THE MASSACHUSETTS
TOXICS USE REDUCTION INSTITUTE

APPLICATION OF TOXICS USE REDUCTION TO OSHA POLICY AND PROGRAMS

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Application of Toxics Use Reduction to OSHA Policy and Programs

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The 1994 - 1995 Toxics Use Reduction Research Fellows Program

The Toxics Use Reduction Institute
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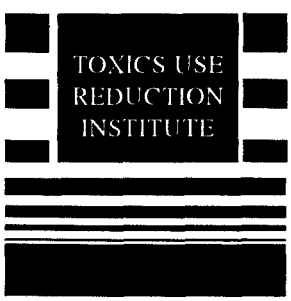

The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to promote the reduction in the use of toxic chemicals or the generation of toxic chemical byproducts in industry and commerce. Further information can be obtained by writing the Toxics Use Reduction Institute, University of Massachusetts Lowell, One University Avenue, Lowell, Massachusetts 01854.

Toxics Use Reduction Institute
Research Fellows Program

In 1991, the Toxics Use Reduction Institute established the Research Fellows Program at the University of Massachusetts Lowell (UML). The Research Fellows Program funds toxics use reduction projects performed by a graduate student and his/her advisor. The goals of the Research Fellows Program are:

- to develop technologies, materials, processes, and methods for implementing toxics use reduction techniques
- to develop an understanding of toxics use reduction among UML graduate students and faculty
- to facilitate the integration of the concept of toxics use reduction into UML research projects
- to provide UML faculty with "incubator" funding for toxics use reduction related research, and
- to act as a liaison between Massachusetts industries and UML faculty.

Notice

ACKNOWLEDGEMENTS

The Toxics Use Reduction Institute provided financial support for this research during the 1994-95 school year. Dr. Rafael Moure-Eraso, Associate Professor in the Work Environment Program at the University of Massachusetts Lowell and Senior Policy Advisor on Chemical Exposure Prevention for OSHA supplied essential information, documents and ideas during the development of this research. Karen Thomas of TURI also provided important feedback and support throughout the year. David May and Fred Malaby of OSHA generously took time to explain current OSHA practices and programs.

The opinions and recommendations contained in this report do not necessarily represent the views and policies of TURI, the Work Environment Program or the individuals named.

EXECUTIVE SUMMARY

Until recently, environmental and occupational health concerns about toxic substances were neatly demarcated at the roof, walls or property line of the industrial plant. Inside was the territory of occupational safety and health representatives, professionals and regulators. Outside was the purview of environmental advocates. When environmentalists realized that "end-of-pipe" solutions to toxic wastes were not working, and turned their attention to the source of environmental toxics in production processes where chemicals were used and produced, this clear line began to disintegrate. It has not, however, disappeared.

Although the locus of attention for environmental solutions has shifted to the inside of the plant and to the workplace sources of toxic contaminants, the concern of environmental regulators and advocates about impacts continues to be focused primarily outside the plant. Relatively little attention is paid to worker health and safety when it comes to targeting priority substances for use reduction or choosing alternative processes to current toxic ones.

For its part, the occupational health field has not yet embraced the primary prevention perspective of toxics use reduction. It remains fixed on an engineering control framework, with local ventilation the solution of choice. And yet, it is common sense that worker protection from exposure to toxic substances is most effective when they are eliminated from the workplace or drastically reduced.

This report surveys the options which can be used to reduce the use of toxics in the workplace, and suggests differences in the ways in which occupational health representatives and professionals might look at toxics use reduction for occupational health purposes. It also examines OSHA's current regulations, policies and programs with respect to toxic substances, and suggests ways in which these can provide opportunities or obstacles to promoting toxics use reduction for occupational health.

The report suggests that a shift in mindset in the occupational health community is necessary for OSHA to embrace toxics use reduction as a primary means of protecting the health of workers. It recommends ways in which the Work Environment Program and the Toxics Use Reduction Institute at the University of Massachusetts Lowell can take further leadership to make this shift happen. And finally, the report suggests a number of initiatives which OSHA could undertake to investigate and promote the practical application of toxics use reduction initiatives in occupational health.

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PROJECT DESCRIPTION

This research project is designed to identify and investigate opportunities for the application of toxics use reduction approaches in OSHA policy, regulations, enforcement and voluntary programs.

The research also has the practical objective of helping the Toxics Use Reduction Institute to elaborate its currently very brief section on Occupational Safety and Health in the draft report "Regulatory and Practical Issues in the Promotion of Toxics Use Reduction in Massachusetts".

OSHA, like most government occupational health and safety agencies around the world, speaks about the importance of primary prevention in occupational health. In its policy statements and in the preambles to its health standards, OSHA calls on industry to employ the standard hierarchy of industrial hygiene controls: engineering controls (such as substitution, isolation and enclosure, local and general ventilation), followed by work practices or administrative procedures and finally personal protective equipment. In practice OSHA emphasizes enclosure and ventilation strategies to reduce exposures and, to a lesser extent, work practices and personal protective equipment. Primary prevention strategies such as substitution or other toxics use reduction options are rarely advanced as a means of eliminating toxic exposures and occupational diseases. The secondary prevention strategies which OSHA promotes have limited effectiveness in reducing workplace exposures. As a result, many completely preventable chronic industrial diseases persist.

Even where exposure controls have been employed effectively to reduce day-to-day exposures, the potential remains for worker exposures due to equipment failures or human error because toxic substances are still in use. In some instances, accidental releases are the main source of worker exposures. Some of these exposures can and do have catastrophic effects.

The continued use of toxic chemicals, albeit in a controlled way, may also present an ongoing risk to the population adjacent to the plant and to the general environment.

OSHA's emphasis on engineering controls such as local ventilation is akin to the "end-of-pipe" solutions advanced on the environmental side of chemical contamination during the last two decades. "Controlled" exposures often become atmospheric emissions, wastewater discharges or solid wastes for the general environment. However, like environmental policy makers, OSHA

must face the fact that control of toxic hazards is not the main solution to long-term worker health and safety problems. Pollution prevention and toxics use reduction should be central to the ongoing reduction of workplace disease.

The task of this study, then, is to explore and propose ways in which OSHA can work within its mandate to advance pollution prevention/toxics use reduction in the workplace as a regulatory and policy strategy. There exist a number of opportunities for the application of such approaches.

RESEARCH METHODOLOGY

Standard policy research procedures have been used for this research. The work includes searches of the literature, drawing on public policy, toxicological, environmental, and occupational health journals, documents and data bases. The search brings together information in the following areas:

- legal mandates, authority and limitations of OSHA;
- current policy and regulations pertaining to toxic substances;
- organizational and programmatic structures and divisions of the agencies;
- relevant historical information on shifts and present conjuncture with respect to policy orientation;
- OSHA organizational practices;
- current and potential interface with environmental issues/agencies;
- toxics use reduction law and practices;
- proposals by other researchers for toxics use reduction initiatives that could apply to occupational health practice, government policy and regulation;
- use by other governments of toxics use reduction initiatives in the occupational health arena.

The research also involves communication with key informants from OSHA and related agencies, as well as policy researchers, to help identify factors which are not clear in the literature, including:

- opportunities for pollution prevention regulations, programs and practices, given the political and cultural climate of the agency and the government;
- obstacles to development of pollution prevention in occupational safety and health in general and in OSHA in particular.

TOXICS USE REDUCTION

A. Introduction

Toxics use reduction is a term which came into use in the late 1980's, as laws aimed at decreasing both the numbers and the quantities of toxics substances used in industry were debated and passed in several states.

In Massachusetts law, toxics use reduction is defined as any "in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product ... without shifting risks between workers, consumers, or parts of the environment."[1]

Among the goals of the Act, are the following:

> "(a) to promote toxics use reduction as the preferred means for preventing risks associated with the production and use of toxic substances, including risks to workers, consumers, the public and the environment;
>
> (b) to promote toxics use reduction as the preferred means for achieving compliance with any state or federal law or regulation pertaining to toxics production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics, or releases of toxics into the environment;
>
> (c) to promote the coordination and enforcement of federal and state laws and regulations pertaining to chemical production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics and the release of toxics into the environment ..."[2]

During the last decade, toxics use reduction has gained recognition as the primary prevention strategy for pollution prevention and waste minimization. Toxics which are not produced or used cannot be released to the work or general environment and cannot affect the health of workers or the public.

Since 1989, fourteen states have enacted some form of toxics use reduction or hazardous waste management legislation which promotes source reduction. Most of these laws require industries to prepare toxics use reduction plans and to periodically report

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[1] Massachusetts General Laws 310 CMR - 1086

[2] Massachusetts General Laws, 310 CMR - 1081

on quantities of toxics used. All of them provide for technical assistance and/or information to be made available to industries. So far, none of the states have set specific performance or other standards requiring industries to reduce use or production of toxics.

At the federal level, the Pollution Prevention Act of 1990 mandates the EPA to develop and implement a strategy to promote source reduction as the preferred approach to preventing pollution. The Act also established a Source Reduction Clearinghouse, provided some funds for states to promote the use of TUR techniques by business, and required facilities filing a Toxic Chemical Release Form to include a toxic source reduction and recycling report for the preceding calendar year.[3]

These laws have lead businesses to undertake more and more initiatives to reduce toxics use in the workplace. But a number of other important pressures are operating to promote toxic use reduction initiatives as well:

- prevailing public sentiment of the unacceptability of toxics use and pollution;
- public pressure resulting from Toxics Release Inventory reports, which identify specific industries as major polluters;
- environmental standards which restrict emissions, discharges, landfilling or other disposal of toxic wastes;
- international agreements to phase out ozone-depleting chemicals;
- occupational health standards, which require major reductions of in-plant emissions for some substances;
- the process safety management standard;
- restrictions in the use, production, sale or presence of certain substances governed by food, drug or pesticide laws;
- increasing costs of some toxic materials used as inputs;
- increasing costs of waste management and disposal;
- liability for toxic effects to consumers and the community;
- overhauls to production processes undertaken for other reasons (to modernize plant, improve productivity and/or competitiveness), but which provide an opportunity to reduce toxics use.

Any employer who undertakes toxics use reduction is likely responding to a mix of the incentives listed above. So far, however, published reports indicate that the main motivators are

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[3] Stenzel (1991)

compliance with hazardous waste regulations and reduction of costs associated with waste disposal.[4]

B. Survey of Toxics Use Reduction Options

There are a number of different approaches that an employer might use to undertake toxics use reduction in a plant or facility. There are also a number of slightly different classification schemes used to categorize the actions which an industry might undertake. This paper uses the categories set out in the Massachusetts Toxics Use Reduction Act. The Act lists six options for reducing toxics use in the workplace: input substitution, product reformulation, process redesign, process modernization/upgrading, improved operations and maintenance and in-process recycling and reuse. Each of these options is described at more length below, with examples.[5]

1. Product Reformulation

A product may be a toxic substance, or it may incorporate toxics in its production. The goal of product reformulation therefore, might be to make a less toxic product which serves the same purpose as a more toxic one, or to alter a product in such a way as to reduce the use of toxics in its production. Reformulation may change the characteristics of a product, and may need to be negotiated with major customers.[6] Examples of reformulating end products to make them, or the processes which produce them less toxic or less environmentally damaging include:

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[4] See reports in EPA (1990), TURA Reports (1994), Washington State Department of Ecology (1994), AESF (1994)

[5] Although distinguishing these options is useful for conceptual purposes, the options are not always easily demarcated in practice. Product reformulation and input substitution are often closely linked. Differentiating between process redesign and process modernization may be difficult. In a toxics use reduction effort in a particular industry, plant or workplace, several options may be implemented together. Product reformulation in one workplace (paint manufacturer) may result in input substitution in another (use of less toxic paints).

[6] Office of Technical Assistance (1992), page 50

- replacing mineral spirits-based paints with water-based formulas;[7]
- vegetable and soy-based printing inks instead of mineral-based inks;
- production of biodegradable vegetable-based polymers (plastics) in place of petroleum-based plastics.
- eliminating toxic cleaning and finishing processes by making metal parts out of stainless steel.

2. Input substitution

Input substitution means to change some or all of the materials of production. For the purposes of toxics use reduction, the new chemical input must be non-toxic or less toxic than that which it replaces. Such an approach may involve substitution of raw materials, chemical intermediates, or substances used for operations peripheral to a specific production process (cleaning or maintenance, for example). "Drop-in" substitutes which can replace raw materials or chemical intermediates with little or no other process change are not often easy to identify. Raw material substitutes often require changes in production equipment or process -- the temperature and pressure at which a process is conducted, for example -- or alter significant characteristics of a finished product.[8] Consequently, much of the research on substitutes so far reported in the scientific literature has focused on solvents and other materials which tend to be external to the main production process.[9]

Not all input substitutions for environmental purposes result in toxics use reduction. The substitution of used paper for wood pulp in paper-making may be environmentally sound, for instance, but it may also result in increased worker exposure to dozens of low-level toxic contaminants including colorants, petroleum-based inks and glues applied to the paper by its previous users. However, the replacement of chromium compounds by aluminium/ titanium compounds in tanning does result in toxics use reduction, as does the substitution of vegetable or soy-based inks for mineral-based inks in printing.

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[7] Except where otherwise indicated, examples of TUR options are drawn from A Practical Guide to Toxics Use Reduction by the Office of Technical Assistance.

[8] Darvin and Wander (1990), Marino (1990)

[9] Washington State Department of Ecology (1994)

Other input substitutes described in the literature include the following:

- water-based coolants used in place of coolant oils;
- substitutes for heavy metals compounds in pigments;
- aqueous, alkaline, terpene or citrus-based cleaners instead of chlorinated solvents for degreasing and cleaning operations;[10]
- alkaline zinc baths to replace zinc-cyanide plating processes;[11]
- soy-oil based inks in place of petroleum-based inks in offset printing;
- canola-based lubricating and cutting oils substituted for mineral-based oils;[12]
- caustic paint strippers replacing chlorinated solvent strippers;
- replacement of acid cleaning with brine baths in aluminum production;
- use of high-solid paint to reduce volatile organic chemicals (VOCs) emitted to air.[13]

3. Process Redesign/Alternative Process Technology

The Massachusetts Office of Technical Assistance describes process redesign as "using production machinery of a different design than the machinery currently in use."[14] Process redesign may involve a major technology change, which is usually embarked upon for reasons other than toxics use reduction, but may include TUR as a goal. Examples include:

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[10] See Ahlert (1990), Evanoff (1991), Ficklin and Hickle (1990), Office of Technical Assistance (1992) and many others. The substitution of aqueous solutions for chlorinated solvents dominates the pollution prevention literature.

[11] Office of Technical Assistance (1992). For other source reduction alternatives to zinc-cyanide plating see U.S. EPA (1992b).

[12] Cathy Walker, Canadian Automobile Workers, personal communication

[13] Washington State Department of Ecology (1994)

[14] Office of Technology Assistance (1992), page 52

- ozone bleaching processes which eliminate the use of chlorine in paper production;
- computerized dyeing operations which conserve heavy metal dyes and replace conventional dye operations;
- replacement of solvent-based paint stripping with reusable abrasive blast media;[15]
- replacement of cyanide zinc plating with non-cyanide processes (using zinc hydroxide);
- ultrasonic baths to replace solvent cleaning of metal parts.[16]

4. Process Modernization

This option may be difficult to distinguish from process redesign in some instances. Rather than fundamental changes to production technology, however, process modernization usually involves relatively modest upgrades of current production equipment such as:

- lids or floating roofs put on degreasing or solvent storage tanks to reduce evaporative losses and worker exposures;
- addition of drag-out tanks to a plating line to recapture and reuse plating solution;
- adjusting flow rates, temperature settings and operating pressures to reduce toxic byproducts;
- retrofitting vapour degreasers;[17]
- replacing open pumping systems with closed loop pipelines to reduce fugitive gases.[18]

5. Improved Production Operations, Work Procedures and Maintenance

The Massachusetts Office of Technical Assistance suggests that dramatic reductions in toxics use might result from improving operations and maintenance, preventing the loss of material inputs through spills or inadvertent emissions. Attention to such procedures may also reduce the incidence of serious chemical accidents. Many of these procedures are targeted by OSHA's Process Safety Management regulation. Examples include:

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[15] EPA Guide to Cleaner Technologies: Organic Coating Removal (February, 1994)

[16] Randall (1990)

[17] Washington State Department of Ecology (1994)

[18] Washington State Department of Ecology (1994)

- just-in-time chemical purchasing, which reduces quantities of chemicals stored on site and hence reduces the potential for major accidental releases;
- tank overfill alarms;
- training in proper substance transfer procedures;
- maintenance systems to better identify and correct leaking valves, pipes, pumps, containers, fill hose or fill line connections;
- centralized inventory and chemical tracking systems to identify areas where unnecessary amount of toxics used and to target chemicals for reductions;[19]
- chemicals purchase in bulk containers to reduce drum spills;[20]
- slower dragout procedures from plating tanks to minimize loss of plating solutions.

6. Recycling, Reuse or Extended Use of Toxic Materials Within the Plant

Waste materials may be recaptured and returned to the originating process as a substitute for new chemical inputs or may be reclaimed for other uses. Recycling operations usually involve the design and installation of capture systems, filtration or other contaminant removal processes, procedures to separate two or more media, and/or chemical treatments. Such procedures "with or without purification or complete recovery, are methods well suited to solvents, reaction baths, process intermediates, and co-product."[21]

The recycling option appears to be industry's favoured approach to toxics use reduction, judging by the number of reports published in the literature. Certainly, recycling appeals to employers looking to save money on raw material purchases and to reduce costs of waste disposal.

In Massachusetts, recycling only counts as toxics use reduction if it is done in-process. The Office of Technical Assistance warns that additional handling and transporting of recycled toxic substances sent off-site can pose a threat to the safety and health of transport workers and the public.[22] Depending on the

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[19] Washington State Department of Ecology (1994), pages 10, 12

[20] Washington State Department of Ecology (1994)

[21] Ahlert (1990)

[22] Office of Technical Assistance (1992)

methods used, within-plant recycling can also increase worker exposures. Examples of toxics recycling include:

- collection of waste inks (of various colours) and reconstitution as black ink;
- installation of closed-loop collection sumps into which spent cutting oils can be skimmed of soils, treated with biocides and returned to the process;
- increasing concentration of metal plating solutions in rinse tanks, to allow reuse of contents as make-up plating solution;
- recovery and recycle of calcium fluoride from stainless steel pickling liquor;[23]
- chrome recovery/recycling in tanning operations;
- oil-water separation to allow for reuse of oil (described for the aerospace industry).[24]

Toxic use reduction possibilities may be greater in secondary manufacturing as opposed to primary chemical production industries. In the chemical industry, TUR options will consist mainly of improvements in internal processes, maintenance procedures and internal recycling (Options 5 and 6 in the scheme outlined above) to reduce emissions inside and outside the plant, as opposed to substantive reductions in use. In some limited situations, chemical producers may be able to alter feedstocks and intermediate chemicals used, going to less toxic processes and inputs to produce chemical products. They may also redesign products and produce less toxic ones. However, it is unlikely that a chemical manufacturer working with petroleum-based products will shift to products from biomass (for example, from mineral oil lubricants to canola oil lubricants) although a user industry might well make that shift where the latter products are available and comparable in cost.

TOXICS USE REDUCTION AND OCCUPATIONAL HEALTH AND SAFETY

It makes sense that a systematic reduction in the use of toxics will substantially reduce risks to workers currently exposed to hazardous chemicals, as well as decreasing emissions to the environment as a whole. It is puzzling, therefore, that existing TUR initiatives pay relatively little attention to worker health issues and that occupational health advocates and policy-makers generally ignore toxics use reduction as a means of decreasing worker risk. This section explores each of these conundrums in turn.

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[23] Drabkin and Rissman (1987)

[24] Washington State Department of Ecology (1994), page 11

A. Worker Health in Toxics Use Reduction Programs

Some toxics use reduction programs do specifically promote worker health and safety. The Massachusetts Toxics Use Reduction Act, for example, describes TUR as a preferred means of preventing risks to workers and of achieving compliance with industrial hygiene and worker safety regulations. It also seeks to promote coordination between occupational health and environmental laws and regulations.

New Jersey's Pollution Prevention Act also describes worker protection as a goal of its legislation, as do several other states which have modeled their legislation at least in part on the Massachusetts Toxics Use Reduction Act.[25] However, this focus doesn't hold true in every state toxics use reduction act.

Despite TURA's declaration of worker health and safety as an objective of the Act, the main quantitative goal of the legislation is the reduction of hazardous wastes in Massachusetts by 50% by 1997. This reflects the dominance of environmental concerns in the act and in its application. TURA also targets relatively large users and producers of regulated chemicals for toxics use reduction planning (at least 10,000 pounds for users, 25,000 for producers). While this may have an impact on reducing toxics in the general environment, it may have little effect on worker exposures to toxics, which can be most problematic in small, technologically unsophisticated operations.

The priority of the general environment over the work environment is also reflected in the guidance materials provided by the Office of Technical Assistance[26] and to a lesser extent in the materials developed by the Toxics Use Reduction Institute for training toxics use reduction planners in Massachusetts.[27]

The OTA guide says almost nothing about worker health and safety, ignoring the emphasis in the Act on worker health and safety as one of the goals of TURA. Both the OTA and TURI manuals downplay the potentially important role of safety and health representatives on the TUR planning team. After targeting members from management, engineering and design, environmental compliance, finance, sales and production workers as key members of the planning team, both OTA and TURI suggest that larger

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[25] State of New Jersey (undated)

[26] Office of Technical Assistance (1992)

[27] Toxics User Reduction Institute (1994)

companies "might consider including" a safety and health representative, among several other possible members.[28]

It is odd that the TURI manual downplays the role of workers and occupational health and safety representatives on the TUR planning team, given that in 1991 the Institute commissioned MassCOSH[29] to prepare the booklet "Labor and Toxics Use Reduction". The booklet suggests ways in which trade unionists might initiate or participate in toxics use reduction initiatives to reduce worker exposures. It also addresses the problems of risk shifting which can occur in TUR programs.

In its Curriculum for Toxics User Reduction Planners, TURI also suggests that planners consider potential health and safety problems in assessing which TUR options to implement. The TURI manual includes a chapter on workplace health and safety which links occupational and environmental concerns related to toxics use. The chapter recommends a protocol for observing worker exposures during plant walkarounds, use of Material Safety Data Sheets in assessing chemical toxicity, and review of air monitoring data to identify in-plant emissions. It also emphasizes the importance of selecting TUR options which do not shift chemical exposure burdens to workers, or expose them to safety hazards. Unfortunately, discussion of this chapter takes up only a very small portion of the TUR planner training to date.

The shortcomings of the Act and manuals which guide its implementation do not mean that the TUR programs initiated as a result of TURA are of no benefit to workers. In 1994, the First Annual Governor's Awards for Toxics Use Reduction honoured six TUR programs in Massachusetts. Five of these programs have instituted changes that clearly reduce or eliminate worker exposures to certain toxics and appear to improve working conditions.[30] They include:

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[28] Of course in many companies the environmental compliance officer also has responsibility for safety and health. However, this person should be encouraged to wear both hats as a member of the TUR planning team, not to doff one or to consider it optional.

[29] The Massachusetts Coalition for Occupational Safety and Health

[30] The TUR program descriptions provided by the companies were not detailed enough to be certain that no risk shifting -- from chemical to physical or ergonomic hazards, for example -- took place in some of these operations, however.

- use of non-hazardous cleaners for parts and brakes in vehicle maintenance depots, ending exposures of workers to hazardous solvents;
- elimination of the use of organochlorine solvents by installing aqueous cleaning systems (two companies did this, one substituting citrus-based terpenes, the other using unspecified water-based "biodegradable" cleaners);
- replacement of an acid-based process for cleaning and inspecting metal parts by a tumblast abrasive cleaning machine, eliminating worker exposures to acids;
- use of a nitrogen-based heat treat system in place of acid baths for treating stainless steel instruments;
- eliminating cadmium from silver solder operations;
- development and introduction of new materials handling and reaction techniques, to reduce laboratory use of chemicals by over 90%, decrease worker and student exposures and eliminate the potential for fires and explosions in the labs.

More than twenty-five other companies also sought Governor's Awards. A quick review of the applications from these companies revealed a few more TUR programs which appear to contribute to worker health and safety, while many others described changes that appear to provide no clear benefit to workers.[31] Many applications made no mention of worker exposures or other working conditions.

A more detailed study of TUR initiatives in Massachusetts is needed to determine the extent to which worker health and safety motivates toxics use reduction in the state, and the benefits which accrue to workers from these programs.

However, judging by the national literature on pollution prevention and toxics use reduction, concern for worker health and safety appears to motivate companies to undertake TUR in relatively few cases. In fact, most of the TUR project reports reviewed for this study neglect even to mention worker exposures to toxics or to other risks associated with process equipment.[32]

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[31] A number of applications sought recognition for eliminating ozone-depleting chemicals, something the companies are required to do by 1995 in any case. While eliminating the use of CFC's is an important environmental goal, these substances are comparatively less toxic and less explosive than many potential substitutes. Workers do not always benefit from their removal.

[32] See EPA (1990), Washington State Department of Ecology (1994), AESF (1994)

Not one report described measuring worker exposures before or after implementation of TUR, or discussed potential shifts in risk to workers that may result from changes in chemical inputs, processes or equipment. Consequently, it is difficult to assess the effects of existing TUR projects on worker health and safety.

Despite this failure to directly assess TUR's effect on working conditions, much of the literature assumes that toxic use reduction projects will reduce worker exposures and/or risks. In fairly simple TUR projects, involving drop-in substitutes of non-toxic substances or processes for toxic ones, this assumption probably holds true. However, TUR projects are not always, or perhaps even often, this straightforward.

Take, as a case in point, research currently underway by a research fellow at the Toxics Use Reduction Institute. This researcher is investigating an alternative to tetrachloroethylene (also known as perchloroethylene or "perc") in drycleaning. He is examining the potential for supercritical fluid cleaning, using carbon dioxide under pressure. To clean certain types of stains, the supercritical fluid needs a boost. Consequently the researcher is looking at adding enzymes, called subtilisins, which are also used in some detergents. Now finding a substitute for tetrachloroethylene in dry cleaning is a laudable goal. Tetrachloroethylene is a neurotoxin, causes liver damage and dermatitis, and probably causes cancer and reproductive effects. A number of worker deaths have resulted from acute exposures.[33] Consumers are also exposed to tetrachloroethylene as it offgases from clothing after cleaning. (Tetrachloroethylene can also be absorbed through the skin.) And substantial quantities are released to the environment from a myriad of small drycleaning operations. This is a serious problem, given the growing environmental dispersion of organochlorines and their potential for disruption of human and animal reproductive functions. Supercritical cleaning, the alternative under investigation, is not without risks, however. First, it takes place in a pressure vessel, which raises concerns for the physical safety of workers. Second, subtilisins are recognized respiratory sensitizers; they can cause asthma in some exposed workers.[34] It may be that the combined risk of pressure vessels and exposures to subtilisins are less hazardous than chronic exposure to tetrachloroethylene. However, this reduction of worker risk cannot be assumed.

The potential for risk shifting of any toxics use reduction option should be examined from the following perspectives:

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[33] Proctor and Hughes (1988) has a description of the occupational toxicity of tetrachloroethylene.

[34] Chan-Yeung (1990)

- risk shift from environment to worker (e.g. waste recycling projects which prolong worker exposures while reducing quantities of substances used and waste produced);
- from one health effect to another (e.g. substitution of TCM-TB,[35] a severe dermal and respiratory irritant, for the carcinogen pentachlorophenol in treating lumber);
- from chemical health risk to safety risk (e.g. the use of flammable or explosive substances to replace CFC's for refrigerant or propellant purposes).

In order for toxics use reduction to achieve the goals of minimizing hazardous waste at source without shifting risks to workers, occupational health and safety perspectives and goals must be more clearly incorporated into TUR legislation and training. Health and safety representatives must be involved in TUR planning. And assessment of changes in risks to workers must be a part of every evaluation of TUR initiatives.

B. Primary Prevention/Toxics Use Reduction in Occupational Health

In the last century British miners took canaries into the coal mines because the birds were sensitive to the asphyxiating properties of methane (also an explosive gas). When a bird keeled over and died, miners ran for the surface.

For more than two decades occupational health advocates have described workers as canaries for the general public. Workers who work with or produce chemicals generally have higher exposures to industrial toxics, are usually the first to show the ill effects, and are usually the hardest hit. It is curious and disturbing, therefore, that toxics use reduction or pollution prevention still have no place in the daily vocabulary of most worker health and safety representatives, industrial hygienists or occupational health policy makers.

Input substitution and other forms of toxics use reduction constitute a common sense approach to reducing occupational disease. There is no risk of exposure or ill health from a toxic

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[35] TCM-TB is short for 2-(Thiocyanomethylthio)benzothiazole. It was used briefly in British Columbia when European nations introduced import bans on pentachlorophenol-treated lumber. Workers found TCM-TB to be intolerable, however, and walked off the job until substitutes could be introduced. According to UFCW representative Larry Stoffman, the search for less toxic substitutes or alternative means of processing the lumber is still underway. (Personal communication)

substance which is absent from the workplace. There is reduced risk when toxics use is diminished across the board. However, most current occupational health and safety policy is based on the notion that all toxic chemicals can be safely controlled in the workplace. Yet even with the best designed control system in place, low-level exposures, breakdowns, accidents, spills and leaks occur. It is impossible to safeguard against every contingency.

Every industrial hygiene textbook and training program teaches the "principles of control". The "principles" outline a hierarchy of controls, naming substitution, and sometimes process changes and improvements in operations and maintenance as the preferred means of reducing worker exposures to hazardous chemicals. Down the hierarchy are enclosure (of the toxic substance), isolation (of the worker from the substance) and ventilation. Despite the hierarchy, all of the above measures are usually lumped together in the general category of "engineering controls" and treated by hygiene practitioners as equally valid approaches. Engineering controls are considered preferable to administrative controls and personal protective equipment, which are found at the bottom of the hierarchy.

Most textbooks pay lip service to the hierarchy of controls and to substitution and process change as the preferable "control" methods. Following a brief introduction to the principles of control, the texts then move on to analyze in detail the control methods that hygienists are really expected to use: ventilation and personal protective equipment, especially respirators. The most recent edition of Patty's Industrial Hygiene and Toxicology, a venerated hygiene reference text, illustrates the pattern by devoting a single page to substitution and process changes compared to more than 100 pages on ventilation systems and respirators.[36]

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[36] Clayton GD, Clayton FE (editors) Patty's Industrial Hygiene and Toxicology, pages 137-194 and 675-720. Ironically, the author of the engineering controls section of the text says this about substitution: "Substitution, although frequently one of the most simple engineering principles to apply, often is overlooked as an appropriate solution to an industrial hygiene problem. There is a tendency to analyze a particular problem from the standpoint of correcting rather than eliminating it. For example, the first inclination in considering a vapour exposure problem in a degreasing operation is to provide ventilation of the operation rather than consider substituting a solvent having a much lower degree of hazard associated with its use. However substitution of less hazardous substances, changing from one type of process equipment

Patty's section on substitution describes the potential of the method for effectively "controlling" hazards and provides a few examples of substitutions. (Patty's considers both input substitutions and equipment or process changes under the heading of substitutions.) The text emphasizes the problem of switching from one chemical with one type of hazard, to another which presents a different hazard. However, it offers little practical advice about how to implement substitution strategies.

This lack of practical advice is the norm in other spheres of the occupational hygiene literature as well. A search on recent editions of the NIOSHTIC occupational health data base, OSHA CD-ROM and an ILO data base turned up no documents which used as key words any of the following phrases: "pollution prevention," "toxics use reduction," "source reduction," "input reduction," "phase-out" or "ban". "Process change" brought up a few documents, but none in the toxics use reduction context. "Substitution" was the only word which identified a significant number of references, but only a handful of these addressed substitution as a central issue -- mainly dealing with the unintended occupational health consequences of phasing out CFC's.[37]

By contrast, many occupational health articles, guidelines, texts and handbooks are devoted to the design and operation of ventilation systems or the appropriate selection, fit-testing and maintenance of respirators. The rapidly growing literature on substitution, process change and equipment modification is mainly in the engineering and environmental fields, and it is not by and large informed by occupational health sensibilities.

A similar neglect can be seen in the course offerings in most occupational hygiene programs. Toxics use reduction and pollution prevention are not part of the curriculum in any serious way.

Even the Work Environment Program at the University of Massachusetts at Lowell, which maintains a strong connection to the Toxics Use Reduction Institute, has not yet fully integrated TUR into the curriculum. The WEP is unusual in that it includes an optional course on toxics use reduction. However, this course is not required and to date has not been listed in the master plans for any of the four study concentrations in the program. Few students enrol in the TUR course, which suggests it is not yet seen as an important subject in the field of industrial

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to another, or in some cases even changing the process itself, may provide an effective control of a hazard at minimal expense."

[37] Olander (1991)

hygiene. The required hygiene courses are more conventional. Although the principles of toxics use reduction are taught, the main body of the courses are devoted to air monitoring, ventilation and personal protective equipment.

This neglect is reflected at the level of occupational health policy as well. In regulations, substitution is often mentioned as a "control" method, but rarely is substitution mandated by law. There are a couple of exceptions. A Danish regulation was passed in 1982, requiring that "(a) substance or material which may constitute a danger to or in any other way adversely affects safety and health shall not be used if it can be replaced by a harmless, less dangerous or less harmful substance or material."[38] The Canadian Labour Code, which applies to federal government employees, communications, transportation and bank workers, also contains a general duty clause that requires employers to substitute less toxic substances for more toxic ones whenever feasible. A similar provision is included in provincial legislation in the province of Newfoundland, and is contemplated in Ontario. Unfortunately, these laws are not enforceable as written and only one employer -- Bell Canada -- pressed by the union representing its workers, has established a process for targeting materials for substitution and criteria for choosing less toxic substances.[39]

Occupational health advocates may stick to traditional methods of control because these have resulted in improving working conditions over the last several decades. Ventilation, improved housekeeping, and equipment modifications to reduce airborne concentrations of toxics have certainly reduced worker exposures in many workplaces. The incidence of many acute illnesses and of the most obvious of chronic occupational diseases such as lead poisoning, asbestosis and silicosis has fallen. Control of toxics has not, however, eliminated workplace morbidity and mortality. Hard-to-control, low-level exposures continue to give rise to more subtle but debilitating effects and to long-latency diseases (which appear many years from first exposure, making it hard to establish causality).

Also, ventilation, wet sprays and other traditional forms of workplace exposure shift risks from workers to the environment by venting toxics to the atmosphere, or collecting them in wastewater or in solid form and disposing of them in surface water or landfill sites. Such activities create a clear conflict

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[38] Nielsen (1991)

[39] Personal communications with Gary Cwitco, former Director of Occupational Health and Safety, Communications Workers of Canada

between occupational health and environmental goals and although widely used, are no longer acceptable.

Occupational health needs to make the leap which the environmental field has recently taken, towards a fundamentally more preventive approach to reducing toxic hazards. This does not mean that occupational health can simply follow the path laid out by environmentalists, however. An approach to toxics use reduction for occupational health purposes will necessarily differ from that undertaken to reduce the release of hazardous waste, though the two may well complement each other.

What is common to the two approaches is a general concern for human toxicity, especially for the mutagenic, carcinogenic and reproductive effects of industrial chemicals. The potential of some toxics to accumulate in human tissues and cause chronic disease is a shared worry. The flammable and explosive properties of chemicals are also of interest to both occupational health and environmental advocates, since chemical fires and explosions potentially threaten both workers and communities.

However, many concerns would differ between workplace-focused and environmentally-driven approaches to TUR. For example, occupational health priority might be given to reducing use of substances which are released in significant quantities into workplace air, where environmental priority is given to less volatile substances released in large quantities to the general environment in waste water or in solid wastes. Eliminating an ozone-depleting substance may have high priority for environmental purposes, but relatively low priority for worker health. The chart on the following page may serve as a first iteration of criteria for toxics use reduction priorities for achieving environmental or occupational objectives or both.

Ideally, a toxics use reduction planning team would take into account all of the criteria listed. However, to ensure that worker health and safety is accounted for, occupational health representatives should focus on those criteria which correspond to their primary concerns.

Criteria for Prioritizing Substances or Processes, Selecting Options for Toxics Use Reduction Programs by Environmental or Occupational Safety and Health Goals

Criteria	Goals	
	ENV	OSH
Amount released to general environment	*	
Persistence and bioaccumulation in environment, ecosystems	*	
Ecosystem toxicity	*	
Effects on ozone layer or global climate change	*	
Human mutagenic, carcinogenic and reproductive reproductive effects	*	*
Long biological half-life in human tissue	*	*
Flammability and/or explosivity	*	*
Amount released in work environment		*
Irritant, dermal, narcotic, asphyxiant, sensitization and other acute effects[40]		*
Physical hazards (heat, noise, vibration) associated with process or proposed options		*
Mechanical safety and ergonomic impacts from existing processes, work practices, or changes for TUR purposes		*
Job insecurity or deskilling which arise from changes in production[41]		*

[40] These health consequences are mainly confined to the workplace, where exposures are high enough to elicit the listed effects. Irritant gases such as sulphur dioxide and nitrous oxides are also of concern to environmental advocates because they are released in huge quantities to the general environment and have public health consequences.

[41] Unemployment is at least as bad for the health of workers as many chemical exposures.

TOXICS USE REDUCTION AND OSHA

A. OSHA's Mandate and Functioning

OSHA's mandate, as set out by the Occupational Safety and Health Act of 1970, is "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions."[42] The regulation of hazardous substances is only one part of this mandate. OSHA is also responsible to regulate a huge range of safety hazards, physical hazards (including noise, radiation and temperature extremes) and workplace ergonomic hazards.

OSHA is responsible for:

- developing occupational safety and occupational health standards;[43]
- enforcing compliance with the laws and regulations by inspecting workplaces and employer injury and disease records, writing orders, and assigning penalties;
- short-term training of OSHA personnel, and training of employers and employees in the recognition, avoidance and prevention of unhealthful working conditions;
- consultation services for employers and employees;
- approving and monitoring state occupational health and safety programs.[44]

The OSH Act itself emphasizes a traditional command and control model of regulation and enforcement. The Act sets out detailed rulemaking procedures for the development and promulgation of new safety and health standards, incorporating several opportunities for public comment and for legal challenges to such standards.

Republican anti-regulatory policies, together with cumbersome rulemaking procedures and onerous interpretations of requirements by the courts have seriously impeded OSHA's regulatory initiatives, however. Republican administrations, especially in Reagan era, appointed anti-regulatory agency directors, recalled or weakened proposed standards, and established cost and feasibility testing.

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[42] Occupational Health and Safety Act of 1970, Section (2)(b).

[43] The Act gave OSHA permission to adopt national consensus standards and Federal standards during the first few years of operation.

[44] Each of these functions is described in more detail later.

OSHA's record on enforcement activities is less clear. The agency has alternated between more and less activist orientations towards enforcement, depending on who holds the position of Assistant Secretary responsible for OSHA. However activist a particular director, enforcement has consistently been hamstrung by lack of resources[45] and by an obstructive adjudicatory body.[46]

Workplace safety hazards dominated both the regulatory and enforcement sides of OSHA's work for many years, in part because physical injuries and fatalities from safety hazards are usually easier to identify, assess and regulate than those resulting from chronic chemical exposures. Most of the consensus standards adopted by OSHA during its first two years were safety-related. OSHA employed one industrial hygienist for every 10 safety inspectors in its early years.[47] In 1976, the health standards staff consisted of only 26 people.[48] Over time, public demands have shifted more of OSHA's resources to the health hazards of toxic substances. However, the ratio of safety to health inspections is still more than 3 to 1.[49]

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[45] OSHA's budget has not kept pace with inflation since the late 70's. The agency currently receives the equivalent of $3 per worker annually, compared to $249 per U.S. citizen allocated to the Environmental Protection Agency. (David May, OSHA New Hampshire Area Director, Work Environment Program Seminar, October 24, 1994.) Congress is currently considering substantial budget cuts to OSHA.

[46] The Occupational Safety and Health Review Commission has the responsibility for hearing employer appeals of OSHA citations or penalties, to adjudicate their validity. The Commission consists of three members appointed by the President. Many of these appointees have been openly hostile to OSHA's mission and have attempted to limit OSHA's regulatory authority. Employers contest a great many citations -- up to 20% in some years -- which creates a huge backlog of cases at the Commission. Meantime, employers are not obliged to abate the cited hazards. (McGarity and Shapiro, 1993)

[47] Ford (1991)

[48] McGarity and Shapiro (1993). Even now, the Directorate of Health Standards Programs employs only 50 people. (Daniel, 1992)

[49] In fiscal year 1992, there were 33,361 safety inspections compared to 9,070 health inspections. (Andersen and Patterson, Summer 1993)

The current OSHA leadership has made a number of internal administrative changes to attempt to rationalize and speed up standard-setting.[50] OSHA is also undergoing a "reinvention" process, to improve inspection targeting and effectiveness and to reduce paperwork.[51] However, the current political climate is not a good one for new initiatives at OSHA. A Special Report in the Occupational Safety and Health Reporter indicates that OSHA is coping with a significant manpower shortage:

> "(T)he scope of OSHA's responsibilities has grown dramatically... Since the early 1970's, the number of workplaces covered by OSHA has risen from 3.5 million to 6 million and the number of workers covered has grown from 58 million to 96 million. However, the number of full-time OSHA positions has dropped significantly since 1980, and in the past six years the number of inspections has declined by 40 percent."[52]

The new Republican Congress has an anti-regulatory agenda at least as strong as that of the early Reagan administration, and is looking to curb OSHA even further. Substantial budget cuts are proposed. Risk assessment requirements which would further slow the chemical regulations process are also proposed.

B. OSHA's Standards

In the main, OSHA has taken a specifications approach to the regulation of safety hazards and more performance-oriented approach to health standards, especially with regard to exposure prevention and control measures.

1. Air Contaminants Standard:

OSHA began regulating toxics with passage of the first Air Contaminants Standard. This was one of several national consensus standards which the OSH Act permitted OSHA to adopt during the first two years of its existence, to jump-start the regulation-setting process. The standard adopted as legally enforceable exposure limits the 1968 list of Threshold Limit Values (TLVs) for 410 substances.

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50 Silverstein Memorandum (November 19, 1994)

51 Bowers (1994), David May (Work Environment Program Seminar, October 24, 1994)

52 Combs, Scott and Sullivan (1994)

The TLVs are recommended by the American Conference of Governmental Hygienists.[53] These standards have probably done little to reduce exposures in industry, since they appear to have been based more on industrial exposures current at the time they were recommended, than on levels which would protect workers from health effects.[54]

OSHA updated the 1971 Permissible Exposure Limits in 1989, reducing limits for 212 substances and adding new limits for 164 additional chemicals. OSHA continued to rely heavily on TLVs -- more recent ones -- and some NIOSH Recommended Exposures Limits in this process. However, the new Air Contaminants Standard was vacated by the Eleventh Circuit Court in 1992, resulting in a return to the old PELs. Consequently, workers continue to be exposed to hazardous levels of many toxic substances without recourse.

The Air Contaminants Standards are performance standards. The PELs provide the main legal requirement. The Standards say only this about controlling exposures:

> "To achieve compliance ..., administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees within the limits prescribed by this section."[55]

Air Contaminants Standards could contribute to toxics use reduction in two ways. First, PELs could be set at truly protective levels (which means, among other things, that OSHA must end its reliance on the ACGIH TLVs). Lower PELs can be technology-forcing, both for prevention/TUR technologies and control technologies. They make it more difficult for employers

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[53] Despite its name, the American Conference of Governmental Industrial Hygienists and particularly its Threshold Limit Value Committee have been long dominated by corporate interests. Until recently, the TLVs for many substances, were researched and recommended by representatives of the same companies which produced and sold the chemicals. See Castleman and Zeim (1989) for further details.

[54] Roach and Rappaport (1990). This study of 28 TLVs for which the TLV Committee cited human studies, demonstrated that more than 20 of 28 TLVs were set at levels equal to or higher than exposures which caused human health effects in the literature reviewed by the TLV Committee in setting the limit.

[55] CFR 1910.1000 (e)

to use secondary exposure prevention methods such as conventional ventilation controls or respiratory protection and still be in compliance. At least some employers would be compelled to look for substitutes or investigate process changes that could eliminate the use of highly toxic substances. To make the message more direct, the Air Contaminants Standard could also incorporate a clear hierarchy of compliance methods, with reduction of the use of toxics at the top of the list.[56]

2. Individual Health Standards:

Over the last 24 years, OSHA has also promulgated 26 health standards regulating individual substances. Thirteen of these regulations were "boilerplate" standards for a group of chemically-related carcinogens. (Fourteen carcinogens were originally regulated, but one standard was vacated by the courts.)[57]

Individual health standards are quite lengthy, providing substantial direction for employers on:

- Scope and Application - sets out the industries or processes where the regulation applies;
- Permissible Exposure Limit(s) - outlines one or more of time-weighted average exposures permitted, short-term limits, excursion limits or ceilings;
- Exposure Monitoring - describes prescribed sampling procedures, interpretation of results, and notification requirements;
- Regulated Areas - limited entry and posting requirements for areas where exposures may exceed the PEL;
- Methods of Compliance - sets out requirement to use engineering controls and work practices as primary measures to reduce exposures below the PEL; may also identify operations where engineering controls are infeasible; describes compliance program requirements where exposures exceed the PEL;

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[56] It would be naive to think that these relatively simple changes could be easily incorporated into the law. OSHA's failed attempt to update the PELs with modestly more protective limits demonstrates the political difficulty.

[57] These standards did not establish PELs. They did set down strict requirements for use, including isolation and enclosure conditions, ventilation, protective clothing and respiratory equipment, decontamination procedures, hygiene facilities and practices.

- Respiratory Protection and Personal Protective Equipment - describes when respirators and other ppe are to be used, as well as selection, maintenance and training requirements;
- Emergency Situations - requirements for a written emergency plan, for alerting and evacuating employees;
- Medical Surveillance - medical testing and reporting requirements.

The standard may also include various technical appendices which operate as non-obligatory guidelines.

The Act requires that health standards ensure "to the extent feasible" that no employee will suffer impairment of health or function even if exposed for his working life.

It has proved very difficult for OSHA to develop and promulgate health standards. Only two health standards have been unchallenged in the courts. With each successive attempt at health standard setting, OSHA has been forced into an increasingly defensive posture, positioning itself for subsequent judicial reviews.[58] OSHA carries out ever more and wider-ranging research, writing longer justifications of its position to the point where the preamble for the most recently completed standard (cadmium) exceeds 300 closely-written pages in the Federal Register. This costs many millions of dollars for research, public hearings, and litigation and slows standard-setting to a crawl. Of OSHA's 25 health standards, 28% took 6 or more years to complete and promulgate; 40% took 5 or more years; and almost half took more than 3 years.[59]

OSHA could encourage toxics use reduction in individual chemical health standards in the same way outlined for the Air Contaminants Standards -- lowering PELs and incorporating a clearer hierarchy of controls with product reformulation, process change and substitution at the top. In fact, PELs for individual health standards are usually much more protective than the PELs in the Air Contaminants Standard, and to some extent may already indirectly encourage TUR approaches for some substances (asbestos, for example). Because this approach is indirect, and because it deals with substances one by one, it has serious limitations, however.

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[58] The Preamble to the Methylenediamine Standard discusses this problem quite openly.

[59] McGarity and Shapiro (1993)

Individual health standards also provide the opportunity for more detailed discussion of toxics use reduction options for specific toxic substances. OSHA has taken a few tentative steps in this direction. In an Advanced Notice of Proposed Rulemaking, for example, OSHA may invite comment on the toxicity, availability and feasibility of substitutes, as it did in preparation for the methylenediamine standard.[60] In its Regulatory Impact Analysis for the cadmium standard, OSHA mentioned that some substitution options exist for cadmium, and briefly discussed the role of EPA in providing incentives to substitute away from cadmium pigments. The agency retained a neutral posture with respect to substitution, however, suggesting that the "limits of substitution had been reached" in the plastics industry, which consumes 80-90% of cadmium used in the U.S.[61]

OSHA is hampered by the Supreme Court's cotton dust decision, which held that OSHA must enact the most protective standard possible to eliminate a significant risk of material health impairment, subject to the constraints of technological and economic feasibility.[62] This puts limits on the technology-forcing capacity of a new standard, because it implies that controls must already be known and assessed as part of the standard-setting process.

3. Process Safety Management Standard:

Several of OSHA's safety standards regulate safety practices related to toxic substances. The most important of these is the Process Safety Management Standard (PSM). The PSM is a unique OSHA standard in that it was mandated by the Clean Air Act

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60 Preamble to the Methylenediamine Standard, Section III, "Events Leading to the Final Standard"

61 Preamble to the Cadmium Standard, Section VIII, "Regulatory Impact Analysis". OSHA did attempt to build substitution into rulemaking with its proposed Carcinogens Policy in 1980. The Policy would have required employers to reduce exposure to known carcinogens to the lowest feasible level, unless there were less hazardous substitutes, in which case no exposure would be allowed. The Policy would also have shifted the onus on industry to prove infeasibility. Unfortunately, the Policy was abandoned by OSHA at the beginning of the Reagan administration.

62 Mick and Jacoby (1991)

Amendments of 1990. A counterpart standard on Risk Management Programs for Chemical Accidental Release Prevention is under development at the EPA. Both the PSM and the proposed EPA Risk Management rule are geared to preventing releases and chemical accidents, rather than reducing toxics use per se.[63]

The PSM applies to employers who use or store one or more of 130 toxic, reactive, flammable or explosive chemicals. If a company uses or stores more than a specified threshold level of the chemical, then it must:

- carry out a hazard analysis of the processes in which the chemicals are used;
- establish written guidelines for processes;
- train involved workers;
- appropriately implement and manage process changes to reduce risks;
- investigate release incidents;
- develop emergency plans.[64]

As it is written, the PSM leads companies to consider and adopt the TUR options of process modernization as well as improved production operations, work procedures and maintenance. A large number of companies have moved to "just-in-time" chemical delivery systems to avoid having potentially dangerous quantities of toxics on hand. To a lesser extent, and indirectly, PSM may also lead some companies to process redesign and substitution initiatives. It would be useful to make toxics use reduction a more central objective of this act, and to provide guidance to employers about planning and implementing TUR as a central means for reducing the risk of chemical accidents.[65]

4. Methods of Compliance Proposed Rule:

Because of the difficulties OSHA faces in promulgating individual standards, it has turned, to the development of "generic standards" which provide more performance-oriented requirements for a broad range of substances. The Air Contaminants Standard

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[63] Nicholas Ashford and Ken Geiser have both criticized this failing of EPA's Risk Management Rule, but to my knowledge, no similar criticism has been made of the PSM.

[64] Ryan (1992)

[65] Both the National Environmental Law Center and Nicholas Ashford of MIT have written a variety of documents which make more specific recommendations for promoting Toxics Use Reduction through the Process Safety Management standard.

is one of these, as is the Hazard Communication Standard. OSHA has also proposed generic standards governing exposure assessment, medical surveillance, safety and health programs, recordkeeping, respirators and personal protective equipment.

OSHA's methods of compliance policy was first adopted in the Air Contaminants standard, which requires that employers rely primarily on "engineering controls" to prevent employee exposures from exceeding permissible exposure levels. This requirement is also stated in OSHA's Respiratory Protection Standard.[66] In 1981 this policy was targeted for review by the President's Task Force on Regulatory Relief. Employers had long pressured the government to allow more extensive use of respirators, rather than engineering controls. They were seeking to shift legal requirements even farther down the hierarchy of controls set out in industrial hygiene principles.

In 1983, OSHA published an Advanced Notice of Proposed Rulemaking, seeking comment on expanding the permitted uses of respirators. In 1989, OSHA proposed the following permitted uses of respirators, on the grounds of general infeasibility of engineering controls:[67]

"1. During the time necessary to install feasible engineering controls;
2. Where feasible engineering controls result in only a negligible reduction in exposure;
3. During emergencies, life saving, recovery operations, repair, shutdowns, and field situations where there is a lack of utilities for implementing engineering controls;
4. Operations requiring added protection where there is a failure of normal controls;
5. Entries into unknown atmospheres."

In discussing the second point, OSHA noted that "confining discussion about the effectiveness of feasible controls to 'conventional' controls may dictate unwarranted conclusion of infeasibility, loss of productivity or ineffectiveness. NIOSH has pointed out that, for the plastics industry, implementing controls for cotton dust, and in silica flour milling, engineering control modifications and innovation increased production and control effectiveness over 'conventional' technology. Innovative controls which are available will have to be assessed before this exception may be relied upon."[68]

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[66] 29 CFR 1910.134(a)(1)

[67] Federal Register (June 5, 1989)

[68] Federal Register (June 5, 1989), page 23994

Unfortunately, OSHA did not develop this commentary further, to specify consideration of "innovative" TUR options such as input substitution, or process changes which would eliminate the use or production of toxics, although these would be logical approaches, not only when "conventional" engineering controls result in negligible reduction of exposure, but also where the failure of normal controls would result in dangerous levels of exposure, as in point four.

OSHA withdrew the proposed rule on Methods of Compliance in February of 1994. It is still on the 1994-95 regulatory schedule, however, listed as one of four "additional projects". Should OSHA reactivate consideration of a new rule on methods of compliance, it should shift attention to the preventive end of the spectrum, and focus on toxics use reduction as priority methods for reducing worker exposures to hazardous chemicals.

C. Enforcement

Section 8 of the OSH Act sets out the powers of inspectors to enter and inspect workplaces in order to ensure compliance with the Act and safety and health regulations. OSHA sets the following priorities for inspections:[69]

1. reports of imminent danger;
2. investigation of fatalities or catastrophes involving hospitalization of 5 or more employees;
3. formal complaints of violations which threaten physical harm;
4. follow-up inspections for willful, repeated and high-gravity violations; employer failure to respond to a failure-to-abate notification; or citations resulting from imminent danger situations.
5. programmed inspections aimed at high-hazard industries, occupations or toxic substances. Priority industries may be selected on the basis of: injury incidence rates; previous citation history; exposure to toxic substances; random selection; or special emphasis programs.[70] Employers who participate in selected voluntary compliance programs may be exempted from programmed inspections.

Inspections are carried out by OSHA compliance safety and health officers (CSHO's) who specialize either in safety or industrial hygiene. The inspections may be limited to specific hazards, to

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[69] Andersen and Patterson (Summer, 1993)

[70] Process safety management was a special emphasis program for several years before the PSM standard was promulgated, for example.

recordkeeping, or may be "wall-to-wall" inspections of the workplace.

The CSHO reports inspection results to the area office and the area director determines any citations to issue and/or penalties to impose.

The OSH Act was amended in 1990 to increase penalties for violations of the Act, standards, rules or orders. Ironically, Congress opposed these increases over the objections of the Assistant Secretary for Labor then responsible for OSHA. The penalties are as follows:

- other-than-serious violation -- up to $7000 per violation, which may be adjusted downward based on employer good faith, history and size of business;
- serious violation -- death or serious physical harm could result and employer knew or should have known; fine is up to $7000 but may also be adjusted downward;
- willful violation -- penalties up to $70,000 for each violation with minimum of $5000 for each; a willful violation that results in death is punishable by a fine of $250,000 - $500,000 or imprisonment for up to 6 months;
- repeated violation -- initial penalty is multiplied by a factor of 2, 5 or 10 depending on the size of the establishment;
- failure-to-abate violation; penalty up to $7000 for each day beyond prescribed abatement date.

The employer must correct the cited conditions by the abatement date established by the OSHA area director, or petition for more time. The employer may also contest the citation and/or the penalty by submitting a written objection to the Occupational Safety and Health Review Commission for adjudication. When an employer contests citations in this way, he is not required to abate until the OSHRC has reviewed his case. This can lead to long delays in abatement.

In practise, OSHA's area director enters into informal negotiations and settlement agreements that revise proposed citations and penalties in order to ensure a timely correction of problems and avoid prolonged legal disputes.[71] Sometimes OSHA area directors are able to negotiate agreements which go beyond the specific requirements of the law in return for reducing citations and penalties. Typically, such agreements include periodic air monitoring, employee training, periodic safety or health inspections, medical monitoring and/or establishment of joint health and safety committees. In a few instances, area

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[71] David May, personal communication (January, 1995)

directors may negotiate substitution of less toxic substances, or other toxics use reduction initiatives. A review of 60 negotiated settlements in New Hampshire identified two agreements which contained TUR provisions.[72]

For egregious cases, where an employer has shown flagrant disregard for OSHA regulations, OSHA can issue a separate penalty for each occurrence of a violation of the same standard up to a sevenfold increase in allowable penalties. Such penalties can total millions of dollars in the case of a major workplace accident or where a corporation has plants and offices in several parts of the country, all operating with the same disregard for health and safety regulations. This has lead to the practise of corporatewide settlements in OSHA. Companies facing multi-million dollar fines and bad publicity are usually eager to sit down and negotiate. Here too, OSHA has the leeway not only to insist on immediate abatement efforts, but also to negotiate programs beyond those which are required by law, in return for reducing fines.[73]

OSHA has entered into more than 80 corporatewide settlements since 1987. Fines, even reduced, have reached as high as $10 million. A number of major corporations have been the targets, including: Phillips, CITGO, USX, GM, Ford, Chrysler, Shell Oil, Fina Oil, Monsanto, Scott Paper, Kaiser Aluminum, Exxon, Union Carbide and DuPont.[74]

OSHA has used corporatewide settlements to "get the attention" of the employer community on special emphasis programs. The huge fines assure substantial publicity for each corporatewide settlement. In the late 1980's, for example, OSHA took on corporations on process safety management and on occupational safety and health recordkeeping. Sometimes, the agency has used these settlements to define acceptable controls related to a

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[72] David May (1991)

[73] Some of these programs may be outside the immediate purview of the workplace. The 1991 settlement with CITGO Petroleum Corporation, for example, included a donation by CITGO to NIOSH for development of a process safety management training program for petrochemical employees.

[74] Several of these companies -- USX, GM, DuPont, Exxon and Union Carbide -- have also been named to the annual "America's Least Wanted List" of companies rated by New York-based Council on Economic Priorities in terms of total toxic releases, hazardous waste management and environmental clean-up efforts.

specific standard.[75] While settlements which focus on process safety management encourage the TUR options of improved production operations, work procedures and maintenance contained in the PSM standard, they do not at present push companies beyond these limited horizons.

OSHA's regional administrators and area directors are empowered to develop special emphasis programs for targeting enforcement to selected industries, hazards or other workplace characteristics. Regional and area directors can also develop experimental programs, which depart from standard OSHA practise in ways other than targeting. Such programs must be approved by the national office and evaluated over time. Maine's "Top 200" Program is a good example.[76]

Over the last decade, Maine's lost-time injury rate topped the average rate of other states by 71%. Previous compliance inspections achieved corrections of cited hazards, but no overall decrease in the injury rate. The Maine area office decided that what was needed was sustainable, comprehensive health and safety programs. In early 1993, the New England Region targeted 200 Maine companies that employ 30% of workforce but experience 45% of compensable injuries and illness. Every three months, OSHA sent a letter to 50 employers (and labor representatives, if any) outlining their workers' compensation profile and information to help develop an action plan. OSHA gave each of these employers 45 days to develop a comprehensive action plan to reduce injuries and illnesses and achieve compliance. Planning is to involve employees. Employers who do not respond are placed on a primary inspection list and scheduled for enforcement inspections. Employers who develop proactive, acceptable plans are placed on a secondary inspection list. One out of five is randomly selected for inspection to ensure the plan of action is underway.

OSHA describes the response to this program as "exceptional" and provides several examples, including a Boise Cascade paper mill where a 1989 wall-to-wall inspection resulted in 2,972 identified hazards and millions in proposed penalties. The company launched a model for the "200" program and in four years reduced compensation costs to 1/36 of 1988 level and set a national

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[75] A 1993 corporatewide settlement agreement with the National Electrical Manufacturers Association (representing Marathon Power Technologies) specifies engineering controls and work practices for controlling exposures to cadmium, including: enclosure, local ventilation, preventive maintenance of ventilation equipment, hygiene facilities and other provisions.

[76] Falacci (Fall 1993)

record for hours worked without an accident. OSHA has proposed expanding this program to implement it nationwide.

The local settlement, corporatewide settlement, and local experimental programs provide a number of opportunities for innovative applications of toxics use reduction programs for occupational health and safety.

D. Oversight of State and Federal Sector Programs

The OSH Act encourages states to develop their own occupational safety and health programs. The state's plan must provide protection at least equal to that provided by OSHA, which means it needs to adopt and enforce standards as good as or better than OSHA's. OSHA provides grants to the states to develop state plans, establish data-collection systems and train personnel. Once a state plan is approved, OSHA funds up to 50 percent of the program's operating costs.[77]

In practise, most of the state programs fall short even of the protection which OSHA offers. A 1992 OSHA evaluation of 22 state programs found deficiencies in all of them.[78] Most of the states were substantially behind OSHA in standards promulgation. Many had lower inspection rates than OSHA's already dismal level of inspections, failed to classify violations as serious, willful or repeat and failed to verify abatement actions by those employers they did cite.

The one advantage of the state program system is that the Act allows any State agency or court to assert jurisdiction under State law for any occupational safety and health issue for which OSHA has issued no standard. An activist state administration may take the lead in developing new or innovative occupational safety and health laws or policies Over the last two decades some states have taken leadership in providing certain more protective regulations or practices, pushing OSHA to play "catch-up". This happened with the Hazard Communication standard, when the administration was stalling OSHA regulation at a national level.[79]

The OSH Act requires federal agencies to set up comprehensive occupational safety and health programs consistent with the standards promulgated under Section 6 of the Act. OSHA conducts inspections and issues notices of violation to federal agencies,

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[77] Ford (1991)

[78] U.S. DOL Press Release (January 31, 1992)

[79] David May, personal communication; McGarity and Shapiro (1993)

and can negotiate nationwide abatement agreements, but does not have the authority to issue penalties. Federal agencies employ substantial numbers of safety and health specialists. The Department of Defense, for example, employs about 10,000 full-time occupational safety and health professionals.[80] These agencies also employ large numbers of environmental compliance officers. DOD and NASA have even developed their own standards. Were toxics use reduction to become an occupational health priority, federal agencies would be well-placed to provide model programs.

E. Consultation Services

OSHA operates a free, voluntary consultation service targeted at small employers in high hazard industries. In some states, specific industries are targeted and consultants actively solicit employer participation.[81] The service is also available to the public sector in states without state plans. In all instances, however, consultants enter workplaces only at the specific invitation of the employer. The program is separate from the enforcement program, and to emphasize the separation, OSHA consultants work out of home-based offices. No citations are issued or penalties proposed. In fact, the company undergoing a consultation is exempted from programmed inspections for a one-year period.[82] However, the employer who asks for an OSHA consultation commits to correcting serious safety and health hazards prior to the visit. (The consultant will help develop an abatement schedule.) And failure to correct a serious hazard will lead to a report of non-compliance to the area office.

The consultation may be restricted to a specific problem -- ergonomics, hearing conservation, air contaminants, hazard communication, trenching or machine guarding for example -- or may be comprehensive. The service can provide the following:

- appraisal of hazards and work practices;
- assistance in establishing or appraising and improving safety and health programs;
- conference with management on findings;
- written report of recommendations and agreements;
- training and implementation assistance;
- follow-up.

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[80] Bergin et al (Summer 1993)

[81] Cole (Summer 1993), Fleming (Winter 1992)

[82] Given the scarcity of OSHA resources, this is not much incentive.

Consultants specialize in either safety or health (hygiene). Consultation staff may attend specialized courses offered by the OSHA Training Institute and an annual consultation conference to exchange program experiences, discuss policy guidance and explore new ideas. They also have access to OSHA consultation and enforcement data bases (IMIS).

A consultant visit is organized very similarly to an inspection. The consultant gets information about the company prior to the visit, reviews relevant standards and arranges for any necessary sampling equipment. The visit involves an opening conference, walkaround assessment and closing conference in which:

- hazardous conditions are summarized and reviewed;
- recommendations for eliminating or controlling hazards are discussed;
- timeframes are agreed on; and
- training needs may be discussed.

The employer is required to make a written report to the consultant on the correction of hazards. The consultant may carry out follow-up visits to verify corrections. At the end, the consultant prepares a report of the whole process.

No evaluations of OSHA's consultation services appear to have have been published, and I have not discussed these services with the appropriate OSHA personnel. Consequently I do not know to what extent toxics use reduction options are ever recommended to employers as the preferred means for reducing occupational risks. However, these services may have potential for promoting TUR -- especially existing technologies -- in small workplaces.

F. Voluntary Protection Program

Under the Reagan administration, OSHA shifted emphasis from "command and control" to voluntary compliance. OSHA set up the Voluntary Protection Program, designed to:

- recognize the outstanding achievements of those who have successfully incorporated comprehensive safety and health programs into their total management system;
- motivate others to achieve excellent safety and health results; and
- establish a relationship among employers and OSHA that is based on cooperation rather than coercion.[83]

The Program has three categories -- Demonstration, Merit and Star -- each with successively more comprehensive criteria. To become Star candidates, employers must meet the following requirements:

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[83] Ford (Spring 1991)

- develop clear policies of management commitment to safety and health;
- carry out workplace hazard analysis to identify existing and potential hazards;
- implement hazard prevention and control systems to correct identified hazards;
- develop safety and health training;
- ensure employee participation in the program;
- evaluate the program annually;
- maintain injury rates below the national average for the industry.

Despite the investment of significant resources, the Voluntary Protection Program has had limited success.[84] Relatively few employers enrol. Of those who do, only 97 worksites had achieved Star distinction up to 1992; 18 had maintained Star quality programs for 6 consecutive years; one for 9 years.[85]

The Voluntary Protection Program did spawn the Safety and Health Management Guidelines which OSHA issued in 1989, and which formed the basis of the OSHA reforms proposed a few years ago. Drawing on effective VPP programs, the guidelines describe in some detail the major elements of an effective safety and health program.[86] Many of the recommendations parallel the practices of toxics use reduction planning. A workplace which integrated toxics use reduction with a comprehensive health and safety program could accomplish a great many occupational health and environmental goals without duplicating effort.

G. Training

The OSHA Training Institute in Des Plaines, Illinois, provides training for federal and state compliance officers, state consultants, other federal agency personnel and -- to a lesser

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[84] Fred Malaby, personal communication (October 1994)

[85] Catanzaro (Fall 1992)

[86] The elements include: written management health and safety policy, participation of management and employees in the operation of the program, annual evaluations, comprehensive surveys to construct hazard inventories, regular inspections, investigation of accidents and near misses, analysis of patterns of illness and injuries, control of hazards (using conventional industrial hygiene approaches), preventive maintenance programs, emergency planning and practice, and health and safety training.

extent -- private sector employers and employees.[87] Institute courses are pretty much designed as "meat and potatoes" programs to cover the traditional occupational safety and hygiene gamut. Not surprisingly, OSHA courses which examine control measures emphasize ventilation and proper use of personal protective equipment rather than toxics use reduction options.

OSHA also awards grants to nonprofit organizations to undertake training and education in occupational health and safety. This year's grants went for training in ergonomics, construction safety, small business safety and health programs, logging safety, lockout/tagout and process safety management.[88]

There appears to be some leeway for Regions and grantees to look at alternative training programs. An innovative program on application of toxics use reduction options to occupational health might well receive consideration in states with TUR legislation.

H. Interface between OSHA and EPA

OSHA has a number of formal agreements with EPA and other agencies, to try to sort out responsibilities in areas of overlapping concern. Negotiations may initially arise out of a jurisdictional conflict between the agencies. Agencies attempt to settle these conflicts by agreeing to a Memorandum of Understanding (MOU) which clarifies the agencies' respective authorities, responsibilities for inspection and enforcement, provide guidelines for coordinated activities, if any, and may establish procedures for settling further disputes.[89]

In 1987, OSHA, NIOSH and EPA implemented an MOU to coordinate and exchange information on health issues and regulatory activities.[90] The MOU established the ONE committee, which meets monthly "to coordinate programs and activities related to standards and to ensure a regular exchange of ideas and information on current and future projects." In 1993 the Mine Safety and Health Administration joined the committee.

In the fall of 1994, the Office of Pollution Prevention at EPA made a proposal to the ONE Committee on enhanced cooperation on occupational chemicals in preparation for developing a national

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87 Ford (Spring 1991)

88 U.S. DOL OSHA Region I News Release (September 28, 1994)

89 Solheim (Summer 1990)

90 Mallinger (Spring 1994)

strategy for workplace toxics.[91] The proposal recommends coordination in:

- standard-setting, especially on updates of the Air Contaminants Standard and of the OSHA 6(b) individual health standards;
- compliance/enforcement issues, by using TRI data for enforcement targeting, coordinated compliance strategies for new OSHA health standards such as methylene chloride;
- use of voluntary programs to promote private and public sector leadership on pollution prevention for reduction of occupational exposures;
- coordinated research to fill data gaps for priority chemicals;
- long-term alignment of policies and priorities including simultaneous review of occupational and environmental issues for specific operations hazardous operations (such as degreasing).

OSHA and EPA signed a further Memorandum of Understanding in 1990, agreeing to cooperation and coordination in training, data and information exchange, technical assistance and referrals of alleged violations. The agencies also agreed to develop an annual workplan to identify and define priority joint projects during the year. The MOU laid the groundwork for joint inspections "as necessary to carry out the legislative purposes of the respective statutory authorities", although the agreement emphasized interagency referrals over joint inspections.[92] OSHA agreed to refer to EPA, for example:

- worker allegations of significant adverse reactions to a chemical which poses a potential hazard to public health or the environment;
- accidental, unpermitted, or deliberate releases of chemicals beyond the workplace;
- unsafe handling, storage or use of chemicals or waste materials in apparent violation of EPA-administered laws.

The agencies agreed to develop and conduct periodic training programs for each other's personnel to facilitate valid referrals and to support joint enforcement and inspection initiatives.

In the intervening years, EPA and OSHA have cooperated on multi-media inspections of several petrochemical plants in Regions II, III, V, and VI, in keeping with priority concerns of both

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[91] OPPT (November 23, 1994)

[92] Memorandum of Understanding, November 23, 1990

agencies to prevent major chemical accidents.[93] EPA provided OSHA with toxics release inventory data for the targeted facilities and provided technical assistance during chemical process safety reviews.

EPA and OSHA also participate in an inter-agency workgroup to address the risks posed by exposure to lead. While the two agencies agreed to inspect lead smelters together in 1991-92, OSHA was unable to target full-scale inspections of the same facilities EPA inspected. However OSHA provided EPA with blood lead data on workers targeted by EPA for inspections.

OSHA and EPA also carry out concurrent inspections of hazardous waste incinerators.

It is evident from various "progress reports" that the interagency coordination has not been smooth.[94] The Progress Report for FY 1992 was critical about the effectiveness of joint inspections[95] and the proposed plan for OSHA-EPA cooperative activities for FY 1995 admitted:

> "There is ample evidence that the lack of a workplan after FY91 and the failure of previous efforts at cross training reflects a lack of management attention or interest or both."

Interagency cooperation appeared to be briefly invigorated in the fall of 1994. In preparation for the FY 1995 workplan, OSHA asked regional representatives to recommend areas of cooperation

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[93] Roy Clason, Memorandum (May 15, 1992)

[94] Progress Report (November 8, 1991)

[95] "The two agencies have learned, however, that joint inspections do not represent the most efficient means of enforcement for either agency. The two major impediments encountered were an inability to locate facilities that met the targeting requirements of both agencies, and the disparity in the time needed by each agency to complete an inspection. EPA's inspections required, at most, one day for sampling the air, water, and soil around a plant and reviewing hazardous waste disposal procedures. OSHA's inspections, on the other hand, often required weeks of careful in-plant analysis. The expected benefit to the employer of less time with an inspector in the facility was not realized, and since the OSHA and EPA teams worked separately, there was no significant increase in the number of referrals."

at the regional level. The comments emphasized the need for a simple referral form and cross-training of inspectors to make for more effective interagency compliance referrals. OSHA regional representatives also asked for personal interaction between OSHA compliance officers and EPA field investigators, as well as local information exchanges between the agencies on specific issues such as engineering control technologies recommended by EPA, or site-specific effluent data. One region recommended joint "multimedia" seminars for selected industry sectors to improve understanding of the interrelatedness of OSHA and EPA regulations.

This flurry of proposals for joint activity is unlikely to bear fruit in the near future, however. The November elections have put both agencies on the defensive, which makes new initiatives even more difficult. This is particularly unfortunate, because it reinforces the insulation of OSHA from the new pollution prevention thinking which EPA and the environmental community has been undergoing.

One current EPA initiative highlights the continued insularity of the two organizations and their respective constituencies. The 1994 Common Sense Initiative (CSI) convenes teams of government representatives, business and environmentalists to examine ways in which regulation can be altered to promote pollution prevention in six highly polluting industries, including:

- automobile assembly;
- computers and electronics;
- iron and steel;
- metal plating and finishing;
- petroleum refining; and
- printing.

The CSI projects are intended to move environmental protection from substance-by-substance regulation to industry-based source reduction. EPA also hopes to promote cooperation, flexibility and creativity in environmental regulation.

The Metal Finishing Industry Group is situated in Region I and includes representatives from the industry, from environmental organizations, state and local government representatives and EPA officials. Despite the fact that metal finishing operations are quite hazardous for workers, and any changes in chemicals, processes operations will impact significantly on the work environment, neither OSHA nor labor groups were initially invited to participate in this project.[96]

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[96] Dr. Rafael Moure-Eraso, OSHA's part-time Advisor on Chemical Exposure Prevention, was invited to participate in a recent tele-conference for the metal

If toxics use reduction initiatives are to effectively embrace worker health, and if occupational health proponents are to promote primary prevention, then this type of organizational insularity must end.

OPPORTUNITIES AND OBSTACLES FOR TOXICS USE REDUCTION IN OSHA

In the fall of 1994, as this research began, it was possible to be reasonably optimistic about the potential for developing toxics use reduction initiatives in OSHA. Pollution prevention had caught on internationally. Conferences and publications described practical programs for substituting common solvents, altering polluting equipment and redesigning toxic processes. Some form of toxics use reduction legislation had been passed in more than a dozen states, several of them defining worker health as a major goal. Massachusetts and other states had experienced several years of TUR planning and were getting ready to evaluate and possibly to expand the application of TUR.

At the national level, anti-regulatory ideologues were momentarily out of power and a more pro-active OSHA leadership had been appointed. A proposed OSHA Reform Bill set out important requirements for workplace safety and health programs, joint safety and health committees and employee participation in enforcement proceedings, improvements in injury reporting, increases in penalties and other provisions. The new OSHA Director of Policy was taking important steps to rationalize and prioritize policy and standard-setting in the agency. Clear policy goals were being established, consistent procedures developed, and deadlines set.[97] A Senior Policy Advisor for Chemical Exposure Prevention was appointed for the first time in OSHA's history.

OSHA-EPA interagency programs and cooperation looked to be reinvigorated. EPA appointed several industrial hygienists with labor experience and an understanding of the relationship between pollution prevention and working conditions. One of these hygienists coordinates the work of the ONE Committee as a major responsibility.

Unfortunately, before this particular conjunction of events bore fruit, what may be the most anti-regulatory Congress in the history of the U.S. was elected, making substantive new national initiatives hard to imagine. Instead, OSHA is on the defensive, anticipating major budget cuts, stuck with tedious reviews of

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finishing group, after the group had been meeting for approximately 6 months.

[97] OSHA Directorate of Policy (August 1994)

existing regulations for "streamlining", and facing the proliferation of risk assessment hurdles in the development of new standards.

Not all of the obstacles result from the current political context. OSHA is plagued by decades-old problems that also make new initiatives difficult: low national priority for occupational safety and health (reflected in OSHA's limited resources); a cumbersome, adversarial rulemaking process; interference of the Office of Management and Budget; hostile members of the Occupational Safety and Health Review Commission; poor coordination with NIOSH and EPA; and location in a professional community with a narrow, control-oriented perspective on reducing hazards.

These obstacles do not make OSHA TUR initiatives impossible, but may limit them to pilot projects and regional or local discretionary initiatives for the time being. This is a good time to press forward on conceptual frameworks for the application of toxics use reduction initiatives to occupational health and safety, to be ready when another window of opportunity for national action is presented.

RECOMMENDATIONS FOR ENCOURAGING OSHA TUR INITIATIVES

A. Changing the Conceptual Framework

Government agencies are seldom in the forefront of major conceptual changes. The culture around them has to alter first, building significant pressure to shift them in a new direction. OSHA is no different, and in view of the political and resource constraints it confronts, may be slower than other agencies to adopt new ideas. Unless the occupational health community embraces toxics use reduction and pollution prevention as the priority means of reducing occupational hazards, OSHA is unlikely to make this leap.

The Work Environment Program at the University of Massachusetts Lowell and the Toxics Use Reduction Institute have a unique partnership which has already begun the work necessary to make this shift. However, more need to be done. A comprehensive approach is necessary, involving changes in:

- curriculum, especially for industrial hygiene students;
- research;
- participation in occupational safety and health and pollution prevention conferences and symposiums;
- publications; and
- interaction with government officials, labor representatives and business.

1. Curriculum:

An important first step would be to better integrate toxics use reduction and environmental issues in general into the industrial hygiene and policy curricula. Many graduating hygienists find employment with companies where they have dual responsibilities for both occupational health and environmental compliance. This provides an added incentive to integrate toxics use reduction into basic level courses on work environment policy and industrial hygiene.[98] TUR should also get at least equal weight with ventilation and personal protective equipment in the advanced course currently titled "Engineering Controls and Personal Protective Equipment". The Toxics Use Reduction course should explicitly examine the application of TUR for occupational as well as environmental health purposes. The course on Health Hazards of Manufacturing Processes should include visits to and evaluations of workplaces which have done TUR planning. Advanced level courses should be developed to explore practical, conceptual and policy issues in the application of TUR for occupational health purposes. These changes to curriculum will take some considerable effort to accomplish, not least because of the certification requirements for industrial hygiene practitioners, which remain firmly focused on air monitoring and engineering controls. There is also a dearth of published materials and research on the overlap between toxics use reduction and occupational health and safety, which could provide the base of readings necessary for new courses or even new emphases in existing courses.

2. Research:

TURI has supported the research of several WEP doctoral candidates on issues related to toxics use reduction and chemical bans. This research should be expanded, however, to more fully investigate the relationship between toxics use reduction and occupational health and safety and to integrate TUR into the WEP curriculum. This research should be regarded as an opportunity both to venture further into a new field, to better integrate the work of faculty and staff in the WEP and TURI and to provide new areas of investigation for students. While the WEP and TURI should take the lead in this research, it also needs to be taken up by other academic and research institutions, OSHA and NIOSH, and consequently specific topics are described in a separate section below.

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[98] Preliminary discussions are now underway among some WEP faculty to incorporate toxics use reduction into industrial hygiene.

3. Participation in Conferences and Symposiums:

To encourage policy-makers, researchers and others to begin incorporating TUR into occupational health, or to include worker health and safety in planning TUR for environmental purposes, staff and faculty from the WEP and TURI should make presentations and encourage discussion on the topic in meetings, conferences and symposiums. Industrial hygienists from EPA have sponsored workshops on toxics use reduction at two recent American Industrial Hygiene Association Conventions (with the participation of Dr. Moure-Eraso in the most recent meeting). These activities should be continued and expanded. A workshop on TUR approaches to occupational safety and health is being proposed for the Pollution Prevention Roundtable in Miami in December 1995. Similar workshops should also be promoted at the American Public Health Association Annual Conference and other meetings.

4. Publications:

New Solutions is unique in that it attempts to link discussion on occupational and environmental policy issues. The journal could help advance this discussion by soliciting and publishing articles on the interface between toxics use reduction and occupational health and safety. Similarly, TURI publications should include this kind of material.

5. Interaction with Government Officials, Labor Representatives, and Business Leaders:

Faculty and staff at the WEP and TURI operate in both formal and informal networks of academics, government staff, labor representatives and business managers. It is important to introduce ideas for TUR applications to occupational safety and health into these networks.

B. Initiate and Support Research

OSHA, NIOSH, academic institutions and others should initiate and publish research which investigates and analyzes both practical and conceptual issues in primary prevention of toxics exposures. Important research topics include the following:

- case studies of current TUR programs, analyzed to explore the impacts -- positive and negative -- of TUR on working conditions and occupational health;
- description of primary prevention efforts such as input substitution and process changes which have been undertaken for occupational safety and health purposes;

- examination of the impediments in occupational safety and health culture to advocacy of primary prevention alternatives;
- development of criteria for prioritizing and selecting TUR applications for occupational safety and health purposes;
- investigation of international experience with TUR applications to occupational health and safety;
- examination of the impact of onerous OSHA regulations (low PELs, specification and surveillance requirements) on toxics use;
- exploration of the relation between Toxics Release Inventory data and occupational exposures (to see if TRI data can effectively help target TUR opportunities for occupational health);
- examination of the current and potential uses of TUR options in local and corporatewide OSHA settlements;
- more specific guidance on ways in which toxics use reduction options could be incorporated into existing or proposed occupational safety and health standards.

There are a wide range of other research topics which are implicitly suggested in other recommendations outlined below.

C. Pilot Projects which Integrate OSH and TUR Initiatives

Pilot projects which could integrate toxics use reduction and occupational safety and health initiatives, and advance our understanding of both problems and prospects are outlined below:

1. Region I OSHA/OTA Project

Dr. Rafael Moure-Eraso, OSHA's Advisor on Chemical Exposure Prevention has proposed a joint project with the Region I office of OSHA and the Massachusetts Office of Technical Assistance, which offers consultation services to employers attempting to design and implement TUR programs. The project has targeted chemicals which are of both environmental and occupational concern, especially substances for which lower PELs are contemplated for the near future. At present, Dr. Moure-Eraso and OSHA are working to identify workplaces which use such chemicals, and expose workers to levels which may have to be substantially reduced under proposed regulations, even if they appear to be in compliance at present. These workplaces will be offered advice by OSHA (including a member of OSHA's national Hazards Response Team) working together with the OTA, on toxics use reduction options for the purposes of reducing worker exposures (simultaneously ensuring compliance with environmental regulations). If the project is successful, it will result in one or more case studies of the application of TUR for occupational safety and health purposes, help establish a cooperative relationship between OSHA and OTA, and cross-

fertilize the thinking of the two organizations. Similar pilots should also be encouraged in other states with toxics use reduction laws and consultant services in TUR.

2. The Common Sense Initiative

The Common Sense initiative provides a series of ready-made pilots which should incorporate OSHA and labor representation so as to integrate environmental and occupational health goals for industrial pollution prevention planning. Ideally, occupational safety and health representation and analysis should be integrated into all six industrial sectors. In particular, the Steering Group for the Metal Finishing Industry Sector, situated in the Northeast, should be targeted for integration.

3. Federal Department Pilots

Pilots could also be encouraged in federal departments which have strong safety and health programs and have undertaken and promoted pollution prevention initiatives. The Department of Defense is one such federal department.

D. Standard-Setting

It will be very difficult to get toxics use reduction options explicitly targeted as priority methods of compliance in OSHA standards, especially in the current political climate. Nevertheless, there are a number of standards in progress for which toxics use reduction options should be proposed. The standard on chromium is a particularly important target, because it is an important environmental and occupational pollutant and the standard is still at a relatively early stage of development. Other standards under consideration which might incorporate more explicit references to toxics use reduction options include proposed rules on asbestos, methylene chloride and glycol ethers.

If OSHA reconsiders its Methods of Compliance Policy, then explicit priority should be given to input substitution, process changes or modernization and other methods of reducing toxics use and exposure to workers.

The Process Safety Management standard already includes some toxics use reduction options, although they are not labelled as such. If toxics use reduction is to become a priority in occupational health regulation, then those preventive measures which involve TUR should be highlighted as preferable options. It is not necessary to change the standard to do this. However, guidance and training materials should explicitly identify PSM requirements for process changes, operations and inventory controls, and maintenance programs as options which ultimately reduce toxics use and releases to the environment.

At this point in time, it may be more fruitful to look for state-plan states to incorporate toxics use reduction into occupational health and safety laws than to focus on the national level. Working at the state and local levels to promote right-to-know laws was an effective strategy which ultimately gained acceptance for an OSHA Hazards Communication Standard, during a time when it was politically difficult to move this agenda forward at a national level. In New England, only Connecticut and Vermont have state occupational safety and health programs, and are unlikely to take leadership of this sort. It might be up to states such as Washington, which has a fairly comprehensive Toxics Use Reduction law and a strong occupational safety and health program to take such an initiative.

E. Occupational Safety and Health Enforcement

Unless toxics use reduction provisions are written into OSHA laws and regulations, compliance officers cannot order employers to comply with standards by means of TUR options. However, OSHA has three discretionary enforcement activities where toxics use reduction could be applied.

A regional or local experimental enforcement program could incorporate TUR. The Maine 200 program requires employers to establish safety and health programs and set up joint safety and health committees which are not required by law, if employers wish to avoid wall-to-wall inspections and probable penalties in the near future. There is no reason that such programs could not further direct employers to investigate toxics use reduction options as the priority "control" measures for worker exposure to hazardous substances.

OSHA area directors could also negotiate toxics use reduction options in local settlement processes. This is done in isolated instances now, but OSHA could encourage area directors to use TUR options much more extensively without altering laws or standards. In states such as Massachusetts, where free consultant services are offered to help employers design and implement TUR programs, area directors could refer employers to these services as part of a settlement procedure.

TUR options could also be promoted in corporatewide settlements. Industries could be targeted not only on the basis of non-compliance, but also where toxics use reduction options are available and underutilized as a means of worker protection. For example, OSHA could target out-of-compliance employers in the six Common Sense Initiative industries, negotiating corporatewide agreements to incorporate TUR options identified in the CSI process.

F. Consultation Services

OSHA's consultation services provide an opportunity to bring toxics use reduction to smaller, high-risk workplaces that might well be missed by OSHA enforcement efforts, and also by TUR programs (in states which have them). Because consultations are done at the employer's request, managers may be more amenable to toxics use reduction measures as a means of reducing worker exposure, especially where low-cost technologies can be plugged in relatively easily. Consultants would need to have access to information on the range of available TUR technologies and options.

In Massachusetts, it may be possible for OSHA consultants to collaborate with the Office of Technical Assistance in designing and recommending toxics use reduction programs for small workplaces.

G. Voluntary Protection Programs

It would be relatively easy for OSHA to build toxics use reduction into the Safety and Health Management Guidelines. At present, the guidelines follow OSHA's usual hierarchical approach to control of hazards. Primary prevention methods, including toxics use reduction, should be clearly defined at the top of the hierarchy. Employers in the VPP should also be required to produce some evidence that they have investigated and implemented primary prevention methods to reduce worker risks.

H. Training

Most of the above recommendations hinge on a change of culture in the occupational safety and health community and in OSHA. A key factor in shifting OSHA from a "control" focus to a "prevention" focus is training.

OSHA and EPA have discussed cross-training for several years. This training should be implemented soon and it should not be limited to a review of existing regulations so that inspectors of each agency can more effectively refer potential problems of non-compliance to the other. Toxics use reduction should be included in the training of OSHA compliance officers. The problems of risk shifting from the environment to workers should be part of the training of EPA investigators. Cross-training should include dialogue on the interface between the occupational and environmental hazards of toxic substances, on the best means of preventing pollution within the workplace and outside it, and ways in which the two agencies can complement each other's work.

OSHA should also provide grants to non-profit organizations to develop experimental training programs and materials on the use of toxics use reduction for occupational health purposes.

CONCLUSIONS

OSHA and occupational safety and health advocates in general need to embrace primary prevention as the best means of protecting workers from hazardous workplace exposures. To accomplish this requires first of all a shift in mindset, an understanding that toxics use reduction is not just a means of improving the general environment, but an essential tool for reducing workplace injuries and disease. The Work Environment Program and the Toxics Use Reduction Institute at the University of Massachusetts Lowell could play a major role in promoting this new perspective.

To maximize the benefits for worker health, and minimize risk shifting, occupational safety and health and worker representatives need to be key players in the planning and implementation of pollution prevention or toxics use reduction initiatives both at the policy level and in individual workplaces, even where these initiatives are undertaken primarily for environmental purposes. OSHA should develop pilot projects to demonstrate and evaluate how such collaboration could work.

This paper has outlined a large number of practical steps which OSHA could and should take to incorporate TUR into occupational safety and health policy, enforcement, consultation and training, without resorting to the difficult task of changing the OSH Act or existing regulations. It has also suggested projects which might be undertaken at a local or regional level, where the difficulties at the national level might be overwhelming at present. It is time for OSHA to make primary prevention its main objective and join in the effort to make workplace exposures to toxics a thing of the past.

BIBLIOGRAPHY

General Documents, Books and Articles Related to OSHA Mandate, Laws, Regulations, Structure and Functioning

Anderson J, Patterson B. Summer 1993. "Enforcement -- Answers to Some Frequently Asked Questions," *Job Safety & Health Quarterly* 4(4):16-20

Anonymous. Summer 1993. "Consultation Tennessee Style," *Job Safety & Health Quarterly* 4(4):25-29

Anonymous. December 1993. "Managing Chemical Risks," *The New England Consortium's Quarterly* 4(4):1-5

Anonymous. Winter 1993. "Safety and Health in the Federal Sector," *Job Safety & Health Quarterly* 4(2):6-10

Anonymous. Winter 1993. "Bureau of Labor Statistics Releases Occupational Injuries and Illnesses Survey," *Job Safety & Health Quarterly* 4(2):12-14

Bergin EJ. Spring 1992. "OSHA's Policy Office Tackles a Wide Range of Issues," *Job Safety and Health Quarterly* 3(3):14-17

Bowers E. Spring 1994. *"OSHA Initiatives Produce Immediate Policy Changes," Job Safety & Health Quarterly* 5(3):32-34

Catanzaro G. Summer 1992. "ABB Air Preheater: OSHA's First 9-Year Star Site," *Job Safety & Health Quarterly* 3(4):26-27

Collier J, Catanzaro G. Fall 1989. "Safety and Health Management Guidelines," *Job Safety & Health Quarterly* 1(1):26-27

Combs J, Scott D, Sullivan J. 1994. "OSHA Program at 'Critical Juncture' Union, Business, Government Officials Told," *Occupational Safety and Health Reporter* 7-27-94:404-421

Daniel M. Winter 1992. "Helping Workers and Workplaces Comply with OSHA Standards," *Job Safety & Health Quarterly* 3(2):9-13

Directorate of Compliance Programs. March 28, 1994. *Procedures for Approval of Local Emphasis Programs and Experimental Programs.* Occupational Safety and Health Administration

Falacci, M. Fall 1993. "Maine's 'Top 200' Program," Job Safety & Health Quarterly 4(1)35-38

Ford RD. Spring 1991. "Twenty Years of Change at OSHA," *Job Safety & Health Quarterly* 2(3):20-33

Foreman P. Winter 1993. "Program Analysts," *Job Safety and Health Quarterly* 4(2):18-24

Foster JF. Winter 1993. "Who's Covered," *Job Safety & Health Quarterly* 4(2): 15-17

Golian A. Fall 1992. "The Office of Field Programs: Communication and Coordination with the Field," *Job Safety & Health Quarterly* 3(1):7-12

Kulick R, Rearick E. Fall 1993. "Reinventing OSHA -- A New Beginning," *Job Safety & Health Quarterly* 4(1):15-17

Lofgren DJ. 1989. *Dangerous Premises: An Insider's View of OSHA Enforcement.* Itaca, New York: ILR Press

Mallinger S. Spring 1994. "NIOSH and OSHA Working Together," *Job Safety & Health Quarterly* 5(3):29-31

Massachusetts Coalition for Occupational Safety and Health. February 7, 1992. Labor and Toxics Use Reduction: Opportunities and Challenges (draft booklet)

McGarity TO, Shapiro SA. 1993. *Workers at Risk: The Failed Promise of the Occupational Safety and Health Administration.* Westport: Praeger Publishers

Mintz B. 1984. *OSHA: History, Law, and Policy.* Washington: The Bureau of National Affairs

Noble C. 1986. *Liberalism at Work: The Rise and Fall of OSHA.* Philadelphia: Temple University Press

Noble C. 1990. "OSHA at 20: Regulatory Strategy and Institutional Structure in the Work Environment," *New Solutions.* Vol 1(1):30-41

Penney JL. 1992. "Regulating Hazardous Substances: A Comprehensive Approach," *New Solutions* 2(4):68-81

Ruttenberg R. 1993. "Is OMB Interfering with Worker Health and Safety Protection?" New Solutions 3(1):76-80

Ryan T. 1992. OSHA's Process Safety and Environmental Law. (Unpublished paper)

Silverstein M. November 19, 1994. *Memorandum for Chuck Adkins re Proposed System for Prioritizing OSHA Regulations.* Occupational Safety and Health Administration

Turner EE, Owen TR. Winter 1991. "Health Standards and the Rulemaking Process," Job Safety and Health Quarterly 2(2):8-10

U.S. Department of Labor. 1989. *Fact Sheet No. 89-26: OSHA's Expanded Hazard Communication Standard.* Occupational Safety and Health Administration

U.S. Department of Labor. 1991. *How to Prepare for Workplace Emergencies.* Occupational Safety and Health Administration

U.S. Department of Labor. 1991. *Corporate-wide Settlement Agreement with CITGO Petroleum Corporation.* Occupational Safety and Health Administration

U.S. Department of Labor. 1991. *Corporate-wide Settlement Agreement with IMC Fertilizer and ANGUS Chemical Company.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(a). *Acting Assistant Secretary Strunk Releases Evaluations of 22 State Job Safety and Health Programs.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(b). *All About OSHA. Occupational Safety and Health Administration*

U.S. Department of Labor. 1992(c). *Fact Sheet No. 92-45: Process Safety Management of Highly Hazardous Chemicals.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(d). *Fact Sheet No. 92-14: Setting Occupational Safety and Health Standards.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(e). *USDOL Program Highlights: Civil Penalties Policy.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(f). *USDOL Program Highlights: Variances under OSHA.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992(g). *USDOL Program Highlights: Voluntary Protection Programs.* Occupational Safety and Health Administration

U.S. Department of Labor. 1993. *Corporate-wide Settlement Agreement with Fraser Paper, Ltd.* Occupational Safety and Health Administration

U.S. Department of Labor. 1993. *Principal Emergency Response and Preparedness Requirements in OSHA Standards and Guidance for Safety and Health Programs.* Occupational Safety and Health Administration

U.S. Department of Labor. 1994. *General Industry Digest.* Occupational Safety and Health Administration

U.S. Government. 1990. *Occupational Safety and Health: Inspectors' Opinions on Improving OSHA Effectiveness.* (Fact sheet for Subcommittee on Health and Safety, Committee on Education and Labor, House of Representatives). Government Accounting Office

Warren W. Winter 1991. "OSHA Safety and Health Consultation Services for Employers," *Job Safety & Health Quarterly* 2(2):26-28

Weil D. 1992. "Reforming OSHA: Modest Proposals for Major Change," *New Solutions* 2(4):26-36

Weinberg J. Summer 1993. "Partnerships in Safety and Health," *Job Safety & Health Quarterly* 4(4):7-12

Toxics Use Reduction Programs

Ahlert RC. September 1990. "Systematic Process Design Analysis for Waste Minimization," *The Environmental Challenge of the 1990's (Proceedings: International Conference on Pollution Prevention, June 10-13, 1990)* Washington: Environmental Protection Agency

Alexander K, Donohue V. 1990. "Cleaner Technologies in the Tanning Industry," *The Environmental Challenge of the 1990's*, op cit, pp. 19-31

American Electroplaters and Surface Finishers Society. 1994. *Proceedings: 15th Annual AESF/EPA Pollution Prevention and Control Conference, January 24-27, 1994.* Orlando, Florida

Darvin CH, Wander J. 1990. "Degreasing System Pollution Prevention Evaluation," Presentation to the Air and Waste Management Association, 84th Annual Meeting & Exhibition, Vancouver, British Columbia, June 16-21, 1991

Drabkin M, Rissman E. 1987. *Waste Minimization Audits at Generators of Corrosive and Heavy Metal Wastes.* Cincinnati: Environmental Protection Agency

Evanoff . 1991. "Hazardous Waste Reduction in the Aerospace Industry," *Chemical Engineering Progress.* 86:4, pp. 51-61

Ficklin AC, Hickle GL. 1990. "Materials Substitution at the Rocky Flats Plant," *The Environmental Challenge of the 1990's.* op cit, pp. 263-273

Marino FA. 1990. "Environmental Health and Safety Impacts of Alternatives to Ozone Depleting Solvents," *Environmental Challenge of the 1990's.* op cit

Massachusetts General Laws, "An Act to Promote Reduced Use of Toxic and Hazardous Substances in the Commonwealth," House Bill No. 6161, Boston MA, June 26, 1989

Massachusetts Toxics Use Reduction Institute. 1995. *Toxic Chemical Management in Massachusetts: The Second Report on Further Chemical Restriction Policies.* University of Massachusetts Lowell

Office of Technical Assistance. 1992. *A Practical Guide to Toxics Use Reduction.* Executive Office of Environmental Affairs, Commonwealth of Massachusetts

Olander L et al. 1991. "Occupational Implications of the Chlorofluorocarbon Ban in Sweden," *American Journal of Industrial Medicine* 19:818-826

Randall PM. 1990. "Prototype Evaluation Initiatives in a New Jersey Vehicle Maintenance and Repair Facility," *The Environmental Challenge of the 1990's, op cit*

Roy M. 1991. "Pollution Prevention, Organizational Culture and Social Learning," Environmental Law. 22:189-251

State of New Jersey Department of Environmental Protection and Energy. Undated. *Ten Most Commonly Asked Questions About: The New Jersey Pollution Prevention Act and Regulations.* Trenton, NJ

Toxics Use Reduction Institute. 1994. *Curriculum for Toxics Use Reduction Planners, 6th edition.* University of Massachusetts Lowell

U.S. Environmental Protection Agency. September 1992. *Guides to Pollution Prevention: Metal Casting and Heat Treating Industry.* Cincinnati, Ohio

U.S. Environmental Protection Agency. October 1992. *Guides to Pollution Prevention: The Metal Finishing Industry.* Cincinnati, Ohio

U.S. Environmental Protection Agency. February 1994. *Guides to Pollution Prevention: Organic Coating Removal.* Cincinnati, Ohio

Washington State Department of Ecology. December 1994. *Pollution Prevention Measurement in Washington State.*

Pollution Prevention Policy

Ashford N. November 30, 1993. *Testimony on the Proposed Rule on Risk Management Programs for Chemical Accidental Release Prevention (40 CFR Part 68)*

Ashford N. 1993. *The Coordination of Environmental and Workplace Concerns in Governmental Programs and Initiatives.* (Draft proposal, unpublished)

Ashford N. 1993. "Understanding Technological Responses of Industrial Firms to Environmental Problems: Implications for Government Policy," *Environmental Strategies for Industry.* Editors K. Fischer and J. Schot. Washington: Pergamon Press pp. 277-307

Center for Technology, Policy and Industrial Development, MIT. February 1994. *Recent Experience in Encouraging the Use of Pollution Prevention in Enforcement Settlements.* (Unpublished report summary)

Geiser K, Berlin A, Hensley J, Thomas, K. September 1994. *A Draft Report on Regulatory and Practical Issues in the Promotion of Toxics Use Reduction in Massachusetts.* Toxics Use Reduction Institute, University of Massachusetts at Lowell

Geiser K. 1994. *Written Comments on the Proposed Rule on Risk Management Programs for Chemical Accident Release Prevention.* (Submission to the EPA)

Gregory M. 1993. *Pollution Prevention in Occupational and Environmental Contexts.* Presentation to the First U.S./Mexico Occupational Health Conference, Scottsdale, Arizona, October 2, 1993

Jackson T. 1993. *Clean Production Strategies: Developing Preventive Environmental Management in the Industrial Economy.* Boca Raton: Lewis Publishers

Rossi M, Ellenbecker M, Geiser K. "Techniques in Toxics Use Reduction," *New Solutions* 2(2):25-32

Roy M. February 1990. "Toxics Use Reduction in Massachusetts: The Whole-Facility Approach," *Pollution Prevention News*

Sasson A. Winter 1994. "Where the Action Is: Pollution Prevention and Regulatory Integration," *P2 Post*

Stenzel PL. 1991. "Toxics Use Reduction Legislation: An Important 'Next Step' After Right to Know" *Utah Law Review* 4:707-748

OSHA/EPA Documents Relating to Cooperation Common Sense Initiative

Schnare D. No date. *Memo to Jana Edwards: A Draft of EPA's Proposed OSHA-EPA FY95 Workplan.* Occupational Safety and Health Administration

U.S. Department of Labor. November 13, 1990. *Memorandum of Understanding between the U.S. Department of Labour, OSHA and the U.S. EPA Office of Enforcement.* Occupational Safety and Health Administration

U.S. Department of Labor. No date. *FY 1991 Workplan, Agreement on Training and Agreement on Data Exchange, Implementing the Memorandum of Understanding between the U.S. DOL OSHA and the U.S. EPA.* Occupational Safety and Health Administration

U.S. Department of Labor. No date. *Progress Report, FY 1991 Workplan Under the OSHA/EPA Enforcement Memorandum of Understanding.* Occupational Safety and Health Administration

U.S. Department of Labor. 1992. *Progress Report on the FY 1992 Workplan Under the OSHA/EPA Enforcement Memorandum of Understanding.* Occupational Safety and Health Administration

U.S. Department of Labor. No date. *Summary of Suggestions for OSHA-EPA Cooperation from the Regions.* Occupational Safety and Health Administration

U.S. Environmental Protection Agency. No date. *The Common Sense Initiative: A New Generation of Environmental Protection.*

U.S. Environmental Protection Agency. 1994. *Common Sense Initiative - Metal Finishing Industry Sector, Proposal to Establish Steering Group and Workgroups.*

U.S. Environmental Protection Agency. 1994. *Minutes, Common Sense Initiative/Metal Finishing Industry Organizing Group Meeting, September 13, 1994*

Other

Proctor NH, Hughes JP, Fischman ML. 1988. *Chemical Hazards of the Workplace.* 2nd Edition, J.B. Lippincott Company, Philadelphia