NATURAL RESOURCES JOURNAL

Volume 23
Issue 3 *Symposium on Environmental Management: The Policy Perspective*

Summer 1983

Regulating Hazardous Waste Incinerators under the Resource Conservation and Recovery Act

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This paper discusses the Environmental Protection Agency's (EPA) regulation of incinerators that burn hazardous waste under the Resource Conservation and Recovery Act. First, we present the history of current EPA regulations. Next, we examine some preliminary results of applying cost and risk models to controls for hazardous waste incinerators. Finally, we discuss some of EPA's regulatory options for changing the current requirements. To achieve greater economic and administrative efficiency, we prefer an approach where EPA prescribes a risk methodology and determines an allowable level of risk based on a national risk-cost analysis, but gives wide latitude to the incinerator operators in how they will achieve these levels of safety.

HISTORY OF EPA's CURRENT INCINERATION REGULATIONS

On October 21, 1976, Congress enacted the Resource Conservation and Recovery Act (RCRA), which gives EPA the legal authority to define hazardous waste and regulate its managment.[1] Section 6924 of Subchapter III gave EPA 18 months from October 21, 1976 to

> *promulgate regulations establishing such performance standards,* applicable to owners and operators of facilities for the treatment, storage, or disposal of hazardous waste . . . *as may be necessary to protect human health and the environment.* Such standards shall include, but need not be limited to, requirements respecting . . . treatment, storage, or disposal of all such waste received by the facility pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator (emphasis added).[2]

RCRA is silent on the issue of whether EPA may consider costs or economic impacts while setting these standards.

Faced with the formidable task of promulgating regulations quickly,

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1. The Resource Conservation and Recovery Act of 1976, 42 U.S.C.A. §§6901–6987 (1976), as amended by the Quiet Communities Act of 1978, 42 U.S.C.A. §§4901–4918 (1978).
2. 42 U.S.C.A. §6924.

EPA first proposed regulations to implement RCRA on December 18, 1978.[3] The proposed incinerator regulations contained operating and performance standards, and would have required incinerators to operate at a specified temperature, retention time, and level of excess oxygen.[4] For performance, the regulations would have required the incinerator to destroy 99.99 percent of the "mass feed rate of principal toxic components of waste going into the incinerator."[5] All regulations were to be implemented through a permitting process.

The background document accompanying the proposed regulations provided EPA's rationale for each standard. In each case, the rationale focused on the technical feasibility of the requirement. As justification for the destruction efficiency requirement, the background document stated that

> [t]he test work performed by EPA . . . to demonstrate destruction of hazardous chemical wastes produced destruction efficiencies of 99.99 percent in five commercial scale different incineration units. . . . Thus, EPA has determined that 99.99 percent destruction efficiency is state-of-the-art and can be routinely obtained in commercial scale incinerators.[6]

The rationale supporting retention time and temperature requirements argued that "two second retention time at or near 1000° with adequate excess air has proved to be sufficient for more than 99.9 percent destruction of most organic pesticides studied."[7] Neither the preamble to the proposed regulations nor the background document discussed the cost of the standards or the relation between the standards and the level of risk to human health.

EPA held public hearings and accepted public comment on the proposed regulations. Public comment of interest to this paper focused on three issues. First, many criticized the proposed temperature and retention time requirements, claiming that incinerators could meet the destruction efficiency requirement at shorter times and lower temperatures. Others, however, alleged that incinerators could not obtain the 99.99 percent destruction efficiency. Finally, some suggested that the destruction efficiency require-

3. 43 Fed. Reg. 59,008–59,009 (1978).

4. Retention time refers to the length of time the waste stays in the combustion chamber. Excess oxygen is the additional oxygen above the minimum quantity required for the combustion reactions.

5. *Supra* note 3, at 58,989. The proposed regulations also would have established requirements for conducting tests of incinerators to ensure required performance (trial burns), monitoring, automatic waste feed cut-off devices, particulate emissions, combustion efficiencies, and administrative standards, all of which are beyond the scope of this paper.

6. OFFICE OF SOLID WASTE, U.S. ENVIRONMENTAL PROTECTION AGENCY, DRAFT BACKGROUND DOCUMENT, § 250.45-1, STANDARDS FOR HAZARDOUS WASTE INCINERATORS 77 (Dec. 15, 1978).

7. *Id.* at 66.

ment should be keyed to specific waste streams, that it should apply to combustion by-products, and that it could not be applied to metals.

In response to these comments, EPA prepared revisions to the proposed regulations. The revisions included an interim final rule[8] and a proposed rule, both of which appeared in the Federal Register on January 23, 1981.

In the interim rule, EPA dropped the retention time, temperature, and excess oxygen requirements. EPA noted in the preamble that

> [d]ifferent wastes and different incinerator designs have been shown in EPA tests to attain the required destruction and removal efficiencies under a variety of operating conditions. . . . These specific operating standards will now, however, be specified on a case-by-case basis during the permit drafting process based primarily on the results of trial burns (or alternative data) which demonstrate the operating conditions necessary to achieve compliance with the performance rule.[9]

EPA also slightly modified the destruction efficiency requirement, replacing it with a destruction and removal efficiency (DRE) requirement, also set at 99.99 percent. The Agency specified that the DRE applied only to principal organic hazardous constituents (referred to as POHCs), which would be identified in the permitting process. Thus, incinerators could either destroy the organic waste or remove it with air pollution control devices. Again, EPA's argument centered on feasibility:

> Finally, on the most important point (attainability), EPA surveyed U.S. and international technical literature to obtain all available data on performance of incinerators destroying hazardous waste. . . . Data clearly indicate that commercial hazardous waste incinerators can attain a 99.99% DRE for a wide-range of organic hazardous wastes, including those most difficult to burn.[10]

The preamble to the interim rule contains an estimate of incremental cost per ton of waste incinerated under the regulations, and EPA prepared a cost study supporting these estimates. There are, however, no cost-risk comparisons, calculations, or discussions.

Although the interim rule does not address the issues of metals, by-products, and setting waste specific DREs, the preamble recognizes the omission:

> There are limits to the destruction and removal efficiency approach. It does not control the actual mass of POHCs emitted since . . . mass emissions vary directly in proportion to variations in mass feed rate.

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8. Interim final rules, if used, are promulgated between final rules and proposals. The regulated community must comply with an interim final rule. EPA, however, receives public comment on the rule and considers these comments in promulgating its final rule.

9. 46 Fed. Reg. 7673 (1981).

10. *Id.* at 7674.

> Perhaps most importantly, the approach fails to account for emissions of hazardous combustion by-products which may be equally or more hazardous than POHCs themselves. Finally, metals, since they are not combustible, are not now controlled using this approach.[11]

To overcome the limits to the DRE approach, EPA separately proposed: (1) limiting the emission of hazardous waste by-products, (2) allowing a variance to the 99.99 percent DRE standard based on a site-specific risk assessment, and (3) limiting the emission of toxic metals, elemental halogens, and hydrogen halides based on risk assessment. Although the variance to DRE could result in either a more or less stringent requirement, the preamble indicates that EPA viewed the variance primarily as a way of strengthening the regulation. Indeed,

> . . . the Agency considered the option of allowing use of the variance only to raise the performance standard. The primary reason for including the variance is to ensure protection of human health in those instances where either a highly toxic stack emission or a very high through-put results in potential risk to humans even at a 99.99% DRE. Although a 99.99% DRE may not be required to protect human health in other instances, the Agency is reluctant to allow incinerators to operate below performance levels that are widely attainable by current technology. . . . On the other hand, the Agency recognizes that there are competing considerations which argue for making the variance flexible in both directions. For example, the 99.99% DRE may not be necessary to protect human health in a location remote from population or where the waste being burned is only marginally hazardous.[12]

Again there is no discussion of the cost of incremental levels of risk abatement. EPA did not specify any given model or methodology for performing the risk assessment, leaving it to the applicant to select, and the permit writer to ratify, ways of calculating emission rates, estimating air dispersion and exposure estimates, and determining the relation between dosage of chemicals and health effects.

Because EPA promulgated its incinerator rule in interim final form, it requested and received public comment on the rule. EPA also received criticism of its regulation through the Presidential Task Force on Regulatory Relief and in litigation. The Chemical Manufacturers Association (CMA) alleged that many of its members would have to shut down their

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11. *Id.* at 7669.

12. *Id.* at 7686. The background document accompanying the proposal displays the results of risk assessments which indicate that burning 30,000 MT/year of waste streams from petroleum refining, vinyl chloride monomer, textile wool scouring sludge, and electronic components waste solvents, produces lifetime cancer risks for the most exposed individual ranging from a high of one in 100,000 (10^{-5}) to a low of one in 100 billion (10–11).

incinerators because they would be unable to meet the DRE standard, and that many incinerators could operate at standards less stringent than a 99.99 percent DRE and still not pose undue risk. The CMA also alleged that the cost of complying with these regulations for its 300 members' incinerators would be about $700 million per year. In the face of these comments, on October 20, 1981 EPA proposed to suspend the effective date of the incinerator rule for existing incinerators while it re-examined the regulations. The preamble to the proposed suspension stated that EPA had already started a regulatory impact analysis with cost and risk components for the rule under Executive Order 12,291, and that the analysis would be useful in evaluating CMA's assertions.[13]

Almost eight months later, and before EPA had completed the Regulatory Impact Analysis, the Agency withdrew the proposal to suspend the rule.[14] Several comments on the proposed suspension attacked CMA's analysis, and, as EPA noted in the preamble to the withdrawal,

> . . . the association did not provide substantive data to support any of these points. In response to a specific request by EPA for further information, the association has stated that the above points were based on estimates made by industry experts in the absence of hard data.[15]

Thus, EPA now regulates incinerators under a performance standard that calls for destroying or removing 99.99 percent of the principal organic hazardous constituents. In the record leading to the current standard, EPA has not systematically examined the level of risk this standard and other alternative standards pose to human health. Nor has the Agency considered the cost of alternative standards, or the cost-risk implications of the current or alternative standards. EPA is, however, considering all of these issues in its ongoing review of the current regulations, and will consider amending the regulations if its analysis shows changes are warranted.[16]

THE COSTS OF REGULATING INCINERATORS

The January 23, 1981 interim rule provides estimates of the cost of

13. *Supra* note 9, at 51,408. President Reagan issued Executive Order 12291 on February 17, 1981 to "reduce the burden of existing and future regulations . . . and insure well-reasoned regulations. . . ." The Order requires agencies, to the extent permitted by law, to prepare a Regulatory Impact Analysis for major rules. In the analysis, the agency must show that its regulatory program addresses a real problem, that the benefits of the rule outweighs its costs, and that the agency has selected the best way of solving the problem. Although EPA issued the incinerator regulations before the Order was issued, the Presidential Task Force on Regulatory Relief asked EPA to review the hazardous waste regulations in accordance with the Order. *See* 46 Fed. Reg. 13,193 (1981).

14. 47 Fed. Reg. 27,516–27,517 (1982).

15. *Id.* at 27,518.

16. *Id.* at 55,882.

incinerator controls. A document titled *Preliminary Incinerator Unit Cost Study for Part 264,*[17] shows how EPA developed these estimates.

Determining the functional relation between performance (DRE) and operating and design parameters (retention time, temperature, and excess air, etc.) is an extremely difficult task. Because EPA was unable to determine this relation, it calculated the cost of the DRE requirement by assuming that a specified temperature would produce a 99.99 percent DRE. EPA then calculated the quantity and cost of the excess fuel necessary to reach the requisite temperature (and hence 99.99 percent DRE) from an assumed starting temperature and DRE. EPA estimated the cost of this excess fuel at $224,000 per year for a liquid injection incinerator with a capacity of 10,000 metric tons (MT)/year burning halogenated liquids, and $1,162,000 per year for a rotary kiln incinerator with a capacity of 20,000 MT/year burning solids, sludges, and highly toxic materials. It also assumed, conservatively, that incinerators burning highly toxic materials would have to reline their refractories in order to reach the higher temperature necessary to achieve the performance standard. EPA estimated this initial cost at $130,000.[18]

The Agency is now constructing a more sophisticated cost model. This model will more accurately estimate the least costly way to achieve various retention time and temperature combinations. To use the model, however, one must still specify the relation among performance and operating conditions outside of the costing model.

THE RISKS OF INCINERATORS

Risk to human health from incinerating hazardous waste is primarily from airborne pollutants that are not destroyed during incineration or that recombine in the incinerator or atmosphere to form new compounds. The risk from incinerating hazardous waste generally depends on the factors cited in Figure 1: the volume of hazardous constituents incinerated; how efficiently they are destroyed or removed by the incinerator; to what extent they chemically change in the atmosphere, return to the land or surface water, and disperse; how easily they are absorbed by humans; and the relation between the dose received and the potential effect.

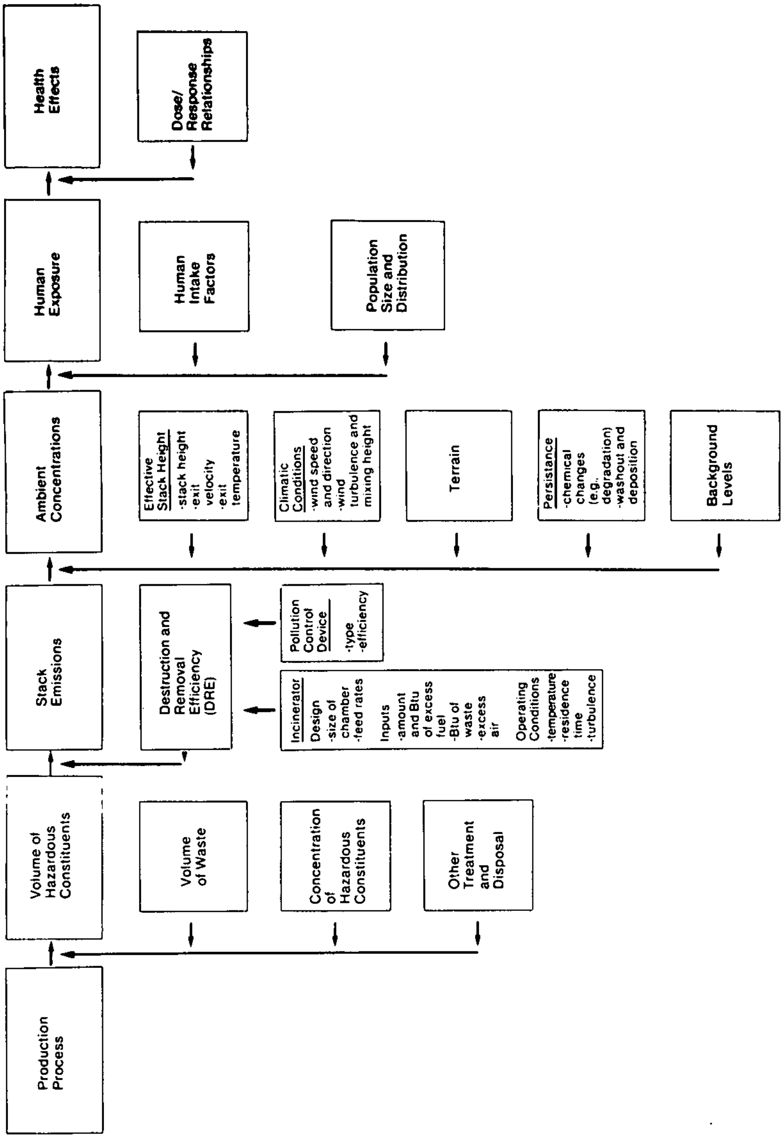
Chronic health effects from hazardous waste involve two broad types of hazardous compounds: those for which there is assumed to be a threshold level below which there is no effect, and those that are presumed to pose some risk at every level of dose. For those compounds with a threshold, an acceptable daily intake (ADI) is often presumed, which is

17. U.S. ENVIRONMENTAL PROTECTION AGENCY, PRELIMINARY INCINERATOR UNIT COST STUDY FOR PART 264 (1981).

18. *Id.* at 37.

FIGURE 1

FACTORS INFLUENCING THE RISK OF INCINERATING HAZARDOUS WASTE



usually set at some fraction of the threshold. The latter group is principally composed of carcinogens, but also includes mutagens (which cause mutations), teratogens (which cause birth defects), and oncogens (which cause tumors). All toxics suspected to be in this category are presumed to have a threshold and an ADI.

There are many possible measures of health effects, including:

—the highest risk to any individual,

—the total risk (the sum of all individual risks or expected number of cases for carcinogens),

—the "average" risk (the mean, median, or mode of risks posed to all individuals),

—the total number of people exposed to some risk,

—the nonrandom distribution of risks among the people exposed (high risks concentrated on city dwellers or minorities, for example), and

—disparities in the risks among the people exposed (high risk concentrated on only some city dwellers, with low risks for others, for example).

When measuring risk, one must separate threshold from nonthreshold compounds. For carcinogens, risk models often predict some exposure and, hence, some risk to everyone within the area under study. For compounds with an ADI, however, it is at least theoretically possible to establish a limit (ADI/100, for example) below which exposures from hazardous waste incinerators could not reasonably be expected to contribute significantly to any background levels of the compound that might be present in the diet or from other sources. In such cases, a zero risk could be assumed for certain portions of the study areas. EPA has not yet established such a limit in its hazardous waste regulations, however.

In examining risks from hazardous waste incinerators, only estimates of the highest risk to any individual and the total risk are reported or examined in detail.[19] Calculations for both measures of risk assume that all individuals have the same susceptibility.

Information on the other measures of risk would be useful in future analyses. Some measure of central tendency of the distribution of risks posed ("average" risk) would be helpful in comparing alternatives, as would the number of people exposed. EPA could easily derive these measures using existing data. The first four measures—highest risk, total risk, average risk, and number of people exposed—essentially describe

19. All risk information is either directly from or derived from "Interim Report on Hazardous Waste Incineration Risk Analysis (Draft)" dated August 2, 1982 and prepared for EPA by Industrial Economics, Inc. of Cambridge, MA.

the frequency distribution of risks. The final two measures—randomness and disparity—would assist in identifying especially inequitable situations. To determine how randomly distributed the effects are, EPA would have to analyze the population patterns on a site-by-site basis. The disparity in risk levels posed, however, could be derived using existing data if applied to actual sites.

The balanced use of these different measures is controversial. The Congressional Office of Technology Assessment, for example, has expressed a fear that using a total risk criterion rather than risk to the maximum exposed individual will provide less protection for rural areas (with lower population densities) than for urban areas (with higher population densities).[20]

In spite of the importance of these other measures and the differences inherent in measuring compounds with ADIs, not enough research has been completed or undertaken to analyze hazardous waste incinerators using these methods. The data and approaches presented in the rest of this paper are focused, therefore, on total risks and risks to the maximum exposed individual from carcinogens.

Model Used

The risk model used to analyze incinerators is actually a combination of the Industrial Source Complex Model (ISCM), a 1970 population data base, and health hazard potency values developed by EPA's Environmental Criteria and Assessment Office in Cincinnati.

In affecting risk levels, certain variables are beyond the control of the incinerator operator. Within the health effects module, dose-response relationships and human intake factors are standard for each compound. Within the ISCM, terrain is assumed to be flat or, at most, gently rolling. No background levels in threshold compounds are assumed. Chemical changes (such as degradation) and washout (through rain) and deposition (through settling) are similarly not included. With these variables specified, the ISCM then only requires the specification of the set of variables within an incinerator operator's control, specifically, a particular location to set the climatic conditions and population size and density variables; and inputs on emissions, stack height and diameter, and the velocity and temperature of the gases existing from the incinerator stack.

Preliminary Results

The Industrial Economics, Inc. (IEc) study[21] used the results of the

20. OFFICE OF TECHNOLOGY ASSESSMENT, CONGRESS OF THE UNITED STATES TECHNOLOGIES AND MANAGEMENT STRATEGIES FOR HAZARDOUS WASTE CONTROL 394 (Mar. 1983).

21. *Supra* note 19.

EPA models to estimate the range of risks (assuming equal susceptibility of all persons) to the maximum exposed individual from carcinogens, the total number of expected cancer cases, and the percent of areas receiving greater than the acceptable daily intake of noncarcinogens. The study establishes these ranges by selecting characteristics of real incinerators in actual locations but burning hypothetical, although common, wastes. It is important to note that all risk calculations are based only on (1) exposures within a circle of 20 kilometer radius centered on the location, and (2) inhalation exposures. Further modeling based on exposures in a larger area or through ingestion might well change the risk numbers.

For the risk to the maximum exposed individual from carcinogens (see Table 1), risk levels range over nine orders of magnitude (over three billion fold). Because every test burn at facilities burning hazardous wastes has shown DREs in excess of 99 percent, we use this level as a benchmark against which to measure the marginal increase in safety achievable by different DRE levels, since assuming higher levels simply makes the marginal increase smaller. Thus, for the medium size facility continuously burning medium toxicity waste at full capacity in an area that produces medium exposure levels, the 99.99 percent DRE standard lowers the lifetime risk of an individual contracting cancer from about *1 chance in 10 million* to *1 chance in 1 billion.*

Although the exact distribution of incinerators within these categories is uncertain, most incinerators are small. We estimate that perhaps 75 percent of all hazardous waste incinerators burn less waste each year than the "medium" volume category in the IEc report, and that perhaps 50 percent burn less than the "lowest" volume category. Even incinerators in the lowest volume category, however, may still pose potentially significant risk (8×10^{-5}) if burning highly toxic waste in areas of poor weather conditions and population distribution.

The pattern of the expected number of cancer cases induced by individual incinerators after 70 years of facility operation is similar.[22] The expected number of cases around individual incinerators varies over *100 billion times,* or 11 orders of magnitude. The variation results from several factors. Differences in the toxicity of the waste seem to cause risk to vary between four and five orders of magnitude. Volumes of waste streams are related to about two to three orders of magnitude variation in risk, and different patterns of weather and population together account for about three to four orders of magnitude (see Table 1). Examining the medium size facility-medium toxicity-medium exposure case again, we find that the models predict 6×10^{-4} cases over 70 years of exposure—

22. The number of expected cases equates, for carcinogens, with the criteria of total risk because a linear response to unit dose is assumed at low dose levels.

TABLE 1

MAXIMUM LIFETIME RISK AND CANCER CASES OVER 70 YEARS AT 99 PERCENT DESTRUCTION AND REMOVAL EFFICIENCY, By Maximum Concentration Area, Level of Human Exposure, Waste Toxicity, and Incinerator Volume

Waste Toxicity and Incinerator Volume	MAXIMUM LIFETIME RISK Maximum Area Concentration			NUMBER OF CANCER CASES Level of Human Exposure		
	Lowest	Medium	Highest	Lowest	Medium	Highest
Lowest Toxicity Waste						
Lowest Volume	4×10^{-11}	3×10^{-10}	1×10^{-9}	1×10^{-8}	1×10^{-6}	3×10^{-5}
Medium Volume	4×10^{-10}	3×10^{-9}	1×10^{-8}	1×10^{-7}	1×10^{-5}	3×10^{-4}
Highest Volume	3×10^{-8}	2×10^{-7}	9×10^{-7}	9×10^{-6}	9×10^{-4}	2×10^{-2}
Medium Toxicity Waste						
Lowest Volume	2×10^{-9}	1×10^{-8}	6×10^{-8}	6×10^{-7}	6×10^{-5}	1×10^{-3}
Medium Volume	2×10^{-8}	1×10^{-7}	6×10^{-7}	6×10^{-6}	6×10^{-4}	1×10^{-2}
Highest Volume	1×10^{-6}	1×10^{-5}	4×10^{-5}	4×10^{-4}	5×10^{-2}	1
Highest Toxicity Waste						
Lowest Volume	2×10^{-6}	2×10^{-5}	8×10^{-5}	8×10^{-4}	8×10^{-2}	2
Medium Volume	2×10^{-5}	2×10^{-4}	8×10^{-4}	8×10^{-3}	8×10^{-1}	19
Highest Volume	2×10^{-3}	2×10^{-2}	6×10^{-2}	6×10^{-1}	62	1430

Note: The following definitions apply to the above labels:

	Waste Toxicity $(mg/kg/day)^{-1}$	Unit Volume (lbs/hr)	Maximum Area Concentration (ug/m^3)	Level of Human Exposure (person–ug/m^3)
Lowest	5.52×10^{-6}	100	36	1.94×10^4
Medium	2.67×10^{-4}	1,000	300	1.24×10^6
Highest	3.70×10^{-1}	75,000	1,191	2.87×10^7

Source: Derived from "Interim Report on Hazardous Waste Incineration Risk Analysis (Draft)" dated August 2, 1982, prepared by Industrial Economics, Inc. for EPA.

or about one statistical case every 100,000 years or so. A 99.99 percent DRE standard lessens that risk to about one case every 10 million years.

For noncarcinogens, the available results are less complete, but again show that significant risks are present only in severe combinations of high toxicity wastes burned in large volumes. In only two of the 27 categories were DREs greater than 99 percent required to keep exposures under the acceptable daily intake, and in those cases a standard of 99.9 percent was sufficient.

Implications

The data and models underlying these preliminary results are quite uncertain. The potency data are mostly extrapolations of study results of high-dose, short-term effects in animals to low-dose, long-term effects in humans. In addition, relatively few chemicals have been studied at all. Air dispersion models have been developing for a number of years but are still not completely accurate. Further, the exposure models used do not account for bio-accumulation or synergism. Our analysis of EPA's current incinerator rule is therefore limited by the research and models available. Nevertheless, the data are probably sufficient to allow us to draw some conclusions. Further, in spite of all the uncertainties in the results of the risk models, the second, third, and fourth conclusions which follow will remain valid for almost any conceivable set of risk outcomes.

First, the regulation seems to control many trivial risks. This is largely the result of not basing the standard on risk criteria, but on a best available technology (BAT) approach. Second, because the rule is based solely on a single variable (DRE) which is only one factor affecting risk, it allows tremendous variation in actual risk levels posed around individual incinerators. Third, this variation could only be efficient if the cost of abating the risk also displayed tremendous variation in the same proportions, but it is unlikely that costs show this pattern. Control costs of the low risk cases must be extremely small to be justified by most common benefit-cost rules-of-thumb. In contrast, very expensive controls can easily be justified for the riskiest cases. If we assume that incinerators would achieve a 99 percent DRE in the absence of any regulation, then the 99.99 percent DRE standard is cost-beneficial for our most innocuous case only if an incinerator can comply with the regulations for 3 cents every 70 years. On the other hand, the riskiest possible incinerator modeled would be cost-beneficial even if it cost about $60 million per year to comply.[23] A fourth conclusion is that some tiering in the requirements would therefore be highly efficient. This is especially important because incineration competes with other disposal technologies such as landfilling, whose risks may be much greater, but whose costs relative to incineration are substantially less. If costly, but unnecessary, requirements for incinerators

23. The following calculations conservatively assume a statistical life is worth 3 million dollars and that all cancer cases end in death.

In the innocuous case we have $\frac{(10^{-8}) - (10^{-10})\text{ cases}}{70\text{ years}} \times \frac{\$3 \times 10^{6}}{\text{death}} = \frac{\$3 \times 10^{-2}}{70\text{ yrs.}}$

In the riskiest case we have $\frac{(1430 - 14.3)\text{ deaths}}{70\text{ years}} \times \frac{\$3 \times 10^{6}}{\text{death}} \approx \frac{4.2 \times 10^{9}}{70\text{ yrs.}} = \frac{\$60\text{ million}}{\text{year}}$

can be eliminated, not only will costs decline, but overall protection of human health may also increase as incinerator use increases.

REGULATORY OPTIONS

The possible areas in which EPA can intercede with regulations are depicted in Figure 1. There are six major stages in translating the generation of pollutants into health hazards. Regulations that attempt to control effects directly tend to be more effective and efficient. As regulations attempt to control risks by restrictions farther removed from effects (such as through human exposure, ambient conditions, emissions, the volume of waste handled by a particular technology, or the production process), the leverage is more strained, and it is harder to link regulatory actions to probable effects. Industry spends more money complying with regulations that may not lead to reductions in risks. The public debate tends to become more technical, tedious, and disjointed from hoped-for accomplishments. For example, which is the more important question: whether 99.99 percent DRE is achievable or whether it reduces health risks in any real way?

A Utopian Approach

In an economist's utopia, policymakers would choose the appropriate level of safety after considering the costs of attaining that safety. These decisions would be guided partly by studies revealing people's willingness to pay for risk reduction and partly by the political process. EPA would then leave to the individual incinerator operators most of the technical decisions of how best to meet these safety levels. Choices for incinerator operators would be significantly more diverse than under the current regulation. The choice of location—important because differences in population levels and distributions and climatic conditions affect risk—would be open. Factors affecting effective stack height (which contributes to dispersion and hence to lower maximum levels of exposure) could also be varied. The DRE would be a flexible target rather than a fixed standard. And perhaps most important, the volume and toxicity of the waste could be varied (recall that most of the variation in final risk estimates appears to result from differences in toxicities and volume). Treatment processes (including recycling) and source reduction would be more to an operator's advantage than under a fixed standard.

Further, once the original rights to pollution had been set, EPA would be indifferent as to their future distribution, leaving it to the marketplace to guarantee protection.[24] Trades within specified areas could thus be made among willing parties. Firms could sell portions of their rights to new firms, or trade rights for different compounds or speculate in risk-right "futures." The ownership of risk rights would not prevent scrutiny by state or federal agencies, however. EPA could still require permits that would specify the range of acceptable practices to meet risk levels, and that would verify the firm was not exceeding its allowable level of risks.

Environmental groups or the government could also buy up rights to improve environmental quality. Federal appropriations could thus be used to buy environmental improvements directly, rather than gambling on the effects of indirect regulations. Conversely, if government policy shifted toward education or defense or reducing the deficit, for example, the government could sell from its stockpile of acquired rights to finance those expenditures.

Let us conclude our fantasy and return to political realities. Although we would be delighted with increased research into how such a system could be made operational (if ever), little political support exists for such a program. Nonetheless, features of this approach might be workable under other systems, and greater efficiency obtainable using relatively conventional methods.

An Administrative Compromise

EPA's existing proposal to allow individual variances is certainly feasible. If nothing else, the proposal provides an escape valve for cases where the existing regulations are clearly inappropriate. The site-by-site risk assessment is, however, an expensive way to buy reform. Only those who expect to save a great deal will likely be willing to risk the considerable expense of such a process. We suspect that firms burning relatively small amounts of waste will be most adversely affected, and will shift to other disposal methods rather than continue to incinerate their waste.

Another approach would be to rid the site-by-site risk assessment process of its most administratively burdensome features—for example, the repetitive task of judging the appropriateness of alternative models, adjusting the model to make local assessments, and the inconsistency and public discord that accompany local determinations of the appropriate level of risk. Eliminating these burdensome features would render this approach less efficient than the site-by-site approach for facilities that

24. The initial risk levels could be set in such a way that total risks for particular areas would be constrained to acceptable levels, and trades allowed only within these defined geographic areas. Further, these rights would be risk-based, and would imply different emission levels for different operators after considering their location, waste toxicity, and other site-specific factors.

performed an assessment, but judged against the existing standard, the streamlined process seems to offer significant improvements. In addition, such an approach would probably have far greater effect because more incinerators would be included under it. What would be the main features of such a system, and how could EPA construct it?

First, the system could use a single set of EPA-approved models and assumptions, eliminating the need for repetitive justifications. Second, it would be based on nationally derived and applied levels of acceptable risk, which would be set using some rough risk-cost analysis. Third, these standards would be preset, allowing the public to know what to expect in terms of risk and operators to know what would be required of them. Finally, this approach would allow flexibility on all factors that are easily determinable, but make worst cases assumptions for site meteorology and population density patterns.

Although determination of requirements under such an approach would be slightly more complicated than setting an across-the-board 99.99 percent standard, it would not be extremely complex. Further, the system would be flexible and therefore more efficient since the operator could meet EPA's prescribed risk level in less expensive ways. For example, the operator could comply by burning less waste, by altering or better characterizing the waste stream to bring it into lower toxicity groups, by increasing the height of the stack, or by relocating. Finally, in some cases the risk around an incinerator would require less than a 99.99 percent DRE for adequate protection. Whatever the operator's choice, society would still be assured that the acceptable risk levels would not be exceeded.

EPA could construct such a system by determining the various risks of burning hazardous wastes and assuming worst case conditions for meteorology, population distribution within the affected area, and background levels of pollutants (including the possible contribution from other hazardous waste incinerators). A sensitive determination of the likely responses by operators to different combinations of requirements would be necessary to adequately estimate the costs of alternatives. With this information on costs and risks, EPA could make a decision on the appropriate categories of important variables and on what the risk category would be for each combination of variables.

SUMMARY

EPA used a traditional best available technology approach in regulating incinerators that burn hazardous waste. Because of large variations in risk around these incinerators, a risk-based standard would offer several advantages. A risk-based approach would:

- assure levels of protection for the public, so long as risks were correctly calculated,
- provide greater flexibility in industry's response, with resulting lower costs and probably greater compliance, and
- improve public policy debate by focusing on ends rather than means.