U.S. House of Representatives
Committee on Transportation and Infrastructure
Washington, DC 20515

James L. Oberstar
Chairman

David Heymsfeld, Chief of Staff
Ward W. McCarragher, Chief Counsel

John L. Mica
Ranking Republican Member

James W. Coon II, Republican Chief of Staff

April 29, 2009

SUMMARY OF SUBJECT MATTER

TO: Members of the Subcommittee on Water Resources and Environment

FROM: Subcommittee on Water Resources and Environment Staff

SUBJECT: Hearing on "Coal Combustion Waste Storage and Water Quality"

PURPOSE OF HEARING

On Thursday, April 30, 2009, at 10:00 a.m., in Room 2167 Rayburn House Office Building, the Subcommittee on Water Resources and Environment will receive testimony from representatives from the United States Environmental Protection Agency, the Maryland Department of Environmental Quality, academia, and other interested parties. The purpose of this hearing is to gather more information on the relationship between the storage and disposal of coal combustion waste (CCW) and water quality.

BACKGROUND

This memorandum provides information on coal combustion storage, waste, disposal and reuse practices, regulations concerning storage, disposal and reuse, and the water quality implications of storage and disposal.

Coal Combustion Waste

In 2007, 131 million tons of ash[1], or CCW, was produced by the 460 coal-fired power plants located across the United States. CCW consists of a variety of residues that remain after coal has been burned. These materials include coarse particles that settle to the bottom of the power plant's

[1] Coal ash is referred to by a number of names, including coal combustion byproducts, waste, product, or residue. Regulatory agencies generally refer to the material as CCW. We will use this nomenclature in this memorandum.

combustion chamber, as well as fine particles that are removed from the flue gas. The various types of CCW include:

- *Fly ash:* Fly ash is captured in the power plant's stack, or chimney, by particulate removal processes, such as electrostatic precipitation or fabric filters, to avoid release into the air. It has a fine consistency like talcum powder.

- *Bottom ash:* Bottom ash consists of coarse, gritty particles that are too large to be carried in flue gases. This material either gathers on the furnace walls or falls through open grates on the floor of the furnace into an ash hopper. Bottom ash has a size and consistency similar to fine sand or gravel.

- *Boiler slag:* Boiler slag is produced when molten coal slag comes into contact with water used in power plant furnaces. The molten slag fractures, crystallizes, and then forms pellets. Boiler slag is uniform in size, hard, and durable.

- *Flue gas desulfurization (FGD) material:* FGD is a chemical process implemented in order to meet Clean Air Act emissions requirements. The process chemically combines the sulfur gases released during combustion by reacting them with a binding agent, or sorbent, such as limestone, lime, or ammonia. Depending on the FGD process used at a particular plant, the FGD material produced can be either a wet sludge or dry powder.

Of the 131 million tons of coal ash produced in 2007, the American Coal Ash Association estimates that 71 million tons is fly ash, 20 million tons is bottom ash and boiler slag, and 40 million tons is FGD material.

The physical and chemical characteristics of CCW are a function of the chemical characteristics of the source coal, coal-cleaning processes and technologies, the chemical characteristics of any co-fired materials, and the processes or technology used to burn the coal and filter the ash at a given plant. CCW represents the noncombustible constituents of coal. Therefore, the chemical constituency of the coal component of CCW is strongly influenced by the source coal used. CCW can also include the chemical characteristics of non-coal substances that may be co-fired along with the coal, such as wood, biomass, plastics, petroleum coke, tire-derived fuel, refuse-derived fuel, or manufactured gas plant waste. Finally, CCW characteristics are affected by the combustion, air emission control, and residue-handling, or CCW-handling (collection systems that will result in either wet or dry CCW), technologies used at a particular plant.

The principle constituents found in CCW include silica, alumina, iron oxide, potassium, calcium, and magnesium. The distribution of these components is a function of the regional source of the coal. Different regions produce different types of coal: for example, bituminous, sub-bituminous, or lignite.

Coal also naturally contains arsenic, barium, beryllium, boron, cadmium, chromium, thallium, selenium, molybdenum, and mercury in small concentrations, among other elements. When coal is burned, the metals become concentrated at levels higher than that found in the natural, unburned coal. Most of these metals are captured in the ash and FGD materials. While levels of these metals will vary, based on the particular source of the CCW, all CCW will likely include these materials. CCWs will also likely include toxic organic materials, such as dioxins and polycyclic aromatic hydrocarbons (PAH) compounds.

As the nation's energy needs increase and air pollution regulations become more stringent, the Department of Energy's (DOE) National Energy Technology Laboratory anticipates that the volumes of CCW produced will increase. DOE anticipates an additional 30 million tons of CCW will be produced annually within at least ten years.

Regulation of Coal Storage and Disposal

CCW is currently subject to regulation as a non-hazardous (solid waste) substance under the Resource Conservation and Recovery Act (RCRA), and is exempt from federal hazardous waste management regulations under that statute. As a result, it is regulated primarily by the states. These state statutory and regulatory requirements vary considerably. In practical terms, the primary federal role in the management of CCW storage and disposal is through Clean Water Act permitting requirements (for those CCW storage and disposal facilities subject to them).

Federal Regulation: The federal government has weighed the regulation of CCW since at least 1980. During the 1980 RCRA reauthorization, Representative Bevill introduced an amendment, which was adopted, that required EPA to defer the imposition of hazardous waste regulatory requirements for CCW until data regarding the materials' potential hazard to human health or the environment could be analyzed. This is referred to as the Bevill Amendment. According to the Congressional Research Service (CRS), since 1980, EPA has conducted various studies, submitted reports to Congress, and made regulatory determinations in response to the directives in the Bevill Amendment. Other federal agencies, such as the Department of Interior's Office of Surface Mining (OSM), have also engaged in actions concerning the storage or disposal of CCW.

In 1999, partly as a result of variations in state requirements, EPA determined that national regulations under RCRA regarding CCW disposal were needed. On May 22, 2000, EPA issued a regulatory determination[2] that concluded that CCW waste from power producing facilities did not warrant regulation as a hazardous waste under Subtitle C of RCRA.[3] However, EPA determined that national regulations as non-hazardous waste (solid waste) under Subtitle D of RCRA were warranted for CCW when disposed or stored in landfills or surface impoundments. In order to consistently regulate CCW, EPA stated its intent to promulgate regulations under Subtitle D. To date, regulations pursuant to this regulatory determination have not been proposed or issued.

In its May 22, 2000 regulatory determination, EPA also concluded that no additional regulations were warranted for CCW to be reused or used beneficially. The agency stated that it did

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[2] 65 FR 32214.

[3] RCRA was enacted in 1976. It is intended to protect human health and the environment from the potential hazards of waste disposal and to ensure that wastes are managed in an environmentally sound manner. RCRA's Subtitle C creates a hazardous waste management program that directs EPA to develop criteria for identifying the characteristics of hazardous waste and to develop waste management criteria applicable to that hazardous waste. RCRA's Subtitle D establishes state and local governments as the primary planning, regulating, and implementing entities for the management of solid waste. Solid waste under Subtitle D commonly includes household garbage and non-hazardous solid waste. In 1984, the Hazardous and Solid Waste Amendments to RCRA directed EPA to establish national criteria for municipal solid waste landfills under Subtitle D.

not wish to place any unnecessary barriers on the beneficial use of CCW so that the material could be used in applications that conserve natural resources and reduce disposal costs.

In March, 2007, OSM issued an advance notice of proposed rulemaking regarding the disposal of CCW in active and abandoned mines. However, draft rules have not yet been proposed. In addition, following the December 2008 CCW release at the Tennessee Valley Authority's Kingston Fossil Plant (Harriman, Tennessee), the EPA announced on March 9, 2009 that the agency would propose regulations to address CCW disposal in landfills and surface impoundments by the end of 2009.

Some CCW storage or disposal units – especially surface impoundments, which handle wet CCW – may be subject to federal water pollution control regulations. A storage or disposal unit that has an outfall that discharges to surface water is required to meet the effluent guidelines pursuant to the Clean Water Act, and specified in a facility's National Pollutant Discharge Elimination System (NPDES) permit.

State Regulation: Other than federal water pollution regulations, and in the absence of federal solid waste regulations under RCRA, the de facto controlling regulatory regime for CCW storage and disposal is subject to the requirements of the state in which a particular facility is located. State regulations for CCW storage and disposal vary from state to state. They can also vary from storage unit to storage unit. For example, a given state may regulate landfills and surface impoundments using different regulatory requirements. Additionally, for example, older units may be treated differently than newer units, based on 'grandfathering' provisions.

CCW Management Approaches

Currently, CCW is stored in approximately 1,300 locations across the United States. Of these, 620 are actively being used. This subset includes landfills, storage ponds, and surface impoundments. The remaining approximately 700 locations are old, unused, or closed sites.

After the coal is burned in a power plant furnace, the residue is removed from the plant. Depending on a given plant's technology and processes, the CCW residue is removed in either a dry or wet form. To aid the transportation from the furnace to storage or disposal facilities, some facilities use technology that mixes the ash with water. This slurry is then pumped to storage facilities known as surface impoundments. Over time the solids will settle out in these facilities, leaving water at the surface. This water is ultimately removed from the impoundment. Surface impoundments, used for the storage of wet CCW, may be a natural or a man-made depression or diked area formed of earthen materials. Ash that is removed from facilities in a dry form is stored, or disposed of, in landfills. CCW is also disposed of, in either wet or dry forms, or as an amalgamation with other materials, in either surface or underground mines. The Utilities Solid Waste Activities Group estimates that 45 percent of operating storage and disposal sites are surface impoundments.

States use a variety of regulatory approaches for their storage facilities. Many states use their dam safety requirements to regulate the construction, operation, and maintenance of surface impoundments. CRS notes, however, that "the presence of strong dam safety requirements is not a guarantee that regulated units will actually be operated and maintained according to those requirements. The requirements may be only as strong as a state's ability to enforce them." Some states do require groundwater monitoring to detect contamination from a disposal unit. However, CRS notes that a lesser number are likely to have regulatory requirements to prevent groundwater contamination from occurring. For example, water contamination could be prevented in such an instance by the installation of a liner in older, unlined impoundments or landfills.

Water Quality Implications

In recent years, EPA has renewed its research on the potential for coal ash constituents to leach into groundwater and nearby surface water. In a series of studies, EPA researchers found traditionally applied leachate methods and tests for testing contaminant infiltration may not reliably reflect actual leaching and infiltration processes in the field. As a result, researchers have been developing more sophisticated testing techniques that better encompass the range of conditions expected to be found in the field. In late 2008, EPA's Office of Solid Waste recommended the use of some of these newer leachate methods and tests, and is in the process of adopting these testing protocols in its primary guidance for testing and evaluating solid waste.[4] Analyzing samples in conditions more similar to those actually found in the field, EPA researchers have often found significantly higher leachability of contaminants, compared to the older, traditional leachate methods. Among their findings were:

- Boron and cadmium levels that ranged from being in compliance with drinking water standards to levels ten times higher, in FGD material leachate;
- Selenium levels that ranged from being in compliance with drinking water standards to levels at least 60 times higher, in FGD material leachate;
- Barium, beryllium, boron, cadmium, chromium, thallium, selenium, and molybdenum levels that ranged from being in compliance with drinking water standards to levels not in compliance with those standards, in leachate from fly ash;
- Arsenic levels that ranged from being in compliance with drinking water standards to levels 30 times higher, in leachate from fly ash.

EPA conclusions from these studies were that CCW should not be stored or used in environments where it will come into contact with water.

Incidents of water contamination have taken place. In December 2007, a Maryland judge signed a $54 million settlement between Constellation Energy and residents of Gambrills, Maryland. Constellation Energy was penalized for dumping CCW into a wet sand and gravel quarry, ostensibly as part of a reclamation project. The CCW contaminated private wells in the area with aluminum, arsenic, beryllium, cadmium, lead, manganese, and thallium, at levels above drinking water standards.

The potential for CCW to leach contaminants after being reused (i.e. beneficial use) is a function of whether the waste is bound or encapsulated. For example, adding CCW as a component of concrete, or as a cement additive, would 'lock' toxic contaminants into the material. However, an unencapsulated use, such as for structural fill without a liner or as a soil additive, may result in the leaching of contaminants.

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[4] This EPA guidance is referred to as SW-846, or 'Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.'

In addition, in March 2006, the National Research Council (NRC) issued a study that warned of the potential for water contamination from CCW disposal in underground mines.[5] The NRC committee found that the disposal of CCW in underground coal mines is a viable management option as long as the waste placement was properly planned. This planning requires an integrated process involving waste characterization, site characterization, management and engineering design of placement activities, and design and implementation of a monitoring regime. The NRC also noted that relatively little is known about the potential for the disposal of CCW in mines to degrade groundwater and surface waters, particularly over the long term.

Beneficial Reuse of CCW

Coal ash can be recycled into other products, which is referred to as "beneficial reuse." The American Coal Ash Association estimates that 43 percent of all coal ash produced in the United States was "beneficially reused" in 2007, amounting to approximately 56 million tons.[6]

Types of Beneficial Reuse: One of the most common beneficial uses of coal combustion waste is the application of fly ash in the production of portland cement, an ingredient used to make concrete. Fly ash contains silica, alumina, calcium, and iron oxides that bind to components of portland cement, which actually increase the long-term durability of concrete.[7] Additionally, fly ash used in portland cement reduces the significant greenhouse gas emissions that are normally released during the production of portland cement. Several recent projects have used fly ash in portland cement, including the new I-35W bridge in Minnesota and the Ronald Reagan Building and International Trade Center in Washington, D.C.

CCW can also be applied as a soil amendment that chemically or physically modifies the composition of the soil. It can be used to add nutrients in nutrient deficient soils, reduce soil acidity, increase the aeration in clay solids, or increase the water-bearing capacity of sandy soils.[8] However, these practices should be properly monitored to prevent soil toxicity, because constituents may leach into groundwater.

Another increasingly common beneficial reuse of coal combustion wastes is that of flue gas desulfurization residues, which are used as synthetic gypsum in order to make wallboard. This has become economically attractive to the wallboard industry, which has increasingly opened new plants near coal utility facilities.[9]

There are also several other less common examples of beneficial reuse of CCW. Bottom ash and fly ash may also be used to create structural fill to produce road base materials, manufactured aggregates, flowable fills, and embankments. Boiler slag is commonly used as a component of roofing tiles and shingles, as well as a component of sand-blasting abrasives. Additionally, CCW is

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5 NRC. 2006. *Managing Coal Combustion Residues in Mines.*
6 *See Ibid.*
7 Federal Highway Administration. "Fly Ash Facts for Highway Engineers." http://www.fhwa.dot.gov/pavement/recycling/fafacts.pdf
8 Carlson, C.L., and D.C. Adriano. 1993. Environmental impacts of coal combustion residues. Journal of Environmental Quality 22:227-247.
9 National Academy of Sciences. "Managing Coal Combustion Residues in Mines." Page 47.

used as traction control material on snow- and ice-covered roadways and as a performance enhancing product in paints, coatings, and adhesives.[10]

Potential Issues with Beneficial Reuse: There has been broad agreement that beneficial reuse of CCW is preferable to the storage of coal ash in landfills, mines, or surface impoundments. The EPA came to a similar conclusion in its 2000 regulatory determination on CCW, which explicitly states that its regulation under RCRA Subtitle C or D is unwarranted when coal ash is "beneficially reused." EPA concluded that such uses are unlikely to present significant risks to human health or the environment, and that regulating CCW as a hazardous waste would probably discourage its reuse and result in a greater harm to the environment.[11]

However, it is worth noting that broad studies have not been conducted examining the potential ecological or human health impacts of beneficially reused CCW. Some environmentalists have voiced skepticism that all beneficial reuses of CCW are safe. For example, one study shows that the use of fly or bottom ash in golf course root mix resulted in increased toxicity levels in leachate, compared to a control group.[12] EPA and other organizations recognize that CCW needs to be managed properly and that precautions should be applied when using CCW in unencapsulated uses. Therefore, while beneficial reuse may be less environmentally harmful than storing CCW in landfills, surface impoundments, or mines, more research may be necessary to make a more reliable determination of the circumstances when beneficial reuse of CCW is appropriate.

WITNESSES

Panel I

Mr. Barry Breen
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Washington, D.C.
Accompanied By:
Mr. Michael Shapiro
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Water
Washington, D.C.

[10] National Academy of Sciences. "Managing Coal Combustion Residues in Mines." Page 46-47.
[11] EPA. "Regulatory Determination on Wastes from the Combustion of Fossil Fuels; Final Rule." 40 CFR Part 261. http://www.epa.gov/osw/nonhaz/industrial/ special/fossil/ff2f-fr.pdf
[12] Schlossberg, Maxim J. and William P. Miller. "Trace Element Transport in Putting Green Root Mixes Amended by Coal Combustion Products (CCP)." *Coal Combustion Byproducts and Environmental Issues.* 2006.

Ms. Catherine McCabe
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Enforcement and Compliance Assurance
Washington, D.C.

Hon. Shari Wilson
Secretary
Maryland Department of the Environment
Baltimore, Maryland

Panel II

Mr. Eric Schaeffer
Executive Director
Environmental Integrity Project
Washington, D.C.

Mr. John M. McManus
Vice President of Environmental Services
American Electric Power
Columbus, Ohio

Mr. David Goss
Former Executive Director
American Coal Ash Association
Aurora, Colorado
representing the Edison Electric Institute

Dr. Conrad Volz
Assistant Professor, of Environmental and Occupational Health
Director, Center for Healthy Environments and Communities
University of Pittsburgh
Pittsburgh, Pennsylvania
representing the Utility Solid Waste Activities Group