GANNON STATION UNITS 1-4 CONVERSION

Public Workshop

September 3, 1980

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My name is William N. Cantrell and I am employed by Tampa Electric Company as a senior engineer in the Environmental Planning Department.

Tampa Electric Company (TECO) is an investor-owned public utility with a service area of approximately 1900 square miles consisting of close to 300,000 customers primarily in Hillsborough, Polk and Pasco Counties.

TECO owns and operates the Francis J. Gannon Generating Station, which is located at Port Sutton where McKay Bay joins Hillsborough Bay. The generating station is comprised of six generating units commencing commercial operation between 1957 and 1967. Units 1-4 currently burn low sulfur Number 6 fuel oil and Units 5 and 6 currently burn low sulfur coal.

Gannon Units 1-4 were designed for and originally burned coal. TECO has continuously evaluated the economic feasibility of reconverting these units to coal-firing. In late 1979 the Company determined that conversion to low-sulfur coal would result in a net economic gain over remaining on low sulfur oil.

In addition, since the units were technically capable of accommodating coal, they were likely candidates for the issuance of prohibition orders under the Powerplant and Industrial Fuel Use Act of 1978.

The Company began investigations into how the conversion would fit into the state and federal environmental regulatory structure. It was determined that electrostatic precipitators could be added to each unit to meet the particulate emission limit of 0.1 lbs. per million BTU.

Sulfur dioxide emission limitations were more complex. There is an SO_2 emission limit for the units while burning oil, but it was not readily apparent what the applicable SO_2 limit should be while burning coal. There are only two basic ways to meet the existing SO_2 emission limitation on Units 1-4 while burning coal. One of these is by the use of flue gas desulfurization (FGD) systems. The use of FGD could prevent an increase in sulfur dioxide emissions but at a cost that makes the conversion economically unjustifiable. For example, conversion utilizing FGD, if practical, would result in a capital cost of $328 million and an increase in annual revenue requirements totaling approximately $300 million over the next 20 years. In addition to the cost consideration, there is not sufficient physical space at the site to construct, operate, and maintain the FGD equipment in addition to the particulate control equipment already planned and required. The other alternative is by the use of a low sulfur coal. Because all six units have wet bottom slag tap boilers, a coal has to be utilized which has a low melting point ash and more importantly, that the ash when melted has low viscosity. Most of the low sulfur coals in this country do not meet these two important characteristics. After great difficulty, Tampa Electric Company developed operational modifications that allowed the burning of a low sulfur (nominally 1.3%) coal in Units 5 and 6. The utilization of this coal in Units 1-4 is feasible, and with the use of the proposed limitations would result in no increase above present emission levels.

The use of this low sulfur coal combined with new electrostatic precipitators seems to be the only economical and environmentally acceptable approach to effecting the conversion. Specifically, the reconversion capital cost is estimated at $83 million and there will be a net savings of approximately $134 million over the next 20 years. Accordingly TECO petitioned the Florida Environmental Regulation Commission (ERC) in February 1980 to amend certain portions of state environmental rules to agree with counterpart Federal rules in which a conversion of this type is subject to a streamlined review procedure. The ERC authorized the Department of Environmental Regulation (DER) to work with TECO on the subject petition.

The DER urged TECO to look for alternative conversion proposals which would result in no net increase in emissions of SO_2.

The Company has studied a number of various fuel combinations. Assuming that gas and oil have lower sulfur dioxide emission rates than coal, then the partial use of gas or oil with coal would result in proportionately lower emissions. The first alternative studied is to convert the units to have a dual capability to be operated either with coal or oil. It is possible to fire coal with oil as a backup fuel. However, the backup capability would be only for short-term firing and every time a switch was made to oil firing, the unit would have to be shut down for a thorough cleaning of the ash particles from the cyclone to minimize erosion problems. Since the oil firing would be for short periods only, there would be only minimal benefits to long-term emissions.

The second alternative is to convert the units to be operated either with coal or gas. This alternative is also possible but is subject to the same limitations as the coal or oil alternative. The boiler manufacturer also advises that the units might have to be derated when firing gas. There would have to be extensive study of cyclone instability and burner pulsation problems as well.

The third alternative is the firing of coal-oil mixtures. To date there has been no industry experience firing coal-oil mixtures in a cyclone furnace. A lengthy and costly development program would have to be undertaken to prove the feasibility and to develop reliable firing techniques in a cyclone boiler.

The fourth alternative is the firing of coal-gas mixtures. There is no industry experience at all with this firing technique and so testing would have to go through model and pilot plant stages, another costly and lengthy process.

The fifth alternative is the separate but simultaneous firing of coal with oil or gas. The boiler manufacturer has technically ruled out the simultaneous firing of coal and oil or coal and gas in a cyclone boiler with a common windbox due to the problems expected in controlling the firing rate and combustion air simultaneously for the widely divergent fuels.

In addition to the unattractiveness or infeasibility of the aforementioned alternatives, it should be noted that the purpose of a prohibition order under the Fuel Use Act is to cease the use of oil and gas and that the use of any of these options would be difficult to get granted. This applies to what might be a sixth alternative--that of converting only one, two, or three of the four affected units to coal. This would mitigate the sulfur dioxide emissions proportionally but would also mitigate the economic savings proportionally.

The proposal to convert all four units to low sulfur coal still appears to be the only economically and environmentally acceptable alternative. To satisfy the request that the conversion proposal result in no net increase in SO_2 emissions, TECO modified its proposal to incorporate the use of a "cap" or bubble on Gannon Station. Under this proposal there would continue to be individual unit emission limitations, but there would also be a station limitation, identical to the sum of the current unit limitations. This would ensure that allowable SO_2 emissions would not increase as a result of the conversion.

In addition to allowable emissions, an attempt has been made to predict what actual emissions will be in future years under this proposal. Actual emissions of sulfur dioxide vary from year to year and depend entirely on two factors: emission rate (and therefore sulfur content) and production rate (or amount of usage of the plant). Future emission rates can be estimated based on past records on the proposed coal and production rate can be forecast quite accurately with the use of a generation planning model that takes into account system and unit capability, forecasted load, and planned as well as forced maintenance down time. From these two factors, future actual emissions can be calculated and compared to past actual emissions. Specifically, in the years that Units 1-4 have burned oil, 1977-1979, actual emissions have ranged from a low of 33,039 tons to a high of 38,532 tons. In future years 1980-1989, actual emissions from Gannon Station with Units 1-4 burning coal are forecasted to range from a low of 34,515 tons to a high of 38,152 tons. The difference between the low in 1977 and the high in 1979 is primarily due to a 14.6% increase in generation in 1979 over 1977.

An appropriate background in which to view this proposed conversion is that of ambient air quality. The Gannon facility is located in a non-attainment area for particulates. It has been shown that high particulate levels measured in this area are not primarily due to industrial point sources such as Gannon. In addition, with the retrofit of high-efficiency electrostatic precipitators, the existing particulate emission limit of 0.1 lbs/MMBTU will not be exceeded.

TECO and Hillsborough County Environmental Protection Commission (HCEPC) maintain extensive ambient air monitoring stations in Hillsborough County. Many of these stations monitor sulfur dioxide levels in the vicinity of Gannon Station.

Since 1975 there has been only one 24-hour period when a monitored concentration anywhere near Gannon Station was above one-half the Florida Ambient Air Quality Standard (FAAQS) of 260 ug/m^3 and that value (171 ug/m^3) was not approaching the standard. The 24-hour standard appears to be controlling when reviewing modeling results, but it is interesting to note the annual average concentrations at these monitors. In 1979, there were no annual average monitored concentrations above one-half the FAAQS of 60 ug/m^3 and in fact only one value was above one-third of this standard.

Since TECO filed the original petition in February of this year, many meetings have been held with the DER, HCEPC, USEPA, Public Service Commission, and the Department of Energy and many questions have been asked. The most significant of these questions dealt with short-term ambient SO_2 impacts, the effect of sulfur variability in coal, and the method of demonstrating compliance after conversion. To answer these questions, the Company undertook several studies.

The first study was a detailed atmospheric dispersion modeling study of ambient SO_2 impacts. Three station load cases, 100%, 75% and 50% were examined and both 3-hour and 24-hour time periods were evaluated. This study was performed by Environmental Science and Engineering, Inc. of Gainesville, Florida, and a report has been prepared which addresses the methodology and results. The report has been available for public inspection since Monday, August 25, 1980, and the results are in the form of what emission rate is necessary for each combination of load and averaging time. These particular results will be discussed later as part of a proposed compliance plan.

The second study dealt with a statistical analysis of long- and short-term sulfur dioxide emission variability for the coal presently burned in Units 5 and 6 and proposed for Units 1-4. The inputs to this study were the weekly emissions data submitted by TECO to the DER and emissions data from fuel analyses performed over a six-week period on coal samples collected to specifically represent three hour periods of operation. The statistical study was performed by Entropy Environmentalists, Inc. of Research Triangle Park, N.C. and a report has been prepared and available for public inspection since Monday, August 25, 1980. These results will also be discussed as part of the proposed compliance plan.

Entropy Environmentalists, Inc. also addressed the technical merits of the two accepted emission monitoring techniques in terms of their use as compliance determination procedures. These two techniques are fuel analysis and continuous monitoring.

The basic requirements of any emission monitoring system are that it; one - obtain a representative sample; two - perform an accurate analysis; three - not be subject to frequent malfunctions. The results of this study indicate that both fuel analysis and continuous emission monitors provide a representative sample. The accuracy of an analysis depends largely on two factors: (1) the bias of the analytical procedure and (2) the stability of the analytical method. Continuous emission monitors are designed to be capable of measuring emission levels within $\pm$ 20 percent with a confidence level of 95 percent. The accuracy of the data reported by continuous systems is also affected by drift (stability) allowed in the Performance Specifications. This allowed drift can compound the 20% bias allowed by the Relative Accuracy Specification. Furthermore, emissions are determined by two monitoring systems, an SO_2 and a diluent system and the biases introduced by independent diverging drifts could be additive. The determination of the sulfur dioxide content of a coal sample is performed using established ASTM or equivalent procedures which are fundamentally not subject to these inaccuracies. The third major requirement of any emission monitoring system is the ability of the system to function without excessive loss of data from system malfunctions. Continuous emission monitors are complex electronic instruments having to function in a corrosive atmosphere. Surveys of existing continuous emission monitoring systems indicate that total monitor system availability may only be 51 to 73%. TECO however has experienced excellent reliability in fuel sampling procedures over many years of operation. In particular, during the six-week intensive period of coal sampling for the statistical study, only one data point out of a total of 331 was not obtained. Entropy concludes that fuel sampling analysis is a fully adequate procedure for determining the sulfur dioxide emissions at the Gannon Station. Furthermore, the utilization of fuel analysis techniques provides an anticipatory feature in that the emission rate can be determined before the coal is burned so that, if necessary, appropriate measures can be taken to ensure compliance. In addition, with fuel analysis, duplicate samples are routinely saved in order for different or additional analyses to be performed at a later date. TECO has concluded that continuous emission monitoring systems would not provide any greater confidence in compliance status than does the present fuel sampling and analysis.

The results of these studies have led to the development of a proposed sulfur dioxide compliance plan which will be made part of the station's operating permit after conversion. This plan has been developed to explain how Gannon Station operations will be maintained in such a manner that sulfur dioxide emissions will not exceed allowable limits and that Florida Ambient Air Quality Standards will be protected.

The purpose of Part I of the plan is to show compliance with a 2.4 lbs. SO_2/MMBTU emission limit and a 10.6 tons SO_2/hour emission cap over a weekly averaging period and ensure compliance with Florida Ambient Air Quality Standards. Inputs to this portion of the plan include weekly station generation data, station heat rate data and weekly composite fuel analysis results.

As shown graphically on Figure 1, the plant operating range to ensure compliance with existing emission limitations is dependent on weekly station load and weekly composite fuel quality (lbs. SO_2/MMBTU). Operating the plant below 8850 MMBTU/HR (73% load) on a weekly average with a 2.4 lb/MMBTU or less fuel automatically ensures compliance with both the emission limit and the emission cap. When the plant is operated above 8850 MMBTU/HR on a weekly average, the fuel quality must be below 2.4 lbs. SO_2/MMBTU. The maximum weekly average heat input for a given fuel quality can be obtained from Figure 1.

Compliance on a weekly basis will be demonstrated in the following manner. A weekly composite fuel analysis will be obtained and the SO_2 emission rate will be calculated using the percent sulfur and the heating value of the fuel in the following equation:

$$\text{lbs } SO_2/\text{MMBTU} = \frac{(\text{percent sulfur}/100)(.95)(2 \text{ lb } SO_2/\text{lb S})(1{,}000{,}000 \text{ BTU/MMBTU})}{(\text{heating value, BTU/lb})}$$

The tons of SO_2/hour will be calculated from the weekly heat input. The weekly heat input is calculated from the weekly generation and the station heat rate as follows:

Heat input, MMBTU/week = (heat rate, MMBTU/KWH) (generation, KWH/week)

The tons SO_2 emitted per hour will then be calculated as follows:

$$\text{tons } SO_2/\text{hour} = \frac{(\text{heat input, MMBTU/week})\ (\text{lb } SO_2/\text{MMBTU})}{(2000 \text{ lb/ton})\ (168 \text{ hour/week})}$$

The purpose of Part II of the compliance plan is to ensure protection of the 24 hour and 3 hour Florida AAQS based on actual conditions modeled and actual load conditions.

The primary input to this part of the compliance plan is the peak load availability and forecast for the following day. If this value is less than 10,050 MMBTU/HR then the sulfur variability statistics and Part I of this plan assure protection of the AAQS and no further action need be taken.

If the projected peak load is above 10,050 MMBTU/HR (see Figure 2), then a fuel analysis of the coal to be burned the following day will be performed. When the result of this fuel analysis is obtained and the lbs SO_2 per MMBTU has been calculated, Figure 2 will be examined to find the maximum allowable operating point. The Plant Superintendent will then be notified of the maximum allowable operating point.

In addition, the compliance plan provides for certain verifications in the future. The first verification concerns sulfur variability. An examination of weekly composite fuel analysis results will allow a straightforward evaluation of overall fuel quality in terms of sulfur dioxide emission rate. To provide an extra level of confidence that sulfur variability after conversion has not changed significantly from that currently observed, in one week (7 concurrent days) per year, daily fuel samples will be collected, analyzed, and evaluated statistically. The second area concerns accuracy of emission monitoring. At some period in each year when daily fuel samples are being collected, a stack test for sulfur dioxide will be conducted for the purpose of comparing those stack test results to fuel analysis results.

The last item in the compliance plan involves reporting. TECO has proposed that the reporting of compliance status shall be performed on a quarterly calendar basis. Each report shall consist of weekly average emission rate in lbs/MMBTU and tons/hour, daily emission rates and generation data for those periods necessary, and any results of sulfur variability and stack sampling if performed during the quarter. TECO has also proposed that excess emissions shall be reported in a timely manner, allowing for analysis of fuel samples and other data to be finalized.

Construction is planned to commence in March 1982. Unit outages for precipitator tie-ins would occur at the rate of one per year, each lasting 6 months between May 1 and November 1.

In summary, TECO is favorably inclined toward the conversion of Gannon Units 1-4 to low sulfur coal as an alternative to the use of No. 6 fuel oil for the following reasons.

1. This conversion is in accordance with the goals of the National Energy Policy to help reduce current dependence on foreign oil. The conversion would save approximately 2 million barrels of oil per year by 1990 and would reduce TECO's 1973-1978 average burn by 65%.

2. Studies of ambient impacts and sulfur variability demonstrate that ambient standards for sulfur dioxide will not be jeopardized by the utilization of low sulfur coal in Units 1-4 as proposed by TECO.

3. Conversion to low sulfur coal results in net savings of approximately $134 million to our customers over the next 20 years.

Because conversion to low-sulfur coal provides the best combination of economic and environmental considerations, Tampa Electric Company has approached the Florida Department of Environmental Regulation for the necessary modification to state emission regulations.