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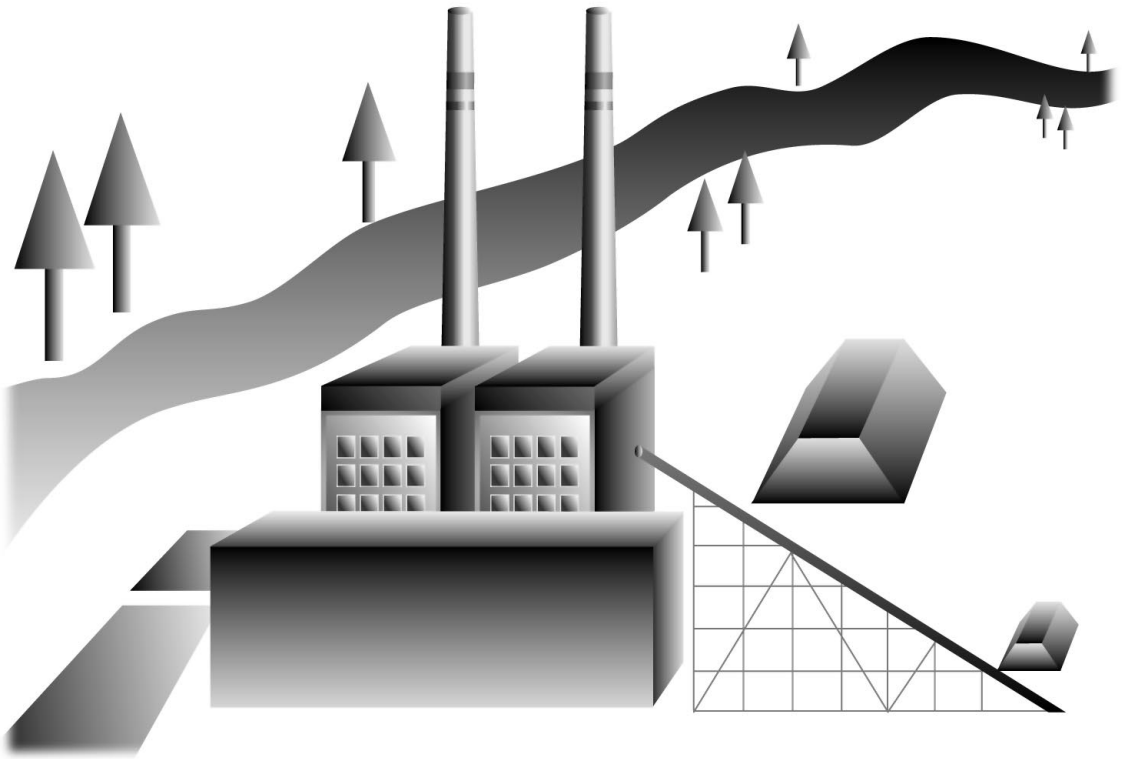
Report to Congress

Wastes from the Combustion of Fossil Fuels

Volume 1 – Executive Summary



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EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 BACKGROUND

Section 3001(b)(3)(A)(i) of the Resource Conservation and Recovery Act (RCRA) excludes certain large-volume wastes generated primarily from the combustion of coal or other fossil fuels from being regulated as hazardous waste under Subtitle C of RCRA, pending completion of a Report to Congress required by Section 8002(n) and a determination by the U.S. Environmental Protection Agency (EPA) Administrator either to promulgate regulations under Subtitle C or to deem such regulations as being unwarranted.

In 1988, EPA published the *Report to Congress on Wastes from the Combustion of Coal by Electric Utility Power Plants* (EPA, 1988). The report, however, did not address comanaged utility coal combustion wastes, other fossil fuel wastes that are generated by utilities, and wastes from non-utility boilers burning any type of fossil fuel. Further, because of other priorities, EPA did not complete a regulatory determination on fossil fuel combustion (FFC) wastes at that time.

In 1991, a suit was filed against EPA for failure to complete a regulatory determination on FFC wastes (Gearhart v. Reilly Civil No. 91-2345 (D.D.C.). On June 30, 1992, the Agency entered into a Consent Decree that established a schedule for EPA to complete the regulatory determinations for all FFC wastes. FFC wastes were divided into two categories: (1) fly ash, bottom ash, boiler slag, and flue gas emission control waste from the combustion of coal by electric utilities and independent commercial power producers, and (2) all remaining wastes subject to RCRA Sections 3001(b)(3)(A)(i) and 8002(n). On August 9, 1993, EPA published a determination for the first category of wastes, concluding that regulation under Subtitle C for these wastes was not warranted. To make an appropriate determination for the second category or "remaining wastes," EPA decided that additional study was necessary. Under the current court-ordered deadlines, the Agency must complete this Report to Congress by March 31, 1999, and issue a regulatory determination by October 1, 1999.

In keeping with its court-ordered schedule, and pursuant to the requirements of Section 3001(b)(3)(A)(i) and Section 8002(n) of RCRA, the EPA has prepared this report on remaining FFC wastes. In addition to complying with the Congressional mandate, this report will serve to establish a factual basis for EPA decision-making regarding the appropriate regulatory status, under RCRA, of remaining FFC wastes. The report addresses the following eight study factors required by Section 8002(n) of RCRA for FFC wastes:

1. The source and volumes of such materials generated per year
2. Present disposal practices
3. Potential danger, if any, to human health and the environment from the disposal of such materials
4. Documented cases in which danger to human health or the environment has been proved
5. Alternatives to current disposal methods
6. The costs of such alternatives

7. The impact of those alternatives on the use of natural resources

8. The current and potential utilization of such materials.

In addition, the report includes a review of applicable state and federal regulations so that regulatory decisions that derive from the report will avoid duplication of existing requirements.

1.2 SCOPE AND ORGANIZATION OF THE REPORT TO CONGRESS

This report addresses the remaining wastes from FFC. As defined in the 1992 Consent Decree, remaining wastes comprise the following:

- Fly ash, bottom ash, boiler slag, and flue gas emission control wastes from the combustion of coal by electric utility power plants, when such wastes are mixed with, codisposed, cotreated, or otherwise comanaged with other wastes generated in conjunction with the combustion of coal or other fossil fuels

- Any other wastes subject to Section 8002(n) of RCRA, except fly ash, bottom ash, boiler slag, and flue gas emission wastes from coal combustion by electric utilities.

For the purposes of this report, EPA is addressing the following FFC wastes:

- Comanaged coal combustion wastes, wastes from the combustion of petroleum coke, and wastes from mixtures of coal and other fuels ("coburning") generated by utilities.

- Wastes from the combustion of coal, petroleum coke, and mixtures of coal and other fuels (coburning) generated by non-utilities.

- Wastes from the combustion of coal, petroleum coke, and mixtures of coal and other fuels (coburning) by facilities that employ fluidized bed combustion technology.

- Wastes from the combustion of oil by utilities and non-utilities.

- Wastes from the combustion of natural gas by utilities and non-utilities.

The report is organized into seven chapters that address the study factors required under Section 8002(n) of RCRA. Chapter 2 provides an overview of FFC in the United States, including a brief description of the utility and non-utility sectors and a discussion of projected trends for the industry. Chapters 3 through 7 parallel the categories of remaining wastes listed above in Section 1.2. Chapter 3 focuses on comanaged utility coal combustion waste and also covers coburning by utilities. Chapter 4 examines non-utility coal combustion waste. Chapters 5 and 6 discuss fluidized bed combustion wastes and oil combustion wastes, respectively. Chapter 7 focuses on natural gas combustion wastes. Chapters 3 through 6 each provide overviews of their relevant sectors; describe the wastes generated, their characteristics, and volumes; and examine current waste management practices, potential and documented dangers to human health and the environment, existing regulatory controls, waste management alternatives, and costs and economic impacts. Chapter 7 presents a brief overview of natural gas combustion technology (additional discussion of natural gas combustion wastes is not warranted because of minimal waste generation). Finally, each of the chapters presents the Agency's findings and recommendations.

2.0 INFORMATION SOURCES AND METHODS

In conducting this study, EPA gathered publicly available information from a broad range of sources, including federal and state agencies, industry trade groups, environmental organizations, and open literature. EPA reviewed information on each of the Section 8002(n) study factors for each of the FFC waste sectors. For many study factors, very limited information existed prior to this study. Accordingly, EPA worked closely with the Edison Electric Institute's (EEI) Utility Solid Waste Activities Group (USWAG), the Electric Power Research Institute (EPRI), and the Council of Industrial Boiler Owners (CIBO) as those organizations developed new information in support of EPA's decision process. Because other ongoing EPA projects currently focus on portions of the FFC waste generator universe, EPA also leveraged data collection efforts conducted for air, industrial waste, and hazardous waste programs. In addition, EPA maintained contact with a number of environmental organizations to share information and ideas regarding beneficial uses of some FFC wastes and methods of characterizing the risks associated with FFC wastes.

In the Agency's part 1 fossil fuel combustion regulatory determination (58 FR 42466, 8/9/93), the Agency applied a three-step decision-making process. Under this procedure, the Agency first considers the potential impacts of the wastes in question on human health and the environment. If EPA finds there may be significant impact, the Agency next considers whether there is a need for regulation under RCRA Subtitle C in light of existing waste management practices and existing regulatory controls imposed by states under authorities other than Subtitle C. The Agency also considers whether Subtitle C would effectively address problems associated with the waste without imposing significant unnecessary controls. Finally, if the Agency concludes that additional regulation under Subtitle C is warranted, EPA considers the potential economic impacts and affects on operations and beneficial uses of the wastes from such regulation on the industry.

In this report, EPA has continued to consider the factors previously utilized in the three-step decision-making process, since the Agency believes that these factors appropriately reflect the statutory criteria in Section 8002 of RCRA that EPA must consider in issuing this report. The Agency has modified somewhat, however, how those factors are considered in formulating its recommendations. Rather than apply the statutory criteria in rigid, stepwise fashion, EPA has considered the totality of the relevant factors (i.e., the potential environmental and human health impacts, the need, if any, for additional regulation and, finally, the potential impacts of imposing regulation under subtitle C in developing the report's recommendations). The step-wise approach to making regulatory determinations assumes that it is possible to reach readily discernable, yes-or-no decisions regarding each step in the decision-making process. As we gain experience in evaluating Bevill wastes, however, we have learned that such clear-cut answers may not be possible for each individual decision-making criterion, and that it may be necessary to balance all the relevant factors to reach the appropriate recommendation. For example, where a particular waste poses some potential risk, but existing controls are wholly inadequate and regulation under subtitle C would not cause severe economic dislocation, a determination to regulate the waste may be appropriate. Conversely, where a waste poses more substantial risks but existing controls are generally adequate and the costs of subtitle C controls would be substantial, continuing the exemption might be the appropriate outcome. In both cases, each individual decision criterion may not yield a definitive regulatory determination. Instead, considering the totality of the relevant factors would be most likely to yield a rational conclusion consistent with our statutory mandate. Thus, EPA will take this approach in this report and the regulatory determination to follow, which the Agency believes is consistent with the broad decision-making discretion that Congress intended EPA to exercise in making regulatory determinations for Bevill wastes.

To support each of these analytical steps, and to address data limitations, EPA performed a variety of specific analyses. These included human health and ecological risk assessment, analyses of existing federal and state regulatory programs, and economic impact analyses.

3.0 SUMMARY OF FINDINGS: COAL-FIRED UTILITY COMANAGED WASTES

Coal-fired utilities represent the largest single category of fossil fuel combustion, and likewise generate the greatest proportion of FFC wastes. Each year, utilities burn roughly 900-million tons of coal using a variety of conventional combustion technologies. Utility coal usage results in the generation of roughly 100-million tons of large-volume FFC wastes: fly ash, bottom, ash, boiler slag, and flue gas desulfurization (FGD) sludge. These wastes may be managed in landfills and surface impoundments, or, increasingly, may be applied to a variety of beneficial uses.

In addition to large volume wastes, utilities generate a variety of low-volume wastes that result from supporting processes (see Section 3.1.4) that are ancillary to the combustion and power generation processes. Low-volume wastes include the following:

- Coal pile runoff
- Coal mill rejects/pyrites
- Boiler blowdown
- Cooling tower blowdown and sludge
- Water treatment sludge
- Regeneration waste streams
- Air heater and precipitator washwater
- Boiler chemical cleaning waste
- Floor and yard drains and sumps
- Laboratory wastes
- Wastewater treatment sludge.

In 1993, EPA completed its regulatory determination on large-volume wastes from coal-fired electric utilities and independent power producers (IPPs). The regulatory determination permanently exempts large-volume FFC wastes from utilities and IPPs from hazardous waste regulation. However, the exemption only extends to large-volume wastes that are managed alone. Recent studies conducted by EPRI demonstrate that most utility operators comanage some or all of their large-volume wastes with low-volume wastes. Accordingly, remaining wastes include most utility large-volume wastes as they are actually managed.

EPA estimates that there are roughly 600 FFC waste management units operated at approximately 450 coal-fired utility power plants. These units include equal proportions of landfills and surface impoundments, with recent trends suggesting increasing preference for landfills. Nearly all of the surface impoundments are located onsite, while landfills may be onsite or offsite. Based on utility survey data, EPA estimates that more than 80 percent of these operations comanage large- and low-volume wastes.

Individual surface impoundments and landfills may comanage as many as 15 different low-volume waste streams. Surface impoundments typically comanage more different waste types (a median of eight) than do landfills (a median of four). Coal mill rejects are among the most common wastes to be comanaged in landfill and impoundments, while floor drain wastes, coal pile runoff, and water treatment wastes are also commonly disposed in comanaged waste impoundments. The total quantity of low-volume wastes managed in landfills will generally be small compared with the large-volume wastes. In surface impoundments, however, the low-volume wastes may be very large compared with the quantity

of ash disposed. This relative measure largely reflects the volume of water and not the solids content of the low-volume waste.

The size of comanaged waste units ranges from modest to very large, with some surface impoundments covering 1,500 acres or more. Median landfill and surface impoundment capacities are 3.8- and 3.4-million cubic yards, respectively.

Nearly all comanagement units operate under some sort of regulatory permit. Additionally, more than half of landfills and roughly one quarter of impoundments are lined with compacted clay, asphalt, synthetic, or other type of liner. Significantly, the newer the management unit the more likely it will possess modern environmental controls, such as liners, monitoring requirements, cover requirements, and other features.

In addition to traditional waste management in landfills and surface impoundments, utility coal combustion wastes can be used in a variety of applications. Categories of beneficial use include cement and concrete products, construction fills (including structural fill, flowable fill, and road base), agricultural uses, waste management applications, mining applications, and incorporation into other products. Overall, these uses reportedly account for nearly 30 percent of annual waste generation nationwide. Given the prevalence of comanagement, EPA believes that much of these wastes may be comanaged wastes.

In the 1988 Report to Congress and 1993 Regulatory Determination, EPA evaluated whether large-volume wastes exhibited any of the four characteristics of hazardous waste: corrosivity, reactivity, ignitability, and toxicity. EPA determined that large-volume utility coal combustion wastes are unlikely to be corrosive, reactive, or ignitable. EPA also found that metals generally are not found in leachate above the toxicity characteristic (TC) levels.

Based on limited available data, EPA concludes that comanaged wastes also generally are not corrosive, reactive, ignitable, or toxic. Available data on low-volume waste characteristics show that some low-volume wastes occasionally exhibit RCRA corrosivity (regeneration wastes, boiler chemical cleaning wastes) and RCRA toxicity (coal pile runoff, regeneration wastes, boiler chemical cleaning wastes). However, most comanaged waste units predominantly contain large-volume wastes and/or dilute low-volume waste waters, reducing the likelihood that the combined wastes will exhibit hazardous characteristics. Further, waste characterization data collected from comanaged waste landfills and impoundments show no exceedences of TC levels in any TCLP sample of comanaged wastes, and exhibit only infrequent exceedences of TC levels in *in situ* pore water samples from some impoundments.

EPA also found that coal mill rejects containing pyritic sulfur may result in the generation of acidic leachate from comanaged wastes that exceeed TC levels. In fact, most of the exceedences of TC levels observed in *in situ* pore water samples from comanaged waste impoundments appear to be associated with oxidation of pyrites contained in coal mill rejects.

EPA examined the risks associated with comanaged wastes and focused on metals as constituents of concern. The Agency used the *Composite Model for Leachate Migration with Transformation Products v1.2* (EPACMTP) to evaluate the potential risks associated with human ingestion of contaminated ground water. Additionally, EPA used an integrated, multi pathway exposure model to examine human health and ecological risks from inhalation, ingestion, and direct contact to contaminated media above ground.

EPA selected the EPACMTP to model the movement in ground water of metals of concern released from waste landfills and surface impoundments. Waste management scenarios were developed for use with EPACMTP using site-specific, industry-wide, and general nationwide information to estimate values for parameters describing waste and management unit properties (e.g., unit size, waste density), unit environmental settings (e.g., recharge rate, soil properties, ground-water velocity), and contaminant properties (e.g., retardation factors). Each scenario was used to predict the peak metals concentrations expected to occur in a nearby drinking water well during a 10,000-year study period. Comparing the predicted peak concentration with health-based benchmarks, EPA estimated the risk to an individual receptor exposed through ingestion of contaminated drinking water.

EPA calculated estimated risks for each scenario by selecting combinations of variables most likely to produce high-end (to include the 95th percentile of all possible risks) results. EPA then performed probabilistic modeling to determine where the deterministic results fell within a distribution of estimated risks. Finally, EPA performed sensitivity analyses to improve its confidence in the overall estimate of risks.

Overall, EPA found that the ground-water pathway risks associated with all modeled constituents of concern, except for arsenic, fell below a hazard quotient of 1 or a lifetime cancer risk of 1×10^{-6}. Potential risks associated with arsenic in the landfill and the surface impoundment high-end deterministic scenarios were 3×10^{-4} and 5×10^{-4}, respectively. Monte Carlo probabilistic risks for the landfill and impoundment were 4×10^{-5} and 2×10^{-5}, respectively. For arsenic, the risk for young children increased roughly 25 percent compared to the adult receptors.

EPA also considered the time at which risks were predicted to result from the release of constituents of concern in each of the scenarios. EPA found that the concentration of arsenic in ground water at the receptor well would not reach the health-based level for arsenic (e.g., achieve a risk level of 1×10^{-6}) for roughly 500 years. For the landfill, the predicted time to reach a risk of 1×10^{-6} or more was found to exceed 3,500 years.

As in the case for the ground-water risk assessment, EPA conducted a broad above-ground risk assessment to estimate potential risks associated with direct and indirect exposure to wastes and waste contaminated media. Using the Indirect Exposure Methodology (IEM), EPA estimated the concentration of constituents of concern in air, soils, and plant and animal tissues resulting from airborne and waterborne releases of comanaged wastes. EPA then estimated the human health risks associated with exposure to the contaminated media for a wide range of exposure scenarios. To provide confidence in its model results, EPA conducted sensitivity analyses for each scenario, constituent, and receptor, focusing in particular on those driving parameters for which only limited information was available.

EPA found no risks from the ingestion exposure route in excess of 10^{-6} (cancer), or with hazard quotients in excess of 1, except for arsenic in the case of agricultural applications and when managed in an onsite active landfill. For both the landfill and the impoundment, for arsenic, ingestion risks were found at the 10^{-6} level for both the farmer and the child of the farmer. In the agricultural use scenario, EPA found arsenic risks from this composite and complex pathway to be 5×10^{-5}.

EPA examined potential ecological risks from comanaged waste landfills and impoundments using the modeling results generated for the above-ground human health risk assessment. EPA compared the predicted media concentrations of metals of concern with calculated benchmark values for a wide range of ecological receptors, including mammals, birds, and amphibians, as well as collections of soil, sediment, and surface water organisms. The risk estimates for landfills and land application units suggest that ecological risks associated with the release and surface transport of chemicals of concern are not

likely to be significant for these management/use practices. The risk estimates for comanaged coal ash surface impoundments and associated drainage systems indicate that this scenario is of special concern. In particular, EPA found that the concentrations of some metals of concern (e.g., aluminum, boron, selenium) may be present in surface impoundment waters at levels well in excess of the benchmark values for amphibians, birds, and/or mammals.

EPA reviewed a range of information sources to identify possible cases of documented damages to human health or the environment arising from comanaged waste practices. EPA identified a total of six sites at which comanagement of coal combustion wastes has occurred and which meet one or more "tests of proof" for damage cases. Five of these sites were previously identified in the 1988 Report to Congress and the 1993 Regulatory Determination (58 FR 42473, 8/9/93). A sixth site was more recently identified by EPA. Detrimental effects from these sites included the presence of contaminants in drinking water wells above maximum contaminant levels (MCLs) and vegetative damage in wetlands or streams.

EPA reviewed current state regulations governing management of FFC wastes and found that states currently have more authority to impose controls on utility coal combustion waste management units than in previous years. In addition to regulatory permits, the majority of states are now able to require siting controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls. EPA believes that the use of such controls has the potential to mitigate risks, particularly ground-water pathway risks, from comanaged waste disposal.

The utility sector in recent years has increasingly installed more environmental controls for comanaged waste facilities. Today more than one-half of the landfills and one quarter of the impoundments are lined. Other examples of in-place controls include leachate collection, ground-water monitoring, and operation under regulatory permits, each of which has a high rate of implementation at landfill management units, and significant implementation at surface impoundment management units.

EPA analyzed the costs and economic impacts of a risk mitigation alternative that would require comanaged wastes to be managed in units compliant with RCRA Subtitle D requirements. This alternative was designed to mitigate the potential ground-water human health risks found for unlined management units. The Agency also considered alternatives to mitigate the potential risk from agricultural use of these wastes, including a standard limiting the arsenic concentration in wastes intended for this use.

The alternative technology selected to target the identified risks for landfills and surface impoundments at coal-fired utilities is construction of new, composite-lined units. EPA's estimate of annualized incremental compliance cost for this alternative for the whole industry is from $800 million per year to $900 million per year, with a most likely estimate of $860 million per year. At the individual plant level, incremental compliance costs would reduce net income as a percentage of revenues by 1.5 to 2.1 percent, depending on the plant size. While this incremental cost should not affect the financial viability of coal-fired plants, EPA recognizes that such profit margin reductions may be considered significant by the individual utility. At the industry level, the total incremental cost represents 0.4 percent of the value of sales. Individual operators would likely take this effect into consideration, along with several other factors, in assessing how soon to close marginal coal plants and what type of new plants to build. This implies that a possible effect of the alternative would be a shift to alternative energy sources.

Recommendations: Coal-Fired Utility Comanaged Wastes

Following are the Agency's recommendations for the wastes covered in this chapter. The recommendations are based on EPA's analysis of the eight Congressionally mandated study factors (Section 1.2). These conclusions are subject to change based on continuing information collection, continuing consultations with other government agencies and the Congress, and comments and new information submitted to EPA during the comment period and any public hearings on this report. The final Agency decision on the appropriate regulatory status for these wastes will be issued after receipt and consideration of comments as part of the Regulatory Determination, which will be issued within 6 months.

1. *The Agency has tentatively concluded that disposal of these wastes should remain exempt from RCRA Subtitle C.*

The Agency has tentatively concluded that the comanaged wastes generated at coal-fired utilities, including petroleum coke combustion wastes as well as wastes from other fuels co-fired with coal, generally present a low inherent toxicity, are seldom characteristically hazardous, and generally do not present a risk to human health and the environment. Current management practices and trends and existing state and federal authorities appear adequate for protection of human health and the environment. State programs increasingly require more sophisticated environmental controls, and tend to focus on utility waste management due to the high waste volumes. For example, the frequency of environmental inspections at utilities is among the highest of all the major industry sectors in the United States. Most of the landfills and 40 percent of the impoundments implement ground-water monitoring, reflecting the states' focus on this industry sector. In addition, the Agency has identified relatively few damages cases. Although one damage case identified arsenic as a constituent of concern, none of the damage cases affected human receptors. These types of facilities are typically located in areas of low population and thus present infrequent opportunity for human exposure. The industry trend, as detailed in this chapter, is to line waste disposal units and to use dry ash handling techniques at new facilities; dry ash handling eliminates the use of impoundments for waste management. Currently, more than one-half of the active landfills are lined. Although one-quarter of all existing active impoundments are lined, about 45 percent of the impoundments constructed since 1975 have been lined.

If these wastes were listed as hazardous, and therefore regulated under Subtitle C, coal combustion units would be required to obtain a Subtitle C permit, which would unnecessarily duplicate existing State requirements, and would establish a series of waste unit design and operating requirements for these wastes that would most often be in excess of requirements to protect human health and the environment. The estimated total annual cost to mitigate the potential arsenic risk identified in this study exceeds $800 million. This cost does not represent implementation of full Subtitle C controls, but rather Subtitle C requirements modified by RCRA 3004(x) factors to target the identified risks. The Agency estimates that the total cost of full Subtitle C controls would be several times this amount. Full Subtitle C controls include location restrictions, manifesting, liners, leachate collection, ground-water monitoring, covers, dust control, closure controls, financial assurance, and corrective action.

For these reasons, EPA tentatively concludes that Subtitle C is inappropriate to address any problems associated with disposal of these wastes and that the continued use of site and region specific approaches by the states is more appropriate for addressing the limited human health and environmental risks that may be associated with disposal of these wastes. For the issues discussed below involving agricultural use and management of these wastes in mines (minefill), the Agency is still considering whether some regulation under RCRA Subtitle C may be warranted.

The Agency identified several situations where pyrite materials (sulfur-bearing components of mill rejects) comanaged with coal combustion wastes might have been of concern. The pyritic waste materials had turned acidic and may have caused localized environmental damage. One such situation is considered to be a damage case. While mismanagement of these pyritic wastes can theoretically cause problems because of their inherent chemical properties, such evidence is rare, and the Agency has no means of systematically evaluating the extent to which they would cause or contribute to risks. To address the problem management situations, the Agency has engaged the utility industry in a program to ensure that these particular wastes are appropriately managed, as reflected in the industry's development of technical guidance and an industry education program concerning proper management of pyritic materials. The Agency is encouraged by the industry program, and has tentatively concluded that additional regulation of pyrite disposal is not necessary. EPA, however, will follow-up with oversight on the industry's progress with management of these wastes, and will revisit this issue if necessary.

The Agency identified potential ecological risks from selenium (mammals), although potential risks were also found from arsenic (birds), aluminum (amphibians), and boron (amphibians) for coal combustion wastes that are comanaged in surface impoundments. While the waters in surface impoundments can theoretically pose risks to birds, mammals, and amphibians exposed to them, the Agency has no actual information about the scale and frequency at which receptors are actually exposed, and therefore cannot quantify the magnitude of the actual ecological impacts at these facilities. No documented or anecdotal ecological impact information was available with which to compare with the risk modeling results. Moreover, the Agency was unable to identify any feasible risk mitigation practices for these very large impoundments other than to continue to rely on the Clean Water Act new source standards to move the industry toward dry handling of the coal combustion wastes. (Dry handling methods do not involve surface impoundments and therefore do not present the ecological risks identified for impoundments.) Outright elimination of the large impoundments would impose extremely high costs on the operators. The benefits to be derived from elimination of impoundments are uncertain due to unavailability of information on actual receptor exposure rates and impacts as described above. The Agency solicits information on the practices and techniques that may be effective in mitigating the potential ecological risks, considering the large surface areas involved at these facilities.

2. *The Agency has tentatively concluded that most beneficial uses of these wastes should remain exempt from RCRA Subtitle C.*

No significant risks to human health and the environment were identified or believed to exist for any beneficial uses of these wastes, with the possible exception of minefill and agricultural use as discussed below. This is based on one or more of the following reasons for each use or resulting product: absence of identifiable damage cases, fixation of the waste in finished products which immobilizes the material, and/or low probability of human exposure to the material.

3. *The Agency is tentatively considering the option of subjecting practices involving the use of these wastes for agricultural purposes (i.e., as a soil nutrient supplement or other amendment) to some form of regulation under Subtitle C.*

As mentioned above, the Agency identified potential risk from exposure to arsenic in these wastes when they are used for agricultural purposes. The risks identified with this practice are of sufficient concern to consider whether some form of control under Subtitle C is appropriate, given the increasing trend for use of these materials as agricultural amendments. An example of such controls could include regulation of the content of these materials such that arsenic concentrations could be no higher than that found in agricultural lime. On the other hand, imposition of controls under Subtitle C may not be warranted if sufficient protection may be afforded by the Agency engaging the industry to

establish voluntary controls on this practice. An example of such voluntary controls could consist of an agreement to limit the level of arsenic in these materials. The Agency solicits comment on its tentative conclusion and specific approaches that could be pursued to address the concern. While the part 1 regulatory determination exempted all beneficial uses for the large-volume coal combustion wastes, the tentative conclusion for the comanaged wastes would also affect the status of the part 1 wastes for agricultural use. This is because the source of the identified risk is the metal content of the coal combustion wastes. The Agency has no information indicating that any of the comanaged low-volume wastes significantly affect the identified potential risks and, therefore, the risks should be comparable for the wastes subject to the part 1 regulatory determination. Additionally, the Agency considers its current risk analysis for this practice to be more thorough than that conducted for the part 1 wastes, and accordingly believes it proper to reconsider the part 1 wastes in this respect.

As indicated in the summary above, although the practice of minefilling these wastes is within the scope of this study, the Agency currently lacks sufficient information with which to adequately assess risk associated with this practice. Several factors make the practice of minefilling difficult to assess. First, minefill is occurring in areas where there are often pre-existing environmental concerns, such as acid mine drainage. With its existing data the Agency is unable to determine if elevated contaminants in ground water are due to minefill practices, or rather are associated with pre-existing problems or conditions. Second, although minefill in a surface pit has similarities to landfill situations we have modeled, both surface and subsurface minefill raises complexities beyond the landfill model. Third, these operations, with their pre-existing concerns, may require very site-specific determinations that do not lend themselves to national standards.

The Agency solicits comment on whether there are some minefill practices that are universally poor and warrant specific attention. For example, the Agency has found several situations where cement kiln dust placed in direct contact with the ground-water table has created problems. EPA specifically seeks comment on whether coal or other fossil fuel combustion wastes used as minefill and placed in direct contact with the water table would create other environmental concerns, and if that specific practice should be regulated. Last, with a few exceptions, use of these wastes as minefill is generally a recent practice and therefore long-term practices and environmental data cannot be assessed. The potential for risks associated with this practice may be of sufficient concern to consider whether some form of control under Subtitle C is appropriate, given the increasing trend for use of these materials as minefill. The Agency's focus is on potential risks that may be posed via the ground-water and surface pathways from use of these wastes as minefill. The Agency solicits additional information in the form of additional case studies of actual minefill situations, with the following types of information: minefill project design including areal extent, volumes, depth, environmental controls, mine spoils mixing ratio; characterization of combustion wastes that are involved; the background, pre-existing conditions in ground water at the mine location; and the depth to ground water at the mine location. The Agency is also interested in obtaining information on analytical modeling tools that can simulate fractured flow conditions and facilitate prediction of alkalinity consumption by acid mine drainage intrusion into the combustion wastes. The Agency will consider such comments and information in the formulation of the Regulatory Determination.

4.0 SUMMARY OF FINDINGS: NON-UTILITY COAL COMBUSTION WASTES

Coal-fired non-utilities use the same combustion technologies and fuels as coal-fired utilities. As a result, they generate the same large-volume and low-volume combustion wastes as utilities. In addition, non-utilities have the potential to generate a wide range of process wastes unrelated to the combustion of fossil fuels. These process wastes may be disposed along with combustion wastes.

Coal-fired non-utilities include a larger number of facilities than utilities. Non-utility boilers, however, are smaller in size than utility boilers and include a larger percentage of stoker (as opposed to pulverized coal) boilers. As a result, these facilities use less fuel than utilities. Non-utilities also less frequently use particulate control and flue gas desulfurization (FGD) technologies. As a result of these factors, non-utilities as a population generate much lower quantities of coal combustion waste than do utilities; large-volume coal combustion wastes at non-utilities represent about 6 percent of the amount of similar wastes generated by utilities.

EPA believes that non-utility coal combustion waste characteristics are similar to those of utility coal combustion wastes and that metals are the class of constituents of concern. A comparison of leachate concentrations of metals from the available data representing non-utility wastes suggests that differences are not significant for the purpose of evaluating risk to human health and the environment. Based on the observed similarity of non-utility and utility coal combustion wastes, EPA relied on data for comanaged utility coal combustion wastes to characterize non-utility coal combustion wastes. Comanaged waste data were chosen, rather than data representing large-volume non-utility coal combustion wastes alone, because of the high rate of comanagement at non-utilities and because the comanaged waste data are more extensive.

The predominant management practice for non-utility coal combustion waste is landfilling. Few facilities operate surface impoundments. The available data also suggest a larger proportion of offsite landfills (including commercial facilities) for non-utilities than for utilities. Comingling of large-volume coal combustion wastes and other wastes at non-utilities appears to be as common as at utilities. Low-volume combustion wastes comanaged include the same types reported for utilities, although coal mill rejects in particular are comanaged less frequently at non-utilities. Non-utilities also comingle combustion wastes with a wide variety of noncombustion wastes.

Based on the lower waste generation rates at non-utilities, non-utility landfills are expected to be much smaller than those for utility coal combustion wastes. The available data for onsite landfills suggest these units may less frequently employ environmental controls (particularly liners) than do utility landfills. No data are available on the offsite landfills that manage non-utility coal combustion wastes. Many of these units, however, are expected to be commercial industrial or municipal waste landfills that accept a variety of other wastes and are subject to state solid waste management requirements.

The available data indicate that non-utilities sometimes apply their coal combustion wastes in beneficial uses, including agricultural use and minefilling. EPA believes that nearly all of the beneficial uses applied by utilities also are applicable to non-utility wastes.

EPA modeled potential risks to human health and the environment from non-utility coal combustion wastes managed in small unlined, onsite landfills and applied to agricultural use. In assessing ground-water risks, EPA found that potential high-end risks associated with all modeled constituents of concern, except for arsenic, fell below a hazard quotient of 1 or a lifetime cancer risk of

1×10^{-6}. Potential high-end risks associated with arsenic exceeded 1×10^{-4}. EPA found, however, that the concentration of arsenic in ground water at a receptor well would not achieve a risk level of 1×10^{-6} for 1,400 years. In assessing above-ground multi-pathway risks, EPA found no plausible risks except in agricultural applications, where risks would be similar to those for utility coal combustion wastes.

EPA identified four Superfund Records of Decision involving non-utility coal combustion wastes (codisposed with other wastes). Two of these cases met the "test of proof" for a damage case. In both of these cases, noncombustion wastes are codisposed with coal combustion wastes and the source of the coal combustion waste (utility or non-utility) is unspecified. In one of these cases, the available information does not implicate, or rule out, contributing influences from coal combustion wastes. In the second case, an area used as a fly ash waste pile is identified as a potential source of risk. EPA also reviewed information for about 50 additional sites collected from conversations with state personnel and the review of facility-specific files at state offices. At these latter sites, although releases of waste have been documented and ground-water monitoring results show exceedences of standards in some cases, documentation was not available that would satisfy the "test of proof" for damage cases.

Currently 44 states (representing 87 percent of non-utility coal-fired electrical generating capacity) duplicate the federal policy exempting coal combustion wastes from hazardous waste regulation. Therefore, the majority of non-utility coal combustion wastes would be subject to state solid (non-hazardous) waste requirements because they do not fail the hazardous waste tests and/or are generated in the 44 states that duplicate the federal exemption. These requirements are expected to be essentially the same as those applicable to utility coal combustion wastes—the majority of states have the authority to require permits and to impose physical controls and monitoring requirements on non-utility landfills, at least on a case-by-case basis. The available data on waste management practices suggest that states have exercised their authority to impose controls, although perhaps to a lesser extent at non-utilities than at utilities.

EPA examined in greater detail state requirements in five states (Indiana, Pennsylvania, Wisconsin, North Carolina, and Virginia) accounting for more than 20 percent of coal-fired non-utility electrical generating capacity. EPA found that state requirements have become more stringent over time. States, however, vary in their approaches to regulating landfills that may manage non-utility coal combustion wastes. For example, programs in Indiana and Pennsylvania impose requirements tailored to the characteristics of the waste. North Carolina may impose requirements based on site-specific modeling. In Virginia, requirements apply generically to all industrial wastes. Wisconsin may modify its requirements specifically for landfills designed to receive coal combustion ash. In several of the states studied, coal combustion wastes may be disposed of in landfills that are "grandfathered" out of liner and other requirements.

EPA analyzed the costs and economic impacts of a risk mitigation alternative that would require non-utility coal combustion wastes to be managed in units compliant with RCRA Subtitle D requirements. The Agency also considered alternatives to mitigate the potential risk from agricultural use of these wastes, including a standard limiting the arsenic concentration in wastes intended for this use. EPA has not estimated the costs for such an approach, but believes they would be minimal because of the small quantity of waste that would be affected.

The risk mitigation alternative would require non-utility coal combustors that currently operate unlined landfills to construct new, composite-lined landfills or transport waste to an offsite commercial Subtitle D landfill. EPA's estimate of annualized incremental compliance cost for this alternative for all coal-fired non-utilities is $103 million per year. Facilities in the food processing, pulp and paper, chemical manufacturing, primary metals, and transportation equipment sectors would bear the majority

of these costs. The costs would affect only a small percentage of facilities in each of these sectors (i.e., those that operate coal-fired boilers) At average-sized facilities in these industries, incremental compliance costs would represent 0.2 percent to 0.5 percent of facility sales, depending on the industry. At large facilities in each sector, which are more likely those that operate coal-fired boilers, incremental compliance costs would represent 0.1 percent or less of facility sales. This should not affect the financial viability of individual plants. At the industry level, the total incremental cost represents an even smaller percentage of sales because of the small number of facilities affected compared to the total number in each industry sector.

Recommendations: Non-Utility Coal Combustion Wastes

Following are the Agency's recommendations for the wastes covered in this chapter. The recommendations are based on EPA's analysis of the eight Congressionally mandated study factors (Section 1.2). These conclusions are subject to change based on continuing information collection, continuing consultations with other government agencies and the Congress, and comments and new information submitted to EPA during the comment period and any public hearings on this report. The final Agency decision on the appropriate regulatory status for these wastes will be issued after receipt and consideration of comments as part of the Regulatory Determination, which will be issued within 6 months.

1. *The Agency has tentatively concluded that disposal of these wastes should remain exempt from RCRA Subtitle C.*

As with the utility coal combustion wastes addressed in Chapter 3, the Agency has tentatively concluded that the non-utility CCWs, including wastes from petroleum coke combustion and from other fuels that are co-fired with coal, and also low-volume wastes where they are managed with the combustion wastes, generally present a low inherent toxicity, are seldom characteristically hazardous, and generally do not present a risk to human health and the environment. State programs increasingly require more sophisticated environmental controls at these types of facilities. There are few damage cases and none of the identified damage cases exclusively involved these wastes or affected human receptors. These types of facilities are typically located in areas of low population and thus present infrequent opportunity for human exposure. The Agency believes that no significant ecological risks are posed by disposal of these wastes. The predominant practice is to manage these wastes in landfills, with a much lower frequency of using impoundments. Environmental controls are common at the landfills. For example, nearly all implement ground-water monitoring and runoff controls, and two-thirds have leachate collection. Overall, the Agency believes that when these wastes are disposed, regulation under Subtitle C authority is not warranted. For the issues discussed below involving agricultural use and management of these wastes in mines (minefill), the Agency is still considering whether some regulation under RCRA Subtitle C may be warranted.

There is a very small segment of non-utility coal burners that generates mill rejects, a low-volume waste, that may be comanaged with the CCWs. The Agency has the same concerns about the potential for problem management situations involving pyritic materials as described for utilities in Chapter 3. Although the Agency did not identify any of these situations at non-utility facilities during this study, it is engaging the non-utility sector in a program to ensure that these particular wastes are appropriately managed. This effort parallels the pyrites management program described for utilities in Chapter 3. EPA will follow-up with oversight on the industry's management of these wastes, and will revisit this issue if necessary.

2. *The Agency has tentatively concluded that most beneficial uses of these wastes should remain exempt from Subtitle C.*

No significant risks to human health and the environment were identified or believed to exist for any beneficial uses of these wastes, with the possible exception of minefill and agricultural use as discussed below. This is based on one or more of the following reasons for each use or resulting product: absence of identifiable damage cases, fixation of the waste in finished products which immobilizes the material, and/or low probability of human exposure to the material.

3. The Agency is tentatively considering the option of subjecting practices involving the use of these wastes for agricultural purposes (i.e., as a soil nutrient supplement or other amendment) to some form of regulation under Subtitle C.

As mentioned above, the Agency identified potential risk from exposure to arsenic in these wastes when they are used for agricultural purposes. The risks identified with this practice may be of sufficient concern to consider whether some form of control under Subtitle C is appropriate, given the increasing trend for use of these materials as agricultural amendments. An example of such controls could include regulation of the content of these materials such that arsenic concentrations could be no higher than that found in agricultural lime. On the other hand, imposition of controls under Subtitle C may not be warranted if sufficient protection may be afforded by the Agency engaging the industry to establish voluntary controls on this practice. An example of such voluntary controls could consist of an agreement to limit the level of arsenic in these materials. The Agency solicits comment on its tentative conclusion and specific approaches that could be pursued to address the concern.

Non-utility burners of coal, particularly those that generate significant quantities of combustion wastes, may have opportunities for their wastes to be minefilled, that is, permanently placed in mine voids similar to the practice with some utility combustion wastes. As discussed in Chapter 3, the Agency currently lacks sufficient information with which to adequately assess risk associated with this practice and, therefore, to decide whether this practice should remain exempt from Subtitle C. For the same reasons discussed in Chapter 3's recommendations, the Agency solicits comment on whether there are some minefill practices that are universally poor and warrant specific attention. EPA also seeks comment on whether coal or other fossil fuel combustion wastes used as minefill and placed in direct contact with the water table would create environmental concerns, and if that specific practice should be regulated. The Agency's focus is on potential risks that may be posed via the ground-water and surface pathways from use of these wastes as minefill.

5.0 SUMMARY OF FINDINGS: FLUIDIZED BED COMBUSTION WASTES

Fluidized bed combustion (FBC) is an emerging technology for the combustion of fossil and other fuels. In FBC processes, fuel is burned on a bed of incombustible material (e.g., sand and limestone) while combustion air is forced upward at high velocities, making the particles flow as a fluid. Coal is the most common fossil fuel burned by FBC facilities, although some facilities burn waste coal, petroleum coke, or other fuels. The bed material often includes a sorbent, such as limestone, that allows the capture of sulfur oxides without the end-of-stack scrubbers often required for conventional coal combustion processes.

FBC makes up only a small portion of the fossil fuel combustion universe—approximately 1 percent of fossil fuel-fired capacity. As of December 1996, there were 84 facilities with 123 FBC boilers representing 4,951 megawatts of equivalent electrical generating capacity (CIBO, 1997). Together, these facilities generated more than 9-million short tons of FBC wastes, or roughly 10 percent of the volume of FFC wastes generated by conventional coal-fired utilities.

Like conventional coal boilers, FBC boilers generate fly ash and bottom ash (called bed ash). FBC fly ash and bed ash contain noncombustible mineral matter, sorbent material, and unburned carbon. The major constituents of FBC waste are calcium, sulfur, silicon, iron, aluminum, magnesium, and potassium. As with conventional coal combustion waste, most of these constituents are present in the form of oxides. Due to the presence of sorbent material, however, FBC wastes have a higher content of calcium and sulfate and a lower content of silica and alumina than conventional coal combustion wastes (CIBO, 1997).

Based on the TCLP and EP data, FBC wastes rarely exhibit RCRA characteristic toxicity. Only one FBC site of 24 (4 percent) for which data are available had any samples of waste for which TCLP or EP analyses exceeded the regulatory threshold any metal. At that site, a facility that burns waste coal, one sample of fly ash exceeded the threshold for mercury. Similarly, no sample from seven sites analyzed for organics exceeded a threshold value.

The Council of Industrial Boiler Owners (CIBO) report that landfilling is the most common FBC waste disposal practice. While four FBC waste surface impoundments have been identified, EPA believes the impoundments represent unusual cases. FBC waste landfills are smaller than conventional utility landfills, with a median fill capacity of 1.5-million cubic yards. Nearly all of the landfills for which data are available are permitted disposal units, and roughly half of the landfills are lined.

Like conventional coal combustion wastes, FBC wastes may be applied to useful purposes as an alternative to traditional waste management. In fact, according to CIBO survey statistics, the majority of FBC wastes currently are beneficially used. The most dominant use of these wastes is in minefills (61 percent), followed by waste stabilization (6 percent), construction fills (5 percent), and agricultural uses (1 percent). Overall, roughly 75 percent of all FBC wastes may be beneficially reused.

As with coal-fired utility comanaged wastes, EPA examined the potential human health and ecological risks associated with the disposal of FBC wastes. For the ground-water exposure pathway, EPA modeled the risks associated with landfills. Overall, EPA found that the risks associated with all modeled constituents of concern, except for antimony, arsenic, beryllium, and chromium, fell below a hazard quotient of 1 or a lifetime cancer risk of 1×10^{-6}. Potential risks associated with arsenic in the

high-end deterministic scenario exceeded 1×10^{-4}. Probabilistic results for all of these metals were more than 1 order of magnitude lower than the deterministic results at the same confidence level.

EPA also considered the time at which risks were predicted to result from the release of constituents of concern. EPA found that the concentration of arsenic in ground water at the receptor well would not reach the health-based level for arsenic (i.e., achieve a risk level of 1×10^{-6}) for more than 3,000 years. The times to reach the antimony health-based level and the beryllium MCL in ground water were predicted to be nearly 6,000 years and greater than 6,500 years, respectively.

EPA found no ingestion risks in the above-ground human health risk assessment except for the FBC agricultural use scenario. In the agricultural use scenario, EPA found arsenic risks from this composite and complex pathway to be at five times the 10^{-5} level, for both the farmer and the child of farmer receptors.

EPA found no ecological risks associated with FBC wastes. In addition, EPA found no documented cases of damage associated with FBC waste management.

EPA reviewed current state regulations governing management of FFC wastes and found that states currently have more authority to impose controls on UCCW management units than in previous years. In addition to regulatory permits, the majority of states are now able to require siting controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls. EPA believes that the use of such controls has the potential to mitigate risks, particularly ground-water pathway risks, from comanaged waste disposal.

States increasingly have begun to impose controls on FBC waste management units. In addition to regulatory permit programs, the majority of states now have the authority to require siting controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily or other operational cover, and fugitive dust controls for management of these wastes.

EPA analyzed the costs and economic impacts of a risk mitigation alternative that would require FBC wastes that are currently disposed of to be managed in units compliant with RCRA Subtitle D requirements. The Agency also analyzed the cost of a ban on minefilling and agricultural use for FBC wastes, requiring wastes currently destined for these uses also to be managed in Subtitle D units.

The risk mitigation alternative would require FBC facilities that currently operate unlined landfills to construct new composite-lined landfills or transport waste to an offsite commercial Subtitle D landfill. EPA's estimate of annualized incremental compliance cost for this alternative for all FBC facilities is $32 million per year for currently disposed quantities of waste. If the quantities of FBC waste currently used in minefilling and agricultural applications also were subject to the Subtitle D-based alternative, the additional incremental compliance cost would be an estimated $52 million per year (for a total of some $84 million per year). Other approaches, such as a limit on the arsenic concentration in FBC wastes destined for agricultural use, would substantially reduce this latter cost.

EPA analyzed economic impacts *excluding* costs for quantities currently used in minefilling and agriculture. Half of the potentially affected FBC facilities are in the electric service industry (i.e., independent power producers and utilities). At individual facilities in this sector, incremental compliance costs would reduce net income as a percentage of revenues by 1.4 percent to 1.7 percent, depending on the plant size. While this incremental cost should not affect the financial viability of coal-fired plants, EPA recognizes that such profit margin reductions may be considered significant by the individual firm. At the industry level in the electric service sector, the total incremental cost represents

0.3 percent of the value of sales. In other industrial/institutional sectors, FBC facilities represent an even smaller share of their industries than do conventional non-utility combustors. Thus, individual facility impacts and industry level impacts in these sectors would be similar to or less than those discussed for coal-fired non-utilities.

Recommendations: Fluidized Bed Combustion Wastes

Following are the Agency's recommendations for the wastes covered in this chapter. The recommendations are based on EPA's analysis of the eight Congressionally mandated study factors (Section 1.2). These conclusions are subject to change based on continuing information collection, continuing consultations with other government agencies and the Congress, and comments and new information submitted to EPA during the comment period and any public hearings on this report. The final Agency decision on the appropriate regulatory status for these wastes will be issued after receipt and consideration of comments as part of the Regulatory Determination, which will be issued within 6 months.

1. *The Agency has tentatively concluded that disposal of these wastes should remain exempt from RCRA Subtitle C.*

As with the utility and non-utility coal combustion wastes addressed in Chapters 3 and 4, the Agency has tentatively concluded that FBC wastes, including wastes from petroleum coke combustion and from other fuels that are co-fired with coal, and also low-volume wastes where they are managed with the combustion wastes, generally present a low inherent toxicity, are seldom characteristically hazardous, and generally do not present a risk to human health and the environment. State programs increasingly require more sophisticated environmental controls at these types of facilities. For example, most all of the FBC landfills are subject to regulatory permits and ground-water monitoring requirements; nearly all implement dust suppression and runon/runoff controls. No documented damage cases were identified and no significant ecological risks were identified. These types of facilities are typically located in areas of low population and thus present infrequent opportunity for human exposure. Although arsenic was identified from EPA modeling to pose a potential risk at unlined landfills, there were no documented problem or damage cases identified with arsenic as a constituent of concern. The predominant practice is to manage these wastes in landfills, with a much lower frequency of using impoundments. Nearly half of the landfills are lined and more than half have leachate collection systems and covers. Overall, the Agency believes that regulation under Subtitle C authority is not warranted when these wastes are disposed. For the issues discussed below involving agricultural use and management of these wastes in mines (minefill), the Agency is still considering whether some regulation under RCRA Subtitle C may be warranted.

2. *The Agency has tentatively concluded that most beneficial uses of these wastes should remain exempt from Subtitle C.*

No significant risks to human health and the environment were identified or believed to exist for any beneficial uses of these wastes, with the possible exception of minefill and agricultural use as discussed below. This is based on one or more of the following reasons for each use or resulting product: absence of identifiable damage cases, fixation of the waste in finished products which immobilizes the material, and/or low probability of human exposure to the material.

3. The Agency is tentatively considering the option of subjecting practices involving the use of these wastes for agricultural purposes (i.e., as a soil nutrient supplement or other amendment) to some form of regulation under Subtitle C.

As mentioned above, the Agency identified potential risk from exposure to arsenic in these wastes when they are used for agricultural purposes. The risks identified with this practice may be of sufficient concern to consider whether some form of control under Subtitle C is appropriate, given the increasing trend for use of these materials as agricultural amendments. An example of such controls could include regulation of the content of these materials such that arsenic concentrations could be no higher than that found in agricultural lime. On the other hand, imposition of controls under Subtitle C may not be warranted if sufficient protection may be afforded by the Agency engaging the industry to establish voluntary controls on this practice. An example of such voluntary controls could consist of an agreement to limit the level of arsenic in these materials. The Agency solicits comment on its tentative conclusion and specific approaches that could be pursued to address the concern..

A significant amount of FBC waste, about 60 percent, is used for minefill. Of this amount, large quantities are used specifically for reclamation of old surface coal mine working. EPA recognizes that mine reclamation practices with the highly alkaline FBC wastes can have some significant, positive environmental benefits. For example, the FBC wastes contribute to neutralizing acid mine drainage at the old mine workings, and when mine reclamation activities are completed, new productive uses may be made of the land. The Agency also realizes that there are a number of well-managed state mine reclamation programs that oversee the application of FBC wastes. RCRA, however, does require the Agency to review the management of these wastes. As discussed in Chapter 3's recommendations, the potential for risks associated with this practice may be of sufficient concern to consider whether some form of control under Subtitle C is appropriate, given the increasing trend for use of these materials as minefill. The Agency, however, currently lacks sufficient information with which to adequately assess risk associated with this practice and therefore to decide whether this practice should remain exempt from Subtitle C. The Agency solicits comment on whether there are some minefill practices that are universally poor and warrant specific attention. For example, the Agency has found several situations in which cement kiln dust placed in direct contact with the ground-water table has created problems. EPA also seeks comment on whether coal or other fossil fuel combustion wastes used as minefill and placed in direct contact with the water table would create environmental concerns, and if that specific practice should be regulated. The Agency's focus is on potential risks that may be posed via the ground-water and surface pathways from use of these wastes as minefill.

6.0 SUMMARY OF FINDINGS: OIL COMBUSTION WASTES

Oil combustion wastes (which include fly ash and bottom ash) are generated in significant quantities only when residual fuel oil is burned in oil-fired steam electric boilers. Other technologies (e.g., combustion turbines) and fuels (e.g., distillate oil) generate little or no wastes. Overall, oil combustion wastes are generated in much smaller quantities than other large-volume fossil fuel combustion wastes. Oil-fired utilities, as opposed to non-utilities, generate the majority (more than 80 percent) of these wastes. The majority of oil combustion waste generation and management also takes place in the Northeast, mid-Atlantic, and Florida, consistent with the use of oil by utilities to provide baseload power supplies in these regions.

Metals are the class of constituents of concern in oil combustion wastes. These wastes can contain high levels of vanadium and nickel, and varying levels of other metals. Oil combustion wastes, however, only infrequently exhibit the RCRA characteristic of toxicity (6 percent of available samples). Exceedences for arsenic, cadmium, chromium, lead, and/or selenium were observed in at least one sample from seven (or 18 percent) of the 40 sites for which data were available.

The common management practices at oil-fired utilities include onsite settling basins and offsite landfills, with a few onsite landfills (monofills managing only oil combustion wastes) represented. The most common practice for oil bottom ash is to collect it dry and transport it to an offsite landfill. Fly ash, on the other hand, typically is sluiced wet to an onsite solids settling basin (SSB) where it is managed along with low-volume liquid wastes such as equipment washwaters and boiler chemical cleaning wastes. Solids from these basins are typically dredged on an "as-needed" basis and transported to an offsite landfill. Oil combustion wastes have not been used extensively for beneficial use applications similar to those reported for other fossil fuel combustion wastes. Several oil-fired utilities, however, have reported sending their waste offsite for vanadium recovery as an alternative to offsite landfilling, when economically viable.

Oil combustion waste management units typically are much smaller than those for utility coal combustion wastes. About two-thirds of the SSBs for which data were available are lined. The unlined SSBs are percolation basins permitted under state regulations to discharge to ground water. Limited data for SSBs suggest a trend toward the increasing use of liners. The few onsite landfills observed are lined or partially lined. No data are available on the offsite landfills that manage oil combustion wastes. Because of the small quantities of oil combustion waste generated, however, these units are expected to be commercial industrial or municipal waste landfills that accept a variety of other wastes and are subject to state solid waste management requirements.

EPA modeled potential risks to human health and the environment from oil combustion wastes managed in small, unlined landfills and surface impoundments (solid settling basins). In assessing ground-water risks, EPA found that potential high-end risks associated with arsenic exceeded 1×10^{-5}. For nickel and vanadium, potential high-end hazard quotients exceeded 1. In assessing above-ground multi-pathway risks, EPA found a potential risk at the low 10^{-6} level for arsenic ingestion for a child living near an onsite landfill. No non-groundwater risks were found for the solid settling basins.

EPA identified a total of nine sites managing oil combustion wastes that have ground-water contamination. Only one of these sites, however, met the test of proof for a damage case. The level of contamination at these sites was not always above MCLs or other state standards. In no case was there evidence that the contaminated ground-water is used as drinking water.

Only 26 states extend the federal exemption from hazardous waste requirements to oil combustion wastes. These 26 states, however, represent more than 80 percent of oil-fired utility capacity and, therefore, the majority of waste generation. These states vary in their application of solid (non-hazardous) waste management requirements to oil combustion waste management units. EPA examined state requirements in the states accounting for the greatest share of oil-fired utility capacity (Florida, New York, Massachusetts, and Pennsylvania). EPA found that, in two of these states, oil combustion wastes may be disposed of in landfills that are "grandfathered" out of liner and other requirements. Three of the four states do not impose specific design requirements on the solids settling basins typically used to store oil combustion wastes. Two of these states permit discharges to ground water from these units.

EPA analyzed the costs and economic impacts of a risk mitigation alternative that would require oil combustion wastes to be managed in units compliant with RCRA Subtitle D requirements. Most significantly, this alternative would require oil-fired utilities that currently operate unlined solids settling basins to construct new, composite-lined basins. EPA's estimate of annualized incremental compliance cost for this alternative for the whole industry is from $1.0 million per year to $3.5 million per year, with a most likely estimate of $1.7 million per year. At the individual plant level, incremental compliance costs would reduce net income as a percentage of revenues by 0.1 percent to 0.4 percent, depending on the plant size. This reduction should not affect the financial viability of individual oil-fired plants. At the industry level, the total incremental cost represents less than one-tenth of 1 percent of the value of sales. Thus, the cost of compliance would be a very small percentage of revenues.

Recommendations: Oil Combustion Wastes

Following are the Agency's recommendations for the wastes covered in this chapter. The recommendations are based on EPA's analysis of the eight Congressionally mandated study factors (Section 1.2). These conclusions are subject to change based on continuing information collection, continuing consultations with other government agencies and the Congress, and comments and new information submitted to EPA during the comment period and any public hearings on this report. The final Agency decision on the appropriate regulatory status for these wastes will be issued after receipt and consideration of comments as part of the Regulatory Determination, which will be issued within 6 months.

1. *The Agency is considering two approaches to address the potential risks that may be posed by disposal of these wastes. One approach would be regulatory using Subtitle C authority and the other would be to encourage voluntary changes in industry practices.*

The Agency found in many cases that OCWs, whether managed alone or comanaged with low-volume wastes, are seldom characteristically hazardous and may not present a significant risk to human health and the environment. These cases include situations in which the wastes are managed in lined units with adequate cover. The Agency believes that no significant ecological risks are posed by disposal of these wastes. Only one damage case was identified and it did not affect human receptors.

In light of the results of EPA's risk assessment, however, the Agency is concerned about situations in which the wastes are managed in unlined units, particularly comanagement in settling basins and impoundments that are designed and operated to discharge to ground water. As discussed in this chapter, the Agency's risk analysis suggests that three metals may pose potential ground-water pathway risks at such facilities: arsenic, nickel, and vanadium. While there is a trend in recent years to line new units and the Agency has anecdotal information that some facilities are preparing to either line or close their unlined units, the Agency has particular concerns with the high levels of nickel and vanadium in the wastes and in the leachate that is being discharged to ground water. The Agency's risk analysis

identified high hazard quotients and short time periods to exceedence of health-based risk criteria at potential ground-water receptor locations for nickel and vanadium. The risks identified with these practices may be of sufficient concern to consider whether tailored regulations are necessary to target the potential risks. On the other hand, since the recent industry and state regulatory trends have been toward liners and ground-water monitoring for these waste disposal units, sufficient protection may be obtained by facilitating this trend and engaging the industry to voluntarily establish the appropriate controls. An example would be to line the existing unlined units and, where appropriate, to implement ground-water monitoring. The Agency solicits comment on its tentative conclusion, specific approaches that could be pursued to address these concerns, and the identification of only one damage case.

2. *The Agency has tentatively concluded that the existing beneficial uses of these wastes should remain exempt from Subtitle C.*

There are few existing beneficial uses of these wastes, which include components of cement, concrete, and construction fill as discussed in this chapter. No significant risks to human health exist for the identified beneficial uses of these wastes. This is based on one or more of the following reasons for each use: absence of identifiable damage cases, fixation of the waste in finished products which immobilized the material, and/or low probability of human exposure to the material. In the case of vanadium recovery operations, a valuable product is being produced; however, if the wastes resulting from the metal recovery processes are hazardous, they will be subject to the existing hazardous waste requirements.

Unlike coal combustion wastes, these wastes are not known to be used in minefill or agricultural applications. These wastes are not generated at rates high enough to justify their transport and use for filling mine voids. There are no known benefits to using these wastes for agricultural purposes.

7.0 SUMMARY OF FINDINGS: NATURAL GAS COMBUSTION WASTES

Natural gas is the second most significant fossil fuel used by utilities in the United States. In 1996, gas-fired units accounted for approximately 20 percent of utility generating capacity, but only 9 percent of utility electricity generated. This generation rate represents a decline of 15 percent from the level reported in 1995 due in part to a substantial increase in the cost of gas in 1996. (Use of hydroelectric, oil-fired, and geothermal sources increased in 1996 to make up for the decrease in use of gas) (EIA, 1998). Many gas-fired units are used to generate power during periods of peak demand.

Gas-fired units generate virtually no solid waste. Thus, although a significant portion of capacity is represented by gas combustors, this study does not include extensive analysis of natural gas combustors. The Agency intends to continue the exemption from Resource Conservation and Recovery Act (RCRA) Subtitle C for gas combustors.

Natural gas combustion accounts for a substantial fraction of both utility and non-utility generating capacity. Natural gas combustion technologies are similar to those used for oil combustion. In gas-fired steam electric boilers, gas is injected into the furnace in the presence of excess air. The same burner designs used for oil also are used to inject and combust natural gas. In fact, many combustion units can utilize either oil or gas. Unlike oil, natural gas does not require preparation (atomization) for mixing with combustion air (Stultz and Kitto, 1992). Because of its negligible ash content, combustion of natural gas generates virtually no solid waste; therefore, this study focuses primarily on coal-fired and oil-fired combustors.

Recommendations: Natural Gas Combustion Wastes

Following are the Agency's recommendations for the wastes covered in this chapter. The recommendations are based on EPA's analysis of the eight Congressionally mandated study factors (Section 1.2). These conclusions are subject to change based on continuing information collection, continuing consultations with other government agencies and the Congress, and comments and new information submitted to EPA during the comment period and any public hearings on this report. The final Agency decision on the appropriate regulatory status for these wastes will be issued after receipt and consideration of comments as part of the Regulatory Determination, which will be issued within 6 months.

1. *The Agency has tentatively concluded that it will retain the Subtitle C exemption for natural gas combustors.*

The Agency has tentatively concluded that it will retain the Subtitle C exemption for natural gas combustors. The Agency solicits comment on whether it is appropriate to retain or remove the Subtitle C exemption for natural gas combustion since there are no solid wastes generated by the process.

REFERENCES

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GLOSSARY*

ACAA – American Coal Ash Association.

air heater or **air preheater** – device that uses flue gases to preheat combustion input air.

air heater and precipitator washwater – wastes resulting from the periodic cleaning of the fireside (i.e., the side exposed to hot combustion products) of heat exchanging surfaces.

air monitoring system – periodic collection and analysis of air samples near a waste management unit.

alkalinity – the amount of carbonates, bicarbonates, hydroxides, and silicates or phosphates in a liquid. Reported as grains per gallon, pH, or parts per million of carbonate. Indicated by a pH of greater than 7.

anthracite – a hard black lustrous rank of coal (see coal rank).

APC – air pollution control.

ash – incombustible material in fuel that can become waste after combustion.

ash fusion temperature – the temperature at which a cone of coal or coke ash exhibits certain melting characteristics.

ASTM – American Society for Testing and Materials.

ASTSWMO – Association of State and Territorial Solid Waste Management Officials.

backfill – a project in which an excavation area is refilled with earth or other materials.

BACT – Best Available Control Technology under the Clean Air Act.

baghouse – an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags usually made of glass fibers.

baseload – that portion of electricity demand from a station or boiler that is practically constant for long periods.

baseload unit – an electrical generating unit that is used to supply baseload, and thus is operated continuously at an essentially constant rate.

BAT – Best Available Technology Economically Achievable under the Clean Water Act.

bed ash – spent bed material and fuel ash (bottom ash) that settle on the bottom of an FBC boiler.

bituminous coal – A common dense black rank of coal (see coal rank).

* References for this glossary include EIA, 1997d; EPA, 1988; CIBO, 1997c, and Stultz and Kitto, 1992.

BMP – best management practice under the Clean Water Act.

boiler – a closed vessel in which heat from an external combustion source (such as a fossil fuel) is transferred to produce hot water or generate steam.

boiler blowdown – waste generated by removal of a portion of boiler water for the purpose of reducing solid concentration or discharging sludge.

boiler chemical cleaning waste – waste resulting from the cleaning of boiler surfaces using chemical solutions.

boiler slag – melted and fused particles of ash that collect on the bottom of the boiler. Slag forms when operating temperatures exceed ash fusion temperature.

bottom ash – large ash particles that settle on the bottom of a boiler. Bottom ash does not melt and therefore remains in the form of unconsolidated ash.

BPT – Best Practicable Control Technology Currently Available under the Clean Water Act.

Btu – British Thermal Unit, a unit of heat energy.

bubbling fluidized bed system – a fluidized bed combustion system in which excess air passes through the bed in the form of bubbles. These systems have air velocities of 5 to 12 feet per second and larger bed particle size than circulating fluidized bed systems. These conditions result in a dense bed (45 pounds per cubic foot) with a well-defined surface.

Bunker C fuel oil – a residual fuel oil, also characterized as No. 6 fuel oil, which is used for commercial and industrial heating, electricity generation, and to power ships.

CAA – Clean Air Act.

CCW – coal combustion waste.

CERCLA – the Comprehensive Environmental Response, Compensation, and Liability Act, commonly referred to as Superfund.

CIBO – Council of Industrial Boiler Owners.

circulating fluidized bed system – a fluidized bed system that has high air velocities (as high as 30 feet per second) and fine particle sizes. As a result, the fluid bed is less dense (35 pounds per cubic foot) and has no well-defined top surface. Large quantities of bed material are recaptured from the gas stream and recirculated back to the furnace to maintain bed inventory.

CMTP – Composite Model for Leachate Migration with Transformation Products.

coal cleaning – the act of processing coal prior to combustion to change its characteristics (e.g., size, ash content, and/or sulfur content).

coal pile runoff – surface water runoff produced by precipitation falling on coal storage areas.

coal mill rejects – solid waste produced by onsite processing of coal in a mill prior to use.

coal rank – a system of classifying coal corresponding to its degree of metamorphism, geologic age, and heating value. Ranks include anthracite, bituminous, subbituminous, and lignite, with anthracite being the oldest and lignite being the youngest.

cogeneration – the production of electricity and another form of useful thermal energy (steam or hot water) from a single source.

combustion turbine (CT) – a system that uses exhaust from combustion (typically of oil or natural gas) directly to drive turbines.

compaction – the act of compacting waste after placement to reduce or prevent wind and water erosion of the waste and subsequent release to the environment.

condenser – a device that converts low-pressure steam back to water by transferring heat to a cooling water system.

cooling tower/cooling pond – recirculating cooling water system used to transfer heat picked up in the condenser to the atmosphere by evaporative cooling.

cooling tower basin sludge – solids that collect in the bottom of cooling towers and must be removed periodically and disposed.

cooling tower blowdown – water withdrawn from the cooling system in order to control the concentration of impurities in the cooling water.

corrosivity – see RCRA Subtitle C characteristics.

cover – a barrier placed on top of a waste management unit.

culm – refuse from the cleaning of anthracite coal.

CWA – Clean Water Act.

cyclone furnace – A combustion technology that creates a cyclone-like air circulation pattern causing smaller particles to burn in suspension, while larger particles adhere to a molten layer of slag that forms on the barrel walls.

demineralizer regenerant and rinses – see regeneration waste streams.

dioxin – general term for polychlorinated dibenzo-p-dioxins (PCDDs), a class of toxic chemicals.

distillate fuel oil – one of the petroleum fractions produced in conventional distillation operations. Included are products known as No. 1, No. 2, and No. 4 fuel oils.

dry scrubber – a flue gas desulfurization system in which the resulting byproduct is a dry, typically fine, powder.

dust suppression/control – conditioning waste with water or other liquid before and during transport and placement to prevent airborne transport of the waste and to reduce inhalation exposure to site workers.

economizer – a device for transferring heat from combustion exhaust to boiler input water.

EEI – Edison Electric Institute.

EEI database – 1994 EEI Power Statistics Database.

EIA – The U.S. Department of Energy's Energy Information Association.

electrostatic precipitator (ESP) – an air pollution control device that imparts an electrical charge to particulates in a gas stream, causing them to collect on an electrode.

EP – Extraction Procedure.

EPACMTP – EPA's Composite Model for Leachate Migration with Transformation Products.

EPRI – Electric Power Research Institute.

fabric filter – see baghouse.

FGD – flue gas desulfurization.

flue gas – the gaseous products of combustion that exit a boiler through a flue or stack.

flue gas desulfurization (FGD) technology – device that is used to remove sulfur oxides from flue gas after combustion.

flue gas desulfurization (FGD) waste – waste that is generated during the process of removing sulfur oxide gas from the flue gas after combustion.

fluidized bed combustion (FBC) – a combustion process in which fuel is burned on a bed of incombustible material (e.g., sand and limestone) while combustion air is forced upward at high velocities, making the particles flow as a fluid.

fly ash – suspended, uncombusted ash particles carried out of the boiler along with flue gases.

fossil fuel – a naturally occuring organic fuel, including coal, oil, and natural gas.

Furan – general term for polychlorinated dibenzofurans (PCDFs), a class of toxic chemicals.

generating unit – a combination of one or more boilers operated together to produce electricity or other useable thermal energy. May include one or more turbines, fuel processing systems, and/or air pollution control devices.

gigawatt (GW) – one billion watts.

gob – refuse from the cleaning of bituminous coal.

ground water monitoring system – one or several wells from which samples of ground water are periodically collected and analyzed.

HAP – Hazardous Air Pollutant under the Clean Air Act.

HDPE – high density polyethylene.

ignitability – see RCRA Subtitle C characteristics.

kilowatt (kW) – one thousand watts.

landfill – a facility or part of a facility in which wastes are placed for disposal in or on land.

leachate – the liquid resulting from water percolating through waste.

leachate collection system – a series of drains and tubing placed beneath a waste management unit, typically a landfill, that collect leachate for treatment or disposal.

lift – the depth of a cell in a landfill.

lignite – a brownish-black rank of coal (see coal rank).

lime – calcium oxide (CaO).

limestone – calcium carbonate ($CaCO_3$).

liner – a barrier placed underneath a landfill or on the bottom and/or sides of a surface impoundment.

MCL – maximum contaminant level.

mechanical collector – an air pollution control device that forces a cyclonic flow of the exit gas. This flow causes ash particles to be thrown against the walls of the collector and drop out of the gas.

megawatt (MW) – one million watts.

minefill – a project involving placement of fossil fuel combustion wastes in mine voids, whether for purposes of disposal or for beneficial uses such as mine reclamation.

monofill – a landfill that contains only one type of waste.

NAAQS – National Ambient Air Quality Standards under the Clean Air Act.

natural gas – a fossil fuel consisting of a mixture of hydrocarbon and nonhydrocarbon gases found beneath the Earth's surface.

NESHAP – National Emissions Standards for Hazardous Air Pollutants under the Clean Air Act.

No. 1 fuel oil – A light distillate fuel oil intended for use in vaporizing pot-type burners.

No. 2 fuel oil – A distillate fuel oil for use in atomizing-type burners for domestic heating or for moderate capacity commercial-industrial burner units.

No. 4 fuel oil – a fuel oil for commercial burner installations not equipped with preheating facilities. It is used extensively in industrial plants. This grade is a blend of distillate fuel oil and residual fuel oil stocks.

No. 5 fuel oil – a residual fuel oil of medium viscosity.

No. 6 fuel oil – a residual fuel oil used for commercial and industrial heating, electricity generation, and to power ships. Includes Bunker C fuel oil.

non-utility – for purposes of this study, an entity that combusts fossil fuel and whose primary commercial activity is not the production of electricity (see utility).

NPDES – National Pollution Discharge Elimination System under the Clean Water Act.

NSPS – New Source Performance Standards under either the Clean Water Act or Clean Air Act.

OCW – oil combustion waste.

particulates – fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in the air or emissions.

PCB – polychlorinated biphenyls, a class of toxic chemicals.

PCDD – polychlorinated dibenzo-p-dioxin.

PCDF – polychlorinated dibenzofuran.

PDWS – Primary Drinking Water Standards established by the Safe Drinking Water Act.

peakload – the maximum electricity demand from a facility or boiler that occurs during a specified period of time.

peakload unit or peaking unit – an electrical generating unit that is used to supply peakload, and thus is used intermittently during periods of high demand.

percolation basin – a surface impoundment in which liquids are allowed to discharge (percolate) into the ground.

petroleum coke – solid carbaceous residue remaining in oil refining stills after the distillation process.

PM – particulate matter.

pore water – interstitial water from borings of waste managed in surface impoundments.

POTW – Publicly Owned Treatment Works.

pozzolanic – forming a strong, slow-hardening cement-like substance when mixed with lime or other hardening material.

PSD – prevention of significant deterioration under the Clean Air Act.

PSES – Pretreatment Standards for Existing Sources under the Clean Water Act.

pulverized coal (PC) boiler or pulverizer – a combustion technology that burns finely ground coal in suspension.

PVC – polyvinyl chloride.

pyrites – iron sulfide (FeS_2) minerals that may oxidize during the combustion process to generate sulfur oxide gases. Pyrites may be a component of coal mill rejects.

RCRA – Resource Conservation and Recovery Act, as amended (Pub. L. 94-580). The legislation under which EPA regulates solid and hazardous waste.

RCRA Subtitle C characteristics – criteria used to determine if an unlisted waste is a hazardous waste under Subtitle C of RCRA.

> corrosivity – a solid waste is considered corrosive if it is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, or if it is a liquid and corrodes steel at a rate greater than 6.35 millimeters per year at a test temperature of 55°C.
>
> toxicity – a solid waste exhibits the characteristic of toxicity if, after extraction by a prescribed EPA method, it yields a metal concentration 100 times the acceptable concentration limits set forth in EPA's primary drinking water standards.
>
> ignitability – a solid waste exhibits the characteristic of ignitability if it is a liquid with a flashpoint below 60°C or a non-liquid capable of causing fires at standard temperature and pressure.
>
> reactivity – a waste is considered reactive if it reacts violently, forms potentially explosive mixtures, or generates toxic fumes when mixed with water, or if it is normally unstable and undergoes violent change without deteriorating.

reactivity – see RCRA Subtitle C characteristics.

regeneration waste streams – wastes resulting from periodic cleaning of ion exchange beds used to remove mineral salts from boiler makeup water.

reinjection – the act of returning fly ash to a boiler to use any residual carbon content as fuel.

residual fuel oil – the heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. Included are No. 5 fuel oil, Navy Special, and No. 6 fuel oil (which includes Bunker C fuel oil).

RIA – Regulatory Impact Analysis.

run-on and runoff control and collection system – Run-on controls prevent precipitation runoff from other parts of a site from reaching waste management areas. Runoff controls and collection systems prevent precipitation runoff from the waste management unit from being transported offsite.

scrubber – an air pollution control device used to remove particulates or contaminant gases from flue gas (see wet scrubber and dry scrubber).

SDWS – Secondary Drinking Water Standards established by the Safe Drinking Water Act.

SIC – Standard Industrial Classification.

SIP – State Implementation Plan under the Clean Air Act.

slag – molten or fused solid matter.

sluice water – liquid used to transport combustion waste or other material.

sluiced ash – combustion waste that has been transported using liquid.

slurry – a mixture of insoluble matter in a fluid.

SPLP – Synthetic Precipitation Leaching Procedure.

spray canal – recirculating cooling water system used to transfer heat picked up in the condenser to the atmosphere by evaporative cooling.

SSB – solids settling basin.

Standard Industrial Classification (SIC) code – a code developed by the U.S. government that categorizes businesses into groups with similar economic activities.

steam electric boiler – a system that combusts fuel in a boiler to produce steam, which in turn is used to provide heat or steam or drive turbines.

stoker – a combustion technology using a mechanically operated fuel feeding mechanism to distribute solid fuel over a grate for combustion.

subbituminous coal – an intermediate ranked coal between lignite and bituminous with more carbon and less moisture than lignite (see coal rank).

superheater – a device that follows a boiler and uses exhaust gases from combustion to raise the temperature of steam generated in the boiler.

surface impoundment – a facility that is a natural topographic depression, artificial excavation, or diked area formed primarily of earthen materials (although it may be lined with artificial materials), which is designed to hold an accumulation of liquid wastes containing free liquids.

surface water monitoring system – periodic collection and analysis of surface water samples near a waste management unit.

TCLP – Toxicity Characteristic Leaching Procedure.

toxicity – see RCRA Subtitle C characteristics.

TSS – total suspended solids.

UCCW – utility coal combustion waste.

unit – see generating unit or waste management unit.

USWAG – Utility Solid Waste Activities Group.

utility – a private or public organization that generates, transmits, distributes, or sells electricity. For purposes of this study, includes independent power producers regulated under the Public Utility Regulatory Policies Act (PURPA).

waste management unit – a structure, typically a landfill or surface impoundment, in which waste is placed for disposal or storage.

wastewater treatment sludge – waste generated from the treatment in settling basins or other treatment facilities of liquid waste streams.

water treatment sludge – waste resulting from treatment of makeup water for the steam cycle or for non-contact cooling.

watt – a unit of electrical power.

wet scrubber – a device utilizing a liquid, designed to separate particulate matter or gaseous contaminants from a gas stream by one or more mechanisms such as absorption, condensation, diffusion, or inertial impaction.