Exhibit No.:	
Issues:	Fuel and Purchased Power
Witness:	David W. Elliott
Sponsoring Party:	MO PSC Staff
Type of Exhibit:	Direct Testimony
Case No.:	ER-2007-0004
Date Testimony Prepared:	January 18, 2007

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

DIRECT TESTIMONY

OF

DAVID W. ELLIOTT

AQUILA, INC.

D/B/A AQUILA NETWORKS-MPS

AND AQUILA NETWORKS-L&P

CASE NO. ER-2007-0004

Jefferson City, Missouri
January 2007

****Denotes Highly Confidential Information****

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BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the matter of Aquila, Inc. d/b/a Aquila Networks-MPS and Aquila Networks-L&P, for authority to file tariffs increasing electric rates for the service provided to customers in the Aquila Networks-MPS and Aquila Networks-L&P service areas.	))))))	Case No. ER-2007-0004

AFFIDAVIT OF DAVID W. ELLIOTT

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

David W. Elliott, of lawful age, on his oath states: that he has participated in the preparation of the following Direct Testimony in question and answer form, consisting of 12 pages of Direct Testimony to be presented in the above case, that the answers in the following Direct Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true to the best of his knowledge and belief.

David W. Elliott

Subscribed and sworn to before me this 17th day of January, 2007.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

SUSAN L. SUNDERMEYER
My Commission Expires
September 21, 2010
Callaway County
Commission #06942086

Susan L. Sundermeyer
Notary Public

My commission expires 9-21-10

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CASE NO. ER-2007-0004

Q. Please state your name and business address.

A. David W. Elliott, P.O. Box 360, Jefferson City, Missouri, 65102.

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

A. I am employed by the Missouri Public Service Commission (Commission) as a Utility Engineering Specialist in the Energy Department of the Utility Operations Division.

Q. Please describe your educational and work background.

A. I graduated from Iowa State University with a Bachelor of Science degree in Mechanical Engineering in May 1975. I was employed by Iowa-Illinois Gas and Electric Company (IIGE) as an engineer from July 1975 to May 1993. While at IIGE, I worked at Riverside Generating Station, first as an assistant to the maintenance engineer, and then as an engineer responsible for monitoring station performance. In 1982, I transferred to the Mechanical Design Division of the Engineering Department where I was an engineer responsible for various construction and maintenance projects at IIGE's power plants. In September 1993, I began my employment with the Commission.

Q. Have you previously filed testimony before the Commission?

A. Yes. Please refer to Schedule 1 for the list of cases I have filed in.

Q. What is the purpose of your testimony in this Aquila, Inc. rate case, Case No. ER-2007-0004?

A. The purpose of my testimony is to present the results of the Public Service Commission Staff's (Staff) production cost model simulations that were used to establish a reasonable level of annualized variable fuel and purchased power expense for Aquila, Inc. (Aquila) for the updated test year.

EXECUTIVE SUMMARY

Q. Please provide an executive summary of your testimony.

A. This testimony describes the modeling methods and inputs used to determine the variable fuel and purchased power costs necessary to meet the net system loads in this case. Inputs include such items as net system loads, fuel type, fuel prices, turbine-generator operating characteristics, and purchased power prices. Staff used the RealTime® production costs model, which Aquila also used. Staff used the same fuel allocation methodology used by Staff and Aquila in the last rate case, Case No. ER-2005-0436. The variable fuel and purchased power cost for electric is ** ___________ **.

FUEL AND PURCHASED POWER ANALYSIS

Q. What is a production cost model?

A. A production cost model estimates the cost to meet a utility's net system load. Staff's production cost model is a computer program used to perform an hour-by-hour, chronological simulation of a utility's generation and power purchases. The model simulates the way the company dispatches its generating units and schedules purchased power to meet the net system load in a least cost manner.

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Q. What is meant by an "hour-by-hour, chronological simulation" of a utility's generation and power purchases?

A. The production cost model used by Staff operates in a chronological fashion, meeting each hour's energy demand, or load, before moving to the next hour. It schedules purchased power, or dispatches generating units to serve the load in each hour in a least-cost manner based upon the fuel prices, unit availability and operating conditions, and the cost of purchased power.

Q. What production cost model did Staff use in this case?

A. Staff used the RealTime® production cost model developed by The Emelar Group. This is the same model used by Staff in all electric cases since 1995 that required a production cost model scenario.

Q. What production cost model does Aquila use?

A. Aquila also uses the RealTime® production cost model.

Q. To which of the Aquila's operations are you directing your testimony?

A. This testimony addresses the electric operations of Aquila in Missouri, Aquila Networks-MPS (MPS) and Aquila Networks-L&P (L&P).

Q. How are the MPS and the L&P systems modeled?

A. Because the generating units in both systems are dispatched to meet the combined systems load, or jointly dispatched, one model scenario dispatches all the units to meet the combined loads of MPS and L&P. In addition, in order to quantify the amount of the jointly dispatched costs to be allocated to each of the systems, the model has scenarios in which each system is independently dispatched. Finally, in order to determine the allocation of the L&P Lake Road Plant fuel costs to L&P's electric customers and to its industrial steam customers, the model has a steam scenario for dispatching the boilers at Lake Road Plant.

Q. How many different scenarios did you run?

A. I ran five different scenarios. One electric scenario for MPS on a stand-alone basis, one electric scenario for L&P on a stand-alone basis, one steam scenario for L&P electric stand-alone scenario, one electric scenario for the joint dispatch of a combined MPS and L&P operation, and one steam scenario for the joint dispatch electric scenario.

Q. Why did you run steam scenarios for an electric case?

A. The boilers at Lake Road Plant are on a common header system which supplies steam not only to three (3) turbines for the purpose of generating electricity, but also to L&P's industrial steam customers. As a result, the cost of steam to produce electricity and the cost of steam for sale are interrelated, and therefore it is necessary to run both electric and steam scenarios. A brief description of the boilers and common header system at Lake Road Plant that serves three turbine generators and the industrial steam customers is found in Schedule 6.

Q. Why was it necessary to model two steam scenarios?

A. Both steam scenarios were necessary because the cost of operation of the L&P electric system varies based on the cost of operation of the L&P steam system. The Lake Road Plant costs in the joint electric dispatch with steam sales would be different than in the stand-alone L&P electric dispatch scenario with steam sales.

Q. Why did you run stand-alone electric scenarios?

A. I needed results of the stand-alone electric scenarios in order to allocate the annualized fuel and purchased power costs of the joint scenario back to the two divisions, L&P and MPS. Schedule 2 attached to my testimony, shows the allocation method for fuel and purchased power costs. Schedule 4 shows the allocated costs.

Q. What is meant by joint dispatch?

A. Joint dispatch in this case refers to the fact that Aquila dispatches both its MPS units and its L&P units to meet the combined net system load of MPS and L&P. This allows the units in one division to be used to help meet load in the other division when otherwise that division would run a more expensive unit, or purchase higher priced power to meet load.

Q. What plant does Aquila use to produce steam?

A. Aquila uses five boilers at the L&P Lake Road Plant to produce steam for three turbine-generators (Lake Road Units 1, 2, and 3) to generate electricity, and for sale to steam customers. (See diagram in Schedule 6-2).

Q. How did Staff determine fuel costs for Lake Road Units 1, 2, and 3?

A. Staff ran a production cost model steam scenario using only the boilers at Lake Road Plant, or steam scenario. Inputs to this model steam scenario were the hourly steam load of L&P steam customers, and calculated amounts of steam used for electric generation by Lake Road turbine-generators 1, 2, and 3.

Q. What were the sources of the input data used in the model?

A. The sources of the input data used in the model are listed in Schedule 3.

Q. What is purchased power?

A. Purchased power is the hourly energy that is purchased in the market place from other electric suppliers in order to help meet the load of the electric utility company. For the model, the cost of purchased energy is necessary for modeling dispatching. Any fixed, or demand charge associated with a purchase is not accounted for in the model simulation.

Q. Does Aquila purchase energy to serve native load?

A. Yes. Aquila purchases energy from other sources during times of plant forced or planned outages and during times when it is more economical to purchase energy rather than generate energy.

Q. What were the sources of data used to calculate purchased power prices and to determine the amount of energy available?

A. The data used to calculate purchased power prices and to determine the amount of energy available was submitted to Staff by Aquila, as required by Commission Rule 4 CSR 240-3.190 (3.190 data).

Q. What different types of purchased power were used in the production cost model?

A. Two types of purchased power were used in the production cost model: capacity contract purchases, and spot purchased energy.

Q. Please explain what is meant by capacity contract purchases.

A. Capacity contract purchases are energy purchases made under firm capacity contracts. Typically under these contracts, the purchaser pays a variable cost for the amount of megawatt-hours (MWh) that is actually being purchased in any given hour, and also a fixed cost for the ability to receive a maximum number of megawatts (MW) per hour. The purchasing company can obtain any quantity of hourly energy up to the maximum amount shown in the capacity contract. As noted earlier, only the energy purchases are included in the modeling process.

Q. What capacity contract purchases were used in the production cost model?

A. The capacity contract purchases I used in the production cost model are the Nebraska Public Power District Gentlemen Purchase (NPPD), Gray County Wind Energy LLP Purchase (Wind), and Nebraska Public Power District Cooper Purchase (Cooper) contracts. These are firm, long term, contracts that Aquila has entered into with each of these entities.

Q. How did you calculate the hourly energy prices for each capacity contract?

A. I used historical prices for energy obtained from 3.190 data for the NPPD, and the Wind contracts. The prices were the same for each hour of the year regardless of amount of energy purchased up to the contract maximum. The Cooper capacity contract is a unit participation purchase; i.e., the energy output is tied to a specific unit. Therefore, Staff models the Cooper capacity contract as a unit in the production cost model which will take into effect the outages.

Q. How did you determine the hourly amount of capacity for each capacity contract?

A. I used the contract amount of capacity for the Cooper and NPPD contracts. For the Wind capacity contract I used historical hourly generation data.

Q. What is spot energy?

A. Spot energy is energy purchased on an hourly basis rather than through a longer-term contract. The purchasing company decides to buy spot energy from one or more suppliers based on the economics and availability of its generating units and capacity purchases. Purchases of spot energy are made in order to lower costs when the spot market price is below both the marginal cost of providing that energy from the company's generating units and the cost of capacity purchases. Since the spot market depends on energy supply and demand, the prices tend to be much more volatile than capacity purchases.

Q. What methodology did you use to determine the spot energy prices?

A. I used a procedure developed by the Commission's Energy Department-Engineering Section in 1996. It is described in the document entitled A Methodology to Calculate Representative Prices for Purchased Energy in the Spot Market. The method uses a statistical calculation based on the truncated normal distribution curve to represent the hourly purchased power prices in the spot market. Aquila's actual hourly non-contract transaction prices, obtained from Aquila's 3.190 data from January 2005 through September 2006 are used as price inputs in the calculation. The calculation yields an hourly spot energy price for each hour of the year.

Q. How did you determine the amount of spot purchased energy available?

A. I limited the hourly spot purchased energy available to the maximum that was actually purchased in the same hour across all days of each particular month as shown by the 3.190 data. For example, the maximum amount of allowed MW to be purchased in the model for the hour of 1:00 pm until 2:00 pm in October was the maximum amount actually purchased by Aquila in October 2005 between the hours of 1:00 pm and 2:00 pm, regardless of what day the purchase occurred.

First the spot energy available for each stand-alone case (i.e., for MPS and for L&P separately) was determined. The amount of spot energy available for MPS was then added to the corresponding amount for L&P to produce a combined amount of spot energy available for the joint dispatch scenario. This combined amount was input into Staff's production cost model to calculate the amount of spot energy purchased to meet load in a least cost manner.

Q. Is there any other type of purchases?

A. Yes. Emergency energy is energy purchased on a short-term hourly basis when energy is needed to meet load irrespective of economic considerations, such as when large a unit goes off line unexpectedly, multiple units go off line, or the utility experiences transmission problems. In these rare emergency instances, the price of energy would likely be considerably higher than spot, as it is purchased only when other resources become unavailable.

Q. How did you account for emergency energy cost?

A. I multiplied the number of estimated megawatt-hours the model could not meet load by $500/MWhr. This high price reflects the rare instances when emergency energy would be purchased after all generating resources and other purchases were exhausted. Only the L&P stand-alone scenario required emergency purchases

Q. What unit heat rates did Staff use in the model?

A. Staff used heat rates supplied by Aquila for this case.

Q. What is a heat rate?

A. A heat rate is the amount of energy (MMBTUs) from fuel required to produce one kilowatt-hour (kWh).

Q. What types of unit outages are used in the model?

A. There are two types of unit outages used in the model. Maintenance outages are those times when the unit is scheduled to be off line in order to perform maintenance on the unit. Forced outages are those times when the unit is forced off line because of a failure or because it is in need of immediate repairs.

Q. How did Staff develop its model inputs for maintenance outages?

A. Staff calculated maintenance outage hours for every unit based on the eight years of data on actual maintenance outages supplied by Aquila. These maintenance hours represent hours for both major and normal annual outages. These hours are entered into the model at specific times during the year, usually during the fall and spring, which are typical outage times.

Q. What forced outage hours did Staff use in the model?

A. Staff used the same eight years of outage data supplied by Aquila and developed an average forced outage factor (forced outage hours/8760) for each unit. These outage factors are entered into the model for each unit to allow the model to determine the annual number of outage hours. Because forced outages can occur at any time, the model uses a statistical sampling method to determine when the outages will occur.

Q. How did Staff determine unit capacities used in the model?

A. Staff reviewed Aquila's 3.190 data for 2005 to determine maximum unit capacities.

Q. For Staff's model, did you include any generic generating units?

A. Yes. Because Staff's position in the last case was that Aquila should have installed generating capacity to replace the expiring Aries capacity contract, I used five generic combustion turbines in the model. For further discussions, please refer to the direct testimony of Staff Witnesses Charles R. Hyneman and Lena M. Mantle.

Q. Did you perform any fuel cost analysis outside of the model?

A. Yes. I calculated a cost for banking boilers 3, and 4 at Lake Road Plant and I calculated a cost for using gas for flame stabilization in Boiler 5 at Lake Road.

Q. Please describe what banking is.

A. A boiler is banked by keeping it at a temperature of several hundred degrees when not producing steam. This allows the boiler to be brought on line to produce steam in a relatively short period of time should the need arise. Typically a boiler is banked when there are several boilers on a header system providing steam, and reliability is an important issue. One boiler may be operating and providing the steam needed and a second boiler may be banked as a standby. If the first boiler is unable to respond to the increase in steam needed or it goes off line, the banked boiler can be brought up to operating pressure and temperature quickly.

Q. Please describe what flame stabilization is.

A. A boiler burning coal may have an unstable coal flame if it is operating at a low load, if abnormally wet coal is being burned due to heavy rains, or if coal of widely varying quality is being burned. When such conditions occur, the operation may require burning natural gas in order to stabilize the flame in the boiler. Furthermore, a coal flame that extinguishes while the boiler is on line creates both operational problems and a potentially dangerous explosive condition. Gas is burned to avoid this unsafe condition.

Q. How were both of these costs calculated?

A. I used the spreadsheet developed and used by Aquila for the allocation process (See Schedule 5). This spreadsheet used results of the model steam scenario to determine when boilers were banked and the amount of gas used daily for these boilers while banked. The spreadsheet also calculated the fuel used for boiler flame stabilization. These amounts are multiplied by the price of gas to determine the costs.

Q. What Lake Road Plant boiler data did Staff use in the steam model?

A. Staff used the data furnished by Aquila. See Schedule 3 for list of data requests.

Q. Are there additional calculations performed in conjunction with the production model?

A. Yes. Several spreadsheet calculations are done as part of the process to determine Lake Road Plant fuel costs for the electric and steam customers.

Q. Have you prepared a description of the procedure to help explain the process of determining the fuel costs?

A. Yes. Schedule 5 outlines the allocation process and identifies the spreadsheets used to calculate the allocated fuel costs. These spreadsheets were created to calculate the Lake Road Plant fuel allocations in accordance with allocation procedures filed in Case No. EO-94-36, and was required to be used by Order of the Commission.

Q. Please briefly summarize the results of the production cost model simulations.

A. The results of the production cost model simulation runs are shown in Schedule 4. The annual cost of fuel and purchased power for the joint electric dispatch of MPS and L&P is ** ____________ **. This amount was supplied to Staff witness Charles R. Hyneman. For further discussion of how Staff annualized the overall fuel expense in this case, please refer to the direct testimony of Mr. Hyneman.

Q. Does this conclude your direct testimony?

A. Yes, it does.

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Previous Testimony of
David W. Elliott

1) ER-94-163, St. Joseph Light & Power Co.
2) HR-94-177, St. Joseph Light & Power Co.
3) ER-94-174, The Empire District Electric Co.
4) ER-95-279, The Empire District Electric Co.
5) EM-96-149, Union Electric Co.
6) ER-99-247, St. Joseph Light & Power Co.
7) EM-2000-369, UtiliCorp United, Inc. and The Empire District Electric Co.
8) ER-2001-299, The Empire District Electric Co.
9) ER-2001-672, Utilicorp United, Inc.
10) ER-2002-424, The Empire District Electric Co.
11) ER-2004-0034, Aquila, Inc.
12) ER-2004-0570, The Empire District Electric Co.
13) HM-2004-01618, Trigen-Kansas City Energy Corp. and Thermal North America, Inc.
14) ER-2005-0436, Aquila, Inc.
15) HR-2005-0450, Aquila, Inc.
16) ER-2006-0315, The Empire District Electric Co.
17) ER-2006-0314, Kansas City Power & Light Co.

Allocation of Electric Fuel Expenses

A = Fuel and purchase power expenses for Aquila

B = Fuel and purchased power expenses for L&P stand-alone

C = Fuel and purchased power expenses for MPS stand-alone

D = Fuel and purchased power expenses of Aquila allocated to L&P

E= Fuel and purchased power expenses of Aquila allocated to MPS

Allocation formula:

$$D = A \times (B / (B + C))$$

$$E = A \times (C / (B + C))$$

Schedule 2

INPUT DATA SOURCES FOR
REALTIME PRODUCTION COST MODEL

INPUT	SOURCE
Heat Rate Curves	Aquila's response to Staff Data Requests No. 34 in ER-2006-0004.
Forced Outage Hours	Aquila's responses to Staff Data Request No. 64 in ER-2006-0004.
Maintenance Hours	Aquila's responses to Staff Data Requests No. 64 in ER-2006-0004.
Purchased Power Prices & Energy	Aquila’s monthly data provided per 4 CSR 240-3.190
Hourly Net System Loads	Staff Witness Shawn Lange
Fuel prices	Staff Witness Charles R. Hyneman
Unit Specific Data	Aquila's response to Staff Data Request No 34 in ER-2006-0004.
Steam sales	Staff Witness Shawn Lange

Schedule 3

Schedule 4

Is Deemed

Highly Confidential

In Its Entirety

<u>Lake Road 900 lb Steam System Allocation of Fuel Costs</u>
<u>Staff Procedure</u>

1. The electric scenario is run to meet the hourly electric loads.
2. This scenario produces the costs of dispatching all the units needed to meet the net system load. A specific report from this scenario identifies the hourly electric generation for Lake Road Turbines 1, 2, and 3, which are connected to the 900 lb steam header system.
3. An Excel spreadsheet (Stmoutin) is then used to calculate the hourly amount of steam in mmBTUs required for the Lake Road Turbines 1, 2, and 3 to generate these hourly electric loads. This calculation uses the turbine heat rate curves to determine the amount of mmBTUs.
4. The hourly steam mmBTU requirements needed for Lake Road Turbines 1, 2, and 3 are added to the hourly steam mmBTU load requirements of the L&P steam customers.
5. The steam scenario is run to meet the hourly steam loads and calculates the fuel costs for boilers to produce the steam.
6. This scenario produces the costs of the fuel used by the five boilers generate the steam required for the Lake Road Turbines 1, 2, and 3, and the industrial steam customers. Several reports from this scenario break this fuel usage into daily amounts, by boiler, and by fuel type.
7. An Excel spreadsheet (ALOC) is used to allocate the daily fuel cost between the Lake Road Turbines 1, 2, and 3, and the steam customers.
8. The annual fuel costs for Lake Road Turbines 1, 2, and 3 are added to the fuel cost of the other units to determine total fuel costs for the electric customers.
9. The annual fuel cost for the steam customers is determined in the spreadsheet ALLOC.

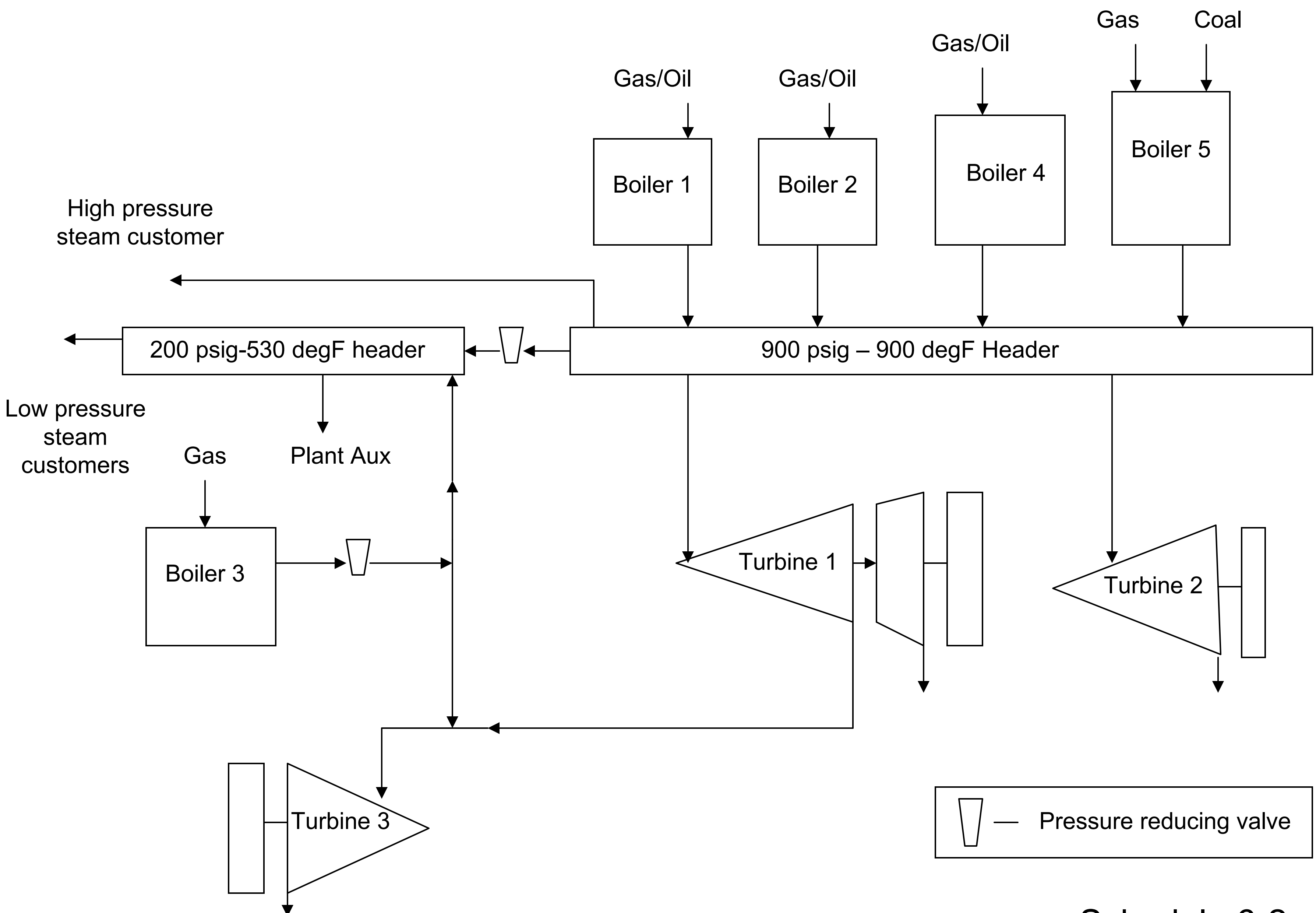
Lake Road Plant 900 Lb Steam System

Lake Road Plant 900 lb steam system consists of five boilers (Boiler 1, 2, 3, 4 and 5) connected to a steam header system, which supplies steam to both the industrial steam customers and the Lake Road turbines 1, 2, and 3 (see schedule 6-2)to produce electricity. Boilers 1 through 4 burn natural gas while Boiler 5 can both natural gas and coal. Boilers 1, 2, 4, and 5 all produce steam at 900 pounds per square inch gauge (psig), while Boiler 3 produces steam at 685 psig. Turbines 1 and 2 require steam at 900 psig and Turbine 3 requires steam at 200 psig. Turbine 1 is an extraction type turbine with an extraction point at 200 psig.

One of the industrial steam customers takes steam at 850 psig while the remaining industrial steam customers take steam at 150 psig. Steam is produced at a higher pressure than the customer requirements in order to compensate for any reduction in pressure due to friction in the transportation piping system from the plant to the customers.

There are two header systems, one at 900 psig and one at 200 psig. The two headers are tied together through a pressure reducing valve that allows steam at 900 psig to flow into the 200 psig header. This way all the 900 psig steam boilers can supply steam to the industrial steam customers at either pressure and can also supply steam to all the turbines. Boiler 3 with the pressure reducing valve can only supply steam to the low pressure industrial steam customers and turbine 3.

Turbine 1 is an extraction type turbine which allows a certain amount of steam to be removed from a certain point in the turbine at a specific pressure, which in this case is 200 psig. This reduces the amount of steam passing through the remaining blade sections of the turbine which affects the overall amount of electricity generated. The energy in the steam before it is extracted is used to rotate the turbine to produce electricity. An extraction turbine can be used to generate electricity while producing available steam at a reduced pressure instead of merely reducing the steam pressure by a pressure reducing valve.



Schedule 6-2

Lake Road Plant 900 Lb System