United States Environmental Protection Agency

Office of Air Quality Planning and Standards
Research Triangle Park NC 27711

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September 1980

Air

Glass Manufacturing Plants — Background Information for Promulgated Standards of Performance

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Glass Manufacturing Plants — Background Information for Promulgated Standards of Performance

Emission Standards and Engineering Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air, Noise, and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

September 1980

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ENVIRONMENTAL PROTECTION AGENCY

Background Information
and Final
Environmental Impact Statement
for Glass Manufacturing Plants

Prepared by:

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Research Triangle Park, NC 27711

1. The promulgated standards of performance will limit particulate matter emissions from new, modified, and reconstructed glass manufacturing plants. Section 111 of the Clean Air Act (42 U.S.C. 7411), as amended, directs the Administrator to establish standards of performance for any category of new stationary source of air pollution that ". . . causes or contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare." Approximately 17 States located in all areas of the nation will be affected by these standards.

2. Copies of this document have been sent to the following Federal Departments: Labor, Health and Human Services, Defense, Transportation, Agriculture, Commerce, Interior, and Energy; the National Science Foundation; the Council on Environmental Quality; members of the State and Territorial Air Pollution Program Administrators; the Association of Local Air Pollution Control Officials; EPA Regional Administrators; and other interested parties.

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4. Copies of this document may be obtained from:

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1. SUMMARY

On July 20, 1977, a notice of intent to develop standards of performance for glass manufacturing plants was published in the Federal Register (42 FR 37213). Prior to proposal of the standards, interested parties were advised by public notice in the Federal Register (43 FR 11259, March 17, 1978) of a meeting of the National Air Pollution Control Techniques Advisory Committee to discuss the glass manufacturing plant standards recommended for proposal. This meeting occurred on April 5-6, 1978. The meeting was open to the public and each attendee was given an opportunity to comment on the standards recommended for proposal. As a result of this meeting several changes were made to the recommended standards. On June 14, 1979, glass manufacturing plants was added to the list of categories of stationary sources which the Administrator has determined may contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare (44 FR 34193).

On June 15, 1979, the Environmental Protection Agency (EPA) proposed standards of performance for glass manufacturing plants (44 FR 34840) under authority of Section 111 of the Clean Air Act. Public comments were requrested on the proposal and on the listing of glass manufacturing plants in the Federal Register publication. Thirty-three comment letters were received and 11 interested parties testified at the public hearing. These comments were made by glass manufacturers; an *ad hoc* industry group; a trade association; local, State and Federal government offices; and an environmental group. The comments that were submitted, along with the responses to these comments, are summarized in this document. The summary of comments and responses serves as the basis for the revisions that have been made to the standards between proposal and promulgation.

1.1 SUMMARY OF CHANGES SINCE PROPOSAL

A number of changes of varying importance have been made since proposal of these standards. One of the most significant of these is the change made to the regulation in response to comments that the establishment of the pressed and blown (other-than soda-lime) category had been based on an incorrect evaluation of the data. The pressed and blown glass melting standards are now set out in three subcategories: (1) borosilicate, 1.0 lb/ton (2) soda-lime and lead, 0.2 lb/ton and (3) other-than borosilicate, soda-lime, and lead, 0.5 lb/ton. These standards, as well as the others, are based on data which show their achievability. The definitions of the terms "pressed and blown glass," "lead recipe," and "borosilicate recipe" in Section 60.291 of the regulation have also been redrafted or added as a result of these changes. Further study and analysis also showed that the limits promulgated for the flat glass and wool fiberglass categories should be 0.45 lb/ton and 0.5 lb/ton, respectively. Where appropriate, the applicable impacts have been adjusted to reflect these uncontrolled emission rate and limitational changes. Refer to the Emission Control Technology section (2.2) of this document.

An adjustment was provided for in the regulation for the calculation of the furnace emission rate in order to take into consideration the fact that there are emissions at times of no production due to the maintenance of the molten glass at the proper temperature. Refer to the Emission Control Technology section (2.2) of this document.

A change was made to the proposed test method. The promulgated standards require that the filter box temperature for EPA Method 5 tests be maintained at up to 350°F as opposed to the proposed temperature of 250°F. Section 60.296(b) was redrafted accordingly. Refer to the Test Methods and Monitoring section (2.8) of this document.

Another change was made in response to comments that the definition of the affected facility was ambiguous. Section 60.290 of the Regulation was changed to clarify the definition of the affected facility. Refer to the Clarifications section (2.9) of this document.

The introductory sentence of Section 60.291 of the regulation was changed to better define the meanings of the Section's defined terms.

Table 2-1. LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR THE GLASS MANUFACTURING INDUSTRY (CONTINUED)

Commenter*	Affiliation
D-23	Ronald A. Friesen, Chief Industrial Project Evaluation and Control Safety Development Branch State of California Air Resources Board 1102 Q Street Post Office Box 2815 Sacramento, California 95812
D-26	William V. Skidmore Acting Deputy General Counsel General Counsel of the United States Department of Commerce Washington, D.C. 20230
D-27	Daniel J. Goodwin, Manager Division of Air Pollution Control Illinois Environmental Protection Agency 2200 Churchill Road Springfield, Illinois 62706
D-29, D-33	Joseph V. Saliga, President Society for Glass Science and Practices Post Office Box 166 Clarksburg, West Virginia 26301
D-30, F-1	Charles N. Frantz Acting Manager Environmental Control Department Owens-Illinois Post Office Box 1035 Toledo, Ohio 43666
D-31	Jeff Jacobson Plant Engineer Guardian Industries Corporation 11535 East Mountain View Kingsburg, California 93631

Table 2-1. LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR THE GLASS MANUFACTURING INDUSTRY (CONCLUDED)

Commenter*	Affiliation
F-1, G-3, G-5	Roger Strelow E. Donald Elliot Ad Hoc Glass Industry Air Quality Group Leva, Hawes, Symington, Martin & Oppenheimer 815 Connecticut Avenue, N.W. Washington, D.C. 20006
F-1, G-4	Ronald Moore Glass Container Division Engineering & Research Department Owens-Illinois Post Office Box 1035 Toledo, Ohio 43666
F-1	Larry Sculley, Manager Environmental and Natural Resources Practice Peat, Marwick & Mitchell & Company Washington, D.C.
F-1	Domhnall OBroin Society for Glass Science and Practices Post Office Box 166 Clarksburg, West Virginia 26301

Table 2-1. LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR THE GLASS MANUFACTURING INDUSTRY (CONTINUED)

Commenter*	Affiliation
D-16, F-1	Robert G. Dreyfuss Vice President, Technical Services Metropak Containers Corporation 1099 Wall Street West Lyndhurst, New Jersey 07071
D-17	Edward D. Switala Manager, Air Quality Owens-Corning Fiberglas Corporation Fiberglas Tower Toledo, Ohio 43659
D-18	George H. Lawrence, President American Gas Association 1515 Wilson Boulevard Arlington, Virginia 22209
D-19, D-32, F-1	Robert A. Drake, Technical Director Glass Packaging Institute 1800 K Street, N.W. Washington, D.C. 20006
D-20	Donald L. Shepherd, Environmental Engineer Hugh W. Jernigan, Jr. Environmental Engineering Technician North Carolina Department of Natural Resources and Community Development Division of Environmental Management 8003 Silas Creek Parkway Extension Winston-Salem, North Carolina 27106
D-21	John T. Harrsen Environmental Control Operation Lighting Research and Technical Services Operation General Electric Company, Nela Park Cleveland, Ohio 44112
D-22	Brendan T. Byrne, Governor State of New Jersey Office of the Governor Trenton, New Jersey 08625

Table 2-1. LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR THE GLASS MANUFACTURING INDUSTRY (CONTINUED)

Commenter*	Affiliation
D-8	C.M. LeCroy, Senior Chemist Forming Process Evaluation PPG Industries, Incorporated Post Office Box 949 Lexington, North Carolina 27292
D-9	Howard Lewis Director of Regulatory Affairs Adolph Coors Company Golden, Colorado 80401
D-10	George J. Tyler, Director New Jersey State Department of Environmental Protection Division of Environmental Quality John Fitch Plaza, CN027 Trenton, New Jersey 08625
D-11, F-1	J.N. Siegfried, Manager Community Environmental Control Johns-Manville Sales Corporation Ken-Caryl Ranch Denver, Colorado 80217
D-12	V.H. Sussman, Director Stationary Source Environmental Control Environmental and Safety Engineering Ford Motor Company One Parklane Boulevard Dearborn, Michigan 48126
D-12B, D-12C, F-1	Frank P. Partee, Principal Staff Engineer Compliance and Liaison Department Ford Motor Company One Parklane Boulevard Dearborn, Michigan 48126
D-13	Harry H. Hovey, Jr., P.E. Director, Division of Air New York State Department of Environmental Conservation 50 Wolf Road Albany, New York 12233

Sections 60.293 through 60.295 are now reserved, and proposed Section 60.293 (Test Methods and Procedures) is now Section 60.296. Refer to the Clarifications section (2.9) of this document for details.

The term "glass manufacturing plant" was deleted from Section 60.291. This term was determined to be unnecessary.

The term "glass production" has been replaced in Section 60.291 by the term "glass produced" to better describe the basis upon which compliance is to be determined.

The term "pot furnace" has been deleted from Section 60.291. This was done partially in response to a comment from the industry that the glass melting furnace described in the proposed definition is a "day tank." It was also pointed out that the designed production capacity for day tanks is more properly represented by 4,550 kilograms of glass produced per day. The definition was deleted as being unnecessary and the exemption was changed. Refer to the Modification, Reconstruction, and Other Considerations section (2.3) and Clarifications section (2.9) of this document.

The term "hand glass melting furnace" was added to Section 60.291 in order to define the new category of glass melting furnace being exempted from compliance with the standards. Refer to the Modifications, Reconstruction, and Other Considerations section (2.3) of this document.

The term "recipe" was deleted from Section 60.291 and sodium sulfate was included as a miscellaneous material for the "soda-lime recipe" definition.

Section 60.292(b) of the proposed regulation has been redrafted to more precisely describe the process by which the heating value for liquid and gaseous fuels are to be determined and has been changed to Section 60.296(f).

In response to additional comments from industry, the uncontrolled emission rates used in the impact analyses of the proposed standards were changed for both the container glass and flat glass categories. The representative uncontrolled emission rate used for proposal for container glass melting furnaces was 1.5 lb/ton, rather than 2.5 lb/ton. The representative uncontrolled emission rate used for proposal for flat glass melting furnaces was 2.0 lb/ton, rather than 3.0 lb/ton. Refer to the General Issues section (2.4) of this document.

1.2 SUMMARY OF IMPACTS OF THE PROMULGATED ACTION

1.2.1 Environmental Impacts of the Promulgated Action

The promulgated standards will reduce projected 1984 emissions from new uncontrolled glass melting furnaces from about 4,890 megagrams per year [Mg/yr] (5,390 tons/yr) to about 550 Mg/yr (610 tons/year). This is a reduction of about 90 percent of uncontrolled emissions. Meeting a typical State Implementation Plan (SIP), however, will reduce emissions from new uncontrolled furnaces by about 3,150 Mg/yr (3,475 tons/yr). The promulgated standards will exceed the reduction achieved under a typical SIP by about 1,190 Mg/yr (1,310 tons/yr). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new glass manufacturing plants.

The promulgated standards are based on the use of electrostatic precipitators (ESPs) and fabric filters, which are dry control techniques; therefore, no water discharge will be generated and there will be no adverse water pollution impact.

The solid waste impact of the promulgated standards will be minimal. Less than 2 Mg (2.2 tons) of particulate will be collected for every 1,000 Mg (1,102 tons) of glass produced. In some cases, this material can be recycled, or it can be landfilled if recycling proves unattractive. The current solid waste disposal practice among most controlled plants surveyed is landfilling. Since landfill operations are subject to State regulation, this disposal method is not expected to have an adverse environmental impact. The additional solid material collected under the promulgated standards will not differ chemically from the material collected under a typical SIP regulation; therefore, adverse impact from landfilling will be minimal. Also, recycling of the solids has no adverse environmental impact. The environmental impacts of the promulgated standards are summarized in Table 1-1.

1.2.2 Energy Impacts of the Promulgated Action

For model plants in the glass manufacturing industry, the total increased energy consumption that will result from the promulgated standards, including the amount attributable to SIP, ranges from about

Table 1-1. MATRIX OF ENVIRONMENTAL AND ECONOMIC IMPACTS OF THE PROMULGATED ACTION

IMPACT / ACTION	Air	Water Pollution	Solid Waste	Energy	Noise	Economic	Inflationary
Option I (Proposed standards)	$+3^{xx}$	0	-1	-1^{xx}	0	-1^{xx}	-1^{xx}
Option II	$+2^{xx}$	-1^{xx}	-1	-1^{xx}	0	-1^{xx}	-1^{xx}
No Standards or Delayed Standards	0	0	0	0	0	0	0

Key:
+ Beneficial Impact
- Adverse Impact

0 No Impact
1 Negligible Impact
2 Small Impact
3 Moderate Impact
4 Large Impact

x Short-term Impact
xx Long-term Impact
xxx Irreversible Impact

0.1 to 2 percent of the energy consumed to produce glass in new plants. The energy required in excess of that required by a typical SIP regulation to control all new glass melting furnaces constructed by 1984 to the level of the promulgated standards will be about 9.13×10^5 kilowatt-hours per year in the fifth year and is not considered significant. Thus, the promulgated standards will have a minimal impact on national energy consumption.

1.2.3 Economic Impacts of the Promulgated Action

Compliance with the standards will result in annualized costs in the glass manufacturing industry of about $8.5 million by 1984. Cumulative capital costs of complying with the promulgated standards for the glass manufacturing industry as a whole will amount to about $28 million between 1979 through 1984. The percent price increase for products from new plants necessary to offset costs of compliance with the promulgated standards will range from about 0.3 percent in the wool fiberglass category to about 1.8 percent in the container glass category. Industry-wide, the price increase for products from new plants will amount to about 0.7 percent. The economic impacts of the promulgated standards are summarized in Table 1-1. These economic impacts are reasonable.

2.0 SUMMARY OF PUBLIC COMMENTS

The list of commenters and their affiliations is shown in Table 2-1. Thirty-three letters contained comments and 11 people testified at the public hearing relative to the proposed standards and Volume I of the Background Information Document. The significant comments have been combined into the following nine major areas:

1. Need for Standards
2. Emission Control Technology
3. Modification, Reconstruction, and Other Considerations
4. General Issues
5. Environmental Impacts
6. Economic Impacts
7. Energy Impacts
8. Test Methods and Monitoring
9. Clarifications

The comments and issues and the responses to them are discussed in the following Section of this chapter. A summary of the changes to the standards is included in Section 1.1.

2.1 NEED FOR STANDARDS

Several commenters questioned the need for standards of performance for the glass manufacutring industry. Standards of performance are promulgated under Section 111 of the Clean Air Act. Section 111(b)(1)(A) requires that the Administrator establish standards of performance for categories of new, modified, or reconstructed stationary sources which in his judgment cause or contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare. The overriding purpose of standards of performance is to prevent new air pollution problems from developing by requiring the

Table 2-1. LIST OF COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR THE GLASS MANUFACTURING INDUSTRY

Commenter*	Affiliation
D-2B, D-15, F-1, G-1	Werner Ganz Director of Engineering - Facilities Libbey-Owens-Ford Company Technical Center 1701 East Broadway Toledo, Ohio 43605
D-4B	Fresno County Air Pollution Control District 1246 "L" Street Fresno, California 93721
D-5	George B. Zurheide, Vice President Environmental Engineering CertainTeed Corporation Post Office Box 1100 Blue Bell, Pennsylvania 19422
D-6	Daniel S. Welebir, R.S., MPH Environmental Health Director San Joaquin Local Health District 1601 East Hazelton Avenue Post Office Box 2009 Stockton, California 95201
D-6, D-7, F-1, G-2	J.T. Destefano, Director Safety, Health and Environmental Affairs PPG Industries, Incorporated 1000 RIDC Plaza Box 2811 Pittsburgh, Pennsylvania 15230
D-7A	G.H. Mosely, Manager Environmental Control Corning Glass Works Corning, New York 14830

*These designators represent docket entry numbers for Docket OAQPS 79-2.
These docket entries are available for public inspection at:
U.S. Environmental Protection Agency, Central Docket Section
Room 2902
Waterside Mall
401 M Street, S.W.
Washington, D.C. 20460

application of the best technological system of continuous emission reduction which the Administrator determines to be adequately demonstrated. The 1977 Amendments to the Clean Air Act added the words, "in the Administrator's judgment," and the words, "may reasonably be anticipated," to the statutory test. The legislative history for these changes stresses two points: (1) the Act is preventive, and regulatory action should be taken to prevent harm before it occurs; and (2) standards should consider the cumulative impact of sources and not just the risk from a single class of sources.

The 1977 Amendments to the Clean Air Act also required that the Administrator promulgate a priority list of source categories for which standards of performance are to be promulgated. The Priority List, 40 CFR 60.18, was proposed in the Federal Register on August 31, 1978 (43 FR 38872). Glass manufacturing was ranked thirty-eighth on that list. On June 14, 1979, the Administrator listed glass manufacturing (44 FR 34193) among the categories of stationary sources which contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare. Even though glass manufacturing had been included on the proposed priority list, it was listed because the priority list had not been finalized.

Commenters questioned the ranking of glass manufacturing as thirty-eighth on the proposed priority list and questioned basing the decision to add glass manufacturing to the list of significant source categories on the proposed priority list. Development of the priority list was initiated by compiling data on a large number of source categories from literature resources. Major stationary source categories were then subjected to a priority ranking procedure using the three criteria specified in Section 111(f) of the Act. The procedure ranks source categories on a pollutant-by-pollutant basis. In this ranking, first priority was given to the quantity of emissions, second priority was given to the potential impact on health or welfare, and third priority was given to mobility. This procedure resulted in glass manufacturing being ranked thirty-eighth on the proposed priority list.

The ranking of glass manufacturing on the proposed priority list was reviewed when deciding to establish new source performance standards for glass manufacturing plants. However, this review was made only for comparison with other actions that EPA was considering. The Priority List was only used for comparison purposes because the Priority List had not been finalized.

Another study was conducted to investigate the glass manufacturing industry in more detail. This study resulted in the development of a Background Information Document (BID), Volume I which specifically addressed the industry in terms of its structure, processes, and emission control techniques. The BID also described modification and reconstruction, alternative regulatory options, and the environmental, economic, and energy impacts that would be associated with the implementation of the various regulatory options. The decision to develop these standards was based on the BID study but weighed factors similar to those considered in the development of EPA's Priority List. National glass production is estimated to grow annually at a rate of up to 7 percent through 1984; the industry, while concentrated in 17 States, is not geographically tied to either markets or resources, thereby having relative mobility; and the industry is a significant contributor to air pollution, as well as having a high ranking with regard to potential emission reduction. These factors, as discussed in the preamble (44 FR 34841) to the proposed standards, led to the development of these standards of performance. Each of these factors was questioned by commenters.

Commenters questioned the glass manufacturing industry's ability to locate its plants in order to avoid stringent SIP regulations. In adding glass manufacturing to the list of stationary source categories, EPA also explained that new glass manufacturing operations could be located in States which have less restrictive SIP regulations. Industry commenters explained that raw material, customer, and financial considerations were much more important in determining plant location than the stringency of a particular State's environmental regulatory scheme.

All of these factors need to be taken into consideration in deciding where to construct a new facility. What was meant to be emphasized was the relative flexibility in location that a glass manufacturer has in locating a new plant. Manufacturers who have the freedom to locate a new plant with only minor restrictions caused by raw material suppliers and product market are considered to have mobility. Glass manufacturing plants are not restricted to locating in a particular region of the country as would a coal mine or a stone quarry. For this industry, raw materials and glass products can be and are shipped across the country.

The glass industry, due to its relative mobility, could readily locate in States with less stringent standards or compliance deadlines. This has in fact occurred in at least one State where, at a public hearing, a glass industry representative specifically suggested that his company would relocate and construct new plants in another State to avoid having to "spend multi-million dollars for air pollution control equipment." This was shown to be somewhat of a trend by the State involved when it was found that in the past five years in excess of 10 percent of the State's glass furnances have been shutdown and no new ones constructed (docket entry OAQPS 77/1-IV-D-10). This is especially significant while considering the glass industry's nationwide production increases in the past several years. One purpose of these nationally applicable standards is to avoid situations in which industries could be lured to one State from another just by virtue of there being a less stringent regulation in effect.

Commenters suggested that particulate emissions from glass manufacturing plants do not contribute significantly to air pollution. These commenters explained that the estimated reduction of 1,620 tons/yr of particulate emissions from glass manufacturing plants is small in comparison to the total quantity of nationwide particulate emissions and to the quantity of emissions from other industries.

Almost any industry by itself accounts for a small portion of the Nation's total emissions. The 1,620 tons/yr. estimate of emissions reduced by the proposed standards was the quantity attributable to the proposed standards and neglected the emission reduction attributable to SIP regulations. In addition, this quantity only applied to glass manufacturing plants estimated to be built within a 5 year period, i.e., new sources. The total emissions reduced by the promulgated standards for new sources, including the emissions reduced by SIP regulation, is about 4,800 tons/yr. in the fifth-year. Also, these emissions only originate in about 20 States.

Specifically referred to by the commenter was the National Asphalt Pavement Association case [539 F.2d 775 (1976)]. The commenter implied that EPA, in that case, relied for its "significance" determination on a 1967 study estimating controlled emissions from the subject industry to increase from 243,000 tons/year to 403,000 tons/year in 1977. That would be the fifth year annual particulate emissions increase of 160,000 tons. The commenter went on to compare the study's increase to the increase in the amount of particulate emissions estimated by EPA to be emitted in 1983 by glass manufacturing plants having to meet typical SIP requirements (1,620 tons/yr), noting the difference between 160,000 tons/yr and 1,620 tons/yr.

What the commenter failed to note was the Court's determination in "National Asphalt," in the paragraph following the discussion of the study, that the Administrator never relied on the disputed 1967 study to estimate the industry's level of controlled emissions. The Court instead found that the Administrator based his decision to develop standards on uncontrolled emissions, stringencies of SIP's, the number of existing plants, and the expected rate of growth in the number of plants. At no time in the "National Asphalt" opinion did the Court find a specific quantity of emissions to be "significant" as alleged by the commenter.

A figure that was offered to the Court, in "National Asphalt," for consideration was an estimate, made by the petitioning company, of the industry's total annual particulate emissions for 1972 amounting to 40,000 tons. Noting this figure, it is interesting to compare an estimation made by EPA that in 1976 the total annual particulate emissions for the glass manufacturing industry were approximately 20,000 tons.

Regardless of the quantity of emissions estimated to be attributable to an industry, the Administrator is called upon in the Clean Air Act to evaluate an industry's contribution to air pollution and make a determination as to the significance of the subject industry's emission contribution. A firm definition of "significant" contribution cannot be applied nationwide due to variations in topography, emission source distribution, and heights from which the pollutant is emitted. Instead it is necessary that the Administrator make a determination of "significance" on an industry-by-industry basis. However, general criteria are presently being used to develop standards for sources on the priority list. If a source category includes sources that may emit about 110 Mg per year and show growth potential, then standards are being developed. In addition, as noted in the preamble (44 FR 49223) to the final priority list (40 CFR 60.16); the Administrator may develop standards for sources not on the priority list, especially certain minor sources.

In the case of the glass manufacturing industry, the Administrator has determined that particulate emissions from new or modified glass manufacturing plants will contribute significantly to air pollution, even though the total amount of emissions is a small portion of the Nation's total particulate emissions and this industry has been determined to significantly contribute to the Nation's total emissions.

The quantity of emissions for an industrial category is not the only criterion considered. With regard to public health and welfare, the submicron size of most glass melting furnance-generated particulates, among other factors, requires consideration. (docket entry OAQPS-77/1 IV-D-10.) Of special concern is the capability of these submicron particles to by-pass the body's respiratory filters and penetrate deeply into the lungs. In excess of 30 percent of the particles less than 1 micrometer in size that penetrate the pulmonary system are deposited there. These particulates also have fairly long lives in the atmosphere and can absorb toxic gases, thus leading to potentially severe synergistic effects when inhaled.

A report prepared by the National Academy of Sciences discussed that while population and regional variables such as temperature, relative humidity, nutritional state, exercise, and coexistent pulmonary and circulatory disease should be taken into account in analyzing the effects of inhaled particles, particles that are soluble in the respiratory tract fluid, such as the ones emitted by glass melting furances, systemic uptake may be relatively complete for all deposition patterns. It was emphasized that as a result of this exposure local toxic and/or irritant effects may result.

Commenters suggested that particulate emissions from glass manufacturing plants do not contribute significantly to air pollution because Class I Prevention of Significant Deterioration (PSD) increments were not exceeded. The fact that emissions from a single plant would be less than the Class I PSD increment does not show that the category should not be listed. First, the test is whether the category, not an individual plant, contributes significantly. Second, although a single plant might not exceed a Class I increment, it could contribute significantly to total level of emissions in excess of the increment. Most importantly, the major purpose of Section 111 is to "prevent new air pollution problems." National Asphalt Pavement Association v. Train, 539 F.2d 775, 783 (D.C. Circ., 1976). That is, new source performance standards should prevent standards of PSD increments from being threatened by requiring maximum control of new sources. It is, therefore, not necessary to show that individual sources in the category would violate an increment.

Commenters questioned the establishment of standards for glass manufacturing plants before the establishment of standards for source categories with a higher priority. The priority ranking in 40 CFR 60.16 is indicated by the number to the left of each source category and is used to decide the order in which new projects are initiated. However, this is not necessarily an indicator of the order in which projects will be completed. The establishment of these standards began before the priority list was proposed, as indicated in the notice of intent to develop an NSPS published in the Federal Register on July 20, 1977 (42 FR 37213). Therefore, because the establishment of these standards began before the priority list was promulgated, establishment of glass manufacturing standards before establishment of standards for source categories with a higher priority is appropriate. It would also be pointless and wasteful to postpone the development of a source category project already started simply because the source category is lower on the priority list than other source categories.

Based on the judgment that particulate air pollutants from glass melting furnaces contribute significantly to air pollution, which may be reasonably anticipated to endanger public health or welfare, the EPA listed glass manufacturing plants as a source category necessitating the establishment of new source performance standards. Comments, as discussed above, have not led to a change in this decision.

Several commenters suggested that standards of performance should have been developed for NO_x and SO_2 emissions, in addition to standards for particulate emissions. In deciding to regulate particulate emissions only, consideration was given to the possible regulation of NO_x and SO_2 emissions. The relative contributions to air pollution that NO_x and SO_2 emissions from glass manufacturing plants present is recognized and has been considered. However, the analysis of the glass manufacturing industry did not find control techniques for NO_x and SO_2 adequately demonstrated. Therefore, new source performance standards were not proposed for the control of NO_x and SO_2.

Several States have enacted or are in the process of enacting regulations mandating the control of NO_x and SO_2 emissions from manufacturing processes such as glass manufacturing. Means of control are being developed by industry and the Office of Research and Development and applied for both NO_x and SO_2 in an attempt to comply with these State regulations. Control techniques for NO_x and SO_2 may be demonstrated; however, the presently available analysis has not evaluated these techniques fully. If, at the time of the fourth-year regulatory review, control techniques are found to be adequately demonstrated for the control of NO_x and SO_2 emissions from glass manufacturing plants, an in-depth review of standard of performance for NO_x and SO_2 from glass manufacturing plants could be undertaken.

Commenters suggested that standards of performance should have been developed for SO_2 rather than standards for particulate matter. These commenters pointed out that the ranking of pollutants used to establish EPA's proposed priority list was in the following order for glass manufacturing: SO_2, particulate matter, and NO_x. They explained that this ranking, which assigns a relative priority to pollutants based upon the potential impact of NSPS, should lead the EPA to develop SO_2 standards before particulate matter standards. However, the EPA considers it appropriate to base the listing decision partially on one form of emissions (i.e., SO_2), and yet propose a standard for one of the others (i.e., NO_x or particulate matter).

Again, as stated previously, the analysis of the glass manufacturing industry did not find control techniques for emissions other than particulates to be adequately demonstrated. Due to limited resources and the immediate feasibility of setting standards for the control of particulate emissions, it was decided to proceed with the development of these regulations. It was considered to be impractical and wasteful to delay the progress of these standards to wait for the possibility that some means of control for the other pollutants (SO_2 and NO_x) could be immediately investigated.

Several commenters mentioned that certain emissions, such as fluoride, boron, and lead emissions, were not specifically regulated. These emissions are unique to glass manufacturing plants in a small portion of the glass manufacturing industry and are, therefore, small in amount. The development of these promulgated standards of performance was based on industry-wide considerations. Thus, the particular concern was concentrated on particulates, SO_2, and NO_x, that is, pollutants common to all the glass manufacturing industry. Review of these emissions could occur at the fourth-year regulatory review.

One commenter suggested that the EPA did not seriously consider the alternative of rejecting New Jersey's Governor Byrne's petition that standards of performance be established for glass manufacturing plants. As a result of the Governor's petition, an evaluation of his claims was made. This petition was submitted with the same intent that an application of the Governor of a State under Section 111(g)(2) would today be submitted. A notice of intent to develop the standards of performance for glass melting furnaces was published in the Federal Register (42 FR 37213) on July 20, 1977.

In the performance of the analysis, all relevant factors were taken into consideration in determining whether to proceed with or reject the Governor's petition that new source performance standards be developed for the glass manufacturing industry. In this case, the Administrator has determined that glass manufacturing plants contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare. Therefore, the Governor's petition was evaluated, found to have merit, and resulted in the proposal of these standards in June 1979.

2.2 EMISSION CONTROL TECHNOLOGY

One commenter suggested that the limitations imposed by the standards of performance invite borderline compliance status in all of the four major categories of glass manufacturing plants. This commenter stated that not providing a sufficient regulatory cushion does not follow in the intended spirit of the development of these standards. Other commenters questioned the ability of the glass manufacturing industry to achieve compliance with the standards.

Upon reviewing data submitted during this rulemaking, some of the standards have been changed to more accurately reflect the emission control capabilities of the four categories of glass production. The promulgated standards of performance are based on test results conducted in accordance with EPA Method 5 and the Los Angeles Air Pollution Control District (LAAPCD) method, as discussed in the preamble to the proposed standards. The standards are based on emission data and detailed engineering and cost analyses and were not developed to invite borderline compliance, as suggested by the commenter. The promulgated standards reflect, for each individual category of glass manufacturing plant, the best system of continuous emission reduction, which the EPA has determined to be adequately demonstrated taking into consideration the costs, and nonair quality health and environmental, and energy impacts associated with their attainment.

The container glass and pressed and blown (soda-lime) glass standards are the only ones to remain as they were proposed. The standards for the wool fiberglass and flat glass categories, as well as most of standards for the pressed and blown glass sub-categories, were changed. In addition, pressed and blown glass is now separated into three sub-categories: borosilicate; soda-lime and lead; and, other-than borosilicate, soda-lime, and lead. Refer to the discussions in the specific subsections in this section for an explanation of the changes to these standards.

Several commenters were concerned that technology transfer had been used in setting some of the standards. Specifically referred to were the wool fiberglass and flat glass standards.

The promulgated standards have been based on verified test results. These tests were conducted on glass melting furnaces for each category and sub-category of glass formulation that are covered by these standards. However, this is not to say that technology transfer is not a valid means for determining an available control technology appropriate for the development of new source performance standards. The Clean Air Act does not require that the best system of continuous emission reduction for a particular source category must have been actually applied to sources in that category but rather that the system should be adequately demonstrated.

The decision to regulate the glass manufacturing industry as four categories of production was made based on technological information received and collected prior to and subsequent to proposal as well as regulatory simplification, as mandated by Executive Order 12044. In assessing the entire glass manufacturing industry it was determined that the source to be regulated, the glass melting furnace, varied technologically in principally four areas of production (container glass, pressed and blown glass, fiberglass, and flat glass). In the process of determining the major categories of glass production it was found that the pressed and blown glass category had, within itself, areas of production that were individually unique as to their potential for particulate emission control. As a result, the pressed and blown category was divided into three subcategories: borosilicate, soda-lime and lead, and other-than borosilicate, soda-lime, and lead.

It was not practically possible to test glass manufacturing plants melting all types of batch formulations. The Standard Industrial Classification Manual lists in excess of 80 final glass products. Each of these glass products is liable to have several glass formulations depending upon the final use of the product, the color of the final product, or the manufacturer of the product.

Despite the numerous formulations utilized throughout the industry it was found, through data and information received, that the four major categories and the three subcategories for pressed and blown glass selected for these standards adequately represent the emission reduction levels achievable for the melting of all glass formulations. There is no reason to believe that any affected facility, as defined in the regulation, will not be able to comply with the standards. The standards set out in the regulation represent levels of control typically achievable by manufacturers of all types of glass.

Control device design considerations are influenced by process factors such as; glass type; production rate; furnace size; volume flow, temperature, and moisture of the gas stream; amount, type, and size of particulate; the resistivity of the particulate and gas stream; and the presence of other pollutants. These process factors have been taken into account by dividing the industry into four major categories with certain subcategories. Each category and subcategory represents a set of process factors that typify that category or subcategory. Thus, by segmenting the glass manufacturing industry into categories and subcategories, where data showed this necessary, process factors that influence control device design considerations have been considered. Also, by segmenting the glass manufacturing industry into these categories and subcategories, the influence of the process factors has been minimized. Therefore, collecting pertinent information and then establishing standards by categories has allowed the development of achievable standards for the glass manufacturing industry. Thus, variations in these process factors presented by the manufacture of the 80 or so glass types do not preclude the achievability of the standards.

Process factors, as mentioned above, are generally known before the design of a control device. In the glass manufacturing industry, these factors have been characterized by EPA, by individuals and by industry personnel. During the design of a control device used to bring a glass melting furnace into compliance with the standards, an air pollution control engineer would review available information and appropriately size the control device. Design procedures, while generally the same from design to design, require different information for each design. Information on the volume flow, temperature, and moisture of the gas stream can be readily determined from design considerations for the glass melting furnace. In addition, the amount of particulate, the type of particulate, and the resistivity of the particulate and gas stream can be determined from glass melting furnace design considerations, including the glass type, the size of the furnace, and the production rate. The size of particulates from glass melting furances has been characterized. Such factors were considered in establishing the promulgated standards of performance.

A commenter suggested that EPA, in promulgating the standards as proposed, will not allow industry to choose its method of compliance from a wide range of methods available to it. The proposed standards of performance were based on the criteria set forth in Section 111 of the Clean Air Act for the best available continuous method of emission reduction that has been adequately demonstrated. The promulgated standards are based on the emission limitations that are achievable and are not meant to exclude any one method of control. Many forms of control have been investigated in the development of these standards. However, not all forms of control are capable of achieving the degree of control necessary to comply with the standards; this conclusion is based on presently available information. For example, scrubbers have been investigated in the development of these standards and in virtually all cases were found not to achieve the new standards. This does not mean that scrubbers cannot be designed to effectively control glass plant particulate emissions and to achieve compliance with the standards. Means of emission reduction, not presently able to meet the standards, could possibly be designed to meet them at a later date.

During the public comment period, comments were received concerning the use of process modifications as a method of reducing particulate emissions from the glass melting furnace. Many of the comments indicated that during the development of the Background Information Document, (BID) Volume I, EPA did not perform a thorough investigation into the use of process modifications as a continuous emission reduction technique. These commenters also stated that process modifications are effective methods of emission control, and, therefore should be considered as alternatives to the add-on control devices as the basis for these standards of performance.

In light of these comments and the need to resolve this issue, a re-examination into the use of process modifications was performed. Before attempting to address these comments, a review of the material used in the development of the section on process modification in the BID, as well as a review of the BID itself, was performed. Throughout this review each industry segment was dealt with separately.

Background Material. A review of the docket material as it relates to the use of process modifications in the flat glass manufacturing industry reveals that the types of process changes being employed by this segment of the industry to control air emissions are primarily designed to reduce both the entrainment of dust in the combustion gases and the volatilization of the melt. In Source Assessment: Flat Glass Manufacturing Plants, EPA 600/2-76-0326 (docket entry OAQPS 77/1-II-A-3), the elimination of less than 44 micrometer (minus 325-mesh) particles in the feed material and the addition of water to the glass batch are two techniques identified as process modifications that will minimize dust entrainment. The flat glass source assessment report further states that the volatilization of the melt can be reduced by controlling the feed material, by designing the furnace properly, by lowering the furnace temperature with electric melting, and by reducing salt cake (sodium sulfate)..

Salt cake or another sulfate is a necessary flux that prevents scum formation in the melting furnace and aids in the melting process. Manufacturers reduce salt cake by eliminating excess sodium sulfate through glass formulation changes. However, exact details are considered proprietary. The flat glass source assessment report states that by improving the overall furnace efficiency with techniques, such as:

(1) improving the refractories for corrosion resistance and better insulation;

(2) increasing the checker volume for better heat recovery;

(3) controlling combustion to produce large luminous flames that eliminate hot spots in the furnace and provide better heat transfer to the melt and applied instrumentation to regulate air/fuel mixtures;

(4) monitor furnace temperature and stack gas composition; and

(5) automatically charge the batch into the furnace and reverse the air flow through the regenerative checkers;

emissions from fluxing agents will be lowered. As a result of these process changes, the flat glass source assessment report states that fuel consumption rates in the flat glass manufacturing industry have decreased significantly.

In addition, the flat glass source assessment report identified furnace temperature as having a profound influence on the particulate emission rate. The report referred to two studies which indicated that emission rates increased exponentially with temperature. The furnace temperature can be lowered by improving furnace efficiencies, by decreasing the production rate, and by utilizing supplemental electric heating.

Although the flat glass source assessment report identified electric boosting as a means of lowering furnace temperature, thereby reducing emissions, it also stated that due to the rather large production rates typical of that segment of the industry, electric boosting has been found to be very difficult to employ in flat glass production. The difficulty of utilizing electric boosting in the flat glass manufacturing industry was further illustrated in a study supplied by PPG Industries, Incorporated (PPG) [docket entry OAQPS 77/1-II-I-67]. It is PPG's belief that electric boosting is not yet proven technologically on the scale required by PPG; but on a trial basis, (utilizing small-sized furnaces) electric boosting has reduced emissions. PPG's study also provided information on experimentation with batch pelletizing and salt cake reduction in which a 30 percent reduction in particulate emissions was reported. PPG also indicated that further work must be performed in these areas before they can be used on a large scale.

A review of the docket material with respect to the <u>container glass</u> industry reveals that process modifications are used extensively by this segment of the industry. Glass formulation changes have reduced the use of materials, such as sulfates, fluorides, and selenium, and the use of arsenic has virtually been eliminated (docket entry OAQPS 77/1-II-I-41).

The container glass industry has performed extensive work in modifying furnace design to increase fuel efficiency which can in turn lead to a decrease in combustion products, a decrease in dust entrainment by hot combustion gases over the melting glass batch, and a possible decrease in furnace temperature (docket entry OAQPS 77/1-II-A-5). The methods currently in practice to improve furnace efficiency are virtually the same as the techniques used by the flat glass manufacturing industry, except that electric melting and electric boosting have been used to a much greater extent. Innovative techniques, such as batch preheating and agglomeration, have been researched by a joint EPA and Department of Energy (DOE) effort but are still considered to be in the developmental stages (docket entry OAQPS 77/1-II-B-248).

The use of all-electric melting and electric boosting in the container glass industry has been wide-spread. Approximately half of the container glass manufacturers in the United States have electric boosters; and at least one hundred all-electric furnaces, ranging in size from 4 to 140 tons/day, are in operation throughout the world (docket entry OAQPS 77/1-II-I-40).

The docket contains several examples of the type of emission reductions which can be attained by employing electric boosting. In a letter from Mr. K.B. Tanner Jr. to Mr. D.R. Goodwin (EPA), dated October 12, 1977 (docket entry OAQPS 77/1-II-D-179), Mr. Tanner presented emission data for one of Brockway Glass Company's plants in Pomona, California, in which particulate emissions were reduced through the use of electric boosting to a level of 0.68 lb/ton. Mr. H.R. Carroll of the Glass Container Corporation in a letter to Mr. Herring (EPA) dated October 14, 1977 (docket entry OAQPS 77/1-II-D-183), presented test data for the Knox, Pennsylvania, plant which indicated a particulate emission level of 1.2 lbs/ton. In still another letter from Mr. L.E. Cruser of the Ball Corporation, to Mr. Ronald Boone (State of North Carolina), dated January 20, 1977 (docket entry OAQPS 77/1-II-D-117), test data were presented which indicated a particulate emission level of 1.5 lbs/ton.

Also contained in the docket is a letter from Mr. Robert Drake of the Glass Packaging Institute to Mr. D.R. Goodwin (EPA), dated September 19, 1978 (docket entry OAQPS 77/1-II-D-248). Mr. Drake claimed that new melting furnaces that would be subject to the New Source Performance Standards could generally achieve a particulate emission limitation of 0.8 lb/ton of glass produced by employing available process modifications, including electric boosting.

The docket contains a letter from Mr. John F. Blumenfeld, of the Hartford Division of Emhart Industries, Inc. to Ms. Margaret A. Timothy, (JACA, Inc.) dated May 19, 1978 (docket entry OAQPS 77/1-II-I-65, exhibit 3), in which a different view of electric boosting is presented. In this letter, Mr. Blumenfeld states that electric boosting shortens the life-span of a furnace, since it results in higher temperature molten glass and usually is used to increase the pull rate. Both of these factors increase the furnace's rate of erosion. Mr. Blumenfeld is also of the opinion that fuel firing rates in a boosted furnace are generally higher than in a non-boosted furnace. However, the letter continued by stating that although the tons per furnace life are greater with an electric boosted furnace than for the non-boosted furnace (25 percent increase in factory output), this increase is often off-set by the cost of electricity.

In attempting to assess the benefits of all-electric melting in the container glass industry, the docket contains an article entitled, "Energy Use and Air Pollution Control in New Process Technology" (docket entry OAQPS 77/1-II-I-40). The article states that the cold top electric melter has many benefits. Since there is no fossil fuel being fired, SO_2 emissions are reduced significantly. In addition, NO_x is not created because there is no combustion taking place in the air's atmosphere above the melt. The only air emissions are from the decomposition of carbonates, sulfates, nitrates, etc. in the glass batch. There is also no dusting due to the entrainment of batch ingredients as occurs when the high velocity flames of fossil fuel-fired melting tanks are in use. The exhaust is almost entirely

CO_2 plus a quantity of SO_2. The all-electric melter also provides no water effluent streams.

The benefits of electric melting are also contained in an article entitled, "Practical Data for Electric Melting" by Robert E. Loesels (docket entry OAQPS 77/1-II-I-23). The article states that electric melting utilizes 65 to 88 percent of the direct heating energy. It also states that the cost of an electric furnace is less due to the fact that there is no need for regenerator chambers, port racks, checkers, flues, reversing valves, and, in most cases, stacks are eliminated.

The problems associated with electric melting in the container glass industry are illustrated in an article entitled, "Pollution Control" by Roy S. Arrandale (docket entry OAQPS 77/1-II-I-16, December 1974). Mr. Arrandale is of the opinion that electric melting shortens the life-span of the furnace, due to its severe attack upon the refractories. Mr. Arrandale continues in his article by stating that the electric furnaces now being built are generally of the 100 tons/day or less production capacity. It is Mr. Arrandale's opinion that these furnaces are too small to adequately supply molten glass to the container forming process and, therefore, are uneconomical production-wise for the container glass industry. Also, one of the major problems associated with electric melting is that the furnaces are restricted to glasses having suitable electrical conductivity characteristics and mild chemical attack on molybdenum or graphite electrodes at molten glass temperature. Contrary to Mr. Loesel's statements, Mr. Arrandale is of the opinion that the cost of an electric furnace will be very high, due to the fact that electric power is becoming shorter in supply and the energy cost for the furnace is doubled. Mr. Arrandale's article also stated that the electric melter is not thermodynamically efficient.

Also contained in the docket is an engineering study program entitled, "Glass Furnace Emissions Abatement: Particulate Control Through Process Modification," prepared for the Glass Container Manufacturers' Institute (GCMI) by TRW Systems Group (docket entry OAQPS 77/1-II-I-9A). This is a parametric analysis of a number of variables that were performed utilizing a generalized computer program.

The process variables that were evaluated were melt temperature and stack gas temperature. The chemistry variables evaluated were salt cake input concentration, water concentration in the gas-melt equilibrium zone, steam injection into process effluent, calcium carbonate injection into the process effluent, and the utilization of fuel oil with varying sulfur contents.

The study concluded that the most effective process modifications, identified as resulting in 60 percent to 70 percent particulate emission reductions, are the reduction of the glass melting temperature to below 2400°F and the use of a dry air curtain between the high water vapor concentration flame combustion zone and the melt surface. The study also added that neither of these process modifications may be economically attractive because of reduced furnace capacity. In a review of this report, GCMI agreed that the reduction of glass temperature to below 2400°F is not practical. As for the method of using a dry air curtain between the high water vapor concentration flame combustion zone and the melt surface, GCMI was of the opinion that further study is needed.

A review of the docket material as it pertains to process modifications in the pressed and blown glass industry reveals that the modifications of the feed material and the furnace design are virtually identical to the types of modifications employed in the container glass industry. The only real difference between the two categories is that electric melting is utilized to a much greater extent in the manufacture of pressed and blown glassware than in container glass production (docket entry OAQPS 77/1-II-A-7). The pressed and blown glass manufacturing industry is better adapted for the use of all-electric melting due to the small-sized furnaces employed by this segment of the industry.

In a position paper entitled, "Proposed Regulation Change for Pressed, Blown, or Spun Soda-Lime Glass Melting Furnaces," submitted by the Carr-Lowrey Glass Company (docket entry OAQPS 77/1-II-I-20), the point is raised that due to the research that has been done over the past few years, such as with the removal of volatile materials from the batch (i.e., sulfur and fluorides), particulate emissions have been reduced by as much as 50 percent. The paper further states that their Anchor-Hocking plant has not been able to develop a new batch formulation which would provide the necessary glass quality for Carr-Lowrey production requirements. The major contributing factor to this problem is the fact that the speciality glass requires very close control of the glass constituency in order to achieve the intricate forming that is characteristic of much of the production. Removal of the volatile components beyond a limited amount or other batch modifications would be a detriment to the forming characteristics. Additional batch ingredients would have to be added to the formulation, resulting in no net emission reductions. This position paper concluded that it would not be possible to make the significant process changes, such as decreasing the melter temperature, which would have a positive effect on emission reduction. Electric boosting in this industry does have a positive effect upon emission reduction, but the related costs are very high.

In a letter from Mr. J.T. Harrsen (G.E. Co., Inc.) to Ms. Margaret A. Timothy (JACA, Inc.), dated May 23, 1978 (docket entry OAQPS 77/1-II-I-65, exhibit 4), Mr. Harrsen was of the opinion that electric boosting in the pressed and blown glass industry has not been in use long enough to make a determination as to its effects on furnace life. In addition, Mr. Harrsen was of the opinion that all-electric melting is still considered to be in the experimental stages.

The topic of all-electric melting in the pressed and blown glass industry was also mentioned in an EPA trip report (docket entry OAQPS 77/1-II-E-21). Corning Glass representatives characterized cold crown vertical melting as follows:

> "no emissions; very expensive, due to high electric power costs; cannot melt all types of glass; unforgiving--tank control is critical; can be used for fluoride, opal and Pyrex seal beam headlights."

A review of the docket material as it pertains to process modifications in the wool fiberglass industry indicates that the electric furnace is used by individual fiberglass manufacturers and relatively low emission levels are reported. The future installation of electric furnaces in new fiberglass plants is uncertain due to the unclear energy situation production limitations, and the problem of the space requirement in converting from a liquid or gaseous fuel-firing furnace to an all-electric furnace (docket entry OAQPS 77/1-II-A-1).

Background Information Document. An examination of the section on process modifications in the BID reveals that many of the process changes discussed earlier are also contained in this section. The BID states that reducing the amounts of certain materials in the feed, increasing the use of cullet, installing sensing and controlling equipment, modifying the burner design and firing pattern, and utilizing electric boosting are examples of the types of process modifications employed by the glass manufacturing industry.

The BID also points out the benefits of some of the process changes. Certain process changes have caused the elimination of arsenic from the feed material in the container glass industry. In addition, the amounts of soda, fluorides, and selenium fed to the furnace have been minimized. Many process modifications offer the double benefit of lowering pollutant emission rates as well as lowering fossil fuel consumption rates. The BID further states that emission tests were not available to document the lowering of particulate emissions by the use of process modifications.

The BID also contains a discussion on electric boosting, in which it indicates that this technique decreases the required bridge wall temperature, decreasing the fuel consumption rate, which therefore decreases the particulate and gaseous pollutant levels. This discussion was also accompanied by references to indicate the type of emission reductions which have been associated with electric boosting. In a Glass Packaging Institute "Issue Paper," (docket entry OAQPS 77/1-II-D-11) it was reported that electric boosting has reduced particulate emissions to a level of between 0.68 to 1.76 lbs/ton, a range which is described as a rough estimate, due to the fact that some of these emission tests were not performed according to the specified EPA Method 5 procedures. Another reference is to a gas-fired/electric boost container glass furnace in which the particulate emission per kilogram of glass produced dropped 55 percent, along with the consumption of less energy (docket entry OAQPS 77/1-II-I-20). The BID concluded the discussion by stating that, in general, the levels of particulate emissions from glass melting furnaces using process modifications are indistinguishable from the uncontrolled emission levels.

The BID also contained a section on the use of all-electric melting in the glass manufacturing industry. A review of this section reveals that because the surface of the melter in a cold top electric furnace is maintained at ambient temperature and fresh raw batch materials are fed continuously over the entire surface, the emissions are greatly reduced. The gases discharged largely consist of carbon dioxide and water vapor. Construction costs are generally less since there are no regenerator chambers, port necks, checkers, flues, or reversing valves, and in most cases stacks are eliminated.

Because many of these melters do not have stacks, the level of emission control cannot be soundly documented. However, from the nature of the melting process, potential emissions can be deduced and relative amounts of emissions can be estimated. In general, all-electric melters have particulate emission levels of approximately 0.2 lb/ton in the production of soda-lime and borosilicate glasses. In addition, this can be accomplished with no changes in the solid waste or water pollution impacts.

All-electric melting is a relatively new technology in the glass manufacturing industry. Therefore, there are several limitations as to the application of this technique throughout the industry. Not all glasses possess the electrical properties required for successful all-electric melting. Additionally, the all-electric technology is not far enough advanced to satisfactorily produce glass in large quantities.

After reviewing the section on process modifications in the BID, along with the material used to develop that section, several conclusions can be reached. An attempt was made by EPA to formulate a comprehensive information base with respect to the use of process modifications in the glass manufacturing industry. Information was gathered from a wide variety of sources, including technical journals, private contractors' reports, and industry comments. In addition, industry was requested to supply any additional information which could possibly aid in the evaluation of this method of emission control (i.e., Section 114 letters).

The information that was compiled enabled EPA to present a rather accurate account of the types of process modifications employed by industry in controlling particulate emissions. The material also gave an indication as to the possible benefits, as well as the potential problems, that could occur when employing certain process changes. In addition, the material provided an indication as to the possible levels of particulate emissions that could be attained by certain segments of the industry when employing certain process changes. However, this study was by no means complete. Many issues concerning the use of process modifications were left unresolved. There was a general lack of evidence substantiating the efficiency of many of the process changes employed by industry to control emissions. This problem was compounded by the fact that several glass manufacturers considered the exact details of their process modifications as proprietary information.

Be that as it may, the lack of information does not indicate that EPA performed an inadequate investigation into the use of process modifications, nor does it indicate that the contents are in any way misleading or incorrect. What this does indicate is that a considerable amount of uncertainty exists with regard to the ability of process modifications to control particulate emissions in the glass manufacturing industry. This point is further illustrated when reviewing the docket material.

The docket material clearly indicates a diversity of opinion as to the performance capabilities associated with the use of process modifications as a method of continuous emission abatement. A process modification technique considered beneficial by one individual was also criticized as being a possible hazard by another individual. The docket also contains reports by industry representatives indicating that many forms of process modifications are still considered to be in their experimental stages. There are also reports which indicate that certain process changes can only be employed in a particular segment of the industry or at a particular production rate.

In view of the fact that, at the time of the study on the use of process modifications in the glass manufacturing industry, a considerable amount of uncertainty existed as to the use and the capabilities of this method as a continuous means of emission abatement, it can be concluded that the decision to base the NSPS on add-on control devices of demonstrated effectiveness was justified.

Comments Received After Proposal. The remainder of this discussion deals specifically with the comments on the use of process modifications in the glass manufacturing industry that were received after the proposal of the standards. While reviewing those comments, it became apparent that many of the commenters raised issues which have already been discussed in the Background Material and Background Information Document sections of this document.

The docket contains five comments concerning the use of process modifications in the flat glass industry. In a letter from Mr. J.T. Destefano (PPG, Inc.) to Mr. D.R. Goodwin (EPA) dated August 10, 1979 (docket entry OAQPS 77/1-IV-D-7), Mr. Destefano stated that PPG believes that process modifications are a preferable form of emission control and reduction for a flat glass furnace, rather than add-on controls. It is Mr. Destefano's opinion that certain process modifications are the best available control technology because they have been demonstrated, are a more reasonable means of achieving the goals of emission reduction, control all emissions rather than merely particulates, and are more reliable. However, Mr. Destefano was of the opinion that the ultimate level of control is uncertain at the present time. Mr. Destefano also attached eight test results for three of the PPG Industries, Inc. plants that have attempted process modifications. The particulate emissions ranged from 2.01 lbs/ton to 1.08 lbs/ton, with an average of approximately 1.41 lbs/ton. Mr. Destefano explained that three of the furnaces at these three plants employed salt cake reduction techniques, while the remaining furnaces used other raw material modifications. It has been PPG's position throughout the development of these standards that the exact details concerning several raw material modifications are considered proprietary (refer to Summary of Meeting Held Between EPA and PPG Industries Inc., dated August 21, 1979, docket entry OAQPS 77/1-IV-E-3).

Also included in the docket is a letter from Mr. V.S. Sussman of the Ford Motor Company, dated August 13, 1979 (docket entry OAQPS 77/1-IV-D-12). In this letter Mr. Sussman states that batch modifications (i.e., pelletized batch feed system and raw materials alteration) have decreased particulate emissions at their facilities by 59 percent on the average (assuming an uncontrolled emission rate of 3 lbs/ton with no energy penalties, no adverse environmental side effects, and with a relatively minimal cost). This emission reduction claim was also accompanied by test results from 22 furnaces, with only 5 of the 22 test results accompanied by emission data (docket entry OAQPS 77/1-IV-D-12B). This data does indicate that particulate emission levels are moving downward from 1.73 lbs/ton in 1974 to 1.05 lbs/ton in 1977. This translates to a particulate emission reduction of approximately 39 percent (15 percent assuming an average emission rate of 2.0 lbs/ton). Mr. Sussman also stated that an additional benefit of process modifications has been the reduction of SO_2 emissions by as much as 70 percent. The letter concludes by suggesting that process modifications should be a control option to achieve compliance with the standard set at 1.1 lbs/ton.

Mr. Frank Partee of the Ford Motor Company stated during the public hearing on the proposed standards of performance for new glass melting furnaces under Section 111 (docket entry OAQPS 77/1-IV-F-1) that a meaningful Option II should be established at a level which could be achieved by process changes, such as batch formula modifications. Mr. Partee is also of the opinion that a reasonable standard for flat glass production would be 1.1 lbs/ton.

Mr. Werner Ganz of the Libbey-Owens Ford Company in a letter to the Central Docket Section, dated September 5, 1979 (docket entry OAQPS 77/1-IV-D-15), stated that at their Lathrop, California, facility process modifications have reduced particulate emissions from 1.27 lbs/ton to 0.65 lb/ton. This translates to a 49 percent reduction in particulate emissions. Mr. Ganz also stated that process modifications reduce not only particulate matter emissions but other pollutant emissions as well. In addition, he pointed out that process modifications can eliminate any adverse environmental effects because disposal of residuals is reduced.

Again, the comments concerning the use of process modifications in the container glass industry were very similar to the type of comments presented earlier in the Background Material and Background Information Document sections of this document. The only comment that supplied additional information was a report prepared by Mr. Roger Strelow for the Glass Packaging Institute, dated September 14, 1979 (docket entry OAQPS 77/1-IV-D-19). Mr. Strelow presented stack test results from 10 container glass furnaces that have employed electric boosting. The results indicate an average particulate emission level of 0.44 lb/ton. It must be pointed out that although the standard may at times be achievable with the use of process modifications that achievability is not assured.

Also accompanying Mr. Strelow's comment was a report entitled, "Optimizing Operating Conditions to Reduce Stack Emissions From a Glass Container Furnace," by K.B. Tanner, Jr. (1975) In the report Mr. Tanner stated that increasing the production rate, and therefore the temperature, increases the particulate emission rate. If the bridge wall operating temperature is decreased 100°F, the result will be a 50 percent decrease in the emission rate. The report further indicated that a reduction of SO_2 emissions can be accomplished by careful furnace operation and selection of batch composition. Additionally, the formation of oxides of nitrogen, it was claimed, can be controlled by the flame temperature and availability of oxygen in the combustion zone. Mr. Tanner also reports that the use of carbon as a minor ingredient in a flint glass batch has reduced particulate emissions by a factor of two.

In addition to this report, Mr. Strelow's comments were accompanied by another report entitled, "Control of Fine Particulates From Continuous Melting Regenerative Container Glass Furnaces," by H. Simon and J.E. Williamson (1975). The report indicated that the future looks brighter for all-electric furnaces (which are usually too small and electric energy rates are too expensive to seriously compete with the larger fuel-fired furnace) in the event of gas use curtailment. Also, rate increases narrow the advantage now enjoyed by gas-fired equipment. The report further indicated that electric boosting is a proven aid in reducing air contaminant emissions from fuel-fired furnaces. Accompanying this statement were six test results of furnaces employing electric boosting as an emission control technique. The results indicated an average emission level of 1.47 lbs/ton, with a low of 1.25 lbs/ton (1972). The report also stated that with the use of minor operational variations in air-fuel ratio, batch moisture, and pull rates the average particulate emission level for five furnaces was 0.65 lb/ton. In addition to these results, the report stated that four tests were conducted on furnaces using operational variations and electric boosting. The test results indicated an average particulate emission level of 0.58 lb/ton. The report also contained test results from five all-electric melters which indicated a particulate emission level of 0.23 lb/ton. The report concluded with the statement that electric boosting and modification of the operating variables may allow some fuel-fired furnaces to operate with very low emission rates. It must be pointed out again that although the standard may at times be achievable with the use of process modifications that achievability is not assured.

Mr. Strelow's comments were also accompanied by another report entitled, "Use of Electric Boost to Reduce Glass Furnace Emissions," by R.J. Ryder. The purpose of Mr. Ryder's report was to describe methods that have been developed which permit acceptably accurate estimations to be made of emissions of particulates and NO_x from glass melting operations when electric boosting is used to provide temperature and emission reduction. The report, supplemented with test results, indicated that the use of electric boosting coupled with a decrease in above-the-melt temperatures were quite successful in reducing the emissions of particulates to approximately 0.58 lb/ton. In addition, emissions of NO_x were greatly reduced.

There were three comments received concerning the use of process modifications in the pressed and blown glass industry. In a letter from Mr. G.H. Mosely of Corning Glass Works, Inc. to Mr. D.R. Goodwin (EPA), dated December 15, 1978 (docket entry OAQPS 77/1-IV-D-7A, reference 7), Mr. Mosely states that process modifications are much more effective than add-on control devices in terms of energy utilization, initial capital cost, and operating and maintenance costs. In addition, Mr. Mosely believes that process modifications offer the benefit of eliminating any potentially hazardous solid waste. Mr. Mosely concluded by stating that process modifications should be considered the best demonstrated control technology for borosilicate-type glass. Mr. Mosely also attached test results from furnaces using a combination of emission reduction techniques such as batch composition, tank operation, and electric boosting. The results indicated that for borosilicate type glass, particulate emissions were approximately 1.5 lbs/ton. The particulate emission level for lead-type glass averaged approximately 1.8 lbs/ton and the particulate emission level for "non-soda-lime"-type glass averaged approximately 1.7 lbs/ton. Also contained in this letter were estimates of the cost of particulate removal for the process changes being employed by Corning Glass Works. The results indicated that for borosilicate-type glass, an abatement cost of approximately $1.13/lb of particulate removed can be accomplished. In addition, lead-type glass would attain an abatement cost of $.39/lb of particulate removed. The letter concluded with the statement that the pressed and blown glass industry should be allowed to use the option of process modifications as a means of meeting the limits set for new sources.

Another comment concerning the use of process modifications in the pressed and blown glass industry was included in a letter from Mr. C.M. LeCroy of PPG Industries, Inc. to the Central Docket Section (docket entry OAQPS 77/1-IV-D-8). Mr. LeCroy was of the opinion that process modifications currently under study by PPG, could possibly allow PPG to operate a 100 tons/day furnace and meet the New Jersey standards without the use of add-on control equipment.

The post public hearing docket contains one comment concerning the use of process modifications in the wool fiberglass industry. In a report from Mr. E.D. Switala of Owens-Corning Fiberglas Corporation to the Central Docket Section, dated September 12, 1979 (docket entry OAQPS 77/1-IV-D-17), Mr. Switala stated that process modifications offer a variety of advantages over add-on controls, such as lower capital costs, lower fuel oil and natural gas consumption, reduction of furnace emissions, and reduction of equipment malfunction downtime. Mr. Switala concluded his comments by stating that process modifications can be used to meet a particulate emission level of 0.8 lb/ton.

Summary. After reviewing the section in the BID on process modifications, along with the materials used to develop that section, it is apparent that the use of process modifications in the glass manufacturing industry was taken into consideration during the development of these standards of performance. The types of process change employed by industry, along with the possible benefits and potential problems associated with these techniques, were presented accurately. However, it is clearly evident that many issues concerning these methods were left unresolved.

These issues were left unresolved because the information on this area of emission control was minimal and often lacked substantiating evidence. The information on emission reduction indicated that emission reduction by process modifications is uncertain with respect to the effectiveness of the technique. This uncertainty led to the decision to base the NSPS on an add-on control device of known and proven effectiveness.

Since proposal of the standards of performance for the glass manufacturing industry, additional information has been made available concerning the use of process modifications. This information has indicated that progress is being made by several glass manufacturers in reducing emissions by the use of certain process modification techniques. However, several problems arise in attempting to evaluate this progress. A major problem which has been experienced throughout the compilation of these standards is that there has been a general lack of quantifiable emission data accompanying the reported emission levels. This limitation has been primarily due to industry's insistence that the exact details of many of the process modifications be considered highly confidential.

An additionally important factor in considering the use of these process modification techniques is that from the information submitted, it appears that a variety of achievable emission levels exist. Only in certain instances has the data indicated that the particulate emission reductions attributable to process modifications approach the levels required by the promulgated standards. The majority of the data indicates particulate emission levels slightly lower than, or in some cases higher than, the uncontrolled emission rates.

It appears from the data submitted that the most effective form of process modifications is the all-electric melter. However, all-electric melting has several limitations. At present, the all-electric melter is restricted in most cases to a furnace capacity of less than 100 tons/day and glass types with specific electrical characteristics. In addition, all-electric melting has reportedly substantially reduced the campaign life of these furnaces. The second most effective form of process modification technique appears to be electric boosting. But, it appears that there are also several limitations associated with this type of process change. As indicated from the information submitted, there is no clear indication as to the levels of emission reduction potentially achievable with electric boosting or if these levels can be reached on a continuous basis. Another limitation associated with electric boosting is that electric boost is also restricted to melting a glass type with specific electrical characteristics. Also, it has reportedly substantially reduced the campaign life of these furnaces. It is for these reasons that the EPA considers all-electric melting and electric boosting to be inadequately demonstrated means of continuous emission reduction for the industry. Other process changes such as furnace temperature reduction, limitations on production rates, and glass formulation changes are not considered to be appropriate because they are simply not practical for the industry; the techniques are not well defined; the techniques presently only represent a non-continuous means of emission reduction.

It is quite evident from the responses to the request by EPA to supply any information concerning the use of process modifications that only major manufacturers have the research and developmental resources to attain the lower emission levels through the use of process modifications. It must be pointed out that only the manufacturers who have performed extensive experimentation in this area of emission control have indicated the desire to base the NSPS on the use of process modifications; yet these manufacturers have also indicated that it would be impossible to disclose the exact details of many of the techniques to other manufacturers for competitive reasons.

The re-examination into the use of process modifications in the glass manufacturing industry has led to the conclusion by EPA that process modifications are still in the research and development stages; the achievable levels of emission reduction are not well defined; the emission reductions may not be continuous; the reported emission reductions are based on proprietary information, and; only the large manufacturers have the ability to reduce emissions with process modifications. Therefore, it has been decided to base promulgated standards on an add-on control device of known and proven effectiveness.

It should be pointed out that Section 111(j) of the Clean Air Act provides a means by which an industry source subject to new source performance standards can request the EPA for one or more waivers from the requirements of Section 111 with respect to any pollutant to encourage the use of an innovative technological system of continuous emission reduction. The purpose of this Section of the Act is to allow and encourage industry to develop new means of control, such as process modifications, subject to certain restrictions.

If the source can adequately show that:

(1) the proposed system or systems have not been adequately demonstrated;

(2) the proposed system or systems will operate effectively and there is substantial likelihood that such system or systems will achieve greater continuous emission reduction than that required to be achieved under the standards of performance which would otherwise apply, or achieve at least an equivalent reduction at lower cost in terms of energy, economic, or nonair quality environmental impact;

(3) the owner or operator of the proposed source has demonstrated to the satisfaction of the EPA that the proposed system will not cause or contribute to an unreasonable risk to public health, welfare, or safety in its operation, function, or malfunction; and

(4) the number of waivers granted with respect to a proposed technological system of continuous emission reduction does not exceed such number as the EPA finds necessary to ascertain whether or not such system will achieve the conditions specified in (2) and (3), the EPA with the consent of the Governor of the State in which the source is to be located, and after notice and opportunity for a public hearing may grant a waiver from the requirement from Section 111. There are additional factors and limitations that the EPA is required to consider in making this determination, and they are found in Section 111(j) of the Clean Air Act.

Until such time that process modifications can be shown to be an effective means of continuous emission reduction able to achieve the limitations imposed by these standards, industry has at its disposal on an individual basis, and subject to the terms of Section 111(j), a means for developing and perfecting these methods of control.

Another commenter pointed out that there was no provision in the standards requiring the installation of standby equipment in case of failure. The standards require that the method of control utilized by the affected facility be able to achieve compliance with the standards continuously. This would include the maintenance of such method in accordance with best engineering practices. Specifically addressing this point is an EPA regulation [40 CFR 60.11(d)] which reads, in part, as follows:

> At all times, including periods of startup, shutdown, and malfunction, owners and operators shall, to the extent practicable maintain and operate any affected facility <u>including associated air pollution control equipment</u>, in a manner consistent with good air pollution control practice for minimizing emissions. (Emphasis added.)

The cost of such maintenance was taken into account in performing the economic analyis for these standards.

Other commenters suggested that a linearly related production rate mass particulate standard is unfair to those furnaces operating at low production rates due to such things as non-production incidents and holidays. It was claimed that plants operating at such lower production rates would be required to meet inordinately stringent limitations.

Commenters suggested that a linearly related production rate mass standard is unfair to those furnaces operating at low production rates due to such things as non-production incidents and holidays. A related comment raised by several commenters suggested that the proposed standards would prove to be unfair to those furnaces operating at other than "normal" levels of production. Specifically of concern to these commenters was the inability of glass furnaces to achieve a zero emission rate at times when the production rate approaches zero. It was emphasized by the commenters that even when the production rate of a glass melting furnace is zero there would be associated emissions due to the maintenance of the molten glass at the proper temperature.

In an attempt to resolve this issue it was suggested by a commenter that a lowest level emission limit be set at either 227 g/hr or 454 g/hr. This commenter explained that, based on the industry-wide estimation that emission levels at zero production rate are roughly 20 percent of those at normal production rates, a lowest level emission limit would have to be incorporated in the standards in order for furnaces operating at the lower end of their operational ranges to be able to comply with the standards. Due to the concerns expressed by these commenters, the method for the calculation of the furnace emission rate was changed in order to correct for the fact that emissions are generated at zero production rate.

Correction factors were developed after reviewing comments on this issue. Only one commenter offered a solution to this issue. This commenter suggested that a lowest level emission limit be set at either 227 g/hr or 454 g/hr. In comparing these figures with the controlled emission rates using the 20 percent figure it was determined that a correction of 227 g/hr should be applied to the container, pressed and blown (soda-lime and lead), and pressed and blown (other-than borosilicate, soda-lime, and lead) glass categories and subcategories; and an adjustment of 454 g/hr should be applied to the pressed and blown (borosilicate), wool fiberglass, and flat glass categories and subcategory.

The mechanism for providing the correction factors is to subtract this predetermined amount (g/hr) from the particulate emission rate (g/hr) determined in the procedure using EPA's Method 5. That amount is consequently applied to the rate of glass production (kg/hr) which is ultimately used to determine the furnace emission rate (g/kg). By using these correction factors, the furnace emission rate will approach zero as the production rate approaches zero, thereby making the standards slightly easier to achieve.

For the purposes of these standards the furnace emission rate will be computed as follows:

$$R = \frac{E - A}{P}$$

Where:

(1) R is the furnace emission rate (g/kg);

(2) E is the particulate emission rate (g/hr);

(3) A is the zero production rate adjustment

A is [227g/hr for container glass, pressed and blown (soda-lime and lead) glass, and pressed and blown (other-than borosilicate, soda-lime, and lead) glass;

A is 454 g/hr for pressed and blown (borosilicate) glass, wool fiberglass, and flat glass]

(4) P is the rate of glass production (kg/hr).

Although the standards will be slightly easier to achieve, the impacts of the standards will not be substantially affected. This correction factor should not lead to the design of control devices any less efficient than those considered appropriately designed to achieve the standards. This is due to the fact that as the production rate increases from zero, the particulate emission increases and outweighs the zero production rate correction factors. Thus, emission reduction and cost impacts will not be substantially changed.

Container Glass. One commenter referred to a hearing held in New Jersey in 1975 before the New Jersey Department of Environmental Protection. It was the commenter's contention that based on the testimony presented at that hearing, manufacturers of electrostatic precipitators (ESP) could not guarantee the achievement of the State imposed limits. Other commenters also questioned the achievability of the proposed container glass standard of performance for container glass manufacturing plants.

The proposed standards of performance were based on test results conducted in accordance with EPA Method 5 and the LAAPCD method, as discussed in the preamble to the proposed standards. Emission tests (using EPA Method 5) on three container glass furnaces equipped with ESPs indicate an average particulate emission of 0.06 g/kg (0.12 lb/ton) of glass pulled. These tests show the achievability of the proposed standards through the use of ESPs. These glass melting furances are typical of glass melting furnaces for container glass manufacturing plants. Process factors, such as production rates and glass type, of these plants are representative of container glass melting furnaces likely to be built.

The least representative aspect of these furnaces is that none of them used fuel oil as the fuel of combustion. Use of natural gas does not generate sulfur oxides in addition to those resulting from the raw materials. Use of fuel oils containing sulfur most likely increases the generation of sulfur oxides. In some cases, these sulfur oxides may require removal. One reported approach is to introduce a chemical absorbent and collect the sulfur oxides in a dry particulate. As one commenter noted, these particulates increase the quantity of total particulates that must be removed in order to comply with the proposed standard.

The quantity of particulates added as a result of using a chemical absorbent to remove sulfur oxides does not preclude the achievability of the proposed standards. If a plant must remove sulfur oxides through absorption in addition to particulates, the total quantity of particulates would be known. With this factor known, design of an ESP that could achieve the proposed standard is possible. Also, the size and therefore the cost of an ESP would change only minimally because the size of an ESP is primarily influenced by the volumetric gas flow rate and minimally influenced by the quantity of the particulates to remove. Consequently, this addition of particulates does not preclude the achievability of the proposed standards. This was seen in test results submitted by one commenter. Thus, this aspect of the data base does not indicate that the proposed standards are not achievable.

Emission test data for container glass furnaces equipped with fabric filters are not available. However, emission test results for a pressed and blown glass furnace melting a soda-lime formulation essentially identical to that used for container glass indicate that emissions can be reduced to 0.12 g/kg (0.24 lb/ton) of glass pulled with a fabric filter. This fabric filter installation was tested with the Los Angeles Air Pollution Control District particulate matter test method (LAAPCD Method), which considers the combined weight of the particulate matter collected in water-filled impingers and of that collected on a filter. EPA Method 5 also uses impingers and a filter, but considers only the weight of the particulate matter collected on the filter. The LAAPCD Method collects a larger amount of particulate matter than does EPA Method 5, and, consequently, greater mass emissions would be reported for comparable tests. Using only the "dry" data (front-half data) compiled in this test report an emission rate of .076 lb/ton is calculated. Therefore, it can be readily assumed that an emission level of 0.1 g/kg (0.2 lb/ton), as determined by EPA Method 5, could be achieved by a container glass furnace equipped with a properly designed and operated fabric filter.

Even though this furnace melted a soda-lime formulation essentially identical to that used for container glass, its glass production rate is low compared to typical container glass melting furnaces and it also burned natural gas. However, design of a fabric filter could be completed that would achieve the proposed standards for container glass melting furnaces because the factors needed for the design would be known.

Based on data compiled during the development of this rulemaking, an emission level of 0.1 g/kg (0.2 lb/ton) of glass pulled from container glass furnaces firing natural gas that can be achieved with either electrostatic precipitation and fabric filters. The promulgated standards reflect the degree of continuous emission reduction which the EPA has determined to be adequately demonstrated after taking into consideration the cost of achieving such emission reduction, nonair quality health and environmental impacts, and energy requirements for each category of glass manufacturing plants. These considerations are discussed in sections Environmental Impacts, Economic Impacts, and Energy Impacts.

Pressed and Blown Glass. One commenter questioned the validity of referenced test results cited in Chapter 4 of the Background Information Document, Volume I. Specifically, test Reference Numbers 25 and 41 through 44 were mentioned as being either inaccurate or misreferenced. As explained below, test Reference Numbers 41 and 44 were incorrectly reported in BID, Volume I. These incorrectly reported tests were used in part, as the basis for the proposed standards for the pressed and blown glass (other than soda-lime) subcategory. Thus the change in the standards, discussed below, was required.

The data for test reference No. 25 were verified to be correct; however, the source was misreferenced as being from an Owens-Illinois plant. The data were actually from a soda-lead borosilicate glassware Corning Glass Works plant and should have been referenced to Reference 22.

In Table 4-4, page 4-23 of the Background Information Document, Volume I, the omission of the particulate emissions from the precipitator outlet for Test No. 41 was an oversight. Upon reviewing the test data, two sets of data were found from the same referenced company. These tests were of borosilicate furnaces controlled by electrostatic precipitators.

The first test, test No. 41a, was of a 25 tons/day borosilicate furnace. This test was conducted February 25-26, 1976, using EPA Method 5. Based on the input data, the average emission rate was 0.09 lb/ton. When correcting to an estimated 85 percent pull rate, the new emission rate is 0.11 lb/ton. During the testing period, the ESP was processing about 42 percent of the design volume flow rate (scfm).

The second emission test, designated as 41b, was for a 95.6 tons/day borosilicate furnace. This test was conducted September 28-30, 1977, using EPA Method 5. Based on fill rates, the average emission rate was 1.42 lbs/ton. The corrected emission rate is 1.67 lbs/ton for 85 percent pull rate. During the test, the ESP unit was reported to be operating at about 61 percent over the design flow rate (scfm), and the efficiency of the precipitator was about 83 percent.

These two emission tests, 41a and 41b, yielded emission rates from ESPs operating at about 60 percent under design and 60 percent over design capacity, respectively. These test results are also from furnaces differing in size. Thus, a conservative assumption would be that an average of the two test results is representative of the actual emission rates. Accordingly, an average emission rate of 0.89 lb/ton will be used for emission test Reference 41.

Referenced tests 42 and 43 were performed at the cited facilities and show levels of control achievable by ESPs on a continuous basis. Therefore, the origin of information was correct and not incorrect as the commenter suggested test No. 42 measured an emission rate of 1.14 lb/ton and test No. 43 measured an emission rate of 0.96 lb/ton.

However, emission test Reference 44 contained erroneous mass emission rates. From the April 28, 1976, test performed on the ESP-controlled furnace using EPA Method 5, an emission rate of 0.95 lb/ton was calculated. The furnace for this test was fired with No. 5 fuel oil with electric boost and was melting borosilicate glass.

Several commenters suggested that various glass products be taken out of their generalized categories and be set apart individually as additional glass manufacturing categories. The necessity for this action, they claimed, is the individually unique processing characteristics of particular glass products and in their unique emission characteristics. They claim that specific glass products, such as textile and continuous-strand fiberglass [included in the proposed pressed and blown (other-than soda-lime) category], borosilicate pressed and blown glass [included in the proposed pressed and blown (other-than soda-lime) category], and hand blown glass [included in the proposed pressed and blown (other-than soda-lime) category], contain either unique processing characteristics or emission characteristics, or both.

However, the decision to divide the glass manufacturing industry into four categories, as discussed earlier, was made based on technical and economic considerations. Rather than promulgate an individual standard for each individual type of glass item produced, which number in excess of 80, four categories were chosen based on engineering judgment that was based on the similarities of the process factors including characteristics of glass melting furnaces and types of glass produced. As discussed below, further division of the pressed and blown glass category was based on technical considerations to make certain the standards are achievable. Taking into consideration the basic technical and economic characteristics of all the types of glass manufactured, four major categories were finally chosen to represent the industry: container glass, pressed and blown glass (borosilicate; soda-lime and lead; and other-than borosilicate, soda-lime, and lead), wool fiberglass, and flat glass.

The further division of the pressed and blown glass manufacturing category has not altered the predicted impacts of the promulgated standards. The new plants, predicted to be constructed within the impact analysis period for the two original subcategories, were allotted to the new subcategories, the total number of new plants remaining the same. In addition, as discussed in the Economic Impacts section of this document, the cost and economic analyses do not require substantial changes and indicate the same impacts as presented when the standards were proposed; i.e., the cost and economic impacts are reasonable because the standards are clearly affordable and the product pricing is less than 1 percent.

The decision to subdivide the pressed and blown glass category into three subcategories was based on test data and information gathered throughout the development of these standards. In studying the data and information it was found that borosilicate-type glass emissions were uniformly the most difficult to control, with soda-lime and lead glass emissions being relatively more controllable. With these two extremes in potential particulate emission control, the balance of the pressed and blown glass formulations (other-than borosilicate, soda-lime, and lead) were found to be controlled, at least, at a relatively median level of control.

As a result of comments received on the proposed standards, a review of the achievability of standards for pressed and blown borosilicate glass melting furnaces was performed to evaluate industry's contentions that the proposed standard for pressed and blown borosilicate glass melting furnaces was unachievable. It was alleged that these furnaces are up to four times more difficult to control than other types of furnaces. In addition, as explained above, the tests had been incorrectly reported in the Background Information Document, Volume 1. These tests dealt with the pressed and blown borosilicate subcategory. Also, a commenter contended that pressed and blown lead glass manufacturing plants could achieve a more restrictive standard.

Emission tests using EPA Method 5 on four furnaces melting pressed and blown glass with borosilicate formulations and equipped with ESPs yeilded a representative emission rate of about 1.0 lb/ton of glass produced. All of these test results except one were less than 1.0 lb/ton. The test result greater than 1.0 lb/ton was collected at an ESP with a specific collection area of 0.65 ft^2/scfm and found an emission rate of 1.14 lbs/ton. For the other tests, the specific collection area was greater than 0.85 ft^2/scfm and averaged about 1 ft^2/scfm. The specific collection area (ft^2 of ESP plat collection area 1 standard cubic foot per minute of gas flow) directly influences the collection efficiency of an ESP. Thus, the test result showing 1.14 lbs/ton only indicates that an ESP operated less efficiently would not reduce the emission rate to less than 1.0 lb/ton. In evaluating the size of an ESP needed to meet the proposed standard, a specific collection area of 1.0 ft^2/scfm was used. Therefore, because the emission tests did not confirm the achievability of the proposed standard of 0.5 lb/ton and the proposed standard needs changed, a review of the test data was needed. These emission test data indicate that a limit of 1.0 lb/ton would be achievable for furnaces melting borosilicate type glasses controlled by an electrostatic precipitator. This limitation of 1.0 lb/ton is promulgated as the standard for pressed and blown (borosilicate) glass.

Emission test results for pressed and blown lead glass plant average 0.23 lb/ton. Two of six test results are higher in value than this average. Reviewing the information on these plants indicates that the specific collection area for one of these two plants was less than the specific collection area for the remainder of the plants. However, other process variables were similar. The information on the other plant did not include the specific collection area. The average of the test results for the remaining plants is 0.13 lb/ton. Thus, because the information on all the tests shows that the larger values are most likely a result of ESPs designed for less efficiency than the remainder of the values, these emission tests indicate that furnaces melting lead glass can achieve a limit of 0.2 lb/ton, equal to that proposed for soda-lime pressed and blown glass controlled by an electrostatic precipitator or possibly a fabric filter. As a result, a second subcategory for pressed and blown (soda-lime and lead) glass is promulgated at 0.2 lb/ton.

Finally, glasses being produced that are of other-than borosilicate, soda-lime, and lead recipes have been found, as discussed in the preamble to the proposed standards, through referenced tests and data set out in Tables 4-2 and 4-4 of the Background Information Document, Volume I, to be able to achieve a 0.5 lb/ton standard with either an electrostatic precipitator or a fabric filter. As a result, a third subcategory for pressed and blown (other-than borosilicate, soda-lime, and lead) glass is promulgated at 0.5 lb/ton.

Another commenter stated that the average controlled emissions from a borosilicate furnace controlled by an electrostatic precipitator is 1.56 lbs/ton. It was his opinion that the standard should be 1.56 lbs/ton.

Standards of performance are not based on controlled emissions averaged over a number of plants. These standards are based on the application of the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, any non-air quality health and environmental impact and energy requirements) the Administrator has determined to be adequately demonstrated. In choosing a limitation indicative of the best technological system of continuous emission reduction, emission test data from the better controlled, representative sources are reviewed and a limitation indicative of these emission tests data is chosen as the standard.

Wool Fiberglass. A commenter pointed out that the three emission tests for wool fiberglass furnaces controlled by ESPs referred to in the preamble for proposal and the Background Information Document, Volume I, were actually three runs taken in sequence on the same furnace and were not, as had been suggested in the BID, Volume I, from three separate furnaces. The three referenced tests were actually three runs on the same furnace as pointed out by the commenter. This test of three runs averaged to 0.36 lb/ton. A series of five tests was actually conducted. The first three tests were run with all three fields of the electrostatic precipitator (ESP) energized. The last two tests however, were run with less than the total number of electrical fields.

The first test, conducted after putting the ESP on the line, yielded an emission rate of 0.72 lb/ton. This result is unusual in that the test was conducted in what appears to have been similar to startup conditions. Just prior to commencement of the testing the ESP was taken off line, inspected, and cleaned. This test, however, cannot be considered non-representative for this unit, but is considered to be highly suspect after comparing it with the tests conducted immediately following it.

The next two tests were run at substantially identical conditions and yielded results of 0.19 lb/ton and 0.17 lb/ton, respectively. The fourth test, conducted on the same day as the third, was unlike the three prior tests in that the ESP was only operated with two of the three electrical fields energized. Despite this reduction in collection potential the emission rate was 0.2 lb/ton, substantially lower than the first test and noticably similar to the second and third tests.

The fifth test was conducted with only one of the three electrical fields operating and yielded an emission rate of 2.25 lbs/ton. This result shows the effects of operating a control device at less than designed operating levels. This test should obviously be discounted as being unrepresentative of normal operating conditions for an ESP controlled glass melting furnace.

Emission tests conducted on wool fiberglass furnaces controlled by ESPs and fabric filters indicate that a level of 0.5 lb/ton can be achieved. Emission tests indicate a level of 0.36 lb/ton is achievable, even using a worst-case interpretation of the data, by an ESP and a level of 0.4 lb/ton is achievable by fabric filters. Also, an emission test using the LAAPCD method on a wool fiberglass plant using a fabric filter control device shows a level of 0.52 lb/ton which indicates that a standard more restrictive than 0.52 lb/ton would be attainable. This is a reasonable assumption because of differences between EPA's Method 5 and the LAAPCD's testing method. Test results for a furnace tested according to the LAAPCD's method are higher than when tested according to EPA's Method 5. Based on this, it can be assumed that this standard can be met by using an electrostatic precipitator or a fabric filter. Because the data that was the basis for the proposed standard was three runs of one test and not three tests, the standard has been changed from 0.4 lb/ton to 0.5 lb/ton. The impacts associated with the change in the standard from 0.4 lb/ton to 0.5 lb/ton will be minimal and are explained in the Environmental, Economic, and Energy Impact sections of this document.

One commenter suggested that the wool fiberglass industry utilizes a unique process separate from the other categories and should not have its standard based on a technology transfer. The opinion of this commenter was that the wool fiberglass sector of the glass manufacturing industry had not been sufficiently investigated.

The standard is based solely on test results conducted at wool fiberglass plants with emissions typical of wool fiberglass plants. Technology transfer was not used in developing the standard for wool fiberglass manufacturing plants. However, as discussed above, the design of a control device to bring a wool fiberglass manufacturing plant into compliance with this standard would require consideration of plant-specific process factors. If a wool fiberglass plant, for instance, uses a recuperative heat recovery system rather than a regenerative system, then the ordinary design of the control device must take into consideration the uniqueness that may result from this difference. These differences were considered in proposing the standard for wool fiberglass plants. In addition, a plant was tested and a level of 0.52 lb/ton was measured using the LAAPCD's method. Emission test results were collected, reviewed, and analyzed for wool fiberglass plants having glass melting furnaces controlled by fabric filters and ESPs, and plants utilizing all-electric glass melting furnaces. These results reflect the ability of this category's glass melting furnaces to meet the standard with ESPs and fabric filters.

Flat Glass. Several commenters suggested that control technology in the flat glass industry has not been adequately demonstrated and that the proposed standard of 0.3 lb/ton was too stringent. Commenters also disagreed with the transfer of control technology from container glass melting furnaces to flat glass melting furnaces. Commenters did not consider the proposal of a standard based on technology transfer to be reasonable.

The basis for using technology transfer was the similarity in the soda-lime formulations used by both container and flat glass manufacturers and the chemical composition and the physical characteristics of the particulate emissions. The conclusion that the percentage reduction in particulate emissions achieved by the control of container glass furnaces could also be achieved by the control of flat glass furnaces, thereby lending credence to the transfer of technology theory, was supported by an ESP manufacturer's performance guarantee.

Since proposal, an emission test performed by EPA and an ESP manufacturer has become available for an oil-fired flat glass plant with an ESP. This emission test does not clearly confirm that the proposed emission limit of 0.3 lb/ton is achievable. This test was performed at a 1-year-old flat glass plant. To maintain confidentiality, as requested by the plant, the production rate must be withheld but a particulate emission rate was measured to be about 5 lbs/hr. Based on these factors and an allowance to ensure the achievability of the standard, the promulgated standard for flat glass melting furnaces is set at 0.45 lb/ton. This standard is clearly supported by the emission test performed by EPA.

The promulgated numerical emission limit includes an allowance for variations in exact testing procedures, age of control devices, and the limited data upon which the standard is based. The allowance is primarily a means of assuring that flat glass plants can achieve the promulgated standards especially in light of the fact that one emission test is the basis upon which the standard is set. The flat glass standard does not have a fuel-oil increment, as in the proposed standards, because the promulgated standard is based on emission tests performed at an oil-fired flat glass manufacturing plant. These tests were conducted in accordance with modified EPA Method 5 procedures. A temperature of 350°F was maintained in the filter box. Refer to the Test Methods and Monitoring section of this document.

Commenters suggested that process modifications were the only demonstrated techniques available for particulate emission reduction from flat glass manufacturing plants. Process modifications were considered in the development of the promulgated standard. However, test data available before proposal indicated that emission reduction by process modifications is indefinite with respect to the effectiveness of such techniques. Refer to the general discussion on process modifications located in this section of this document. The selection of the best demonstrated system of continuous emission control was based on analyses performed determining the technological effectiveness and the environmental, economic, and energy impacts associated with its selection. These analyses led EPA to the conclusion that a level of control more stringent than that that may be consistently achieved by process modifications represents the best demonstrated system of continuous emission reduction for this industry.

The members of the flat glass manufacturing industry that support basing the standard on process modifications claim that they can consistently maintain emissions at a rate of approximately 1.1 lbs/ton. However, an emission test was performed in an attempt to confirm compliance with a State's regulation by using process modifications. The results of those emission tests yielded an average controlled emission rate of 1.4 lbs/ton, which is higher than the industry suggested process modification rate of 1.1 lbs/ton. As shown by this example and other emission tests, an emission rate of 1.1 lbs/ton achieved through process modifications is not certain. Only an average of approximately a 30 percent emission reduction, or 1.4 lbs/ton could be achieved by process modifications if an uncontrolled emission rate of 2.0 lbs/ton is assumed.

An additionally important factor in considering the industry's suggested use of process modification techniques is that the technology involved in achieving this rate is considered confidential by those manufacturers who recommend the 1.1 lbs/ton rate. It seems that only the major manufacturers of flat glass have the research and development resources at their disposal to experiment with process modifications in the form of altered batch formulations and forms of innovative technology. And many of these batch formulations and technological innovations are in experimental development. In fact, comments have indicated that product quality may be affected by process modifications. In these instances, suspension of the use of process modifications, necessarily resulting in the exceedance of the standards, may be necessary to expedite the attainment of product quality.

Data made available since proposal have not added any certainty to the question of the effectiveness of process modification techniques for flat glass manufacturing. From the test results received, it is apparent that no consistency in emission reduction can be achieved by any one form of process modification. Results range from 0.5 lb/ton to greater than 2.0 lbs/ton for flat glass melting furnaces experimenting with process modifications.

Several commenters also contended that various SIP limitations were being met by flat glass manufacturers by producing without add-on control devices and using process modifications. Using the baseline as an indicator of what is typically required of new flat glass plants to meet, it can be seen that the industry's suggested uncontrolled emission rate achieved through the use of confidential process modifications (1.12 lbs/ton) cannot comply with a majority of the SIPs, although some do. Flat glass plants located in California and

New Jersey have been equipped with add-on controls to comply with SIPs. Industry's ability to comply with State limitations by using process modifications and without the use of add-on control equipment has been accomplished, in some cases, through reduction in production rates.

The flat glass industry's suggestion that the standard should be based on an apparently experimental and unproven means of emission reduction is not convincing. EPA considers the use of process modifications in the manufacture of flat glass to be an inadequately demonstrated means of emission reduction. Thus, even though the intent of the standards is not to preclude the use of process modifications, the selection of the best system of continuous emission reduction is based on add-on emission reduction techniques of known and proven effectiveness that have been considered adequately demonstrated.

The available information concerning the methods of emission reduction which industry has suggested for the basis of this standard has not led the EPA to change the decision that add-on control technology should be the basis of this standard of performance. However, EPA has information which indicates that the standard could be achieved using process modification techniques in some instances. This information is unique to one manufacturer, is considered proprietary by this manufacturer, and does not, as stated before, indicate that process modification techniques are demonstrated methods of control for the glass manufacturing industry.

2.3 MODIFICATION, RECONSTRUCTION, AND OTHER CONSIDERATIONS

Most of the comments concerning the exemption of all-electric melters [40 CFR 60.292(e)], the fuel conversion exemptions [40 CFR 60.292(c)], the exemption for plants producing less than 2.0 tons of glass per day [40 CFR 60.292(e)], and the rebricking exemption [40 CFR 60.292(d)] supported them as being necessary for the future development of the glass manufacturing industry. However, two commenters suggested that the all-electric melter exemption and the liquid fuel increment are inappropriate in light of the energy constraints under which the Nation is presently operating. One commenter expressed the opinion that to encourage the use of electric power and liquid fuels, such as fuel oil, as opposed to natural gas was contrary to national energy policies.

During the course of the development of these standards, it was found that, due to production constraints, all-electric melters are only feasible for furnaces of relatively low pull rates. This being the case, only a fraction of the projected new plants predicted to be constructed over the 5-year period following the promulgation of these standards can possibly use electric power for melting exclusively. Thus, the exemption for all-electric melters is not expected to shift the energy use of this industry to any great extent. Another energy factor taken into consideration is the fact that electricity will be increasingly produced by the firing of coal. This is consistent with the Nation's goals of attempting to utilize its coal resources rather than importing other fossil fuels.

Available information on well-operated and maintained all-electric furnaces indicated that particulate emissions are only slightly higher than fossil fuel-fired furnaces controlled to meet the promulgated standards. Most of these all-electric furnaces are open to the atmosphere and do not have stacks. In order to test all-electric melters, a stack or concentrated emission outlet would have to be designed and constructed. In light of the minimal emissions produced by the all-electric melter melting process, the cost and inconvenience were determined to outweigh any benefits that might accrue. Therefore, all-electric melting furnaces are not regulated by the promulgated standards.

One commenter suggested that the all-electric glass melting furnace exemption would encourage all new furnaces, estimated to be constructed through 1984, to use electricity as their only means of heat production. It was the commenter's opinion that to have this occur would precipitate a secondary environmental impact at the electric generating plants that would more than offset the emission reduction benefits realized at the glass manufacturing plants.

A major element upon which the commenter based his conclusion is incorrect. It was assumed by the commenter that all of the estimated production growth through 1983 would be attributed to all-electric glass melting furnaces. All-electric melting technology has several key limitations which restrict its applicability throughout all categories of the glass industry. Not all glasses possess the electrical properties required for successful all-electric furnace operation; certain glass formulations attack the electrodes presently used in all-electric furnaces; and all-electric melter technology is not far enough advanced to satisfactorily produce glass in large quantities. Consequently, all-electric furnaces are presently limited to portions of the container, pressed and blown, and wool fiberglass categories.

The commenter estimated the secondary environmental impact attributable to these standards to be approximately 50,000 tons of particulate emissions per year. It is uncertain as to the commenter's source for his air pollution per BTU figures, but it appears to have been some form of uncontrolled emission rate for a coal-fired utility boiler. Using AP-42's emission factor for an uncontrolled utility boiler fired with pulverized bituminous coal, the coal having a heating value of approximately 13,000 BTUs per pound, an emission rate of approximately 0.62 pounds of particulate per million BTUs is calcuated. This would result in a net reduction in emissions of approximately 37 percent. It must be noted, however, that as of 1971 new coal-fired utility boilers have had to comply with a new source performance standard (NSPS) limiting this source's emissions to 0.1 pound of particulate per million BTUs. Using this NSPS limitation, a net reduction of approximately 82 percent is achieved. Additionally, it should be noted that as of 1979 new coal-fired utility boilers will have to comply with a recently revised NSPS limitation of 0.03 pound of particulate per million BTUs. The implementation of this newest limitation on coal-fired utility boilers will result in an net emission reduction of approximately 87 percent.

Based on the calculations presented above for a 100 ton per day furnace operating 365 days per year, with referenced power requirements of 850 kWh/per ton of glass produced and 10,000 BTUs per kWh required, the estimated minimal impacts and the benefits expected to accrue from the implementation of this technology led to the all-electric melter exemption being retained.

A few commenters were of the opinion that implementation of the liquid fuel increment allowed for the firing of fuel oil would encourage the burning of fuel oil at glass manufacturing plants. It should be recognized that, barring substantial supply curtailments, glass manufacturers will use natural gas rather than fuel oil. Natural gas is preferred because fuel oil burns less cleanly and is less combustion efficient. For these reasons, as well as others of less significance, natural gas is perferred to fuel oil. The ultimate influence will be economics and not the liquid fuel increment. Without a disproportionate imbalance in price and availability the use of fuel oil will not be encouraged by this liquid fuel increment.

Several commenters questioned the 15 percent allowance in the liquid fuel increment in the proposed standards for the firing of fuel oil as opposed to natural gas. They were of the belief that a substantially larger increment would more accurately reflect the actual increase in particulate matter emissions attributable to the firing of fuel oil in glass melting furnaces.

These standards of performance are based predominantly on test results from glass melting furnaces firing natural gas. Realizing the increased particulate emissions experienced when firing fuel oil as opposed to natural gas, an increment was developed for the proposed standards that was considered representative. This increment was set at 15 percent as a result of an analysis performed with the data that were available at that time.

Since proposal, additional data have been received that, when considered with data already in EPA's possession, suggest a larger percentage increment might be more representative for the industry. The data considered were submitted by both industrial and governmental sources.

Data in EPA's possession prior to proposal specifically comparing one furnace's particulate matter emissions while firing oil and then natural gas were compiled by EPA's Industrial Environmental Research Laboratory (IERL). These tests were part of an IERL test program conducted on uncontrolled glass melting furnaces in 1976. The four tests considered in setting the increment for the proposed standards were conducted on a pressed and blown (borosilicate) glass melting furnace. Refer to docket entries OAQPS-77/1-II-B-81 and II-B-101.

Two of the four tests were conducted on this furnace while firing fuel oil of an unknown sulfur content. The remaining tests were conducted while firing natural gas. The natural gas firing tests revealed particulate emissions averaging approximately 6.5 lbs/hr while the fuel-oil firing tests averaged approximately 7.3 lbs/hr. In comparing these emission rates, as to the amount of glass produced at the times of the tests (24.6 tons/day and 25.1 tons/day, respectively), figures of 6.34 lbs/ton of glass for natural gas firing and 7.00 lbs/ton of glass for fuel-oil firing were calculated. Therefore, the difference in emissions attributable to the firing of these two fuels was approximately 10 percent.

Since proposal, Ford Motor Company (Ford) has submitted test data (docket entry OAQPS 77/1-IV-D-12) comparing particulate emissions from its Nashville Number 2 furnace. These test results were compiled over a span of approximately five years on an uncontrolled flat glass melting furnace. The initial tests, conducted while firing natural gas, ranged from a high of 2.81 lbs/ton in March 1973 to a low of 1.05 lbs/ton in April 1977. The firing of fuel oil, on the other hand, resulted in a range of emissions from 1.40 lbs/ton in April 1978 to 1.69 lbs/ton in May 1978.

For purposes of this analysis, the natural gas-firing test from March 1973 was considered, but was not taken into account, as it was inordinately high with respect to the other test results. A possible reason for this high test result could be attributable to the relatively recent advances made by the industry in salt cake reduction in batch formulations. Averaging the natural gas-firing test results covering a period of less than two years (December 1975 to October 1977), an emission rate of 1.41 lbs/ton was calculated. This rate, when compared to the average emission rate calculated for firing fuel oils of varying sulfur contents of from 0.73 percent to 0.98 percent, (1.55 lbs/ton), revealed a difference of approximately 10 percent.

It was the commenter's suggestion that the last two test results for fuel oil-firing should be used when comparing the emissions attributable to fuel oil-firing as opposed to natural gas-firing. This average emission rate was 1.14 lbs/ton and when compared to the average rate for fuel oil-firing, 1.55 lbs/ton, resulted in a 36 percent increase in particulate emissions attributable to fuel oil-firing.

However, a more accurate comparison can be made by using the test results compiled by Ford while firing natural gas in October 1977 (1.23 lbs/ton) and then firing Number 6 fuel oil in November 1977 (1.56 lbs/ton) on the same furance. This 1-month testing interval tends to minimize the effects on the test results that may be attributable to batch modifications and represents fuel oil-firing for an oil with 0.85 percent sulfur content. This comparison reveals a difference in emissions of approximately 27 percent.

Owens-Illinois submitted test data for its Mansfield, Massachusetts, container glass plant (docket entry OAQPS 77/1-II-D-238). These tests were conducted in April 1978 to measure the control efficiency of a electrostatic precipitator (ESP) controlling two fuel oil-fired furnaces. The ESP is also operated in conjunction with a sodium carbonate pretreatment spray system.

It was explained by Owens-Illinois that the installation of this pretreatment system, located before the electrostatic precipitator, was necessitated by difficulties encountered in the removal of the particulate from the ESP's collector plates. It was pointed out by Owens-Illinois that sulfur in the fuel oil, upon combustion, reacts with the particulates and significantly contributes to the accelerated deterioration of these plates. In an effort to minimize this deterioration, Owens-Illinois developed a sodium carbonate exhaust gas pretreatment system. It is the purpose of this system to convert the sulfur trioxide formed in the combustion of the fuel oil to an alkaline sulfate particulate. This particulate matter, it was explained, is easier to remove from the ESP collector plates and minimizes plate deterioration.

The test results from three runs taken at the outlet of this 2-year-old electrostatic precipitator ranged from 0.17 lb/ton to 0.31 lb/ton. The average emission rate for the three runs was

0.26 lb/ton while firing 0.9 percent sulfur Number 6 fuel oil. It is important to note that the successive runs did not follow an increasing or decreasing pattern; the last run presented the lowest emission rate. It should be additionally noted that the promulgated standard is 0.26 lb/ton for container furnaces firing fuel oil. This Owens-Illinois test demonstrates the ability of two glass container furnaces controlled by an ESP, in operation in excess of two years, to meet the promulgated standard with the introduction of added pretreatment material to the gas stream.

Judging from the data collected, the percentage of sulfur contained in No. 6 oil used to fire a glass melting furnace influences the amount of particulate emissions collected while conducting source sampling. Although the reason for this phenomenon is not fully understood, it is considered a possibility that EPA's Test Method 5 requirement that the filter temperature be maintained at 250°F may effect these results. In response to comments received and tests conducted subsequent to proposal, the Method 5 filter temperature has been raised to up to 350°F. Data indicate that Method 5 collects sulfuric acid mist at a filter box temperature of 250° F but not at 350°F. By changing the filter box temperature to 350° F, the influence of the sulfur in No. 6 oil as well as in the raw materials should be diminished. Refer to the Test Methods and Monitoring section (2.8) of this document for details on the issue concerning the filter box temperature.

It should also be pointed out that comments offered by Mr. Strelow in behalf of the Glass Packaging Institute (docket entry OAQPS 77/1-IV-D-19, at 78-82) inadvertently misinterpreted a study prepared by the New Jersey Bureau of Air Pollution Control on Fuel Oil Particulate Emissions from Direct Fired Combustion Sources (docket entry OAQPS-77/1-II-I-22). It was Mr. Strelow's contention that the calculations presented on page 14 of the study (Glass Furnaces Data Sheet) represented increases in emissions attributable to the firing of fuel oil over natural gas. The numbers cited in Mr. Strelow's comments (30.60 percent and 89.95 percent) do not represent increases in particulate emissions but instead represent theoretical calculations based on emission factors developed by New Jersey's Bureau of Air Pollution Control estimating the percent of total particulate emissions that could be attributable to the firing of fuel oil. There is no mention of emissions attributable to the firing of natural gas; therefore, no comparison of the two based on these data can be made.

As a result of data received, comments offered, and a review of the issue the increment for firing fuel oil was increased to 30 percent. In choosing the 30 percent increment, the theoretical analysis was weighed against the data concerning this issue. The data collected through testing were used to establish the increment because the theoretical analysis is questionable. The theoretical analysis is particularly questionable after considering the effects of the change in the filter box temperature and its influence on the amount of particulate indicated by the original Method 5 tests that support the theoretical analysis. In addition, data collected through testing would include variables not possible to include in the theoretical analysis, such as the influence of the requirement for sulfur as part of the glass product.

The liquid fuel increment is needed to compensate for the additional particulate that results from burning a fuel that contains ash. The standards were based mainly on data collected at gas-fired furnaces. Therefore, an increment such as has been implemented is appropriate.

Commenters suggested that the proposed exemption for "day pot furnaces," or more accurately termed day tanks, week tanks, or pot furnaces, does not adequately cover small production glass furnaces. Specifically in question was whether the proposed two tons of glass produced per day (TPD) criterion as an exemption for "day pot furnaces" was an adequate representation of the typical design capacity of a newly constructed small production glass furnace.

The primary reason for the provision of this exemption was economic. These small glass melting furnaces constitute an extremely small percentage of the Nation's total glass production. Commenters stated that the cost to control these small volume furnaces in some cases was as much as 10 times the cost to construct a new furnace. As stated in preamble to the proposed standards, their control is considered economically unreasonable. It is the intent of this exemption to exclude small glass manufacturing plants from having to comply with a standard that would effectively put them out of business.

Data submitted by industry representatives indicated that a greater production rate should be used as a cutoff for this exemption. It was pointed out that the approximate average daily pull rate for day tanks is presently 0.989 tons and for week tanks is presently 4.1 tons. A commenter suggested that tanks of a production capacity of equal to or less than 5 TPD, the largest daily pull rate for any one furnace in either category, should be exempted from the standards. Industry statistics show that this daily production rate (5 TPD) would be a maximum for pot furnaces, day tanks, and week tanks that are likely to be constructed. Thus, the exemption was extended from 2 TPD to 5 TPD.

In developing the promulgated standards it was ultimately decided to exempt all hand glass melting furnaces from having to comply with these standards. This decision was based on a further analysis of the industry precipitated by comments received. Hand glass furnaces would not likely be able to survive the associated economic impact. Thus, hand glass melting furnaces were exempted from having to comply with these standards of performance. This is not to say that standards will never be developed for these furnaces; standards may, at some later date, be developed if a subsequent analysis of this segment of the industry shows that they are necessary and viable. There would be no associated impacts as a result of this change as there were no hand glass furnaces expected to be built within the next five years.

Other commenters suggested that the cutoff be set at as high as 15 TPD. All known furnaces producing greater than 5 TPD are continuous production furnaces. The proposed standards addressed continuous production furnaces and evaluated the smallest continuous production furnaces at an average operational capacity of 50 TPD. No comments were received that indicated this size furnace was not representative of new small continuous production furnaces. In any case, the intent of these standards is to cover continuous production furnances and therefore, any new glass melting furnace with a production capacity in excess of 5 TPD, not specifically exempted, is subject to the standards.

In addition, in gathering data to support the standards, information and data on existing glass melting furnaces producing less than 50 TPD were reviewed and considered in establishing the standards. All indications were that new continuous glass melting furnaces that are being constructed are 50 TPD or more. Thus, the exemption was extended only to include all glass melting furnaces designed to produce five tons or less of glass per day.

2.4 GENERAL ISSUES

Several commenters stated that the State Implementation Plan (SIP) used for comparison of the impacts of the proposed standards was not typical. They stated that a SIP such as New Jersey's should not be considered typical for the industry due to the relatively few glass manufacturing plants located in that State. Prior to the proposal of these standards, an analysis was made of this very issue and was included in the docket (docket entry OAQPS 77/1-II-A-16).

The analysis explained that to visually compare the baseline SIP profile on a graph to other SIP profiles would not accurately reflect the typicalness of the baseline SIP. The typical SIP for this industry was found to be one similar to both New Jersey's and Pennsylvania's. To view New Jersey's SIP on a graph, illustrating its regulatory restrictiveness versus pull rate relationship in comparison to other states having a major share of the Nation's glass manufacturing plants [California, Illinois, and Tennessee (new and existing source rules), Indiana, New York, Ohio, Oklahoma, Pennsylvania, Texas, and West Virginia], New Jersey's SIP may not appear to be typical. But, to accurately reflect the status of the air pollution control requirements that the glass manufacturing industry would experience if no NSPS were established, this graphical relationship was considered jointly with a relationship exhibiting the relative share of the number of glass manufacturing plants located within each of the States.

The container glass industry is highly concentrated within the States of California, Pennsylvania, Illinois, and New Jersey. Most plants of the pressed and blown category are located in West Virginia, Ohio, and Pennsylvania. Flat glass is for the most part spread evenly among Tennessee, Pennsylvania, California, Ohio, and Michigan. And finally, a large share of the wool fiberglass is produced in Kansas, Ohio, New Jersey, and California.

The major portion of the container glass industry is required to comply with SIPs having a restrictiveness comparable to New Jersey's. It is readily apparent by comparing the graphical relationships with the number of plants located in each State that the four States with the largest volume of container glass production (California, Pennsylvania, Illinois, and New Jersey) also have the strictest standards. It is especially important to note that the container glass industry represents approximately 70 percent of the nationwide total glass production. This gives added weight to considering New Jersey's SIP typical, especially when comparing the four major container glass States' SIPs.

The pressed and blown industry plants, on the other hand, are relatively small in size and production output as compared to the other categories. Knowing this, it can be seen that West Virginia's emission limitations are the second most restrictive for the sources with pull rates of less than approximately 60 tons per day. The State of Ohio's limitations have not been representative of those by which industry in general has to abide. Pennsylvania, the third major pressed and blown industry State, has emission limitations much like New Jersey's; actually, it's restrictions are more stringent for the lower production rate glass manufacturing plants than New Jersey's.

Wool fiberglass production is led jointly by California (with emission limitations very similar to New Jersey's) and Ohio. These two States are followed by New Jersey, Kansas (median in nature), Georgia (median in nature), Indiana (median in nature), and Texas (relatively less restrictive).

The flat glass category is led by Tennessee, a State with a SIP that is graphically in the middle of the restrictiveness scheme. Following Tennessee are Pennsylvania (the standard after which New Jersey's SIP was modeled), California (with emission limitations very similar to New Jersey's), Ohio and Michigan (which has standards much the same as New York's, median in nature).

Choosing New Jersey's SIP as being generally typical throughout the glass manufacturing industry is reasonable. A large portion of the industry is located in New Jersey and Pennsylvania and in States with similar SIP profiles. Considering the nationwide glass production represented by these States, the variety of categories of glass produced within their bounds, and the relative restrictiveness of each of the SIPs, a SIP similar to New Jersey's is the best choice for the purposes of the study performed. To select the emission limitations set by New Jersey's SIP as being typical provides for a representative view of the industry-wide emission limitations imposed on glass manufacturing plants as they exist today.

Despite the conclusions of this analysis, an effort was made to compare impacts using New Jersey's SIP with the impacts using Tennessee's SIP, a "visually typical" SIP. (docket entry OAQPS 77/1-II-A-16.) The cost impacts associated with a baseline based on Tennessee's SIP yields, as with a baseline based on New Jersey's SIP, a minimal impact to the consumer. The largest consumer price percent increase attributable to the standards (represented by the container glass category) based on the selection of New Jersey's SIP is approximately 1.8 percent and based on the selection of Tennessee's SIP is approximately 2.5 percent. This analysis overestimated the consumer price percent increase by choosing Tennessee's SIP but, despite this fact, the consumer price percent increase of 2.5 percent would not have indicated a prohibitive impact on the container glass manufacturing industry.

In summary, the suggestion that New Jersey's SIP should not be considered typical for the glass manufacturing industry does not warrant the re-evaluation of the impacts associated with the promulgation of these standards. Taking into consideration all of the points just explained, a SIP similar to New Jersey's is considered typical for the glass manufacturing industry.

The impacts of the standards have been adjusted to the five year period from 1979 to 1984 because the actual impact of the standards will begin for plants built after June 15, 1979. However, the dollars are still on a January 1978 basis.

A commenter suggested that a different format should be used in setting the standards. It was commented that different means of determining compliance should be used. It was specifically suggested that such criteria as the amount of particulate emitted annually and the amount of particulate emitted per hour of production be used. It was additionally suggested that the standards be based on fill rate rather than pull rate, as well as, to develop concentration standards as opposed to mass standards.

Two alternative formats were considered for the proposed standards: mass standards, which limit emissions per unit of feed to the glass furnace or per unit of glass produced by the glass furnace; and concentration standards, which limit emissions per unit volume of exhaust gases discharged to the atmosphere.

Enforcement of concentration standards requires a minimum of data and information, decreasing the costs of enforcement and reducing chances of error. Furthermore, vendors of emission control equipment usually guarantee equipment performance in terms of the pollutant concentration in the discharge gas stream.

There is a potential for circumventing concentration standards by diluting the exhaust gases discharged to the atmosphere with excess air, thus lowering the concentration of pollutants emitted but not the total mass emitted. This problem can be overcome, however, by correcting the concentration measured in the gas stream to a reference condition, such as a specified oxygen percentage in the gas stream.

Concentration standards would penalize energy-efficient furnaces since a decrease in the amount of fuel required to melt glass decreases the volume of gases released but not the quantity of particulate matter emitted. As a result, the concentration of particulate matter in the exhaust gas stream would be increased even though the total mass emitted remained the same. Even if a concentration standard were corrected to a specified oxygen content in the gas stream, this penalizing effect of the concentration would not be overcome.

Primary disadvantages of mass standards, as compared to concentration standards, are that their enforcement is more costly and that they require more numerous calculations and increase the opportunities for error. Determining mass emissions requires the development of a material balance on process data concerning the operation of the plant, whether it be input flow rates or production flow rates. Development of this balance depends on the availability and reliability of production figures supplied by the plant. Gathering of these data increases the testing or monitoring necessary, the time involved, and consequently, the costs. Manipulation of these data increases the number of calculations necessary, e.g., the conversion of volumetric flow rates to mass flow rates, thus compounding errors inherent in the data and increasing the degree of inaccuracy.

As explained in the preamble to the proposed standards, even though concentration standards involve lower resource requirements for testing than mass standards, mass standards are more suitable for regulation of particulate emissions from glass melting furnaces because of their flexibility to accommodate process improvements and their direct relationship to the quantity of particulate emitted to the atmosphere. These advantages outweigh the drawbacks associated with creating and manipulating a data base. Consequently, mass standards are selected as the format for expressing standards of performance for glass melting furnaces.

Standards based on limiting the emissions from glass melting furnaces in units of grams of particulate per kilogram of glass produced were selected rather than a mass of particulate collected per unit of time in order to take into account the vast range of production rates in the glass manufacturing industry. In order to develop cohesive emission standards to be applied equitably to furnaces of all sizes within the particular categories of glass production, standards based on emission mass per unit of mass production were selected. Another factor considered is the energy conservation attributable to mass standards as opposed to standards based on exhaust gas flows and volumes. Basing a standard on other than the relationship between emissions and production rate could possibly encourage the use of additional energy to manipulate the test results.

The promulgated standards express allowable particulate emissions in grams of particulates per kilogram of glass pulled. While emissions data referring to raw material input as well as data referring to glass pulled were used in the development of the standards, an examination of the several sectors of the glass manufacturing industry indicated that an emission rate based on quantity of glass pulled would be more typical of industry measurment practices. Accordingly, the mass of glass pulled is used as the denominator in the standards. Raw material input data could possibly be employed to aid in the estimate of glass pulled from a furnace if a quantitative relationship between raw material input and glass pulled were developed following good engineering methods. The better and most used means of calculation of the production rate is the actual pull rate of the furnace, calculated by taking representative samples and analyzing, at regular intervals, glass as it is produced. Refer to Appendix C of this document.

One commenter suggested that improved installation and burner systems will result in more efficient furnaces and less unnamed emissions. It was further suggested that the emission reductions resulting from these installation and burner improvements will more than offset the emissions created by any new furnaces that will be put into operation. To date, no such technology has been demonstrated and no data have been submitted that indicate that these technological advancements are readily forthcoming for the control of particulates. Standards of performance are based on demonstrated means of control. This being the case, the suggested installation and burner system advancements, have not been considered as the basis for these standards of performance.

Container Glass. Several commenters suggested that the uncontrolled particulate matter emission rate for container glass should be 1.5 lbs/ton or 1.12 lbs/ton, not 2.5 lbs/ton. These commenters stated that the emission tests used by EPA in selecting its uncontrolled emission rate were not representative of the industry's emissions as they are today.

The uncontrolled emission rate used in the analysis of the impacts of the proposed standard for container glass was based on emission tests conducted by an EPA contractor covering a wide spectrum of the glass manufacturing industry. These results were used in response to comments made by industry at the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) meeting. It was in response to those comments, expressing concern with the basis of the uncontrolled emission rate used prior to NAPCTAC (1.5 lbs/ton), that the rate for analyzing the impacts of the proposed standard was changed to 2.5 lbs/ton.

Some industry representatives suggested that the uncontrolled emission rate for container glass is as low as 1.12 lbs/ton. This figure is based on the utilization of process modifications and are not considered to be representative of the container glass industry on the whole. Refer to the Emission Control Technology section of this document for further details on this issue. As this suggested rate is not presently prevalent throughout the industry, it was not used to develop the standard's impacts.

Following the proposal of the standard, however, industry submitted updated test results that show the uncontrolled emission rate for container glass production to be more properly represented by 1.5 lbs/ton. These tests were conducted on a number of different container glass furnaces and reflect emissions from these types of furances as they presently operate. Even though the 2.5 lbs/ton rate used for the proposed standard's evaluation is realistically possible, the uncontrolled emission rate of 1.5 lbs/ton was selected as the rate most representative of the industry as it exists today.

The impacts associated with this change in uncontrolled emission rate from 2.5 to 1.5 lbs/ton are minimal and have not affected the decision to regulate this category of the industry. However, the re-evaluation of the impacts is discussed in the Environmental, Economic, and Energy Impact sections of this document.

Wool Fiberglass. It was one commenter's contention that the uncontrolled emission rate for the wool fiberglass category would be more properly represented by a rate of from 22.0 lbs/ton to 30.0 lbs/ton. Other comments have been received that suggest the uncontrolled emission rate of 10.0 lbs/ton, used in the development of the impacts attributed to this standard of performance, was accurate for the wool fiberglass industry.

The source tests used to determine the uncontrolled emission rate and used to develop the impacts of the standard were conducted at representative plants and were performed in accordance with EPA Method 5 and LAAPCD's source test method. Uncontrolled emission rates are used solely to develop environmental, economic, and energy impacts associated with the promulgation of these standards. A review of test data shows that the uncontrolled emission rate ranges from less than 10.0 lbs/ton to greater than 20.0 lbs/ton. However, the uncontrolled emission rate representative of new wool fiberglass plants is best indicated by 10 lbs/ton. EPA believes, after reviewing the test data in its possession, that the 10 lbs/ton figure reasonably reflects the uncontrolled emission rate for the wool fiberglass industry as it presently operates.

Flat Glass. Some commenters questioned the uncontrolled particulate matter emission rate for flat glass manufacturing plants of 3.0 pounds per ton of glass produced (3.0 lbs/ton). These commenters considered the 3.0 lbs/ton rate large, especially in light of industry technological advancements, such as process modifications, that have evolved in the industry over the past several years. One commenter explained that 3.0 lbs/ton may have been representative of the uncontrolled emission rate for the flat glass manufacturing industry five to seven years ago.

EPA selected 3.0 lbs/ton as a conservative estimate based on information received concerning flat glass manufacturing plants. Historically, flat glass manufacturing plant uncontrolled particulate emission rates have been as high as 4.0 lbs/ton or more. However, in the past five to seven years, the industry has reduced its uncontrolled emissions.

Industry commenters suggested that the industry-wide uncontrolled emission rate should be in the vicinity of 1.12 lbs/ton. This figure was selected by industry as a result of the industry's survey of the four major flat glass manufacturers in this country. However, review of available data, which includes values greater than 2.0 lbs/ton, several values greater than 1.5 lbs/ton and a few values less than 1.0 lb/ton, indicates that the 1.12 lbs/ton emission rate is a rate more typical of flat glass melting furnaces that might have the capability to utilize advanced process modification techniques. However, as discussed in detail in the Emission Control Technology section of this document, process modifications are not readily available to the industry on the whole and are not considered representative. It is for this reason that the 1.12 lbs/ton figure was not used to evaluate the flat glass industry's regulatory impacts. As a result of the comments mentioned and test data presently available, a decision was made to evaluate the impacts of the flat glass standard based on an uncontrolled emission rate of 2.0 lbs/ton. A re-evaluation of the impacts is discussed in the Environmental, Economic, and Energy Impact sections of this document.

2.5 ENVIRONMENTAL IMPACT

One commenter stated that there has been no experience to his knowledge in the recycling of particulates collected from glass furnace exhaust gases. Depending on the category of glass production, the collected particulate may be recycled as a raw material. In certain cases, recycling collected particulate requires changes in the batch formulation. In other cases, chemical constituents of the collected particulate limit the recycling of the collected particulate as a raw material. For the categories that follow this practice of recycling, the solid waste disposal impact will be essentially zero.

Industry representatives were concerned that certain emissions, such as fluoride, boron, and lead, may adversely affect the environment if landfilled in the form of collected particulate. No data were submitted nor does EPA have data to substantiate the claims of adverse environmental effects resulting from the landfilling of particulates containing these elements. However, should these landfilled particulates, at a later date, be determined to adversely affect the public health and welfare, these landfilling operations could be covered by the Resource Conservation and Recovery Act (RCRA) [42 U.S.C. 6901, *et seq*.].

One commenter suggested that solid waste disposal of the collected particulates could possibly endanger the public health or welfare. Industry has suggested that the disposal of particulates might interfere with drinking water or stream quality standards. Less than 2 Mg (2.2 tons) of particulate will be collected for every 1,000 Mg (1,102 tons) of glass produced. There is no indication that landfilling, the commonly practiced method of solid waste disposal, will create such a problem. As landfill operations are subject to State regulation and the particulates collected as a result of the promulgation of these standards do not differ chemically from the material collected under a typical SIP regulation, there is a minimal adverse impact on the environment. Therefore, current practices in landfilling are expected to continue throughout the industry and the waste impact of these standards is considered to be minimal.

One commenter suggested that the proposed standards of performance were not based on EPA's ambient air analysis. The establishment of standards of performance for new, modified, or reconstructed stationary sources is based on the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, any nonair quality health and environmental impact and energy requirements) the EPA determines has been adequately demonstrated. Standards of performance are based on air quality concerns, but additionally require that the best system of demonstrated continuous emission reduction be applied. Standards of performance are not based on ambient air analyses resulting from dispersion modeling.

The determination of significance is also not made based on the annual average contributions of particulate matter per plant as is done for PSD purposes. The issue of significance is addressed in the Need For Standards section (2.1) of this document.

One commenter claimed that the Industrial Source (ISCST) Model was neither EPA approved nor available to the public. The commenter further implied that the Single Source (CRSTER) Model probably should have been used and questioned the addition of downwash as an option.

The report on the dispersion modeling performed by H.E. Cramer Company, Incorporated dated August 1978 clearly states:

> "For the model features used in this study the ISCST Program corresponds to the Single Source (CRSTER) Model, modified to incorporate the Huber (1977) procedures for quantifying the effects of aerodynamic downwash on plume dispersion."

Thus, the ISCST Program is compatible with the CRSTER Model which is both approved and available.

Downwash is calculated in order to show the effects of air currents, affected by stack heights, geography, and structures that influence the plume emanating from the glass melting furnace stack. The addition of downwash as an option also has merit in that the Huber procedures have been technically reviewed and have appeared in papers presented to the American Meteorological Society and the Air Pollution Control Association.

The commenter also criticized the fact that downwash was considered in the analysis. In reviewing the August 1978 dispersion study it has been found that the procedures used to determine whether downwash should be considered are consistent with state-of-the-art downwash calculations. This procedure involves taking the ratio of the sum of the physical stack height and momentum plume rise to the building height and comparing the value to 2.5. Ratios less than 2.5 have been shown, generally, to indicate possible downwash. A stack height of 21 meters (70 feet) was used in this analysis. Based on the above ratio test, downwash was included. If 30 meter (100 foot) stacks had been included in the analysis as the commenter suggested, downwash still should have been included in the analysis for most cases. Hence, the inclusion of downwash in the glass manufacturing analysis was justified.

One commenter was concerned about the possible national health and welfare effect of the plumes of charged particles emitted from ESPs. Of specific concern was the possible influence these particles will have on the climate in the immediate vicinity of the regulated glass manufacturing plants and on the climate on a global basis.

The comment specifically referred to a preprint of a report presented at a technical meeting by the representatives of the National Oceanic and Atmospheric Administration dealing with electric field measurements in coal-fired power plant plumes. However, the report itself came to no conclusions as to global climatic effects. And, electric field measurements indicated similar conditions downwind from wet scrubbers. At present, the actual phenomenon is not clearly understood and, as recommended in the report, requires further review. Thus, we have no reason to believe that this phenomenon would result in any significant impact on the environment.

Container Glass. The promulgated standard will reduce particulate emissions from a new uncontrolled container glass melting furnace from about 58 Mg/year (64 tons/year) to about 8 Mg/year (9 tons/year). This is a reduction of about 86 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 21 Mg/year (23 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 29 Mg/year (32 tons/year).

Twenty-five new container glass melting furnaces are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the container glass manufacturing plants subject to this standard is 1,600 tons/year. Meeting a typical SIP would reduce particulate emissions from 25 new container glass furnaces to about 1,025 tons/year. Achievement of the standard will reduce the particulate emissions for these 25 container glass furnaces to about 225 tons/year.

Pressed and Blown Glass (Borosilicate). The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (borosilicate) glass melting furnace designed to operate at 100 tons/day from about 156 Mg/year (172 tons/year) to about 15 Mg/year (17 tons/year). This is a reduction of about 90 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 130 Mg/year (143 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 11 Mg/year (12 tons/year). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (borosilicate) glass manufacturing plants.

Two new pressed and blown (borosilicate) glass melting furnaces designed to operate at 100 tons/day are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the pressed and blown (borosilicate) glass manufacturing plants designed to operate at 100 tons/day subject to this standard is 344 tons/year. Meeting a typical SIP would reduce particulate emissions from the two pressed and blown (borosilicate) glass melting furnaces operating at 100 tons/day expected to be subject to this standard to about 58 tons/year. Achievement of the standard will reduce the particulate emissions for these two affected facilities to about 34 tons/year.

The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (borosilicate) glass melting furnace designed to operate at 50 tons/day from about 78 Mg/year (86 tons/year) to about 8.2 Mg/year (9 tons/year). This is a reduction of about 89 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 55 Mg/year (61 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 19 Mg/year (21 tons/year). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (borosilicate) glass manufacturing plants.

No new pressed and blown (borosilicate) glass melting furnaces designed to operate at 50 tons/day are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the pressed and blown (borosilicate) glass manufacturing plants designed to operate at 50 tons/day subject to this standard is therefore zero. However, meeting a typical SIP would reduce uncontrolled particulate emissions (86 tons/yr) from one pressed and blown (borosilicate) glass melting furnace designed to operate at 50 tons/day expected to be subject to this standard to about 25 tons/year. Achievement of the standard will reduce the particulate emissions for an affected facility to about 9 tons/year.

Pressed and Blown (Soda-lime and Lead). The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (soda-lime and lead) glass melting furnace designed to operate at 100 tons/day from about 39 Mg/year (43 tons/year) to about 2.7 Mg/year (3 tons/year). This is a reduction of about 93 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 13 Mg/year (14 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 24 Mg/year (26 tons/year). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (soda-lime and lead) glass manufacturing plants.

Six new pressed and blown (soda-lime and lead) glass melting furnaces designed to operate at 100 tons/day are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the pressed and blown (soda-lime and lead) glass manufacturing plants designed to operate at 100 tons/day subject to this standard is 258 tons/year. Meeting a typical SIP would reduce particulate emissions from the six pressed and blown (soda-lime and lead) glass melting furnaces designed to operate at 100 tons/day expected to be subject to this standard to about 174 tons/day. Achievement of the standard will reduce the particulate emissions from these six affected facilities to about 18 tons/year.

The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (soda-lime and lead) glass melting furnace designed to operate at 50 tons/day from about 19 Mg/year (21 tons/year) to about 1.8 Mg/year (2 tons/year). This is a reduction of about 90 percent of the uncontrolled emissions. As the typical SIP limitation exceeds the uncontrolled emission rate, the total emission reduction is attributable to the standard. This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (soda-lime and lead) glass manufacturing plants.

Four new pressed and blown (soda-lime and lead) glass melting furnaces designed to operate at 50 tons/day are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the pressed and blown (soda-lime and lead) glass manufacturing plants designed to operate at 50 tons/day subject to this standard is 84 tons/year. Achievement of the standard will reduce the particulate emissions for these four affected facilities to about 8 tons/year.

Pressed and Blown Glass (Other-Than Borosilicate, Soda-Lime, and Lead). The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (other-than borosilicate, soda-lime and lead) glass melting furnace designed to operate at 100 tons/day from about 156 Mg/yr (172 tons/yr) to about 8.2 Mg/yr (9 tons/yr). This is a reduction of about 95 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 130 Mg/yr (143 tons/yr). The promulgated standard will result in a reduction in the level of emissions achieved under a typical standard by about 18 Mg/yr (20 tons/yr). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (other-than borosilicate, soda-lime and lead) glass manufacturing plants.

No new pressed and blown (other-than borosilicate, soda-lime and lead) glass melting furnaces designed to operate at 100 tons/day are expected to be built by 1984. Therefore, there is no predicted environmental impact associated with this subcategory of glass melting furnace.

The promulgated standard will reduce particulate emissions from a new uncontrolled pressed and blown (other-than borosilicate, soda-lime and lead) glass melting furnace designed to operate at 50 tons/day from about 78 Mg/yr (86 tons/yr) to about 3.6 Mg/yr (4 tons/yr). This is a reduction of about 95 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 55 Mg/yr (61 tons/yr). The promulgated standard will result in a reduction in the level of emissions achieved under a typical standard by about 19 Mg/yr (21 tons/yr). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (other-than borosilicate, soda-lime and lead) glass manufacturing plants.

One new pressed and blown (other-than borosilicate, soda-lime and lead) glass melting furnace designed to operate at 50 tons/day is expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the pressed and blown (other-than borosilicate, soda-lime and lead) glass manufacturing plant designed to operate at 50 tons/day subject to this standard is 86 tons/yr. Meeting a typical SIP would reduce particulate emissions from the pressed and blown (other-than borosilicate, soda-lime and lead) glass furnace operating at 50 tons/day expected to be subject to this standard to about 25 tons/yr. Achievement of the standard will reduce the particulate emissions from this affected facility to about 4 tons/yr. This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new pressed and blown (other-than borosilicate, soda-lime and lead) glass manufacturing plants.

Wool Fiberglass. The promulgated standard will reduce particulate emissions from a new uncontrolled wool fiberglass melting furnace from about 312 Mg/year (343 tons/year) to about 15 Mg/year (17 tons/year). This is a reduction of about 95 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from a new uncontrolled furnace by about 278 Mg/year (306 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 18 Mg/year (20 tons/year). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new wool fiberglass manufacturing plants.

Six new wool fiberglass melting furnaces are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the wool fiberglass manufacturing plants subject to this standard is 2,058 tons/year. Meeting a typical SIP would reduce particulate emissions from the six wool fiberglass furnaces expected to be subject to this standard to about 222 tons/year. Achievement of the standard will reduce the particulate emissions for these six affected facilities to about 102 tons/year.

Flat Glass. The promulgated standard will reduce particulate emissions from a new uncontrolled flat glass melting furnace from about 218 Mg/year (240 tons/year) to about 49 Mg/year (54 tons/year). This is a reduction of about 77 percent of the uncontrolled emissions. Meeting a typical SIP, however, would reduce particulate emissions from an uncontrolled furnace by about 147 Mg/year (162 tons/year). The promulgated standard will result in a reduction in the level of emissions achieved under a typical SIP by about 22 Mg/year (24 tons/year). This reduction in emissions will result in a reduction of ambient air concentrations of particulate matter in the vicinity of new flat glass manufacturing plants.

Four new flat glass melting furnaces are expected to be built by 1984. The total particulate emissions expected to be emitted by 1984 for the flat glass manufacturing plants subject to this standard is 960 tons/year. Meeting a typical SIP would reduce particulate emissions from the four flat glass furnaces expected to be subject to this standard to about 312 tons/year. Achievement of the standard will reduce the particulate emissions for these four affected facilities to about 216 tons/year.

2.6 ECONOMIC IMPACT

Several commenters suggested that the cost-effectiveness of the proposed standards, i.e., high costs per unit of pollutant removed, does not warrant the promulgation of standards. These commenters appear to claim that the cost of removing one kilogram of particulate exceeds the benefits derived from its removal.

The cost and benefit to public health and welfare associated with the reduction of air pollutant emissions is difficult, if not impossible, to quantify. In general, it is much easier to quantify the cost of emission reduction than to quantify the benefit. Thus, the cost is usually the subject of much discussion whereas the benefit is not. Given the inability to quantify both the cost and the benefit, it is not possible to determine whether the cost of control exceeds the benefits associated with control. Thus, it would be inappropriate to make a regulatory decision based on a cost-benefit analysis.

Cost-effectiveness calculations are certainly useful in regulatory analyses for choosing among competing regulatory alternatives which achieve the same level of control. On the other hand, cost-effectiveness has too many limitations to be used as the major decision-making factor in setting standards of performance under Section 111. First, the most cost-effective controls for a source are often at the low end of the spectrum of pollutant reduction where the cost per unit of pollutant removed is typically low. The level of control associated with standards of performance under Section 111 of the Clean Air Act would typically not correspond to the most cost-effective control. Second, it is not practical to identify a numerical criterion which represents an upper limit in cost per unit of pollutant removed. Technological differences among industries cause control costs for any given pollutant to vary considerably. In the case of glass manufacturing, this is illustrated by the fact that among several segments there are considerable differences in cost per unit of pollutant removed. There are also segments where little difference in costs between SIPs and NSPS is evident, while in other segments there are distinct differences. Third, the economic impact analysis employed in this instance used the most costly controls to determine worst-case effects. The other less costly alternatives that achieve equivalent control levels are also available to the source.

In reaching the conclusion that the promulgated standards would have no significant economic impact on the glass manufacturing industry, other factors besides cost-effectiveness, were taken into consideration. The costs associated with the achievement of these promulgated standards were considered in the context of the cost structure of the industry by means of an economic analysis including, where necessary, a discounted cash flow model. Upon making these considerations, the economic impacts of the proposed standards were determined to be reasonable. These impacts are still considered reasonable for the promulgated standards of performance.

Commenters claimed that the cost of particulate control should be totally attributed to the standards of performance. The cost of the standards of performance are analyzed based on the assumption that SIP regulations require control where uncontrolled emissions are greater than SIP allowed emissions. As discussed in the General Issues section of this document, SIPs similar to New Jersey's and Pennsylvania's are considered typical of what glass manufacturing plants have been required to comply with. These SIPs require, in most cases, emission reduction through add-on control technology. It would be unrealistic not to delete the cost that a new plant would incur without the establishment of standards of performance. Therefore, it is realistic to estimate the added or incremental cost that would be incurred if a standard of performance control level greater than that required by SIP is established.

These commenters argued that uncontrolled emission rates and SIP regulations do not necessitate the use of add-on controls as indicated in the economic analysis. However, as explained in the Emission Control Technology section of this document, typical glass melting furnaces, with the exception of the 50 tons/day pressed and blown (soda-lime and lead) glass furnaces, located in States with representative SIP regulations require add-on controls.

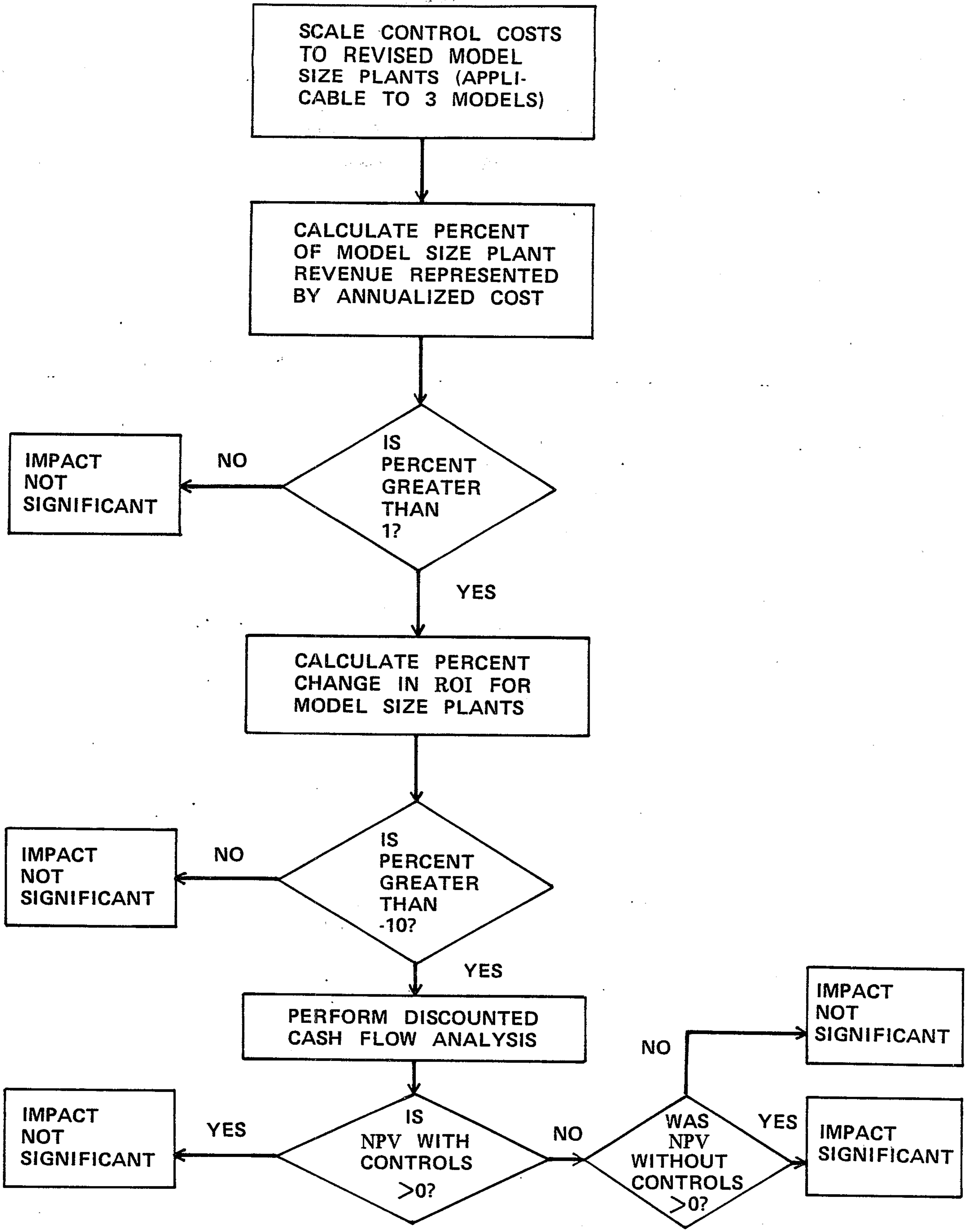
Other commenters stated that process modifications were more cost-effective than the controls analyzed and that process modifications should be the basis upon which the standards are set. (Refer to the discussion on process modifications in the Emission Control Technology section of this document.) Process modifications are not precluded from use as a method of compliance with a NSPS. If they are indeed more cost-effective than those regulatory alternatives analyzed then those sources that can utilize process modifications will experience lesser impacts than those estimated in the regulatory analysis.

One commenter suggested that more weight should be given to economic costs than a mere determination that the industry can bear the costs of a control technique and still survive. The comment appears to refer to the focus of the discounted cash flow (DCF) technique on whether or not controls will inhibit the building of new glass manufacturing plants. The use of the DCF was limited to special cases where survival might have been in question. However, for most of the glass manufacturing categories the DCF analysis was not needed because the impact of the standards does not approach the point where survival might be in question. For example, the industry average price increase is less than 1 percent, a price increase that would not deter the construction of any new plants by itself.

A review of the economic impact analysis may be helpful. Figure 1 is a flow chart description of the decision-making process used in evaluating the Economic Impact Assessment of the New Source Performance Standards (NSPS) for glass manufacturing plants. The first step called for a scaling of certain model plant control costs to obtain control costs for other plant sizes suggested by industry as not being covered by the model plant sizes. The next step in the calculations was to determine the percent of plant revenue represented by the annualized control cost for each model and the other sized plants. The control costs selected for these calculations were for the highest-cost for a regulatory alternative. The purpose of this step was to determine the price increase potential of the controls if costs are passed on to the consumer, or the profit reduction that would occur with no product price increases. Revenue was determined on the basis of the capacity, capacity utilization rate, and price per unit of output determined for that particular industry category.

A decision point followed those calculations. If the percentage of cost to plant revenue was less than 1 percent, the cost was not considered to have a significant impact. For those plants incurring a control cost greater than 1 percent, a further test was applied to determine if the decrease in return on investment (ROI) after pollution controls was greater than 10 percent. If the decrease was less than 10 percent, then that size plant was estimated not to experience a significant economic impact. If the percent decrease was greater than 10, that size plant was subjected to a further set of calculations to determine if the impact was significant. It must be noted that this 10 percent limit was not considered as the point of significant impact as was implied by some commenters. Ten percent was considered as a screening criterion to determine which plants would receive further analysis by a more sophisticated financial technique.

For the remaining plants a discounted cash flow (DCF) analysis (refer to Appendix B) was performed to determine if significant economic impacts were present for these glass manufacturing plants. If the net present value (NPV), as determined from the discounted cash flow



NOTE: ROI—RETURN ON INVESTMENT

NPV—NET PRESENT VALUE DETERMINED FROM DISCOUNTED CASH FLOW ANALYSIS

FIGURE 1. IMPACT DECISION FLOW CHART

calculations, was greater than zero then the controls were estimated to not have a significant impact. If the NPV was less than zero, and it would have been greater than zero in the absence of NSPS, the plant was considered to be significantly impacted. The minimum acceptable rate of return for the industry was used to discount future cash flows for computing NPV.

By following this decision process, two plants were found to be in the category requiring a DCF analysis to determine if significant impact was present. (Refer to BID, Volume I and Appendix B of this document.) The 50-tons per day handmade consumerware plant was subjected to a DCF analysis as was the 500 tons per day container glass manufacturing plant. The results of the DCF analyses for each of those plants indicated that the incremental controls of the most costly NSPS would not produce a NPV less than zero. It was, therefore, concluded that the construction of new facilities of these types would not be inhibited by the glass manufacturing NSPS.

Thus, the impact analysis which has been performed, does indeed go beyond the mere determination that the industry can survive. The analysis yields figures which indicate the specific (quantitative) impact on profits, on ROI, and on price increases. It should be noted that, for most of the glass manufacturing categories the test for survival fell far short of the survival point (yielding less than the minimum acceptable rate of return), indicating no significant impact.

A commenter explained that because the starting point of the economic impact analysis is the "minimum" acceptable return, and additional expenses are then deducted, by definition the result will come out below the minimum acceptable rate of return. The comment appears to refer to the DCF analysis where the pre-NSPS control profit rate was selected as the minimum acceptable rate to the industry. Thus, any deterioration in that rate would be unacceptable.

The internal logic of the comment is correct. Given any return (whether or not "minimum" acceptable), the imposition of additional expenses will, by definition, further reduce that return. However, in the analysis, rate of return was not used as the decisive parameter for determining impact significance. Rate of return was used only as one ingredient in the total analysis. Specifically, it was used as the discount rate of projected cash flows of the new source to determine if the NPV of such cash flows, after discount, exceeded the initial investment.

However, this comment caused other parts of the economic analysis to be re-examined. This led to the conclusion that the same minimum acceptable return under discussion can, in fact, be considered to be inappropriate for one of the procedures that was followed. That procedure also involved using the minimum threshold rate to calculate yearly pre-NSPS profit levels in the DCF analysis. This may have been due to a misunderstanding by EPA as to the intended use of this minimum threshold rate when supplied by the Glass Packaging Institute.

Taking the analysis performed by Peat, Marwick & Mitchell (PMM) in their report (docket entry OAQPS 77/1-IV-D-19), instead of the BID, Volume I, Chapter 8 calculation on this point, it is noted that the ultimate conclusion remains unchanged. That is, the change in rate of return due to the incremental new source performance standards' costs is not significant enough for the project to be rejected. The PMM calculations even overestimate the impact shown in EPA's regulatory analysis because both SIP and incremental NSPS costs were used in PMM's calculations.

The Peat, Marwick & Mitchell DCF analysis was similar in other respects to EPA's DCF analysis with the following exceptions: 1) the regulatory analysis' use of a 15 percent pre-tax profit was reduced to 8 percent, 2) the full amount of interest was added back as cash flow (as opposed to interest times the tax rate which was used in EPA's analysis and which EPA still maintains is more proper), 3) the use of full control costs to meet the NSPS as opposed to EPA's use of incremental cost between the SIP and the NSPS levels. Even under this analysis, the economic impact of the standards is reasonable.

It was commented that the economic analysis indicates that the impact of the new source performance standards on a new grassroots plant would be to change the projected rate of return from 14 percent to 12 percent. The commenter explained that this is a 15 percent change in the expected rate of return, it is a significant change even by the criteria used in the Economic Impact Analysis (Chapter 8 of the BID, Volume I), and is hardly an incentive to construct. The commenter also stated that the total air pollution control cost should be used to calculate the change in the projected rate of return.

The comment appears to assume that a 10 percent change in rate of return was considered to be the level of significant impact. As explained earlier, the economic impact of a new source performance standard is the impact of going beyond SIP control levels to the more stringent NSPS levels. EPA's economic impact analysis uses the incremental cost in going from one stage to the other, recognizing that in the absence of a NSPS the new source would have to attain SIP control level.

If the full-cost assumption were to be followed, the commenter's figures would be correct. On the other hand, using the assumption that only incremental new source performance standard costs are relevant, calculations show a change from 14 percent to 13.1 percent in the projected rate of return period. This is a decrease of 7 percent, as opposed to the 15 percent decrease calculated by the commenter.

However, it is important to note that the 10 percent limit, referred to in the BID and as explained earlier, was not a figure beyond which the development of new source performance standards would be ruled out, but was a figure beyond which other analyses would be brought into play. As a result of the DCF anaylsis, it was concluded that the construction of new facilities for all glass types would not be inhibited by the glass manufacturing plants NSPS.

Two commenters made comments with respect to the 10 percent rate of interest used in the analysis. It was suggested that with the prime rate at 13 percent as of September 1979 and little indication of a downturn in the short or medium term, use of a 10 percent interest rate understates cost.

When the annualized cost calculations were made, the prime interest rate was less than the 10 percent figure used. The 10 percent figure used was not based on an attempt to track a highly variable prime (The prime rate has risen from 10 to 20 percent and fallen to 11 percent in the first 6 months of 1980). It is a conservative figure generally employed in analyses to reflect cost of capital under applicable financing instruments. It is adjusted periodically to reflect any persistent trend.

Pollution control expenditures are generally not financed at prime rates, but at lower rates reflecting the longer loan period and financing instruments available. For example, even at the recent unusually high prime rate (15 1/4 percent on February 4, 1980) an A-grade (Moody's) long-term industrial bond yield was 12.21 percent. Yields on Aa and Aaa rated bonds were lower.

Annualized cost calculations in the glass manufacturing industry are not highly sensitive to interest rate changes. For example, if the 10 percent rate used was adjusted to the 13 percent rate cited in the comment, an increase of 30 percent, the estimated annualized cost would increase by 7.7 percent from $351,000 annually to $378,000 annually for a fabric filter designed to achieve the standard for container glass. This would not appreciably affect findings in this industry with regard to new plant construction. The highest potential price increase of any of the glass segments studies would only change by 0.1 percent.

Further, if current interest rates were used in an analysis other financial and economic data used in the DCF analysis, would also require updating. These other financial and economic data used in the analysis were all tied to conditions at a point in time. If the interest rates are updated then these other data must be updated. Once this would be done, the DCF analysis would most likely, indicate the same result. The purpose in selecting one point in time to base the analysis around is to provide a common basis for all the data.

A commenter claimed that EPA cannot analyze the effect of standards on a number of new plants constructed in a time period by simply estimating a rate of return expected from a typical plant, under price and cost assumptions like the ones used in the Background Information Document, Volume I. The comment appears to question the ability to extrapolate the results of a model plant analysis, using one set of data, on the industry.

Using typical or model plant parameters is the most prevalent technique utilized in economic impact studies involving standards of performance (and other regulations) developed by or for EPA, and is widely accepted by various industrial segments previously affected by EPA regulations. Model plant analysis is a technique which is capable of addressing regulatory impacts on projected new plants which typically face financial parameters, including costs, which are different from those faced by existing plants.

A model plant analysis begins with an assessment of the range of plant sizes expected to be built in the future. This is done to make certain that the analysis is reasonably representative of what should occur once the standards are put into effect. Typically, this range is different from the range of existing plant sizes. Once a future plant size range is determined, a model plant is selected at the low end of this range for economic analysis. This is done to ensure a conservative analytical framework, due to economies of scale which typically prevail with respect to production and pollution control costs.

A commenter suggested that reasons why a company decides to build a new plant should be addressed before the effects of the regulation on new plant construction are assessed. This commenter suggested that the approach used in the BID, Volume I, would lead one to conclude that either all plants will be built or no plants will be built. The comment appears to, again, refer to the limitations of using one model plant to make generalizations to an industry segment. The model plant analysis used in the economic analysis has general application to the categories considered since it utilizes worst-case conditions to evaluate impacts.

The comment also appears to suggest that other criteria for plant construction should be used in the analysis. Concerning other criteria for building new plants, EPA concurs that other criteria such as maintenance of market share or technological advances may enter into deciding whether a new plant would be built or not. However, these criteria are not subject to quantification and the application of a specific industry-wide criterion. Furthermore, regardless of the "reason" for construction, new plant construction limited by other criteria, would not allow a review of the impacts of the standards.

Use of the model plant approach allows a review of the effects of the regulation on new plant construction. In order to implement this approach a large amount of data must be compiled and analyzed. For the development of these standards the data were compiled and analyzed and, when finalized, were used to efficiently develop model plants and compare the impacts these standards will present environmentally, economically, and energy-wise. The model plant approach is a sufficiently informative approach and efficiently determines the impacts of the standards on the construction of new plants.

It was suggested by a commenter that an estimate of 1982 shipments cannot be used directly to estimate the expected number of new glass manufacturing plants to be constructed by 1982. In performing the analysis, it was assumed that plant operation for the newly constructed glass plants would be at 100 percent capacity, rather than at some lesser rate. Reduction in this capacity utilization rate would indeed require construction of additional new plants, with a consequent increase in industry costs.

Experience in the industry shows a general production rate capacity utilization of 90 percent or more (Background Information Document, Volume I, Section 8.1.3.5 - Supply Considerations). By adjusting the calculations to take this 90 percent production rate into account, the total industry control costs would increase by approximately 11 percent. However, the assumption that new plants would be operated at 100 percent of capacity is not unreasonable, particularly in an industry where plants are operated at 90 percent or more and in some cases greater than 100 percent of design capacity. Therefore, 100 percent is considered to be a correct capacity utilization figure. This does not significantly affect the economic impacts associated with the promulgation of these standards.

In addition, as explained below, during preparation of the Background Information Document, Volume 1, two estimations of the number of new plants were made. In order to maximize industry wide cost estimates, the largest estimation of the number of plants was chosen as the basis for estimating industry cost. Adjusting the calculations by 11 percent would not be appropriate because the maximum industry-wide costs have been calculated.

One commenter stated that the estimate (industry-wide annualized costs) of $5 million a year for new sources to meet the standards is only a fraction of the total, once the entire industry is covered by these standards (i.e., those built over the next 5 years). The commenter added that once all industry capacity is subject to the standards, the total cost would be $33.9 million per year. This would occur after all existing industry would become subject to the standrds. This is likely to take many years.

Concerning the number of years, the 5-year period used is consistent with other considerations. Performance standards are reviewed on a 4-year cycle, the additional year allowing for a certain amount of rulemaking time. Secondly, a "period" is specified in Executive Order 12044 [Section 4(f)] for applying a dollar criteria to industry-wide costs for each year within the total time span. To predict impacts beyond five years would not tend to change the validity of the standards and their impacts. However, in order to be consistent with Executive Order 12044, a 5-year period is necessary. Thus, in the case of new source performance standards for glass manufacturing plants, it is appropriate and reasonable that a fifth-year review be used.

Concerning the $33.9 million/year, this figure does appear to be correct, assuming that there is a point in the future at which all present capacity has become subject to NSPS. Although not expected to occur soon, this may eventuate through such events as the replacement of existing plants with new plants. However, the $33.9 million/year figure still does not affect the conclusion of the economic impact analysis. First, the analysis of the impact on individual plants is unaffected, regardless of whether the total costs for all plants are taken to be $5 million or $33.9 million/year. Second, with an annualized cost of control estimated to be $33.9 million, a proportionate increase in emission reduction would occur. Thus, because the impacts would not differ in perspective, if the entire industry were covered rather than just the new plants built within five years, the $33.9 million/year would not affect the conclusion of the economic impact.

Container Glass. One commenter said that the scaling conversions from a 250 tons/day container glass plant to a 500 tons/day container glass plant are not explained.

Use of the scaling conversions was needed to adjust capital and annualized costs for a 250 tons/day to a 500 tons/day container glass plant. This adjustment was made so that information supplied by the Glass Packaging Institute could be used in the economic analysis. This adjustment resulted in an overstatement of costs in the economic impacts section of the Background Information Document, Volume I. The scaling method used to estimate control costs for the 500 tons/day plant was to less-than-double the incremental costs for the 250 tons/day container glass plant. This method was predicated on the tendency for economies of scale to prevail over control equipment. However, by using the scaling formula utilized by EPA in Section 8.2 of the Background Information Document, Volume I, for the 250 tons/day plant, the incremental capital cost would be $120,000 less than that postulated on a proportional basis for the 500 tons/day plant, whereas the annualized cost would be $56,000 higher. These adjustments are required after recomputing the impact on the rate of return. The rate of return after controls would be reduced by about 0.1 percent.

One commenter suggested that erroneous tax assumptions, when corrected, result in figures showing that new container glass plants subject to the standards would not profitably repay the original investment necessary to build them. There are two tax assumptions about which questions have been raised by this comment. One involves treatment of interest and the other involves the allocation of the investment tax credit over different years.

The commenter asserted that interest in the DCF analysis was treated as a tax credit and not as a deduction, as interest is normally treated. In fact, however, interest was deducted as an expense in computing profits in the DCF analysis and then added back to cash flow. The reason for this add-back is to account for the tax shelter of interest for borrowed money. The treatment of interest in this manner follows the recommendations of well-known authors in the financial field, including the ones cited by PMM in their comments.

The use of the investment tax credit in the DCF analysis was improper, as suggested by the commenter. The investment tax credit was incorrectly used in full in the first year calculation of the DCF. Under the Internal Revenue Code, only one-half of the amount of taxes payable in any one year may be used as the investment tax credit. Unused portions of an investment tax credit in any one year can be distributed over a certain number of subsequent years.

As a result of this error, the NPV of the tax credit is less than it would have been had it been used fully in the first year. The resultant correction of the DCF amount is approximately 0.1 percent. This percentage is estimated by taking the increase in model plant control costs attributable to this error ($56,000), recognizing that it represents a $0.34/ton increase in control costs, and applying it to the relationship supplied by the Glass Packaging Institute's comments on EPA's Cash Flow Table (a $7.1/ton increase in control costs results in a 2.0 percent change in R.O.I.). This discrepancy does not alter the conclusion that the economic impact on the container industry is not significant.

Commenters suggested that the EPA failed to consider important potential economic impacts attributable to the proposed standard. Specifically of concern were the effects of the standard on small container glass manufacturers and the effect of competition from substitute products.

In the initial stages of its analysis, EPA utilized a 250 tons/day model plant. Based upon discussions with the Glass Packaging Institute, EPA was persuaded to perform the economic analysis on a 500 tons/day container glass plant, a production level twice that of the previous plant being used in the analysis. EPA purposely selects small plants for its analyses, not to establish a separate treatment for them, but rather to maintain an across-the-board conservative treatment. Small plants are typically deprived of the economies of scale which are available to large plants. Therefore, an analysis of small plants will tend to state the costs incurred by the industry more conservatively (i.e., higher than if a larger sized plant were to be used in the analysis).

For container glass plants, a small plant at 250 tons/day was analyzed and a 1.8 percent increase in the consumer price was estimated to be the result of implementation of the standard. A larger plant (500 tons/day) was analyzed and the increase in the consumer price was estimated to be 1.3 percent. However, larger plants are more centralized and therefore, would experience higher cost for transportation of raw materials and finished products. In any case, the price increase for either sized plant would not be prohibitive in this industry where the price of consumer goods has increased by approximately 8 to 10 percent per year over the past 10 years.

As for competition from substitute products, this was taken into account in the analyses. Part of the analysis was performed on the assumption that in the short run there would be no price increase in glass products due to the severity of competition from other products not similarly impacted. This means that its current competitive position relative to substitute products would be unaffected. The effect of this cost absorption approach is to reduce the potential rate of return of new plants. The use of the DCF analysis was to determine if that reduction would cross the threshold at which new plant construction would be inhibited. The results of this analysis indicated that this threshold had not been crossed.

A commenter suggested that the economic analysis should include the effects on plants of various sizes and on the production of containers for which large, centralized plants may be relatively less practical due to prohibitive transportation costs.

EPA believes that its analysis does include the effects on plants of various sizes. The economic impact analysis was conducted for the smaller plants in the industry, based upon information supplied by the Glass Packaging Institute. The analysis also takes into consideration the fact that larger plants would have greater economies of scale and be in a better position to absorb pollution control costs than the smaller plants. Thus, if the economic impact is not significant for the small plants, it would not be significant for larger plants.

It was suggested by one commenter that prices in the glass manufacturing industry, particularly the container segment, should not be considered to be fixed for rate of return calculation.

Glass products are not commodities which have exhibited wide price fluctuations in the past, in contrast with such commodities as copper, hogs, or soybeans. Due to the acquisition and operation of pollution controls required by the standards, plant costs will inevitably increase and this will result in an upward pressure on prices. However, as shown in the Background Information Document, Volume I's economic analysis, the control costs attributable to the standards in certain instances may not be passed through to the consumer in the form of higher product prices. In these instances this would be due to the price elasticity effects of competition from substitute products.

No indications of circumstances resulting in a downward price trend, such as a major technological breakthrough or a significant increase in the supply of substitute products or demand shifts, have been found to exist or have been alleged to be forthcoming. Therefore, under the steady price scenario, the DCF analysis uses fixed (constant) prices which are consistent with the real (constant) dollar terms used throughout the analysis. In light of the above, a steady price scenario avoids underestimating the regulatory impact.

The incremental installed cost (cost in excess of a typical SIP regulation cost) in January 1978 dollars associated with the standard for controlling particulate emissions from a 225 Mg/day container glass furnace will be about $700 thousand for an ESP and about $1.2 million for a fabric filter. Incremental annualized costs associated with the standard for a 225 Mg/day furnace will be about $200 thousand/year and about $350 thousand/year for an ESP and a fabric filter, respectively.

Incremental cumulative capital costs for the 25 new 225 Mg/day container glass furnaces during the 1979 through 1984 period associated with the standard will be about $17 million if ESPs are used. Fifth-year annualized costs for controlling the 25 new glass melting furnaces to comply with the standard will be about $5 million/year.

Based on the use of control equipment with the highest annualized cost (worst-case conditions), a price increase of about 1.8 percent will be necessary to offset the cost of installing control equipment on a 225 Mg/day container glass furnace to meet the emissions limit of the standard.

Pressed and Blown Glass. It was suggested that the annualized cost for solid waste disposal in the pressed and blown category was calculated incorrectly. It was suggested to be $80.00/ton, not $5.30/ton. The cost of $5.30/ton, presented in Section 8.2 of the Background Information Document, Volume I, is based on the authoritative reference numbers 10 and 11 as shown on pages 8-64 and 8-88. Recent studies indicate that disposal costs in the range of $5.00/ton are typical, with some costs as high as $40.00/ton having been reported. Although it is possible that a cost of $80.00/ton could occur for a specific facility, such a cost appears to be abnormal. Even if a disposal cost of $80.00/ton were to occur, the total annualized control cost would increase only 6.0 percent from the total annualized control cost based on the $5.30/ton cost used in Section 8.2 of the Background Information Document, Volume I. This would still not inhibit the construction of new facilities for the production of any type of glass. However, use of the $5.00/ton is considered reasonable.

One commenter was of the opinion that the economic impacts outlined in the proposed rules do not take hand glass plants into consideration. It was explained that these plants are very small with low daily pull rates, and many of the plants are marginally surviving already. It was this commenter's opinion that the proposed standard would be disastrous for this sector of the industry.

Hand glass plants, as discussed in the Emission Control Technology section (2.2) of this document, have been taken into consideration in the promulgation of these standards in the form of an exemption.

One commenter pointed out that the growth rate figures for the pressed and blown glass categories varied within the Background

Information Document, Volume I. It was noted that Chapter 7 used 3.5 percent and Chapter 8 used 4.0 percent as their respective growth rates.

The use of these two percentages was a mistake. The use of 3.5 percent as an annual growth rate in Chapter 7 (Environmental Impact) would favor industry in revealing less projected emissions (new sources). The use of 4.0 percent as an annual growth rate in Chapter 8 (Economic Impact), on the other hand, would also tend to favor industry showing higher costs attributable to the promulgation of the standards. In selecting a figure to be representative for the industry, the 4 percent estimate was chosen. Four percent is considered to be more accurate due to comments received during the comment period that the industry expansion figures were underestimated. No correction of the impact analysis appears to be required because the 4 percent growth rate was used to estimate the impacts of the proposed standards. However, it is noted that a 4 percent growth rate figure constitutes an assumption which is more conservative than 3.5 percent would have been.

Incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 90 Mg/day pressed and blown glass furnace melting borosilicate formulations will be about $800 thousand for an ESP and about $260 thousand for a fabric filter. Incremental annualized costs for a 90 Mg/day furnace associated with the standard will be about $245 thousand per year and about $85 thousand per year for an ESP and a fabric filter, respectively.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for the two new 90 Mg/day furnaces will be about $500 thousand if fabric filters are used. Fifth-year annualized costs for controlling the two new glass melting furnaces to comply with the standard will be about $160 thousand.

Based on the use of control equipment with the highest annualized costs, a price increase of about 0.8 percent will be necessary to offset the costs of installing control equipment on the 90 Mg/pressed and blown glass furnace melting borosilicate formulations to meet the emission limits of the standard.

Incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 45 Mg/day pressed and blown glass furnace melting borosilicate formulations will be about $760 thousand for an ESP and about $235 thousand for a fabric filter. Incremental annualized costs for a 45 Mg/day furnace associated with the standard will be about $230 thousand/year for an ESP and about $70 thousand/year for a fabric filters.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for a 45 Mg/day furnace will be about $235 thousand if an ESP is used. Fifth-year annualized costs for controlling a new glass melting furnace in this category to comply with the standard will be about $70 thousand.

Based on the use of control equipment with the highest annualized costs (worst-case conditions), a price increase of about 0.4 percent will be necessary to offset the costs of installing control equipment on a 45 Mg/day pressed and blown glass furnace melting borosilicate formulations to meet the emission limits of the standard.

The incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 90 Mg/day pressed and blown glass furnace melting soda-lime and lead formulations will be about $615 thousand for an ESP and about $770 thousand for a fabric filter. Incremental annualized costs for a 90 Mg/day furnace associated with the standard will be about $175 thousand/year and about $235 thousand/year for an ESP and a fabric filter, respectively.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for the six new 90 Mg/day furnaces will be about $3.7 million if ESPs are used. Fifth-year annualized costs for controlling these six new glass melting furnaces to comply with the standard will be about $1.1 million.

Based on the use of control equipment with the highest annualized costs, a price increase of about 0.6 percent will be necessary to offset the costs of installing control equipment on the 90 Mg/day pressed and blown glass furnace melting soda-lime and lead formulations to meet the emission limits of the standard.

The incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 45 Mg/day pressed and blown glass furnace melting soda-lime and lead formulations will be about $740 thousand for an ESP and about $710 thousand for a fabric filter. Incremental annualized costs for a 45 Mg/day furnace associated with the standard will be about $230 thousand/year for both ESPs and fabric filters.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for the four new 45 Mg/day furnaces will be about $2.8 million if a fabric filter is used. Fifth-year annualized costs for controlling the four new glass melting furnaces to comply with the standard will be about $910 thousand.

Based on the use of control equipment with the highest annualized costs (worst case conditions), a price increase of about 0.6 percent will be necessary to offset the costs of installing control equipment on a 45 Mg/day pressed and blown glass furnace melting soda-lime and lead formulations to meet the emission limits of the standard.

Incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 90 Mg/day pressed and blown glass furnace melting other-than borosilicate, soda-lime, and lead formulations will be about $800 thousand for an ESP and about $260 thousand for a fabric filter. Incremental annualized costs for a 90 Mg/day furnace associated with the standard will be about $245 thousand per year and about $85 thousand per year for an ESP and a fabric filter, respectively.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for a new 90 Mg/day furnace will be about $250 thousand if a fabric filter is used. Fifth-year annualized costs for controlling a new glass metlting furance to comply with the standard will be about $80 thousand.

Based on the use of control equipment with the highest annualized costs, a price increase of about 0.4 percent will be necessary to offset the costs of installing control equipment on a 90 Mg/day pressed and blown glass furnace melting formulations other-than borosilicate, soda-lime, and lead to meet the emission limits of the standard.

Incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 45 Mg/day pressed and blown glass furnace melting other-than borosilicate, soda-lime, and lead formulations will be about $760 thousand for an ESP and about $235 thousand for a fabric filter. Incremental annualized costs for a 45 Mg/day furnace associated with the standard will be about $230 thousand/year for an ESP and about $70 thousand/year for a fabric filter.

Incremental cumulative capital costs for the 1979 through 1984 period associated with the standard for the 45 Mg/day furnace will be about $235 thousand if an ESP is used. Fifth-year annualized costs for controlling the new glass melting furnace in this category to comply with the standard will be about $70 thousand.

Based on the use of control equipment with the highest annualized costs (worst case conditions), a price increase of about 0.4 percent will be necessary to offset the costs of installing control equipment on a 45 Mg/day pressed and blown glass furnace melting other-than borosilicate, soda-lime, and lead formulations to meet the emission limits of the standard.

The economic impact for the new pressed and blown glass plants to be built in the near future was based on anaylses of the various segments of this category's three subcategories. It was through these analyses that EPA has determined the economic impacts of these standards of performance to be reasonable.

Wool Fiberglass. One commenter suggested that the wool fiberglass standard would pose a monumental financial burden to the industry in capital and operating costs.

For wool fiberglass, the new source performance standard operating costs are estimated to be 0.3 percent of sales for the model plant analyzed. Just as for all segments of the industry, so also for wool fiberglass, it was assumed that this would lead to no increase in product price, but would be absorbed entirely out of profit. On that basis, these operating costs fell below the criteria for significant impact reconsideration, which were set at 1 percent of product price and 10 percent of rate of return.

It might be added that the assumption of no product price increase is considered to be conservative for this industry segment. As pointed out in Section 8.1 of the Background Information Document, Volume I, projected demand in this segment appears to outstrip general demand and shipments have increased in the face of rising prices. This suggests some possibility of absorbing a 0.3 percent cost increase by means of increased price rather than reduced profit.

As for capital requirements, the new source performance standard capital cost was estimated to be $504,000. This is 0.9 percent of the total capital required for construction of a new model plant. For the companies in this industry segment, this kind of increase in capital requirements would not put them out of the reach of the capital markets.

Incremental installed costs in January 1978 dollars associated with the standard for controlling particulate emissions from a 180 Mg/day wool fiberglass furnace will be about $500 thousand for an ESP and about $70 thousand for a fabric filter. Incremental annualized costs associated with the standard for a 180 Mg/day wool fiberglass furnace will be about $155 thousand/year and about $20 thousand/year for an ESP and a fabric filter, respectively.

Incremental cumulative capital costs for the six new 180 Mg/day wool fiberglass furnaces during the 1979 through 1984 period associated with the standard will be about $3 million if ESPs are used. Fifth-year annualized costs for controlling wool fiberglass furnaces complying with the standard will be about $930 thousand.

Based on the use of control equipment with the highest annualized costs (worst case conditions), a price increase of about 0.3 percent will be necessary to offset the costs of installing control equipment on a 180 Mg/day wool fiberglass furnace to meet the emission limits of the standard.

<u>Flat Glass</u>. One commenter suggested that the number of flat glass plants that will be affected by the standard by 1984 is four.

Due to an apparent computational error in a prior analysis, the number for flat glass plants to be built by 1984 was stated as one. The correct number should have been four. The effect of this correction in the number of new plants is to quadruple the total annualized control costs for this segment in the fifth year from \$190,000 to \$760,000. No change in the impact study's conclusions results from the correction of this computational error.

Annualized costs associated with the promulgated flat glass manufacturing standard will be about \$0.33 million for each of the four new plants expected by 1984. Compliance with the standard will result in annualized costs in the flat glass manufacturing industry of about \$1.32 million by 1984. For typical plants constructed between 1979 through 1984, capital costs associated with the promulgated standard will be about \$1.2 million. Cumulative capital costs of complying with the promulgated standard for the estimated four additional flat glass manufacturing plants will amount to about \$4.8 million between 1979 and 1984. The percent price increase necessary to offset costs of compliance with the promulgated standard will be about 0.8 percent.

2.7 ENERGY IMPACT

One commenter suggested that one of the benefits of implementing process modification techniques is the conservation of energy. As discussed in the Emission Control Technology Section (2.2) of this document, these techniques have not been adequately demonstrated. Therefore, the EPA has not based the standards on these techniques. However, application of process modifications should not conflict with achieving the standards, and thus energy conservation attributable to process modifications should be possible with or without the promulgation of the standards.

Several commenters suggested that the national energy problem was not being adequately taken into consideration if ESPs are installed on glass melting furnaces that are regulated by the promulgated standards.

A detailed energy analysis was made prior to the decision to recommend the use of add-on controls as a means of particulate emission reduction from glass manufacturing plants. This analysis showed that the energy use attributed to the installation of add-on controls to comply with the promulgated standards will be minimal. Refer to Section 1.2.2 of this document for details of these energy impacts associated with the promulgation of these standards.

An additional factor illustrating EPA's concern for the Nation's energy policies is the incremental allowances provided to those glass manufacturers that use fuel oil for their melting operations. This allowance, provided for each of the glass manufacturing categories with the exception of flat glass, effects an equalization in a company's decision of whether to use fuel oil or natural gas to melt its glass. The decision of what fuel to fire by a particular plant would not be based on the respective emission potentials of each type of fuel but would be based on the economics of fuel supply.

Several commenters suggested that process modifications use less energy than add-on control devices. It was their opinion that the installation and operation of add-on controls does not represent a concerted effort on the part of EPA to consider the energy impacts attributable to setting the standards as they are promulgated.

Process modifications, not yet demonstrated as a best system of continuous emission reduction, do require the consumption of less energy by glass manufacturing plants in certain instances (e.g., the reduction of production reduces fuel consumption). In other instances, they require the consumption of more energy by glass manufacturing plants. Although this may be so, energy impacts are not the sole criterion upon which the establishment of NSPS' are based. Energy impacts are one of several factors taken into consideration in setting standards that represent a demonstrated best system of continuous emission reduction. In deciding what standards to establish, such factors as economic, energy, emission reduction, production, and others were considered. The impacts drawn from this analysis were taken into account in the development of these standards.

As previously mentioned, if all the sources projected to be subject to the standards find it necessary to install add-on control devices the energy consumption attributable to the standards will be approximately 62.8 million kWh/yr in 1984. Compared to the energy requirements of the whole plant, this figure is considered small.

<u>Container Glass</u>. The energy required to control particulate emissions from the 25 new container glass furnaces will be about 40.4 million kWh (22 thousand barrels of oil/year) for a typical SIP

regulation for the new furnaces equipped with ESPs. This required energy will be about 0.2 percent of the total energy use of these container glass melting furnaces. The energy impact associated with the promulgation of this standard will not be significant because the energy required to operate an ESP for this standard (40.8 million kWh/yr in 1984) is essentially the same as the energy required to operate an ESP for a typical SIP regulation.

Pressed and Blown Glass (Borosilicate). Control to the level required by a typical SIP regulation of the two new 90 Mg/day pressed and blown glass furnaces melting borosilicate formulations projected to come on-stream during the 1979 through 1984 period will require about 6.6 million kWh (3,700 barrels of oil/year) if an ESP is used. The energy requirements to achieve the standard's emission limit will be essentially the same as the requirements for meeting a typical SIP regulation (6.6 million kWh).

Although there are none projected to be built, the energy required to control particulate emissions from a new 45 Mg/day pressed and blown glass furnace melting borosilicate formulations to the level required by the typical SIP regulation would be about 2.7 million kWh (1,500 barrels of oil/year). The energy required to comply with the standard's emissions limit would be essentially the same as that required for meeting a typical SIP regulation (2.7 million kWh).

The energy required to comply with the emission limit of the standard will be about 0.1 percent of total energy use of the affected pressed and blown (borosilicate) glass melting furnaces in this glass manufacturing category. Considering the small amounts of additional oil and electricity required and the slight increase in total energy use in this sector, the energy impacts of the standard will be negligible.

Pressed and Blown Glass (Soda-Lime and Lead). The energy required to control particulate emissions from the six new pressed and blown (soda-lime and lead) 90 Mg/day furnaces would be 4.1 million kWh (2,500 barrels of oil/year) for a typical SIP regulation, or the standard if ESPs are installed. There will be no energy impact associated with the standard for the new 90 Mg/day furnaces beyond the impact associated with the requirements to meet a typical SIP regulation as the energy requirements are essentially equivalent (4.1 million kWh).

There will be no associated energy requirement for SIP compliance since the four new pressed and blown (soda-lime and lead) 45 Mg/day furnaces will be in compliance with a typical SIP regulation without add-on controls. The estimated energy required to control particulate emissions from the four new 45 Mg/day furnaces projected to come on-stream in the 1979 through 1984 period to the level required by the standard will be about 1.5 million kWh (900 barrels of oil/year).

The energy required for a pressed and blown (soda-lime and lead) glass melting furnace to comply with the emission limits of the standard will be about 0.5 percent of the total energy use of the affected pressed and blown (soda-lime and lead) melting furnaces in this glass manufacturing category. Considering the small amounts of additional oil and electricity required and the slight increase in total energy use in this sector, the energy impacts of the standard are considered reasonable.

Pressed and Blown Glass (Other-Than Borosilicate, Soda-Lime, and Lead). Control to the level required by a typical SIP regulation of the two new 90 Mg/day pressed and blown glass furnaces melting glass formulations other-than borosilicate, soda-lime, and lead projected to come on-stream during the 1979 through 1984 period will require about 2.6 million kWh (1,460 barrels of oil/year) if an ESP is used. The energy requirements to achieve the standard's emission limit will be essentially the same as the requirements for meeting a typical SIP regulation (2.6 million kWh).

Although there are none projected to be built, the energy required to control particulate emissions from a new 45 Mg/day pressed and blown glass furnace melting other-than borosilicate, soda-lime, and lead formulations to the level required by the typical SIP regulation would be about 0.6 million kWh (350 barrels of oil/year). The energy required to comply with the standard's emissions limit would be essentially the same as that required for meeting a typical SIP regulation (0.6 million kWh).

The energy required to comply with the emission limit of the standard will be about 0.1 percent of total energy use of the affected pressed and blown (other-than borosilicate, soda-lime, and lead) melting furnaces in this glass manufacturing category. Considering the small amounts of additional oil and electricity required and the slight increase in total energy use in this sector, the energy impacts of the standard are considered reasonable.

Wool Fiberglass. The estimated energy required to comply with a typical SIP regulation for the six new wool fiberglass furnaces expected to come on-stream in the 1979 through 1984 period will be about 6.8 million kWh (3,850 barrels of oil/year) if ESPs are used. This required energy will be about 0.3 percent of the total energy use of the affected wool fiberglass melting furnaces. Complying with the emission limits of the standard with ESPs will require about 6.9 million kWh (3,900 barrels of oil/year). The energy impacts of the standard are considered reasonable (only about 50 barrels of oil/year).

Flat Glass. Because changes in the uncontrolled emission rate and controlled emission rate were made for the flat glass category, the energy impacts were re-evaluated.

The amount of electrical energy required of the ESP to meet the typical SIP regulation is about 31,800 Btu/ton (1.03×10^{-2} kWh/Kg) of glass. However, to meet the level attributable to the promulgated standard, the ESP will consume approximately 32,200 Btu/ton (1.04×10^{-2} kWh/Kg), which is only an additional energy requirement of approximately 500 Btu/ton (1.5×10^{-4} kWh/Kg), and is considered minimal.

Industry-wide, the addition of four new flat glass melting furnaces by 1984 will require the consumption of approximately 33,600 million Btu (9.839 million kWh) per year to meet the typical SIP regulation, which is equivalent to 5,600 barrels of oil per year. The energy required to control these furnaces to the level of the promulgated standard is approximately 34,150 million Btu (9.97 million kWh) per year, which is an additional consumption of 550 million Btu (0.131 million kWh) per year. This is considered to be reasonable.

The secondary air quality impact associated with the promulgated flat glass standard is not considered to be significant. To meet the typical SIP regulation, the four new flat glass manufacturing plants will cause affected electric utility plants to emit approximately

4.9 tons (4,500 Kg) per year of particulate through 1984. However, to control these furnaces to the level of the promulgated standard, a negligible amount of additional particulate will be emitted by the electric utility plants.

For each of the new flat glass plants, the increased energy consumption that would result from the promulgated standard is about 4 percent of the electrical energy consumed to produce flat glass. This is about 0.2 percent of the total energy consumed to produce flat glass and is considered reasonable.

Because the additional energy requirement attributable to the promulgated standards has no adverse impact on national energy consumption, and the secondary air quality impact is considered negligible, the energy impacts associated with the promulgated standards are considered reasonable.

2.8 TEST METHODS AND MONITORING

Commenters stated that EPA Method 5 contains several sources of error when applied in sampling emissions from soda-lime glass melting furnaces.

First, commenters stated that misclassification of particulate and gaseous species and inflated particulate emission values are errors which can be caused by the use of filter temperatures below the sulfur trioxide dew point. These comments are related to the presence of sulfur trioxide (SO_3) in the exhaust stream from the glass melting furnace. When particulate matter is filtered at about 250°F, sulfur trioxide that is present and which condenses will be collected on the filter as sulfuric acid. The measurement of this sulfuric acid by Method 5 does not constitute an error in the method because Method 5 normally considers sulfuric acid as particulate matter. However, for the glass manufacturing industry, the decision was made to define particulate matter to exclude sulfuric acid for the following reasons: (1) the variability of the SO_3 content in the stack gas with the sulfur content of the fuel was not considered in developing the standards, and (2) the technologies considered in establishing the standards do not control SO_3. Therefore, the method was modified, for glass manufacturing plants, to prevent collection of sulfur trioxide, as sulfuric acid, by allowing the filter and the probe to operate at temperatures of up to 350°F, which is above the acid dew point or condensation point.

Second, commenters stated that sulfuric acid will react with the sodium sulfate particulate matter collected on the filter. To account for this reaction, the commenters suggested that the Method 5 analytical procedure be modified by taking an aliquot from the probe wash and water extract of the filter, after drying and weighing the filter, and titrating to pH 6 with 0.1 N sodium hydroxide. Then the amount of sulfuric acid that reacted can be calculated and subtracted to determine the particulate emission value.

The data that have been submitted indicate that sulfuric acid will react with the particulate matter collected on the filter. EPA evaluated the suggestion as follows: (1) the reaction of sulfuric acid with sodium sulfate particulate will go to completion even at the low levels of sulfuric acid present in gas-fired furnaces and, therefore, uniformly influence particulate emission values whether from gas-fired or fuel oil-fired furnaces; (2) the particulate emission values obtained during data gathering were not corrected for the sulfuric acid reaction; and, (3) if the particulate emission values are adjusted to account for the reaction, then the level of the standard must be appropriately adjusted. Thus, to be consistent with the manner in which the standards were set, the method was not revised to allow that reacted sulfuric acid be subtracted.

Third, commenters remarked that sulfur dioxide (SO_2) and SO_3 can react with the alkali in the Method 5 filter and cause higher than true particulate emission values.

An EPA report indicates that SO_2 or SO_3 reacts with some glass fiber filters resulting in a significant weight gain. The report also shows that this potential weight gain can be avoided by choosing a source of filter material demonstrated to be nonreactive to SO_2 and SO_3. The degree to which this reaction occurs is apparently related to the final rinse step of filter production, which varies according to the supplier. In addition, this potential weight gain is not significant when sampling high concentration emissions for short sampling periods and when the gas contains no SO_2 or SO_3. The use of nonreactive filters has always been an option in Method 5; however, the use of nonreactive filters would eliminate any such weight gain. The filters used in collecting the data used as the basis of this standard may have been reactive or may have been nonreactive. Therefore, EPA is revising Method 5 to require the use of nonreactive filters in testing sources whose gas streams contain SO_2 or SO_3.

Fourth, commenters indicated that EPA Method 5 contains a source of error by including extraneous water vapor.

This comment is related to the fact that sulfuric acid is hygroscopic and retains combined water after desiccation. Experiments have shown that sulfuric acid desiccated with calcium sulfate retains 2 molecules of water per molecule of acid after reaching equilibrium. If samples are desiccated to equilibrium, the amount of combined water remaining would be proportional to the amount of sulfuric acid present in the collected particulate matter; while maintaining the samples at equilibrium during weighing can present some problems, it can be achieved with humidity controlled weighing rooms and careful techniques. This potential source of error is only a problem if sulfuric acid is collected by the filter. Because the method of emission measurement for these standards was modified to prevent sulfuric acid mist from being collected by the filter, this comment is no longer an issue.

Last, commenters also suggested that a quartz or glass nozzle be used on the probe, that the test method should allow a smaller minimum sample volume, and that the two most consistent runs of the required three runs should be used in determining the emission values.

A quartz or glass nozzle is allowed by Method 5. The minimum sample requirement was modified to allow the option of lower sampling volumes provided that a minimum of 50 milligrams of sample is collected. Determination of compliance, as set forth in 40 CFR 60.8, is based on the arithmetic average of three runs. The standards promulgated for glass manufacturing are based on such an average. Therefore, a change in this average would be inconsistent with the data used to establish the standards. However, as set forth in 40 CFR 60.8, if certain conditions exist, compliance may be determined, upon approval by EPA, by using the average of two runs.

2.9 CLARIFICATIONS

Commenters expressed concern with the possible confusion of whether an entire glass manufacturing plant might be considered to be an affected facility if one of its glass melting furnaces was to be modified or reconstructed and thereby subject to these new source performance standards. This confusion was remedied by redrafting the description of the affected facility to delete glass manufacturing plants as part of the affected facility. The affected facility is now limited to the glass melting furnace as defined in the regulation.

Also suggested was a provision to specifically exclude the float bath used in the flat glass category from being regulated as a part of the furnace (affected facility). The float bath is considered to be part of the forming process, not the melting process, and is therefore not regulated by these NSPSs. To remedy this possible area of confusion, the regulation has been rewritten as suggested.

One commenter corrected EPA in its use of the word "day pot furnace" to describe the 2 tons per day glass melting furnaces exempted under the proposed regulations. It was pointed out that the industry-wide term most used to refer to small glass melting furnaces is "pot furnace." It was suggested that instead of the terms "day pot" and "day pot furnace," as used in the proposed regulatory definitions [Section 60.291(c)] and standards for particulate matter [Section 60.292(d)] and the proposed preamble (44 FR 34842), respectively, the term "pot furnace" be used. This term was deleted from the regulation as a result of the exemption of hand glass melting furnaces from compliance with these standards.

The term "glass manufacturing plant" was removed from Section 60.291 Definitions of the regulation because it was not needed.

The recipe definitions were also changed where appropriate to describe the specialized batch formulations found in the pressed and blown glass category. Detailed recipes for borosilicate, soda-lime and lead, and other than borosilicate, soda-lime and lead were included in Section 60.291 Definitions of the regulation.

Sections 60.293 to 60.295 are reserved in the event additional provisions will be necessary for clarity or other reasons.

The term "glass production" in the proposed regulation's Section 60.291 was changed to "glass produced" to better state the basis upon which the standards are determined to be met.

The term "hand glass melting furnace" was added to the regulation in Section 60.291 as a result of the exemption of the furnaces typically operated in this sector of the industry.

APPENDIX A

Control Device	None
Company	Owens-Corning Fiberglas Toledo, Ohio
Furnace	FG-2, All-electric
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-16
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	1
Date	4/18/73
Production Rate, (lb/hr)	Confidential
Stack Flow Rate, (scfm)	14,300
Temperature, (°F)	110
Grain Loading, (Gr/dscf)	0.005
Mass Emissions, (lb/hr)	0.59

Control Device	None
Company	Owens-Corning Fiberglas Toledo, Ohio
Furnace	FG-2, All-electric
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-17
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	3
Date	4/19/73
Production Rate, (lb/hr)	Confidential
Stack Flow Rate, (scfm)	9,680
Temperature, (°F)	126
Grain Loading, (Gr/dscf)	0.01
Mass Emissions, (lb/hr)	0.82

Control Device	None
Company	Owens-Corning Fiberglas Toledo, Ohio
Furnace	#70, All-electric
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-18
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	4
Date	3/15/76
Pull Rate, (lb/hr)	Confidential
Stack Flow Rate, (scfm)	8,613
Temperature, (°F)	116
Grain Loading, (Gr/dscf)	0.013454
Mass Emissions (lb/hr)	0.993

Control Device	None
Company	Ball Corporation El Monte, California
Furnace	No. 2, All-electric
Glass Type	Container
BID, Vol. I Ref.	4-19
EMB Memo Ref.	None (LAAPCD Method)

TEST DATA

Run	1	2	3
Date	12/12/74	1/30/75	2/11/75
Process Weight Rate, (lb/hr)	7774	8107	8060
Stack Flow Rate, (dscf)	400	568	576
Temperature, (°F)	1,040	930	1,090
Grain Loading, (Gr/dscf)	0.2	0.2	0.2
Mass Emissions, (lb/hr)	0.7	0.9	1.0

Control Device	Fabric Filter
Company	Owens-Illinois City of Industry, California
Furnace	B
Glass Type	Pressed and Blown (soda-lime)
BID, Vol. I Ref.	4-24
EMB Memo Ref.	II-B-55, 12/21/77

TEST DATA

Run	1
Date	11/29/73
Process Weight Rate, (lb/hr)	6,827
Flow Rate Thru Control Device, (dscf)	4,600
Temperature, (°F)	650
Grain Loading, (Gr/dscf)	0.066
Mass Emissions, (lb/hr)	2.6

Control Device	Fabric Filter
Company	Corning Glass Works Central Falls, Rhode Island
Furnace	# 08
Glass Type	Pressed and Blown; Soda-Lead-Borosilicate, Code 7720
BID, Vol. I Ref.	4-25
EMB Memo Ref.	II-B-63, 1/09/78

TEST DATA

Run	1	2	3
Date	1/14/77	1/14/77	1/14/77
Fill Rate, (lb/hr)	2,263	2,763	2,263
Flow Rate Thru Control Device, (dscf)	9,197	9,255	9,228
Temperature, (°F)	295	292	292
Grain Loading, (Gr/dscf)	0.005	0.004	0.003
Mass Emissions, (lb/hr)	0.41	0.31	0.27

Control Device	Fabric Filter
Company	Owens Corning Fiberglass Toledo, Ohio
Furnace	T and P20
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-26
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	1
Date	6/04/74
Production Rate, (lb/hr)	Confidential
Flow Rate Thru Control Device, (scfm)	21,200
Temperature, (°F)	220
Grain Loading, (Gr/dscf)	0.012
Mass Emissions, (lb/hr)	2.1

Control Device	Fabric Filter
Company	Owens Corning Fiberglas, Inc.
	Toledo, Ohio
Furnace	K Regenerative
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-27
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	1
Date	6/19/74
Production Rate, (lb/hr)	Confidential
Flow Rate Thru Control Device, (acfm)	14,400
Temperature, (°F)	336
Grain Loading, (Gr/dscf)	0.072
Mass Emissions, (lb/hr)	8.9

Control Device	Fabric Filter
Company	Owens Corning Fiberglas Toledo, Ohio
Furnace	T and P20
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-28
EMB Memo Ref.	II-B-77, 3/16/78

TEST DATA

Run	3
Date	6/04/74
Production Rate, (lb/hr)	Confidential
Flow Rate Thru Control Device, (scfm)	21,200
Temperature, (°F)	224
Grain Loading, (Gr/dscf)	0.017
Mass Emissions, (lb/hr)	3.1

Control Device	Venturi Scrubber
Company	Glass Containers Corporation Dayville, Connecticut
Furnace	#1 #5 Fuel Oil
Glass Type	Container
BID, Vol. I Ref.	4-31
EMB Memo Ref.	II-B-61, 1/05/78

TEST DATA

Run	1	2	3
Date	11/11/75	11/12/75	11/12/75
Pull Rate, (lb/hr)	18,833	18,833	18,833
Flow Rate Thru Control Device, (dscf)	19,174.2	19,691.5	18,732.4
Temperature, (°F)	140	140	140
Grain Loading, (Gr/dscf)	0.0507	0.0361	0.0404
Mass Emissions, (lb/hr)	8.33	6.09	6.49

Control Device	Venturi Scrubber
Company	Glass Containers Corporation Vernon, California
Furnace	No. 1
Glass Type	Container
BID, Vol. I Ref.	4-32
EMB Memo Ref.	None

TEST DATA

Run	1
Date	08/21/74
Process Weight Rate, (lb/hr)	15,720
Flow Rate Thru Control Device, (dscf) inlet/outlet	8,470/8,890
Temperature, (°F)	160
Grain Loading, (Gr/dscf)	0.0225
Mass Emissions, (lb/hr)	1.6

Control Device	Venturi Scrubber
Company	Brockway Glass Company Oakland, California
Furnace	No. 21
Glass Type	Container
BID, Vol. I Ref.	4-33
EMB Memo Ref.	II-B-75, 3/13/78

TEST DATA

Run	1
Date	04/06/77
Production Rate, (lb/hr)	16,333
Flow Rate Thru Control Device, (dscf)	9,400
Temperature, (°F)	150
Grain Loading, (Gr/dscf)	0.00995
Mass Emissions, (lb/hr)	2.3

Control Device	Venturi Scrubber
Company	Glass Containers Corporation Vernon, California
Furnace	No. 1, Natural Gas (runs 1 and 2) Fuel Oil (run 3)
Glass Type	Container
BID, Vol. I Ref.	4-34
EMB Memo Ref.	II-B-41, 10/28/77

TEST DATA

Run	1	2	3
Date	01/24/75	01/29/75	01/31/75
Process Weight Rate, (lb/hr)	15,200	15,700	15,700
Flow Rate Thru Control Device, (dscf) Scrubber inlet/Knockout Tower outlet	8,460/8,460	6,400/8,740	12,100/12,300
Temperature, (°F) Packed Tower Inlet/ Knockout Tower Outlet	960/160	970/160	970/150
Grain Loading, (Gr/dscf)	0.031	0.034	0.335
Mass Emissions, (lb/hr)	2.2	2.5	35.3

Control Device	Electrostatic Precipitator
Company	Thatcher Glass Manufacturing Company Saugus, California
Furnace	No. 3
Glass Type	Container
BID, Vol. I Ref.	4-38
EMB Memo Ref.	None (LAAPCD Method)

TEST DATA

Run	1	2	3
Date	05/02/75	05/07/75	05/09/75
Process Weight Rate, (lb/hr)	26,500	25,827	23,800
Flow Rate Thru Control Device, (dscf) (inlet/outlet)	23,200/30,100	24,000/31,300	27,000/31,000
Temperature, (°F) (inlet/outlet)	670/500	650/500	640/520
Grain Loading, (Gr/dscf)	0.005	0.0034	0.0059
Mass Emissions, (lb/hr)	1.3	0.9	1.6

Control Device	Electrostatic Precipitator
Company	Owens-Illinois Los Angeles, California
Furnace	23 A
Glass Type	Container
BID, Vol. I Ref.	4-39
EMB Memo Ref.	None (LAAPCD Method)

TEST DATA

Run	1	2	3
Date	01/07/75	01/28/75	02/27/75
Process Weight Rate, (lb/hr)	18,816	17,640.7	15,765.5
Flow Rate Thru Control Device, (dscf)	13,500	13,000	13,300
Temperature, (°F)	610	660	620
Grain Loading, (Gr/dscf)	0.00795	0.00740	0.00757
Mass Emissions, (lb/hr)	0.92	0.825	0.9

Control Device	Electrostatic Precipitator
Company	Owens-Illinois
	Los Angeles, California
Furnace	Natural Gas Units A, B, and C
Glass Type	Container
BID, Vol. I Ref.	4-40
EMB Memo Ref.	None

TEST DATA

Run (Unit)	1(A)	2(A)	3(B)	4(A)	5(B)	6(A)	7(B)	8(A)	9(B)	10(C)	11(C)	12(C)	13(C)
Date (1977)	4/26	4/28	4/28	4/28	4/28	4/29	4/29	4/30	4/30	5/3	5/4	5/4	5/5
Production Rate, (lb/hr)	CONFIDENTIAL												
Flow Rate Thru Control Device, (acfm)	85,800	49,400	45,600	49,400	45,600	47,500	44,600	47,200	42,600	43,800	45,300	45,300	41,900
Temperature, (°F)	570	580	500	580	500	590	480	590	490	520	490	490	480
Grain Loading, (Gr/dscf)	0.009	0.003	0.006	0.002	0.004	0.012	0.016	0.007	0.017	0.001	0.004	0.011	0.003
Mass Emissions, (lb/hr)	3.0	0.63	1.11	0.44	0.81	2.17	3.07	1.31	3.10	0.26	0.69	2.2	0.48

Control Device	Electrostatic Precipitator
Company	General Electric Company Jackson, Mississippi
Furnace	Natural Gas
Glass Type	Pressed and Blown (Borosilicate)
BID, Vol. I Ref.	4-41(a)
EMB Memo Ref.	II-B-47, 11/11/77

TEST DATA

Run	1	2	3
Date	02/25/76	02/26/76	02/26/76
Process Weight Rate, (lb/hr)	2,170	2,170	2,245
Flow Rate Thru Control Device, (acfm)	9,501	9,754	9,588
Temperature, (°F)	323	326	325
Grain Loading, (Gr/dscf)	0.0020	0.0020	0.0020
Mass Emissions, (lb/hr)	0.1025	0.1040	0.1001

Control Device	Electrostatic Precipitator
Company	General Electric Company Niles - Mahoning, Ohio
Furnace	
Glass Type	Pressed and Blown (Borosilicate)
BID, Vol. I Ref.	4-41(b)
EMB Memo Ref.	II-B-76, 3/13/78

TEST DATA

Run	1	2	3
Date	09/28/77	09/28/77	09/28/77
Process Weight Rate, (lb/hr)		Confidential	
Flow Rate Thru Control Device, (dscf)	31,021	31,531	29,022
Temperature, (°F)	504	483	494
Grain Loading, (Gr/dscf)	0.02857	0.02594	0.02916
Mass Emissions, (lb/hr)	6.94	6.35	6.69

Control Device	Electrostatic Precipitator (2)
Company	Owens-Illinois Vineland, New Jersey
Furnace	J, K, L, M, and R.
Glass Type	Pressed and Blown (Borosilicate)
BID, Vol. I Ref.	4-42
EMB Memo Ref.	II-B-5, 12/22/77; II-B-60, 1/3/78; II-B-99, 12/3/78

TEST DATA

Run	1	2	3
Date	12/05/73	12/05/73	12/06/73
Process Weight Rate, (lb/hr)	13,321	13,189	13,694
Flow Rate Thru Control Device, (dscf)	47,810	48,136	52,601
Temperature, (°F)	414	410	426
Grain Loading, (Gr/dscf)	0.020	0.018	0.017
Mass Emissions, (lb/hr)	(None presented)		

Control Device	Electrostatic Precipitator
Company	Corning Glass Company Fallbrook, New York
Furnace	Tank 41 Natural Gas with Excess Air
Glass Type	Pressed and Blown (Borosilicate)
BID, Vol. I Ref.	4-43
EMB Memo Ref.	II-B-63, 1/09/78

TEST DATA

Run	1	2	3
Date	08/06/75	08/06/75	08/06/75
Fill Rate, (lb/hr)	1,046	1,046	1,046
Stack Flow Rate, (dscf)	8,420	8,730	8,295
Temperature, (°F)	295	298	296
Grain Loading, (Gr/dscf)	0.005	0.007	0.009
Mass Emissions, (lb/hr)	0.38	0.48	0.66

Control Device	Electrostatic Precipitator
Company	General Electric Company Somerset, Kentucky
Furnace	# 5, Fuel Oil
Glass Type	Pressed and Blown (Borosilicate)
BID, Vol. I Ref.	4-44
EMB Memo Ref.	II-B-48, 11/14/77

TEST DATA

Run	1	2	3
Date	04/28/76	04/28/76	04/28/76
Production Rate, (lb/hr)	8,750	8,750	8,750
Flow Rate Thru Control Device, (acfm)	29,927	30,646	30,400
Temperature, (°F)	458	462	458
Grain Loading, (Gr/scf)	0.0270	0.0329	0.0322
Mass Emissions, (lb/hr)	3.61	4.48	4.4

Control Device	Electrostatic Precipitator
Company	Corning Glass Works
	Charleroi, Pennsylvania
Furnace	Tank 66, Natural Gas
Glass Type	Pressed and Blown (Fluoride/Opal)
BID, Vol. I Ref.	4-45
EMB Memo Ref.	II-B-63, 1/09/78

TEST DATA

Run	1	2
Date	03/19/76	03/19/76
Fill Rate, (lb/hr)	8,000	8,000
Flow Rate Thru Control Device, (dscf)	19,165	18,690
Temperature, (°F)	364	377
Grain Loading, (Gr/dscf)	0.006	0.008
Mass Emissions, (lb/hr)	1.05	1.25

Control Device	Electrostatic Precipitator
Company	Corning Glass Works State College, Pennsylvania
Furnace	Tank 222, Natural Gas with Excess Air
Glass Type	Pressed and Blown (lead)
BID, Vol. I Ref.	4-46
EMB Memo Ref.	II-B-63, 1/09/78; II-B-54, 12/09/77

TEST DATA

Run	1
Date	04/30/75
Fill Rate, (lb/hr)	5,500
Flow Rate Thru Control Device, (dscf)	14,650
Temperature, (°F)	396
Grain Loading, (Gr/dscf)	0.0024
Mass Emissions, (lb/hr)	0.31

Control Device	Electrostatic Precipitator
Company	General Electric Company Logan, Ohio
Furnace	Natural Gas
Glass Type	Pressed and Blown (lead)
BID, Vol. I Ref.	4-47
EMB Memo Ref.	II-B-49, 11/14/77

TEST DATA

Run	1	2	3
Date	04/21/76	04/21/76	04/22/76
Fill Rate, (lb/hr)	3,760	3,760	3,760
Flow Rate Thru Control Device, (acfm)		17,600	17,789
Temperature, (°F)		365	370
Grain Loading, (Gr/dscf)		0.0040	0.0028
Mass Emissions, (lb/hr)	0.278	0.347	0.247

Control Device	Electrostatic Precipitator
Company	Corning Glass Works
	State College, Pennsylvania
Furnace	Tank 221, Natural Gas
Glass Type	Pressed and Blown (Lead)
BID, Vol. I Ref.	4-48
EMB Memo Ref.	II-B-63, 1/09/78

TEST DATA

	(Dry Particulate)	(Dry Particulate)	(Total Particulate)
Run	1	2	3
Date	11/04/75	11/04/75	11/04/75
Fill Rate, (lb/hr)	15,167	15,167	15,167
Flow Rate Thru Control Device, (dscf)	35,370	35,390	33,910
Temperature, (°F)	422	419	421
Grain Loading, (Gr/dscf)	0.0013	0.0016	0.0052
Mass Emissions, (lb/hr)	0.4	0.49	1.5 (Total) 0.5 (Dry)

Control Device	Electrostatic Precipitator
Company	Corning Glass Works Danville, Kentucky
Furnace	Tank 122; Natural Gas with Excess Air
Glass Type	Pressed and Blown (lead)
BID, Vol. I Ref.	4-49
EMB Memo Ref.	II-B-63, 1/9/78

TEST DATA

Run	1	2	3	4	5
Date	11/18/75	11/18/75	11/19/75	11/19/75	11/19/75
Fill Rate, (lb/hr)	6,374	6,374	6,049	6,049	6,049
Flow Rate Thru Control Device, (dscf)	16,170	15,700	15,900	16,100	16,600
Temperature, (°F)	331	338	325	308	304
Grain Loading, (Gr/dscf)	0.0044	0.0021	0.0034	0.0032	0.0025
Mass Emissions, (lb/hr)	0.61	0.28	0.46	0.44	0.36

Control Device	Electrostatic Precipitator
Company	Owens-Illinois Vineland, New Jersey
Furnace	H
Glass Type	Pressed and Blown (lead)
BID, Vol. I Ref.	4-50
EMB Memo Ref.	None

TEST DATA

Run	1	2	3
Date	10/08/74	10/09/74	10/09/74
Process Weight Rate, (lb/hr)	2,494	2,347	2,347
Flow Rate Thru Control Device, (dscf)	11,135	10,045	11,270
Temperature, (°F)	325	325	330
Grain Loading, (Gr/dscf)	0.004	0.004	0.005
Mass Emissions, (lb/hr)	0.3	0.4	0.4

Control Device	Electrostatic Precipitator
Company	GTE Sylvania
	Versailles, Kentucky
Furnace	Propane and #6 Fuel Oil
Glass Type	Pressed and Blown (lead)
BID, Vol. I Ref.	4-51
EMB Memo Ref.	IV-B-14, 6/18/80

TEST DATA

Run	1	2	3
Date	08/24/76	08/24/76	08/25/76
Process Weight Rate, (lb/hr)	5,200	5,200	5,200
Flow Rate Thru Control Device, (dscf)	11,211	11,334	11,265
Temperature, (°F)	419	430	451
Grain Loading, (Gr/dscf)	0.015	0.015	0.015
Mass Emissions, (lb/hr)	1.4	1.42	1.45

Control Device	Electrostatic Precipitator
Company	Owens-Illinois Los Angeles, California
Furnace	#23A
Glass Type	Pressed and Blown (Potash-Soda-Lead)
BID, Vol. I Ref.	4-52
EMB Memo Ref.	None (LAAPCD Method)

TEST DATA

Run	North ESP		South ESP
Date	07/09/74		07/09/74
Process Weight Rate, (lb/hr)		21,524.4	
Flow Rate Thru Control Device, (dscf)	7,650		7,390
Temperature, (°F)	670		630
Grain Loading, (Gr/dscf)	0.022		0.00991
Mass Emissions, (lb/hr)	1.4		0.6

Control Device	Electrostatic Precipitator
Company	Johns-Manville Sales Corporation Parkersburg, West Virginia
Furnace	#402
BID, Vol. I Ref.	4-53
EMB Memo Ref.	II-B-92, 06/08/78

TEST DATA

Run	1
Date	11/09/77
Production Rate, (lb/hr)	10,000
Flow Rate Thru Control Device, (dscf)	23,810
Temperature, (°F) ESP Inlet/Outlet	550/510
Grain Loading, (Gr/dscf)	0.0175
Mass Emissions, (lb/hr)	3.58

Control Device	Electrostatic Precipitator
Company	Johns-Manville Sales Corporation
	Parkersburg, West Virginia
Furnace	#402
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-54
EMB Memo Ref.	II-B-92, 06/08/78

TEST DATA

Run	2
Date	11/09/77
Production Rate, (lb/hr)	10,000
Flow Rate Thru Control Device, (dscf)	23,582
Temperature, (°F) ESP Inlet/Outlet	550/505
Grain Loading, (Gr/dscf)	0.0047
Mass Emissions, (lb/hr)	0.961

Control Device	Electrostatic Precipitator
Company	Johns-Manville Sales Corporation
	Parkersburg, West Virginia
Furnace	#402
Glass Type	Wool Fiberglass
BID, Vol. I Ref.	4-55
EMB Memo Ref.	II-B-92, 06/08/78

TEST DATA

Run	3
Date	11/10/77
Production Rate, (lb/hr)	10,000
Flow Rate Thru Control Device, (dscf)	24,277
Temperature, (°F) ESP Inlet/Outlet	550/495
Grain Loading, (Gr/dscf)	0.0041
Mass Emissions, (lb/hr)	0.861

Control Device	Electrostatic Precipitator
Company	Guardian Industries, Inc. Kingsburg, California
Furnace	Oil-Fired
Glass Type	Flat
BID, Vol. I Ref.	None
EMB Memo Ref.	None - Final Report No. 2600-01-1079 EPA Contract No. 68-02-2813 Work Assignment No. 38

TEST DATA

Run	2	3	4
Date	9/18/79	9/19/79	9/19/79
Production Rate, (lb/hr)		Confidential	
Gas Sample Volume At Std. Conditions, (Ft^3)	54.137	51.650	51.855
Stack Gas Velocity, (Ft/sec)	57.95	57.61	57.35
Temperature, (°F)	614	620	620
Grain Loading, (Gr/dscf)	0.0156	0.0143	0.0230
Mass Emissions, (lb/hr)	5.22	4.70	7.59

APPENDIX B

APPENDIX B

An Explanation of the Discounted Cash Flow Methodology

The use of the discounted cash flow (DCF) methodology has several purposes: 1) it helps to overcome the disadvantages of a static tool such as ROI, Return on Investment, which is computed on the basis of one year's figures and 2) it can take into consideration all of the various cash inflows and outflows that occur on a random or changing basis over the life of a project. Concerning variation in cash flows, an investment tax credit is one example of a cash flow that only occurs in the first or early years of the project life. Other examples giving rise to varying cash flows are differences in financing and depreciation periods over the useful life of a project for both the basic process equipment as well as pollution control equipment. A static analysis which focuses on the data of only one year cannot adequately take all of these changing variables into account.

The DCF technique estimates and compares cash inflows over the life of any project (e.g., newly constructed plants). The changing value of money over time is considered in the comparisions by discounting those cash flows to the present time. The discount rate used is the firm's cost of capital. The effect of inflation over a project life can also be taken into consideration by choosing the firm's real cost of capital or a constant or current dollars cost of capital.

If the present value of the discounted cash inflows is greater than the present value of the discounted cash outflows, the project is economically justified. The difference between the discounted cash inflows and outflows is the net present value. If the net present value of a project with NSPS controls yields a net present value greater than zero, then it can be concluded that the impact of NSPS controls would not cause an inhibition of the project.

The DCF technique is considered appropriate for decision making on a profit maximizing basis, and has the capacity to address all the important economic variables involved in such a decision context. It is recognized that factors other than profit maximization may exert considerable influence in individual plant investment decisions (maintenance or enhancement of market shares is one example); however, such factors are generally not amenable to objective analysis.

The cash inflows of the project generally consist of the firm's after-tax profit, plus the various sources of depreciation and, in this instance, after-tax interest. The cash outflows are dependent on the method of project financing and selection of discount rate. Two general approaches can be used. If the weighted average cost of capital is the discount rate, the cash outflows consist of the initial investment and any sustaining capital expenditures that would be necessary to maintain the useful life of the project. In this case, sustaining capital expenditures were assumed to be zero. In contrast, if the cost of equity is the discount rate, the cash outflows consist of the initial equity portion of the total investment plus the debt repayments that occur over the financing period.

Concerning the specific cash inflows and outflows, Table 8-28 of the Background Information Document, Vol. 1 for the New Source Performance Standards for glass manufacturing plants presented the formulae and the sources of data for the actual tables that followed (8-29 through 8-31). Table 8-28 provides information for either the weighted average cost of capital or the cost of equity at discount rates. Tables 8-29 and 8-30 employ the cost of equity discount method, whereas Table 8-31 employs the weighted average cost of capital.

As they now appear in the Background Information Document, Vol. 1, there are some changes required in the lines for Tables 8-29 through 8-31 concerning cash inflows and outflows. Tables 8-29 and 8-30 mistakenly include interest time tax as a cash inflow, whereas Table 8-31 mistakenly includes debt repayments as a cash outflow. These lines in those three tables should be eliminated and the subsequent yearly cash flows corrected by subtracting the amount in these lines from the yearly cash flows.

The information on the left-hand side of Table 8-28 is for both the container and handmade consumerware DCF. All the calculations of Tables 8-29 through 8-31 were computed on a per-ton-of-glass-produced basis.

The first seven lines of Table 8-28 are all connected to the derivation of the cash inflow of line 6, i.e. profit. The first line indicates that the initial cash inflow is the revenue received from the sale of product, which is the average selling price per ton. To take cost into account, that average selling price is multiplied by a profit rate before taxes and before pollution control costs. The resultant figure is profit before taxes. The next figure subtracted from that profit level is the annualized pollution control cost, taken from the tables in Section 8.2 and divided by the average tons produced so that the utilization rate or yield of the plant is taken into consideration. The annualized control costs in Section 8.2 were computed on the basis of full capacity and annual costs. The resultant cash flow at this point is profit before taxes and after pollution control costs. This amount is then multiplied by the tax rate, which at the time of the analysis was 48 percent. This calculcation yields taxes payable, which when deducted from the previous line results in the next line, or profits. It should here be noted that line 7 should read, "Profit After Taxes and After Pollution Control," not "Profit Before Taxes and After Pollution Control."

The next cash inflow that must be included is the investment tax credit which is available for the purchase of equipment, including pollution control equipment. The Internal Revenue Code provides that 10 percent of the equipment cost can be taken as a credit against taxes payable, beginning in the first year of the project life. There are rules applicable to the limit of investment tax credit that can be taken in any one year. The limit at the time that these calculations were performed was 50 percent of the taxes payable (line 6).

The next cash inflow included is the depreciation from the buildings and equipment, including pollution control equipment. The depreciation periods for equipment were assumed to be 15 years for both the container and handmade consumerware industries. The depreciation period for a building was assumed to be 40 years in the case of container glass plants and 33 years in the case of handmade consumerware plants. Equipment depreciation was derived by taking the total equipment cost for the new investment, including baseline control, and dividing that cost by 15 years, and then further dividing that yearly figure by the number of tons of production capacity times the yield of the plant in any one year. In the case of the three DCF calculations presented in Tables 8-29 through 8-31 the yields were less in the first year than in the second year. This is why the costs in 1978 differ from those of 1979. To obtain building depreciation a similar procedure is followed as that for the equipment depreciation.

In the weighted average cost of capital discounting approach, the next cash flow to enter is interest times the tax rate of 48 percent. The purpose of including interest times tax as a cash flow is to recognize the tax savings that were generated by the use of someone else's borrowed money in the business. The interest rate utilized was 10 percent which was multiplied in the first year by the amount of the total investment in the project for which debt was incurred and by the tax rate. Subsequent years' interest levels are lower due to yearly debt payments. In the case of the 500 ton per day container glass plant, the debt incurred was 85 percent of the investment. The resultant interest calculation yields the yearly amount of after-tax interest which then must be divided by the number of tons of container glass produced in a given year.

Under the cost of equity DCF approach, the cash flow for debt repayments must be subtracted as a cash flow. The amount of debt is determined by multiplying the total investment by the percent that is funded by debt and dividing by the yearly production capacity of the plant multiplied by the yearly production yield. The assumptions (from industry sources) were that the container glass plant would be 85 percent debt financed and that the handmade consumerware plant would be 50 percent debt financed.

The net cash flow line represents the net sum of the cash inflows minus the cash outflows. For the weighted average cost of capital DCF method, this represents profit plus the investment tax credit plus depreciation plus interest multiplied by tax. For the cost of equity method, the net cash flow is the sum of profit plus investment tax credit plus depreciation minus debt repayment. Each year's net cash flow is multiplied by a discount rate which takes into account the value of money to the firm, to obtain the discounted cash flow. For the weighted average cost of capital method, the discount rate was 8 percent, whereas it was 15 percent under the cost of equity method. (Figures supplied by the industry.) The present value of the discounted cash flow for 20 years was then compared to the initial equity investment under the cost of equity discounting method (Tables 8-29 and 8-30) and to the total investment under the weighted average cost of capital method (Table 8-31). In all cases the net present value was greater than those investment figures, signifying that the project returned more than the minimum acceptable rate of return and thus justified the project, i.e., the building of the new plant.

APPENDIX C

APPENDIX C

Startup Considerations

Introduction

The promulgated standards of performance for glass manufacturing plants apply to new, modified, and reconstruced glass melting furnaces. A glass melting furnace is a unit comprising a refractory vessel in which raw materials are charged, melted at high temperatures, refined, and conditioned to produce molten glass. Glass melting furnaces with a production capacity of less than 5 tons/day and all-electric melting are exempt from the promulgated standards of performance. In addition, an increment of 30 percent is provided for oil-fired glass melting furnaces, except for flat glass melting furances.

Specifically, the standards of performance, as they apply to gas-fired glass melting furnaces would limit particulate exhaust emissions to: (1) 0.2 lb/ton of container glass produced, (2) 1.0 lb/ton of pressed and blown (borosilicate) glass produced, (3) 0.2 lb/ton of pressed and blown (soda-lime and lead) glass produced, (4) 0.5 lb/ton of pressed and blown (other-than borosilicate, soda-lime and lead) glass produced, (5) 0.5 lb/ton of wool fiberglass produced, and (6) 0.45 lb/ton of flat glass produced. Sources constructed, reconstructed, or modified after June 15, 1979 would be subject to the regulation.

Process Description

There are four basic processes involved in glass manufacturing: 1) raw materials handling and mixing, 2) glass melting, 3) forming and finishing, and 4) packaging. As mentioned above, standards of performance for the glass manufacturing industry apply only to the glass melting process. A detailed description of the glass melting process is included in Volume I, "Glass Manufacturing Plants, Background Information: Proposed Standards of Performance," EPA-450/3-79-005a (refer to pages 3-6 to 3-8).

Glass Melting Furnace

The glass melting furnace consists of a foundation, superstructure, and retaining walls, raw materials charging system, heat exchangers, melter, cooling system, exhaust boosting equipment, integral control systems, and instrumentation, and appendages for conditioning and distributing molten glass to forming apparatuses.

There are basically four types of glass melting furnaces in use today by the glass manufacturing industry. As mentioned earlier, glass melting furnaces designed to produce 5 tons or less of glass per day and all-electric furnaces are exempt from the standards of performance and therefore will not be discussed. The remaining two types of melting furnaces are direct-fired and continuous and are referred to as regenerative and recuperative furnaces. Many of these furnaces have added electric induction systems called "boosters" to increase capacity. The furnaces are fired either by natural gas or fuel oil. A detailed description of regenerative and recuperative furnaces is included in Volume I, "Glass Manufacturing Plants, Background Information: Proposed Standards of Performance," EPA-450/3-79-005a (refer to pages 3-6 to 3-8).

Mixed raw materials are fed into the furnace by a charging system and float on the bed of molten glass until it melts. Here, in the melter section at a temperature of approximately 2,700°F, diffusion and chemical reaction transform the batch into molten glass. Glass flows from the melter into a second compartment, commonly referred to as the refiner, where it is mixed for homogeneity and heat conditioned to eliminate bubbles and stones. Glass temperature is gradually lowered to about 2,200°F before exiting the furnace for forming.

Air pollutants generated in the melting of glass arise from the vaporization of raw materials and the combustion of fuel. Pollutants emitted from fossil fuel-fired furnaces producing soda-lime glass are oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbons, and submicron-sized particulates. Other pollutants such as, arsenic, borates, fluorides and lead, which are emitted in the exhaust of pressed and blown glass furnaces make significant contributions to the total emissions from the glass industry. Vents located opposite the refiner section of the furnace exhaust all air pollutants generated during the melting process to a stack. Exhaust gases are either ducted to an air pollution control device before exiting through the stack or directly to the atmosphere.

Pre-Startup Operations

Although the glass manufacturing industry has been classified into four major categories depending upon the type of raw materials used and/or final product, the procedures involved in furnace pre-startup and startup are virtually the same. During the pre-startup phase of a glass melting furnace, all ancillary processes such as raw material handling and transport, forming and finishing, conveying, packaging, and fuel storage must be tested under operating conditions prior to the introduction of batch into the furnace. Electrical systems and mechanical equipment are tested initially on an individual basis and then as integral parts of the process operation. Instrumentation and control panels are also debugged during this phase. In addition, various calculations are performed to determine the exact position to place the forming machines to ensure proper alignment after furnace expansion has occurred. Preliminary testing and debugging may last from 1 to 3 months.

Once "pre-startup shakedown" has been completed the "seasoning" or drying out of the furnace begins. New refractory consisting of a high alumina, zerconia, and silica composition contains residual amounts of water that must be driven off before batch can be fed into the furnace. Seasoning requires the placement of supplemental natural gas burners at various locations along the refractory wall. The drying phase is a gradual warming of the bricks lasting about 2 to 3 days at a temperature between 100 to 150°F. The furnace is constantly being monitored during the drying phase and throughout the entire operation to ensure that the refractory temperature is increasing uniformly. If the refractory heats up too fast or a situation develops where there is a nonuniform heat up, internal stresses can loosen or crack the refractory wall.

As the drying phase nears completion, the temperature is gradually increased to between 2,000 to 2,700°F. During this heatup phase two critical movements occur within the refractory lining. At a temperature of about 1,400°F the first expansion takes place and at approximately 2,000°F the second expansion occurs. The two movements result in a total expansion of the furnace of approximately six inches. Horizontal and vertical tie rods located within the network of the refractory lining may have to be adjusted during the heatup phase to allow for the expansion. Approximately 48 hours are required to successfully "heatup" the furnace.

Once the furnace has reached the desired temperature (approximately 2,700°F) and if all equipment checks are satisfactory the supplemental burners are removed, a fine layer of cullet is added to the furnace and the furnace burners are brought on line. Cullet is used as the initial ingredient because it requires a relatively minimal amount of energy to get it to a molten state.

Once the molten cullet reaches a predetermined level in the furnace, mixed raw ingredients are fed to the furnace. The molten glass level rises to a point and then flows through a drainage bushing where the glass is returned to the system as cullet. This process lasts several days while glass quality checks and equipment adjustments are performed. When the glass has met the desired quality specifications and if all auxiliary equipment checks out, the drainage bushing is closed and molten glass is routed to the forming operation.

Startup Operation

Startup for glass manufacturing operations is generally considered to be the point at which glass is produced (refer to Section 60.296, Test Methods and Procedures of the promulgated Regulation). Although the desired production rate may take several weeks or even months to attain, it is during this period that substantial quantities of particulate matter is being generated.

Once startup has begun, an intensive period of equipment shakedown takes place. Process operations must be synchronized, conveyor and feed systems are adjusted, instrumentation is rechecked under actual operating conditions and air pollution control equipment is monitored. Depending upon the extent of the equipment debugging, fine tuning, and the designated percent of capacity at which the line is to operate at, production for market may take several weeks or possibly months to attain. Extended delays would result from malfunction or failure of auxiliary equipment such as conveying systems, material and fuel feeding systems, and instrumentation. Unless major process equipment malfunctions or fails, a 180 day startup period, allowing for equipment shakedown prior to the required performance tests, provides sufficient time to reach desired product quality and production rates.

Glass Produced

Introduction

For the complete definition of "glass produced" refer to Section 60.291, entitled, "Definitions" of the promulgated Regulation. The following are possible guidelines which may be used when determining the amount of glass produced. Each method discussed is considered to be accurate and currently in use throughout each category of the glass manufacturing industry.

Flat Glass

The method employed by the flat glass industry to determine the amount of glass produced involves removing and inspecting sections of glass taken from the glass ribbon immediately after cooling. From this section density calculations and thickness measurements are made. These measurements, together with the known width of the ribbon and the speed at which the line is moving provides an accurate accounting of the amount of glass produced.

Fiberglass

The fiberglass industry uses what is commonly referred to as a "dipper" to determine the amount of glass produced. The procedure involves removing a spinner from the forming process and inserting the dipper under the bushing. The dipper, which is a rectangular cup of a known volume captures the molten glass flowing out of the bushing. The time required to fill the dipper is recorded as is the weight of the glass in the dipper. This procedure is used to determine the glass flow rate out of the bushing. The flow rate is then multiplyed by the number of bushings per melting furnace to determine the total amount of glass produced per furnace per unit of time.

Container Glass

In the container glass industry, the amount of glass produced per melting furnace is determined by removing a representative sample container from the line, weighting it, then multiplying that by the total number of molten glass "globs" entering each forming unit per unit of time.

Pressed and Blown Glass

The method employed by the pressed and blown glass industry to determine the amount of glass produced per melting furnace is essentially idenitcal to the method used by the container glass industry. A representative sample is removed from the line, weighed and then multiplied by the total number of globs entering each forming unit per unit of time.

Addendum to the Glass Manufacturing Plants Background Information: Proposed Standards of Performance (EPA-450/3-79-005a)

Addendum to the Glass Manufacturing Plants Background Information: Proposed Standards of Performance (EPA-450/3-79-005a)

Table 4-1 of the Background Information Document, Volume I has been revised for emission test reference numbers (ETRN) 16, 17, 18, and 19. The mass emissions for ETRNs 18 and 19 were changed as well as the particulate concentrations for ETRNs 16, 17, 18, and 19.

Table 4-2 of the Background Information Document, Volume I has been revised for ETRNs 24, 25, 26, 27, and 28. The mass emissions and the particulate concentrations for these ETRNs were changed.

Table 4-3 of the Background Information Document, Volume I has been revised for ETRNs 32, 33, and 34. The mass emissions for ETRNs 32 and 34 were changed as well as the particulate concentrations for ETRNs 32, 33, and 34.

Table 4-4 of the Background Information Document, Volume I has been revised for ETRNs 38 through 55, inclusive. The mass emissions for ETRNs 38, 39, 40, 41, 44, 45, 46, 48, 50, 51, and 52 were changed. The particulate concentrations for all of the ETRNs except 43 and 50 were changed. ETRN 41 was changed to 41a and 41b and ETRN 56 was added.

There are no additional associated impacts as a result of these ETRN revisions.

Table 8-7 of the Background Information Document, Volume I has been revised to properly present the flow rates for the Pressed and Blown (Borosilicate, Opal, and Lead) industry segment. The flow rates for the 100 ton per day model plant is corrected to 906 m^3 min.(32,000 acfm) and the flow rate for the 50 ton per day model plant is corrected to 453 m^3 min.(16,00 acfm). These flow rates are identical for the respective model plant sizes for the three new Pressed and Blown sub-categories (Borosilicate, Soda-Lime and Lead, and Other-Than Borosilicate, Soda-Lime, and Lead) used in the promulgated regulation.

The effects of this correction in flow rates will be a slight decrease in costs. This will result in a minimal economic impact to the industry.

Table 4-1. ALL-ELECTRIC GLASS MELTING FURNACE PARTICULATE EMISSIONS TESTS

Emission Test Reference Number*	Glass Industry Category	Glass Type	All-Electric Furnace Particulate Emissions		
			Mass Emissions		Particulate Concentration
			(g/kg)	(lb/T)	(gr/DSCF)
16	Wool Fiberglass	Soda-Lime Borosilicate	0.05	.10	.005
17	Wool Fiberglass	Soda-Lime Borosilicate	.07	.14	.01
18	Wool Fiberglass	Soda-Lime Borosilicate	.10	.19	.013
19	Container	Soda-Lime	.11	.22	.2

*References are listed at the end of the Chapter.

Table 4-2. PARTICULATE EMISSION TEST RESULTS FOR GLASS MELTING FURNACES EQUIPPED WITH FABRIC FILTERS

Emission Test Reference Number*	Glass Industry Category	Glass Type	Air Cloth Ratio	Particulate Removal Efficiency (Percent)	Fabric Filter Outlet Particulate Emissions		
					Mass Emissions		Particulate Concentration
					(g/kg)	(lb/T)	(gr/DSCF)
24	Pressed and Blown: Soda-lime and lead	Soda-Lime	0.65:1	72	.38	.76	.066
25	Pressed and Blown: Borosilicate	Soda-Lead-borosilicate	0.6:1	94.8	.14	.27	.004
26	Wool Fiberglass	Borosilicate	0.85:1		.19	.37	.012
27	Wool Fiberglass	Soda-lime Borosilicate	0.5:1		.6	1.2	.072
28	Wool Fiberglass	Soda-lime Borosilicate	-		.28	.55	.017

*References are listed at the end of the Chapter.

Table 4-3. PARTICULATE EMISSION TEST RESULTS FOR GLASS MELTING FURNACES EQUIPPED WITH VENTURI-SCRUBBERS

Emission Test Reference Number*	Glass Industry Category	Glass Type	Particulate Removal Efficiency (Percent)	Venturi-Scrubber Outlet Particulate Emissions: Mass Emissions (g/kg)	Mass Emissions (lb/T)	Particulate Concentration (gr/DSCF)
31	Container	Soda-lime	82.5	.37	.74	.042
32	Container	Soda-lime		.10	.20	.023
33	Container	Soda-lime	79.6	.14	.28	.010
34	Container	Soda-lime		.16	.31	.033

*References are listed at the end of the Chapter.

Table 4-4. PARTICULATE EMISSION TEST RESULTS FOR GLASS MELTING FURNACES EQUIPPED WITH ELECTROSTATIC PRECIPITATORS

Emission Test Reference Number*	Glass Industry Category	Glass Type	Specific Collection Area $[m^2/(Mm^3/s)]$	Specific Collection Area $(Ft^2/SCFM)$	Percent of Design SCFM During Test	Particulate Removal Efficiency (Percent)	Precipitator Outlet Particulate Emissions: Mass Emissions (g/kg)	Mass Emissions (lb/T)	Particulate Concentration (gr/DSCF)
38	Container	Soda-lime	**	**		91	.05	.10	.005
39	Container	Soda-lime	138	(0.65)	83		.05	.10	.008
40	Container	Soda-lime	237	(1.12)	116		.07	.14	.007
41a	Pressed and Blown: Borosilicate	Borosilicate					.05	.09	.002
41b	Pressed and Blown: Borosilicate	Borosilicate					.71	1.42	.028
42	Pressed and Blown: Borosilicate	Borosilicate	138	(0.65)	89		.57	1.14	.018
43	Pressed and Blown: Borosilicate	Borosilicate	290	(1.37)	43		.48	.96	.007
44	Pressed and Blown: Borosilicate	Borosilicate					.48	.95	.031
45	Pressed and Blown: (Other)	Fluoride/Opal	379	(1.79)	84		.15	.29	.007
46	Pressed and Blown: Soda-lime and Lead	Lead	233	(1.09)	75	98	.06	.11	.002
47	Pressed and Blown: Soda-lime and Lead	Lead	337	(1.59)	117		.08	.16	.003
48	Pressed and Blown: Soda-lime and Lead	Lead					.03	.06	.003
49	Pressed and Blown: Soda-lime and Lead	Lead	183	(.86)	91		.07	.14	.003

Table 4-4. PARTICULATE EMISSION TEST RESULTS FOR GLASS MELTING FURNACES EQUIPPED WITH ELECTROSTATIC PRECIPITATORS

Emission Test Reference Number*	Glass Industry Category	Glass Type	Specific Collection Area		Percent of Design SCFM During Test	Particulate Removal Efficiency (Percent)	Precipitator Outlet Particulate Emissions		
							Mass Emissions		Particulate Concentration
			$[m^2/(Mm^3/s)]$	$(Ft^2/SCFM)$			(g/kg)	(lb/T)	(gr/DSCF)
50	Pressed and Blown: Soda-lime and Lead	Lead	195	(.92)	80		.16	.31	.004
51	Pressed and Blown: Soda-lime and Lead	Lead				97	.28	.55	.015
52	Pressed and Blown: Soda-lime and Lead	Potash-soda-lead	237	(1.12)	122		.10	.19	.016
53	Wool Fiberglass	Borosilicate	220	(1.04)			.36	.72	.018
54	Wool Fiberglass	Borosilicate	222	(1.05)			.09	.19	.005
55	Wool Fiberglass	Borosilicate	216	(1.02)			.09	.17	.004
56	Flat	Soda-lime					.18	.35	.018

*References are listed at the end of the Chapter.

**Claimed proprietary

NOTE: (Other) - Other Than Borosilicate, Soda-lime, and Lead.

TECHNICAL REPORT DATA

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This document is the second volume of EPA 450/3-79-005 series. The first volume discussed the proposed standards and the resulting environmental and economic impacts.

16. ABSTRACT

Standards of performance are being promulgated under Section 111 of the Clean Air Act to control particulate matter emissions from new, modified, and reconstructed glass manufacturing plants. This document contains a detailed summary of the public comments on the proposed standards (44 FR 34840), responses to these comments and a summary of the changes to the proposed standards.

17. KEY WORDS AND DOCUMENT ANALYSIS

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