

August 1991

WASTE MINIMIZATION

EPA Data Are Severely Flawed



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**Program Evaluation and
Methodology Division**

B-235931

August 5, 1991

The Honorable Quentin N. Burdick
Chairman, Committee on Environment
and Public Works
United States Senate

The Honorable Max Baucus
Chairman, Subcommittee on Environmental
Protection
Committee on Environment and Public Works
United States Senate

Your letter of January 31, 1990, asked us to evaluate the quality of the Environmental Protection Agency (EPA) data that will be used to determine the need for mandatory hazardous waste minimization requirements.¹ This letter presents our initial findings in response to your request; that is, our assessment of the quality of the data derived from EPA's National Survey of Hazardous Waste Generators. We plan to undertake a detailed study to determine (1) the degree and causes of measurement error, if any, in the data EPA has collected; (2) how to reduce or eliminate the errors, if any; and (3) how to minimize any future problems.

Background

Hazardous waste minimization refers to practices that reduce the generation of wastes or recycle and treat them and that lead to overall reductions in the volume of hazardous waste that ultimately enters the environment. Source reduction is any activity that reduces or eliminates the generation of hazardous waste.

Section 8002(r) of the Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984, required EPA to report to the Congress by October 1, 1986, on the feasibility and desirability of establishing mandatory hazardous waste minimization requirements (as opposed to continuing with industry's voluntary efforts). In October 1986, EPA reported that it had insufficient data to address the question adequately and that it could not fully

¹We define waste minimization as including the separate components of source reduction and recycling. In this report, we address the former; specifically, the EPA's efforts to develop data on progress in achieving source reduction.

respond before December 1990 at the earliest. EPA did not institute mandatory waste minimization controls in 1986, but the agency did not preclude the enactment of such controls in the future. Also, EPA did not issue its recommendations on mandatory controls by the stated deadline, but the agency did inform the General Accounting Office (GAO) on its progress on the commitments it had made in its 1986 report to the Congress.

Since 1986, EPA has worked toward redesigning the hazardous waste information system. The principal components of the information system design are new and revised data collection mechanisms, such as sample surveys and censuses. In February 1990, we published an evaluation of the information system design and its components, including our assessment of progress on waste minimization.² We identified measurement and data collection problems that were likely to impair data reliability, validity, and accuracy. We now present our initial findings regarding the quality of the actual waste generation and minimization data that have proceeded from the system design. Our analysis is based upon data collected from EPA's National Survey of Hazardous Waste Generators.

Results in Brief

All the data quality problems we identified in our February 1990 report as likely to occur did occur. These problems included the system's inability to integrate data, uncertain data validity based on inappropriate measurement, and uncertain data reliability based on inadequate data collection methods. Some of these problems were of such severity that EPA had to abandon all of the central analyses of waste minimization progress that the agency had originally planned to prepare for the Congress. Problems such as the extent of missing data were of special importance in negatively affecting the assessment of progress on hazardous waste minimization. These findings suggest that the information EPA presents to the Congress will not serve a useful purpose for understanding the extent and determinants of waste minimization or for determining whether mandatory or other requirements may need to be included in the reauthorization of RCRA.

²Hazardous Waste: EPA's Generation and Management Data Need Further Improvement (GAO/PEMD-90-3, Feb. 9, 1990).

Objective, Scope, and Methodology

In this evaluation, we focused on an assessment of the hazardous waste minimization data collected by EPA's redesigned information system. The objective of this study was to determine whether the system design flaws we had identified in our February 1990 report did, in fact, produce the data quality problems we had predicted and, if so, to determine their magnitude.

The information on which this report is based was obtained from multiple sources and required both qualitative and quantitative analyses. We reviewed EPA documents and interviewed EPA officials and contractors about hazardous waste minimization data quality problems. We conducted computer analyses of EPA's initial National Survey of Hazardous Waste Generators.³ We determined data quality by using correlational analysis techniques and direct inspection of survey item responses.⁴ Finally, we administered a retest of certain questions from the EPA survey, and we conducted site visits to large-quantity waste handlers to discuss responses. We conducted our evaluation between June 1990 and March 1991 in accordance with generally accepted government auditing standards.

Principal Findings

Inability to Integrate Data

EPA developed three national data sets that originally were intended to provide information about industry's progress on hazardous waste minimization: (1) the National Survey of Hazardous Waste Generators, (2) the waste minimization portion of the 1987 cycle of the RCRA reporting system, and (3) the Toxic Chemical Release Inventory. Each of these data sets contained important waste minimization measurement items. However, the waste minimization portion of the 1987 cycle of the RCRA reporting system and the Toxic Chemical Release Inventory had problems that did not allow the integration of data. EPA, then, will have

³This survey covered hazardous waste information for the years 1985 and 1986.

⁴While we conducted our assessment, EPA was conducting further quality control work (re-contacting facilities) to correct some obvious errors detected in the survey results. This final data set was not ready for us to examine during our evaluation. The statistics we have reported reflect the data collected by the EPA survey, not the final EPA data that reflect the agency's quality control work. This is appropriate because our effort here is to examine the results of system design at the front end rather than the changes proceeding from quality control at the termination of the process. In any case, we do not expect that the final data will significantly vary from the original, because the quality control work is very limited in scope, and thus, any of its effects on the conclusions of our evaluation should be insignificant.

to rely primarily on the data derived from its Survey of Hazardous Waste Generators to reach conclusions about the extent of industry's progress on hazardous waste minimization.⁵ However, the survey's design limits the generalizability of the waste minimization data, as discussed below.

An inspection of the data items on the survey shows that waste generation amounts are only provided for the years 1985 and 1986. If available data on waste generation were limited to those collected in the survey, a waste minimization trend analysis would compare waste generation rates for those 2 years. The waste handlers we spoke with suggested that the use of these 2 years would not necessarily provide a representative trend of waste production. For example, during one of these years, a firm had a one-time spill of hazardous material. Other generator facilities would, at irregular intervals, clean storage tanks or the floors in the production facilities. Since some of these events occurred in either 1985 or 1986, the hazardous waste generation data for these 2 years was inflated.

Data Validity

Our previous evaluation found a significant measurement problem that brought into question the validity of the data from the generator survey. The problem involved the measures that EPA used to assess industry progress in achieving hazardous waste minimization.

EPA examines whether progress has occurred in achieving source reduction by measuring the change in waste generation from one year to the next—for example, 1985 to 1986—standardized by the change in the amount of production in the same years. The four necessary data elements are combined as follows to create the production ratio:

$$\frac{\text{Production 1985/Production 1986}}{\text{Generation 1985/Generation 1986}}$$

The average decrease in waste generation per unit of production across waste streams or facilities represents progress in achieving waste minimization.⁶ If hazardous waste generated per unit of production

⁵See our February 1990 report, Hazardous Waste, pp. 82-103, for detailed information about data collection problems.

⁶See Hazardous Waste, p. 77, for a detailed discussion about the design flaws of the production ratio measure.

increases, waste minimization decreases. Conversely, if waste generated per unit of production decreases, waste minimization increases.

One official of a generating firm we spoke with suggested that the measure of hazardous waste generation standardized by production did not adequately document progress on waste minimization. For example, a pharmaceutical firm operates a research division in addition to production facilities. The research division generates hazardous waste, but an official there suggested that it is not possible to proportionally relate the amount of research to the amount of hazardous waste generated.⁷ Another generator, a petroleum plant, makes about 24 different products. Each product generates different amounts of waste, an official of the firm stated, and relating waste to each product would be difficult; relating wastes to all products would be meaningless.

Data Reliability

The extent of data reliability in the generator survey is also questionable. Two items on the generator survey measured the amount of hazardous waste generated in 1986 in slightly different ways. Correlating these items constitutes one type of test of reliability. If the items are highly reliable, the correlation between them will be nearly a perfect 1.00. By statistical convention, items that have correlations of less than 0.80 are not considered reliable. What we found was that the correlation between these two measures of waste generation was 0.47, revealing an unacceptably low reliability based on the 0.80 standard. The estimates of the total amount of waste generated in 1986 produced by the two measures differ by over 6 million tons for large-quantity generators in the survey. Such a lack of correspondence between two items measuring the same phenomenon suggests that the estimates of total waste generated are also not reliable.

Another reliability issue centers upon the source code variable, which is important for identifying large quantities of hazardous waste generated by production processes for which effective waste minimization techniques are known. Requiring technological controls or "best management" practices on these production processes with large waste volumes is one possible mandatory control for waste minimization. However, EPA officials have indicated that the production process or waste source (which generated the waste) cannot be analyzed because the survey's design limits the amount of detailed information that can be obtained.

⁷Measuring the amount of research is difficult, while production can—within limits—be quantified.

Indicating the exact waste source on the survey often is not possible because of the complexity of production processes.

To assess any implications of this survey design flaw on data reliability, we discussed responses to our survey retest with respondents. We found that source codes are not mutually exclusive and have different meanings for different industries. Furthermore, we found that, for a given facility, these codes vary according to who fills out the survey. This suggests that the codes are subject to interpretation, and responses are thus subject to unknown levels of measurement error. As a result, the source codes have serious reliability problems.

Other Data Problems

In our previous report, we found other problems likely to affect the quality of EPA's data on industry progress on hazardous waste minimization. Specifically, we found that the agency had not developed adequate federal reporting regulations to require officials of generating firms to report the necessary information. While section 3007 of RCRA requires them to respond to EPA's survey, it does not require them to keep records of many of the data elements requested. We believe that this could lead to significant nonresponse on specific items.⁸

In fact, what we found was that approximately 60 percent of the respondents did not report one or more of the data elements necessary to calculate the change in waste generation per unit of production between 1985 and 1986. One EPA analyst referred to the problem of missing data as "the cancer on the generator survey." Missing data of this degree of severity destroys not only the generalizability of the results but also their credibility.

Respondents to the generator survey were required to report the amount of each waste stream that was generated in 1986 and then to report the amount of each of these waste streams that was generated in 1985. This means that a waste stream that was discontinued after 1985 was not required to be reported. A check of the data set showed that some respondents did report waste streams with a zero amount generated in 1986; however, it is possible that many others did not. This means that any increase in the amount of waste generated per unit of production between 1985 and 1986 may be artifactual rather than real.

⁸See Hazardous Waste, p. 85.

The generator survey asks facilities about programs in place to promote waste minimization. However, the short period surveyed (1985 and 1986) does not allow enough time for any significant effect of these programs to become evident. To assess the extent to which inference problems may have followed from this design flaw, we discussed our survey retest data with generator officials. They pointed out that the 2-year time period was too short to assess the effects of waste minimization programs.⁹ We believe that tracking progress on hazardous waste minimization for a longer period of time would provide a truer picture of program effects, since this extended duration would both establish trend lines and limit spurious effects.

Conclusions

Given these data problems, we cannot state clearly whether or not progress has been made on hazardous waste minimization. Further, because of the number and severity of data problems outlined above, we have not been able to identify examples of promising waste minimization efforts. Our initial assessment of the EPA's data on waste minimization shows that, as before, the agency will not be able to answer any of the central questions the Congress has asked about the extent of the progress, if any, that industry has made on minimizing waste generation. These questions require information on the amount of waste generated per unit of production and the industry characteristics (including voluntary efforts) that may affect the feasibility of waste minimization.

EPA officials have indicated that their modified analyses will not even address these questions. Whether the analyses EPA eventually presents to the Congress will comply with the requirements set forth in section 8002(r) of RCRA remains unclear. While the act specifically requires EPA to address standards of performance, management practices, and legislative changes, it does not specifically require the empirical analysis of change or the assessment of the effectiveness of specific waste minimization efforts that EPA had originally planned. However, these empirical assessments are a prerequisite to demonstrating whether progress has been made in minimizing waste. Without them, neither EPA nor GAO can determine how effective the voluntary program has been and whether requiring certain standards or management practices is needed to stimulate greater effort at waste minimization.

⁹EPA officials also told us that the amount of time necessary for a waste minimization program to take effect was unclear.

As a result, we believe that the information EPA plans to present to the Congress will not be useful for deliberations concerning

- whether or not the problem of waste generation is growing,
- which voluntary interventions by industry have been effective, and
- what types of mandatory or other requirements may be necessary for inclusion in the reauthorization of RCRA.

Recommendations

We recommend that the Administrator of EPA direct the Assistant Administrator for Solid Waste and Emergency Response to

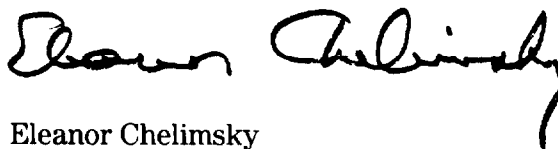
- amend federal recordkeeping to ensure that the information that EPA requests about hazardous waste minimization will be methodologically sound and readily accessible,
- devise waste minimization measures that account for the mix of production processes and for nonproduction activity that generates hazardous waste, and
- investigate industry's perception of EPA efforts at measuring waste minimization and initiate changes as appropriate.

Agency Comments

At the request of the Committee, we did not obtain formal agency comments on this report.

As agreed with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its date of issue. At that time we will send copies to the Administrator of the Environmental Protection Agency and to other interested parties upon request.

If you have any questions or would like additional information, please call me at (202) 275-1854 or Kwai-Cheung Chan, Director of Program Evaluation in the Physical Systems Areas, at (202) 275-3092. Major contributors to this report are listed in the appendix.



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