ACC Crystalline Silica Panel

Potential New Silica Standard with a PEL of 50 ug/m^3 and Ancillary Requirements:
Analysis of Compliance Costs, Economic Impacts, Measurability
Environomics Incorporated and URS Corporation. August 2, 2011

American Chemistry Council

Summary of Our Conclusions

Anticipated Compliance Costs and Economic Impacts under Potential New Regulation

Annualized Costs for Potential New Silica Regulation With PEL at 50 ug/m^3 and Ancillary Provisions (in millions of yr 2000 or 2009 $/yr)

	General Industry & Maritime			Construction			TOTAL
	Engineering Controls	Shipbuilding	Ancillary Provisions	Engineering Controls	Respirators	Ancillary Provisions	
OSHA's SBREFA cost estimates from 2003	**330.1**	**28.5**	**15.4**	**244.7**	**175.2**	**248.5**	**1,042.4**
Corrections/adjustments to OSHA's estimates	+ 2,806.5	0	+ 27.7	+ 299.1	0	+ 200.7	+ 3,334.1
Subtotal after adjustments -- total costs expressed in year 2000 dollars	**3,136.6**	**28.5**	**43.1**	**543.8**	**175.2**	**449.2**	**4,376.5**
Adjust all cost estimates to convert from year 2000 dollars to year 2009 dollars.	+ 770.5	+ 7.0	+ 10.6	+ 133.6	+ 43.0	+ 110.4	+ 1,075.1
TOTAL, in millions of 2009 dollars	**3,907.1**	**35.5**	**53.7**	**677.3**	**218.3**	**559.6**	**5,451.5**

- $5.5 billion/year in annualized compliance costs results in an estimated revenue loss for affected industries of $1.1 billion/year.
- On an annual basis, a $1.1 billion/year estimated loss in final demand for affected industries likely yields:
  - 17,354 lost jobs (or, more precisely, 17,354 lost person-years of employment) per year
  - $3.1 billion in lost economic output (GDP) per year
  - These losses could be incurred each year the standard is in effect – so that over 10 years, there would be a loss of approximately 170,000 person-years of employment and $30 billion of lost economic output.

Corrections and Adjustments that We Made to OSHA's 2003 SBREFA Cost Estimating Methodology

- We used a much better approach for determining the extent to which engineering controls will be needed in general industry as a function of exposure information.

- We recognized that if some workers on a production line or operation at a facility are overexposed while others are not, engineering controls will be installed in that operation to protect all the workers.

- We included the likely costs of baghouses and HEPA filtration in cost estimates for local exhaust ventilation (LEV).

- We rejected the assumption that construction industry employers will be able to implement engineering controls only for those employees who are overexposed and only when the overexposures occur.

- We calculated costs for most ancillary provisions in general industry based on the assumption that engineering controls will eliminate overexposures for 90% (as opposed to 96%) of all employees currently exposed above 50 ug/m^3.

- We adjusted a few of OSHA's unit cost assumptions.

Corrections and Adjustments that We Would Like To Have Made, But Didn't

- There are many more adjustments that we believe would be appropriate, but that we were unable to make:
  - Many more of OSHA's costing assumptions need revision (e.g., productivity penalties, wage rates, amount of additional LEV needed).
  - We didn't include the increased costs occasioned by the trial and error nature of projects designed to increase LEV capacity.
  - We didn't adjust OSHA's cost estimates for several general industry sectors where we were unable to follow OSHA's calculations.
  - A statistical approach to evaluating exposure information would suggest an even greater need for engineering controls.
  - We gave only limited review to OSHA's cost estimates for construction.

Methodological Issues in Estimating Economic Impacts of Annualized Compliance Costs: Step 1

- OSHA performed only a screening analysis and didn't try to quantify economic impacts.

- We used a two-step process to quantify expected economic impacts.

- Step #1: Estimate the market impact (on price, quantity, revenues) of $X/year in compliance costs for a U.S. industry.
  - This depends on supply and demand curves for the industry's products.
  - We assumed constant elasticity of supply (1.0) and demand (-1.5) curves for each affected industry, consistent with common EPA economic analysis practice.
  - Based on these assumptions, we calculated that the post-equilibrium revenue loss would equal 20% of the annualized compliance costs.

Methodological Issues in Estimating Economic Impacts of Annualized Compliance Costs: Step 2

- Step #2: We used the IMPLAN input-output model to estimate aggregate economic impacts given the estimated annual revenue loss for each directly affected industry.
  - IMPLAN sums direct, indirect and induced impacts.
  - Projected economic impacts over the first few years are understated due to the annualized nature of the compliance cost estimates.
  - Due to stocks/flows issues and the nature of the IMPLAN model, the lost jobs can best be understood as annual lost person-years of employment.

Measurability Concerns for Crystalline Silica

- Crystalline silica is notoriously difficult to analyze accurately and reliably at exposure concentrations of 100 µg/m^3 and below.

- In the NIOSH Lab Certification Proficiency Analytical Testing (PAT) program – a highly controlled environment using uniformly spiked samples in the same matrices for all labs – the Relative Standard Deviation (RSD) for silica, a measure of analytical precision, typically has been found to be 15-17%.

  - Since the Acceptable Range for PAT program labs is +/- 3x the RSD, results for labs measuring spiked samples where the mean value is 100 µg and the RSD is 17% would be deemed "acceptable" at up to +/- 51% above or below the mean – *i.e.*, anywhere from 49 µg to 151 µg.

  - The PAT program RSD results for silica are very high relative to the results for other substances, *e.g.*, 3-4 times higher than the RSD results for metals.

- When PAT program samples are spiked to levels below 80 µg/filter, the degree of variance increases. Significant deterioration in precision occurs at levels below 60 µg/filter.

  - At a typical sampling rate of 1.7 Liters/minute, an 8-hour sample of air having a silica concentration of 50 µg/m^3 would deposit only about 40 µg of silica on the filter. So analytical precision at a PEL of 50 µg/m^3 would be even worse than the PAT program RSD results of 15-17% suggest.

- There is even more variance in the analysis of real world samples, where the analytical error is compounded by sampling error and by matrices that contain interferences requiring many additional sample handling procedures that are highly technique-oriented.

Implications of Inaccuracies and Imprecision in Measurements of Crystalline Silica Below 100 $\mu g/m^3$

- Reliable determinations of whether a facility is in compliance with a PEL of 50 $\mu g/m^3$ will be extremely difficult – if not impossible – to achieve.
- This would create enforcement problems for OSHA and decision-making problems for employers, who would have to decide whether costly engineering controls are needed and whether ancillary provisions of the Standard apply based on exposure measurements whose accuracy and reliability are questionable at best.
  - This could drive up compliance costs beyond our estimate of $5.5 billion/year, because:
    - In some cases, monitoring results would indicate that exposures are above the PEL, when in fact they are not; and
    - In other cases, employers could not be confident that exposures are below the PEL even when sampling results are below 50 $\mu g/m^3$.
- Before OSHA considers lowering the PEL, adequate sampling and analytical procedures must be developed and proven over time.

Estimated Costs and Adverse Economic Impacts of a Potential New OSHA Occupational Exposure Standard for Crystalline Silica With a PEL of 50 ug/m³ and Ancillary Requirements

Draft Final Report
For the American Chemistry Council Crystalline Silica Panel

July, 2011

Environomics, Inc.
URS Corporation

TABLE OF CONTENTS

Executive Summary

The Occupational Safety and Health Administration (OSHA) will likely soon issue a proposed regulation that will reduce the Permissible Exposure Limit (PEL) for workers exposed to crystalline silica in the General Industry, Construction and Maritime sectors of the U.S. economy. The current occupational exposure limit for worker exposure to respirable crystalline silica is essentially 100 ug/m^3 on an 8-hour time-weighted average basis. OSHA seems poised to propose a regulation that will cut this limit in half, to 50 ug/m^3. The proposed regulation will also likely include a variety of "ancillary requirements" to accompany this tighter standard, including requirements that employers must conduct exposure monitoring for silica; must provide medical surveillance for some workers; must identify work zones where exposures may exceed the PEL, mark these zones and limit access to them; must provide training regarding silica hazards; and more.

The American Chemistry Council's (ACC's) Crystalline Silica Panel is a group of companies and trade associations that produce, use or encounter silica in their businesses. The Panel believes that a new regulation such as the one OSHA is likely soon to propose -- including a PEL reduced to 50 ug/m^3 and ancillary requirements -- will have serious adverse economic impacts on affected industries and throughout the U.S. economy. The Panel has requested two consulting firms, URS Corporation (engineering) and Environomics Incorporated (economics), to estimate the compliance costs and economic impacts that this regulation might entail. This report summarizes the results of the consulting firms' analysis in response to the Panel's request.

OSHA has been contemplating a regulation to reduce the occupational exposure standard for crystalline silica for more than a decade. In 2003, the Agency completed several steps toward developing a new silica regulation, including drafting regulatory language that would have established a new PEL alternatively at 50 ug/m^3, at 75 ug/m^3, or at 100 ug/m^3 with ancillary requirements; completing a draft Economic Analysis that analyzed the costs and benefits of these alternative regulations; and completing most of the activities required under the Regulatory Flexibility Act (RFA) and the Small Business Regulatory Enforcement and Fairness Act (SBREFA) for these alternative potential regulations.

The ACC Crystalline Silica Panel's consultants have completed three steps in order to estimate the compliance costs and economic impacts that would likely result from a new silica worker exposure standard at 50 ug/m^3:

1. **Review OSHA's compliance cost estimates.** We began with OSHA's cost estimates for the 50 ug/m^3 alternative regulation that the Agency prepared for the SBREFA process in 2003. Despite the Panel's efforts to obtain more current costing documents from OSHA, the Agency has not made public any further cost analysis materials beyond those prepared in 2003.

2. **Revise OSHA's calculations so as to develop better and more accurate compliance cost estimates.** We corrected, improved upon and updated OSHA's compliance cost estimates in various ways. We estimated costs for some compliance activities that OSHA missed in the Agency's earlier analysis. We employed some better methods and more realistic assumptions in estimating what employers will need to do to comply with a lower PEL and what their costs will be. We also updated OSHA's estimates so as to express compliance costs in year 2009 dollars instead of year 2000 dollars as OSHA did previously. Although we made substantial changes to large portions of OSHA's cost analysis, we nevertheless could not review and revise OSHA's earlier estimates as comprehensively as we would have preferred. Important components of OSHA's analysis have not been documented by the Agency and they are, in effect, not reviewable. Our revisions to OSHA's cost estimates stop short of what we would generate if we had full access to OSHA's earlier work.

3. **Estimate the adverse economic impacts – particularly on employment and on GDP -- that will result from these compliance costs.** We then ran our improved estimate of compliance costs for a 50 ug/m^3 PEL regulation through a widely used input-output model in order to estimate the economic impacts that will result from such a regulation. The compliance costs from the new regulation will raise the costs of doing business for affected manufacturing and construction industry employers. Prices will rise and output by affected U.S. producers will fall. The input-output model traces the loss of jobs and GDP that will result throughout the U.S. economy

Conclusions: Projected Economic Impacts From a Standard at 50 ug/m^3

As part of the SBREFA process in 2003, OSHA estimated the costs to comply with a 50 microgram standard and ancillary requirements at $1.042 billion/year in 2000 dollars.

When various corrections and adjustments are made to OSHA's analyses, the estimated annualized costs of the standard increase by more than a factor of four, from $1.042 billion/year to $4.38 billion/year in year 2000 dollars. Since these are annualized costs, they would be incurred each year the standard is in effect.

When the estimated annualized costs are adjusted from year 2000 dollars to year 2009 dollars (an inflation factor of 24.6% over these nine years), the estimated costs of the standard become $5.45 billion/year.

The following table shows the impact of each of the six adjustments and corrections that we made to OSHA's cost estimates, and then the impact of converting to 2009 dollars.

Re-Estimated Costs for Potential New Silica Regulation With PEL at 50 ug/m^3 and Ancillary Provisions (in millions of year 2000 or 2009 $/yr)

	General Industry & Maritime			Construction			TOTAL
	Engineering Controls	Shipbuilding	Ancillary Provisions	Engineering Controls	Respirators	Ancillary Provisions	
OSHA's SBREFA cost estimates	330.1	28.5	15.4	244.7	175.2	248.5	1,042.4
6 additions/adjustments to OSHA's estimates	+ 2,806.5	0	+ 27.7	+ 299.1	0	+ 200.7	+ 3,334.1
Subtotal after 6 adjustments – total costs expressed in year 2000 dollars	3,136.6	28.5	43.1	543.8	175.2	449.2	4,376.5
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The American Chemistry Council's (ACC's) Crystalline Silica Panel is a group of companies and trade associations that produce, use or encounter silica in their businesses. The Panel believes that a new regulation such as the one OSHA is likely soon to propose -- including a PEL reduced to 50 ug/m^3 and ancillary requirements -- will have serious adverse economic impacts on affected industries and throughout the U.S. economy. The Panel has requested two consulting firms, URS Corporation (engineering) and Environomics Incorporated (economics), to estimate the compliance costs and economic impacts that this regulation might entail. This report summarizes the results of the consulting firms' analysis in response to the Panel's request.

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TOTAL in 2009 dollars	3,907.1	35.5	53.7	677.3	

When these estimated compliance costs are converted into projected revenue losses for the affected industries and then run through the IMPLAN input-output model, the model predicts the following economic impacts for each year that these compliance costs are incurred:

Annual Economic Impacts of Potential New Standard With PEL at 50 ug/m^3 (2009 $/yr in millions)

Impact Type	Employment	Output
Direct Effect	-5,841	-$1,091.3
Indirect Effect	-4,520	-$958.3
Induced Effect	-6,993	-$1,039.2
Total Effect	-17,354	-$3,088.8

Direct effects include impacts on the particular industries that directly bear the regulatory compliance costs. Indirect effects include impacts on suppliers to the directly affected industries. Induced effects are the impacts resulting from reduced spending by employees of the directly and indirectly affected industries, as a result of reduced earnings by these employees. The total effect is the sum of direct, indirect and induced effects

The result each year if OSHA were to promulgate a new occupational exposure standard for crystalline silica with a PEL at 50 ug/m^3 and ancillary requirements would be a loss of more than 17,000 jobs and a negative impact on the economy of more than $3 billion. Over a 10-year period, this would amount to a loss of more than 170,000 jobs and $30 billion of economic output.

We expect that the actual costs and impacts if OSHA were to promulgate such a regulation would be even larger than those we have estimated here, for several reasons. First, our various corrections and adjustments to OSHA's estimates are incomplete. Because OSHA's 2003 cost estimates are not fully documented and understandable, we have been unable to critique and re-estimate OSHA's conclusions for all of the affected industries and/or activities. Second, neither OSHA's estimates nor our re-estimates fully reflect the difficult-to-quantify costs (which likely are quite high) for the "trial-and-error-style" upgrades to industrial facility ventilation systems that OSHA forecasts as the most common sort of engineering control general industry will need to implement.

Finally, of course, the cost and economic impact estimates that we have developed reflect our analysis of the draft occupational exposure standard with a PEL of 50 ug/m^3 that OSHA prepared for the SBREFA process in 2003. The standard that OSHA is planning to publish later this summer may be different from the Agency's draft standard in 2003. We have not seen the new standard that OSHA will propose or the economic analyses OSHA is using to support it.

Introduction

The Occupational Safety and Health Administration (OSHA) will likely soon issue a proposed regulation that will reduce the Permissible Exposure Limit (PEL) for worker exposure to crystalline silica in the General Industry, Construction and Maritime sectors of the U.S. economy. The current occupational exposure limit for worker exposure to respirable crystalline silica is essentially 100 ug/m^3 on an 8-hour time-weighted average basis. OSHA seems poised to propose a regulation that will cut this limit in half, to 50 ug/m^3. The proposed regulation will also likely include a variety of "ancillary requirements" to accompany this tighter standard, including requirements that employers must conduct exposure monitoring for silica; must provide medical surveillance for some workers; must identify work zones where exposures may exceed the PEL, mark these zones and limit access to them; must provide training regarding silica hazards; and more.

OSHA has been contemplating such a regulation to tighten the occupational exposure standard for crystalline silica for more than a decade. In 2003, the Agency completed the process required by the Regulatory Flexibility Act for any regulation that may have a "significant impact on a substantial number of small entities". With the assistance of the Small Business Administration and the Office of Management and Budget, OSHA convened a Small Business Advocacy Review Panel (SBARP) to obtain advice and recommendations from affected small entities (small businesses) about the potential impacts of a new silica regulation. OSHA also in 2003 completed a Preliminary Initial Regulatory Flexibility Analysis (PIRFA) and draft Economic Analysis that analyzed the costs and benefits of alternative draft regulations that would have established the PEL at 50 ug/m^3, at 75 ug/m^3, or at 100 ug/m^3.

The American Chemistry Council's Crystalline Silica Panel is a group of companies and trade associations that produce, use or encounter silica in their businesses. For over 20 years, the Panel has undertaken efforts to increase knowledge about silica and to promote sound science in governmental initiatives addressing silica. It has sponsored research and analyses on the health risks associated with silica exposure and on related issues of sampling and analysis and economic impacts of reducing the exposure limit. The Panel and various of its members have interacted with OSHA and other regulatory agencies here and abroad regarding these issues. Some Panel members participated in OSHA's Small Business Regulatory Enforcement and Fairness Act (SBREFA) proceedings in 2003, including providing small business representatives for the SBARP and providing comments on OSHA's analyses supporting a potential new regulation.

The Crystalline Silica Panel believes that a new regulation establishing a tighter PEL for crystalline silica is not needed – because if universal compliance with the current standard of 100 ug/m^3 were achieved, silica-related health risks would be negligible. Compliance with a tighter standard will provide little additional health benefit for workers and will cost billions of dollars annually at a time when U.S. businesses cannot afford these costs. A potential new silica regulation will most directly affect two of the nation's most important and vulnerable economic sectors: the construction industry and small manufacturing businesses.

- The construction industry in the U.S. is suffering badly from a combination of the collapse in housing markets, the financial crisis and now a sharp decline in public sector construction spending as a result of budget deficits. Some analysts project that construction spending will remain depressed for the next 5 - 10 years.

- More than 87% of the manufacturing facilities that OSHA projects as likely affected by a new silica regulation are owned by small businesses. Most of these small manufacturing businesses have been stressed by the recent recession and have not yet recovered. The manufacturing sectors that will be most affected by a new silica regulation also suffer from additional problems. Foundries in the U.S. (which produce metal castings for a wide range of uses) are now subject to fierce competition from imports and off-shoring. The other affected manufacturing sectors -- production of bricks, clay tile, pottery, concrete products and refractory materials -- all involve selling into currently depressed markets for construction materials.

The Crystalline Silica Panel has contracted with two consulting firms, URS Corporation (engineering) and Environomics Incorporated (economics), to estimate the likely economic impacts on U.S. businesses, GDP, and jobs if OSHA were to promulgate a regulation reducing the PEL for crystalline silica to 50 ug/m^3, along with associated ancillary requirements. This report summarizes the results of the consulting firms' analysis.

Our economic analysis of a potential regulation establishing a new worker exposure standard for crystalline silica proceeds in three steps:

1. **Review OSHA's compliance cost estimates.** We begin with OSHA's detailed estimates prepared in 2003 of the costs that each affected U.S. industry would incur to comply with a regulation reducing the PEL to 50 ug/m^3 and prescribing various ancillary requirements. OSHA prepared these estimates for the SBREFA proceedings in 2003 and has not made public any more recent compliance cost estimates than these, despite the Panel's efforts to obtain more current costing documents from OSHA.

2. **Revise OSHA's calculations so as to develop better and more accurate compliance cost estimates.** We correct, improve upon and update OSHA's 2003 compliance cost estimates in various ways. We estimate costs for some compliance activities that OSHA missed in the Agency's earlier analysis. We employ some better methods and more realistic assumptions in estimating what employers will need to do to comply with a lower PEL and what their costs will be. We also update OSHA's estimates so as to express compliance costs in year 2009 dollars instead of year 2000 dollars as OSHA did previously. However, partly because some of OSHA's cost analysis is not documented and, in effect, not reviewable (i.e., some of the key data and calculations are not included or explained anywhere in the docket), and partly because we have limited time and resources to conduct our review, we have been able to improve only selected portions of OSHA's analysis. Our revisions to OSHA's cost estimates stop short of what we would generate if we had full access to OSHA's earlier work.

3. **Estimate the adverse economic impacts -- particularly on employment and on GDP -- that will result from these compliance costs.** We then run our improved estimate of compliance costs for a 50 ug/m^3 PEL regulation through a widely used input-output model in order to estimate the economic impacts that will result from such a regulation.

The compliance costs from the new regulation will raise the costs of doing business for affected manufacturing and construction industry employers. Prices will rise and output by affected U.S. producers will fall. The input-output model traces the loss of jobs and GDP that will result throughout the U.S. economy.

I. OSHA's Estimated Compliance Costs for New Silica Regulations

As a part of the SBREFA proceedings in 2003, OSHA prepared draft regulations that would establish a new PEL for crystalline silica at any of three alternative levels: 50, 75, or 100 ug/m^3. One regulation would apply to General Industry and Maritime (shipbuilding) employers, another regulation would apply to employers in the Construction industry. The draft regulations also specified ancillary requirements that employers would need to meet in addition to the new PEL, including requirements for:

- Exposure assessment;
- Regulated areas;
- Protective work clothing;
- Hygiene facilities;
- Housekeeping;
- Employee health screening;
- Medical removal protection;
- Hazard communication;
- Employee information and training;
- Recordkeeping

OSHA also prepared various supporting analyses intended in part to provide the small entity representatives involved in the SBREFA process a picture of the rationale for and impacts of the draft regulations. In these analyses, OSHA estimated the costs, risk reduction, monetized benefits and economic impacts that would result from promulgation of a new PEL at each of the three alternative levels the Agency was considering in 2003.

The Crystalline Silica Panel believes that OSHA is now on the verge of publishing a new proposed standard for crystalline silica with a PEL of 50 ug/m^3. The new standard evidently will apply to General Industry, Maritime and Construction, and will likely include ancillary requirements similar to those that OSHA suggested in 2003. In sum, the new regulations that OSHA will soon propose seem likely to be very similar to the draft regulations with a PEL of 50 ug/m^3 that OSHA analyzed in 2003. In evaluating what impacts might ensue from the upcoming potential new silica standards, the Crystalline Silica Panel has therefore begun its assessment by reviewing OSHA's earlier cost analysis for the 2003 draft regulations.

In 2003, OSHA estimated the compliance costs for a standard having a PEL of 50 ug/m^3 and ancillary provisions at a little more than $1 billion per year, as follows:

OSHA's Estimated Annualized Costs for Potential New Silica Regulations With PEL of 50 ug/m^3 and Ancillary Provisions (in millions of year 2000 $ per year)

General Industry & Maritime			Construction			TOTAL
Engineering Controls	Shipbuilding	Ancillary Provisions	Engineering Controls	Respirators	Ancillary Provisions	
330.3	28.5	14.7	244.7	175.2	248.5	1041.9

OSHA has "annualized" these compliance cost estimates, meaning that the Agency combined the estimated one-time capital costs of compliance and the ongoing yearly operating and maintenance costs and then calculated an equivalent stream of constant annual costs. In effect, OSHA estimated the capital and annual costs of the potential new regulations to be the equivalent of a little more than $1 billion per year, with this annual cost continuing every year forever. This annualization procedure is a standard approach in regulatory cost analysis.

At over $1 billion per year, OSHA's estimated cost for a new silica regulation with a PEL of 50 ug/m^3 would make this regulation one of the most costly new regulations affecting American business that the Federal government considers in a typical year.[1]

OSHA followed a similar four-step process for both General Industry and Construction in developing the Agency's cost estimate for employers to comply with a 50 ug/m^3 occupational exposure standard:

1. **Profile workers' exposure to crystalline silica.** OSHA began by assembling sampling information on workers' exposure to crystalline silica for all affected industries. The Agency analyzed the collected exposure information and combined it with information on numbers of employees in different industries and job categories in order to estimate the number of workers in each industry and job category who are exposed to crystalline silica at a level exceeding 50 ug/m^3. This estimated number of workers "overexposed" relative to the potential new PEL provided the starting point for OSHA's cost analysis.

2. **Identify engineering controls that will reduce worker exposures to below the new PEL and employer actions needed to comply with ancillary requirements.** OSHA identified a set of engineering control measures specific to each industry/job category in which workers are overexposed relative to the potential new PEL that -- in OSHA's view -- would suffice to reduce exposures from above the PEL to below it. Thus, for example, OSHA identified covers for conveyors as an effective means of controlling silica dust to which workers are exposed in the material handling yards of facilities in several industries. And, for example again, OSHA identified additional local exhaust ventilation (LEV) as an effective control to protect foundry workers who clean rough castings at grinding work stations. Likewise, OSHA identified a set of actions that employers would need to perform in order to meet each of the ancillary requirements accompanying the draft new PEL, including contracting with industrial hygienists to conduct exposure monitoring at the employers' facilities, training workers who could potentially be exposed to silica about silica hazards, and the like. In each instance, for each identified engineering control and each identified employer action, OSHA also estimated the intensity with which the control or activity would need to be implemented in any situation where it was warranted. OSHA thus estimated, for example, the number of feet of conveyors at a typical facility that would need to be covered, the number of cubic feet per minute (cfm) of additional LEV that would be needed to effectively collect the dust from a typical foundry casting grinding station, the duration of training that an employee potentially exposed to silica might need, etc..

3. **Estimate unit costs for engineering controls and ancillary requirements.** OSHA estimated the unit costs for each component of the potential engineering controls and each action that might be needed to comply with an ancillary requirement. OSHA thus estimated the cost to cover a foot of typical conveyor; the average cost to provide an additional cfm of LEV (which in turn required estimating the unit costs for components needed for this additional cfm of LEV, such as the unit cost -- cost per kilowatt-hour -- for electricity); the cost to sample a single worker's silica exposure over an 8-hour work shift; the cost to prepare and deliver silica training for an employee at risk of silica exposure; and so forth.

4. **Combine estimates on how often engineering controls and ancillary requirement actions will be needed with unit cost information and estimate total compliance costs.** In effect, for each compliance activity, OSHA multiplied the quantity of the activity needed by the unit cost for the activity in order to estimate the total national cost for that activity. Costs were then summed across all the projected compliance activities in order to estimate the total compliance costs for the entire regulation A key point to note is that OSHA chose to organize the entire compliance cost analysis on a "per overexposed worker" basis. OSHA in step #1 had estimated the number of workers in each at-risk job category that were overexposed relative to a potential new PEL of 50 ug/m^3. In step #2 OSHA estimated the need for engineering controls and for ancillary requirement actions also largely on a per overexposed worker basis (e.g., covering one conveyor is needed per every four overexposed workers in pre-production material handling yards). The unit costs initially estimated in step #3 were then converted into a unit cost per worker who is overexposed relative to the PEL. The final multiplication in step #4 involved multiplying the number of overexposed workers by the unit cost per overexposed worker for each engineering control and for each ancillary requirement.

[1] The Office of Information and Regulatory Affairs (OIRA) within the Office of Management and Budget compiles information on the estimated costs of all Federal regulations that OIRA reviews. By law, nearly all Federal agencies are required to submit all significant proposed regulations for OIRA review. OIRA publishes an annual compilation of the sponsoring regulatory agencies' estimates for the costs of all significant final regulations that OIRA has reviewed during the past fiscal year. We reviewed the OIRA compilations covering the ten Federal fiscal years from FY 2001 through FY 2010 (see http://www.whitehouse.gov/omb/inforeg_regpol_reports_congress). This compilation includes all occupational safety and health regulations, all environmental regulations, all homeland security regulations, all transportation regulations, all consumer protection regulations, etc. Over these 10 years, there were only 21 Federal regulations promulgated that had estimated costs exceeding $1 billion per year. Said another way, since FY 2000, there have been an average of only about 2 Federal regulations promulgated per year that impose a burden on the private sector as large as would result from OSHA's potential new occupational exposure standard for crystalline silica. Thus, even by OSHA's own estimate, its potential crystalline silica regulation is exceptionally costly. .

We Have Not Been Able Comprehensively to Review and Revise OSHA's Compliance Cost Estimates. Instead, We Have Made Selective Improvements to These Estimates.

While OSHA developed a large volume of materials describing the Agency's cost and economic impact analyses for the draft regulation -- at least several thousand pages of documents -- these materials are nevertheless incomplete and unfinished. The summary results of OSHA's analysis are available in the record, but often the references for the underlying data are not provided and there is no complete description of all the intermediate calculation steps through which the Agency's estimates are derived. Many of OSHA's key documents in the docket are drafts and reflect partial analyses only. In some instances the documents conflict; there are several instances where a draft document that describes an early step in OSHA's calculation process shows results that are significantly different from what is shown in a second document as the supposed starting point for subsequent calculation steps.

The result is that it is not possible for us to fully understand all the data and calculation steps in OSHA's cost analysis. Unable to fully understand how OSHA derived their numbers, we are limited in our ability to critique them. We have not been able to revise all the elements of OSHA's analysis where we might like to make changes.

The following are several specific examples of the difficulties that we have had in attempting to review and improve OSHA's cost and economic impact analyses:

- OSHA omits nearly one-third of the general industry sectors the Agency identifies as affected by the draft new silica regulation from OSHA's key technical support document. For General Industry, the Agency's cost and economic impact analysis is summarized in a 161-page report by OSHA's contractor ERG, titled: *Draft Final Report. Cost and Economic Impact Analysis of the Draft Crystalline Silica Standard for General Industry*. The technical explanation for several key steps in this summary analysis -- the profile of worker exposures to silica in the various affected industries, and the rationale for selection of specific engineering controls that will effectively reduce worker exposures in each general industry -- in turn can be found in another contractor report, the 282-page *Technological Feasibility Study of Regulatory Alternatives for a Proposed Crystalline Silica Standard*. However, the *Technological Feasibility Study* is incomplete; in the words of OSHA's contractor it is a "Preliminary Draft: Includes Selected Sectors." In fact, the Preliminary Draft *Technological Feasibility Study* that is available includes only ten of fourteen planned chapters on the various affected industry sectors; it omits the chapters on foundries (the general industry sector that would be most affected by the draft regulation), ready-mix concrete (the sector that OSHA projects as bearing the third-highest costs), mineral wool, and perhaps shipyards (it is not clear what one of the missing chapters in the *Technological Feasibility Study* was intended to cover). An earlier draft of a portion of one of the missing chapters of the *Technological Feasibility Study* is available separately in the record, a 71-page unattributed report titled: *2. Foundries (Metal Casting)*. This report, however, provides exposure and technological feasibility information for only three of the dozens of affected foundry SIC codes, accounting for what appears to be less than half of all the affected foundry facilities. This early draft on a portion of the affected foundry sector also conflicts in important ways with the overall foundry industry compliance cost estimates cited in the *Cost and Economic Impact Analysis*.

- For both General Industry and Construction, we believe that OSHA has consistently misinterpreted the information on worker exposure to crystalline silica. The exposure information is critically important insofar as it provides the starting point in the Agency's cost analysis. In our view, the manner in which a worker exposure sample has been obtained importantly affects how that sample should be interpreted. In order for us to correct OSHA's misinterpretation of the exposure data, we need to understand how each set of silica exposure samples included in the overall exposure database has been obtained. We need to understand the origin of OSHA's exposure information in order to critique and re-calculate OSHA's compliance cost estimates that are based on this exposure information.[2]

  To use the exposure data correctly in estimating compliance costs, the reviewer must know whether each set of exposure samples represents a single worker sampled across multiple work shifts, multiple workers in the same area of a plant sampled at the same time, or different workers in different areas of a plant sampled at different times. However, such information on the derivation of individual sets of worker exposure information is only occasionally available in the docket supporting OSHA's silica SBREFA proceedings. The docket usually includes reasonably accessible information on the derivation of exposure samples when the exposure information has been drawn from a report on a NIOSH, OSHA or OSHA contractor site visit to a facility in one of the affected industries. The docket does not include this information when the source of the exposure data is something other than a NIOSH, OSHA or contractor report, such as a silica SEP report or site visit or IMIS. Overall, for all the general industry exposure samples that OSHA included in the Agency's silica exposure profile, the desired derivation information is available for only a little more than half of all samples.

[2] Consider, for example, a set of five worker exposure samples that were obtained at a single facility and what these samples suggest about whether that facility would need to implement engineering controls in order to reduce exposures to below a potential new PEL of 50 ug/m^3. Assume that one of these exposure samples exceeds the potential new PEL of 50 ug/m^3 and that four do not. OSHA would interpret this set of five exposure samples that includes one "overexposure" as suggesting that 1/5 of all employees and, by extension, 1/5 of all facilities, will need additional engineering controls to reduce exposures below the new PEL, and the Agency begins its cost calculations accordingly. We disagree with OSHA's simple assumption that the percentage of workers and facilities that will need exposure-reducing controls is given by the percentage of samples that exceed the PEL. In fact, if the five samples were derived from a single worker across his work shifts on five different days, the four samples showing exposures below the PEL would be irrelevant in determining whether the worker is overexposed and the facility needs to implement controls. OSHA's exposure standard requires that a worker <u>virtually never</u> be exposed above the PEL -- the single exposure sample showing an overexposure during one of the worker's five sampled shifts is sufficient to necessitate engineering controls that will protect this worker across all of his shifts. The same sort of conclusion holds if the five exposure samples were obtained on a single day from five different workers performing the same sort of work in a single area of a plant. Assume, for example, five workers in the pre-production materials handling yard of a brick manufacturing plant, where an open, uncovered conveyor carrying clay raw materials generates silica-containing dust to which the workers are exposed. If even one of these workers is exposed even occasionally by the dusty conveyor to silica levels exceeding the PEL, the conveyor will need to be covered to reduce this "overexposed" worker's exposure. In our hypothetical situation where the exposure samples for four workers have been below the PEL but the sample for one worker has exceeded the PEL, the four exposure samples that are below the PEL are irrelevant: the employer will need to install the engineering control that has the effect of reducing exposures for all five of the employees because one of the employees in this area is overexposed.

We responded to these sorts of gaps or contradictions in the record explaining OSHA's analyses in either of two ways:

- In some instances we made an assumption about what OSHA's underlying data may have been or how OSHA must have performed a calculation step, and we then proceeded to revise and improve the portion of OSHA's analysis about which we made the assumption. We have identified these situations and assumptions in this paper.

- In other instances we left OSHA's calculations alone, either because we were unable to make any confident assumption about what the Agency had done or because this part of the analysis accounted for a small share of OSHA's total estimated compliance costs and did not appear to warrant the effort that would be needed to revise it. As a result, in revising and improving OSHA's compliance cost estimates, we have left many portions of OSHA's analysis unchanged even though we might, with further review and effort, disagree with them. In several tables throughout the remainder of this document where we show our estimate for some portion of compliance costs compared against OSHA's estimate for that portion of compliance costs, the two numbers are the same. In most instances this does not mean that we agree with OSHA's estimate. To the contrary, it usually means only that we did not review and adjust this particular portion of OSHA's estimate.

In an attempt to resolve some of these gaps and uncertainties about parts of OSHA's analysis, we asked OSHA staff if they would provide us with an electronic version of the Agency contractor's Excel spreadsheets detailing the compliance cost calculations for each affected industry, beginning with each industry's profile of silica exposures. OSHA staff declined to provide us with this material.

Some of these uncertainties in OSHA's cost analysis also might have been clarified and we might have been able to perform a more thorough review if a copy of the draft regulatory language that was considered in 2003 had been available. Unfortunately, no draft regulation is in the OSHA docket or otherwise available.

We note also two additional reasons why in some cases we did not review and critique some portions of OSHA's cost analysis:

- The Crystalline Silica Panel includes as members mostly organizations more concerned with OSHA's potential new silica regulation for General Industry than with the potential new regulation for Construction. The Panel requested us to focus our review more intensively on OSHA's cost analysis for general industry, and to rely for review of OSHA's construction industry cost analysis largely on a previous assessment of the draft Construction regulation that had been prepared for some Panel members in 2003 by PricewaterhouseCoopers.[3]

[3] The Reform OSHA Coalition. *SBREFA Panel Comments: OSHA Draft Proposed Standards for Occupational Exposure to Crystalline Silica in Construction, General Industry and Maritime.* November 25, 2003. See OSHA Docket H006A, Exhibit 8-9.

- In general we were concerned with conducting a cost-effective review of OSHA's analyses. We thus sought to identify and correct a few larger problems in OSHA's analyses in preference to many smaller problems.

II. Corrections and Adjustments to OSHA's SBREFA Cost Estimates for a Standard Having a PEL of 50 ug/m^3 With Ancillary Provisions

We made seven major adjustments to OSHA's cost estimates. In the following pages we discuss these adjustments and show the impact of each adjustment on the estimated compliance costs for the potential new regulation.

Adjustment #1: Correct OSHA's underestimate of the extent to which engineering controls would be needed in General Industry.

OSHA assumed most commonly that general industry employers would need to implement one control measure (e.g., additional LEV, an enclosed control room that protects an operator from a dusty process, water spray added to a saw) for every four workers in a job category who are exposed at levels exceeding the proposed PEL. OSHA thus estimated the number of instances in which a control will be needed for a job category in an industry by dividing the number of overexposed workers in that job category by four. This procedure greatly underestimates the extent to which controls will be needed:

- The great majority of facilities in these industries are small, such that there rarely are as many as four employees in each at-risk job category at a facility who would be protected by a control if it were needed. In Appendix 1 we provide a table showing that there is a median of only 2 employees per at-risk job category at the average-sized general industry facility.

- When a control is needed in an area of a manufacturing plant to protect a worker who is exposed above the PEL, it is rare that all the other workers also protected by that control will also be exposed above the PEL. Many areas within general industry facilities include both some workers who are exposed above the PEL and other workers who are not. Controls cannot be targeted as precisely as OSHA assumes to protect only workers who are overexposed. Many more controls will be needed than would be calculated assuming one control even for every two overexposed workers.

We used a different procedure than OSHA did in estimating how often controls will be needed for general industry. Instead of making simple but inaccurate assumptions about how the number of controls might relate to the number of overexposed workers, we evaluated the available exposure data for workers in each area of each plant, and then judged on a plant-by-plant basis whether or not controls would be needed. We assumed that controls would be needed for an area of a plant if one or more workers in that area were overexposed, and that controls would not be needed if no workers in that area were overexposed. We implemented this "facility-by-facility" approach specifically for the structural clay products industry in judging whether engineering controls are or are not needed for each worker job category at each plant in this industry for which OSHA had assembled exposure information. The structural clay products industry was the particular industrial sector for which OSHA provided the most comprehensive documentation on how the exposure samples that had been assembled were derived, and it was thus the general industry sector for which we were best able to apply our facility-by-facility approach.[4] Based on the results from analyzing the structural clay products industry exposure data on a facility-by-facility basis, we developed a table relating the fraction of facilities needing engineering controls to the fraction of exposure samples exceeding the PEL. We then used the table to estimate this relationship for industrial sectors other than structural clay products (for which OSHA had provided much less comprehensive documentation about the derivation of the Agency's exposure samples). This facility-by-facility approach to estimating the need for engineering controls for structural clay products and the derivation of the more general table that we used for other industries is described more fully in Appendix 2.

This adjustment – i.e., switching from OSHA's inappropriate approach of assuming one engineering control is required for every four overexposed workers to a more accurate facility-by-facility approach – increases the estimated cost of engineering controls for general industry from $330 million per year (year 2000$), as OSHA estimated, to $1.06 billion per year – as shown on the following table.

[4] We contend that one must know how each worker exposure sample was derived in order to judge appropriately what that sample suggests about whether the employer will need to implement additional engineering controls to reduce worker exposures in the area of the facility from which the sample was taken. Recollect the example we discussed earlier about how one should interpret exposure sample results differently depending on, for example, whether they represent multiple samples for a single worker over multiple days, or multiple samples for multiple workers in a single area of a plant on a single day.

Costs for Engineering Controls for General Industry: Impact of Switching From OSHA's Approach Based on # of Overexposed Workers to Facility-by-Facility Approach (Year 2000 $/yr)

Industry Category	OSHA Cost Estimate (uses percent of workers over PEL)	URS Cost Estimate on Facility basis using "Exposed Worker to Facility Conversion" chart, no size adjustment per facility
Foundries 1	$ 51,388,932	$ 372,114,062
Other Foundries 2	$ 87,761,791	$ 87,761,791
Structural Clay	$ 50,532,307	$ 180,492,301
Pottery	$ 24,458,545	$ 53,511,789
Concrete Products	$ 47,015,472	$ 181,690,078
Dental Laboratories 2	$ 437,505	$ 437,505
Glass Manufacture 3	$ 5,144,823	$ 12,654,454
Jewelry 2	$ 819,424	$ 819,424
Paints and Coatings	$ 2,407,540	$ 2,483,369
Cut Stone and Stone Products	$ 10,093,821	$ 79,871,573
Railroads 2	$ 13,377,790	$ 13,377,790
Ready-Mix Concrete 2	$ 9,358,717	$ 9,358,717
Refractory Products 4	$ 27,281,093	$ 61,685,580
Total Annual Cost	**$ 330,077,761**	**$ 1,056,258,433**

Table footnotes:

1. The total for "Foundries" includes only the three foundry SIC codes (3321: Gray and Ductile Iron Foundries, 3322: Malleable Iron Foundries, and 3325: Steel Foundries) whose respirable quartz exposure data are presented in Table 2-9 of the Draft Technical Feasibility Document. These represent 1,025 of the 2,182 foundries addressed in the Draft Technical Feasibility document. Sufficient data are not available anywhere in the docket to make it clear how OSHA or the Agency's contractor estimated costs for the remaining portion of the foundry industry. The total OSHA cost estimate for all foundries is $139,150,723 per year, leaving $87,761,791 per year in estimated costs for the remaining foundry SIC codes for which the derivation is unclear. We have shown costs for these "Other Foundries" on a separate line below in this table.
2. Sufficient information was not available in the docket to understand, replicate and critique OSHA's cost estimate for these industry categories. Accordingly, URS did not calculate a revised cost estimate for these categories, and OSHA's estimated costs for these categories are shown unadjusted in this table in the "URS Cost Estimate" column.
3. URS believes that OSHA's contractor wrongly applied the distribution of silica exposures (% of exposure samples in each concentration range) for batch operations in the Glass Products Industrial Sector shown in Table 7-2 of the Draft Technical Feasibility Document to both batch operations and material handler columns in Table 7-3. This causes the percentage of material handler samples higher than 50 ug/m^3 to be reported as 50% whereas in reality 83% of these samples were higher than 50 ug/m^3, resulting in an in appropriately low OSHA cost estimate. URS corrected this apparent error in developing our adjusted cost estimates.
4. For the Refractory Products Industrial Sector, the job categories for which exposure information for the sector is presented in the Draft Technical Feasibility Document (Table 14-6) do not correspond in any understandable manner to the job categories that OSHA used in the Cost and Economic Impact Analysis for final cost estimates for this sector. In the absence of any comprehensible data for this sector showing how exposures differ across individual job categories, URS has used the aggregated exposure information for all job categories presented in Table 14-6 (13 out of 52 samples, or 25%, exceeding 50 ug/m^3) to represent exposures for each individual job category, and we have estimated costs using our "facility-by-facility" approach accordingly.

Adjustment #2: Consider the size of the plant in estimating on a plant-by-plant basis how many engineering controls will be needed by General Industry.

We based our engineering control cost estimates for General Industry on a plant-by-plant analysis. We assumed that each area of a plant where workers were overexposed relative to the PEL would need engineering controls to reduce exposures. Thus, if a pre-production material handler employee was exposed above the PEL, we assumed the employer would need to install controls to reduce exposures in his plant's pre-production material handling area. But what of plants that are sufficiently large to have multiple areas where the same function is performed, such as a plant with two separate and different pre-production material handling yards?

We assumed generally that plants classified by OSHA as small will have only one production line and one area of each sort where controls may be needed. In contrast, we assumed that plants classified as medium will have two production lines that may perhaps need to be controlled, while large plants will have three production lines that may need control measures.

This adjustment, when added to the previous adjustment involving switching to a plant-by-plant basis for costing, increases the estimated cost of engineering controls for general industry from the $330 million per year (year 2000$) that OSHA estimated to $1.66 billion per year, as shown on the following table:

Costs for Engineering Controls for General Industry: Impact of Two Adjustments to OSHA's Methodology -- Facility-by-Facility Approach and Adjustment to Reflect Facility Size (Year 2000 $/yr)

Industry Category	OSHA Cost Estimate (uses percent of workers over PEL)	URS Cost Estimate on a Per-Facility basis, and in addition applying a site size adjustment based on percentages of three sizes of facilities available in the ERG Reports
Foundries 1	$ 51,388,932	$ 682,148,608
Other Foundries 2	$ 87,761,791	$ 87,761,791
Structural Clay	$ 50,532,307	$ 308,570,899
Pottery	$ 24,458,545	$ 72,702,557
Concrete Products	$ 47,015,472	$ 258,578,961
Dental Laboratories 2	$ 437,505	$ 437,505
Glass Manufacture 3	$ 5,144,823	$ 20,334,673
Jewelry 2	$ 819,424	$ 819,424
Paints and Coatings	$ 2,407,540	$ 3,682,830
Cut Stone and Stone Products	$ 10,093,821	$ 96,076,708
Railroads 2	$ 13,377,790	$ 13,377,790
Ready-Mix Concrete 2	$ 9,358,717	$ 9,358,717
Refractory Products 4	$ 27,281,093	$ 104,910,513
Total Annual Cost	$ 330,077,761	$ 1,658,760,976

Table footnotes:

1. The total for "Foundries" includes only the three foundry SIC codes (3321: Gray and Ductile Iron Foundries, 3322: Malleable Iron Foundries, and 3325: Steel Foundries) whose respirable quartz exposure data are presented in Table 2-9 of the Draft Technical Feasibility Document. These represent 1,025 of the 2,182 foundries addressed in the Draft Technical Feasibility document. Sufficient data are not available anywhere in the docket to make it clear how OSHA or the Agency's contractor estimated costs for the remaining portion of the foundry industry. The total OSHA cost estimate for all foundries is $139,150,723 per year, leaving $87,761,791 per year in estimated costs for the remaining foundry SIC codes for which the derivation is unclear. We have shown costs for these "Other Foundries" on a separate line below in this table.
2. Sufficient information was not available in the docket to understand, replicate and critique OSHA's cost estimate for these industry categories. Accordingly, URS did not calculate a revised cost estimate for these categories, and OSHA's estimated costs for these categories are shown unadjusted in this table in the "URS Cost Estimate" column.
3. URS believes that OSHA's contractor wrongly applied the distribution of silica exposures (% of exposure samples in each concentration range) for batch operations in the Glass Products Industrial Sector shown in Table 7-2 of the Draft Technical Feasibility Document to both batch operations and material handler columns in Table 7-3. This causes the percentage of material handler samples higher than 50 ug/m^3 to be reported as 50% whereas in reality 83% of these samples were higher than 50 ug/m^3, resulting in an in appropriately low OSHA cost estimate. URS corrected this apparent error in developing our adjusted cost estimates.
4. For the Refractory Products Industrial Sector, the job categories for which exposure information for the sector is presented in the Draft Technical Feasibility Document (Table 14-6) do not correspond in any understandable manner to the job categories that OSHA used in the Cost and Economic Impact Analysis for final cost estimates for this sector. In the absence of any comprehensible data for this sector showing how exposures differ across individual job categories, URS has used the aggregated exposure information for all job categories presented in Table 14-6 (13 out of 52 samples, or 25%, exceeding 50 ug/m^3) to represent exposures for each individual job category, and we have estimated costs using our "facility-by-facility" approach accordingly.

Adjustment #3. Increase the unit costs for local exhaust ventilation (LEV) above those estimated by OSHA. We add costs for HEPA filtration to OSHA's estimated costs for LEV that is recirculated within a facility, and we add costs for baghouse filtration and pre-HEPA filtration for LEV that is exhausted to the outside air.

For this relatively quick critique of OSHA's SBREFA cost estimates, we have not had the time to review and re-estimate in detail most of the Agency's unit costs for implementing controls. We have focused our detailed critique on the unit cost estimates for the particular controls that account for the largest share of total costs. We have not reconsidered OSHA's cost estimates, for example, to reduce a heavy equipment operator's silica exposure by enclosing the cab and providing filtered air in front-end loaders, cranes, fork lifts and the like. Nor have we re-estimated OSHA's projected costs to equip various machines with water sprays to reduce silica dust generation, to cover conveyors, to purchase HEPA vacuums for improved housekeeping, and so forth. We will review OSHA's estimated unit costs for engineering controls in detail when the NPRM and supporting documentation are available.

More than half of the total engineering control costs for general industry that OSHA estimated during the SBREFA process involves providing additional local exhaust ventilation (LEV) for activities where silica dust is generated. We thus reviewed in detail OSHA's procedures for estimating LEV costs. OSHA estimated costs for additional LEV in three steps:

1. Estimate the type and volume of additional LEV that is needed to provide sufficient reductions in silica exposure for each of many different dust-generating tools, machines and processes in general industry. OSHA's estimates for the additional amount of LEV needed ranged from 200 cfm to adequately control a hand tool to 28,800 cfm for a foundry shakeout double draft table.

2. Estimate the fraction of total industry LEV that is provided via recirculated air vs. new make-up air from outdoors.

3. Estimate the costs per cfm for recirculated air (less expensive per cfm because it is already at the in-plant temperature) and for new make-up air from outdoors (more expensive per cfm because it often needs to be heated or cooled to make it suitable for use in the facility).

Because justifications for OSHA's assumptions about how much additional LEV is needed to effectively control each activity could not be found in the docket, we did not critique this first step in OSHA's cost analysis for LEV.

OSHA estimated that 20% of all industrial ventilation air will be discharged outside the plant with no emission controls and new make-up air will come from outdoors and thus may need to be heated or cooled on a seasonal basis. 80% of all industrial ventilation air will be recirculated and thus will not need to be conditioned. OSHA then developed a weighted average cost per cfm that reflected differing costs for conditioned (heated/cooled as appropriate) make-up air vs. unconditioned recirculated air. We believe this 20/80 split that OSHA estimated reflects an unrealistically high share for the less expensive recirculated air. However, we have not yet gathered data to validate this belief, and for this analysis we have not adjusted OSHA's estimated costs to reflect a more accurate split.

With respect to OSHA's unit cost estimates for recirculated and discharged air, as far as we can tell, OSHA did not include any cost for baghouse filtration for either re-circulated or discharged air, and also did not include the cost of HEPA filtration to remove silica and other dust from recycled air as it is re-circulated into the employee areas. Adding costs for a baghouse and HEPA filtration would increase the estimated 20/80 weighted average capital cost per cfm of additional LEV by about 70% over OSHA's SBREFA estimate and the estimated operating and maintenance cost per cfm of additional LEV by about 88%.

This adjustment, when added to the previous two adjustments involving switching to a plant-by-plant basis for costing and reflecting plant size, increases the estimated cost of engineering controls for general industry from the $330 million per year (year 2000$) that OSHA estimated to $3.14 billion per year, as shown on the following table:

Costs for Engineering Controls for General Industry: Impact of Three Adjustments to OSHA's Methodology -- Facility-by-Facility Approach, Adjustment to Reflect Facility Size, and Additional Costs for LEV (Year 2000 $/yr)

Industry Category	OSHA Cost Estimate (uses percent of workers over PEL)	URS Cost Estimate on a Per-Facility basis, using site size adjustment based on percentages of three sizes of facilities available in the ERG Reports, with LEV Cost Correction
Foundries 1	$ 51,388,932	$ 1,476,303,684
Other Foundries 2	$ 87,761,791	$ 87,761,791
Structural Clay	$ 50,532,307	$ 662,932,099
Pottery	$ 24,458,545	$ 170,662,127
Concrete Products	$ 47,015,472	$ 331,445,675
Dental Laboratories 2	$ 437,505	$ 437,505
Glass Manufacture 3	$ 5,144,823	$ 39,423,314
Jewelry 2	$ 819,424	$ 819,424
Paints and Coatings	$ 2,407,540	$ 8,057,992
Cut Stone and Stone Products	$ 10,093,821	$ 111,148,796
Railroads 2	$ 13,377,790	$ 13,377,790
Ready-Mix Concrete 2	$ 9,358,717	$ 9,358,717
Refractory Products 4	$ 27,281,093	$ 224,862,210
Total Annual Cost	$ 330,077,761	$ 3,136,591,123

Table footnotes:

1. The total for "Foundries" includes only the three foundry SIC codes (3321: Gray and Ductile Iron Foundries, 3322: Malleable Iron Foundries, and 3325: Steel Foundries) whose respirable quartz exposure data are presented in Table 2-9 of the Draft Technical Feasibility Document. These represent 1,025 of the 2,182 foundries addressed in the Draft Technical Feasibility document. Sufficient data are not available anywhere in the docket to make it clear how OSHA or the Agency's contractor estimated costs for the remaining portion of the foundry industry. The total OSHA cost estimate for all foundries is $139,150,723 per year, leaving $87,761,791 per year in estimated costs for the remaining foundry SIC codes for which the derivation is unclear. We have shown costs for these "Other Foundries" on a separate line below in this table.
2. Sufficient information was not available in the docket to understand, replicate and critique OSHA's cost estimate for these industry categories. Accordingly, URS did not calculate a revised cost estimate for these categories, and OSHA's estimated costs for these categories are shown unadjusted in this table in the "URS Cost Estimate" column.
3. URS believes that OSHA's contractor wrongly applied the distribution of silica exposures (% of exposure samples in each concentration range) for batch operations in the Glass Products Industrial Sector shown in Table 7-2 of the Draft Technical Feasibility Document to both batch operations and material handler columns in Table 7-3. This causes the percentage of material handler samples higher than 50 ug/m^3 to be reported as 50% whereas in reality 83% of these samples were higher than 50 ug/m^3, resulting in an in appropriately low OSHA cost estimate. URS corrected this apparent error in developing our adjusted cost estimates.
4. For the Refractory Products Industrial Sector, the job categories for which exposure information for the sector is presented in the Draft Technical Feasibility Document (Table 14-6) do not correspond in any understandable manner to the job categories that OSHA used in the Cost and Economic Impact Analysis for final cost estimates for this sector. In the absence of any comprehensible data for this sector showing how exposures differ across individual job categories, URS has used the aggregated exposure information for all job categories presented in Table 14-6 (13 out of 52 samples, or 25%, exceeding 50 ug/m^3) to represent exposures for each individual job category, and we have estimated costs using our "facility-by-facility" approach accordingly.

Adjustment #4: Use more realistic estimates for how often General Industry will need to perform ancillary requirement tasks.

OSHA's cost estimates for employers to meet many of the ancillary requirements are based on the Agency's estimates of the number of workers who will remain exposed above the PEL even after employers implement engineering controls in an attempt to meet the PEL. Thus, for example, since medical surveillance will be required for all employees exposed above the PEL (or action level), medical surveillance costs will be roughly linear with the number of employees that are exposed above the PEL (or action level). Likewise the costs for meeting the "regulated areas" requirements will depend on the number of regulated areas that must be established, which will depend in turn on how many areas there are where employees will remain exposed above the PEL even after installation of engineering controls.

We believe OSHA is far too optimistic about the degree to which employers will be successful in implementing engineering controls that will reduce worker exposures to below a PEL of 50 μg/m^3. OSHA assumes generally in estimating the costs of the ancillary requirements that only 4% of all workers who are currently exposed above 50 ug/m^3 will remain exposed above this level after their employers install engineering controls in an effort to meet a new PEL at this level.

We disagree. Engineering controls will not work sufficiently reliably in differing circumstances for the rate of overexposures relative to a new PEL of 50 μg/m^3 to decline to as little as 4%. Now, some 40 years after employers began efforts to meet the current PEL that is essentially 100 ug/m^3, OSHA finds that approximately 30% of its compliance samples are above the current PEL. It is entirely unrealistic to forecast that this rate of overexposure would fall to only 4% in only several years after employers attempt to comply with a new PEL that is 50% lower. We estimate costs for the ancillary provisions based instead on assuming that 10% of all workers who are currently exposed above 50 ug/m^3 will remain overexposed relative to a new PEL of 50 ug/m^3 after engineering controls have been implemented. This higher figure is based on OSHA's estimate during the SBREFA process to the effect that 10% of all workers currently exposed over 50 ug/m^3 will need to use respirators, at least occasionally, after implementation of engineering controls to meet a new PEL of 50 ug/m^3. In actual practice we believe that the number of overexposed workers will likely remain much higher than even the 10% figure.

We also adjust OSHA's cost estimate for ancillary requirements by increasing some unit cost estimates (e.g., for exposure sampling) and by increasing OSHA's worker wage rates by 30%.[5] A full description of our adjustments to OSHA's cost estimates for ancillary requirements is

[5] We originally increased OSHA's assumed hourly wage rates by 30% to account for OSHA's omission of benefits from the wage rate calculations and to reflect the much higher fully loaded wage rates that PricewaterhouseCoopers recommended in their 2003 critique of OSHA's estimates. Upon further review of the OSHA contractor's narrative materials, it now appears to us that the contractor (ERG) probably did believe that benefits were included in the relatively low labor rates they used in calculating the value of lost work time pursuant to ancillary requirements. Nevertheless, we continue to believe that the 30% adjustment is reasonable to reflect other respects in which OSHA's wage rate estimate is too low. See Appendix 5. The 30% increase to OSHA's assumed wage rates accounts for about $4.5 million/year -- or about 10% -- of our $43.1 million/year estimated cost for general industry ancillary requirements.

included in Appendix 2. Appendix 3 provides a table summarizing our adjustments and showing how they affect the estimated costs for each of the ancillary requirements for General Industry.[6]

In total, we estimate the costs for General Industry employers to comply with the potential new ancillary requirements of a silica standard at $43.1 million per year (year 2000 $) in contrast to OSHA's estimate of $15.4 million per year.[7]

Adjustment #5. Increase OSHA's cost estimates for engineering controls for the construction industry to reflect employers' inability to forecast accurately exactly which at-risk workers will be overexposed relative to a new PEL and which will not.

OSHA estimates the costs for construction industry engineering controls by: 1) identifying appropriate control measures that can reliably reduce exposures to below the PEL; 2) estimating the cost for a single worker at-risk of silica exposure to employ these control measures; and then 3) multiplying the unit cost of the controls by the number of workers who will likely be overexposed relative to the new PEL in the absence of such controls.

We do not disagree with the overall logic of this approach. However, we do disagree that employers will be able accurately to distinguish the particular at-risk workers who will be overexposed from the remaining at-risk workers who will not be overexposed. Whether a particular construction worker performing an at-risk task on a given day will or will not be overexposed is effectively unpredictable. The exposure information that OSHA has assembled shows that workers performing at-risk tasks (e.g., jack hammering, tuck pointing, sawing bricks or concrete blocks, drilling into masonry, etc.) are sometimes exposed above the PEL and sometimes below the PEL depending on numerous aspects of the task and environment that are very difficult to identify and predict. For example, the silica exposure that a jackhammer operator will incur over his work shift depends importantly on such factors as: how much of the shift he spends jack hammering; whether the work is performed indoors or in other confined spaces or outdoors; the silica content of the material he is breaking up; whether the wind is blowing or not; whether he stands upwind or downwind of the dust he generates, whether it is raining or not; and more. Many of these factors are not knowable in advance, and the exact impact of these factors on the worker's exposure cannot reliably be predicted in advance. As a result, the employer cannot be certain in advance of a jackhammer operator's work shift whether the employee is likely to be overexposed or not. The prudent employer and the prudent

[6] Following a recommendation of PricewaterhouseCoopers, we made a relatively minor adjustment to OSHA's cost estimates for ancillary requirements – by annualizing the costs of initial medical screening in a more reasonable manner than the manner in which OSHA appeared to have done it. However, upon further review of the (inadequate) materials in the record documenting this portion of OSHA's cost analysis, we now believe that Pricewaterhouse probably misinterpreted the OSHA contractor's calculations and that no adjustment of OSHA's cost estimate is warranted. Eliminating this adjustment would reduce our estimated cost for general industry ancillary requirements by about 1% or $0.5 million per year. See Addendum.

[7] If we were to delete the two adjustments discussed in the preceding two footnotes, we would estimate the cost of ancillary requirements for general industry at about $38.1 million/year, about 12% less than the $43.1 million/year figure that we use as our cost estimate for ancillary requirements in our analysis of total compliance costs and economic impacts. This potential 12% downward change in our estimate for general industry ancillary requirements would have virtually no effect (about 0.1%) on our overall cost and impact estimates for the entire regulation, because the costs for general industry ancillary requirements constitute only a very small portion of total compliance costs for the potential new regulation. See Addendum.

employee will want to use the exposure-reducing controls in all instances when the at-risk task is performed and overexposures could perhaps result if controls were not to be used.

We have thus recalculated OSHA's costs for engineering controls for the construction industry. We assume that employers will need to adopt controls for all workers when they perform any of the construction tasks that OSHA identifies as at-risk for significant silica exposure. We reject OSHA's assumption to the effect that employers can accurately predict which at-risk workers will be overexposed and can implement controls only in those specific instances when overexposures would otherwise ensue. OSHA's data show that at-risk tasks result in overexposures relative to a PEL of 50 ug/m^3 in about half of all instances in which such tasks are performed. Extending engineering controls to all workers performing at-risk tasks instead of only to the half that actually end up being overexposed results in roughly doubling OSHA's cost estimate.

The table below shows that this adjustment increases the estimated cost of engineering controls for the construction industry from OSHA's figure of $244.7 million/year to $543.8 million/year. Significant adjustments to OSHA's cost estimates are also likely warranted to increase the productivity penalty costs for using LEV and wet methods in construction tasks, and to increase several of OSHA's estimated unit costs. We did not have time to research and make these further adjustments, however.

Costs for Engineering Controls for Construction: Assume Employers Cannot Identify and Implement Controls for Only Those At-Risk Workers Who Will Be Overexposed

Task	OSHA's SBREFA Estimates		Revised Estimates
	% of Time Task Results in Exposure > 50 ug/m3	Engineering Control Costs ($ in millions/yr)	Engineering Control Costs ($ in millions/yr)
Drywall finishing	6.7%	$1.24	$18.51
Earth drilling	50.0%	$15.83	$31.66
Grinding and tuckpointing	93.2%	$93.06	$99.85
Heavy equipment operation	16.7%	$39.99	$239.46
Hole drilling	55.6%	$11.54	$20.76
Impact drilling (jackhammer, demolition)	79.0%	$47.98	$60.73
Masonry cutting -- stationary saws	47.3%	$10.64	$22.49
Masonry cutting -- portable saws	33.3%	$8.29	$24.89
Milling	53.6%	$10.75	$20.06
Rock crushing	100.0%	$5.36	$5.36
Underground construction (tunnels)	20.0%	$0.01	$0.05
TOTAL		$244.69	$543.82

Adjustment #6. Adjust OSHA's cost estimates for ancillary requirements for the construction industry to reflect comments by Pricewaterhouse.

We did not independently review OSHA's cost estimate for construction industry employers to comply with potential silica ancillary requirements. Instead, we accepted most of the comments and analysis developed in 2003 by PricewaterhouseCoopers in their review of OSHA's cost estimates.[8]

[8] PricewaterhouseCoopers. The Reform OSHA Coalition, op cit. November, 2003.

Pricewaterhouse made the following major points in reviewing OSHA's analysis pertaining to construction industry ancillary requirements. OSHA has:

- Significantly underestimated likely costs for exposure assessment. OSHA has underestimated the time and cost for an industrial hygienist to travel to a construction site and sample workers' exposure, and has underestimated unit costs associated with exposure sampling.
- Wrongly annualized the cost of initial medical screening over ten years, as if this cost were for a relatively long-lived capital investment.[9]
- Underestimated the unit costs associated with establishing regulated areas and applied these unit costs to an unrealistically small number of job sites and workers where regulated areas may be needed.
- Underestimated the unit costs for training and the number of workers that will need information and training on how to reduce silica exposure. OSHA estimates information and training needs only for workers exposed above the draft Action Level. Pricewaterhouse estimates training needs for a larger number of workers including "each ... employee prior to, or at the time of initial assignment to a job involving potential exposure to crystalline silica," as OSHA's draft regulation would require.

Pricewaterhouse did not adjust OSHA's cost estimates for respirators, hygiene requirements, or exit screening for workers, largely because OSHA's contractor did not provide sufficient information about how these costs were calculated for these estimates to be reviewable.

We accepted Pricewaterhouse's revisions to OSHA's cost calculations and incorporated them into our present analysis, except that we recalculated Pricewaterhouse's revisions so as to remove the impact of labor rate inflation from them. Pricewaterhouse had adjusted OSHA's cost estimates for several ancillary requirements to reflect inflation in labor rates between 2000 (OSHA's base year for the Agency's cost estimates) and 2003 (Pricewaterhouse's base year for cost estimates). We removed the effect of this wage rate inflation from Pricewaterhouse's numbers. We will adjust all of OSHA's cost estimates to account for inflation in one step at the end of this analysis, going from year 2000 dollars all the way to year 2009 dollars. (The model we use to estimate economic impacts resulting from these compliance costs requires economic variables to be expressed in 2009 dollars.)

[9] However, upon further review of the (inadequate) materials in the record documenting this portion of OSHA's cost analysis, we now believe that Pricewaterhouse probably misinterpreted the OSHA contractor's calculations. ERG may not have annualized the costs of initial medical screening as Pricewaterhouse believed the contractor had done, and Pricewaterhouse's adjustment to reflect what they thought to be more reasonable annualization over three years rather than over ten years may be inappropriate. If we were to remove this particular adjustment from our re-estimates of OSHA's costs for ancillary requirements for construction, our cost estimate would decline by $60 million/year (about 9.6%), from $624.4 million/year to $564.4 million/year. This potential downward change in our cost estimate for construction industry ancillary requirements would have little effect (about 1%) on our overall cost and impact estimates for the entire regulation, because the costs for construction ancillary requirements constitute a very small portion of total compliance costs for the potential new regulation. See Addendum.

Costs for Ancillary Requirements for Construction: Update to Reflect Pricewaterhouse Comments, but Remove Impact of Wage Inflation (in millions of year 2000 $/year)

	OSHA/ERG	Pricewaterhouse	Pricewaterhouse (Without Wage Inflation)
A. Exposure Monitoring	9.9	67.0	65.6
B. Respirator Costs	175.2	175.2	175.2
C. Regulated Areas	20.2	31.7	20.7
D. Hygiene Requirements	33.1	33.1	33.1
E. Initial and Periodic Health Screen			
Initial Health Screening			
Annualized over 10 yrs	22.4	NA	NA
Annualized over 3 yrs	NA	103.2	95.8
Periodic Health Screening			
Option 1	71.0	71.0	71.0
Option 2	106.0	106.0	106.0
F. Exit Screening			
Option 1	19.7	19.7	19.7
Option 2	11.5	11.5	11.5
G. Pulmonary Specialist Referrals	0.4	0.4	0.4
H. Information and Training	39.8	168.5	110.8
I. Abrasive Blasters (separately calculated)			
Option 1	18.2	18.2	18.2
Option 2	19.1	19.1	19.1
Total Ancillary Cost (w/lowest cost Options)	401.6	679.7	602.4
Total Ancillary Cost (w/highest cost Options)	445.8	723.9	646.5
Average of High and Low Costs	423.7	701.8	624.4

Adjustment #7. Adjust all cost estimates to convert from year 2000 dollars to year 2009 dollars.

The model we use to estimate economic impacts resulting from these compliance costs requires economic variables to be expressed in 2009 dollars We thus adjusted both OSHA's cost estimates for the draft regulation and our re-estimates, each of which have been expressed in year 2000 dollars, to convert them both to year 2009 dollars.[10] Based upon the Consumer Price Index, inflation over the nine years from 2000 to 2009 totaled 24.6%. We thus inflated all cost figures by 24.6% to convert from year 2000 dollars to year 2009 dollars.

[10] CPI, All Urban Consumers, 2009 annual index value ÷ 2000 annual index value = 1.2456. Source: http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/

III. Summary of All Adjustments to OSHA's Estimated Costs for a Standard Having a PEL of 50 ug/m^3 With Ancillary Provisions

As part of the SBREFA process in 2003, OSHA estimated the costs to comply with a 50 μg/m^3 standard and ancillary requirements at $1.042 billion/year in 2000 dollars.

When our first six corrections and adjustments are made to OSHA's analyses, the estimated annualized costs of the standard increase by more than a factor of four, from $1.042 billion/year to $4.38 billion/year in year 2000 dollars. Since these are annualized costs, they would be incurred each year the standard is in effect.

When the estimated annualized costs are adjusted from year 2000 dollars to year 2009 dollars (an inflation factor of 24.6% over these nine years), the estimated costs of the standard become $5.45 billion/year.

The following table shows the impact of each of the six adjustments and corrections that we made to OSHA's cost estimates, and then the impact of converting to 2009 dollars.

Re-Estimated Costs for Potential New Silica Regulation With PEL at 50 ug/m3 and Ancillary Provisions (in millions of yr 2000 or 2009 $/yr)

	General Industry & Maritime			Construction			TOTAL
	Engineering Controls	Shipbuilding	Ancillary Provisions	Engineering Controls	Respirators	Ancillary Provisions	
OSHA's SBREFA cost estimates Additions/adjustments to OSHA's estimates:	330.1	28.5	15.4	244.7	176.2	248.5	1,042.4
General industry -- correct OSHA's errors in interpreting exposure information and estimate costs for engineering controls on a per-facility basis instead of on a worker basis	728.2	0.0	0.0	0.0	0.0	0.0	726.2
General industry -- further adjust costs for engineering controls to scale for size of facility	602.5	0.0	0.0	0.0	0.0	0.0	602.5
General industry -- adjust OSHA's unit cost estimates for engineering controls to reflect additional costs for LEV	1,477.8	0.0	0.0	0.0	0.0	0.0	1,477.8
General industry -- ancillary provisions -- base cost calculations on OSHA's alternative estimate that 10% of at-risk workers will remain exposed above the new PEL, not 4%; correct some unit cost assumptions	0.0	0.0	27.7	0.0	0.0	0.0	27.7
Construction -- engineering controls -- assume employers will need to adopt controls for all workers performing at-risk tasks, instead of assuming that employers can accurately predict which workers will be overexposed and can implement controls for only those workers who will be overexposed	0.0	0.0	0.0	299.1	0.0	0.0	299.1
Construction -- ancillary provisions -- adopt Pricewaterhouse adjustments regarding exposure assessment, health screening, training, and regulated areas. Do not make Pricewaterhouse adjustments regarding wage rates.	0.0	0.0	0.0	0.0	0.0	200.7	200.7
Subtotal after 6 adjustments -- total costs expressed in year 2000 dollars	3,136.6	28.5	43.1	543.8	175.2	449.2	4,376.5
General industry and construction -- adjust all cost estimates to convert from year 2000 dollars to year 2009 dollars.	770.5	7.0	10.6	133.6	43.0	110.4	1,075.1
TOTAL in 2009 dollars	3,907.1	35.5	53.7	677.3	218.3	559.6	5,451.5

IV. Economic Impacts of These Projected Compliance Costs

The compliance costs for the new silica standard will represent an increased cost of doing business for firms in the industries affected by the regulation. As U.S. firms incur higher costs for the goods and services they produce that involve worker exposure to crystalline silica, market prices for these goods and services will tend to increase to reflect some or all of the increases in production costs. Competing products and services will begin to appear relatively more attractive in the marketplace, and the market share for goods and services affected by the regulation will decline relative to that for competitors. Thus, for example, the domestic U.S. foundry industry will find its castings less competitive than before the regulation relative to both imported castings (already accounting for some 20% of the U.S. market) and competing products (e.g., forged, die cast or stamped items; items made from plastics or composites). The same will be true of bricks, clay tiles, concrete products, glass, cut stone and other products that involve worker exposure to crystalline silica. The same will be true for construction services: products that involve a substantial amount of construction (e.g., new homes) will suffer increased costs and will tend to lose market share relative to competing products that involve lesser amounts of construction (e.g., existing homes).

In economists' terms, the compliance costs for a new silica standard will shift the supply curves for affected firms backward -- after the regulation, the quantity of product or service that an affected producer is able to provide at any given price will be less than the quantity that could have been supplied absent the regulatory compliance costs. After compliance with the regulation, the backward-shifted supply curve in combination with the unaffected demand curve for the product or service will yield a new market equilibrium with some combination of increased price for the product or service and reduced quantity sold. The exact combination of increased price and reduced quantity will depend on the nature of the supply and demand curves for the product or service. If the demand curve for the item is relatively elastic (e.g., if there are ready substitutes or competitors for the item such as low-priced imports or easily substitutable products made from other materials) then the market impact of the regulation will ultimately tend to be a larger proportional reduction in quantity sold and a smaller proportional reduction in price. If, on the other hand, the demand curve is relatively inelastic and the item is a necessity with little in the way of competitive alternatives, the market response to the regulation will be a larger proportional increase in price and a smaller proportional reduction in quantity sold.

We estimate the economic impacts from the compliance costs associated with the potential new silica regulation in two steps. By "economic impacts", we mean the effects on overall economic output (GDP), employment, governmental tax revenues, prices, imports and exports and other variables of interest that will ultimately ensue as a result of the regulation after all market adjustments. Our two analytical steps are:

1. Estimate the impact of the potential regulation's compliance costs on the value of output (revenues) for each affected U.S. industry. We make assumptions about the nature of the supply and demand curves for each affected industry and estimate the eventual market impact of each affected U.S. industry's regulatory compliance costs on that industry's revenues.

2. Estimate how the expected change in each industry's revenues will then reverberate throughout the economy. If an industry incurs a change in its sales or revenues, this reduction in economic activity will be felt by the industry's suppliers and employees. Several alternative input-output models exist for the entire U.S. economy that mathematically simulate the customer/supplier/employee relationships for each U.S. industry. We have purchased and used one particularly well-suited input-output model, IMPLAN, to estimate the eventual economic impacts throughout the entire economy that will result from the changes in revenues that we estimate for each affected industry in our first analytical step.

Step 1: Estimate the impact of projected silica regulatory compliance costs on affected U.S. industries' revenues

This two-step process that we employ has often been used in other analyses estimating the likely economic impact of potential regulatory costs. The several available input-output models represent a widely respected and convenient tool for estimating economic impacts, but any of these models need as the key input an estimate of the revenue loss for the affected industry that will result from the projected regulatory compliance costs. A frequent approach for this first step in these other analyses has been simply to assume that the annual loss in revenues for the affected industry is equal to the annualized projected regulatory compliance costs for that industry.[11]

We believe that this assumption -- that the revenue loss for the affected industry will be 100% of that industry's estimated compliance costs -- is too extreme. In general, the demand curve for an affected industry's output is unlikely to be so elastic as to lead to a revenue loss as high as 100% of compliance costs. A less elastic demand curve would suggest that some of the compliance costs incurred by affected producers will ultimately be passed through into the market in the form of increased prices: the industry's revenues will tend to decrease as a result of the lesser quantity of goods and services sold, but this impact on revenues can be partly or even completely offset by the increased price that is realized for the reduced output.

In fact, the mathematical relationship between the magnitude of the compliance cost incurred by an industry and the magnitude of the eventual resulting change in industry revenues after market adjustments have occurred depends on the elasticities of the demand and supply curves for the industry's output. In our view, accurately estimating the impact of regulatory compliance costs on an affected industry's revenues should involve simulating the industry's supply and demand curves (which will require estimating supply and demand elasticities) and then modeling the results when the regulatory costs shift the industry's supply curve backward. EPA's Air Office typically conducts its regulatory economic impact analyses in this manner.[12] (OSHA typically

[11] For example, a recent economic impact analysis that has received substantial publicity in the current debate about the jobs impacts of potential new environmental regulations: IHS Global Insight. *The Economic Impact of Proposed EPA Boiler Process Heater MACT Rule on Industrial, Commercial, and Institutional Boiler and Process Heater Operators*. Prepared for Council of Industrial Boiler Owners. August, 2010. Another recent analysis on another major environmental regulation made a similar assumption: NERA Economic Consulting. *Estimated Economic Impacts of EPA 2010 Ozone Proposal*; cited in MAPI/Manufacturers Alliance. *Economic Implications of EPA's Proposed Ozone Standard*. September, 2010.

[12] See, for example, EPA's *Economic Impact Analysis for the Brick and Structural Clay Products Manufacturing NESHAP: Final Rule*. February, 2003. And, more generally, see Section 5 of U.S. EPA. *OAQPS Economic Analysis Resource Document*. April, 1999.

conducts a much less detailed, "screening analysis" when investigating the economic impacts of regulations. In OSHA's screening analyses, compliance costs are simply compared against an industry's revenues and profits, and impacts are judged to be of potential concern if compliance costs exceed 1% of the industry's revenues or 10% of its profits. Because OSHA rarely, if ever, performs the sort of economic impact analysis that we want to conduct here, we have chosen generally to follow the EPA model for how to perform this sort of analysis.)

However, fully implementing EPA's preferred approach to projecting the market impacts of a regulation will usually require a very substantial analytical effort in order to estimate the elasticities of demand and supply for the major outputs of the various industries that will be affected by the regulation. Appropriately transferable pre-existing estimates for an industry's supply and demand elasticities are rarely available. Econometric estimation of industry supply and demand functions is technically difficult and requires difficult-to-obtain price and quantity information for the industry's product markets. In practice, when EPA projects the market response to a regulation, the Agency typically makes assumptions about industry supply and demand elasticities rather than deriving estimates for them or adopting pre-existing estimates. EPA typically assumes an elasticity of supply of 1.0, and often assumes various plausible values for the elasticity of demand and conducts a sensitivity analysis assuming each of these plausible values. Specifically, in EPA's economic impact analysis for an air pollution regulation affecting the structural clay products (mostly brick and clay tile) manufacturing industry, the Agency assumed a market elasticity of supply of 1.0 and an elasticity of demand of -1.5 (see the reference cited above).

For the first step in our current economic impact analysis for the potential new silica standard -- the step in which we estimate the impact of each industry's projected compliance costs on each industry's post-regulatory revenues -- we adopt the EPA Air Office approach. We cannot afford the effort required to estimate supply and demand elasticities for each of the several dozen or more different affected general and construction industries.[13] Instead, we adopt EPA's approach of assuming a supply elasticity of 1.0 for all industries and a demand elasticity of -1.5 (from EPA's structural clay products analysis) and conducting sensitivity analysis to assess the results if other plausible values were assumed for demand elasticity.

We developed a simulation model to assess the relationship between the regulatory compliance costs that an industry bears and the change in the affected industry's revenues after market adjustments, as a function of various assumed values for supply and demand elasticities. In this model, we assumed (as EPA typically does) constant elasticity supply and demand curves, resulting in a functional form of the following sort:

$$Q = A \times P^{\varepsilon}$$

Where Q is the Quantity demanded or supplied,
P is the Price at which that Quantity will be demanded or supplied,
ε is the elasticity of demand or supply,
and A is a different parameter in each of the demand and supply functions

[13] One can define "industry" at various levels of aggregation. OSHA's minimum count for the 2003 SBREFA draft silica regulation is at least 15 affected General Industry "sectors", plus 14 construction industry NAICS codes.

In the model, because of our interest in understanding the relationship between compliance costs and revenues, we entered compliance costs as a constant backward percentage shift in the industry's supply curve, and not (as is most frequently assumed in regulatory impact analyses) as a constant per unit backward shift in the industry's supply curve. We entered regulatory compliance costs in the analysis as a constant percentage of industry revenues (i.e., what percentage of baseline industry revenues does the projected industry compliance cost represent?), not as a constant cost per unit of the industry's output (i.e., for the brick industry, what cost per brick produced does the projected brick industry compliance cost represent?). Thus, for example, we developed the model so as to investigate what would happen if the brick industry incurred a regulatory compliance cost equal to 1% or 5 % or 10% of the industry's revenues, instead of setting the model up to investigate what would happen if the industry incurred regulatory costs equivalent to, say, 1¢ or 2¢ or 3¢ per brick.

Some results from our model are shown in Appendix 4. In short, we conclude that:

- If the industry's elasticity of supply is assumed at 1.0 and elasticity of demand at -1.5 (EPA's typical assumptions and our preferred assumptions for this analysis), the industry's revenue loss after market adjustments will be 20% of compliance costs, or slightly more if annualized compliance costs/year amount to much more than 5-10% of annual pre-regulation industry revenues. These results are bolded and shown in the box in Appendix 4.

- As should be expected, the industry's post-equilibrium revenue loss will exceed this amount (i.e., will exceed 20% or so of annualized compliance costs) if demand is more elastic than -1.5, and will be less than this amount if demand is less elastic than this figure.

- The model suggests that rather extreme circumstances will need to prevail if the industry's revenue loss is to approach 100% of its compliance costs. When the elasticity of supply is 1.0, either demand will need to be extremely elastic or compliance costs will need to be very large relative to revenues in order for the post-equilibrium revenue loss to approach 100% of compliance costs.

- The impact of compliance costs on revenues is diminished when the elasticity of supply is assumed at less than 1.0, and the impact is increased (though this result is not shown in the table in the Appendix) when the elasticity of supply is assumed at more than 1.0. EPA, however, commonly assumes a market supply elasticity of 1.0

We assume for Step 1 of our economic impact analysis the results shown for our preferred elasticity assumptions in the bolded and enclosed section of Appendix 4. We estimate that each U.S. industry affected by the potential new worker exposure standard for crystalline silica will face a post-equilibrium revenue loss equal to 20% of the annualized compliance costs projected for that industry.[14]

[14] The results shown in the bolded and enclosed section of Appendix 4 would appear to suggest some variation in our 20% assumption. For any industry incurring compliance costs so large as to amount to roughly 10% or more of pre-regulation industry revenues, we could perhaps estimate that the post-equilibrium revenue loss due to the regulation will equal 21%, not 20%, of the annualized compliance costs projected for that industry. We believe,

The following table shows the annual compliance costs and revenue losses that we estimate will be incurred by directly affected U.S. industries if OSHA promulgates a regulation establishing a new occupational exposure standard for crystalline silica at 50 ug/m^3. The revenue losses for each industry are estimated at 20 % of their annual compliance costs. The industry groupings shown in this table are as defined by the IMPLAN input-output model that we used for economic impact assessment. We have cross-walked the compliance cost estimates for industry groupings as OSHA defines these groups into corresponding compliance cost estimates for industry groupings as IMPLAN defines them. The total estimated annual compliance cost for the potential new regulation is an identical $5.45 billion/year in 2009 dollars whether spread across the various industry groupings as OSHA defines them or across the various industry groupings as IMPLAN defines them.

Estimated Annual Compliance Costs and Resulting Revenue Losses for Each Industry Directly Affected by a Potential New Silica Regulation (2009 $ in millions per year)

Industry Sector	(2009 $ in millions/year)	
	Compliance Cost	Revenue Loss
Ferrous metal foundries	1,975.0	395.0
Brick, tile, and other structural clay product manufacturing	837.0	167.4
Construction of other new nonresidential structures	490.5	98.1
Construction of new nonresidential commercial and health care structures	291.0	58.2
Clay and nonclay refractory manufacturing	284.0	56.8
Other concrete product manufacturing	234.5	46.9
Pottery, ceramics, and plumbing fixture manufacturing	215.5	43.1
Construction of new residential permanent site single- and multi-family structures	207.5	41.5
Construction of other new residential structures	173.5	34.7
Maintenance and repair construction of nonresidential structures	144.5	28.9
Cut stone and stone product manufacturing	140.5	28.1
Concrete pipe, brick, and block manufacturing	138.0	27.6
Construction of new nonresidential manufacturing structures	82.0	16.4
Maintenance and repair construction of residential structures	65.5	13.1
Miscellaneous nonmetallic mineral product manufacturing	46.5	9.3
Ship building and repairing	35.5	7.1
Other pressed and blown glass and glassware manufacturing	26.0	5.2
Transport by rail	17.0	3.4
Glass container manufacturing	14.0	2.8
Ready-mix concrete manufacturing	12.0	2.4
Paint and coating manufacturing	10.0	2.0
Flat glass manufacturing	10.0	2.0
Jewelry and silverware manufacturing	1.0	0.2
Dental laboratories manufacturing	0.5	0.1
Total	5,451.5	1,090.3

Step 2: Use the input-output model to estimate the economic impacts resulting from the reductions in U.S. industry revenues due to projected silica regulatory compliance costs

Input-output models are commonly used to trace and estimate the economic impacts that will result from a change in final demand or output for one or more sectors of the economy.[15] The

however, that the added precision apparently gained by considering the intensity of the cost burden on the regulated industry (e.g., 1% of revenues vs. 5% of revenues vs. 10% of revenues) is small relative to the uncertainty inherent in assuming supply and demand elasticities. We will use the simple assumption that the post-equilibrium revenue loss for an affected industry is always equal to 20% of the annualized compliance costs projected for that industry.

[15] Some of the following discussion of input-output models and IMPLAN as a specific input-output model has been drawn from IHS Global Insight, op cit., August 2010.

model simulates the flows of goods and services necessary to produce each economic sector's output. A very large system of multipliers within the model describes the change of output for each and every regional industry caused by a one dollar change in final demand for any given industry. Input-output models are geographically based, and can usually be run to simulate the impacts of a change in final demand on economic flows within a locality, within a region, within a State, within the entire nation, or within many other sorts of geographies. In our application, the regulation-induced projected annual change in revenues for each directly affected industrial sector, as shown in the table above, is the change in final demand that drives the model. We use an input-output model to estimate the eventual changes in economic flows in other sectors and in the U.S. economy as a whole that will result from the projected changes in revenues for the sectors directly affected by the regulation.

Three input-output models are commonly used for such purposes: REMI/Policy Insight, the Department of Commerce/Bureau of Economic Analysis RIMS II system of multipliers, and IMPLAN. IMPLAN is an acronym for "Impact Analysis for Planning", and the model is maintained and marketed by the Minnesota IMPLAN Group, Inc.. We chose to use IMPLAN because it has several advantages for our particular purposes:

- IMPLAN is much less expensive to purchase and run than REMI/Policy Insight;
- IMPLAN has significant advantages over RIMS II for nationwide applications, in contrast to applications for smaller geographic zones;
- The IMPLAN data and relationships are updated frequently and the model represents relatively recent economic conditions. We purchased the most recent (2009) IMPLAN data set;
- The manner in which industrial sectors are grouped in IMPLAN is reasonably similar to the manner in which OSHA grouped them in the Agency's regulatory cost analysis; and
- The IMPLAN software and user interface are very easy to work with.

For our purposes, IMPLAN can estimate the impact of our estimated reductions in general industry and construction output on five primary areas of economic activity:

- **Employment**: the number of jobs potentially at risk of being lost as a consequence of compliance with the standards;
- **Labor income**: the amount of employee compensation potentially lost due to compliance with the new standards;
- **Value added**: the economic contribution by different industries that could be affected by implementing the standards;
- **Output or GDP**: the amount of output lost as affected sources close plants and/or attempt to pass the costs on to their customers; and,

- **Tax implications:** the potential loss of federal, state and local tax receipts with reduced economic activity.

For each of these five measures of economic impact, IMPLAN will calculate the total national effect of the regulation-induced loss of revenues and indicate how this effect has arisen:

- **Direct effects** include impacts on the particular industries that directly bear the regulatory compliance costs;
- **Indirect effects** include impacts on suppliers to the directly affected industries;
- **Induced effects** are the impacts resulting from reduced spending by employees of the directly and indirectly affected industries, as a result of reduced earnings by these employees; and
- **The total effect** is the sum of direct, indirect and induced effects.

Results from IMPLAN: Projected Economic Impacts From a Standard at 50 ug/m^3

IMPLAN projects that the potential new regulation will cause the following annual losses in economic activity.

Annual Economic Impacts of Potential New Standard With PEL at 50 ug/m3 (2009 $/yr in millions)

Impact Type	Employment	Labor Income	Total Value Added	Output/GDP	Federal Tax Receipts	State/Local Tax Receipts
Direct Effect	-5,841	-$341.2	-$471.7	-$1,091.3	ND	ND
Indirect Effect	-4,520	-$282.4	-$472.9	-$958.3	ND	ND
Induced Effect	-6,993	-$327.0	-$580.7	-$1,039.2	ND	ND
Total Effect	-17,354	-$950.7	-$1,525.3	-$3,088.8	-$192.4	-$128.7

The result each year if OSHA were to promulgate a new occupational exposure standard for crystalline silica with a PEL at 50 ug/m^3 and ancillary requirements would be a loss of more than 17,000 jobs and a loss in economic output/GDP of more than $3 billion. The losses shown in this table will accrue at this annual rate for every year in which compliance with the new regulation is expected and compliance costs are incurred.

Over a 10-year period, this would amount to a loss of more than 170,000 jobs and more than $30 billion of economic output.

These estimated costs and impacts do not reflect complete corrections and adjustments to OSHA's estimates across all affected industries, so the overall impacts likely would be greater than what we show here. Nor do our estimates fully reflect the difficult-to-quantify costs (which likely are quite high) for the "trial-and-error-style" upgrades to industrial facility ventilation systems that OSHA forecasts as the most common sort of engineering control general industry will need to implement. And, of course, these estimates reflect our analysis of the draft occupational exposure standard with a PEL of 50 ug/m^3 that OSHA developed for the SBREFA

process in 2003. The standard that OSHA is planning to publish later this summer may be different from the Agency's draft standard in 2003. We have not seen the new standard that OSHA will propose or the economic analyses OSHA is using to support it.

ADDENDUM

After re-estimating the costs that OSHA estimated in 2003 for compliance with a potential new regulation establishing a PEL of 50 ug/m^3 and running these costs through the IMPLAN model in order to estimate economic impacts, we became aware that we and PricewaterhouseCoopers may have misinterpreted two poorly documented and unclear sections of OSHA's cost analysis. The issues involve:

1. Whether OSHA's contractor annualized the costs for initial medical examinations (one of the ancillary requirements for both General Industry and Construction) over ten years or instead simply summed all such costs that will accrue over ten years; and

2. What hourly wage rates the contractor assumed in estimating the value to employers of the work time that employees will lose due to compliance with general industry ancillary requirements (e.g., for training, showering, medical exams), and whether these wage rate estimates included benefits.

In developing the cost and economic impact estimates presented in this paper, we made assumptions regarding these two issues that may be inappropriate. We assumed, based on Pricewaterhouse's assertion, that OSHA's contractor had annualized initial medical exam costs over ten years, and we performed our calculations consistent with Pricewaterhouse's suggestion that annualizing over three years would be preferable. We also assumed, based on Pricewaterhouse's critique, that OSHA/ERG's average hourly wage rates were unrealistically low, in part because OSHA/ERG had omitted benefits from these wage rates. We increased ERG's estimated average wage rates by 30% to account for omission of benefits and other problems. We now realize that parts or all of these two sets of assumptions about how OSHA developed their cost estimates may be incorrect – although, as explained in APPENDIX 5, we still believe the wage rate used by OSHA/ERG was too low for other reasons and should be increased by 30%.

The following are the approximate impacts if we had not made any adjustments of the OSHA/ERG cost estimates on these two issues:

- Our 30% increase in the average wage rate assumed for worker time losses contributes $4.5 million/year to the costs we estimate for General Industry ancillary requirements;

- The 3-year annualization procedure that we apply for costs of initial medical examinations contributes about $0.5 million/year to the costs we estimate for General Industry ancillary requirements and $60 million/year to the costs we estimate for Construction Industry ancillary requirements.

In total, if we were to abandon the changes to OSHA's compliance cost estimates that result from these assumptions, we would reduce our estimated cost for the potential new regulation by $65 million per year (in year 2000$), a reduction of 1.5% in our cost estimate totaling $4.38 billion per year for the reduced PEL and ancillary requirements. This 1.5% reduction in projected compliance costs would result in a similar 1.5% reduction in projected economic impacts. These changes are small relative to the costs and impacts that we have estimated in this

paper. We would continue to estimate job losses and a reduction in GDP due to the regulation at approximately 17,000 jobs lost and $3 billion in lost economic output for each year in which compliance with the potential new regulation is required.

APPENDIX I:

Number of Workers in Each At-Risk Job Category at the Average Facility in Each General Industry

Industry	Occupation	Number of Workers in Each At-Risk Job Category at the Average Facility	OSHA's Assumption: # Workers Protected per Control*	OSHA's Assumption: Too High or Too Low?
Captive Foundries	Abrasive blasting operator	2	2	=
Captive Foundries	Cleaning/finishing operator	5	4	L
Captive Foundries	Coremaker	5	1	L
Captive Foundries	Furnace operator	2	4	H
Captive Foundries	Housekeeping worker	NA	NA	NA
Captive Foundries	Knockout operator	1	4	H
Captive Foundries	Maintenance operator	1	8	H
Captive Foundries	Material handler	2	NA	NA
Captive Foundries	Molder	5	4	L
Captive Foundries	Pouring operator	2	4	H
Captive Foundries	Sand mixer (muller) operator	1	4	H
Captive Foundries	Shakeout operator	1	4	H
Concrete products	Finishing operator	3	4	H
Concrete products	Forming line operator	3	NA	NA
Concrete products	Material handler	5	5	=
Concrete products	Mixer operator	1	4	H
Concrete products	Packaging operator	1	4	H
Costume jewelry	Jewelry workers	2	2	=
Cut Stone	Abrasive blasting operator	0	4	H
Cut Stone	Fabricator	1	5	H
Cut Stone	Machine operator	2	4	H
Cut Stone	Sawyer	2	8	H
Cut Stone	Splitter/chopper	0	8	H
Dental laboratories	Dental technician	5	2	L
Fine jewelry	Jewelry workers	5	2	L
Flat glass	Batch operator	4	4	=
Flat glass	Material handler	1	4	H
Iron Foundries	Abrasive blasting operator	4	4	=
Iron Foundries	Cleaning/finishing operator	8	4	L
Iron Foundries	Coremaker	5	1	L
Iron Foundries	Furnace operator	2	4	H
Iron Foundries	Housekeeping worker	NA	NA	NA
Iron Foundries	Knockout operator	1	4	H
Iron Foundries	Maintenance operator	1	8	H
Iron Foundries	Material handler	3	NA	NA
Iron Foundries	Molder	8	4	L
Iron Foundries	Pouring operator	2	4	H
Iron Foundries	Sand mixer (muller) operator	1	4	H
Iron Foundries	Shakeout operator	1	4	H
Mineral wool	Batch operator	3	4	H
Mineral wool	Material handler	1	4	H
Non-Sand Casting Foundries	Abrasive blasting operator	2	2	=
Non-Sand Casting Foundries	Cleaning/finishing operator	5	4	L
Non-Sand Casting Foundries	Coremaker	5	1	L
Non-Sand Casting Foundries	Furnace operator	1	4	H
Non-Sand Casting Foundries	Housekeeping worker	NA	NA	NA
Non-Sand Casting Foundries	Knockout operator	0	4	H
Non-Sand Casting Foundries	Maintenance operator	1	8	H
Non-Sand Casting Foundries	Material handler	2	NA	NA
Non-Sand Casting Foundries	Molder	5	4	L
Non-Sand Casting Foundries	Pouring operator	2	4	H
Non-Sand Casting Foundries	Sand mixer (muller) operator	0	4	H
Non-Sand Casting Foundries	Shakeout operator	0	4	H

Number of Workers in Each At-Risk Job Category at the Average Facility in Each General Industry (continued)

Industry	Occupation	Number of Workers in Each At-Risk Job Category at the Average Facility	OSHA's Assumption: # Workers Protected per Control*	OSHA's Assumption: Too High or Too Low?
Nonferrous Sand Casting Foundries	Abrasive blasting operator	2	2	=
Nonferrous Sand Casting Foundries	Cleaning/finishing operator	4	4	=
Nonferrous Sand Casting Foundries	Coremaker	4	1	L
Nonferrous Sand Casting Foundries	Furnace operator	1	4	H
Nonferrous Sand Casting Foundries	Housekeeping worker	NA	NA	NA
Nonferrous Sand Casting Foundries	Knockout operator	0	4	H
Nonferrous Sand Casting Foundries	Maintenance operator	0	8	H
Nonferrous Sand Casting Foundries	Material handler	1	NA	NA
Nonferrous Sand Casting Foundries	Molder	4	4	=
Nonferrous Sand Casting Foundries	Pouring operator	1	4	H
Nonferrous Sand Casting Foundries	Sand mixer (muller) operator	0	4	H
Nonferrous Sand Casting Foundries	Shakeout operator	0	4	H
Other Ferrous Sand Casting Foundries	Abrasive blasting operator	3	2	L
Other Ferrous Sand Casting Foundries	Cleaning/finishing operator	5	4	L
Other Ferrous Sand Casting Foundries	Coremaker	6	1	L
Other Ferrous Sand Casting Foundries	Furnace operator	2	4	H
Other Ferrous Sand Casting Foundries	Housekeeping worker	NA	NA	NA
Other Ferrous Sand Casting Foundries	Knockout operator	1	4	H
Other Ferrous Sand Casting Foundries	Maintenance operator	1	8	H
Other Ferrous Sand Casting Foundries	Material handler	2	NA	NA
Other Ferrous Sand Casting Foundries	Molder	6	4	L
Other Ferrous Sand Casting Foundries	Pouring operator	2	4	H
Other Ferrous Sand Casting Foundries	Sand mixer (muller) operator	1	4	H
Other Ferrous Sand Casting Foundries	Shakeout operator	1	4	H
Other glass	Batch operator	3	4	H
Other glass	Material handler	1	4	H
Paint	Material handler	NA	NA	NA
Paint	Mixer operator	5	4	L
Pottery	Coatings operator	4	4	=
Pottery	Coatings preparer	1	4	H
Pottery	Finishing operator	1	4	H
Pottery	Forming line operator	9	4	L
Pottery	Material handler	2	4	H
Railroads	Ballast dumper	NA	NA	NA
Railroads	Machine operator	NA	NA	NA
Ready-mix concrete	Material handler	3	4	H
Ready-mix concrete	Mixer operator	1	4	H
Refractories	Forming line operator (pmo)	1	4	H
Refractories	Forming line operator (coatings)	1	4	H
Refractories	Forming line operator (form)	6	4	L
Refractories	Grinding operator	2	4	H
Refractories	Material handler (trader)	0	4	H
Refractories	Material handler (prod)	6	4	L
Refractories	Material handler (post pr)	3	4	H
Structural clay	Forming line operator FMO	1	4	H
Structural clay	Forming line operator (coatings)	1	4	H
Structural clay	Forming line operator (form)	7	4	L
Structural clay	Grinding operator	2	4	H
Structural clay	Material handler LO	0	4	H
Structural clay	Material handler F	7	4	L
Structural clay	Material handler PP	3	4	H

Median # of workers in the at-risk job categories at average plants:	2	OSHA too high:	29
		OSHA too low:	11

APPENDIX 2:

Major Oversights and Issues with the OSHA/ERG Cost Estimates for General Industry to Comply with a New Silica PEL as Reflected in the 2003 SBREFA Documents

This memo documents major oversights and errors of assumption in the OSHA/ERG cost documents for General Industry and proposes changes to make the cost estimates more realistic.

A. Summary of Major Oversights by OSHA/ERG: Engineering Costs for General Industry

1. OSHA's approach in the General Industry Document to implement engineering controls on a worker-by-worker basis is incorrect, and greatly underestimates likely engineering control costs at actual facilities. OSHA used only the number of workers estimated to be exposed over the PEL to determine how many engineering controls will be required industry-wide, when in fact these costs are based on the number of facilities in which they are installed, not just on the number of workers protected, as discussed below. URS has proposed new costs for engineering controls based on a facility-by-facility comparison.

2. OSHA assumes that four workers will most often be covered by one engineering control (such as LEV) and that all four of those workers will be among the employees that were found to be exposed over the PEL. Both of these assumptions are incorrect, and greatly reduced the likely real cost of engineering controls. Based on the worker data in the ERG Technical Feasibility document, many work stations requiring controls have less than four total workers available at most industry sites, especially in those industry categories where small to medium size firms predominate. Exposure data from the ERG Tech feasibility report and data from various available NIOSH sampling visits also demonstrate that most work stations contain a mix of workers with exposures both above and below the PEL. By counting only workers exposed over the target PEL, and by assuming that up to four overexposed workers will all be together to be jointly remediated with each installation of a single engineering control, OSHA greatly underestimates the number of engineering controls required industry-wide. A facility-by-facility approach demonstrates that many facilities will require multiple engineering controls, even when no one work station has a full four employees that would regularly exceed the PEL. Also OSHA did not account for the likely need to discharge LEV systems through such devices as baghouses to meet air emission requirements.

3. We should consider estimating higher costs to reflect the trial-and-error process that characterizes the installation and implementation of engineering controls involving increased ventilation in real-world industrial facilities. Changes to ventilation in one location of a facility often result in unexpected changes in air flow in other locations. The measures initially implemented by CIH and HVAC engineers often prove not to work in practice as hoped. We estimate that the multiple adjustments ultimately needed to get the entire ventilation system working as desired can increase overall engineering controls costs by as much as 25 percent beyond the costs estimated for the initial increment of additional air flow. This has become especially critical in light of the apparently very different assumptions made by ERG as to the number of workers who

would be subject to ancillary provisions for exposure monitoring, medical surveillance, training, etc. described in the Ancillary Costs section of this memo. The URS estimated cost analysis did not account for the trial and error discussed above, which could increase the URS cost estimates by 25%. For purposes of this analysis, however, URS did not make an adjustment to account for this factor.

B. Summary of Major Oversights by OSHA/ERG: Ancillary Costs

1. Ancillary cost assumptions for the 50 ug/M^3 PEL-50 ug/M^3 Action Level Option ("50-50 Option"): URS originally assumed a massive mistake had been made, because the number of exposed workers dropped so low for this Option when compared to the 100 PEL and 75 PEL Options. ERG has assumed that the new engineering controls for most of the at-risk jobs in the 50-50 Option will be 100% effective in reducing worker exposures to below 50 ug/M^3, so that workers in these jobs will not require any monitoring, medical screening, training, etc. There are only a few job classifications where ERG estimates that a portion of the workers may still be over the PEL after engineering controls are in place, and these workers total only about 4% of the affected workers for the other Options. The impact of this ERG/OSHA assumption is that many of the ancillary costs for the 50-50 Option drop about 30-fold compared to the other options, even though this Option has the lowest PEL. This is a major assumption with far reaching effects, and the basis for it is extremely tenuous, for the following reasons:

   - The low ERG cost estimates totally depend on the ERG assumption that the new engineering controls will be almost 100% effective at reducing exposures below 50 ug/M^3. This is an unrealistic assumption. The ERG report notes that many, perhaps a majority, of sites they visited already had engineering controls in place, but most were not effective in protecting the workers even down to the current 100 ug/M^3 PEL, let alone down to 50 ug/M^3. These controls were probably designed by engineers or vendors, and no doubt were deemed sufficient to at least meet the current PEL of 100 ug/M^3. This clearly did not happen, since OSHA estimates that even now, approximately 30% of the workers in at risk jobs are exposed over the 100 ug/M^3 PEL. The ERG report fails to make a convincing argument as to why their new LEV controls, to be installed at sites they have never seen, should in every case be so very much more effective than LEV controls already installed. There are occasional comments in the NIOSH site reports that suggest LEV improvements that could be made, but most often these are second-hand observations about facilities that ERG did not visit. The current ERG estimates are almost certainly overly optimistic, especially since the lower the PEL concentration, the more uncertainty is present in the engineering assumptions regarding the controls.

   - There also is the analytical uncertainty. For this option, OSHA has set the action level equal to the 50 ug/M^3 PEL. This might be a tacit admission that the silica analytical methods are incapable of consistent results either at or below the level of 50 ug/M^3. (This is a known problem and there are many papers written on this issue. This is discussed in other URS comments on the analytical procedures.) It has been documented that even for the PAT samples (performance evaluation samples developed by NIOSH under highly controlled conditions), the precision of all the methods precipitously deteriorates at levels below 60 ug per filter (about 75 ug/M^3 using current sampling protocols). Because of this problem, the initial exposure testing rounds to optimize the engineering controls will very likely show a significant number of anomalous results, where workers will exceed the 50 PEL in some trials, but not in others. Such an eventuality would dramatically increase the number of workers requiring monitoring and medical screening over ERG/OSHA estimates for the 50-50 Option.

- Finally there is a considerable amount of trial and error in optimizing engineering controls. This involves generally several rounds of initial exposure testing after engineering controls are in place. Not only were these initial monitoring costs not included in the ERG cost estimates for this option, but this testing is likely to demonstrate that many more workers will require regularly scheduled monitoring than estimated by ERG, based on reasons 1 and 2 above. In fact, it is a common and expected occurrence that some workers will exceed 50 ug/M^3, while other workers in the same job category will not. This can readily be observed in much of the exposure data in many of the original NIOSH reports, which are a major source of the data used by ERG. Except in instances of extremely high silica exposure, many job categories at the same site have had several workers with either low or not detected silica exposure, but still have a couple of workers in the same job category exposed over 50 ug/M^3. There are even a couple of examples of the same worker being both over and under the 50 ug/M^3 PEL on different sampling days.

2. In short, URS believes that the assumptions ERG and OSHA have applied to the 50-50 Option are inherently flawed, and greatly affect the cost estimates for this option in comparison to the other options. URS believes that the number of affected workers that *potentially* could exceed the 50 action level, requiring monitoring and medical screening for the 50 -50 Option, could approach the number of affected workers for the 100 – 50 Option, which has the same action level.

3. Despite the flaws URS believes are present in the OSHA/ERG cost estimates for ancillary provisions under the 50-50 Option, URS has been very conservative in revamping the OSHA/ERG approach. Thus, URS has developed an alternate estimate based on statements from ERG and OSHA in regards to costs for respirators. On page 3-87, ERG states: "For the purposes of the cost analysis and at OSHA's direction, ERG assumed that ten percent of the at-risk workers would require respirators, at least occasionally, after the implementation of engineering and work practice controls." Therefore, it appears even OSHA recognized that a much larger number of at-risk workers would have the potential to be exposed over the 50 ug/M^3 PEL/AL after engineering controls were installed. Therefore URS will use 10% of the current estimate of affected workers for the 100 PEL Option where applicable in calculating ancillary costs for the 50-50 Option. URS believes that the costs derived using this extremely conservative assumption will be unrealistically low. Nonetheless, we have used that approach for present purposes.

Many of the OSHA unit costs are low. Unit costs from the Price-Waterhouse ("PW") SBREFA report in some instances are better, and will be used where available and applicable to general industry in the URS cost estimates. In some other instances, URS is using a hybrid cost estimate, including elements of the PW report along with other considerations. Most of these are explained in the write-up below for the individual ancillary costs. Also, the long spreadsheet highlights any unit cost adjustments, and explains them. The cost estimates for several of the ancillary provisions include costs for labor in the form of worker down-time or additional time required to perform added requirements. In estimating these labor costs, ERG assumed hourly labor rates that are too low in the opinion of both PW and URS. URS has taken the ERG estimate and multiplied it times 1.3 to account for more reasonable, higher estimated labor rates.

C. Explanation of URS Revised Costs for Engineering Controls for General Industry on a Facility Basis

Due to the incomplete worker silica exposure data and incomplete facility information provided in the SBREFA documents, several work around solutions had to be found to correctly estimate engineering control costs on a facility basis rather than a worker basis. Below are a list of the assumptions and estimates used by URS to obtain a facility-by-facility cost estimate for engineering controls for each of the twelve industrial categories identified and analyzed by OSHA/ERG.

1. As much as possible, URS used data from the ERG Technical Feasibility Document, which though incomplete, provided information for twelve industrial categories. Information was provided regarding at-risk job categories, including number of employees in these job categories along with some limited silica exposure data from NIOSH reports and OSHA inspections for those workers. The exposure data was generally limited to summary form. Also provided were estimated numbers of facilities within these categories, and an estimated size range of the facilities in each category based on the number of total employees. Also useful were some of the NIOSH and ERG site visit reports available in the docket. The individual OSHA inspections were basically copies of a series of disjointed documents with no narrative, and were generally not decipherable or useful.

2. From the exposure data in the Technical Feasibility report, URS calculated a percentage of employees within each job category who exceeded a target PEL—50 and 100 ug/M^3 PEL values were used. Where data was incomplete, some additional assumptions had to be made.

3. The percentage of "at risk" workers within a job category then was used to arrive at an approximate estimate as to how many facilities within each industry category would require engineering controls at each at-risk job station. This was primarily estimated based on extrapolations from the exposure data for the Structural Clay Products Industry, which was the only industry category that provided individual worker silica exposure information for each of the five facilities sampled. The following table was derived from this process:

Exposed Worker to Facility Conversion

% of workers exposed over PEL for a given job description	Percent of total number of facilities requiring engineering controls at that job station
1-6%	10%
7-24%	25%
25-40%	50%
41-50%	75%
51-100%	100%

4. By applying the above percentages to the ERG estimate of the number of facilities within an industry category, URS was able to estimate the total number of facilities within the industry category requiring engineering controls. This provided a better estimate of the number of facilities needing to implement controls. However, unlike the OSHA/ERG estimate, this estimate lacks any adjustments for the size of the facility which is described below.

5. The OSHA/ERG engineering cost estimates, though inadequate, did – at least implicitly – take account of the size of the facilities, since they were based on the total number of overexposed workers. The URS estimate as described above assumes that all facilities are the same size (roughly equal to a small facility with less than 20 employees) and that there is only one production line, so that only one set of engineering controls is required for each work station. However, many of the NIOSH reports were of medium and larger facilities (>20<99, and >99 employees, respectively). It was noted that many of the medium sized facilities had two production lines (often in separate buildings), and one NIOSH report for a large refractory brick facility had three different production lines. Accordingly, URS estimated that engineering control costs would be twice as high for medium sized facilities, and three times as high for large facilities. Using the facility size estimates from the ERG Tech Feasibility Report, we applied those proportionate cost increases to each industrial category.

D. **Unit Cost Changes (both engineering and ancillary)**

1. LEV Capital and Operating Costs: OSHA gave a blanket capital cost for LEV of $11 per CFM (out of a potential range of $8 to $16 (based in part on Industrial Ventilation Manual, 24th edition, and interviews with vendors), regardless of the size of the LEV. This cost was said to "generally consist of ducting and other equipment costs for the immediate work station or individual location, and potentially the cost of incremental capacity and system-wide enhancements for the heating, ventilation, and air conditioning (HVAC) system for the facility." (Page 3-6, ERG cost report.) There is no discussion of the cost of emission control baghouses or HEPA filtering requirements, but later on page 3-7, ERG assumes that 80% of the LEV air will be recycled and takes a deep reduction in HVAC operating costs based on this assumption. However, baghouse and supplemental HEPA filtering should be included as additional capital costs. Instead of OSHA's $11.00 per CFM value, URS has estimated that $15 per CFM is required to accommodate the addition of a baghouse, which would be required whether the air is discharged to the outside air or recycled. This is at the higher end of the $8-$16 cost range cited by ERG.

A second stage of HEPA filtering also is required for all recycled air (80% by ERG's estimate). URS estimates that this would increase the total cost to $19 per CFM for that 80% of the LEV air that is recycled.

2. LEV Operating Costs: ERG takes large discounts in HVAC costs by assuming 80% of facilities would recycle air, but ignores additional maintenance costs for baghouses and HEPA filtration on the LEV systems. ERG assumed $1.10 per CFM (10% of the capital cost per year) for LEV maintenance. URS recommends increasing the maintenance costs to 20% of the new capital costs discussed above each year for two reasons: 1) the highly abrasive nature of the silica dust increases wear on critical parts, and 2) there are increased costs for servicing and maintaining the baghouse and HEPA filter. ERG assumed $1.89 per CFM per year as energy costs. This was an average value based primarily on electricity for operation and HVAC needs. The $1.89 figure was derived assuming the following: 1) that costs for facilities using LEV discharging to the outside would be $4.52 per CFM operating 12 hours per day, and $12.15 per CFM for 24 hour operation; 2) for the 80% of facilities that recycled, ERG assumed costs of $0.61 per CFM for 12 hours, and $1.22 per CFM for 24 hour operation. All of these costs are for electricity from some time prior to 2003. Since we lack the breakdown on number of facilities operating at 12 or 24 hours, URS proposes accepting the original $1.89 per CFM energy estimate at this time, bearing in mind that the electricity and energy costs were current for roughly the 2002 time frame.

3. Exposure assessment costs: fixed costs per site visit: URS did not use the Option 2 direct read technology as proposed by OSHA. It is not an approved industrial hygiene method, it does not directly measure silica and readings will vary by the site and the material used, so that the accuracy is questionable. For the PBZ samples, ERG assumed labor costs only for an IH technician at $75 per hour. Price-Waterhouse states that the combined labor for a site visit would be more than 14 hours, including hours for a CIH as well as an IH tech. These represent fixed costs for a visit to a facility regardless of how many tests are performed at the facility. PW appears to have assumed that the ERG labor estimate was for 1 hour per site visit, but the ERG estimate was for 1 hour of IH labor per sample, not per visit, although the ERG estimate errs in the number of workers assumed to be tested at each facility. For the fixed costs, URS assumed that an IH technician would be at a site for at least 8 hours, at an hourly rate of $75. URS assumed a more realistic hourly rate for a CIH to be $150, and assumed that the remaining six hours would be CIH time setting up the sampling and writing the report. The combined hours add up to a fixed cost per facility of $1500 per sampling visit.

Exposure assessment costs, combining per sample costs with fixed costs: We accept the other per sample test cost estimates (lab analysis and shipping costs) by ERG of $105.50. URS then used the following approach to estimate exposure monitoring costs: 1) As discussed above, URS assumed conservatively that 10% of the number of workers at risk under a 100 μg/M³ PEL would be at risk under a 50 μg/M³ PEL – based on OSHA's estimate that 10% of the at-risk workers under a 100 μg/M³ PEL would have to use respirators (see page 3-87 of the ERG cost report). 2) URS assumed that no more than four workers exposed over the 50 μg/M³ Action Level would be sampled during any individual site sampling visit. 3) URS accepted the ERG estimate that only 19.7% of workers in general industry worked at a facility that made use of outside industrial hygiene consulting services for reasons other than for complying with enforcement of regulatory health standards (page 3-48). 4) The $1500 fixed cost per visit calculated in paragraph 3 above was, divided by four sampled workers per visit to yield $375 in fixed costs per sample. Adding in the ERG per sample cost of $105.50, produces a total per sample cost of $480.50 per sampled worker. URS believes this is a very conservative estimate. We believe that far more than 10% of the affected workers will be at risk under the 50-50 Option than even the revised estimate of 10% allows. This estimate also does not include the per sample costs for the sampling of at-risk workers in a sampling plan devised by a CIH who turn out to be exposed below the 50 PEL/Action Level.

4. Medical surveillance costs are changed to follow Price-Waterhouse recommendations. This includes additional costs, and annualizing medical costs over the three-year cycle in which they occur (and repeat), not the ten-year cycle used by ERG. The number of affected workers will be adjusted upwards as described above, using 10% of the affected workers for the 100 PEL-50 AL Option as described above. (PW may have misunderstood ERG's cost calculation procedure for medical surveillance. ERG's documentation is confusing as to whether they annualized initial medical examination costs over ten years or instead simply added all initial medical examination costs that accrued over ten years. PW's recommendation to revise OSHA's cost estimate in this regard may be inappropriate. See Addendum.)

5. Training: Costs for training under the 50-50 Option will be assumed to be applicable to 10% of production workers who are in an at-risk job category under the 100-50 Option, as described above. For expediency, we will use the ERG unit cost estimates, except for the cost of lost productive labor hours, where we increased ERG's assumed hourly labor rates by 30% as described above.

6. Regulated Areas: The cost of establishing demarcated regulated areas wherever there is a risk that airborne exposures exceed or can be reasonably be expected to exceed the PEL. Price-Waterhouse indicated that for construction, they did not believe that ERG correctly accounted for exposed workers, and we believe this is the case for general industry too, but an alternative approach is needed to account for differences between construction and general industry. ERG has allocated costs for regulated areas on a per-worker basis rather than a per-facility basis, which for this control, like engineering controls, is probably incorrect. Also incorrect is the assumption by ERG that each regulated area covers 8 exposed workers. As we now know, each at-risk job category typically has less than four, let alone eight workers, and a significant number of these workers within the regulated area may not be exposed over the PEL. In addition, each production line likely has more than one area that should be designated a regulated area. However, because the ancillary costs are given by NAICS code rather than by the industrial categories from the ERG Tech Feasibility Report, and in the interest of expediency, we will retain the worker-by-worker framework with the following modifications: since only a fraction of the workers protected in a regulated area will actually exceed the PEL, and since we now know most affected work stations have fewer than 4 employees on average, we will assume that four overexposed workers, rather than eight are contained within an average sized regulated area. We will also assume that the number of affected workers is 10% of the workers affected for the 100-50 Option, rather than the ERG estimate, as explained above. We will accept ERG's annualized unit costs for a regulated area at this time.

7. Hygiene costs (protective clothing costs, lunch room, showers): These OSHA costs are based on worker exposures over the PEL. This category easily has the highest per-worker annualized unit costs. The issue is how many workers would be covered by these requirements. ERG calculated the unit costs, but did not calculate any costs for these items for the 100-50 option or the 75-40 option, assuming that all the PELs would be met for those options through engineering controls. There are costs calculated for the 50-50 Option, but these are based on the abnormally low estimate of workers assumed to be exposed over the 50 PEL, which is less than 4% of the at risk workers. As discussed above, URS will use an estimate of 10% of the affected workers for the 100 PEL Option. ERG gave two options for clothing, one for disposable clothing, and one for reusable clothing, where workers daily vacuumed off the clothes. One sub-option was where the industry provided the reusable clothing and a laundry service. It is our experience that when clothing changes and on-site cleaning are required, most industries provide a work uniform, so URS chose that Option. It was less expensive than disposable clothing, and only somewhat more expensive than requiring workers to provide their own clothing to change into (which has potential liability issues). Both Options included change rooms, showers, and lunch rooms. URS accepted ERG's unit cost estimates, except for the cost of lost productive labor hours, as discussed above.

8. Housekeeping costs: Although discussed along with ancillary costs, and spreadsheets have been generated by ERG for housekeeping costs for the 50-50, 75-40, and 100-50 options, some of the costs of housekeeping also seem to have been included in the engineering controls, along with the purchase and use of HEPA vacuums. URS has accepted the ERG unit costs at this time. Again, for the 50-50 option, URS has conservatively estimated that the number of affected workers would be 10% of the number of affected workers under the 100 PEL Option.

9. Respirator Costs: URS accepts ERG's annualized respirator unit costs. Note that OSHA estimated in the respirator section of the Agency's cost analysis (page 3-87) that 10% of at-risk workers would require respirators, at least occasionally, after employers have implemented engineering and work practice controls in an attempt to comply with the new PEL. In effect, in this section of the analysis OSHA assumes that 10% of at-risk workers will occasionally be exposed above the PEL, in contrast to OSHA's assumption elsewhere in the analysis that only 4% of at-risk workers will be exposed above the PEL. URS believes that either number is still far too low, but we will use this 10% figure in estimating costs for respirators, and also most other ancillary costs, as discussed above.

APPENDIX 3:

Summary of URS Cost Estimate for General Industry Ancillary Requirements (in year 2000 $/yr) (page 1)

		URS Cost Estimate, $/year	URS Affected Workers for 50 PEL Option	OSHA Cost Estimates, $/year	OSHA Affected Workers for 50 PEL Option
-	URS Estimated Baseline of Affected workers for 50 PEL Option (10% of at-risk workers will occasionally exceed the PEL)		9,855		3,504
Table 3-9: Exposure Assessment	Workers Needing Exposure Assessment		7,913		2,679
	No. of Samples per Year for 50-50 option		7,913		2,679
	Annualized Costs Option 1: PBZ Sampling	$ 5,802,275		$ 548,815	
	Annualized Costs Option 2: "Direct Read"	NA		NA	
Table 3-11: Medical Screening Cost	Workers Needing to be Screened		5,132		1,544
	Annualized Costs Option 1	$ 2,159,718		$ 417,914	
	Annualized Costs Option 2	NA		NA	
	Termination and retirement Option 1: Affected Workers (25% of workers needing to be screened per year)		1,283		392
	Annual Costs T & R Workers times $126.83	$ 162,718		$ 49,996	
	Termination and retirement Option 2: Affected Workers		0		289
	T & R Option 2 Annual Costs	NA		NA	
Table 3-14 Pulmonary Specialist Costs	Affected Workers PEL > 50 (Table 3-10)		98,414		98,414
	Estimated Annual Cases of Silica-Related Disease		825		825
	Annual Costs	$ 217,945		$ 217,945	
Table 3-18 Training Costs	Workers Needing Annual Training (Applies to 10% of affected workers)		9,855		2,239
	Annual Training Cost (annualized)	$ 662,686		$ 123,454	
	Workers Needing New Hire Training		2,602		590
	New Hire Training Cost (annualized)	$ 224,681		$ 44,289	
Table 3-22 Clothing and Hygiene Costs	Workers Requiring Hygiene facilities (assume 10% of affected workers over 50 PEL)		9,855		3,504
	Disposable Clothing Annualized cost	NA		NA	
	Reusable Clothing Annualized cost	$ 4,091,710		$ 1,671,081	
	Annualized Cost Change Room	$ 2,752,165		$ 978,967	
	Annualized Cost Shower Facility	$ 576,095		$ 205,545	
	Annualized cost Employee Shower (lost labor)	$ 17,644,756		$ 4,839,004	
	Annualized Cost Vacuum Clothes	$ 1,728,382		$ 614,537	
	Annualized Cost Temperature Controlled Lunchrooms	$ 1,744,992		$ 616,704	
	Annualized Cost Non-temperature Controlled Lunchrooms	NA		NA	

Summary of URS Cost Estimate for General Industry Ancillary Requirements (in year 2000 $/yr) (page 2)

		URS Cost Estimate, $/year	URS Affected Workers for 50 PEL Option	OSHA Cost Estimates, $/year	OSHA Affected Workers for 50 PEL Option
3-25 Housekeeping Costs	Annualized Housekeeping Cost Applies to 10% of all affected workers (column E)	$ 887,963		$ 413,958	
3-28 Regulated area Costs	Regulated Areas Annualized Cost	$ 1,666,987		$ 255,789	
3-29 Respirator Costs	Workers Using Respirators (a) PEL <50 (Applies to 10% of affected workers)		9,855		9,417
	Annualized Cost PEL <50	$ 4,615,159		$ 4,409,437	
3-1 Paperwork Costs	Exposure Assessment Option 1 (workers needing assessment (Column F) times $11.30	$ 89,419		$ 30,253	
	Exposure Assessment Option 2	NA		NA	
	Health Screening Option 1 Workers need log to be screened (Column F) times $19.88	$ 102,029		$ 31,244	
	Health Screening Option 2	NA		NA	

URS Revised Total Ancillary Costs for Proposed Draft Silica Rule, 50 PEL-50 Action Level Option	$	43,127,629		
ERG Estimated Total Ancillary Costs			$	15,427,941

Note: The above URS estimate for ancillary requirement costs assumes that only 10% of at-risk workers will remain occasionally exposed above the PEL/Action Level of 50 after compliance efforts by employers, and that these workers will require exposure monitoring, medical screening, training, and other ancillary costs for the OSHA 50 PEL Option. URS believes that ERG radically overestimated the effectiveness of engineering controls to meet the new, much lower 50 PEL, given the observed difficulty encountered even meeting the current PEL of 100 ug/M3. This is further complicated by the lack of precision of the tests used to measure silica exposure, especially at lower levels. URS believes this revised cost estimate is very conservative, and that the likely number of affected workers requiring ancillary controls will be much greater, which will result in much higher compliance costs than shown in this table.

APPENDIX 4:

Impact of Regulatory Compliance Costs on Post-Equilibrium Industry Revenues, as a Function of Elasticities

Regulatory Compliance Costs as % of Pre-Regulation Industry Revenues	Elasticity of Supply	Elasticity of Demand	Industry Revenue Loss (after Market Adjustments) as % of Compliance Cost
1%	1	-0.5	-34%
5%	1	-0.5	-34%
10%	1	-0.5	-36%
1%	1	-1.0	0%
5%	1	-1.0	0%
10%	1	-1.0	0%
1%	1	-1.5	20%
5%	1	-1.5	20%
10%	1	-1.5	21%
20%	1	-1.5	22%
1%	0.5	-1.5	13%
5%	0.5	-1.5	13%
10%	0.5	-1.5	13%
1%	1	-2.0	33%
5%	1	-2.0	34%
10%	1	-2.0	35%
1%	1	-3.0	50%
5%	1	-3.0	51%
10%	1	-3.0	51%
1%	1	-4.0	60%
5%	1	-4.0	61%
10%	1	-4.0	61%
1%	1	-5.0	67%
5%	1	-5.0	67%
10%	1	-5.0	68%
1%	1	-10.0	82%
5%	1	-10.0	82%
10%	1	-10.0	83%

APPENDIX 5:

Addendum Discussion on Labor Rates for Silica "Ancillary Costs" Based on Pricewaterhouse "Reform OSHA Coalition" SBREFA Comments

Based on a re-reading of the documents, it now appears to us that ERG believed that benefits are included in the relatively low labor rates they used to calculate the costs of lost labor time in complying with various ancillary requirements. However, we could not find any documentation that clearly says what their wage rate assumptions were and what they actually included. Nevertheless, we still believe it is appropriate to increase the labor rates used by ERG by a factor of 1.3 based on the findings in the PricewaterhouseCoopers (PW) report and our review, as explained below. Indeed, it is entirely likely that the factor should have been in a range of 1.4 to 1.5, as ERG appears to have utilized labor rates that were way too low.

The PW discussion of labor rates for construction appears on pages 13-14 of the Reform OSHA Coalition Comments, and it was primarily this discussion that led us to increase the labor rates. One problem PW pointed out is that there are two labor rates used by ERG: one from RS Means for labor costs associated with engineering controls, and a significantly lower labor rate from the BLS Occupational Employment Survey, 2000, used for the ancillary costs (see item #2 at the bottom of page 13 of the "Reform OSHA Coalition" comments). The PW bottom line on wages is that they needed to be adjusted upwards significantly from the BLS values. According to PW, at minimum the labor costs should be 43% higher based on 2003 RS means labor dollars. We decided as a team not to adjust for three years (2000 to 2003) of inflation in our estimates because these would be factored in later in the economic analysis. We misinterpreted the approximately +43% difference in cost between the BLS 2000 estimate and the 2003 RS Means estimate (percentages shown on the fourth line in Table 1 on page 14 of the PW report) as being partly due to inflation, and mistakenly ascribed the rest as due to the inclusion of basic benefits that were not included in the BLS estimate. We therefore chose to increase the labor cost by a 1.3 factor rather than the full 1.4 factor in the PW report because we did not wish to include adjustments for inflation that formed a part of this increase. It appears that PW simply felt the labor estimates used by ERG were too low for the reasons they stated, rather than due to the lack of benefits. Nevertheless, we believe the 1.3 factor, or 30%, is very close to the PW labor rates estimates without inflation, and is still a valid estimate of what actual labor rates were at the time.

It also should be noted that PW thought that the +43% was a minimum adjustment, and that a "fully loaded adjustment" based on 2003 RS Means would be approximately +120% (bottom line of Table 1 on page 14 of the PW report). However, this "fully loaded" estimate includes a profit markup assigned to the worker labor as if it had been contracted out to a customer. Since general industries mostly make their money on sales of a product and not on the sale of labor, we did not use this much higher value. Therefore, we believe the labor estimates that we used are justified and maybe should have been even higher.

Finally, the cost difference we are talking about between the labor rate used by ERG and our 1.3 factor labor rate is extremely small in comparison to the total costs of a 50 $\mu g/m^3$ standard. There are only a few significant areas where this enhanced labor rate was used. Total worker labor lost after the 1.3 factor is added in accounts for approximately 20% of the medical screening costs, 77% of the annual training, 60% of the training of new workers, and 95% of the costs for showering, clothing vacuuming, and housekeeping. The total cost attributable to this labor increase is only about $4.5 million dollars out of total annualized ancillary provision costs of $43.1 million and total overall annualized costs for a 50 $\mu g/m^3$ standard of $4.38 billion (in year 2000$). That amounts to approximately 10% of the ancillary costs and approximately 0.1% of the total estimated annualized costs for a 50 $\mu g/m^3$ standard.