Chapter 3

Coal Combustion Utility Wastes

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INTRODUCTION

As with mining and oil and gas wastes, the 1980 Bevill amendment to the Resource Conservation and Recovery Act (RCRA) exempted wastes resulting from the combustion of fossil fuels from regulation as hazardous wastes until the U.S. Environmental Protection Agency (EPA) submitted a Report to Congress on the adverse effects, if any, of these wastes and determined whether hazardous waste regulation was indeed warranted.[1] The amendment included utility wastes in this special category because of congressional concern that the imposition of unnecessary and costly regulation could reduce the use of coal as a fuel source and thereby increase the Nation's reliance on foreign energy sources (134). EPA's subsequent Report to Congress covered only wastes from the combustion of coal by the electric utility industry because these wastes were believed to account for 90 percent of all wastes generated by the combustion of fossil fuels (118).

Coal combustion utility wastes consist of "high-volume' wastes produced directly from coal combustion and "low-volume" wastes formed during equipment maintenance and water purification processes. The high-volume wastes include:

- fly ash—smaller ash particles entrained by the flue gas and generally captured in the air pollution control device;
- bottom ash—larger ash particles that settle on the bottom of the boiler;
- boiler slag—bottom ash that has melted and reformed into a solid; and
- flue gas desulfurization (FGD) sludge-sludge generated when sulfur dioxide is removed from other flue gases.

Low-volume wastes include boiler and cooling tower blowdown (i.e., boiler water removed from ash or sludge), coal pile runoff, demineralizer regenerants and rinses, boiler cleaning wastes, pyrites, and sump effluents. They are generated in smaller quantities than high-volume wastes, although some (e.g., cooling tower blowdown) can be generated in substantial amounts (118).2 In contrast to high-volume wastes, many low-volume wastes are also produced periodically at each plant rather than on a continuous basis (e.g., boilers may be cleaned, hence boiler cleaning waste produced, only once every 2 to 3 years).[3]

About 10 percent of the amount of coal burned remains in the form of ash.[4] More than 95 percent of all ash (i.e., fly ash, bottom ash, and bottom slag) produced by utilities is composed of oxides of silicon, aluminum, iron, and calcium (1 18). Ash also contains many other trace elements that vary by type and level depending on ash particle size, source of the coal, and other factors; these elements can include arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, and selenium, among others. Many are in the form of oxides tied up in complex silicates.

The composition of FGD sludge depends in part on the reagent used to absorb sulfur dioxide from the gas (e.g., lime or limestone, sodium hydroxide, or sodium sulfate). In addition, FGD sludge can contain oxides and trace elements derived from fly ash that is caught in air pollution control scrubbers; the type and concentration of trace elements would reflect their levels in the ash. FGD sludge maybe of more concern than ash because of higher concentrations of sulfur and other contaminants. Implementation of the 1990 Clean Air Act Amendments will significantly increase the amount of FGD sludge requiring disposal.

Low-volume cleaning wastes can contain significant levels of trace elements like lead and cleaning reagents such as chlorides, algicides, and phenols.

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[1]RCRA Sec. 3001(b)(3)(A).

[2]The Utility Solid Waste Activities Group (USWAG), review comments, Feb. 22, 1991.

[3]K. Ladwig, Wisconsin Electric Power Co., personal communication, Feb. 28, 1991.

[4]USWAG (review comments, Feb. 22, 1991) indicates that ash content usually is between 8 and 10 percent, whereas EPA (119) indicated that ash content generally is more than 10 percent.

WASTE GENERATION

EPA estimated that coal-burning utilities account for 90 percent of the wastes produced by fossil fuel combustion in the industry (118). EPA provided two estimates for quantities of coal combustion wastes—85 million tons and 1 billion tons—that differ primarily in the inclusion of wastewater in the higher estimates The Utility Solid Waste Activities Group (USWAG), which represents most of the electric generation industry,[6] believes that the estimate of 85 million tons of high-volume wastes is more accurate. The industry explains that water is added simply to facilitate management of the wastes and should not be included in measurements of waste generation because it is either discharged to surface water under a National Pollutant Discharge Elimination System (NPDES) permit or recycled back to the electricity generating process; it is not disposed of in surface impoundments.[7] Furthermore, the industry has stated that the water does not add to the potential toxicity of the waste.[8] However, discharges to surface waters may contain trace elements derived from the ash or from FGD sludge.[9]

CURRENT MANAGEMENT PRACTICES

Coal combustion wastes can be treated, stored, or disposed of either in landfills or in surface impoundments (see figure 3-l). In general, coal ash and other wastes are sluiced into a surface impoundment where the solids settle out, leaving relatively clear water at the surface. The solids may accumulate in the surface impoundment until it is full, or they may be dredged periodically and taken to another disposal site such as a landfill (118). The water in the impoundment is often discharged to surface water, with or without treatment, under a NPDES permit; 95 percent of all coal combustion utilities have NPDES permits. Approximately 20 percent of all surface impoundments recirculate sluice water back to the combustion process.[10] Ash and flue gas desulfurization sludges are generally disposed of in landfills after they are generated or after they have been dredged from surface impoundments (118).

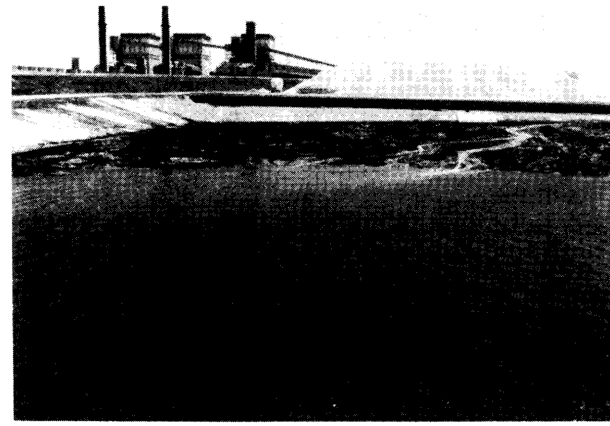


Photo credit: Electric Power Research Institute

Surface impoundment at coal-fired electric utility.

Most low-volume wastes are disposed of in landfills or surface impoundments. Some are codisposed with ash or FGD sludge, sometimes with treatment such as neutralization. USWAG believes

[5] First, EPA estimated in its Report to Congress that coal-fired powerplants generated 85 million tons of wastes in 1984-about 69 million tons of all types of ash and 16 million tons of FGD sludge (118). EPA expected the quantities of ash and FGD sludge to increase to 120 million tons and 50 million tons per year, respectively, by the year 2000, due to increased dependence on coal for electricity production. These quantities do not include the weight of wastewater used to sluice the ash and FGD sludge into surface impoundments. Also, EPA did not estimate the quantities of low-volume cleaning and maintenance wastes. Second, EPA conducted a screening survey of industrial Subtitle D facilities (116). For the electric power generation industry (Standard Industrial Classification Code 491 1), EPA estimated that almost 4,000 establishments produced nearly 1 billion tons of waste in 1985 (1 16). This quantity includes the weight of wastewater used to sluice ash into surface impoundments from the boilers and other wastewater involved in the coal combustion process. It also includes all electric power generating facilities, not just those burning coal. Although EPA is not certain how the data in the two studies are related, it appears that wastes from the approximately 500 coal-burning electric utilities included in the Report to Congress (1 18) would be included among the electric power generation industry wastes in the screening survey (R. Tonetti, U.S. EPA, personal communication, August 1990).

[6] USWAG is an informal consortium composed of the Edison Electric Institute, the American Public Power Association, the National Rural Electric Cooperative Association, and approximately 75 electric utility operating companies. Together, USWAG members represent more than 85 percent of the total electric generating capacity of the United States.

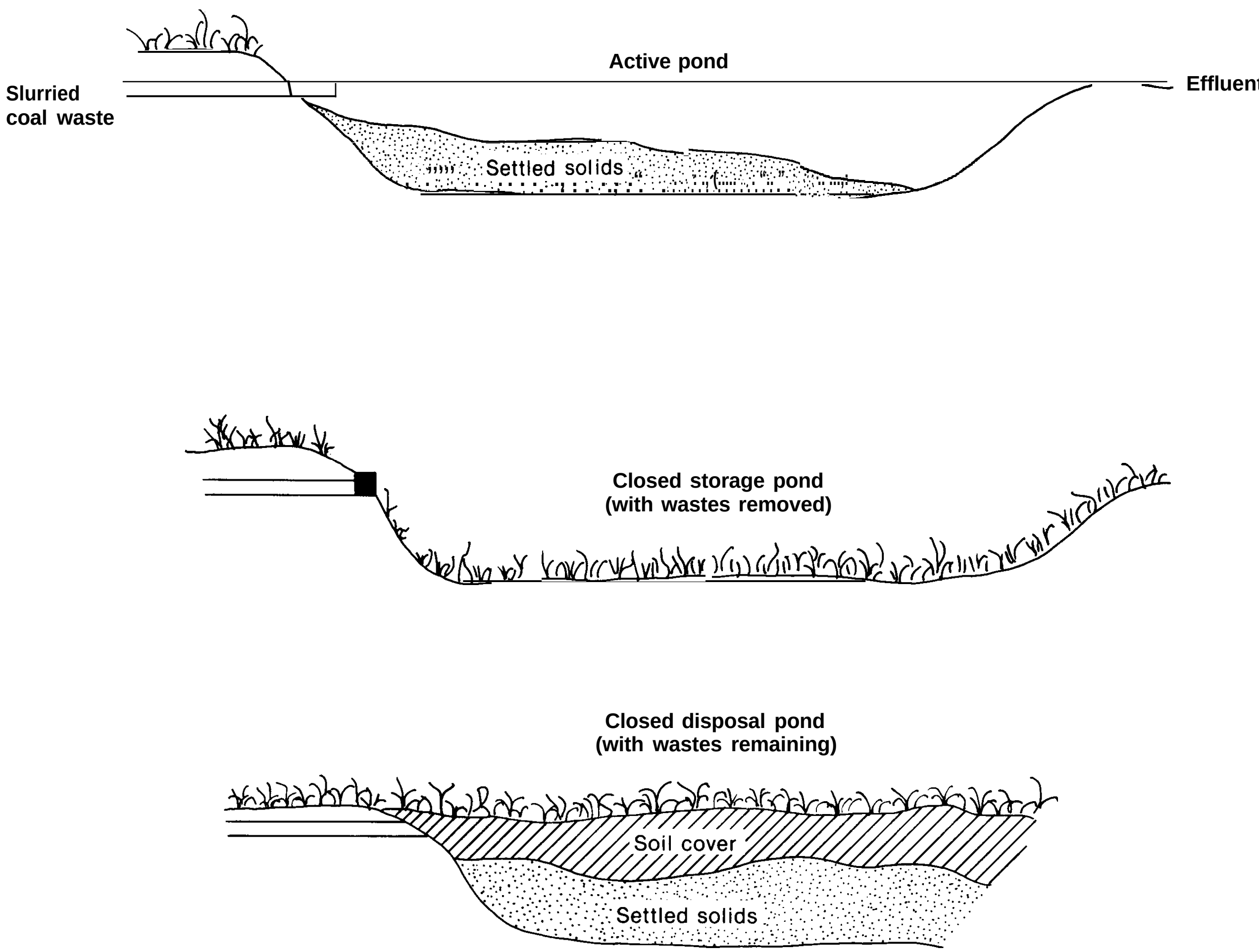
[7] Issues such as these draw into question the validity and comparability of generation estimates across different industries and studies. This may also mean that some RCRA-exempted wastes are included in the total volume of Subtitle D manufacturing wastes estimated by the screening survey.

[8] USWAG, review cements, Feb. 22, 1991.

[9] Additional FGD sludge will likely be generated as facilities comply with new emission standards required in the 1990 Clean Air Act (CAA) Amendments. The effects of the clean coal technologies and new emission standards in the CAA Amendments on the generation and management of coal combustion wastes have not been fully assessed.

[10] J. Roewer, Edison Electric Institute, personal communication, April 1991.

Figure 3-l-Typical Stages in the Life of a Surface Impoundment



SOURCE: U.S. Environmental Protection Agency, *Report to Congress: Wastes From the Combustion of Coal by Electric Utility Power Plants, EPA/530-SW-88-O02* (Washington, DC: February 1988).

that about 30 percent of utilities codispose high- and low-volume wastes; however, this does not indicate the volume of waste codisposed. Table 3-1 lists different management scenarios for typical low-volume wastes (118). No estimates are available on the amount of low-volume wastes that are handled as hazardous by the utilities and sent off-site for management.[11]

Clay or other liners may lower the rate at which leachate is released from impoundments. As of the mid-1980s, however, only 25 percent of all units—including about 40 percent of landfills and 13 percent of surface impoundments-for which information was available had some type of liner (118).[12] Of the generating units built since 1975,40 percent had liners; 60 percent of units built since 1975 that handled FGD sludge had liners. EPA estimated that only about 15 percent of all units had leachate collection systems and about 35 percent had groundwater monitoring systems. The extent to which liners, leachate controls, and groundwater monitoring occur at today's waste management units is unknown.

[11]K. Ladwig, Wisconsin Electric Power Co., personal communication, Feb. 28, 1991.

[12]Ch. 1 discusses a recent survey (33) of State requirements for liners at non-hazardous industrial waste landfills; the survey data do not distinguish landfills that accept only coal combustion wastes from landfills that accept a broader range of Subtitle D solid wastes.

Table 3-l—Methods of Handling, Treating, and Disposing of Low-Volume Wastes

Low-volume waste	Treatment	Predominant disposal method
Waterside cleaning waste	If organic chelating agents are used, waste can be incinerated. If acids are used, waste is often neutralized and metals are precipitated with lime and flocculants.	1. Codisposal with high-volume wastes in pond or landfill following treatment 2. Disposal by contractor
Fireside cleaning waste	Sometimes neutralized and precipitated. For coal-fired plants, most often diverted to ash ponds without treatment. If metal content is high, chemical coagulation and settling are used.	1. Codisposal with high-volume wastes in pond without treatment 2. Pending following treatment
Air preheater cleaning wastes	Settling in ash pond; neutralized and coagulated if combined with other streams before treatment.	1. Codisposal in pond without treatment 2, Pending with treatment
Coal pile runoff	Neutralized by diverting to alkaline ash pond. Fine coal material caught in perimeter ditch is often diverted back to coal pile.	1. Codisposal of sludge in landfill after treatment 2. Codisposal in ash pond
Wastewater treatment	Usually ponded with ash or as a separate waste. Sometimes solids redisposed with bottom ash.	1. Pending 2. Landfilling
Makeup water treatment	Usually codisposed in ash pond.	1. Codisposal in pond
Cooling tower basin sludge	Very little information; infrequent waste. Sludge commingled with wastewater treatment sludge.	1. Landfilling
Demineralize regenerants	Equalized in tanks, then commingled into ash ponds.	1. Pending
Pyrite wastes	Disposed in landfills with bottom ash or diverted to ash pond.	1. Pending 2. Landfilling

SOURCE: U.S. Environmental Protection Agency, *Report to Congress: Wastes From the Combustion of Coal by Electric Utility Power Plants, EPA/530-SW-88-O02* (Washington, DC: February 1988).

Relative Use of Impoundments and Landfills

According to EPA, 80 percent of coal combustion waste from utilities in 1984 was treated, stored, or disposed of in land-based management units (1 18). The remaining 20 percent was reused in various ways. Disposed materials were most often managed in surface impoundments (also called ''wet ponds' and landfills. Based on data for 1,094 electricity generating units (including non-coal-burning units) for which management practices were known, 54 percent (578) disposed of their wastes in landfills and 44 percent (483) disposed of wastes in surface impoundments; the remaining facilities may have disposed of wastes in quarries, mines, or waste piles (118). The utility industry estimates that 49 percent of all units at coal combustion utilities currently manage coal ash in surface impoundments, temporarily or permanently .13

EPA estimated that almost 70 percent of all electric utility generating units managed coal combustion wastes on-site. Two-thirds of the on-site facilities were surface impoundments; most of the remaining on-site facilities were landfills. Landfills, however, accounted for about 95 percent of all off-site disposal. The trend in recent years is toward increasing use of on-site landfills (118).

EPA's screening survey examined more than 4,000 facilities in the electric power generation industry, including about 3,500 non-coal-burning and 500 coal-burning plants (116). EPA estimated that on-site waste management units at these facilities in 1986 consisted of 1,220 surface impoundments, 155 landfills, 110 waste piles, and 43 land application units.

These data may indicate a greater reliance on surface impoundments for electric power generation as a whole than for the coal-burning portion of the industry. The coal combustion industry believes that EPA's Report to Congress more accurately portrays management of coal combustion wastes. Furthermore, the industry believes that the screening survey

13J. Roewer, Edison Electric Institute, personal communication April 1991.

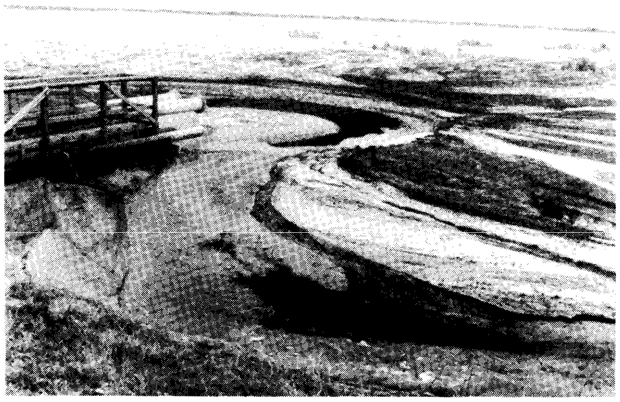


Photo credit: Electric Power Research Institute

Wastewater from coal-fired electric utility is stored or disposed in surface impoundment.

estimate of 1,220 surface impoundments must include wastewater treatment and storage impoundments in addition to disposal impoundments.[14] However, the generally continuous storage or treatment of wastewater in a surface impoundment results in wastewater being present in the impoundment for as long as it is active. The impoundment essentially becomes a disposal site, except for the wastewater in it, which is either recycled or discharged to surface waters under a permit.

Recycling and Waste Reduction

Although most coal-fired electric utility waste is land-disposed, about 20 percent (27 percent of all coal ash and less than 1 percent of FGD sludge) was recycled in 1985 (118). This percentage increased steadily between 1970 and 1985. The industry estimates that between 20 and 28 percent of coal ash being generated today is recycled annually.[15] Currently, about one-third of all bottom ash is recycled in products such as blasting grit or road and construction fill material. About 17 percent of fly ash is used as a concrete or cement additive, among other uses.

EPA's procurement rules under RCRA already promote the use of coal fly ash in cement and concrete.[16] Coal ash can also be used as structural fill, a soil substitute, or an antiskid material, and for mine subsidence control and other applications. Pemsylvania's proposed residual waste regulations would encourage such uses without requiring a permit, if the practices meet certain limitations and the Department of Environmental Resources is sent basic information about the use.[17] The rate of reuse varies among States, depending on market conditions and utility efforts. Wisconsin, for example, currently reuses about 50 percent of its coal ash.[18]

A logical question is whether any opportunities exist to reduce the amount of waste being generated. According to industry representatives, the ability to prevent generation of high-volume coal combustion wastes is minimal because of the composition of the coal itself. Moreover, the 1990 Clean Air Act Amendments and its provisions on increased sulfur dioxide pollution controls will result in the generation of even greater volumes of combustion wastes. The only way to lower these waste volumes significantly would be to use a fuel other than coal, although demand-side management (i.e., utility programs designed to encourage changes in energy use patterns to balance energy supply and demand) might also affect overall coal use. Reducing the use of coal in generating electricity would have detrimental effects on the U.S. coal industry; however, it also is one means of reducing emissions of carbon dioxide, which is the major gas contributing to potential global climate change *(98).* The industry and EPA see utilization, or recycling, of ash ash and FGD sludge as the most realistic way to lower the volume of waste requiring disposal.

RISKS FROM COAL COMBUSTION WASTE MANAGEMENT

According to EPA's Report to Congress (118), virtually no high-volume coal combustion wastes exhibited toxicity levels that would characterize them as hazardous, based on data using the Extraction Procedure (EP), Toxicity Characteristic (TC), and other tests. Cadmium, chromium, and arsenic were the only metals found in ash or FGD sludge at

[14] USWAG, review comments, Feb. 22, 1991.

[15] K. Ladwig, Wisconsin Electric Power Co., personal communication, Feb. 28,1991.

[16] 48 Federal Register 4230, Jan. 28, 1983.

[17] 20 *Pennsylvania Bulletin, vol. 20, No. 8, 1160-1163,* Feb. 24,1990.

[18] K. LadWig, Wisconsin Electric Power Co., personal communication% Feb. 28,1991.

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potentially hazardous levels, but this occurred rarely and depended on the content of the coal.

Some low-volume cleaning wastes, however, were found to be potentially hazardous. Specifically, some samples of boiler cleaning wastes were found to be corrosive, and some had levels of cadmium, chromium, and lead that exceeded EP toxicity limits. However, these wastestreams do not always exhibit hazardous characteristics after disposal. For example, boiler cleaning wastes codisposed with coal ash showed no hazardous waste characteristics (118). EPA concluded that additional research on low-volume wastes was necessary before a clear decision on their risks could be determined.

Moreover, the industry believes that the EP and TC tests overestimate hazards associated with wastes. Both tests attempt to mimic conditions in a municipal solid waste landfill that the industry asserts is much more likely to leach constituents than a landfill used only for coal combustion wastes (134).

Some EPA and industry studies generally show only limited migration of leachate from coal combustion waste facilities, although the data are somewhat limited by the relatively low frequency of groundwater monitoring.

For example, EPA's Report to Congress contains data on the concentration of constituents (for which drinking water standards have been promulgated) in groundwater and surface water downgradient from coal combustion waste disposal sites which show some migration of trace elements from certain sites into surrounding water bodies. Elevated levels of cadmium, chromium, lead, fluoride, iron, manganese, sulfate, and boron were found downgradient in groundwater; cadmium, chromium, and fluoride were found downgradient in surface water. However, drinking water standards were only exceeded infrequently, and only 3.7 percent of the sampling sites had downgradient concentrations of drinking water standard constituents higher than those measured in upgradient wells.[19] Furthermore, in some of these instances, the constituent was found in relatively equivalent concentrations upgradient as well as downgradient, which suggests that contamination was not necessarily caused by the waste disposal sites.

The Radian Corp. (67), at the request of the Electric Power Research Institute (EPRI), studied leaching potential from codisposal of low- and high-volume wastes in a coal ash pond (i.e., surface impoundment). Results from monitoring over a 2-year period showed that the majority of constituents analyzed were found in statistically equivalent concentrations in groundwater upgradient and downgradient of the ash pond or were not detected in either location. Only calcium, magnesium, strontium, and sulfate were found in significantly greater concentrations in the downgradient well, whereas other trace metals from the ash were not detected in downgradient groundwater. Constituents that might be most expected from low-volume wastes (ammonium, bromate, and hydrochloric acid from cleaning solutions; iron, copper, and other scale and metal deposits removed from equipment surfaces during cleaning) were not found in the downgradient samples. Radian concluded that the comanagement of low- and high-volume wastes had no impact on groundwater outside the ash pond. The reason given for this finding was that toxic metals in low-volume wastes are generally insoluble unless the pH of the solution is less than 1.5, which the investigators consider very rare. Furthermore, even if the metals did dissolve, they would be expected to be attenuated in the soil below, where the pH would likely exceed 5 (except in some coniferous and other forested areas). EPRI (21) obtained similar preliminary results from a second study site.

EPA (118) also concluded that the potential for exposure of human populations is likely to be limited, despite some migration of leachate off-site, because: only a limited number of contaminated sites were found; groundwater in the vicinity of utility waste disposal sites is not typically used for drinking water; and most management sites are not near populated areas.

However, these conclusions may be limited by several caveats:

1. 29 percent of the disposal sites in 1984 had people living within 1 kilometer, with popula-

[19] In contrast, data from 21 coal ash monofills in Pennsylvania indicate 17 sites with groundwater that exceeded drinking water standards for sulfates and occasionally exceeded drinkig water standards for iron, lead, arsenic, chromium, and zinc (J. Dernbach, Pennsylvania Department of Environmental Resources, review comments, July 23, 1991).

tions near these sites ranging between O and 3,708 people;
2. 34 percent of the sites had public drinking water systems downgradient from the site, half of which each served more than 5,000 people;
3. a high percentage of sites had populations of rare plant and animal species within 5 kilometers, and EPA found that a high potential existed for exposure of these species to some constituents of coal combustion wastes; and
4. the conclusion that potential exposure was limited did not account for the 'location of future utility sites.

In addition, EPA did not attempt to compile a complete census of damage cases by conducting extensive field studies (118). Even so, EPA was unable to identify any proven damage cases in the seven years prior to its report.

CURRENT REGULATORY PATHWAYS

Current RCRA Status of Coal Combustion Wastes

Based on findings from its report to Congress, EPA (118) made three preliminary recommendations, subject to change based on public comment, regarding the management of coal combustion wastes. RCRA (Sec. 3001 (b)(3)(C)) required EPA to make a regulatory determination on these wastes within 6 months of submitting the report to Congress. However, EPA has yet to do this and its activity on these wastestreams is currently on hold.[20]

EPA's three recommendations were as follows:

1. Because coal combustion wastestreams generally do not exhibit hazardous characteristics as defined under RCRA Subtitle C, high-volume wastes (e.g., fly ash, bottom ash, boiler slag, and FGD sludge) should not be regulated under Subtitle C.
2. The utilization of coal combustion wastes should be encouraged as one method for reducing the amount requiring disposal, to the extent this can be done in an environmentally protective manner.
3. Because some low-volume wastes may exhibit the hazardous waste characteristics of corrosivity and toxicity, EPA intends to further study and seek comment on these wastes and to consider whether they should be regulated under Subtitle C.

Although industry representatives concur with EPA's first two recommendations, they do not believe that low-volume wastes require further research or regulation. Instead, they interpret the Bevill amendment as requiring EPA to study, and base its findings on, the efficacy of "real-world" utility waste management practices and any environmental effects of these practices, not only on laboratory-generated characteristics (e.g., EP toxicity) of the wastes themselves. Furthermore, they contend that codisposal of low- and high-volume wastes is an environmentally sound way to manage the former. As noted above, EPRI is conducting field studies on the codisposal of low- and high-volume utility wastes.

Environmentalists contend that low-volume wastes should not have been included by EPA in the exemptions because they are not "high volume, low hazard" wastes within the Bevill exclusion as interpreted by the courts and that codisposal may encourage dilution as a management method for characteristic wastes.

State Coal Combustion Waste Programs

Coal combustion wastes are currently exempt from RCRA hazardous waste regulation (coal ash sites may still be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) if necessary), and Federal Subtitle D regulations are generally incomplete (see ch. 1). These wastestreams are regulated primarily under State hazardous or solid waste laws. EPA's Report to Congress (118) listed disposal and management requirements promulgated under each State's solid waste regulations; these data were based on a 1983 USWAG report that was updated by EPA.

[20] According t. EPA's review comments on drafts of this paper, the delay is partly because of a July 1988 court riding that directed the Agency to undertake a series of rulemakings and issue a Report to Congress on exempt mineral processing wastes, under a schedule that contained very tight deadlines (*Environmental Defense Fund v. U.S. EPA, 852* F.2d 1316 (D.C. Cir. 1988)). This court order diverted a significant portion of staff and management attention away from utility-related activities, from 1988 through issuance of the mineral processing Report to Congress in July 1990 and the subsequent regulatory determination in May 1991. EPA has received a Notice of Intent to file a citizens' suit over the Agency's failure to issue a final regulatory determination for coal combustion wastes.

However, the EPA report was unclear as to what years the update included.

Based on EPA data, State regulations appear to vary widely, both in general requirements and in the specific details of each requirement. As such, it is difficult to generalize about the extent and quality of regulation of coal combustion disposal facilities. Moreover, no information on implementation and enforcement of these regulations is currently available. In addition, some regulations are likely to have changed since the report was issued.[21]

Forty-three States have exempted coal combustion wastes from hazardous waste regulation. Of the seven States that do not exempt them from such regulation, California burns little coal to produce electricity. The other six (Kentucky, Maine, New Jersey, Oklahoma, Tennessee, and Washington) require that coal combustion wastes be tested for toxicity; if they prove to be toxic, some or all hazardous waste regulations may apply. Classification by the States of a utility's waste as hazardous, however, apparently has been rare (118).

Solid waste regulations of every State require that off-site solid waste disposal facilities be permitted or have some form of approval. EPA has not updated its information on State regulatory programs since issuing its Report to Congress in 1988. Based on that report, a facility operator must meet the following requirements in different States:

- Permitting—Forty-one States required permits for both on-site and off-site facilities,[22] whereas eight States exempted on-site facilities.
- Site restrictions-Thirty States restricted placement of solid waste disposal facilities; these restrictions varied, but they may include banning placement in a 100-year" floodplain or requiring a minimum depth to groundwater.
- Liners-Only five States required all solid waste facilities to have a clay or synthetic liner; six other States could require a liner on a case-by-case basis.
- Leachate control systems-Twelve States required leachate control systems at all solid waste disposal facilities, and eight other States could require them on a case-by-case basis.
- Groundwater monitoring-Seventeen States required groundwater monitoring at all solid waste disposal facilities, and eleven other States could require groundwater monitoring on a case-by-case basis.
- Closure/postclosure—Twenty-six States required some closure or postclosure care, although the details of these requirements were not delineated.
- Financial assurance-Thirteen States required some financial assurance requirement, such as a bond or participation in a waste management fund, to ensure the long-term safety of closed facilities.

ISSUES/QUESTIONS

The previous sections suggest several issues specific to coal combustion utility wastes that Congress might address during the RCRA reauthorization process:

- Relationships Among Federal and State Agencies-Is there a need for regulations specific to coal combustion wastes, or can they be adequately managed under existing or future State and Federal programs for other manufacturing wastes? What degree of primacy does Congress wish States to have in managing coal combustion wastes? Should EPA develop uniform national guidelines for the management of coal combustion wastes and require States to submit detailed management plans for approval, or should EPA limit its efforts to technical and financial support of State-implemented Subtitle D programs?
- Efficacy and Enforcement of Existing Programs-How effective are existing State pro-

21 For example, in August 1988 Ohio established stricter design and siting requirements for "non-toxic" fly ash and bottom ash (i.e., constituent levels in extract from the EP toxicity test of the ash less than 30 times the Drinking Water Standards); however, these ashes remain exempt from solid waste, as well as hazardous waste, regulation (Ohio EPA, DWPC Policy 4.07, Aug. 1, 1988). Pennsylvania's proposed residual waste rules will increase requirements (e.g., liners, leachate control, groundwater monitoring) on all residual waste facilities, including those accepting coal combustion wastes. Facility requirements will vary depending on the concentration of certain hazardous constituents in each wastestream or in a leachate analysis (e.g., EP or TC test) of the wastestream (*Pennsylvania Bulletin*, vol. 20, No. 8, Feb. 24, 1990).

22 In Ohio, "non-toxic" fly ash and bottom ash (but not FGD sludge) are subject to design controls that are similar to non-exempted wastes, but they also are subject to more lenient permitting, siting and financial assurance requirements (E. Brdicka, Ohio Environmental Protection Agency, personal communication, Oct. 21, 1991).

grams? Should independent audits be conducted to assess how effectively various State and Federal programs and regulations are being enforced? Are existing resources sufficient to administer and enforce Federal or State coal combustion waste regulatory programs? If not, what mechanisms are available to provide such resources? What emphasis should be given to the enforcement of coal combustion waste programs relative to other Subtitle D wastes?

- **Regulation of Treatment and Storage Facilities** and Other Production Process Units—Does EPA have sufficient authority under RCRA Subtitle D to regulate production processes (which may include waste treatment and storage facilities) in addition to disposal practices? (Also see ch. 2).

- **Beneficial Use of Coal Combustion Wastes**-Should Congress encourage the beneficial reuse of coal ash? If so, what would constitute beneficial use? Should any limits be placed on such use?

- Regulation of Low- and High-Volume Wastes-Should codisposal in Subtitle D units of low- and high-volume wastes be allowed, or should high- and low-volume wastes be managed separately, given their different characteristics? In either case, what design features should be required for new and existing waste management facilities? Should Subtitle C regulation of low-volume wastes be required if they exhibit a hazardous characteristic?