWh
4. Fuel supply from bunkers to boilers, 388,000 MWh
5. Feedwater System, 270,000 MWh

Clearly the major boiler tube retrofits should greatly reduce the boiler tube leaks.

Slagging and fouling are expected to be different once the coal blend is changed, hopefully improving the characteristics of the ash.

Of great significance is that electrical transformers and aging plant auxiliary equipment are performing extremely well with very few failures and with limited down times when there is a failure.

3.2.3 Fuel Sourcing

Since original commissioning, Clifty's fuel source has changed from high sulfur bituminous to a combination of bituminous and PRB sub-bituminous coals to meet operational requirements and air emission limits. Clifty has a dry fly ash handling system that allows the maximum PRB blend to approx. 75% without incurring pulverizer capacity limits. The sulfur dioxide emission ranges from 0.5 to 1.6 lb/mmBtu.

It is expected that the coal will change to an 80% blend of Illinois Basin coal and 20% PRB when the scubbers are installed in the first 6 months of 2013.

3.3 OBSERVATIONS OF PLANT CONDITIONS

3.3.1 Summary of Plant Conditions

URS Consultants walked-down Clifty Creek Units 3 & 4 from the top to the basement floor, and observed the scrubber installation, coal yard, screens, stacks, conveyors, ash ponds and other plant equipment from the roof of Unit 3. In general the plant was found to be well maintained with most of the boiler components in a condition above average to other coal fired units of this vintage inspected by URS. The Clifty Creek Plant's conservative design and configuration is typical of a multi-unit pulverized coal-fired configuration. This includes a semi-indoor plant fueled through a common, covered coal gallery for the five units. The building is considered a common facility. Given its physical age, the visual condition of Clifty appeared to be very good for this vintage of power plant. There were no obvious signs of deteriorating structures, decking, support steel, piping, pipe supports, thermal insulation, cable trays, etc.

The SCR and precipitator additions, plus the on-going scrubber additions make for a relatively compact arrangement on the site. Space has been well utilized. Based upon observations and discussions with plant personnel, the plant modifications have been well enough designed that they have not created significant maintenance problems for existing equipment due to access limitations. When the SCR's were added, existing steel had to be reinforced, and this process assured all existing steel was carefully examined.

The new scrubbers will force the retirement of the two stacks now in operation. Future use will be for maintenance.

Fly ash is dry. What cannot be sold is trucked to the Clifty landfill.

The dock and unloading facility for the limestone is operational. The scrubbers are about 25% installed. Construction was suspended when re-design was necessary. Construction restarted on 3 May 2011.

There is a staffed chemistry lab performing water chemistry evaluations on site. This is unusual at plants today, but URS considers this an example of a commitment by management to assure the plant is well maintained.

The Clifty Creek simulator appears to be a very will designed facility. Existing operators are scheduled for refresher training once a month. New operators can be fully trained for board work on the simulator. The facility is another commitment by management to assure that operators are well trained and will be ready to react properly when unusual events occur. This facility also is used by controls personnel to assure that planned changes to the controls logic function properly.

There are about 350 people on staff at Clifty Creek. Management is planning for possible retirement of up to 25% of the people in the next four (4) years. Since the plant appears to be one of the respected employers in the area, jobs at the plant are desirable and the turnover is manageable. If the primary turnover is retirement, with the remaining people at the plant there should be adequate managers and senior people to train the replacement personnel.

The plant personnel that URS met were knowledgeable, and focused on the long term viability of the plant. This is extremely important in that decisions should be made based upon long term plant production and availability, not upon short term least cost solutions.

Outages are well planned through a five (5) year rolling schedule. There are preliminary "place holder" outage schedules from 5 to 10 years. There is probably more uncertainty in these schedules right now than in the past because of the addition of the scrubbers. Since scrubber maintenance forces a shutdown of three (3) units for days or weeks, there will have to be adjustments to attempt to perform as many of the standard maintenance and inspection items during each scrubber shutdown. Probably scrubber shutdowns will be timed on the beginning or end of one of the unit major outages, if at all possible.

There are safety committees and other groups that meet regularly representing Kyger Creek and Clifty Creek. This provides good feedback to each plant on which improvements have worked the best. AEP, as the largest sponsor provides extensive technical support and planning. AEP also provides document control services for the plant drawings.

OVEC/IKEC maintains well-documented programs for both capital and maintenance projects done at Clifty. Records were provided that showed all major maintenance on the boilers, turbine generators and other equipment since original plant commissioning. This is impressive record keeping, and is one more example of the long term commitment of management to the maintenance of Clifty Creek.

3.3.2 Capital Improvements, Maintenance & Inspection History Since 2000

Table 2-3-1 tabulates the Capital Improvements and Maintenance expenditure levels from January 2000 through 2010, and the budgeted expenditures through 2015. The capital expenses are dominated by the SCR installation in 2003 and the scrubber installation from 2005 through 2015.

With the major cycle of refurbishments of the boiler completed in 2015 or 2016 at Clifty Creek, the boiler capital expenses are expected to be reduced in 2017. Based on today's known problems, this is reasonable. Also, the basic re-tubing of major sections of the boilers is a significant expense that should lower maintenance costs and forced outages for several years.

The Tubogenerator and Accessory Electric Equipment are budgeted at much less than historic averages through 2015. While this is reasonable through 2015, it is expected these capital costs will increase to around the historic averages after 2015.

The maintenance costs were consistent from 2000 to 2006. In 2007 on and through the budgeted period to 2015, the boiler maintenance expenses increased 50% to 90% over the 2005 values. This reflects the increase in tube failures and other boiler related work necessary to keep the plants functional.

The maintenance expense / budget include the full time maintenance staff, and thus there is a base cost of about 100 people that is relatively stable. The perturbations in maintenance levels are generally a function of the outage schedules and forced outages. Long outages, such as when the SCR's were installed, provide opportunity for more extensive maintenance of the boiler and turbines. There is expected to be some increased staff with the commissioning of the scrubbers, but with the boiler improvements there is expected to be some cost savings to boiler maintenance.

Overall, **Table 3-3-1** indicates a commitment by OVEC to maintain and improve the plants to meet the current requirements.

The following sections summarize of the significant improvements, repairs and inspections represented by the above expenditures.

3.3.2.1 Boiler

Boilers are chemically cleaned every 3 years. Typically the cleaning results in "uncovering" some tube leaks and additional repairs are required.

Each boiler is inspected and repaired annually during a 14 day outage. Typical inspections include visual inspection of steam drum headers, tubes and supports, magnetic particle inspection of selected locations, replication, inspection for ligament cracking, and other standard NDE. Inspections are performed on a schedule and not all inspections are performed annually. Indications are consistently repaired at the time they are found.

SCR units were installed in 2002 and 2003 on units 1 through 5. These units are located above the turbine roof.

Some of the major maintenance on the boilers since 2005 include:

- 30 of the Lower Primary Superheater sloping floor tubes replaced in 2007 on Unit 1.
- Secondary Superheater Outlet Header and the Outlet Legs, Upper Bank and Lower Bank replaced in 2007 on Unit 1.
- Reheat tube sections and the reheater outlet header replaced on Unit 1 in 2007.
- New Air Heater baskets on Units 2, 3 4 & 5 in 2007 through 2010.

Some of the significant boiler improvement projects through 2015 include:

- Unit 5, Replace Sloping Floor, Reheater And Superheat Tubes, 2011
- Unit 4, Replace Sidewalls, 2012
- Unit 6, Replace SSH Out Tubes, Outlet, Legs & Headers, 2013
- Unit 3, Replace First Baffle Wall , Primary Furnace Floor, Primary Furnace Front Wall & Roof, 2014
- Units 2 & 4 Replace First Baffle Wall, Primary Furnace Floor, 2015
- Unit 4 Replace SSH Out Tubes, Outlet Legs & Headers, 2015
- Replace Blowdown Tanks, All 6 Units In 2011 And 2012

3.3.2.2 Turbine - Generator

As noted above, the H.P. turbine components are on a 10 year major overhaul schedule and the L.P. sections on a 20 year major overhaul schedule. Examinations are made annually during the boiler shutdowns. No unusual problems reported since 2002.

A spare HP and LP rotor exists on site for the GE turbine generators. The General Electric spare rotors are maintained and stored at Clifty Creek since they have six GE units.

- Unit 3 HP Generator, stator rewound 2009
- Unit 6 HP Generator, stator rewound 2008
- Unit 3 LP Generator, stator rewound 2009
- Unit 6 LP Generator, stator rewound 2008

3.3.2.3 Emissions Control System

Selective Catalytic Reduction (SCR) systems were installed on 5 of the 6 boilers at Clifty in 2003. Since the current NOx regulation allow "bubbling" of the emissions from both Clifty and Kyger and since OVEC chose to design the reactors for a NOx removal efficiency of 90%, sufficient margin existed to allow one unit to remain uncontrolled. SCR's are now operated whenever the units are operational. This full time operation results in the additional variable operating costs associated with increased consumption of ammonia and catalyst. All associated SCR equipment maintenance should increase proportionally to SCR operating hours.

Electrostatic Precipitators (ESP) were installed on all 6 Clifty units in the late 1970's. Units 1-5 were fitted with "cold side" ESP's while unit 6 was fitted with a "hot side" ESP. The difference in these systems is the location of the ESP relative to the air preheater. The "hot side" is located upstream while the "cold side" ESP is located downstream. The Unit 6 ESP was the first installed at either plant, and "cold side" ESP equipment was chosen for the remaining units. The ESP systems were originally designed for operation with eastern bituminous coals or western sub-bituminous coals. Particulate control on all 11 units has consistently operated well below the regulatory limits.

Flue Gas Desulfurization units (FGD) are not currently installed at Clifty. OVEC planned to install FGDs on all 6 units by January 1, 2010. With design problems that caused a suspension of construction, commissioning is now scheduled during the first 2 quarters of 2013.

No mercury reduction systems are currently installed on any of the Clifty units, although preliminary plans are being considered for likely mercury reduction requirements.

During each available opportunity, forced or planned outage, the SCR is inspected for fly ash accumulation and cleaned if needed.

CEMS and other monitoring systems are calibrated and maintained as necessary.

3.3.2.4 Stack

The existing operating stacks were inspected during 2003 and each underwent expensive repairs. With the recent repairs both stacks should be in very good condition. These stacks will be retired in place when the FGD's are operational in 2013.

3.3.2.5 Balance of Plant

All steel, concrete foundations, turbine generator pedestal and other structural components appear to be in good condition. When the SCRs were installed, columns in the T-G building were reinforced to support the increased loads.

Intake and outflow structures are periodically inspected and no significant deterioration.

Critical pipe and pipe supports are inspected bi-annually and adjusted as needed.

Virtually all the asbestos thermal insulation has been replaced with non-asbestos insulation. Insulators are usually on site each week and assure that the insulation is in good repair.

Electrical cable deterioration has not been a problem, although the 4 kva cable to the pulverizers is being replaced.

Instrumentation and controls are continually being maintained and upgraded. The major upgrade in the control rooms to the Ovation system has been accepted by plant operators and the system is working properly.

Since the 2005 report was written, four feedwater heaters have been replaced or retubed. Heaters are typically re-tubed when 10% of the tubes are plugged.

3.3.2.6 Coal Supply

When the 2005 plant assessment was performed, coal reserves on site were very low. This issue does not appear to be a problem now with about 60 days of reserve available. As the plant is transitioned to Illinois Basin coal, coal deliveries should not be a problem.

3.3.2.7 Transportation

Coal is delivered to plant by barge. Docks are fully functional and in good repair. A separate dock is under construction for off - loading limestone for the scrubbers.

3.3.2.8 Electricity Transmission

No recent changes have been made to the electrical transmission system. The transmission is actually the responsibility of the sponsoring companies, and no long term problems have been identified. Spare transformers at the generator output are available in case of failure.

4.0 ENVIRONMENTAL COMPLIANCE

4.1 COMPLIANCE WITH CURRENT REGULATIONS

Filterable particulate matter (PM) performance tests were conducted in 2007, 2009, and 2010 at both plants. For Clifty Creek, the PM emission limit from the Title V permit is 0.236 lb/MMBtu. PM results from tests done at this plant in September 2007 and August 2009 was well below this limit and ranged from 0.0061 lb/MMBtu measured at the common stack CS001 for Units 1 to 3, and to 0.0485 lb/MMBtu measured at the common stack CS002 for Units 4 to 6. For Kyger Creek, the PM emission limit from the Title V permit is 0.1 lb/MMBtu. PM results from tests conducted in July/August 2007 and in August/September 2010 at this plant were also well below the limit, ranging from 0.0202 lb/MMBtu from Unit 4 to 0.0463 lb/MMBtu from Unit 1.

Most Title V permit deviations reported by OVEC were for short-term excess opacity events. OVEC reported to URS that for Kyger Creek, less than1.5 percent of the operating hours were associated with excess opacity events. This indicates that Kyger Creek was in compliance with the opacity standard more than 98.5 percent of the time.

At both plants, there have been numerous boiler retubing projects. The issue regarding these projects is whether each project or as an aggregate of related projects may be viewed as a modification under New Source Review (Title I of the Clean Air Act) or as routine maintenance repair and replacement (RMRR) activities. EPA views boiler life extension or regaining boiler efficiency loss as a possible modification. As discussed previously in this report, in 2010, it was reported that 74% of the forced outages were attributed to tube failures at Kyger Creek and 70% attributed to tube failures at Clifty Creek. OVEC responded that they have evaluated the tube replacements as RMRR activities which would not be considered a modification. OVEC Legal staff agreed with this assessment that neither boiler life is extended nor loss of boiler efficiency is regained by these tube replacements.

NO_x controls were installed in 2002 and 2003 as SCRs were installed on each of the 5 boilers at Kyger and 5 of the 6 boilers at Clifty. Upgrades to the existing ID fans were completed to ensure that maximum unit output would not be compromised. During this same period, both facilities have been shifting from 100% bituminous coal to a blend of eastern coals and western sub-bituminous coal (PRB). The result has been a reduction in NO_x and SO_2 emissions. With the shift to a higher percentage PRB blend, Clifty has been able to sell the majority of their fly ash, reducing landfill requirements and developing a new revenue stream. All SCRs were designed for 90% removal efficiency and continue to operate at or near design.

Since the submission of the 2005 Independent Technical Review report on both plants, OVEC has addressed the operational issue with the SCRs of the accumulation of fly ash primarily on the first layer of catalyst. The hopper and screens have been changed to prevent the accumulation of fly ash on the catalyst. OVEC stated that the operation of the SCR systems have been greatly improved after these changes were implemented. The ammonia on demand systems continue to operate reliably as well.

In the late 1970's Electrostatic Precipitators (ESP) were installed on each of the boilers at Clifty and Kyger. Also, during this retrofit, new steel reinforced concrete stacks with metal liners were constructed and the existing stacks were partially demolished. As a part of the ESP retrofit each boiler was converted to balanced draft and new induced draft fans were installed. ESP performance and reliability have been very good. Actual particulate emissions are consistently below regulatory limits. Continued excellent performance from these systems is expected. No significant issues exist at this time.

The only significant pollution release reported by OVEC since the 2005 technical report was a fish kill due to a release of ammonia to Kyger Creek by the Kyger Creek plant. The ammonia release was not a normal wastewater stream from the ammonia on demand system. This discharge was a result of an abnormal operation condition that resulted in a buildup of excess water in the system recycle tank containing abnormally high concentrations of urea and ammonia. OVEC paid for the fish kill and took initiative to negotiate a settlement with Ohio EPA. As a result, a settlement was issued by Ohio EPA in the Findings and Orders dated November 8, 2010. OVEC responded timely on February 15, 2011 to the findings and orders. In OVEC response letter dated February 15, 2011, OVEC submitted a timely general plan for Ohio EPA's approval. OVEC has not heard from Ohio EPA as of this date. Once Ohio EPA approves OVEC general plan, OVEC is expected to provide a detailed implementation plan and schedule on measures to be taken to prevent a reoccurrence. OVEC has instituted some interim measures such as bringing in a temporary 21,000 holding tank and they are disposing of the wastewater offsite.

As an aftermath of recent RCRA inspections, OVEC has worked to correct minor RCRA issues. In particular, for Kyger Creek, OVEC has resolved the issue with Ohio EPA from their 2008 inspection that the burning of boiler cleaning material in the boiler is not combustion of RCRA hazardous wastes. This issue re-emerged in the 2010 EPA inspection. This issue is still pending with EPA, and OVEC anticipates no notice of violation from EPA based on information OVEC provided to them.

Overall, both facilities continue to operate and comply with all federal and state environmental regulations. Environmental performance and management oversight continues to be good.

4.2 MODIFICATIONS REQUIRED FOR SCHEDULED REGULATIONS

A review of environmental compliance at both Clifty and Kyger suggests that both facilities have done a good job in achieving substantial compliance with state and federal regulations for air, water and solid waste pollution management. The proposed installation of FGDs on each operating boiler will result in over compliance and the accumulation of SO_2 credits.

FGD systems are currently planned for each of the 11 boilers. The current schedule has the construction tie-ins completed on the first system at Kyger between late 2011 and the first quarter 2012, with all remaining systems operational after tie-ins and commissioning are completed. At Clifty Creek, commissioning is planned for the first two quarters of 2013. With the operation of the FGD and SCR systems, both controls should be sufficient to meet future air EPA regulations such as Utility MACT Rule (proposed on May 3, 2011) and the Transport Rule (proposed on July 6, 2010). Specifically, for mercury control that will be required under the MACT rule, OVEC estimates that the SCR oxidation of mercury will provide for enhanced removal of mercury by the FGD system. OVEC believes that the combined control should be able to meet mercury and other pollutants emission standards in both rules once these rules become final.

The only exception is that Unit 6 at Clifty Creek is not equipped with an SCR system. OVEC's approach is that OVEC could comply with the proposed Transport Rule during the first two years when interstate trading is permitted for this boiler. However, an SCR on Unit 6 at Clifty Creek would likely be necessary after the first two years when interstate trading is no longer permitted under the Transport Rule and it would also likely be necessary to comply with the proposed Utility MACT Rule. AEP Engineering is currently conducting preliminary engineering and developing a cost estimate for retrofitting an SCR on this unit. A decision on whether and when the SCR would be retrofitted would be made once these rules are finalized by EPA.

For compliance with greenhouse gas (GHG) requirements, OVEC has systems in place for reporting GHG emissions. OVEC does not anticipate any future projects that will result in any modification, construction or reconstruction that would trigger the significant GHG increases related to EPA's GHG tailoring rule.

At Clifty Creek, a new landfill with double lining has been operating. This landfill is large enough to accept FGD dewatered wastes, boiler ash, and bottom ash. With the leachate system, OVEC believes that there would be additional modifications or upgrades needed to comply with the future CCP rule when promulgated. However, OVEC is prepared to install mercury treatment system similar to Kyger Creek system, if required.

At Kyger Creek, a new fly ash pond was added to manage fly ash and boiler slag. The fly ash and boiler slag will be periodically dewatered from this pond and the solids will be sent to an on-site landfill. The landfill is large enough to accept dewatered wastes from fly ash pond as well as future FGD wastes. Kyger Creek has a mercury treatment system and chloride purge treatment wastewater treatment plant.

OVEC believes that the proposed Coal Combustion Residuals (CCR) Rule (proposed on June 21, 2010) will be based on classifying ash as a solid waste subject to Subtitle D requirements. Therefore, OVEC believes there will be no significant changes to comply with the CCR rule with the exception of possibly installing a mercury treatment system at Clifty Creek. OVEC believes EPA has no basis to classify ash as a special waste subject to hazardous waste rules under Subtitle C. Therefore, no upgrade studies have been initiated to consider this option, given the low risk that this waste would be subject to Subtitle C.

5.0 REVIEW OF OPERATION PLANS

5.1 COAL SUPPLY

Both Kyger Creek and Clifty Creek plants will be converting from primarily PRB and some Eastern Coal to primarily Eastern Coal with 20% blending with PRB. With the barge facilities there appears to be no significant issues in assuring adequate supplies of coal. Any transportation issues of PRB coal to the sites is greatly reduced with this conversion back to Eastern Coal.

AEP provides coal supply coordination to OVEC.

5.2 EQUIPMENT UPGRADES

The following equipment upgrades are planned over the next few years. This is in addition to standard inspection and maintenance programs that are in place.

Jet Bubble Reactor scrubbers to be installed on all five units at Kyger Plant. Commissioning scheduled for last quarter of 2011, and first quarter 2012.

Jet Bubble Reactor scrubbers to be installed on all six units at Clifty Plant. Commissioning scheduled for first two quarters of 2013.

Major boiler tube replacements on virtually all units planned over the next 4-1/2 years.

Boiler tube leak detection systems have been installed at Kyger Creek. These are scheduled for Clifty Creek in 2013 and 2014.

Clifty Creek coal unloading Plant #1 to be re-built in 2015.

5.3 ENVIRONMENTAL PLANS AND UPGRADES

As discussed in Section 4.2, preliminary plans and cost estimates are on-going to retrofit an SCR system on Unit 6 at Clifty Creek for compliance with future Utility MACT rule.

OVEC submitted a plan to the Ohio EPA in accordance with Order No. 1 of the Director's Final Findings and Orders for Kyger Creek as a result of ammonia release in July 2009 resulting in a fish kill in Kyger Creek. This plan is to address future handling of all wastewater streams associated with the ammonia-on-demand system for eliminating the potential of these wastewater streams from impacting the receiving water body. Interim measures are on-going and final measures will be implemented pending Ohio EPA's approval of the plan.

OVEC worked with the State of Ohio in the 1970's, conducting tests at both plants that ultimately resulted in the exemption of Clifty and Kyger from 316a requirements. Every five (5) years during the renewal of their NPDS permit, OVEC requests a continuation of the exemption and have always been granted it. OVEC expects this process to continue.

For compliance with the proposed cooling water intake rule, 316(b) issued on April 20, 2011, Clifty and Kyger plants' circulating water flow is under a specified percentage of the

Ohio River flow rate. This allows both plants to be exempt from 316(b) requirements. OVEC continues to monitor regulatory actions that could change this exemption. Currently, OVEC believes the most extensive modification that might be required is modification of the traveling screens. Another alternative that has been proposed is to restock the river with fish. OVEC has concluded that no cooling towers or major changes to intake or outflow structures would be required to comply with the proposed 316(b) intake rule.

5.4 TRANSMISSION ADEQUACY

No significant changes are planned.

5.5 PLANNED O&M EXPENDITURES

OVEC is budgeting approximately $70 million dollars per year for Operations and Maintenance through 2015. Much of this cost is fixed by the labor and benefits associated with the approximately 700 people on payroll.

5.6 PLANNED CAPITAL IMPROVEMENTS

Per the budget documents, OVEC is planning to spend $30 to $36 million per year on capital equipment upgrades through 2014. This is a significant increase over the approximately $25 million per years spent from 2006 through 2010. Primary purpose of these expenditures is to re-tube major sections of each boiler. Capital Improvements are reduced to $19 million in 2015, and will probably be less in 2016.

The capital costs of the new scrubbers are not included in the above numbers, but are shown in Tables 2-3-1 and 3-3-1.

- Total installed cost of the scrubbers at Kyger is budgeted at $657,380,663, with about $81,000,000 of this total to be spent in 2011 and 2012. The remainder of the budgeted amount has already been spent.

- Total installed cost of the scrubbers at Clifty is budgeted at $677,405,237, with about $265,000,000 of this total to be spent in 2011 through 2015. The remaining $412,000,000 has already been spent.

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6.0 PROJECTED LIFE EXPECTANCY

The focus of this study is on the physical and operational life expectancy issues; namely assessments of projected plant and equipment longevity and performance based on operating history and experience, current material condition assessments, and plant owner plans for operating and maintaining the subject facilities. This independent engineering study addresses only issues of projected plant performance and the reasonableness of costs projected by owners to maintain desired levels of plant performance. This study does not address issues of economic and financial life expectancy except to point out where existing cost projections appear to be optimistic (low) and where there appears to be a significant likelihood of the plants experiencing higher than budgeted costs that could erode revenue margins. This study focuses on assessing the technology, material condition, operations history, and plans for future operation of Kyger Creek and Clifty Creek, and making judgments about physical and operational life expectancy.

The following conclusions emerge from this review:

1. The five (5) Kyger units and six (6) Clifty units have been operated within design parameters and maintained at a high level for 55 years. The plants continue to generate reliably at or near their rated capacity. Actual steam temperatures are at or less than design, which provides extra design margin for the boiler headers, piping and turbine components.

2. Jet Bubble Reactor scrubbers will be operational at Kyger in 2011 & 2102, and in 2013 at Clifty Creek. This allows the use of Eastern Coals at about 80% with a 20% blend of PRB planned. There is expected to be a "shake-out" period at both plants to optimize the fuel blends and to best interface the operation and maintenance of the scrubbers with the existing plants. While units are similar, the exact optimization at Kyger Creek will probably not be the same at Clifty Creek.

3. The units are all being operated as base load units with limited thermal cycling in the evenings and weekends. Thermal swings are limited by the need to keep the SCR's on line. Ramp rates are generally 2 MWe per minute. Should the units be changed to load following or more severe cycling operation, it is expected that life expectancy would be adversely affected by adding significant thermal cycles to equipment, and by operating equipment at less than optimum conditions. No contingency is included in this evaluation for potential future cycling operation.

4. Maintenance in 2005 through 2010 has continued on the expected schedule described in the 2005 report. Inspection and maintenance expenditures indicate a continued commitment by OVEC to continually maintain the plants for full operation for the foreseeable future. Should maintenance and inspection levels be reduced, life expectancy and availability would be expected to be adversely affected.

5. Planned maintenance through 2015 attempts to greatly reduce the forced outages from boiler tube leaks by replacing large sections of boiler tubes. These change-outs are based on inspection results and the locations of the tube leaks. This should be successful, and both plants have aggressive goals to reduce forced outages.

6. Note that serious operations errors, maintenance errors or equipment failures that can cause explosions, fires, or other catastrophic failures are always a possibility in power plants. In these evaluations, it is assumed that good operations and maintenance practices ensure that no such serious event occurs. OVEC recognizes this issue and the implementation and use of the operation simulators at both sites is a very positive move.

7. If the units continue to be operated and maintained as they are currently, and have been for the past several years, and if current plans for equipment maintenance and upgrades are successfully conducted on an ongoing basis, then an additional 30 years or more of useful life can be reasonably expected.

7.0 CONCLUSIONS

7.1 ABILITY OF PLANT TO OPERATE AS PLANNED

Both the Kyger Creek and Clifty Creek plants are operating at or near their design capability with about 85% availability. In recent years the forced outage rate has been as high as 11% at Kyger and 9% at Clifty Creek. Both plants have improved their forced outage rates significantly in the last 3 years, with further reductions expected.

Each unit has been generally base loaded and the 11 units as a system have produced a low of 15.84 GWhours in 2010 and a high of 17.92 GWhours in 2006. Each unit is still capable of producing its rated power, and does so with a reasonable outage rate.

The installation of the scrubbers will create an additional load of 4 to 8 MWe on each unit. Maintenance of these units will be a challenge because of the multiple units tied to each scrubber. On the positive side, there should be at least one spare pulverizer on each unit at all times with the switch to Eastern Coal, and slagging and fouling may be reduced.

7.2 ADEQUACY OF PROJECTED CAPITAL AND OPERATING COSTS

Capital and maintenance costs are budgeted through 2015, only. These values appear reasonable. There is an expectation that Capital Costs will be reduced beyond 2015. Maintenance Costs will probably be the same or slightly higher with the installation of the scrubbers.

7.3 ENVIRONMENTAL COMPLIANCE, PRESENT AND FUTURE

A review of environmental compliance at both Clifty and Kyger suggests that both facilities have done a good job in substantially complying with state and federal regulations for air, water and solid waste pollution management. The current plan appears to be adequate to meet proposed changes in the regulations but some risks do exist.

In the late 1970's Electrostatic Precipitators (ESP) were installed on each of the boilers at Clifty and Kyger. ESP performance and reliability has been very good. Actual particulate emissions are consistently below regulatory limits. Continued excellent performance from these systems is expected. No significant issues should exist with the addition of the FGD systems.

With the installation of ten SCR systems in 2003, OVEC is meeting NO_x emission requirements at both facilities. Over compliance has resulted in the accumulation of NO_x credits. SCR performance has been very good and similar performance is expected in the future. Changes were completed to hopper and screens to reduce or eliminate the accumulation of fly ash primarily on the first layer of catalyst.

FGD systems are currently planned for each of the 11 boilers. The current schedule has the construction tie-ins completed on the first system at Kyger Creek between late 2011 and the first quarter 2012, with all remaining systems operational after tie-ins and commissioning are completed. At Clifty Creek, commissioning is planned for the first two quarters of 2013. FGD technology is very mature; therefore the risk of these systems not meeting performance guarantees is very low. O&M costs should also be very predictable. The proposed installation of FGD systems on each operating boiler will result in over compliance and the accumulation of SO_2 credits.

Operation of SCR and FGD controls in combination will be important for controlling mercury emissions for compliance with future air regulations. Preliminary plans are on-going for retrofitting Unit 6 at Clifty Creek with SCR. Previous testing at Clifty Creek has indicated that mercury oxidation rates are higher with their PRB-bituminous coal blend than other PRB facilities have reported. From the 2005 Independent Technical Review report, OVEC has stated they should expect 35-40% mercury removal from the co-benefit of the SCR and FGD systems. If additional mercury control is needed, OVEC may need to consider other technologies (e.g., activated carbon injection).

Overall, both plants have maintained an excellent record with respect to wastewater discharge. OVEC has taken a proactive stance to negotiate a settlement with Ohio EPA on the July 2009 ammonia release at Kyger Creek. The improvements being made at Kyger Creek will help reduce the risks of another similar event from occurring at both plants. Good compliance is expected to continue in the future. In the 1970's, OVEC conducted extensive testing that resulted in both the Clifty and Kyger Plants being exempt from 316(a). Also, 316(b) does not apply at either facility due to the relatively low circulating water flow rates compared to the average flow rate of the Ohio River. OVEC feels confident that both the 316(a) exemption and 316(b) exclusion will continue.

OVEC is aware of EPA's rulemaking activity for amending the current NPDES effluent guidelines for the Steam Electric Power Generating Industry. They are monitoring this activity to determine if changes may be required as a result. Per EPA's schedule, EPA plans to propose a rulemaking for this industry in July 2012 and take final action by January 2014.

Management and compliance with the solid/hazardous waste regulations has been good at both plants. Each facility has worked very hard to minimize the use of materials and chemicals that result in the disposal of a hazardous waste. Programs are in place to replace hazardous waste with non-hazardous alternatives and where hazardous materials must be used to minimize the resulting waste.

At Kyger and Clifty, six underground fuel oil storage tanks were closed out at each plant and above ground tanks were installed. If leaks are detected then it is quite possible that ground water monitoring wells will have to be installed around the tanks requiring the plant to monitor ground water for contamination. Monitoring will likely continue as long as the plant is operational. Some risk exists with the closure of these tanks associated with possible ground water contamination and the resulting remediation requirements.

7.4 COMPLIANCE WITH GOOD MANAGEMENT / ENGINEERING PRACTICES

OVEC compiles a number of matrices based on production, forced outages, repairs, emissions, cost of production, energy / kWh and others. It is clear from talking to the plant personnel that this data is used in its planning and decision making to focus resources on operations, inspection and repairs.

Interactions between plant systems are considered when making major decisions, such as additional pollution control equipment, changes in coal blending and water chemistry. This management approach helps avoid modifications that will benefit one portion of the process while not necessarily improving the availability and generation of the entire system.

Consultants are used as appropriate to develop recommendations.

Eleven units have operated for 55 years with minimal major incidents. This implies that the base equipment is operable without causing major incidents, that the processes and procedures are well enough understood that major mistakes have not been made.

Each forced outage is analyzed for trends that indicate a systemic problem. When such problems are discovered, resources are available and are assigned to develop a long term solution.

The OVEC system has a great advantage over many other utilities in that the plants are virtually the same age, with the same equipment, and very similar operating history. Once a systemic problem is observed at one unit, evidence of similar issues can be examined at the other ten units. This limits the "surprises" that can occur at utilities with several different types of equipment, fuel, and operating philosophies.

Of great importance is the management emphasis on long term management of the plants for extended use and high availability. At this time, it appears that this is a very strong culture at both plants. Any change to a management philosophy of short term cost reductions may create degradation of equipment that would seriously impact the expected life of the plant.

7.5 EXPECTED LIFE OF PHYSICAL ASSETS

Projecting the life of any equipment, particularly equipment 55 years old is not an exact science. It is obvious that equipment will wear out and must be repaired or replaced. Boiler tubes, rotating equipment blades and rotors, high temperature pipe, heater tubes, pulverizers and other plant equipment are continuous maintenance items. Judgment criteria to evaluate expected life and URS's judgments are as follows:

1. **Is there evidence of degradation that indicates expended life of major equipment?** The annual planned inspection programs of boilers and high energy equipment, and the attention to detail on maintaining supports that could increase stresses means that none of the boiler headers, steam drums, and most piping systems are not in need of major repair or replacement. Rotating equipment has been operating at high levels of performance without any apparent degradation.

2. **Is there a plan based on past experience and reasonable engineering judgment to identify failing equipment before it becomes a forced outage?** OVEC continues to maintain spare turbine rotors and main transformers. There is redundancy in the boiler feed pumps, feedwater heaters and condensate pumps. Inspections are routinely performed on a high percentage of the major equipment. Plants are heavily staffed with experienced personnel in maintenance, operations and management. This provides a substantial "corporate memory" that helps identify

root causes when incidents occur. This corporate mentality could blind personnel from new ideas, but it appears that OVEC consults often with AEP and other consultants to avoid this trap.

3. **Are there reasonable contingency plans for repair of equipment?** Equipment repairs are planned up to five years in advance. The maintenance and capital expenditure budgets are consistent on an annual basis. This implies a corporate mentality to continue to maintain and inspect equipment on a continual timetable, and not to try to manipulate the budget for low spending for a year or two, resulting in much higher costs 3 or more years later.

4. **Is it reasonable to assume that the equipment will be operated within design parameters?** The experience shows that the equipment is not degrading at a high rate. Primary steam output is at less than design on pressure and temperature. Given the 1050^{0}F design temperature, operation at 10^0 to 30^0 F less than design provides significant increases in stress allowable on the high temperature headers, tubes and pipe.

5. **Are reasonable safeguards in place to avoid major operational incidents that could cause catastrophic damage?** URS did not review operations procedures. However, the recent history shows no significant operational errors that resulted in a major forced outage. The installation of operating room simulators at Kyger Creek and Clifty Creek with regularly scheduled training sessions for experienced and new operators is viewed as a very prudent use of resources to avoid significant operator error.

Based on the current condition of the plants, the plans for continued inspection and maintenance, the continued good operational record, and the plant resources to implement these plans, URS believes it is reasonable to expect that the Kyger Creek and Clifty Creek plants will be able to physically operate for the next thirty years or even longer.

7.6 MAJOR RISKS TO LIFE EXPECTANCY

The above conclusions are based on materials presented by the owners and assumptions about both existing conditions and future operations. This opinion is based upon the following observations:

1. The original design was robust with an unusual amount of redundancy.
2. The operation over the first 48 years was nearly always base loaded with limited thermal cycles on the equipment.
3. Since 2003, some limited load following operation has been performed, but the thermal cycling is limited by the requirement to maintain operation of the SCR's.
4. Appropriate maintenance and inspection of equipment has nearly always been a high priority, and critical equipment has been maintained properly.
5. The plant runs at or below pressure and temperature design conditions.
6. Management is continuing to work towards improvement of maintenance, operation and inspection practices.
7. There appears to be a very strong sense of "ownership" by the plant employees that they are working to assure the plants long term operation.

8. Management appears to be focused on long term plant operation, not on a short term profit.
9. Major equipment repairs have been implemented in the last 4 years, with major events planned through 2015. The major focus is boiler tube and header replacement.
10. Cost of electricity is competitive with neighboring utilities.
11. Major environmental upgrades have been made and will be completed by second quarter of 2013. This will complete the scrubber installation. At this time, all known regulatory requirements will be achieved.
12. At both Clifty and Kyger, sophisticated simulators has been installed to train new operators, and to refresh training of experienced operators. This training emphasis should reduce the potential for catastrophic operator error.
13. Work force is experienced at the plant. Management is aware of likely turnover due to retirement, and is working to assure younger personnel are trained and ready to move into more responsible positions.
14. There is a true focus on water chemistry, including on-site chemists and functional laboratories. This is unusual compared to other plants that have shut down their in-house chemical laboratories.

Physical life expectancy is determined by cost considerations, generally fairly sudden and unacceptably large cost increases rather than long-term gradual erosion of revenue margins. The following are viewed as the major items that could cause a significant change in costs with resultant decrease in physical life expectancy.

A. Equipment failures and/or performance significantly below current expectations that are based on material condition assessments and equipment lifetime prognosis. Key items of equipment that could be subject to unexpected major failures include boilers, steam turbines, generators, transformers, etc. Plant performance parameters that are subject to technical risks include heat rate, summer and winter megawatt ratings, forced outage rates particularly if these are high enough to adversely affect plant capacity value and capacity market revenues, and ability to provide ancillary services and secure their attendant revenues. There are really two (2) categories of risk here; catastrophic mechanical failures, which may be a serious issue for plants and equipment of this vintage, and failure to perform as designed. The latter could apply to individual units on an overall basis, or to specific subsystems, original or new.

B. Units are currently not intended to be operated other than base loaded with limited load following resulting in limited thermal cycling. Additional damage would be incurred by cyclic or load following operation. Thermal stresses and risk of operational events during changing loads and startups would be increased. During power cutbacks or shutdowns, there is risk of damage caused by condensing steam; undrainable low points, entrapped coal or ash, and equipment failures during re-start. Cycling operation that is forced by changes in power market conditions could significantly shorten operational life expectancy.

C. A serious operational error that creates considerable direct and collateral damage. Extended downtime would increase cost and reduce production. Damaged equipment may not be replaceable, or may be inordinately expensive to replace.

D. Major management change that focuses on short term profits over long term availability of the plants could create deterioration of the equipment that is not anticipated based upon the current management focus.

E. Major regulatory changes in mercury emissions limits or other pollutant emissions would cause an increase in required equipment and likely erosions of plant capability and performance.

F. A major fire or other such incident caused by relatively minor failures such as the lube oil system have been known to shut down plants for a long period of time.

G. Major new environmental or other regulatory requirements that selectively impact on Kyger Creek and Clifty Creek to a greater extent than they impact on newer coal plants in the population. An example that comes to mind is an enhanced "new source review" legislation that makes it prohibitively expensive for Kyger and Clifty to continue with major plant improvements.

Most if not all of these risks are generally applicable to all coal fired plants in the United States. Such items as regulatory changes would presumably apply not only to Kyger and Clifty, but also to all other coal fired plants.

A different type of risk could be a combination of a major shift in fuel prices (e. g. coal vs. gas), early wide deployment of new technologies such as IGCC, and onerous new environmental regulations that would cause a shift from coal as a low cost producer to other energy sources, and particularly impact on older coal plants perhaps having high heat rates. Combinations of such circumstances could produce a radical change in the Kyger and Clifty positions in the power markets and tend to shorten economic life. However, such combinations of circumstances are not currently anticipated over the next twenty to thirty year horizon.

TABLE 2-2-1 KYGER CREEK PLANT GROSS POWER GENERATION SUMMARY

YEAR	GROSS GENERATION, MWh					
	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	STATION
2001	1,603,500	1,483,500	1,368,600	1,496,700	1,460,100	**7,412,400**
2002	1,397,227	1,379,928	1,484,098	1,535,731	1,646,212	**7,443,196**
2003	1,531,999	1,662,103	1,330,372	1,354,556	1,403,535	**7,282,565**
2004	1,635,645	1,640,305	1,584,909	1,610,519	1,632,218	**8,103,596**
2005	1,630,224	1,681,938	1,602,597	1,666,620	1,668,242	**8,249,621**
2006	1,638,600	1,632,626	1,545,641	1,727,212	1,386,551	**7,930,630**
2007	1,440,066	1,378,542	1,229,338	1,484,725	1,566,287	**7,098,958**
2008	1,485,897	1,449,869	1,367,792	1,500,407	1,627,661	**7,431,626**
2009	1,474,100	1,397,689	1,546,959	1,508,086	1,574,030	**7,500,864**
2010	1,489,181	1,537,328	1,267,762	1,522,930	1,497,103	**7,314,304**
2011 Jan/Feb	273,453	277,782	272,190	291,030	302,210	**1,416,665**
TOTAL	**15,599,892**	**15,521,610**	**14,600,258**	**15,698,516**	**15,764,149**	**77,184,425**
AVG 2001-2010	**1,532,644**	**1,524,383**	**1,432,807**	**1,540,749**	**1,546,194**	**7,576,776**

TABLE 2-2-2 KYGER CREEK PLANT GENERATION STATISTICS, 2002 THROUGH 2010

GENERAL DESCRIPTION	2002	2003	2004	2005	2006	2007	2008	2009	2010
Plant Capacity (MW)	1086.3	1086.3	1086.3	1086.3	1086.3	1086.3	1086.3	1086.3	1086.3
Plant Capability (MW)	1070	1070	1070	1070	1070	1070	1070	1070	1070
Gross Generation MWhr	7,443,196	7,282,565	8,103,596	8,249,621	7,930,630	7,385,139	7,431,626	7,500,864	7,314,304
Station Use (MWhr)	591,077	548,277	578,529	592,142	590,924	574,641	586,048	591,175	575,501
Net Generation (MWhr)	6,852,119	6,734,288	7,525,067	7,657,479	7,339,706	6,810,498	6,845,578	6,909,689	6,738,803
Plant Load Factor (%)	74%	76%	81%	83%	80%	76%	76%	76%	73%
Plant Capacity Factor (%)	78%	77%	85%				76%	77%	75%
Plant Capability Factor (%)	73%	72%	80%	82%	78%	73%	73%	74%	72%
Coal Burned (Tons)	2,760,922	2,787,089	3,126,355	3,227,185	3,270,506	3,373,944	3,524,167	3,602,670	3,450,193
BTU/Pound Coal (BTU/lb)	12,451	12,057	11,858	11,762	11,283	10,271	9,871	9,847	10,123
BTU/KWHR Net Generation	10,042	9,993	9,837	9,876	10,061	10,184	10,171	10,277	10,375

TABLE 2-2-3 KYGER CREEK AVAILABILITY FACTOR (%)

YEAR	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	PLANT
2000	92.3	91.3	95.8	90.9	92.2	**92.5**
2001	92.4	89.3	85.8	92.0	87.0	**89.3**
2002	79.2	82.2	86.5	91.3	97.4	**87.3**
2003	90.0	98.5	81.8	83.8	84.6	**87.7**
2004	92.6	89.0	90.2	89.2	93.9	**91.0**
2005	90.0	91.0	88.8	89.2	93.1	**90.4**
2006	95.5	92.9	87.3	95.2	79.5	**90.1**
2007	85.2	82.5	89.1	87.3	90.7	**87.0**
2008	84.1	83.6	77.5	88.6	92.8	**85.3**
2009	83.6	79.3	84.9	86.6	87.4	**84.4**
2010	84.4	87.6	73.0	88.4	86.5	**84.0**
2011	89.2	92.0	91.9	96.0	100.0	**93.8**
AVERAGE 2000 TO 2010	**88.1**	**87.9**	**85.5**	**89.3**	**89.6**	**88.1**

2005 TO 2011 BASED ON MONTHLY AVERAGES & DIFFERENCES IN NUMBER OF DAYS IN EACH MONTH NOT ACCOUNTED FOR.

2011 DATA FOR JANUARY AND FEBRUARY ONLY AND NOT INCLUDED IN AVERAGES

TABLE 2-2-4 KYGER CREEK NET GENERATION CAPABILITY HISTORY

UNIT	ANNUAL AVERAGE ESTABLISHED CAPABILITY		ECAR 8 HOUR TEST, WINTER			WINTER AFTER ADJUSTMENT *	SUMMER LOW SIDE NET **	INTEGRATED AUXILIARY POWER
	2000	**2001**	**2003**	**2004**	**2005**	**2010**	**2010**	**2010**
1	212	214	220	219	217	208	199	17.1
2	206	204	211	210	215	207	198	16.9
3	207	206	206	205	207	209	201	15.7
4	205	202	206	207	214	207	199	16.1
5	208	209	204	206	207	208	199	15.9
PLANT TOTAL	**1038**	**1035**	**1047**	**1047**	**1060**	**1039**	**996**	**81.7**

* 2010 WINTER DATA BASED UPON SUMMER CAPABILITY TEST, ADJUSTED FOR AMBIENT CONDITIONS TO WINTER, MINUS INTEGRATED AUXILIARY POWER

** 2010 SUMMER LOW SIDE NET BASED UPON SUMMBER TEST, ADJUSTED FOR AMBIENT CONDTIONS, MINUS INTEGRATED AUXILIARY POWER

TABLE 2-2-5 KYGER CREEK EQUIVALENT FORCED OUTAGE RATES (%)						
YEAR	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	PLANT
2000	2.78	3.60	4.15	4.50	1.79	3.38
2001	5.41	2.77	4.81	10.70	3.61	5.24
2002	6.13	5.29	4.39	3.29	2.24	5.41
2003	5.38	1.07	7.09	3.89	1.82	3.81
2004	3.05	4.76	5.05	4.31	1.95	3.82
2005	5.76	4.65	5.36	5.42	2.84	4.80
2006	8.30	6.51	9.99	6.51	5.24	7.63
2007	8.01	13.20	8.25	11.84	5.57	9.52
2008	10.62	13.03	14.33	11.00	8.33	11.17
2009	11.73	10.41	10.41	5.03	3.86	8.43
2010	5.55	4.08	7.42	8.37	5.70	6.42
2011	10.96	8.89	2.45	1.14	1.35	4.96

NOTE: 2005 TO 2011 BASED ON MONTHLY AVERAGES & DIFFERENCES IN NUMBER OF DAYS IN EACH MONTH NOT ACCOUNTED FOR.
2011 DATA FOR JANUARY AND FEBRUARY ONLY.

TABLE 2-3-1 KYGER CREEK SUMMARY OF TOTAL CAPITAL AND MAINTENANCE EXPENDITURE & BUDGET, 2000 TO 2015

	EXPENDED DOLLARS KYGER CREEK											BUDGETED DOLLARS KYGER CREEK					$ 2000 - 2015	
CAPITAL	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL	AVG
Boiler Plant Equipment	565,229	7,871,375	696,577	182,943,726	10,514,791	2,436,271	44,088,580	749,473	3,105,675	2,259,254	19,570,565	13,488,382	20,827,782	16,605,950	12,763,000	3,415,000	341,901,630	21,368,852
Turbogenerator Units	2,402,603	-	200,310	171,495	-	1,182,204	5,636,469	5,420	3,625,720	-	272,655	-	-	666,380	667,895	667,895	15,499,046	1,033,270
Accessory Electric Equipment	-	-	-	426,564	-	162,197	402,301	-	-	-	-	-	-	-	-	-	991,062	61,941
Misc. Power Plant Equipment	715,958	621,728	65,587	132,970	829,970	763,724	855,597	418,919	379,230	1,182,602	599,873	2,769,675	3,214,200	350,550	-	28,350	12,928,933	808,058
FGD (Including Landfill)	-	-	-	-	-	5,394,757	44,729,752	139,511,758	232,044,189	114,483,843	39,952,821	75,968,211	5,295,332	-	-	-	657,380,663	41,086,291
TOTAL CAPITAL	**3,683,790**	**8,493,103**	**962,474**	**183,674,755**	**11,344,761**	**9,939,153**	**95,712,699**	**140,685,570**	**239,154,814**	**117,925,699**	**60,395,914**	**92,226,268**	**29,337,314**	**17,622,880**	**13,430,895**	**4,111,245**	**1,028,701,334**	**64,293,833**
MAINTENANCE																		
Boiler Plant	13,034,600	14,072,800	14,040,844	15,586,441	15,043,506	16,845,939	15,563,617	24,390,456	21,708,946	31,062,654	26,268,218	20,632,412	25,648,865	23,397,659	27,812,642	24,126,212	329,235,811	20,577,238
Electric Plant	4,467,136	3,458,050	2,324,209	4,512,419	4,877,436	2,524,754	4,050,676	4,023,597	3,497,431	4,480,768	5,892,269	4,734,668	5,447,238	3,232,887	4,917,324	2,772,718	65,213,580	4,075,849
Misc. Steam Plant	463,156	325,229	308,121	378,047	499,975	551,539	568,725	482,808	665,294	742,969	1,021,896	966,139	869,063	900,024	932,074	965,253	10,640,312	665,020
TOTAL MAINTENANCE	**17,964,892**	**17,856,079**	**16,673,174**	**20,476,907**	**20,420,917**	**19,922,232**	**20,183,018**	**28,896,861**	**25,871,671**	**36,286,391**	**33,182,383**	**26,333,219**	**31,965,166**	**27,530,570**	**33,662,040**	**27,864,183**	**405,089,703**	**25,318,106**

TABLE 3-2-1 CLIFTY CREEK PLANT GROSS POWER GENERATION SUMMARY

YEAR	GROSS GENERATION, MWh						
	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6	STATION
2001	1,221,000	1,381,000	1,272,500	1,424,100	1,407,000	1,324,000	8,029,600
2002	1,476,725	1,483,852	1,482,974	1,313,904	1,209,748	1,545,399	8,512,602
2003	1,294,662	1,255,895	1,080,526	1,378,849	1,537,026	1,265,466	7,812,424
2004	1,513,087	1,503,778	1,539,940	1,576,720	1,314,804	1,502,822	8,951,151
2005	1,575,289	1,427,723	1,716,439	1,703,168	1,640,730	1,613,955	9,677,304
2006	1,558,280	1,702,187	1,740,508	1,525,445	1,683,929	1,621,260	9,831,609
2007	1,144,617	1,636,833	1,456,827	1,457,919	1,645,857	1,614,321	8,956,374
2008	1,534,719	1,567,781	1,594,265	1,529,339	1,527,541	1,330,559	9,084,204
2009	1,638,349	1,687,486	1,236,664	1,537,558	1,509,066	1,428,245	9,037,368
2010	1,298,459	1,302,995	1,407,674	1,514,090	1,554,453	1,451,568	8,529,239
2011 Jan/Feb	296,409	301,476	285,581	282,517	267,864	290,730	1,724,577
TOTAL	**14,551,596**	**15,251,006**	**14,813,898**	**15,243,609**	**15,298,018**	**14,988,325**	**90,146,452**
AVG 2001-2010	**1,425,519**	**1,494,953**	**1,452,832**	**1,496,109**	**1,503,015**	**1,469,760**	**8,842,188**

TABLE 3-2-2 CLIFTY CREEK PLANT GENERATION STATISTICS, 2002 THROUGH 2010									
GENERAL DESCRIPTION	STATISTCS PER YEAR								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
Plant Capacity (MW)	1304	1304	1304	1304	1304	1304	1304	1304	1304
Plant Capability (MW)	1284	1284	1284	1284	1284	1284	1284	1284	1284
Gross Generation MWhr	7,443,196	7,282,565	8,951,151	9,677,304	9,831,609	8,956,374	9,084,204	9,037,368	8,529,239
Station Use (MWhr)	673,790	605,559	665,753	696,286	702,973	657,036	669,753	686,135	633,963
Net Generation (MWhr)	7,838,812	7,206,935	8,285,398	8,981,018	9,128,636	8,299,338	8,414,451	8,351,233	7,895,276
Plant Load Factor (%)	70%	67%	74%	77%	79%	73%	76%	77%	73%
Plant Capacity Factor (%)	75%	68%	78%				78%	78%	74%
Plant Capability Factor (%)	70%	64%	73%	80%	81%	74%	75%	74%	70%
Coal Burned (Tons)	4,110,104	3,878,511	4,489,319	4,504,229	4,681,037	4,270,090	4,344,759	4,352,443	4,046,018
BTU/Pound Coal (BTU/lb)	9,731	9,652	9,680	10,230	9,791	9,884	9,956	9,890	9,999
BTU/KWHR Net Generation	10,209	10,386	10,292	10,066	10,047	10,177	10,289	10,316	10,255

TABLE 3-2-3 CLIFTY CREEK AVAILABILITY FACTOR (%)

YEAR	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6	PLANT
2000	89.70	91.50	89.80	87.30	90.70	85.10	**89.02**
2001	81.00	89.00	86.00	92.50	90.80	87.70	**87.83**
2002	90.50	90.30	91.80	83.80	75.30	95.70	**87.90**
2003	76.80	79.10	65.50	85.70	94.40	81.70	**80.53**
2004	82.50	84.80	85.30	89.60	76.10	90.80	**84.85**
2005	84.22	74.49	91.70	90.20	87.09	87.92	**85.93**
2006	84.24	88.63	92.48	82.84	89.10	89.30	**87.77**
2007	64.24	88.08	81.51	86.52	90.43	90.02	**83.47**
2008	87.11	87.34	87.51	83.54	84.81	79.24	**84.93**
2009	93.71	95.64	71.36	86.05	86.97	88.40	**87.02**
2010	74.31	76.21	95.85	88.96	90.31	87.79	**85.57**
2011	93.87	100.00	85.09	93.20	89.19	100.00	**93.56**
AVERAGE 2000 TO 2010	**82.58**	**85.92**	**85.35**	**87.00**	**86.91**	**87.61**	**85.89**

2005 TO 2011 DATA BASED ON MONTHLY AVERAGES & DIFFERENCES IN NUMBER OF DAYS IN MONTH NOT ACCOUNTED FOR.

2011 DATA FOR JANUARY & FEBRUARY ONLY AND NOT INCLUDED IN AVERAGES.

TABLE 3-2-4 CLIFTY CREEK NET GENERATION CAPABILITY HISTORY

UNIT	ANNUAL AVERAGE ESTABLISHED CAPABILITY		ECAR 8 HOUR TEST, WINTER			WINTER AFTER ADJUSTMENT *	SUMMER LOW SIDE NET **	INTEGRATED AUXILIARY POWER
	2000	2001	2003	2004	2005	2010	2010	2010
1	208	208	216	218	223	213	207	16.9
2	209	203	209	214	211	210	204	16.7
3	205	199	213	213	216	211	204	16.7
4	205	203	218	218	217	208	202	16.6
5	215	212	220	215	213	208	201	16.4
6	204	204	201	213	211	218	211	16.2
PLANT TOTAL	**1246**	**1229**	**1277**	**1291**	**1291**	**1268**	**1229**	**99.5**

* 2010 WINTER DATA BASED UPON SUMMER CAPABILITY TEST, ADJUSTED FOR AMBIENT CONDITIONS TO WINTER, MINUS INTEGRATED AUXILIARY POWER

** 2010 SUMMER LOW SIDE NET BASED UPON SUMMBER TEST, ADJUSTED FOR AMBIENT CONDTIONS, MINUS INTEGRATED AUXILIARY POWER

TABLE 3-2-5 CLIFTY CREEK

EQUIVALENT FORCED OUTAGE RATES (%)

YEAR	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6	PLANT
2000	5.24	8.18	4.73	8.13	3.65	8.21	6.36
2001	4.84	5.10	10.91	3.74	3.99	6.55	5.86
2002	4.21	3.07	2.76	2.00	4.73	0.00	2.80
2003	10.51	7.70	19.87	3.20	4.85	5.64	8.63
2004	11.25	9.05	9.71	6.11	10.09	5.49	8.62
2005	13.05	4.98	3.83	7.14	7.06	3.27	6.56
2006	14.83	6.40	6.59	8.88	6.58	7.30	8.82
2007	10.00	5.46	17.54	10.74	7.87	4.64	9.54
2008	11.66	7.76	11.43	4.47	8.49	2.23	7.94
2009	7.75	5.34	7.95	6.59	7.67	7.52	6.87
2010	1.51	8.33	3.19	8.02	4.66	2.73	5.11
2011	1.01	0.29	6.22	5.53	3.95	0.28	2.88

2005 TO 2011 BASED ON MONTHLY AVERAGES & DIFFERENCES IN NUMBER OF DAYS IN MONTH NOT ACCOUNTED FOR.

TABLE 3-3-1 CLIFTY CREEK SUMMARY OF TOTAL CAPITAL AND MAINTENANCE EXPENDITURE & BUDGET, 2000 TO 2015

	EXPENDED DOLLARS CLIFTY CREEK											BUDGETED DOLLARS CLIFTY CREEK					$ 2000-2015	
CAPITAL	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL	AVERAGE
Boiler Plant Equipment	3,007,784	2,627,934	499,678	169,833,312	13,455,914	6,038,674	1,613,795	9,007,676	6,436,296	13,713,879	3,443,720	10,115,000	10,370,000	11,750,000	17,432,650	14,650,000	293,996,312	18,374,770
Turbogenerator Units	64,028	1,261,610	317,500	134,636	349,881	2,515,769	1,250,278	640,058	4,299,145	2,640,057	646,159	439,200	-	-	-	-	14,558,321	909,895
Accessory Electric Equipment	423,536	59,353	266,950	449,471	272,696	-	12,377	24,080	-	59,419	570,469	-	-	-	-	-	2,138,351	133,647
Misc. Power Plant Equipment	383,141	732,180	18,658	314,215	734,270	931,464	926,809	431,035	1,142,133	1,534,491	112,659	4,257,951	2,504,800	2,074,200	186,000	-	16,284,006	1,017,750
FGD (Including Landfill)	-	-	-	-	-	2,669,539	16,001,817	68,826,756	204,253,197	97,420,187	23,188,510	83,127,817	121,456,165	53,682,656	-	6,778,593	677,405,237	42,337,827
TOTAL CAPITAL	3,878,489	4,681,077	1,102,786	170,731,634	14,812,761	12,155,446	19,805,076	78,929,605	216,130,771	115,368,033	27,961,517	97,939,968	134,330,965	67,506,856	17,618,650	21,428,593	1,004,382,227	62,773,889
MAINTENANCE																		
Boiler Plant	11,216,023	11,606,076	13,562,099	16,275,026	17,897,669	19,865,856	19,505,638	28,534,552	30,652,463	33,393,319	32,070,258	37,814,762	35,735,004	34,403,381	31,714,335	33,578,721	407,825,182	25,489,074
Electric Plant	2,529,112	4,184,859	3,096,525	6,445,083	5,216,848	6,077,864	6,259,578	4,366,860	7,552,713	5,620,915	7,601,457	4,219,965	4,394,677	4,949,656	4,822,388	3,973,846	81,312,346	5,082,022
Misc. Steam Plant	709,251	608,421	900,778	848,734	808,071	780,996	880,577	895,334	851,408	970,204	1,283,267	1,179,430	1,105,705	1,141,375	1,178,043	1,214,913	15,356,507	959,782
TOTAL MAINTENANCE	14,454,386	16,399,356	17,559,402	23,568,843	23,922,588	26,724,716	26,645,793	33,796,746	39,056,584	39,984,438	40,954,982	43,214,157	41,235,386	40,494,412	37,714,766	38,767,480	504,494,035	31,530,877