



Coal Combustion Inc.
Understanding the business of coal

Changing Fuel Specifications for Improved Fuel Cost and Flexibility

by

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Abstract

This paper will describe the goals, methods and results of a program initiated by Delmarva Power & Light (DP&L), to expand their coal specifications. The ability to expand coal specs can provide many advantages to a power company. These would include increased flexibility and potentially lower fuel cost. In this instance, the expansion of transportation modes also enhanced the scenario. Although brief, this paper should provide a good understanding of the types of problems that can be encountered, and the cooperative effort necessary to resolve them.

Introduction

Delmarva Power & Light owns and operates two coal-fired electric generating stations with six total units. The Edge Moor Station has two units and Indian River has four. This paper will center on the Indian River Power Station's Units 1-3, which all use the same fuel. Unit 4 is a low sulfur compliance coal unit and is not included in this paper although it is part of the coal specification program. Units 1&2 are 80 megawatt (mw) Babcock & Wilcox (B&W) front wall-fired boilers built in the late 1950's. Unit 3 is a 160 mw B&W wall-fired boiler built in the mid 1960's. These units are equipped with EL type pulverizers and original type burners. The electrostatic precipitators are four field cold-side with medium specific collection area. Coal is delivered by rail and unloaded using a rotary car dumper.

Goals

A goal of any progressive fuel supply department should be to expand the number of coal mines actively responding to bids. This not only increases competition between mines but can add competition in transportation. In many cases, restrictive coal specifications limit bid participation to a few mines and can influence delivered coal prices. Expanding coal specifications to increase the number of mines participating in bid solicitations was the primary goal. Large regions of potentially attractive coals were excluded by the standard bid specification. Those characteristics that excluded these coals were thoroughly investigated. The Fuel Supply Dept. would then have an opportunity to use the market implications of expanded supply to lower fuel cost, and increase flexibility.

Methods Used to Alter Coal Specifications

Although the coal market today can still be characterized as a "buyers" market, the future is uncertain. Delmarva Power & Light felt that restrictive coal quality specifications would exert upward pressure on delivered coal cost regardless of market conditions, but even more so if a "sellers" market evolves. In response to the coal quality issues, DP&L has had a program in place since 1987 to review restrictive coal specifications and make recommendations on new specifications. This "Coal Quality Review Task Force" includes representatives from Fuel Supply, Plant Operations, and Production Staff. Communications and common goals are stressed, as is understanding of coal technology.

Initially, coal quality models were used to explore the impacts of changing quality parameters. After investigating several models, it was felt that using plant data to determine coal quality limits was the preferred method. Initially calculated information was used for adjustments of coal specifications. Test burns and experience are then used to qualify these alternative specs. These new specifications are included as optional or alternate, along with the standard spec. in bid solicitations.

Coal-fired power plants are complex systems consisting of many interconnected components. For convenience, when studying coal quality impacts on equipment,

the following components were grouped together:

- Pulverizers
- Fans
- Ash Handling
- Steam Generator
- Particulate Removal Systems
- Air Preheaters

Five generalized types of impacts can occur for each of these equipment groups:

- Capacity
- Availability
- Heat Rate
- Maintenance
- Associated Operating Costs

The main thrust of the work performed by DP&L was in the capacity impact area. It was felt that the engineering procedures were well developed for evaluating the capacity of the equipment components shown above.

Unfortunately, there are no straight forward universally agreed upon functional relationships between either maintenance cost, or availability and coal quality characteristics. There are several programs available for determining the coal quality impacts on efficiency. These are useful when conducting test burns. Considering the magnitude of maintenance and operational impacts on efficiency, it was felt that these would mask any efficiency impacts that coal quality produces. Therefore, the Fuel Supply Dept. does not use these programs to project coal quality impacts on efficiency or cost.

One area under Associated Operating Costs that can readily be used in coal evaluations is the cost of ash disposal. Power plant operators are well aware of their ash disposal costs. These disposal costs can be converted to coal price and are typically in the range of \$0.05 to \$0.15 per % ash per ton of coal.

Design Specifications

The Indian River units were originally designed to burn high volatile bituminous coal with the following specifications shown in Table I.

Table I
Design Specifications

		Unit 1,2	Unit 3
Moisture %	(Max)	6.0	5.0
Ash %	(Max)	10.0	10.0
Volatile %	(Min)	38.0	38.0
Sulfur %	(Max)	3.1	3.0
Btu/lb	(Min)	13,150	12,800
Grindability HGI	(Min)	60	50
Ash Fusion Deg. F.	(Min)	2000	2000

1987 Bid Specs

The coal quality specifications used to buy coal for these units had evolved over time. Operational experience, plant modifications and environmental considerations had resulted in the specifications being altered by 1987 to those shown in Table II.

Table II
1987 Bid Specs

		Unit 1,2 and Unit 3
Moisture %	(Max)	7.0
Ash %	(Max)	12.0
Volatile %	(Min)	22.0
Sulfur %	(Max)	2.0
Btu/lb	(Min)	12,000
Grindability HGI	(Min)	70
Ash Fusion Deg. F.	(Min)	2250

Sizing specifications were also added due to wet coal handling problems.

5% > 2"	Max
40% > 1/4"	Min
85% > 30Mesh	Min

As shown, the majority of specifications had become less restrictive except for the HGI, sizing and the ash fusion temperatures. The HGI minimum of 70 was particularly restrictive.

Changing HGI Specification

To address the HGI limitation, calculations were performed that related the heating value of the coal to the HGI. These calculations were derived from the Babcock & Wilcox "Steam" book (1) and the Electric Power Research Institute's (EPRI) Project 2256-1 Final Report (2). The results of these calculations are shown below in Table III. They included a ten percent margin to account for pulverizer wear.

Table III
Calculated Btu/lb vs. HGI Relationship

Btu/lb (Min)	HGI (Min)
14,950	50
13,650	55
12,650	60
12,100	65
11,400	70

A test burn was conducted that allowed the standard bid HGI to be reduced to 60 at 12,500 Btu/lb. Test burns of other coals allowed for a better refinement of the relationship between heating value and HGI. The results of these refinements are shown in Table IV. The present day standard bid spec. is 60 HGI at 12,500 Btu/lb with alternative bids (subject to DP&L tests and approval) being accepted using the Table IV guidelines.

Table IV
1994 Alternative Bid Specifications
(Subject to DP&L tests and approval)

Btu/lb (Min)	HGI (Min)
13,500	52
13,000	52
12,500	60
12,000	65
11,500	70

Changing Moisture Specification

Moisture specifications can be set for a variety of reasons: coal handling, mill capacity and boiler efficiency are all affected by moisture levels. The handling properties of coal can vary drastically with surface moisture; dusty when low and causing pluggages when high. Unfortunately, it is not possible to specify a general moisture range that will avoid problems on all coals. Even coals from the same region can behave differently at similar moisture levels. It is best to evaluate individual coals on the actual plant equipment to characterize the handling.

Efficiency changes associated with differing moisture levels does not generally impact the capacity of plant equipment. The surface moisture level of a coal does impact the drying capacity of the pulverizer. The amount of hot air that a unit can deliver to a pulverizer is often limited. Typically it is the amount of hot air supply that limits the moisture level. The drying capacity may be limited by the mill outlet temperature if the coal has a medium to low rank. By performing a heat balance, around the mill, estimates can be made of the maximum surface moisture level. (2) The surface moisture was converted to total moisture by adding two percent inherent moisture. This was performed and then related to a heating value that changed the air to coal ratio. Higher Btu/lb coal requires fewer pounds of coal, therefore increasing the air to coal ratio. The corresponding heating value raised the air to coal ratio enough to allow sufficient drying, which provided the basis for raising the moisture specs. The results of these calculations are shown in Table V, and represent the 1994 Alternative Moisture Bid Specifications.

Table V
1994 Alternative Bid Specification

Btu/lb (Min)	Moist. % (Max)
13,500	8.9
13,000	8.5
12,500	8.0
12,000	7.7
11,500	7.3

As with all alternative bids DP&L reserves the right to test burn the coal to ensure expected performance.

Changing Ash Specification

Plant capacity is directly affected by the ash removal capacity of the electrostatic precipitators (ESP) and the ash handling system. Calculations indicated that the ash handling system was the more restrictive in its capacity than the ESPs. Using the ash systems capacity and the heat input to the units, a maximum ash level per heating value was determined. These values were two to four percent higher than the 1987 specification of twelve percent. High ash levels had not been handled by the plants previously, resulting in an arbitrary one percent reduction in ash specs. across the range. These reduced ash values were incorporated into the 1994 Alternative Ash Bid Specification, shown in Table VI.

Table VI
1994 Alternative Ash Bid Specification

Btu/lb (Min)	Ash % (Max)
13,500	15.3
13,000	14.7
12,500	14.1
12,000	13.5
11,500	12.9

As with the other Alternative Bid Specs DP&L may require a test burn to confirm plant operational capability.

Changing Volatile Specification

Experience had lowered the volatile specification from 38.0% to 22.0% from the late 1950's to 1987. Several coals that appeared attractive due to their sulfur level and location had volatile contents less than 22.0%. Several groups including consultants for the Pennsylvania Energy Development Authority presented information on the use of coals in the 16.0 to 22.0% range. A test burn in 1990 indicated that although the coal burned satisfactory, the handling characteristics were a problem. The moisture was low and considerable dusting resulted with the 90 HGI coal. Tests in 1993 at higher moisture levels indicated that pluggage problems can occur. The coal company responded by altering their preparation plant circuit to reduce the amount of fine coal delivered to DP&L. This cooperation with the coal company to solve plant operational problems has resulted in the 1994 Alternative Volatile Bid Specification being lowered to 17.0%.

Changing Size Specifications

The sizing specifications were relaxed by correlating handling experience with actual sizing samples. It was observed that coals with finer sizing were being used with no apparent problems. Table VII shows the 1987 vs. the 1994 Bid Sizing Specifications.

Table VII
Sizing Bid Specifications

1987 Spec.		1994 Spec.	
5% > 2"	Max	5% > 2"	Max
40% > 1/4"	Min	30% > 1/4"	Min
85% > 30Mesh	Min	80% > 30Mesh	Min

Even today these sizing specifications are being tested, as are all of Delmavra Power & Lights coal specifications. The process is in constant motion as new coals are evaluated and qualified.

Results of Expanding Bid Specifications

The results of the work that Delmarva Power & Light has undertaken can be summarized briefly: The lowest one third of the bids received in the latest solicitation were bid using the Alternative Specifications in one form or another. This response from the coal industry indicates that there are advantages to relaxing bid specifications. DP&L feels confident in their actions, as plant experience is the primary basis for changing the coal quality specifications.

References

1. "STEAM its generation and use" Babcock & Wilcox, Edited by S.C. Stultz and J.B. Kitto, 1992, Library of Congress Catalog Number 92-074123.
2. "Effects of Coal Quality on Power Plant Performance and Cost" EPRI CS-4283, Vol. 2, Review of Coal Quality Impact Evaluation Procedures, Project 2256-1, Final Report, February 1986.