Costs to the Metalcasting Industry of Potential "Ancillary Requirements" That May Be Included in a New Occupational Exposure Standard for Crystalline Silica

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Executive Summary

This report for the American Foundry Society (AFS) estimates the costs to the metalcasting industry of potential "ancillary requirements" that are likely to be included in a new occupational exposure standard for crystalline silica that that the Occupational Safety and Health Administration (OSHA) is developing. The current Permissible Exposure Limit (PEL) for worker exposure to respirable crystalline silica is essentially 100 ug/m^3 on an 8-hour time-weighted average basis. OSHA is developing a new regulation applicable to employers in the General Industry, Construction and Maritime sectors of the U.S. economy that we believe would cut this limit in half, to 50 ug/m^3. The potential regulation also likely will include an Action Level in addition to the new PEL, plus 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 workers for silica-related illnesses; must identify work zones where silica exposures may exceed the PEL, mark these zones and limit access to them; must provide training regarding silica hazards; and more.

OSHA has been working on new regulations to revise the standard for worker exposure to crystalline silica for more than a decade. Industry has interacted extensively with OSHA and others potentially involved in the rulemaking process (e.g., Congress, the Office of Management and Budget) in an attempt to obtain a regulation that ensures effective protection of workers' health while avoiding high compliance costs and avoiding any reduction in the competitiveness of affected U.S. producers. The metalcasting (foundry) industry is the particular industrial sector that appears likely to be most affected by a new silica regulation, with compliance costs for this industry estimated as more than $1.5 billion/year if the regulation establishes a new PEL at 50 ug/m^3 and a full set of ancillary requirements.

Much of industry's advocacy regarding the potential new silica regulation has focused on the issue with the most significant cost implications -- the level at which OSHA chooses to establish the PEL will determine the engineering controls that will be needed and the perhaps very substantial costs that will must be incurred in order to reduce workers' exposures to below whatever PEL is chosen. Recently, though, it has become apparent that there may also be some choices to be made in the new regulation regarding the Action Level and ancillary requirements as well as the PEL, and that the choices regarding Action Level and ancillary requirements may also have significant cost implications. Whereas the costs for industry to implement engineering controls depend exclusively on the PEL that is chosen, the costs to comply with ancillary requirements depend on the choice of both the Action Level and the PEL. Two recent developments have prompted industry to become increasingly concerned with the Action Level and the ancillary requirements as well as the PEL

OSHA has not since 2008 publicly released any materials that reveal the details of the new silica regulation the Agency has been developing. However, most observers in industry believe that OSHA is now continuing to prepare a regulation that would reduce the PEL to 50 ug/m^3 and establish nine sets of ancillary requirements addressing:

- Exposure assessment;
- Health screening and surveillance;
- Clothing and hygiene facilities;

- Regulated areas;
- Housekeeping;
- Respiratory protection;
- Hazard communication and training;
- Record keeping; and
- Designation of a silica competent person.

In a departure from OSHA's usual practice where the Agency typically establishes the Action Level for any toxic substance to be regulated at a level equal to one-half of the PEL for that substance, OSHA has signaled that the new silica regulation will probably establish the Action Level for this substance at the same 50 ug/m^3 level as the new PEL. This is because, as OSHA stated explicitly in 2003, the Agency has not believed that reliable methods exist for sampling and analysis that can accurately quantify airborne concentrations of crystalline silica much below 50 ug/m^3, and thus the Action Level cannot reasonably be established at a level lower than the potential new PEL at 50 ug/m^3.

In the past year-and-a-half, though, two developments have occurred that involve potential alternatives to OSHA's apparently preferred regulation establishing the PEL and the Action Level both at 50 ug/m^3:

- Some industries, not including the metalcasting industry, have suggested a possible compromise between the existing silica standard and OSHA's preferred new regulation. In this potential compromise, the PEL would be retained at the current level of 100 ug/m^3 but the worker health protection offered by the current PEL would be buttressed by adopting an Action Level at 50 ug/m^3 and a full set of ancillary requirements supporting the PEL and Action Level. (The current silica standard includes a PEL but no Action Level, and only a limited set of ancillary requirements.)

- OSHA has indicated that the Agency has become more confident in new analytical methods for crystalline silica, and the Agency appears now to believe that accurate quantification may be possible at levels near 25 ug/m^3. OSHA thus may now be considering an Action Level at 25 ug/m^3 instead of 50 ug/m^3 to accompany the Agency's apparently preferred potential new PEL at 50 ug/m^3.

In order to better understand the implications of OSHA's potential new regulation and alternatives to it, AFS has requested a study estimating the costs to the metalcasting industry of complying with the likely new ancillary requirements for silica under several possible combinations of PEL and Action Level. Specifically, in this study we estimate the costs to the foundry industry of complying with a full set of ancillary requirements under each of three alternative potential combinations of PEL and Action Level, for:

1. A PEL of 100 ug/m^3 and an Action Level of 50 ug/m^3. This is the "compromise" alternative that some industries have suggested.

2. A PEL of 50 ug/m^3 and an Action Level also at 50 ug/m^3. This is the alternative that OSHA has appeared to prefer for nearly a decade, and this may also be what the Agency is proposing currently.

3. A PEL of 50 ug/m^3 and an Action Level at one-half of that, at 25 ug/m^3. Given OSHA's views about improved methods for sampling and analyzing for crystalline silica at low airborne concentrations, the Agency may now be considering this alternative also.

Estimated costs for the foundry industry to comply with OSHA's likely ancillary requirements

We estimate the costs for the U.S. metalcasting industry to comply with OSHA's nine probable sets of ancillary requirements as about $350 million to nearly $500 million per year, depending on the particular PEL and Action Levels that are chosen.

Costs for Metalcasting Industry to Comply With Likely Ancillary Requirements ($/year)

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Exposure Assessment	$ 12,319,397	$ 11,384,054	$ 18,137,744
Health Screening & Surveillance	$ 13,171,043	$ 8,818,556	$ 28,710,552
Clothing & Hygiene Facilities	$ 69,232,475	$ 126,781,556	$ 126,781,556
Regulated Areas	$ 10,824,066	$ 13,776,084	$ 13,776,084
Housekeeping	$ 230,172,653	$ 203,950,452	$ 276,789,899
Respiratory Protection	$ 8,086,772	$ 20,584,511	$ 20,584,511
Hazard Communication & Training	$ 4,755,229	$ 3,723,820	$ 8,125,002
Record Keeping	$ 619,025	$ 804,177	$ 1,445,603
Competent Person	$ 3,134,483	$ 3,134,483	$ 3,134,483
Total: All Ancillary Requirements	**$ 352,315,144**	**$ 392,957,693**	**$ 497,485,436**
(Total for All Ancillary Requirements Except Housekeeping)	$ 122,142,491	$ 189,007,240	$ 220,695,536

These costs for compliance with the potential silica ancillary requirements are very high, averaging about $175,000 per foundry per year for the least costly of the three PEL/Action Level alternatives and nearly $250,000 per foundry per year for the most costly alternative. These costs amount to 1 to 2% of total U.S. foundry industry revenues as of 2007, the most recent year for which a nationwide estimate of revenues for this industry is available from the U.S. Economic Census. Both the specific ancillary requirements that are to be included in the regulation and the levels at which the PEL and Action Level are to be established (and thus the silica concentration levels at which an employer incurs duties under the ancillary requirements) are clearly issues that should be of substantial concern to the industry.

The costs for the industry to comply with the potential ancillary requirements are quite high without regard to which of the three combinations of PEL and Action Level are selected. Nevertheless, standards differing from the 50 ug/m^3 PEL and 50 ug/m^3 Action Level that OSHA has long supported would either save or cost the metalcasting industry a substantial amount. Relative to the 50/50 regulatory option, retaining the current PEL but adopting an Action Level at 50 ug/m^3 and ancillary requirements would save about $40 million per year, or 10%. Or, again relative to the 50/50 option, further reducing the Action Level to 25 ug/m^3 would cost

more than $100 million more per year, an additional 25%.

By far the most costly of the potential ancillary requirements is that for housekeeping. As a housekeeping requirement, OSHA has suggested that the Agency may require all foundries with employees exposed at silica concentrations exceeding the Action Level to undergo thorough cleanings twice per year for as long as employees remain exposed above the Action Level. These cleanings are to involve removal of accumulations of sand from all locations in the foundry, including floors, rafters, other horizontal surfaces, etc., by use of supervacs, power washers, and cherry pickers (to reach rafters, platforms, overhead rails, towers, etc.). By our estimation, somewhat more than half of the cost for these twice-yearly cleanings will result from the need to cease foundry operations for a week each time a cleaning occurs. Most foundries temporarily suspend operations once per year for scheduled maintenance for a week or so; one of OSHA's required cleanings could occur during this scheduled shut-down. However, for most foundries, OSHA's second cleaning would require an unwanted cessation of operations, during which time the foundry would lose about a week's worth of operating profits and contribution toward overhead.

Given the very high costs that we estimate for OSHA's proposed twice-yearly intensive cleanings and the questionable and likely short-lived benefits from such cleanings, we suspect that OSHA may not include this requirement in the eventual new silica regulation.

But even if OSHA were to eliminate the intensive cleaning housekeeping requirement, the eight other remaining sets of ancillary requirements would still cost foundries about $120 million to $220 million per year. Costs for clothing and hygiene facilities will constitute more than half of these remaining costs. OSHA's potential requirements for hygiene facilities will entail significant capital costs for change rooms, showers and lunch rooms for many foundries. In addition, all foundries with employees exposed at levels exceeding the Action Level will need to provide HEPA vacuums that employees must use to clean their clothes whenever they go from an area of the plant where silica concentrations are high to a relatively clean area (e.g., before entering a lunch room or change room, and also break rooms, laboratories, administrative offices, supply rooms, etc.). HEPA vacuums will be needed at the entrances to all these clean locations, including multiple vacuums at many entryways, so that multiple employees arriving simultaneously at an entrance to a clean area (e.g., at the lunch room when the foundry's lunch break begins) can vacuum their clothes without a line forming and delays occurring.

Some discussion about each of the remaining seven likely sets of ancillary requirements is provided in the body of this report.

OSHA has estimated much lower costs for nearly all of the ancillary requirements than we estimate. We suggest that AFS make some effort to persuade OSHA about the unrealistically low nature of the Agency's cost estimates.

One major reason why our cost estimates are sharply different from OSHA's is that OSHA has inappropriately chosen to estimate costs on a "per affected employee" basis. OSHA begins by estimating the costs to meet an ancillary requirement for a single employee (e.g., the per-employee cost to provide a clean, fully enclosed, negative pressure lunch room) and then estimates total costs for the industry to meet the requirement by multiplying this per employee

cost by the number of employees throughout the industry who are exposed to silica concentrations exceeding the PEL or the Action Level (i.e., by the number of "affected" employees). OSHA's approach fails to recognize that the ancillary requirement compels the employer to take the required action if as few as one employee at the facility is exposed at a concentration exceeding the trigger level. In the case of OSHA's potential hygiene area/lunch room requirement, for example, if a foundry has as few as one worker exposed at a silica concentration exceeding the PEL and that employee is going to use a lunch room, then the foundry will need to provide a clean, fully enclosed, negative pressure lunch room sufficient to serve *all* the foundry employees in whatever number and at whatever schedule they typically take lunch. The foundry is very unlikely to provide a lunch room, as OSHA's cost analysis approach supposes, sufficient to serve only the single over-exposed employee. In our "per affected foundry" cost analysis approach, in contrast, we start the analysis by estimating the number of foundries that will need to do something to meet an ancillary requirement (e.g., construct a new, sufficiently sized, clean, negative pressure lunch room or upgrade an existing lunch room), and then multiply the number of foundries that will need to take the action by the cost per foundry to do it.

We also disagree with OSHA about appropriate data or assumptions for many of the hundreds of elements that serve as building blocks in estimating the costs to the industry of the ancillary requirements. These include disagreements about unit costs; about the time required or number of foundry employees required to perform ancillary requirement tasks; about the frequency with which required tasks will need to be performed; and even about what specific tasks need to be performed to meet an ancillary requirement. We estimate the costs to the metalcasting industry of OSHA's potential ancillary requirements in a series of twenty-two linked and highly detailed Microsoft Excel worksheets. An initial set of worksheets itemizes each of the data elements and assumptions that we use in our cost analysis, and cites a source for each data element and rationale for each assumption. Another set of worksheets then shows how we assemble the data elements and assumptions and estimate costs for each ancillary requirement. A final pair of worksheets summarizes the cost estimates. The worksheets are linked such that a user may alter one of the data elements or assumptions in the early worksheets, and the resulting changes to the cost estimates for the industry are then shown automatically in the final two worksheets. This makes it easy for the user to assess the impact of alternative assumptions or to perform sensitivity analysis. The full series of worksheets and this report constitute the two products from our analysis.

I. Introduction and Background

This report estimates the costs to the metalcasting (foundry) industry of potential "ancillary requirements" that are likely to be included in new regulations that the Occupational Safety and Health Administration (OSHA) is developing 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 is developing a regulation that we believe would cut this limit in half, to 50 ug/m^3. The potential regulation also likely will include an Action Level in addition to the new PEL, plus 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 workers for silica-related illnesses; must identify work zones where silica exposures may exceed the PEL, mark these zones and limit access to them; must provide training regarding silica hazards; and more.

OSHA has been developing and considering proposals to reduce the occupational exposure limit for crystalline silica for more than a decade:

- In 2003, OSHA developed a set of alternative draft regulations that would have established the PEL at 50 ug/m^3, at 75 ug/m^3, or would have retained the current PEL at 100 ug/m^3, with each regulation including a full set of ancillary requirements. At that time, OSHA completed the procedural and analytical requirements under the Regulatory Flexibility Act (RFA) and Small Business Regulatory Enforcement and Fairness Act (SBREFA) for any such regulation that may have a "significant impact on a substantial number of small entities", including consultation with small businesses (including foundries) and extensive studies estimating the costs, benefits and economic impacts of the alternative potential regulations.

- In 2008, OSHA revised and updated the cost and technological feasibility analyses for the potential regulations, bringing the total set of analytical materials on feasibility issues to more than a thousand pages, with several hundred pages specific to the foundry industry.

- In 2010 and 2011, OSHA completed interagency and peer review on new versions of the risk and economic analyses supporting the potential regulations.

- In February of 2011, OSHA submitted a complete regulatory package (draft regulation and preamble plus all required supporting analyses) to the Office of Management and Budget (OMB), seeking OMB clearance to publish in the Federal Register a proposed new worker exposure standard for crystalline silica. OMB evidently had some concerns with OSHA's proposal. Although the proposed regulation is formally still undergoing OMB review, we understand that it has been sent back to OSHA to be re-worked in some manner. There is speculation to the effect that the Obama administration, if it is returned to office, intends to start review on a revised regulatory package within several months after the upcoming November election, with publication of a proposed new regulation sometime in 2013.

Only the older of these materials relating to the potential new silica regulations have been available to the public and industry for review. In general, the 2003 and 2008 materials have been publicly available, while the materials since 2010 have remained confidential. Nevertheless, though industry has not seen the current draft proposed regulation and is not certain of its contents, OSHA's current proposal is widely expected to reduce the existing PEL for crystalline silica from 100 ug/m^3 to 50 ug/m^3. We believe that OSHA since 2003 has preferred a PEL of 50 ug/m^3 as striking what the Agency believes to be an appropriate balance between: 1) risk information suggesting significant health benefits for an even tighter standard; but 2) technological/economic feasibility and measurement concerns that would intensify if the standard were reduced below 50 ug/m^3.

Based on OSHA's 2003/2008 silica materials and the parallel sets of administrative requirements that the Agency has adopted for other sorts of airborne toxic substances in general industry (e.g., for hexavalent chromium and for lead), we expect that OSHA's potential new regulation for crystalline silica will require much more than compliance with a tighter PEL. Additionally, the regulation will require employers to implement numerous administrative measures that will complement engineering controls in protecting workers from silica health hazards. These "ancillary requirements" will likely include requirements for employers to provide:

- Exposure assessment,
- Health screening and surveillance,
- Protective clothing and hygiene facilities (change area, showers, clean lunch room),
- Regulated areas,
- Housekeeping,
- Respiratory protection,
- Hazard communication and training,
- Record-keeping, and perhaps
- Designation of a "competent person" to oversee silica compliance activities.

If OSHA eventually promulgates new silica regulations with a PEL 50 ug/m^3 and a full set of ancillary program requirements, the metalcasting industry will face estimated compliance costs exceeding $1.5 billion per year, making it the most heavily impacted industry sector among all those affected by the rule.

The metalcasting industry and AFS have pursued advocacy efforts for many years against such a regulation, with much of these efforts being conducted in coordination with other industries through the American Chemistry Council's Crystalline Silica Panel. To inform and support this advocacy, Environomics and other consultants have prepared for the Panel several analyses addressing health risks, costs, technological feasibility, economic impacts (e.g., job losses) and measurability issues associated with the potential new silica rule. These analyses have focused most intensively on the element of the potential regulation that is expected to impose the highest compliance costs -- the requirement for employers to implement all feasible engineering controls as necessary to keep their workers' exposures from exceeding various alternative potential PELs. Recently, though, additional issues have arisen that highlight the lesser, but still very significant, burdens posed by the combination of ancillary requirements and an Action Level, in contrast to the requirement to comply with the PEL by implementation of all feasible engineering controls:

- Some industries have considered proposing to OSHA a possible compromise where the PEL would be retained at 100 ug/m^3 but the worker health protection offered by the current PEL would be buttressed by adopting an Action Level at 50 ug/m^3 and a full set of ancillary requirements supporting the PEL and Action Level. This raises the question of what sorts of costs and benefits would result from adding ancillary requirements and an Action Level, without any change to the PEL.

- In the 2003 regulatory package, OSHA appeared to be supporting an alternative where the PEL would be set at 50 ug/m^3 and the Action Level (exceedance of which triggers many of the ancillary requirements) would likewise be set at 50 ug/m^3. This approach of setting the Action Level equal to the PEL was unusual: for most other toxic substances that are the object of a worker exposure standard, the Action Level has traditionally been set at one-half of the PEL. For crystalline silica, though, OSHA believed in 2003 that no reliable methods for sampling and analysis existed that could accurately quantify airborne concentrations down to near 25 ug/m^3 (one-half of the potential PEL at 50 ug/m^3), and thus that an Action Level at this low level could not feasibly be implemented. In recent years, though, OSHA appears to have become more confident in new analytical methods for crystalline silica, and the Agency appears now to believe that accurate quantification may be possible at levels near 25 ug/m^3. OSHA thus may now be considering an Action Level at 25 ug/m^3 instead of 50 ug/m^3 to accompany the Agency's apparently preferred potential new PEL at 50 ug/m^3. This possibility again raises the question involving ancillary requirements as to how costs and benefits may be affected by the choice among alternative Action Levels while the PEL remains unchanged.

These sorts of issues have prompted AFS to request this study in which we estimate the costs of OSHA's probable ancillary requirements as a function of various combinations of PEL and Action Level. Specifically, in this study we estimate the costs to the U.S. metalcasting industry of complying with OSHA's likely set of ancillary requirements for crystalline silica under three alternative scenarios:

1. A PEL of 100 ug/m^3 and an Action Level of 50 ug/m^3. This is the "compromise" that some industries have suggested proposing to OSHA: retain the current PEL, but enhance the protectiveness of the standard by adding a full set of ancillary requirements and an Action Level at the traditional level equal to one-half of the PEL.

2. A PEL of 50 ug/m^3 and an Action Level also at 50 ug/m^3. This is the alternative that OSHA appeared to prefer in 2003, and may also be what the Agency is proposing currently.

3. A PEL of 50 ug/m^3 and an Action Level at one-half of that, at 25 ug/m^3. Alternatively, given OSHA's views about the improved feasibility of accurately sampling and analyzing for crystalline silica at low airborne concentrations, the Agency may now be proposing a standard where the PEL is reduced to 50 ug/m^3 and the Action Level is set consistent with tradition at one-half of this level.

II. The Set of Ancillary Requirements that We Analyze

OSHA has not released a draft of the current proposed silica regulation nor any other materials that definitively list the specific ancillary requirements that the Agency would like to mandate. Nevertheless, we are reasonably certain about most of the particular requirements that OSHA now wants to adopt. In 2003, OSHA provided substantial detail on the set of ancillary requirements that the Agency preferred at that time. The 2003 set of ancillary requirements was to be the same for each of the three alternative levels at which OSHA considered setting the PEL (100, 75 or 50 ug/m^3), and the suggested set of ancillary requirements for silica very closely matched the existing sets of requirements that OSHA has established for hexavalent chromium and for lead, the two airborne toxic substances that pose occupational exposure risks perhaps most similar to those posed by crystalline silica. For a few of the potential ancillary requirements, OSHA indicated in 2003 that the agency was considering specific alternatives (e.g., OSHA proposed to require continuing periodic medical screening including X-rays for workers exposed above the Action Level for 30 days per year or more, but indicated that the required frequency for the X-rays could be either once every three years; or alternatively at a lesser frequency that differs from worker to worker depending on the worker's cumulative silica exposure).

In recent discussions with OSHA staff about the potential new regulation for crystalline silica, we have heard nothing that suggests any change in the Agency's thinking since 2003 about what ancillary requirements might be appropriate. Thus, for this analysis, we are estimating costs for the U.S. foundry industry to comply with the specific set of ancillary requirements that OSHA included in the Agency's 2003 regulatory package. We judge that the ancillary requirements that OSHA is proposing now are very similar, if not identical, to those suggested in 2003. The set of ancillary requirements that we address in this analysis is as follows:

Employer Duties Under OSHA's Potential Ancillary Requirements for Crystalline Silica

Exposure assessment

- Initial assessment. Take one sample for the likely most exposed employee in each job category for each shift in each distinct work area where the job is performed
- Periodic monitoring. Sample 2x/yr for each job category exposed above the Action Level. 4x/yr for each job category exposed > PEL

Health screening and surveillance

For any worker placed where exposure exceeds the AL for 30 days or more/yr:

- Initial screening to include: 1) Occupational and health history survey; 2) Physical exam; 3) Chest x-ray; 4) X-ray classified by B-reader; 5) Pulmonary function test; 6) Other tests as necessary.
- Continuing screening on an annual basis to include: 1) Review/update health history; 2) Physical exam; 3) Other tests as necessary. Also, screening every 3 years to include: 1) Chest x-ray; 2) X-ray classified by B-reader

Referral to pulmonary specialist required for any employee with signs of silica-related disease. Must then notify NIOSH.

Medical removal protection may or may not be included in the regulation. (We have not estimated costs for this).

Clothing and hygiene facilities

For all employees exposed above the PEL, provide either disposable protective clothing **or**:

- Non-disposable full-body work clothes (with requirements for laundering, etc.) plus
- Change room with separate storage (lockers) for street clothes and work clothes plus
- Showers

For all employers with employees exposed above the PEL, provide:

- Lunch room with filtered air supply so as to maintain positive pressure, plus
- Vacuum with HEPA filter at entry to lunch room and change/shower room (and other clean areas?) where
- Employees must vacuum (not shake or blow) dust off clothes before entering these areas

Regulated areas

- Establish a regulated area around each operation/area where airborne silica concentration > PEL
- Mark each regulated area and limit entry to employees working in the area and authorized others
- Respirators must be used by each authorized person who enters a regulated area
- Eating, drinking and use of tobacco are prohibited in regulated areas
- Must communicate all this as needed to others who come to your facility

Housekeeping

- Many housekeeping requirements are assumed and costed as elements of feasible engineering controls. Also:
- Must clean up silica-containing material that, if disturbed, could contribute significantly to employee exposure; must use HEPA-filtered vacuum or other equally effective method; water contaminated with silica must be cleaned up before it dries if the dried residue could significantly contribute to exposure
- "OSHA estimates costs for these general housekeeping requirements by estimating the costs for a semi-annual professional cleaning of any facility where workers are exposed above the Action Level "

Respiratory protection

- Must meet requirements of OSHA's Respiratory Protection Standard, including requirements for written respiratory protection program; procedures for selecting respirators, use, cleaning, fit testing, etc.
- Respirators are required: 1) Within regulated areas; 2) When/where feasible controls are not sufficient to reduce exposures below the PEL; 3) While engineering controls and work practices are being installed, repaired, developed; and 4) When requested by an employee

Hazard communication and training

- Cross-reference to OSHA's Hazard Communication Standard (HCS). Must include crystalline silica in hazard communication program, covering labels, MSDSs and information and training
- Employees exposed > AL must be given information on operations that could result in exposures exceeding the PEL, and on principles of safe use/handling of materials containing crystalline silica

Record-keeping

- Employer must keep records of: 1) Exposure monitoring results; 2) Health screening results; 3) Respirator fit test results; 4) Training regarding crystalline silica hazards

Competent person

- Employer must designate a "competent person" (CP) at each facility who: 1) Can recognize silica-related hazards; 2) Has authority to take corrective measures, including temporary stop production, to ensure that exposures do not exceed PEL and reqts of the standard are being met; and 3) Is responsible for establishing the regulated areas.
- No specific educational or training reqts are specified for this person, but employer will be liable if CP is unqualified

Note that some of these potential ancillary requirements apply for each employee who is exposed at a level exceeding the PEL (e.g., respirators) and others apply for each employee who is exposed at a level exceeding the Action Level (e.g., hazard communication/training). Others of the potential ancillary requirements apply to any facility (foundry) that has any employees exposed at a level exceeding the PEL (e.g., lunch room with filtered air and positive pressure) and still others apply to any facility that has any employees exposed at a level exceeding the Action Level (e.g., housekeeping requirement for semi-annual professional cleaning of the facility). In order to estimate the costs to the metalcasting industry for all these potential ancillary requirements, we thus need to estimate the number of foundries that have employees exposed above the Action Level and the PEL and the number of foundry production employees exposed above the Action Level and the PEL. In general, the lower the Action Level and the lower the PEL, the more foundries and employees will be covered by an ancillary requirement and the higher the costs will be to the foundry industry. It should be apparent that the cost to the industry of any particular ancillary requirement will depend, among other things, on the particular PEL and Action Level that are established in the new standard.

III. Methodology and Data for This Analysis

We estimate the costs for the metalcasting industry to meet this set of ancillary requirements under three alternative combinations of PEL and Action Level. We estimate these costs in several steps:

- Define the sorts of "model" foundries that we will analyze. We define a model small foundry as having 25 production employees and a model large facility as having 125 production employees. Assuming these two types of model facilities, we calculate that 909 small model facilities and 1,131 large model facilities will yield exactly the total number of foundries and total number of foundry employees that AFS estimates as comprising the entire U.S. metalcasting industry.[1] We estimate the costs for a small model foundry to meet the ancillary requirements and for a large model foundry to meet the ancillary requirements, and then estimate costs for the entire industry by scaling up

[1] The fact that these calculations suggest an industry consisting of more large than small foundries is troubling. Various other sources indicate that in reality there are many more small foundries than large ones. We believe, though, that 25 and 125 production employees are reasonable numbers to choose in representing model small and large foundries, and, given AFS' estimates to the effect that there are 2,040 metalcasting facilities and 206,958 employees in the industry (for 2011, from AFS *Casting Source Directory Annual Survey*, Al Spada) and that 79% of foundry industry employees appear to be production workers (Bureau of Labor Statistics, *Occupational Employment Statistics, 2011*), our projection that the industry consists of 909 small model facilities and 1,131 large model facilities is simply a matter of mathematics. The reason why this data and mathematical calculation yields a seemingly incorrect mix of small vs. large foundries is, we suspect, because there may be some incompatibility in the various data elements used in the calculation. Perhaps the available data on the number of foundries or the number of foundry employees does not count some or all of the typically quite large captive foundries? Or, perhaps as an opposite sort of possibility, some number of small "mom and pop" foundries or some number of their employees are somehow omitted from the statistics? Or, perhaps we would obtain a more plausible representation of the entire industry if we were to assume that a small model foundry has, let's say, 10 production employees and a large model foundry has, let's say, 150 production employees. (However, assuming these different definitions for our model foundries and re-doing the mathematics, the industry would appear to consist of 1,013 small model foundries and 1,027 large model foundries – better, but still quite different from conventional wisdom.) In conclusion, we guess that there must be some incompatibility among the various statistics used in this calculation. It would not be difficult to re-do the cost calculations in this paper assuming either different sizes for the model small and large facilities and/or different national totals for the numbers of foundries and/or employees.

the estimated per-facility costs by these estimated numbers of small and large model foundries, 909 and 1,131.

- List the actions that a model foundry will need to take in meeting each of the ancillary requirements (e.g., perform initial and recurring exposure assessments);

- Estimate the frequency with which the model foundry will need to take each of the listed actions in order to meet OSHA's ancillary requirements (e.g., monitor exposure four times per year for a representative employee in each area and job category for which exposure exceeds the PEL). The frequencies with which these actions will need to be taken depend on such factors as the number of production workers at the foundry, the levels at which these workers are exposed to silica, and the particular combination of PEL and Action Level that is being analyzed;

- Estimate the unit costs involved in performing each of these actions once. Unit cost might be specified directly (e.g., cost for a visit by an industrial hygienist to conduct exposure sampling at a facility; cost for laboratory analysis of a single sample); or it might be calculated as the combination of some productivity measure (e.g., how many hours on average are required for a foundry manager to decide upon and lay out a regulated area) multiplied by an appropriate hourly cost for performing this activity (e.g., multiplied by the fully loaded hourly wage rate for the manager);

- Build a cost estimate for the entire metalcasting industry by: 1) multiplying unit costs by the frequency with which each action will need to be performed, and then 2) aggregating across actions, across facilities in the industry, and across ancillary requirements.

We develop these cost estimate in a long series of 22 linked Microsoft Excel worksheets. All the worksheets are included in a large Excel workbook file titled "Ancillary Costs -- Complete Est. Costs -- 10-18-12.xls." There are four sets of worksheets included in the workbook:

- First, there are two worksheets that provide basic data on the U.S. metalcasting industry. The first of these worksheets provides data or estimates regarding the number of U.S. foundries, total foundry employment, percentage of employees that are production workers and hence potentially exposed to crystalline silica, number of foundries running two shifts, percentage of workers currently using respirators, and so forth. The second of these worksheets provides estimates regarding worker exposures to crystalline silica: the percentages of foundries that have workers exposed above the various potential PELs and Action Levels, and the percentages of workers that are exposed above these PELs and Action Levels. These exposure estimates are particularly important in determining the frequency with which various ancillary requirement activities will need to be performed, and thus also in determining the costs of the ancillary requirements. We will discuss these exposure estimates further in several pages.

- A series of nine worksheets, one for each of OSHA's nine potential sets of ancillary requirements, showing the data and assumptions on unit costs, frequency and productivity that are needed in estimating the cost for each set of ancillary requirements. In the worksheet for the Exposure Assessment ancillary requirements, for example, we

show our data/assumptions regarding the cost per day for an industrial hygienist to visit a foundry and take exposure samples; the number of full shift employee exposure samples the hygienist can supervise in a day; the productive time lost per employee while a sampling pump is being attached and he is being instructed about the monitoring procedure; the average, fully-loaded hourly wage rate for a foundry production worker that represents the effective cost of taking him away from his work while the exposure monitoring is being set up; and many more such individual data elements and assumptions that are needed in building our cost estimates.

- Another series of nine worksheets in which the information from the previous eleven worksheets (i.e, overall industry information, exposure estimates, data and assumptions on unit costs, frequency and productivity) is combined and cost estimates are generated for each of the nine sets of potential ancillary requirements for the entire U.S. metalcasting industry. Costs are estimated in these nine worksheets for the industry for each of three combinations of PEL and Action Level: for a PEL of 100 ug/m^3 and Action Level of 50 ug/m^3; for a PEL of 50 ug/m^3 and Action Level also at 50 ug/m^3; and for a PEL of 50 ug/m^3 and Action Level of 25 ug/m^3.

- A final pair of summary worksheets in which cost estimates are shown for each of the nine sets of potential ancillary requirements and for the total. One worksheet provides detail on the individual cost components that sum to the total for an ancillary requirement, while the final worksheet shows only the grand totals for each ancillary requirement.

These twenty-two worksheets are linked, such that one can change an assumption or revise a data element in an early worksheet and then immediately see in the final, summary worksheet how the revision affects the estimated total industry costs for the ancillary requirements.[2]

We began our process of estimating the industry's costs to meet OSHA's potential ancillary

[2] The linked nature of the worksheets allows a reviewer or us to perform sensitivity analyses quite easily. One could easily, for example, revise our assumption about how successful the industry will be in reducing worker exposures below the current PEL of 100 ug/m3 if OSHA were to issue a new regulation reaffirming the current PEL, adding an Action Level at 50 ug/m3, and adding a full set of ancillary requirements. We estimate, based on AFS' August, 2011 Metalcasting Facility Crystalline Silica Survey, that 39% of foundries now have no worker exposures exceeding the current PEL, and that this percentage would increase to 45% after foundries respond to this potential new OSHA regulation with additional feasible engineering controls and work practices to reduce silica exposures. In the current set of worksheets, we estimate costs for foundries to comply with OSHA's potential ancillary requirements based on this 45% estimate; in effect, we estimate costs for all foundries to comply with the ancillary requirements while assuming that 45% of all foundries will not need to incur any costs to meet those particular ancillary requirements that are triggered by having employees exposed at levels exceeding the PEL. (Some of the potential ancillary requirements are triggered when a foundry has employees exposed above the PEL, others are triggered when a foundry has employees exposed above the Action Level, and still others [e.g., the "competent person" requirement] would require activities by all foundries without regard to the levels at which employees are exposed.) However, since all of our worksheets are linked, someone reviewing our work could easily re-estimate costs for the industry to comply with the potential ancillary requirements based instead on an assumption that more, or fewer, than 45% of foundries will be successful in eliminating worker exposures that exceed the PEL. One would simply enter the alternative assumption in the second worksheet (Silica Exposure Estimates), and this change will then transmit automatically through all the worksheets. The final two worksheets will then show the revised cost estimates for the ancillary requirements, reflecting the new assumption.

requirements by re-creating in a spreadsheet format the data, assumptions and calculation steps that OSHA used in estimating the cost of these requirements for the SBREFA process in 2003. We developed an initial set of worksheets on unit costs, frequency, productivity, etc. that: 1) listed all the individual data elements and steps that OSHA used in estimating costs for the nine potential ancillary requirements; and 2) posed questions and provided comments about the appropriateness of each element or step comprising OSHA's analysis. AFS distributed these worksheets tracing through OSHA's cost analysis to several foundry EH&S personnel and asked them to review and critique OSHA's data and methods. We assembled the resulting responses -- step-by-step detailed responses from three senior foundry EH&S managers and from one consultant, summarizing both their experience regarding ancillary requirement costs at the particular foundries they are currently working with as well as their judgments regarding the industry in general -- into the third through the twelfth worksheets included in the attached workbook. These nine worksheets show: a) the many individual data elements/steps in OSHA's 2003 cost analysis; and b) our judgments about each of these elements/steps. In the worksheets, for each element/step we show whether or not we agree with OSHA's data and approach, and, in the many instances where we disagree, we provide better data and/or a better approach, based on a combination of the comments from the four foundry EH&S experts and further research that we have conducted (e.g., in some instances we have obtained current vendor price quotes for various equipment or services that foundries will need in the course of complying with the ancillary requirements).[3]

Differing approaches in estimating costs between us and OSHA

The nine worksheets on unit costs, frequency and productivity that we developed and use in our cost analysis include hundreds of instances in which we improve upon or correct an element in OSHA's cost analysis for the ancillary requirements. Perhaps more importantly, though, these nine worksheets also reflect a fundamental difference of opinion between OSHA and us in the overall approach to use in estimating costs for the ancillary requirements.

OSHA in 2003 had estimated costs on a "per affected worker" basis. In estimating the costs, for example, for foundries to provide clean, fully enclosed, negative pressure lunch rooms (one part of the "clothing and hygiene facilities" ancillary requirements) when there are foundry workers exposed at silica levels exceeding the PEL, OSHA: 1) estimated the cost per worker to provide such a lunch room; 2) estimated the number of workers in the foundry industry that would likely be exposed at levels exceeding the PEL; and then 3) estimated the cost to the entire industry of providing such lunch rooms by multiplying (1) by (2).

We disagree with OSHA's "per affected worker" approach, and instead estimate costs to the industry on a "per affected foundry" basis. In this lunch room example, we presume in our cost analysis that if a foundry has as few as one worker exposed at a silica concentration exceeding

[3] We have available another version of these worksheets that shows the individual comments of each of the four industry reviewers instead of only our summary judgments based on the reviewer comments. We are not now providing to AFS this longer version of the worksheets because we believe that the individual comments reveal much cost information that is proprietary to individual companies and that the reviewers would not want to be made public. However, if AFS wants to conduct a more in-depth review of our work, we would be willing to provide the longer version of the worksheets with the four individual reviewer comments, as long as AFS distributes this version for review only to a very limited set of individuals that would not seriously compromise the confidential basis on which the four original reviewers provided their information.

the PEL and that employee is going to use a lunch room, then the foundry will need to provide a clean, fully enclosed, negative pressure lunch room sufficient to serve *all* the foundry employees in whatever number and at whatever schedule they typically take lunch. The foundry is very unlikely to provide a lunch room, as OSHA's approach supposes, exclusively for the single over-exposed employee. Or, if the foundry for some reason does provide some sort of single-employee lunch room, the cost of this unusual lunch room will likely be far higher than the average cost per worker for a typical lunch room that OSHA presumes.[4] In our "per affected foundry" cost analysis approach, we start the analysis by estimating the number of foundries that will need to do something to meet an ancillary requirement, and then multiply the number of foundries that will need to take the action by the cost per foundry to do it.[5] Changing the overall approach in estimating costs for ancillary provisions from OSHA's "per affected worker" to our "per affected foundry" approach results in *much* higher estimated costs.[6]

Differing approaches in estimating exposures

Another important element that distinguishes our approach from OSHA's in estimating costs for the ancillary requirements involves contrasting assumptions about the number of employees likely to be exposed above the various threshold airborne concentrations of crystalline silica that will serve to trigger the different potential ancillary requirements.

OSHA makes a broad assumption that 10% of all production workers currently exposed to concentrations exceeding 100 ug/m^3 or exceeding 50 ug/m^3 will remain exposed above these levels if a PEL were to be established and fully implemented at these levels. Thus, OSHA

[4] OSHA estimates costs to provide a lunch room for workers exposed above the PEL as follows. The Agency estimates that a portable building lunch room meeting the requirements of the potential regulation and serving 15 workers can be rented for $220/month or $2,640 per year. Dividing by the 15 workers served by this lunch room results in an annual cost per employee of $176. OSHA then calculates the total cost to the industry of meeting the lunch room provision of the Clothing and Hygiene Facilities ancillary requirements by multiplying this $176 cost per worker per year by the number of workers across the industry that are expected to be exposed at levels exceeding the PEL. OSHA's approach, in effect, estimates the cost to provide a lunch room meeting the requirements as $352 per year for a small foundry that has, let's say, two production workers exposed above the PEL. In contrast, industry personnel have suggested to us that a typical cost for a small foundry to upgrade an existing lunch room to meet the clean, fully enclosed and negative pressure requirements might be roughly $20,000, and the cost to construct a new lunch room meeting these requirements would be a minimum of $50,000. OSHA's "per affected worker" approach results in greatly underestimating the costs for individual foundries and for the industry as a whole to meet the potential ancillary requirements.

[5] In most instances our cost analysis proceeds further than this. Often the cost of the action that an affected foundry must take will depend in part on the number of the foundry's employees that are exposed above the PEL or the Action Level. For example, OSHA's potential Hazard Communication and Training ancillary requirement specifies that any foundry with employees exposed above the Action Level must develop and provide to the workers exposed above the Action Level a training program in which workers are taught to recognize and to minimize silica hazards. We estimate the costs for foundries to comply with this requirement as consisting of some fixed cost per foundry to develop a silica training program, and then a set of variable costs that increase with the number of employees at the foundry who will be trained, including the costs for employee time spent in training instead of productive work, the costs for training materials distributed to the employees undergoing the training, the costs for instructors to offer the training course (e.g., assuming a maximum of 15 attendees per training session, the number of training sessions per year will need to be at least the number of workers to be trained divided by 15), and so forth.

[6] OSHA also uses this inappropriate "per affected worker" approach in estimating the costs for industry to implement engineering controls as necessary to comply with a tighter PEL established by a potential new regulation. OSHA estimates the engineering control costs to the foundry industry to comply with a new PEL of 50 ug/m3 to be about $140 million/year. We estimate these costs to be more than $1.5 billion/year. Much of the difference involves estimating costs on a "per affected facility" basis instead of using OSHA's "per affected worker" approach.

assumes after implementation of a potential regulation reaffirming the current PEL at 100 ug/m^3 and adding ancillary requirements and an Action Level at 50 ug/m^3, that only 10% of the workers now exposed at levels exceeding 100 ug/m^3 will remain so exposed after employers complete their efforts to comply with such a regulation. Or, for a regulation establishing a new PEL at 50 ug/m^3, OSHA assumes that the number of workers that will remain exposed above 50 ug/m^3 after all compliance efforts are concluded will be 1/10 the number of workers that are now exposed above 50 ug/m^3.

We use a different approach that results in much larger numbers of employees estimated as exposed above various threshold concentrations, and thus a much larger number of foundry workers for whom the ancillary control requirements will have to be implemented. And, because one step in our methodology involves estimating costs on a "per affected foundry" basis, we estimate not only the number or percentage of employees exposed above various threshold concentrations, but we also estimate the number or percentage of *foundries* that have workers exposed above these threshold concentrations.

We use data from the *AFS Metalcasting Facility Crystalline Silica Survey* (August, 2011) in estimating exposure information for both foundries and employees. The survey asked two relevant questions of foundry EH&S managers:

- What percentage of your production employees is exposed to respirable silica at concentrations exceeding 100 ug/m^3? And
- What percentage is exposed above 50 ug/m^3?

Some 70 foundries responded. We assembled the response information so as to generate most of the second and third numerical columns of the following two tables:[7]

% of Foundries That Have No Production Employees Exposed Above Various Silica Concentrations

	Now (from AFS Survey)		After Implementing All Feasible Engr. Controls to Attain PEL (Our Estimate)	
	% w/ no employees exposed > PEL	% w/ no employees exposed > AL	% w/ no employees exposed > PEL	% w/ no employees exposed > AL
For PEL = 100, Action Level (AL) = 50	39.1%	18.9%	*45%*	*21%*
For PEL = 50, Action Level (AL) = 50	18.9%	18.9%	*30%*	*30%*
For PEL = 50, Action Level (AL) = 25	18.9%	*0%*	*30%*	*5%*

For the Foundries That Have Production Employees Exposed Above Various Concentrations, What % of These Employees Are Exposed Above These Levels?

	Now (from AFS Survey)		After Implementing All Feasible Engr. Controls to Attain PEL (Our Estimate)	
	% of employees exposed > PEL at foundries that have at least one employee exposed > PEL	% of employees exposed > AL at foundries that have at least one employee exposed > AL	% of employees exposed > PEL at foundries that have at least one employee exposed > PEL	% of employees exposed > AL at foundries that have at least one employee exposed > AL
For PEL = 100, Action Level (AL) = 50	12.7%	29.7%	*10%*	*27%*
For PEL = 50, Action Level (AL) = 50	29.7%	29.7%	*20%*	*20%*
For PEL = 50, Action Level (AL) = 25	29.7%	*60%*	*20%*	*50%*

[7] The AFS Survey did not ask about exposures exceeding 25 ug/m3, and thus it obtained no data pertinent to a possible Action Level at 25 ug/m3. The 0% and 60% estimates shown in the tables above represent our estimates, not data from the Survey.

We will explain via several examples how we constructed these tables and how the information in them can be interpreted.

The AFS Survey indicated with reference to exposures exceeding 100 ug/m^3, that 39.1% of foundries currently had no employees exposed to concentrations exceeding this level. Alternatively, stating this figure in the manner in which it is presented in the first row of the first table, if the PEL were to be 100 ug/m^3 (which it in fact is), then 39.1% of foundries would now have no employees exposed above this PEL.

The Survey similarly indicated that if the PEL were to be 50 ug/m^3 (which it is not, but OSHA might propose that setting the PEL at this lower level), then as shown in the second and third rows of the first table, only 18.9% of foundries would have no employees exposed above this different, lower PEL. Likewise, if the Action Level were to be 50 ug/m^3 (which it is not, since there is no Action Level for crystalline silica currently, but under some of the potential new standards that are under consideration an Action Level would be set at 50 ug/m^3), only 18.9% of foundries would now have no production employees exposed above this Action Level (as shown in the first and second rows of the first table).

The Survey provided similar information about the percentage of production employees exposed above the 100 ug/m^3 and 50 ug/m^3 threshold levels as it provided regarding the percentage of foundries. Hence the second table showing information about employees, as well as the first table providing data about foundries.

The leftmost two numerical columns of the two tables provide *current* exposure information from the Survey about foundries and about production employees after foundries have had more than 20 years to comply with the existing crystalline silica worker exposure standard, which includes a PEL at 100 ug/m^3, no Action Level, and a limited set of ancillary requirements. How would exposures change from these current levels if OSHA were to promulgate a new, tighter worker exposure standard? Presumably foundry facility owners would implement additional new engineering controls in an attempt to comply with the tighter new standard, and exposures would fall somewhat from their current levels. The tighter the new standard, the more controls would be implemented and the more exposures would decline, presumably. In the two rightmost columns of the two tables, we provide our estimates or judgments about how exposures might change after foundry employers attempt to comply with whatever the new standard is. The leftmost two numerical columns provide (mostly) actual data from the Survey, while the rightmost two columns provide our estimates about what exposures might eventually be after a new standard and new compliance efforts by employers, with our estimates being based in part on the data from the Survey.

For example, we suppose that the percentage of foundries that have no employees exposed above the current PEL of 100 ug/m^3 would increase only slightly (maybe by only 10 – 15%) from current levels if OSHA were to buttress the current standard with an Action Level at 50 ug/m^3 and ancillary requirements. Most foundries have done all that they can feasibly do to meet the current PEL, and further improvements in compliance are likely quite limited. But, some foundries could perhaps do more. Hence, in projecting what the impact might be of such a new standard, we increase the 39.1% figure in the first row of the first table only modestly (by 15%) to 45%. We further presume that the additional controls or better work practices that some

foundries would put in place to increase compliance with the current PEL will generate some reduction in the entire profile of worker exposures -- just as the percentage of foundries with no employees exposed above 100 ug/m^3 will increase slightly, so also will the percentage of foundries with no employees exposed above 50 ug/m^3 increase slightly. We thus presume that a new regulation reaffirming the current PEL but backstopping by adding an Action Level and ancillary requirements will increase the 18.9% figure in the first row of the first table by a small amount (11%) to 21%.

We use a similar rationale in the second table in projecting the impact on employees (in contrast to the impact on foundries) from a new regulation that affirms and backstops the current PEL. The 12.7% figure on the first line declines only modestly to 10%, and the 29.7% figure similarly declines modestly to 27%.

In contrast, we apply a different presumption in projecting the impact of a stronger potential regulation that reduces the PEL to 50 ug/m^3 and establishes an Action Level of 50 ug/m^3. This much more stringent possible regulation would prompt much more investment by foundries in engineering controls and better work practices than would a regulation that reaffirms and backstops the current PEL. The more stringent regulation would likely result in a much larger reduction in worker exposures than would occur with the less stringent regulation. To reflect this presumption, we assume as shown in the second row of the first table that the percentage of foundries with no employees exposed above 50 ug/m^3 would increase sharply as a result of the more stringent regulation, from 18.9% to 30% (59% increase, in contrast to the 15% increase assumed to result from the less stringent, backstopping regulation). Likewise in the second row of the second table, we assume that the percentage of employees exposed above 50 ug/m^3 would decline substantially as a result of the more stringent regulation, from 29.7% currently to 20% (33% reduction) after implementation of controls aimed at meeting the new PEL.

We used similar sorts of reasoning in generating all the entries in the two rightmost columns of the two tables. The second worksheet in the Excel workbook that traces our cost estimates provides a more complete discussion of our rationale for each of the exposure estimates in the two tables.

We also want to repeat our earlier observation that this exposure estimate worksheet and all the other worksheets in the workbook are linked, such that one can easily change an assumption or data element in one worksheet and then quickly see the resulting impact of the change on the cost estimates for the ancillary provisions that are summarized in the final two worksheets. If a reviewer of this report were to disagree with one or more of our assumptions about how exposure levels might change with various possible new OSHA regulations, it would be straightforward to change the appropriate entries in the "Silica Exposure Estimates" worksheet and then see the impact of this change on the cost estimates in the final worksheets.

One final note about our exposure estimates shown in the two tables. Some ancillary requirements will be triggered when a foundry has employees exposed in excess of the PEL, while other ancillary requirements will be triggered when a foundry has employees exposed in excess of the Action Level. In thinking initially about the ancillary requirement costs that might be entailed by a silica standard that (a) establishes a PEL at 100 ug/m^3 and an Action Level at 50 ug/m^3 in comparison to the costs entailed by another standard that (b) establishes both the PEL and the Action Level at 50 ug/m^3, one might be likely to conclude that regulation (b) would

necessarily entail higher costs for ancillary requirements than regulation (a). One's rationale might be that the two possible regulations would establish the same Action Level, so ancillary requirement costs relating to the Action Level will be identical for the two regulations. Any differences between the two regulations in compliance costs for ancillary requirements would thus depend only on the number of employees exposed above the PEL after compliance with regulation (a) compared with regulation (b). Compliance with a PEL of 50 ug/m^3 is obviously more difficult than is compliance with a PEL of 100 ug/m^3; after compliance measures are implemented, more employees would be left exposed above a PEL of 50 ug/m^3 than would be left exposed above a PEL of 100 ug/m^3. Thus, one might conclude that compliance with the ancillary requirements would be more costly for regulation (b) than for regulation (a).

This seemingly sensible line of thinking would be incorrect. It misses the fact that the additional compliance measures (engineering controls plus work practices) induced by regulation (b) relative to regulation (a) will shift the entire distribution of worker exposures downward, leaving fewer workers exposed above 50 ug/m^3 (the Action Level for both regulations a and b) under regulation (b) than under regulation (a). This is shown in the exposure estimate tables that we presented earlier. After compliance with regulation (a) (reaffirm the current PEL and buttress it with an Action Level at 50 ug/m^3), 21% of foundries will have no employees exposed above the Action Level and, for those foundries that do have employees exposed above the Action Level, 27% of their employees will be exposed above this level. In contrast, after compliance with regulation (b) (establish a new PEL and Action Level both at 50 ug/m^3) and implementation of additional engineering controls and work practices, 30% of foundries will have no employees exposed above the Action Level and, for those foundries that do have employees exposed above the Action Level, only 20% of their employees will be exposed above this level. Regulation (b) will result in both fewer foundries and fewer employees exposed above the Action Level than regulation (a). Those ancillary requirements that are triggered by exposures exceeding the PEL will entail lower costs under regulation (a) than under regulation (b), but the opposite will be true for those ancillary requirements that are triggered by exposures exceeding the Action Level. The net result for the entire set of ancillary requirements -- some triggered by exceeding the PEL, some triggered by exceeding the Action Level, and some having multiple triggers -- cannot be determined in advance. We don't know, until we complete the analysis, whether in total the ancillary requirement costs will be higher for the potential compromise standard offered by some industries or higher for OSHA's apparently preferred 50/50 standard.

Summary of data sources used in the cost analysis

The primary sources from which we have derived the data elements included in our cost analysis worksheets are the following:

- The detailed written comments provided by three foundry industry EH&S managers and one consultant in response to AFS' request to them to review our worksheets tracing OSHA's cost analysis for the ancillary requirements. Each of these individuals has had experience in implementing ancillary requirements at foundries for silica and for other toxic substances such as lead. We want to thank Tom Slavin, Mark Broich, Joe Adams and Kay Rowntree for their extensive assistance in providing their data, judgments and advice. While we could provide the detailed version of our worksheets with these individuals' written comments for AFS review, we would prefer not to for confidentiality reasons.

- Follow-up phone conversations with these individuals to clarify their written comments and obtain further information. We have notes summarizing the substance of these conversations, but, again because of confidentiality concerns, would prefer not to provide these notes for review by AFS.

- Docket material assembled by OSHA to support a potential new silica worker exposure standard, particularly including OSHA's detailed cost analysis for the set of ancillary requirements proposed during the SBREFA proceedings in 2003.

- AFS' August, 2011, *Metalcasting Facility Crystalline Silica Survey*. This provides survey information for nearly 80 foundries that we presume are generally representative of the industry, about current worker exposures to crystalline silica, about respirator usage, and about reasons why respirators are used and why exposures exceeding the PEL may continue to occur. We also had follow-up phone discussions with a couple of individual respondents to the survey who have had experience implementing the existing ancillary requirements for lead at brass foundries.

- Additional AFS studies and discussions with staff, particularly Tom Slavin (with Navistar, chairman of the AFS Safety and Health Committee) and Al Spada, providing data mostly about the industry as a whole. Some of the particularly useful studies include: AFS *Metalcasting Forecast & Trends 2011*, AFS and North American Die Casting Association *2007 Operational Cost Survey*, and the *Foundry PPE Job Assessment.*

- Various relevant analyses and surveys developed by or for the ACC Crystalline Silica Panel, including particularly the recent work by Environomics and URS ("Estimated Costs and Adverse Economic Impacts of a Potential New OSHA Occupational Exposure Standard for Crystalline Silica With a PEL of 50 ug/m^3 and Ancillary Requirements", July, 2011) and a 2003 critique by PricewaterhouseCoopers of the potential ancillary requirements that OSHA had suggested at that time.

- Vendor price quotes obtained through the internet for various items that foundries will need to purchase or rent for compliance with the potential ancillary requirements. Examples include rental rates for the equipment needed for OSHA's proposed semi-annual thorough cleaning of any foundry with employees exposed at levels exceeding the Action Level (e.g., pressure washers, cherry pickers, supervacs), costs for bulk purchase of N95 disposable particulate respirators, etc.

We have attempted to list in our cost analysis worksheets the data source for each element of information that is included in the calculations.

IV. Results: Estimated Costs to Comply With Ancillary Requirements

We estimate the costs for the U.S. metalcasting industry to comply with OSHA's nine probable sets of ancillary requirements as about $350 million to nearly $500 million per year, depending on the particular PEL and Action Levels that are chosen.

Costs for Metalcasting Industry Compliance With Likely Ancillary Requirements ($/year)

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Exposure Assessment	$ 12,319,397	$ 11,384,054	$ 18,137,744
Health Screening & Surveillance	$ 13,171,043	$ 8,818,556	$ 28,710,552
Clothing & Hygiene Facilities	$ 69,232,475	$ 126,781,556	$ 126,781,556
Regulated Areas	$ 10,824,066	$ 13,776,084	$ 13,776,084
Housekeeping	$ 230,172,653	$ 203,950,452	$ 276,789,899
Respiratory Protection	$ 8,086,772	$ 20,584,511	$ 20,584,511
Hazard Communication & Training	$ 4,755,229	$ 3,723,820	$ 8,125,002
Record Keeping	$ 619,025	$ 804,177	$ 1,445,603
Competent Person	$ 3,134,483	$ 3,134,483	$ 3,134,483
Total: All Ancillary Requirements	**$ 352,315,144**	**$ 392,957,693**	**$ 497,485,436**
(Total for All Ancillary Requirements Except Housekeeping)	$ 122,142,491	$ 189,007,240	$ 220,695,536

These costs for compliance with the potential silica ancillary requirements are very high, averaging about $180,000 per foundry per year for the least costly of the three PEL/Action Level alternatives and about $250,000 per foundry per year for the most costly alternative. These costs amount to 1 to 2% of total U.S. foundry industry revenues as of 2007, the most recent year for which a nationwide estimate of revenues for this industry is available from the Economic Census. Both the specific ancillary requirements that are to be included in the regulation and the levels at which the PEL and Action Level are to be established (and thus the silica concentration levels at which an employer incurs duties under the ancillary requirements) are clearly issues that should be of substantial concern to the industry.

The costs for the industry to comply with the potential ancillary requirements are quite high without regard to which of the three combinations of PEL and Action Level are selected. Nevertheless, standards differing from the 50 ug/m^3 PEL and 50 ug/m^3 Action Level that OSHA has long supported would either save or cost the metalcasting industry a substantial amount. Relative to the 50/50 regulatory option, retaining the current PEL but adopting an Action Level at 50 ug/m^3 and ancillary requirements would save the metalcasting industry about $40 million per year, a little more than 10%. Or, again relative to the 50/50 option, further reducing the Action Level to 25 ug/m^3 would cost more than $100 million more per year, an additional 25%.

Housekeeping

By far the most costly of the potential ancillary requirements is that for housekeeping. As a housekeeping requirement, OSHA has suggested that the Agency may require all foundries with employees exposed at silica concentrations exceeding the Action Level to undergo thorough cleanings twice per year for as long as exposures continue to exceed the Action Level. These cleanings are to involve removal of accumulations of sand from all locations in the foundry, including floors, rafters, other horizontal surfaces, etc., by use of supervacs, power washers, and

cherry pickers (to reach rafters, platforms, overhead rails, towers, etc.).

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Housekeeping			
Twice/year cleaning of facility if exceed AL -- crew	$ 92,935,255	$ 82,347,694	$ 111,757,585
Twice/year cleaning of facility if > AL -- equipment rental	$ 11,773,047	$ 10,431,814	$ 14,157,461
Twice/year cleaning of facility if > AL --operating profits lost during unwanted plant shutdown	$ 125,464,351	$ 111,170,944	$ 150,874,853
Other housekeeping requirements are costed as a portion of engineering controls	---	---	---
Subtotal, Housekeeping	*$ 230,172,653*	*$ 203,950,452*	*$ 276,789,899*

By our estimation, somewhat more than half of the cost for these twice-yearly cleanings will result from the need to cease foundry operations for a week each time a cleaning occurs. Most foundries temporarily suspend operations once per year for scheduled maintenance for a week or so; one of OSHA's required cleanings could occur during this scheduled shut-down. However, for most foundries, OSHA's second cleaning would require an unwanted cessation of operations, during which time the foundry would lose about a week's worth of operating profits and contribution toward overhead.

Given the very high costs that we estimate for OSHA's proposed twice-yearly intensive cleanings and the questionable and likely short-lived benefits from such cleanings, we suspect that OSHA may decide not to include this requirement in the eventual new silica regulation. There are a variety of other housekeeping requirements in the potential regulation that the Agency plans to include and for which costs are estimated among the various required engineering controls (e.g., prohibition on using compressed air for cleaning surfaces, requirement to vacuum the floors around certain operations at the end of the work day). OSHA may well consider these other housekeeping requirements sufficient after the Agency is informed about the very high costs of the potential twice-yearly cleaning requirement.

Clothing and Hygiene Facilities

But even if OSHA were to eliminate the intensive cleaning housekeeping requirement, the eight other remaining sets of ancillary requirements would still cost foundries about $120 million to $220 million per year. Costs for clothing and hygiene facilities will constitute more than half of these remaining costs.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Clothing & Hygiene Facilities			
Protective clothing and change rooms (for those exposed > PEL)	$ 18,244,775	$ 34,565,258	$ 34,565,258
Showers (for those exposed > PEL)	$ 18,744,940	$ 35,862,405	$ 35,862,405
Lunch rooms (for those exposed > PEL)	$ 4,301,758	$ 5,474,965	$ 5,474,965
HEPA vacuums (those exposed > PEL must vacuum before entering clean area)	$ 27,941,003	$ 50,878,928	$ 50,878,928
Subtotal, Clothing & Hygiene Facilities	*$ 69,232,475*	*$ 126,781,556*	*$ 126,781,556*

OSHA's potential requirements for hygiene facilities will entail significant capital costs for change rooms, showers and lunch rooms for many foundries. In addition, all foundries with employees exposed at levels exceeding the Action Level will need to provide HEPA vacuums that employees must use to clean their clothes whenever they go from an area of the plant where

silica concentrations are high to a relatively clean area. OSHA specifies lunch rooms and change rooms as clean areas where employees exposed above the Action Level will need to vacuum their clothes before entering. Although OSHA does not explicitly say so, we have estimated costs for this vacuuming outside of other sorts of possible "clean areas" that employees working in high exposure areas might want to enter also, including break rooms, laboratories, administrative offices, supply rooms, etc.. HEPA vacuums will be needed at all these locations, including multiple vacuums at many locations so that multiple employees arriving simultaneously at a clean area (e.g., at the lunch room when the foundry's lunch break begins) can vacuum their clothes without a line forming and delays occurring. We have included costs to purchase and maintain the vacuums as well as costs for the time that employees exposed above the PEL must spend vacuuming their clothes.

For change rooms, lockers, shower facilities, lunch rooms and other sorts of capital investments necessitated by an ancillary requirement, we have converted the estimated capital costs into an equivalent recurring stream of annual costs for our summary cost calculations. In each ancillary requirement worksheet, we provide detail on any such cost annualization calculations, including the useful life that we assume for the capital investment (e.g., 25 years for a lunch room, 3 years for a HEPA vacuum, 5 years for the average useful life of the investment in silica training and knowledge that a foundry makes in its silica "competent person"). In general, we use a real interest rate of 7%/year for all of our annualization or discounting calculations.

Exposure Assessment

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Exposure Assessment			
Initial assessment	$ 1,909,276	$ 1,909,276	$ 1,909,276
Periodic monitoring (4x/yr for those > PEL, 2x/yr for those > AL)	$ 10,410,122	$ 9,474,778	$ 16,228,468
Subtotal, Exposure Assessment	*$ 12,319,397*	*$ 11,384,054*	*$ 18,137,744*

We estimate costs for exposure assessment that are much higher than OSHA estimates, for several reasons:

- We believe that more initial assessment samples are required to adequately characterize exposures across the various production worker job categories at a foundry than does OSHA. OSHA assumes 12 job categories and 12 initial assessment samples per foundry. We assume:

    - For a large, one-shift model foundry, 16 samples.
    - For a large, two-shift model foundry, 21 samples.
    - For a small, one-shift model foundry, 9 samples.
    - For a small, two-shift model foundry, 12 samples.

    We assume that large foundries may have several additional job categories (e.g., furnace/ladle repair, and a second type of cleaning/finishing job) and/or locations beyond OSHA's twelve where initial sampling may be necessary. We assume that two-shift foundries will need about 30% more samples than one-shift foundries in order to characterize exposures on the second shift, when different tasks may be performed (e.g.,

melt and pour mostly at night, perform most finishing tasks during the day) and different exposures may result for the same job when it is performed during the different shifts. We also assume that in small one-shift foundries, three of OSHA's twelve presumed job categories may either be absent or filled by employees who work more than one job category at a time.

- We project more employees exposed above the PEL and more employees exposed above the Action Level than does OSHA. (See the previous discussion about exposure estimates.) We thus project a need for more periodic monitoring for these more highly exposed employees than does OSHA.

- OSHA's "per affected worker" approach to estimating costs is inappropriate when estimating the costs for a certified industrial hygienist (CIH) to come to the foundry and take samples, either for initial assessment or for periodic monitoring. For the purposes of this analysis, we have accepted OSHA's estimate that a CIH can supervise up to 8 full-shift worker exposure samples in a day-long visit to a foundry. OSHA's "per affected worker" approach then presumes that a foundry when it has one worker who needs to be monitored can purchase only one-eighth of a CIH's day, or if two workers need to be sampled the foundry can purchase only one-quarter of the CIH's day, etc.. This is obviously not possible if, as OSHA requires, each sample must be full-shift or near-full-shift. We make other, more appropriate assumptions. Among all the variety of cost elements that are included in exposure assessment (e.g., cost of CIH services, cost per sample for lab analysis, value of worker time lost while sampling pump is being attached, cost of supervisor time spent arranging for and overseeing the sampling and keeping records, etc.), the cost of CIH services accounts for about half of the total cost for exposure assessment, so it is particularly important to estimate the costs for CIH services in a reasonable manner.

We estimate a cost for initial assessment that is much lower than the cost we estimate for periodic monitoring, even though all job categories will need to undergo initial assessment but only those for which exposures are above the PEL or Action Level will need to undergo periodic monitoring. Some of the higher cost we estimate for periodic monitoring is because the job categories where exposures are found to exceed the PEL or Action Level will need multiple periodic monitoring samples per year (4x/year for those exposed above the PEL, 2x/year for those exposed above the Action Level) whereas a single sample may suffice for a job category for initial assessment. Another important factor in estimating costs is that initial assessment is, in effect, a capital investment that likely has a multi-year useful life, whereas periodic monitoring must be repeated each year for each job category where exposure remains above the PEL or Action Level. OSHA specifies that an initial assessment for a job category need not be repeated unless and until operations in the foundry change sufficiently for exposure to differ substantially from the level found in the initial assessment. We have assumed for our analysis that initial assessment samples represent a capital investment with a "useful life" averaging 10 years – we assume that it will typically be ten years (or more) before conditions might change/worsen sufficiently so as to warrant re-assessing a job category that was found in an initial assessment to involve exposure below the PEL and Action Level. Annualizing the cost of initial assessment at a foundry assuming a 10-year useful life substantially reduces the costs for initial assessment relative to the continuing every-year costs for periodic monitoring.

Health Screening and Surveillance

The costs that we estimate for this ancillary requirement are lower for OSHA's preferred regulation (50 ug/m^3 PEL and Action Level) than for the compromise that some industries have suggested (100 ug/m^3 PEL and 50 ug/m^3 Action Level). This is because health screening and surveillance costs depend on the number of employees exposed above the Action Level, and engineering controls implemented pursuant to OSHA's preferred tighter 50 ug/m^3 PEL will substantially reduce the number of employees exposed above 50 ug/m^3 relative to the number that would be so exposed if the PEL were to remain at 100 ug/m^3.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Health Screening & Surveillance			
Initial screenings (for new employees exposed > AL)	$ 6,145,707	$ 4,033,750	$ 13,685,939
Continuing surveillance (for continuing employees exposed > AL)	$ 6,519,854	$ 4,279,323	$ 14,519,131
Referrals to pulmonary specialist	$ 505,482	$ 505,482	$ 505,482
Subtotal, Health Screening & Surveillance	*$ 13,171,043*	*$ 8,818,556*	*$ 28,710,552*

Estimated costs for initial screenings for employees newly placed in locations where exposures exceed the Action Level are quite similar to the estimated costs for continuing surveillance for employees continuing to work in such locations. The relative balance between these costs depends on an assumption about the turnover rate for foundry production workers; we used OSHA's assumption based on 2003 data to the effect that 38% of foundry production workers quit/retire/transfer or are laid off each year, to be replaced by new workers who need initial rather than continuing screening. The turnover rate may now be much lower than this 2003 rate, in which case the costs for continuing surveillance would be higher and the costs for initial screenings would be lower than we have estimated. For continuing surveillance, we have assumed an x-ray once every three years, which is the more costly of the two x-ray frequency options that OSHA has been considering.

Regulated Areas

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Regulated Areas			
Setting up regulated areas	$ 830,685	$ 1,057,236	$ 1,057,236
Disposable respirator use for visitors to regulated areas other than workers assigned there	$ 5,635,237	$ 7,172,119	$ 7,172,119
Orientation/training for non-employee visitors to regulated areas	$ 4,358,145	$ 5,546,729	$ 5,546,729
Subtotal, Regulated Areas	*$ 10,824,066*	*$ 13,776,084*	*$ 13,776,084*

The costs that we estimate for setting up regulated areas are relatively small, although we do estimate that a supervisor will need to spend up to several days, depending on the size of the foundry, in deciding how to lay out the regulated areas in instances when multiple foundry operations generate exposures exceeding the PEL. Making a decision about whether to have many smaller regulated areas or fewer larger ones can be complex and important and therefore time-consuming. OSHA devotes a great deal of attention in the Agency's cost analysis to estimating the number of signs and feet of tape, and their cost, that will be needed to mark the regulated areas. We believe these costs will be relatively small, as will the costs in employee

time to install the signs and tape.

OSHA will require all individuals who enter a regulated area to wear a respirator. For those individuals who are foundry employees that normally work in the regulated area, both OSHA and we estimate the costs of providing them with respirators under the Respiratory Protection ancillary requirement. For the many other individuals that may occasionally need to enter a regulated area for reasons other than routinely working there -- for example, foundry personnel performing quality control, maintenance, repair, engineering, administrative, EHS, supplies/materials, supervisory or laboratory functions, as well as a variety of non-foundry personnel (e.g., contractors, consultants, visitors) -- both OSHA and we estimate the costs to provide such additional "authorized persons" with a disposable respirator as one of the costs for the Regulated Areas ancillary requirement. OSHA estimates that two disposable respirators are needed per day to provide for these "authorized persons" for each foundry with regulated areas; we estimate (based on suggestions from several foundries) instead that there will be nine visitors per day to regulated areas in a model small foundry and twenty-nine per day in a model large foundry, each of whom will need to use a disposable respirator. We also estimate costs (OSHA does not) for a supervisor to provide introductory orientation and training on how to put on and use a disposable respirator for each outside/non-foundry visitor to a regulated area.

Respiratory Protection

OSHA will require use of respirators in four situations:

1. Within regulated areas;
2. When and where feasible controls are not sufficient to reduce exposures below the PEL;
3. While engineering controls and work practices are being developed, installed or repaired; and
4. When requested by an employee.

Both we and OSHA estimate costs for use of respirators in a similar manner. We estimate the number of foundry employees who will be exposed at silica concentrations exceeding the PEL, assume that this represents the number of employees who will need respirators, and multiply this number of employees by the annual cost per employee for all activities associated with using an appropriate respirator (purchase the respirator and accessories, training, fit test, cleaning, etc.). OSHA estimates the full cost to equip a worker with a half-mask, non-powered, air purifying respirator as about $470 per year; based on information from several foundries we estimate this cost as about $1,100 per year per employee.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Respiratory Protection			
Respirators for employees exposed > PEL (less credit for current respirator use)	$ 8,086,772	$ 20,584,511	$ 20,584,511
Subtotal, Respiratory Protection	*$ 8,086,772*	*$ 20,584,511*	*$ 20,584,511*

For several of the potential ancillary requirements (e.g., Exposure Assessment, Health Screening and Surveillance), OSHA estimates the cost for the entire industry to implement the requirement and then discounts this cost estimate by a percentage intended to reflect the fraction of the industry that already meets the requirement now. OSHA's rationale, with which we agree, is that

a regulatory cost estimate should reflect the incremental costs -- the costs beyond whatever costs are already being incurred -- to meet the regulatory requirement. If some portion of the industry is already meeting the regulatory requirement, the incremental cost imposed by the regulation is the cost to bring the remainder of the industry up to the standard. In our cost estimation worksheets, we indicate where we disagree with OSHA's judgment about the percentage of the industry that is already meeting a potential requirement.

Curiously, in estimating the costs for respiratory protection, OSHA does not implement this discounting approach so as to reflect the degree to which respirators are now being used in the metalcasting industry. In contrast, we apply a discount factor of 18.6% to reflect the proportion of foundry employees already using respirators, based on data from the AFS *Metalcasting Facility Crystalline Silica Survey*.

Hazard Communication and Training

OSHA will require that information on crystalline silica must be included in the foundry's hazard communication program, which is currently required under the Agency's Hazard Communication Standard. Also, OSHA will require additional training specific to silica: employees who are or will be exposed above the Action Level must be given information on operations that could result in exposures exceeding the PEL, and on principles of safe use and handling of materials containing crystalline silica.

We assume that all foundries already have a haz-com program and training, and that addition of silica to the existing program will entail modest costs for development of silica-related materials, but no additional costs in terms of employee time spent in haz-com training. Silica will be fit into the existing haz-com training course without expanding the amount of time required for the training.

We assume, however, that the detailed, silica-specific training required for employees exposed at concentrations exceeding the Action Level will require additional new training. We assume this training will be 2 hours in duration, once per year for each employee exposed at this level. We estimate three sorts of costs for this training: 1) costs to develop or purchase the new course and materials; 2) costs in the form of employee time spent in training rather than performing their normal jobs; and 3) costs for an instructor or a manager to present the training.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Hazard Communication & Training			
Develop new training on silica plus course materials, for employees exposed > AL	$ 1,212,413	$ 1,188,353	$ 1,298,312
Value of employee time spent in annual silica training	$ 2,240,403	$ 1,470,495	$ 4,989,178
Cost for manager or instructor to present annual silica training	$ 1,302,413	$ 1,064,972	$ 1,837,513
Subtotal, Hazard Communication & Training	*$ 4,755,229*	*$ 3,723,820*	*$ 8,125,002*

Record Keeping

Records must be kept regarding respirator fit information, silica training, results of exposure sampling and monitoring, and health screening/surveillance. Costs to keep records regarding exposure assessment and health screening and surveillance have been included in the cost

estimates for these ancillary requirements. We estimate the costs to keep records relating to respirator fit and relating to silica training as follows.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Record Keeping			
For respirator fit information	$ 210,618	$ 536,118	$ 536,118
For silica training information	$ 408,407	$ 268,059	$ 909,486
Other record-keeping costs incl. in Exposure Assessment and Health Screening/Surveillance	---	---	---
Subtotal, Record Keeping	*$ 619,025*	*$ 804,177*	*$ 1,445,603*

Competent Persons

It appears that OSHA intends to establish a requirement that each foundry must designate a "competent person" to ensure that the facility complies with the requirements of the crystalline silica standard and to oversee various specified aspects of the facility's operations. It appears that this requirement will apply to all foundries, without regard to the foundry's silica exposure levels, and without regard even to whether the foundry conducts operations that can generate a meaningful quantity of airborne crystalline silica.

OSHA does not estimate any costs for foundries to meet this requirement, but we do.

	Cost to Metalcasting Industry of Ancillary Requirements ($/yr)		
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Competent Person			
Value of time spent by competent person in silica training/education	$ 1,393,104	$ 1,393,104	$ 1,393,104
Access for competent person to in-depth silica training and educational materials	$ 1,741,380	$ 1,741,380	$ 1,741,380
Subtotal, Competent Person	*$ 3,134,483*	*$ 3,134,483*	*$ 3,134,483*

We presume that a foundry will designate as the "competent person" a senior EH&S employee who already works at the foundry, and that this individual will fulfill the silica "competent person" responsibilities in the course of his normal job responsibilities, at no incremental cost. We also assume, though, that this individual will need to have some sort of specialized training and education in understanding, recognizing and dealing with silica hazards. OSHA has given no indication that they intend to require any specific training or other qualifications for the "competent person", but we expect that the Agency would bring a serious enforcement action against a foundry if the facility was found to be in non-compliance with the standard and OSHA believed that poor performance by and inadequate qualifications for the "competent person" contributed to the violation.

We estimate costs by presuming that the individual who will serve as competent person will need to undergo forty hours of silica education and training, half of which involves accessing relatively costly pre-packaged events or materials (e.g., attendance at a specialized training course) and half of which involves independent reading, research, investigations and discussions. We treat this assumed forty hours of silica education as a sort of capital investment with a useful life of five years, assuming that this will represent the average tenure of a competent person. The annualized cost of this education and training represents a significant cost for the industry as a whole, in part because OSHA appears likely to require a silica competent person at every foundry without regard to exposure levels at the foundry.

Detailed summary table showing estimated costs for ancillary requirements

The following table provides detail on the costs estimated for each set of ancillary requirements.

Cost to Metalcasting Industry of Ancillary Requirements ($/yr)			
	PEL = 100 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 50 ug/m^3	PEL = 50 ug/m^3, AL = 25 ug/m^3
Exposure Assessment			
Initial assessment	$ 1,909,276	$ 1,909,276	$ 1,909,276
Periodic monitoring (4x/yr for those > PEL, 2x/yr for those > AL)	$ 10,410,122	$ 9,474,778	$ 16,228,468
Subtotal, Exposure Assessment	*$ 12,319,397*	*$ 11,384,054*	*$ 18,137,744*
Health Screening & Surveillance			
Initial screenings (for new employees exposed > AL)	$ 6,145,707	$ 4,033,750	$ 13,685,939
Continuing surveillance (for continuing employees exposed > AL)	$ 6,519,854	$ 4,279,323	$ 14,519,131
Referrals to pulmonary specialist	$ 505,482	$ 505,482	$ 505,482
Subtotal, Health Screening & Surveillance	*$ 13,171,043*	*$ 8,818,556*	*$ 28,710,552*
Clothing & Hygiene Facilities			
Protective clothing and change rooms (for those exposed > PEL)	$ 18,244,775	$ 34,565,258	$ 34,565,258
Showers (for those exposed > PEL)	$ 18,744,940	$ 35,862,405	$ 35,862,405
Lunch rooms (for those exposed > PEL)	$ 4,301,758	$ 5,474,965	$ 5,474,965
HEPA vacuums (those exposed > PEL must vacuum before entering clean area)	$ 27,941,003	$ 50,878,928	$ 50,878,928
Subtotal, Clothing & Hygiene Facilities	*$ 69,232,475*	*$ 126,781,556*	*$ 126,781,556*
Regulated Areas			
Setting up regulated areas	$ 830,685	$ 1,057,236	$ 1,057,236
Disposable respirator use for visitors to regulated areas other than workers assigned t	$ 5,635,237	$ 7,172,119	$ 7,172,119
Orientation/training for non-employee visitors to regulated areas	$ 4,358,145	$ 5,546,729	$ 5,546,729
Subtotal, Regulated Areas	*$ 10,824,066*	*$ 13,776,084*	*$ 13,776,084*
Housekeeping			
Twice/year cleaning of facility if exceed AL -- crew	$ 92,935,255	$ 82,347,694	$ 111,757,585
Twice/year cleaning of facility if > AL -- equipment rental	$ 11,773,047	$ 10,431,814	$ 14,157,461
Twice/year cleaning of facility if > AL --operating profits lost during unwanted plant shu	$ 125,464,351	$ 111,170,944	$ 150,874,853
Other housekeeping requirements are costed as a portion of engineering controls	---	---	---
Subtotal, Housekeeping	*$ 230,172,653*	*$ 203,950,452*	*$ 276,789,899*
Respiratory Protection			
Respirators for employees exposed > PEL (less credit for current respirator use)	$ 8,086,772	$ 20,584,511	$ 20,584,511
Subtotal, Respiratory Protection	*$ 8,086,772*	*$ 20,584,511*	*$ 20,584,511*
Hazard Communication & Training			
Develop new training on silica plus course materials, for employees exposed > AL	$ 1,212,413	$ 1,188,353	$ 1,298,312
Value of employee time spent in annual silica training	$ 2,240,403	$ 1,470,495	$ 4,989,178
Cost for manager or instructor to present annual silica training	$ 1,302,413	$ 1,064,972	$ 1,837,513
Subtotal, Hazard Communication & Training	*$ 4,755,229*	*$ 3,723,820*	*$ 8,125,002*
Record Keeping			
For respirator fit information	$ 210,618	$ 536,118	$ 536,118
For silica training information	$ 408,407	$ 268,059	$ 909,486
Other record-keeping costs incl. in Exposure Assessment and Health Screening/Surve	---	---	---
Subtotal, Record Keeping	*$ 619,025*	*$ 804,177*	*$ 1,445,603*
Competent Person			
Value of time spent by competent person in silica training/education	$ 1,393,104	$ 1,393,104	$ 1,393,104
Access for competent person to in-depth silica training and educational materials	$ 1,741,380	$ 1,741,380	$ 1,741,380
Subtotal, Competent Person	*$ 3,134,483*	*$ 3,134,483*	*$ 3,134,483*
Total: All Ancillary Requirements	**$ 352,315,144**	**$ 392,957,693**	**$ 497,485,436**
(Total for All Ancillary Requirements Except Housekeeping)	$ 122,142,491	$ 189,007,240	$ 220,695,536