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# STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT VOLUME II. PROMULGATED STANDARDS OF PERFORMANCE FOR PETROLEUM REFINERY SULFUR RECOVERY PLANTS

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FINAL

Standards Support and
Environmental Impact Statement

Petroleum Refinery Sulfur Recovery Plants

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# 1. SUMMARY

On October 4, 1976, the Environmental Protection Agency (EPA) proposed a standards of performance for petroleum refinery Claus sulfur recovery plants (41 FR 43866) under authority of section 111 of the Clean Air Act. Public comments were requested on the proposal in the Federal Register publication. Twenty-two letters were received from oil company representatives, State and local air pollution agencies, a vendor of emission source testing equipment, and several Federal agencies. The comments that were submitted along with responses to these comments are summarized in this document. The summary of comments and responses serves as the basis for the revisions which have been made to the standard between proposal and promulgation.

## 1.1 SUMMARY OF CHANGES SINCE PROPOSAL

Only one significant change has been made since proposal of the standard of performance for petroleum refinery Claus sulfur recovery plants. The proposed standard would have required that all petroleum refinery Claus sulfur recovery plants achieve 99.9 percent overall reduction in sulfur emissions. The promulgated standard includes an exemption for Claus sulfur recovery plants with a capacity of 20 long tons per day (LTD) or less, installed in a petroleum refinery with a crude oil capacity of 50,000 barrels per stream day (BSD) or less which is owned or controlled by a refiner with a total combined crude oil processing capacity of 137,500 BSD or less. Otherwise, the promulgated standard does not differ from the proposed standard.

## 1.2 SUMMARY OF THE IMPACTS OF THE PROMULGATED ACTION

### 1.2.1 Alternatives to the Promulgated Action

The alternative control systems are discussed in chapter 4 of the Standards Support and Environmental Impact Statement (SSEIS, Vol. 1). These alternative systems are based upon combinations of the best demonstrated technology, considering costs, for petroleum refinery Claus sulfur recovery plants. The analysis of the alternatives of taking no action and of postponing the promulgated action is outlined in chapter 7 (SSEIS, Vol. 1). These alternatives remain the same.

### 1.2.2 Environmental Impact of the Promulgated Action

The small petroleum refinery exemption will apply to less than 2 1/2 percent of new petroleum refinery Claus sulfur plant capacity. However, in most cases those refinery Claus sulfur recovery plants which are exempted will still be required by existing State regulations to install emission controls equivalent to alternative I (99 percent overall control of sulfur emissions). Thus, the adverse environmental impact of the promulgated standard will be the difference between the emissions resulting from 99.9 percent control and 99 percent control of less than 240 LTD of sulfur emissions by this date. In some cases, this action could lead to a reduction in sulfur emissions because it will not discourage the voluntary installation of sulfur recovery plants at a number of small refineries which are not required by existing regulations to install Claus sulfur recovery plants.

### 1.2.3 Economic Impact of the Promulgated Action

The small petroleum refinery exemption in the promulgated standard will eliminate the adverse economic impact of the standard on small refiners.

An analysis of the economic impact of standards based on alternative II prior to proposal concluded that these standards were affordable for both large and small refiners. The impact on the small refiner's profitability, however, would be over five times the corresponding impact on the large refiner. In terms of the incremental costs of recovering an incremental ton of sulfur, the impact is also much more severe, with the small refiner paying up to $6300 per ton of sulfur removed. This very high incremental cost per incremental ton of sulfur recovered is considered unreasonable, especially in light of the small refiner's inability to pass on pollution control costs as easily as the large refiner. Thus, the promulgated standards include an exemption for the small refiner.

### 1.2.4 Other Considerations

#### 1.2.4.1 Adverse Impacts

The potential adverse impacts associated with these standards are discussed in chapters 1 and 7 of the SSEIS, Vol. 1. These impacts remain unchanged simce the regulations were proposed.

#### 1.2.4.2 Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enforcement of Long-Term Production

This impact is discussed in chapter 7 and 9 of the SSEIS, Vol. 1, and remains unchanged since proposal.

#### 1.2.4.3 Irreversible and Irretrievable Commitments of Resources

This impact is discussed in chapter 7 of the SSEIS, Vol. 1, and remains unchanged since proposal.

# 2. SUMMARY OF PUBLIC COMMENTS

The list of commenters and their affiliations is shown in Table 2-1. Twenty-two letters were received commenting on the proposed standard and Volume 1 of the Standards Support and Environmental Impact Statement. The significant comments have been combined into the following seven major areas:

1. General
2. Emission Control Technology
3. Economic Impact
4. Environmental Impact
5. Energy Impact
6. Legal Considerations
7. Test Methods and Monitoring

The comments and issues, along with responses to these comments, are discussed in the following sections of this chapter. A summary of the changes to the regulation is included in section 2 of chapter 1.

## 2.1 GENERAL

### 2.1.1 Coverage of the Standard

Several commenters stated that it was not clear which sulfur recovery process or processes were meant to be covered by the proposed standard. Others felt that the standard should not be limited to sulfur recovery plants in petroleum refineries; or that the standard should not apply to "stand-by" Claus sulfur recovery plants.

Although other processes are available for removing sulfur from petroleum refinery acid gases (e.g. the Stretford and Giammarco-Vetrocoke-$H_2S$ processes), only the Claus sulfur recovery process is covered by the promulgated standard. Essentially all petroleum refinery sulfur recovery plants will be covered, however, due to the very limited use of alternative sulfur recovery processes in domestic refineries. As of January, 1975, only one U.S. petroleum refinery had installed a Stretford sulfur plant and none had installed a Giammarco-Vetrocoke-$H_2S$ process in lieu of a Claus sulfur recovery plant. Accordingly, the definition of "sulfur recovery plant" has been revised in the promulgated standard to make it clear that only Claus sulfur plants are covered by the standard.

To support proposal of standards of performance, a Standards Support and Environmental Impact Statement (SSEIS) is prepared which includes an in-depth analysis of the environmental, energy, and economic impacts of the proposed standard on the affected industry. The SSEIS supporting the proposed standard dealt only with the petroleum refining industry and, hence, the promulgated standard covers only petroleum refinery Claus sulfur recovery plants.

An SSEIS is currently under development to support proposal of standards of performance for Claus sulfur recovery plants in the natural gas and oil production industry. When these standards are proposed and promulgated, most new, modified, and reconstructed sulfur recovery plants will be covered by standards since petroleum refining and natural gas and oil production presently account for 80 percent of the recovered sulfur production in the U.S.

The promulgated standard will cover "standby" Claus sulfur plants in petroleum refineries although it does not require installation of such units. In those cases where a refiner chooses to install a standby Claus sulfur recovery unit, it will be required to meet the standard when it is in operation.

### 2.1.2 Implementation of Section 111(d)

When standards of performance were proposed, EPA requested comment from States regarding the burden that might be imposed by implementing section 111(d) requiring the development of State plans limiting emissions of reduced sulfur compounds in those States where reduction emission control systems were currently being used to reduce sulfur emissions from petroleum refinery Claus sulfur plants. The Agency felt that where these systems were being used, reduced sulfur compound emissions were less than 300 to 500 ppm which is only slightly higher than the emission limit included in the proposed standard. Implementing section 111(d), therefore, would require a significant amount of Federal and State manpower, but would accomplish little, if any, additional reduction in emissions from refinery Claus sulfur recovery plants.

The one State agency which addressed this issue indicated agreement with this conclusion. Accordingly, section 111(d) will be implemented in the future as time and resources permit, taking into consideration other requirements of the Clean Air Act, as amended, which EPA must implement. However, at this time, no guideline document will be issued and no State plans will be required.

## 2.2 EMISSION CONTROL TECHNOLOGY

### 2.2.3 Data Base for the Standard

Two commenters expressed the view that the data base was insufficient to support the proposed standard. These commenters felt that the emission test data EPA collected was obtained when Claus sulfur recovery plants were operating below design capacity and, therefore, the emission controls were not operating at their rated capacities. Also, these commenters felt that emission control equipment vendor data was relied on too heavily to determine the performance of emission controls.

During the technical investigation to determine the best systems of emission reduction, all known tail gas processes in full operation were tested including tail gas processes in Canadian natural gas plants. During EPA emission tests of the SCOT, Beavon, and Wellman-Lord processes, oil shortages as a result of the 1974 OPEC oil embargo caused the Beavon process tested to operate at 1/3 capacity. The SCOT and Wellman-Lord processes, which were tested, however, were operating very near normal capacity. The results of emission tests conducted by the Los Angeles Air Pollution Control District (LA APCD) at the Beavon, SCOT, and Wellman-Lord units which have been installed in Los Angeles County when these processes were operating at design capacity were also obtained. Subsequently, the LA APCD supplied emission test data for two additional Beavon units which were put into operation following EPA's technical investigation. All the data from LA APCD were comparable to that collected in EPA's emission tests which showed emissions well below the numerical emission limits included in the proposed standard.

In developing standards of performance, not only emission data from existing well-controlled sources are considered, but also guarantees by vendors of control equipment, data and information from pilot and prototype installations, foreign technology, published literature on emission control technology, and contractor reports on the performance of emission control technology. Data and information from vendors, literature surveys, and a contractor's report on tail gas scrubbing systems indicated that several processes, including the SCOT, Beavon, Cleanair, Wellman-Lord, and IFP-2, could comply with the standard which was proposed. Thus, the proposed standard was based on data from a number of sources.

2.2.4 Stringency of the Numerical Emission Limits

Several commenters questioned the ability of emission control systems to reduce sulfur emissions to the level required by the standard. These commenters cited factors such as Claus sulfur recovery plant process fluctuations, the reduced efficiencies of emission controls due to the presence of high concentrations of $CO_2$ in the stream to be treated, and the effect on emissions of the use of fuels containing sulfur for the incinerator step included in the oxidation emission control system (i.e. Wellman-Lord scrubbing).

Unlike the low temperature extended Claus reaction processes, such as the IFP-1 and Sulfreen, tail gas scrubbing systems are not sensitive to the $H_2S/SO_2$ ratios in the exhaust from a Claus sulfur plant. The literature descriptions of tail gas scrubbing systems, such as the SCOT, Beavon, and Wellman-Lord processes, cite their ability to accept, with proper design, routine fluctuations in the exhaust gases from the sulfur recovery plant. Obviously the limit of this dampening effect is the absorbing capacity of the tail gas scrubbing system which is installed. Normal routine fluctuations should not require design of a tail gas scrubbing system with an inordinately large absorbing capacity. Thus, with proper operation and maintenance, emissions from tail gas scrubbing systems will not exceed the numerical emission limit included in the standard due to routine random fluctuations in the exhaust gases from the Claus sulfur recovery plant. Based on emission tests and other information, the numerical emission limits included in the promulgated standard incorporate an adequate margin to allow for Claus process fluctuations.

The reduction emission control systems (i.e. Beavon process) can easily meet the 300 ppmv total sulfur/10 ppmv $H_2S$ emission limit under normal operating conditions. While it is true that a very high concentration of $CO_2$ in the gases treated by the Beavon process could cause an unfavorable shift in the chemical reactions within the process which would reduce its overall efficiency, it is very unlikely that a petroleum refinery sour gas would contain sufficient $CO_2$ to significantly impair its performance.

There is the possibility that in the future partial oxidation of oil will become a major source of refinery fuel gas. In this situation, refinery sour gas could contain high concentrations of $CO_2$. According to the process vendor, however, the Beavon process could be modified to meet the 300 ppmv total sulfur emission limit even in high $CO_2$ applications. This would require steam injection into the Beavon reactor to promote conversion of organic sulfur compounds to $H_2S$, thereby reducing overall sulfur emissions.

With regard to the potential increase in $SO_2$ emissions if a high sulfur fuel is used to satisfy incineration requirement of the oxidation emission control processes, the tail gas scrubbing portion of these processes, which follow the incineration steps, are capable of reducing $SO_2$ emissions to the level of the promulgated standard regardless of the incinerator fuel sulfur content.

### 2.2.5 Restrictions on New Technology

One commenter was concerned that the standard would prevent the development of new technology which would be as effective as oxidation or reduction control systems in controlling sulfur plant emissions, but less costly.

An owner or operator is required only to control emissions from an affected facility so that residual emissions discharged to the atmosphere are at or below the level required by the standard. The owner or operator is not required to use the systems discussed in the SSEIS, but may employ any emission control system which meets the appropriate emission limit.

## 2.3 ECONOMIC IMPACT

### 2.3.1 The Costs of Complying with the Standards Were Underestimated

Several commenters, all from the petroleum industry, believed that the costs required to comply with the standard of performance for petroleum refinery Claus sulfur recovery plants were underestimated. These commenters considered the costs contained in the SSEIS much lower than their actual costs of installing and operating alternative II emission control systems. Also, they believed the incremental investment required by standards based on alternative II over the next five years would exceed the estimate of $110 million.

Other commenters disagreed with certain basic concepts used in developing the economic analysis in the Standards Support and Environmental Impact Statement (SSEIS). Their major comments were: (1) the cost impact of the standard should have been considered in terms of the sulfur produced by the Claus sulfur recovery plant and not in terms of the production of petroleum products by the total refinery; (2) all the pollution control costs resulting from compliance with standards based on alternative II, including the cost of the Claus sulfur recovery plant, should have been considered; (3) the variations in the price paid for recovered sulfur should have been considered; and (4) the additional cost necessary to comply with the standards where a Claus sulfur recovery plant processed a gas stream containing less than 60 percent $H_2S$ should have been considered.

Generally, the costs were based on information received from petroleum refinery sources. It was necessary to scale the investment costs from one size to another and then to increase the costs, which are 1971-72 vintage, to allow for inflation. Both of these manipulations will tend to introduce errors. Based upon a review of the information obtained both during the course of the study and during the comment period, however, there is no need to revise the original cost estimates.

With regard to the total incremental investment required over the next five years by a standard of performance based on alternative emission control system II, the estimate of Claus sulfur plant incremental control costs to comply with the standard and the estimate of the number of Claus sulfur plants that will be covered by the standard are essentially correct. Therefore, the $110 million seems reasonably accurate.

The objective of the economic impact analysis was to determine the reasonableness of the incremental control costs imposed on a petroleum refinery to comply with a standard of performance based on alternative emission control system II. The appropriate basis for such an analysis is the petroleum refinery in which a Claus sulfur plant is constructed, not the sulfur plant itself. While Claus sulfur recovery plants may have been installed in the past primarily for economic reasons, in the future sulfur recovery plants will be installed primarily to comply with State or local air pollution control regulations.

In assessing the economic impact of a standard based on alternative II, the cost of the Claus sulfur recovery plant was not considered a cost attendant to compliance with the standard. This is appropriate since essentially all States where additional petroleum refining capacity will most likely be built already require installation of Claus sulfur recovery plants with alternative I emission control systems. Thus, the economic impact of a standard of performance based on alternative II is only that associated with the additional costs of alternative II over alternative I.

With regard to the variation in the price of elemental sulfur, it is true that this price varies widely from time to time. In determining the incremental costs associated with a standard based on alternative II, however, the change in sulfur revenue is relatively minor compared to the costs associated with other parameters. Consequently, the impact of this variation in the price of elemental sulfur on the estimated costs of complying with promulgated standard is negligible.

It is also true that Claus sulfur recovery plant performance decreases when dilute $H_2S$ gas streams are treated. An investigation of the effect of $H_2S$ concentration on investment costs by R.M. Parsons Company, however, indicates that installing a Claus sulfur recovery plant to handle a 50 percent $H_2S$ acid gas stream, compared to a 90 percent $H_2S$ stream, increases the capital costs from about 10 percent for a 10 LTD plant to about 17 percent for a 100 LTD plant. These percentages are within the overall accuracy of the basic cost estimates.

### 2.3.2 The Costs of Complying with the Standard are Excessive

Several commenters, while not necessarily disagreeing with the cost data, felt that the costs associated with a standard of performance based on alternative emission control system II were unreasonable. Among other things, these commenters indicated that these high costs would mean that sulfur recovery would no longer be a profitable operation in petroleum refineries and that a cost-benefit analysis would have shown the need for more lenient standards. Additionally, these commenters also felt that the costs required to comply with the standard were not justified in all areas of the country.

The fact that a standard of performance based on alternative emission control system II might lessen or eliminate the profit resulting from the operation of an uncontrolled Claus sulfur recovery plant was not a consideration in developing the proposed standard. Standards of performance usually result in increased capital and operating costs. The question is whether the increased costs associated with standards of performance are reasonable. The "reasonableness" of the proposed standard of performance was examined by assessing such factors as whether or not the standard would deter or preclude the construction of additional petroleum refining capacity, the impact upon petroleum product prices and supplies, and the change in petroleum refiner profitability. The impact of a standard of performance based on alternative emission control system II, in terms of these factors, is reasonable.

With regard to cost/benefit analyses, litigation involving standards of performance has clearly established that this sort of analysis is not required by section 111 of the Clean Air Act. The courts have arrived at this conclusion after examining the legislative history of section 111 of the Clean Air Act and in light of the difficulty of assigning a dollar value to the benefits associated with reduced atmospheric pollutant levels.

The primary objective of standards of performance developed under section 111 of the Clean Air Act is to maintain existing air quality and to prevent new air pollution problems from arising. Consequently, these standards are not designed to achieve any specific ambient air quality levels, but are intended to require the use of the best systems of emission reduction, considering costs, environmental impacts, and energy requirements throughout the U.S. Thus, new Claus sulfur recovery plants within petroleum refineries will be required to meet the standard regardless of their geographic location.

### 2.3.3 Exemption of Small Refineries

Several commenters, including a State air pollution control agency, recommended an exemption from the standard for small petroleum refineries and/or petroleum refineries which install small Claus sulfur recovery plants. These commenters felt that the cost impact of the standard on small petroleum refineries would be extremely burdensome, compared to the cost impact on large petroleum refineries. They also felt that an exemption for the small refiner would not have a significant adverse environmental impact since the small refiner represents only a small segment of total domestic petroleum refining capacity. Several of the commenters suggested that a standard covering all new petroleum refinery Claus sulfur recovery plants could actually have a negative environmental impact since this standard would discourage the installation of sulfur recovery plants at petroleum refineries in those few cases where these plants are not already required by existing State air pollution regulations.

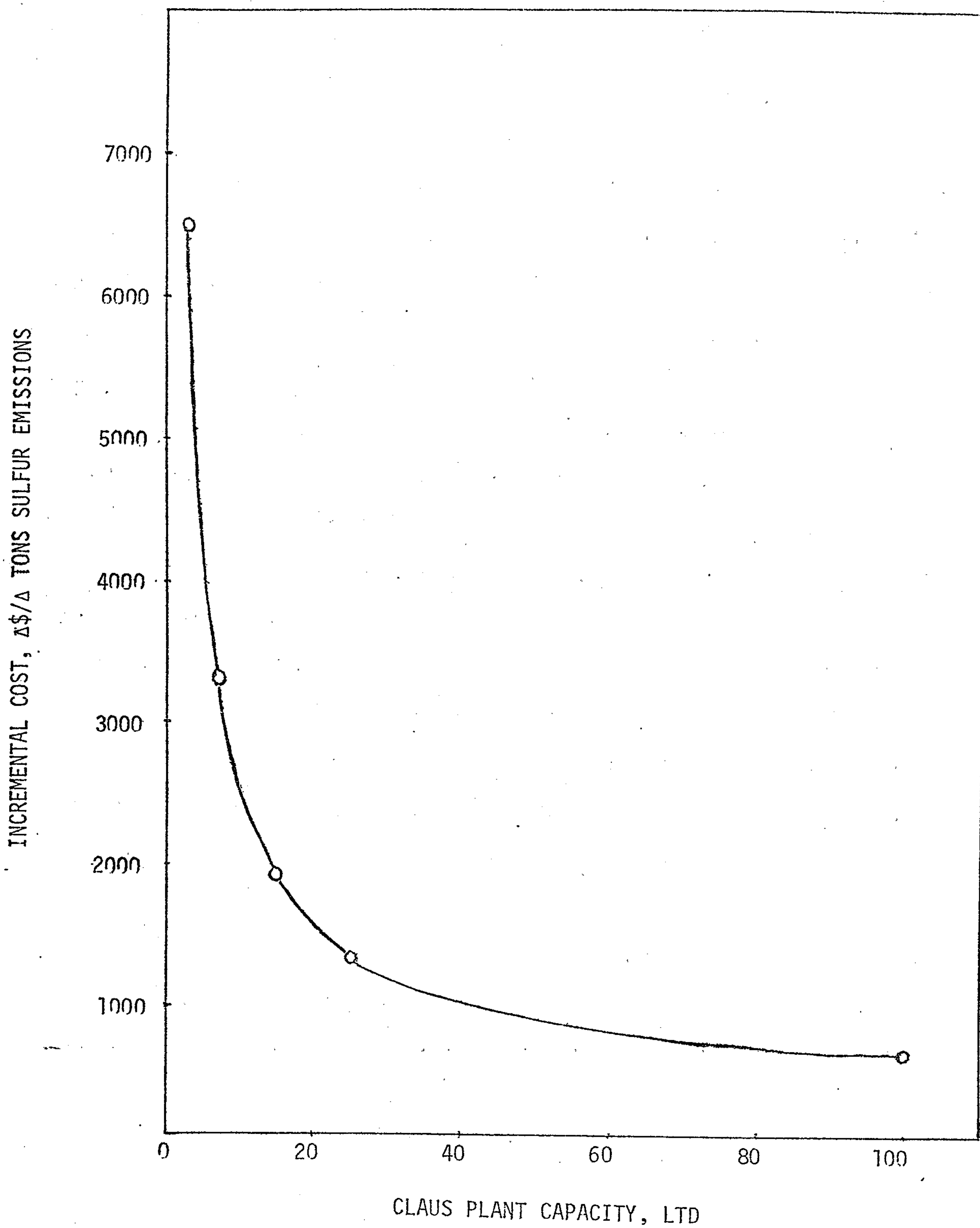
The SSEIS concluded that a standard of performance for Claus sulfur recovery plants based on alternative emission control system II was "affordable" for both large and small refineries. At the same time, however, it was acknowledged that the economic impact of the standard would be much more severe on the small refiner. The small refiner's profits could be reduced by 1.3 to 7.5 percent due to complying with a standard based on alternative II. This impact is over five times that imposed by the standard on the large refiner.

When the economic impact of a standard based on alternative emission control system II is considered from the standpoint of cost effectiveness (i.e., the incremental cost per incremental unit of sulfur emissions controlled at Claus sulfur recovery plants of various capacities), the difference in the impact of the standard on small and large petroleum refineries becomes more extreme. For example, Figure 2.1 shows that the incremental cost of controlling an incremental ton of sulfur emissions to comply with the proposed standard ranges from about $580 for a 100 LTD Claus sulfur recovery plant to about $6300 for a 3 LTD Claus sulfur recovery plant. For small Claus sulfur recovery plants in small petroleum refineries, this very high incremental cost per incremental ton of sulfur recovered is unreasonable. As several commenters have stated, the small refiner cannot increase his prices to recoup pollution control costs as readily as the large refiner due to the competitive nature of the petroleum refining industry. Thus, some relief from the standard is warranted for small Claus sulfur recovery plants at small petroleum refineries.

In a number of cases, relatively large petroleum refineries operate small Claus sulfur recovery plants. Large petroleum refineries, however, should not be able to make use of an exemption from the standard. For large petroleum refineries, regardless of the Claus sulfur recovery plant capacity, the cost of complying with a standard based on alternative emission control system II is reasonable. Consequently, the promulgated standard provides an exemption from the standard only for small petroleum refineries which install a Claus sulfur recovery plant with a capacity of 20 long tons per day (LTD) or less.

The 1977 amendments to the Clean Air Act added a definition of a small petroleum refinery to section 211, which deals with the regulation

Figure 2.1. Incremental Annual Cost vs. Plant Capacity



of fuels. A small petroleum refinery is defined as one with a crude oil processing capacity of 50,000 BD or less which is owned or controlled by a refiner of 137,500 barrels per stream day (BSD) or less. A small petroleum refinery is defined in the promulgated standard consistent with this definition currently included in the Clean Air Act.

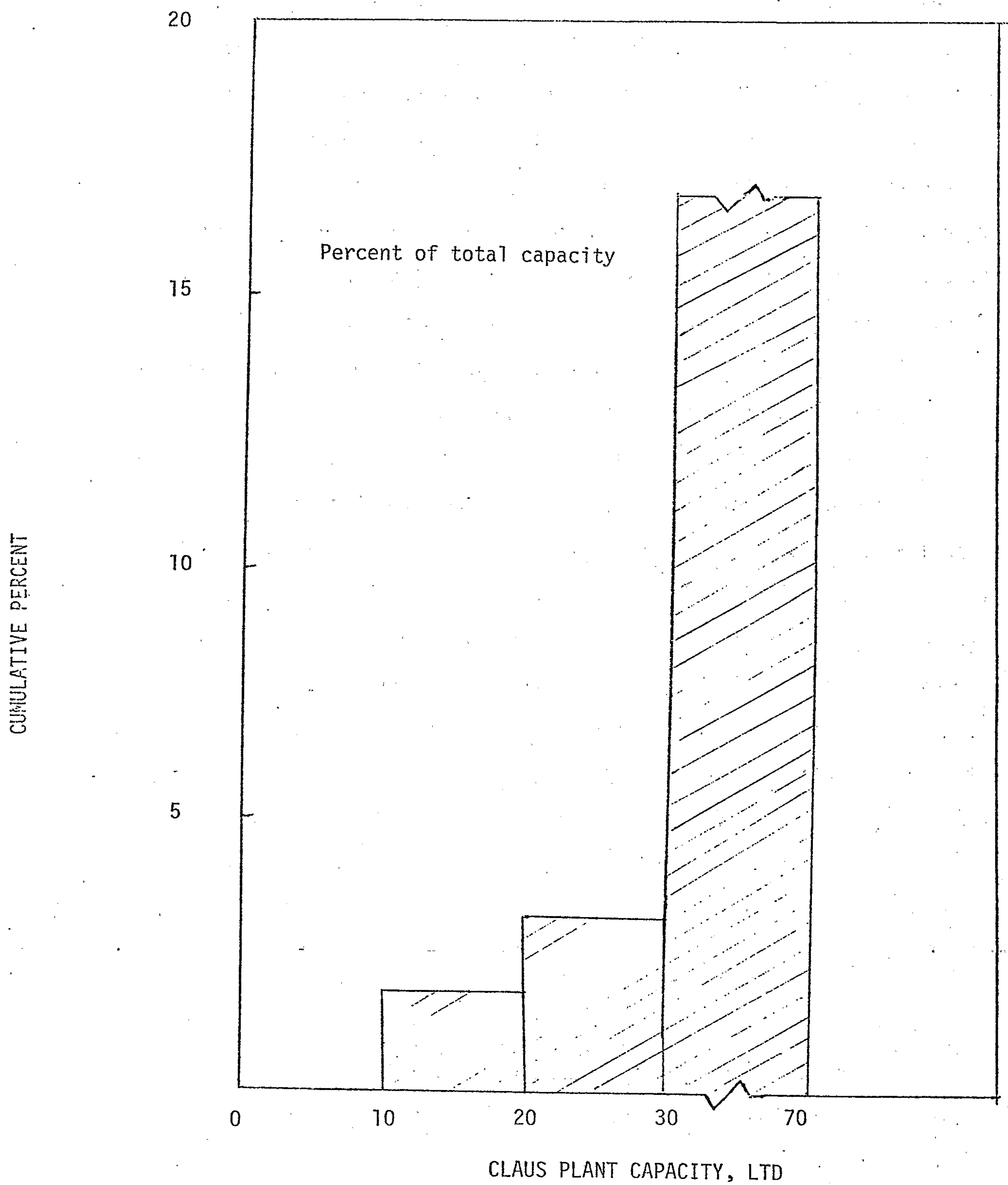
Figure 2.1 was the basis for selecting 20 LTD as the cut-off point for exempting small Claus sulfur recovery plants from compliance with the standard. As shown by this figure, for Claus sulfur plants of less than 20 LTD, the "cost effectiveness" of alternative emission control system II over alternative emission control system I deteriorates rapidly. Thus, this is the most reasonable point for an exemption to become effective.

Figure 2.2 shows that this exemption will apply to less than 2 1/2 percent of new petroleum refinery Calus sulfur plant capacity. As discussed earlier, in most instances these new Claus sulfur recovery plants exempted from the standard will still be required by existing State regulations to install emission control equivalent to alternative I. Consequently, this exemption will not lead to a significant adverse environmental impact. Also, in those few areas where State regulations do not require the installation of Claus sulfur recovery plants, which tends to be States containing only one or two small petroleum refineries, this exemption will avoid the potential adverse impact raised by several commenters of discouraging the installation of these plants.

The following examples illustrate how this exemption is to be applied:

Example 1. A petroleum refinery of 50,000 BSD or less, which is owned or controlled by a refiner with a total crude oil processing capacity of 137,500 BSD or less, with or without existing Claus sulfur recovery plant capacity, exists prior to proposal of the standard. After proposal

Figure 2.2 Capacity Distribution of New Petroleum Refinery Claus Sulfur Recovery Plants (1976-1981)



of the standard, a Claus sulfur recovery plant of 20 LTD or less is installed at the refinery. This new Claus sulfur recovery plant is not covered by the standard. On the other hand, a Claus sulfur recovery plant of 30 LTD added to this refinery would be covered by the standard.

Example 2. A petroleum refinery of 60,000 BSD, which is not owned or controlled by a refiner with a total combined crude oil processing capacity of 137,500 BSD or less, with or without existing Claus sulfur recovery plant capacity, exists prior to proposal of the standard. A Claus sulfur recovery plant of any size added to this refinery (after proposal of the standard) would be covered by the standard since the refinery has a capacity larger than 50,000 BSD.

Example 3. An existing petroleum refinery of 50,000 BSD or less, which is owned or controlled by a refiner with a total crude oil processing capacity of 137,500 BSD or less, operates with an existing Claus sulfur recovery plant capacity of 20 LTD or less. After proposal of the standard, the capacity of the petroleum refinery is increased to more than 50,000 BSD. The existing sulfur recovery plant is not covered by the standard. However, a sulfur recovery plant of any capacity added after the addition of the new refinery capacity is covered by the standard. If the capacity of this petroleum refinery is increased to more than 50,000 BSD and, at the same time, a Claus sulfur recovery plant of 20 LTD or less is also added to this petroleum refinery, the new sulfur recovery plant would be covered by the standard..

## 2.4 ENVIRONMENTAL IMPACT

### 2.4.1 Environmental Impacts of the Standard Were Not Clear

One commenter suggested that the environmental impact statement was one-sided, highly technical, and improperly included within the SSEIS.

Other commenters stated that the adverse impacts which might result from the various liquid and solid wastes discharged from the alternative II emission control systems were not adequately discussed. Two of these commenters also believed that the beneficial impact of the standard (i.e., future reduction in $SO_2$ emissions) were overestimated due to an overestimate of future petroleum refinery Claus sulfur plant capacity.

Litigation involving standards of performance has established that preparation of an environmental impact statement under the National Environmental Policy Act is not necessary for actions under section 111 of the Clean Air Act. Nonetheless, the adverse, as well as beneficial, impacts of standards of performance are considered. The beneficial environmental impacts of the standard of performance for refinery Claus sulfur recovery plants overwhelmingly outweigh the adverse impacts of the standard.

Alternative II emission control systems do discharge varying amounts of liquid wastes. The SSEIS clearly identifies the potential waste streams from the SCOT, Beavon, Stretford, and Wellman-Lord processes. Since these streams are quite small in comparison with the liquid waste streams generated within a typical petroleum refinery and waste treatment systems capable of treating these streams are routinely installed within petroleum refineries, no adverse environmental impact is foreseen.

Waste catalysts from tail gas treating systems are normally reprocessed because of the value of the metals in the catalyst. Since this is not a refinery process, the impact of chemicals or catalyst regeneration was not considered in the environmental assessment. The assessment is limited to direct environmental impact. Secondary impacts, such as additional emissions from manufacture of tail gas system hardware, production of chemicals, or off-site regeneration of spent chemicals, were not assessed.

With regard to the estimate of future Claus sulfur recovery plant capacity, a survey of the latest issue of the "Hydrocarbon Processing" Box Score Supplement indicates that 3800 tons of sulfur capacity is due for completion in 1976 and 1977 alone. Although the publication does not differentiate between Claus sulfur recovery units within petroleum refineries and those in oil and natural gas production fields, an effort was made to list only those units associated with petroleum refining. On this basis, 8000 LTD appears to be a reasonable estimate of 1980 petroleum refinery Claus sulfur plant capacity.

### 2.4.2 Existing State Regulations

Several commenters indicated that contrary to EPA's claim that most State implementation plans (SIP's) require new petroleum refinery Claus sulfur recovery plants to achieve 99 percent control of sulfur emissions, most SIP's do not require this level of control, but generally require control equivalent to only two- or three-stage Claus sulfur recovery plants (about 94-96 percent control). Thus, they felt that a standard of performance based on alternative emission control system I (99 percent control) would result in a substantial reduction in sulfur emissions from petroleum refinery Claus sulfur recovery plants, and that the additional 0.9 percent control required by the proposed standard was unreasonable.

Most new Claus sulfur recovery plant capacity will likely be installed in those States with large petroleum refining capacities. As of 1976, over 90 percent of all U.S. petroleum refining capacity was located in 17 States. A review of the State regulations for new petroleum refinery Claus sulfur recovery plants clearly indicates that the majority of these 17 States require control of sulfur emissions equivalent to alternative emission control system I. Thus, a standard of performance based on alternative I would have little or no impact on petroleum refinery sulfur recovery plant emissions since most new Claus sulfur plants will be required to achieve 99 percent control of emissions due to State regulatory requirements.

In developing standards of performance, State regulations applicable to the facility covered by the standards are reviewed. The main considerations in developing standards of performance, however, are the capabilities of alternative emission control systems and the incremental costs of these systems. Both costs and technology have been discussed in some detail in previous sections and alternative emission control system II is considered "the best system of emission reduction" for petroleum refinery Claus sulfur recovery plants.

## 2.5 ENERGY IMPACT

In the energy impact analysis, the SSEIS concluded that compliance with the proposed standard would lead to a significant energy savings within a petroleum refinery. One commenter felt the basis of this conclusion was not adequately explained. Another commenter felt that the total energy requirements of the reduction control systems of alternative II were not considered. Specifically, this commenter stated that, even though incineration of the off-gases from reduction emission control systems might not be required, up to 25 percent of the fuel that would normally be used for incineration was needed to maintain an incinerator on standby. This energy requirement was not taken into consideration in the energy impact analysis. Generally, all the commenters felt that tail gas scrubbing systems are net consumers of energy and that the energy savings noted were due to the Claus sulfur plant's energy production of by-products, not due to the tail gas scrubbing system.

The prediction of an energy savings associated with a standard based on alternative emission control system II is based on data which show that the major reduction emission control system option of alternative II (the Beavon process) consumes less energy than the major emission control system option of alternative I (the IFP-1 process). The reduced energy consumption of the Beavon process is due to the fact that incineration of the tail gas released to the atmosphere from the Beavon process is not required, while the alternative I system requires incineration of the tail gas before release to the atmosphere. This data shows, however, that the major oxidation emission control system of alternative II (the Wellman-Lord process) is a net consumer of energy compared to alternative I. The incremental energy impact of a standard of performance based on alternative II is equal to the difference in energy consumption between a Claus sulfur plant which has installed alternative II and a Claus sulfur plant which has installed alternative I, since existing State regulations will require new petroleum refinery Claus sulfur recovery plants to install alternative I in lieu of a standard of performance. If future petroleum refinery Claus sulfur plant capacity is equipped half-and-half with the Beavon process and the Wellman-Lord process, an overall energy savings will result.

In estimating the actual energy savings attributable to a standard of performance based on alternative emission control system II, complete recovery of the energy produced by the Claus sulfur plant and the emission control system for both alternative I and alternative II was assumed. This energy savings resulting from the use of alternative II over alternative I was converted to an equivalent barrels of fuel oil. While it may not be feasible in a petroleum refinery to fully utilize the steam produced by a Claus sulfur plant and its emission control system in all cases, even if no energy is recovered, the data show that a significant energy savings results from the use of the Beavon process of alternative II compared to the energy consumption associated with alternative I. Again, this energy savings is due primarily to the difference in incineration requirements between alternative emission control system I and the Beavon process of alternative emission control system II.

Concerning the need to maintain an incinerator in a standby condition within a reduction emission control system, the situation discussed by the commenter who raised this point is unique and is not expected to arise where a new Claus sulfur recovery plant is built with a reduction emission control system. The case in question involved the retrofitting of a Beavon unit at a petroleum refinery on an existing Claus sulfur plant. To reduce installation costs, the refiner elected to use the existing incinerator on the Claus plant rather than install the emergency incineration system which is normally used with the Beavon process to handle emergencies and process upsets. Normally, the only incinerator energy requirement associated with a Beavon unit at a new Claus sulfur recovery plant is the fuel required for the emergency incinerator's pilot light.

Generally, emission control systems are net consumers of energy and the impact of this increased energy consumption is considered in developing standards of performance. With regard to the standard of performance for petroleum refinery Claus sulfur plants, however, no data was submitted to show that the conclusion regarding an energy savings associated with a standard based on alternative emission control system II is significantly in error. In any event, compared to the energy consumption of a typical petroleum refinery, an overall energy consumption considerably greater than the estimate included in the SSEIS would not have a significant adverse impact on energy consumption within a refinery.

## 2.6 LEGAL CONSIDERATIONS

Two commenters questioned EPA's authority for requiring the control of sulfur emissions from petroleum refinery Claus sulfur recovery plants. They contended that in most cases Claus sulfur recovery plants were installed in refineries for the purpose of controlling sulfur emissions. The additional requirement to further control Claus sulfur recovery plant emissions was both unreasonable and not authorized by section 111 of the Clean Air Act.

Generally, petroleum refineries have installed Claus sulfur recovery plants as a profit-making venture, or to meet the requirements of local or State air pollution control regulations. The fact that Claus sulfur recovery plants are used for control of sulfur emissions, however, does not preclude the development of a standard of performance to limit emissions from new Claus sulfur plants. Section 111 of the Clean Air Act directs the Administrator to establish standards which reflect "the degree of emission reduction achievable through the application of the best system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction; and any non-air quality, health, and environmental impacts; and energy requirements) the Administrator determines has been adequately demonstrated for that category of sources."

## 2.7 TEST METHODS AND MONITORING

### 2.7.1 Unsuitability of Reference Method 15

Several commenters were concerned that Reference Method 15 for determining sulfur emissions from petroleum refinery Claus sulfur plants would be too complex, expensive, and hazardous for use in petroleum refinery applications. These commenters felt that this method is only suitable for the laboratory environment.

While Reference Method 15 does require equipment that is relatively expensive and complex, most petroleum refineries currently operate gas chromatographs which are routinely used for process control. Thus, most sources affected by the standard of performance are expected to have the capability to perform the required tests. For those who do not have this capability, however, source test consultants are available who will perform the required tests for a reasonable fee.

The potential hazard of Reference Method 15 is due to the requirement of the flame photometric detector associated with the gas chromatograph for a continuous flame to operate the instrument. The areas in which testing required by the standard would be conducted, however, are not areas which are considered to present an explosion hazard since, in many cases, the exhaust gas being tested is coming from an incinerator. If there were an explosion hazard, a relatively simple solution is available. Since performance testing would be only a short-term project, it would be possible to enclose the flame photometric detector in a box filled with hydrocarbon-free compressed gas.

Reference Method 15 has been thoroughly evaluated in field testing situations and does not present any problems which would preclude its use. The instrumentation will operate over a wide temperature range and does not require rigorous temperature control. The permeation tubes used for calibration must be held at a constant temperature, but this is easily accomplished with the use of a constant temperature bath.

## 2.7.2 Continuous Emission Monitoring

Several commenters raised questions about the continuous emission monitoring requirements included in the standard. One commenter stated that the use of Reference Method 15 as a continuous monitor was not practical. This commenter felt that only $H_2S$ emissions should be monitored continuously and that a number of accurate and reliable $H_2S$ monitors were available at less cost than Reference Method 15 instrumentation. Another commenter questioned the ability of continuous emission monitoring equipment to accurately measure the very low concentrations of pollutants in the tail gases discharged into the atmosphere.

Reference Method 15 was not proposed for use as the continuous monitoring method since it was not developed for that purpose. Performance specifications for continuous emission monitors to monitor emissions of reduced sulfur compounds are currently under development. Thus, the promulgated standard does not require the installation of continuous emission monitors to monitor these emissions until performance specifications for these monitors are proposed and promulgated under Appendix B of 40 CFR Part 60.

Performance specifications for continuous emission monitors to monitor emissions of $SO_2$, however, have already been developed. These monitors are quite capable of measuring $SO_2$ concentrations in the range of 250 ppm. Consequently, the promulgated standard requires the installation of continuous emission monitors to monitor $SO_2$ emissions where an oxidation emission control system or a reduction emission control system followed by an incinerator is employed to comply with the standard.

TABLE 2-1

LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR PETROLEUM REFINERY CLAUS SULFUR RECOVERY PLANTS

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| 15. SUPPLEMENTARY NOTES Volume 1 discussed the proposed standards and the resulting environmental and economic effects. This volume, Volume 2, discusses the differences between the proposed and promulgated standards. | | |

16. ABSTRACT

A national emission standard for sulfur dioxide and reduced sulfur compounds was proposed under authority of section 111 of the Clean Air Act. The intent of the standard was to minimize reduced sulfur and sulfur dioxide emissions from refinery sulfur recovery plants to the level attainable with best available control technology. Twenty-one comment letters were received from the petroleum industry, State and local air pollution control agencies, and other federal agencies. As a result of these comments, changes have been made in the promulgated standard. The major change is an exemption from the standard for sulfur recovery plants of 20 long tons per day (LTD) or less associated with a small petroleum refinery.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
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