

A TECHNICAL REVIEW OF THE FINAL REPORT OF THE NATIONAL ACADEMY OF SCIENCES “MANAGING COAL COMBUSTION RESIDUES IN MINES”¹

Kimery C. Vories²

Abstract. On March 1, 2006, the National Research Council released to the public its final report by the National Academy of Sciences “Managing Coal Combustion Residues (CCRs) in Mines.” Based on the news release of the National Academy of Sciences (NAS), putting coal ash back into mines for reclamation is a viable option for disposal, as long as precautions are taken to protect the environment and public health. The report also acknowledged that CCRs could serve a useful purpose in mine reclamation, lessen the need for new landfills, and potentially neutralize acid mine drainage. The report recommends development of enforceable Federal standards that give the States authority to permit the use of CCRs at mines but allows them to adopt requirements for local conditions.

The report lists 40 findings or recommendations under 12 categories. This paper addresses the merits of these findings on a case by case basis against existing regulatory requirements, the applicability of data evaluated, and consideration of extensive data and scientific studies relevant to the subject. The NAS has chosen to use the term “Coal Combustion Residues” where OSM has historically used the term “Coal Combustion By-Products.” The terms are interchangeable. The author is in agreement with the NAS findings that support: (1) the use of these materials in mine reclamation; (2) the need for specific Federal regulations under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) that spells out the minimum permitting, bonding, and environmental performance standard requirements when they are placed on active coal mines; (3) the research priorities to specifically address the hydrogeologic fate of CCBs and any leachate generated by those CCBs in relation to public health and environmental quality; and (4) to develop mining appropriate leachate tests. A limitation of the report is its inability to: (1) acknowledge the significant differences between regulatory programs that control placement of CCBs at mines; (2) evaluate available ground water monitoring data and scientific research within the context of the applicable regulatory programs; and (3) acknowledge the volumes of scientific studies and State regulatory data that shows no degradation of water quality due to placement of CCBs at SMCRA mines for the last 29 years. The following review is strictly the opinion of the author and carries no institutional endorsement.

Additional Key Words: Coal Combustion By-Products, and Surface Mining Control and Reclamation Act

¹ Paper was presented at the 2007 National Meeting of the American Society of Mining and Reclamation, Gillette, WY, 30 Years of SMCRA and Beyond June 2-7, 2007. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

²Kimery C. Vories, Natural Resource Specialist, US DOI Office of Surface Mining, Mid-Continent Regional Office, 501 Belle St., Alton, Illinois 62002
Proceedings America Society of Mining and Reclamation, 2007 pp 865-883
DOI: 10.21000/JASMR07010865
<http://dx.doi.org/10.21000/JASMR07010865>

Introduction

On March 1, 2006, the National Research Council released to the public its final report by the National Academy of Sciences “Managing Coal Combustion Residues in Mines.” The study was in response to a request from Congress initiated in June of 2004. The study was to determine whether CCRs were placed and disposed of in coal mines with inadequate safeguards and whether this activity is degrading water supplies in coal mines in contravention of SMCRA.

The study was sponsored by the Environmental Protection Agency (EPA). The NAS committee looked at the placement of CCR in abandoned and active, surface and underground coal mines in all major coal basins. A profile of the utility industry was taken into consideration in designing the study to focus on sources producing the greatest quantities of coal combustion wastes.

The committee’s efforts focused on CCR from utility power plants and independent power producers, rather than small business, industries, and institutions. The committee examined regulatory structures and the interaction of programs under EPA’s jurisdiction and the Surface Mining Control and Reclamation Act (SMCRA) implemented by the Office of Surface Mining (OSM) in partnership with States. The committee held six public meetings around the country between October 2004 and August 2005, where they also visited field sites related to their inquiry.

NAS Statement of Task

Specifically, the committee addressed the following points:

1. The adequacy of data collection from surface water and ground water monitoring points established at CCR sites in mines.
2. The impacts to aquatic life in streams draining CCR placement areas and the wetlands, lakes, and rivers receiving these drainages.
3. The responses of mine operators and regulators to adverse or unintended impacts such as the contamination of ground water and pollution of surface waters.
4. Whether CCRs and the mine they are being put in are adequately characterized for such placement to ensure that monitoring programs are effective and groundwater and surface waters are not degraded. (This item is not explicitly in the NAS statement of task but is there implicitly.)
5. Whether there are clear performance standards set and regularly assessed for projects that use CCR for “beneficial purposes” in mines.
6. The status of isolation requirements and whether they are needed.
7. The adequacy of monitoring programs including:
 - a. The status of long-term monitoring and the need for this monitoring after CCR is placed in abandoned mines and active mines when placement is completed and bonds released.
 - b. Whether monitoring is occurring from enough locations;

- c. Whether monitoring occurs for relevant constituents in CCR as determined by characterization of the CCR; and
 - d. Whether there are clear, enforceable corrective actions standards regularly required in the monitoring.
8. The ability of mines receiving large amounts of CCR to achieve economically-productive post mine land uses.
 9. The need for upgraded bonding or other mechanisms to assure that adequate resources are available for adequate periods to perform monitoring and address impacts after CCR placement or disposal operations are completed in coal mines;
 10. The provisions for public involvement in these questions at the permitting and policy-making levels and any results of that involvement;
 11. Evaluate the risks associated with contamination of water supplies and the environment from the disposal or placement of coal combustion residues in coal mines in the context of the requirements for protection of those resources by Resource Conservation and Recovery Act (RCRA) and SMCRA.

A Technical Analysis of the NAS Findings and Recommendations (NRC, 2006)

The following analysis follows the format of the NAS findings (*in italics*) as they appear in the final report followed by a discussion of the technical merit of those findings.

1. Conclusion

- a. *The committee believes that placement of CCR in mines as part of coal mine reclamation may be an appropriate option for the disposal of this material.*

Agree.

2. Value of existing CCR data and information

- a. *The two most common CCR disposal options, surface impoundments and landfills, provide insights into the types of issues that can emerge when the soluble constituents of CCRs are not contained within the waste management system.*
- b. *Although disposal conditions may differ substantially from mine settings, landfills, and surface impoundments are useful for understanding the specific conditions under which CCRs can potentially impact humans and ecosystems. The EPA has identified numerous cases of water contamination related to CCR landfills and surface impoundments that, in many cases, has caused considerable environmental damage. In some landfill settings, groundwater has been degraded to the point that drinking water standards were exceeded off-site. In other landfills and surface impoundments, contamination of surface waters has resulted in considerable environmental damage; in the most extreme cases, multiple species have experienced local extinctions. Such cases are instructive because these impacts can be clearly related to CCR disposal, and they help guide the selection of mining environments for CCR placement that are most protective of human and ecological health.*
- c. *the committee's review of literature and damage cases recognized by EPA supports the EPA's concerns about proper management of CCRs.*

d. As of 2005, EPA had recognized 24 proven damage cases involving CCR landfills and surface impoundments. One CCR coal minefill is under investigation as a potential damage case by EPA.

The following comments address findings 2.a. through d.

The author would disagree with the NAS' use of data from landfills and impoundments as an indicator of CCB leachate characteristics of a SMCRA mine. Conditions at SMCRA mines are substantially different (See pp. 7-9 in Vories, 2002).

ELECTRIC UTILITY CCB DISPOSAL FACILITY

Electric utility disposal sites where toxic leachates have occurred are typically characterized by:

- geographic placement in a floodplain;
- a geologic setting of alluvial sand and gravel usually close to a river;
- ground water that is plentiful and of high quality;
- all types of fossil fuel wastes are placed in these facilities in a wet slurry without any chemical characterization of the material;
- reclamation is accomplished with a shallow layer of fill over the area and revegetated; and
- the Clean Water Act usually covers the area during operation and State Solid Waste regulations at disposal (Fig. 1).

TYPICAL UTILITY CCB STORAGE/DISPOSAL AREA

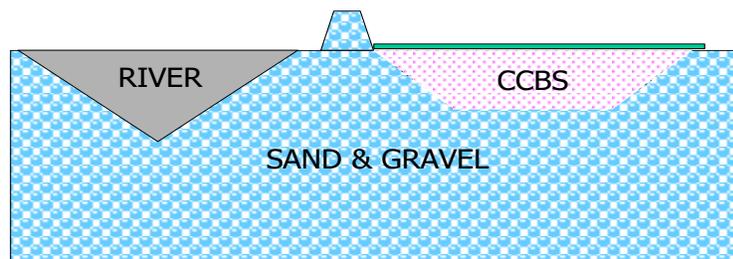


Figure 1. Typical cross-section of an electric utility disposal site where toxic leachate has occurred.

SMCRA MINE SITE CCB PLACEMENT

CCB placement at mine sites typically is characterized by:

- a geographic placement in an upland position;
- a geologic setting of bedrock sandstone, shale, and limestone underlain by an impermeable fire clay below the lowest coal seam that was mined;
- ground water is limited and of poor quality;
- only those CCBs that are leachate tested and approved in the SMCRA permit are allowed for placement on the mine site;
- reclamation is accomplished with a deep layer of spoil over the area followed by topsoil and then revegetated; and
- at all phases, the placement is regulated by the environmental protection permitting and performance standards of SMCRA (see discussion under 5.a.), which include the requirements of the Clean Water Act and applicable State Solid Waste program requirements (Fig. 2).

TYPICAL CCB FILL AT MINE

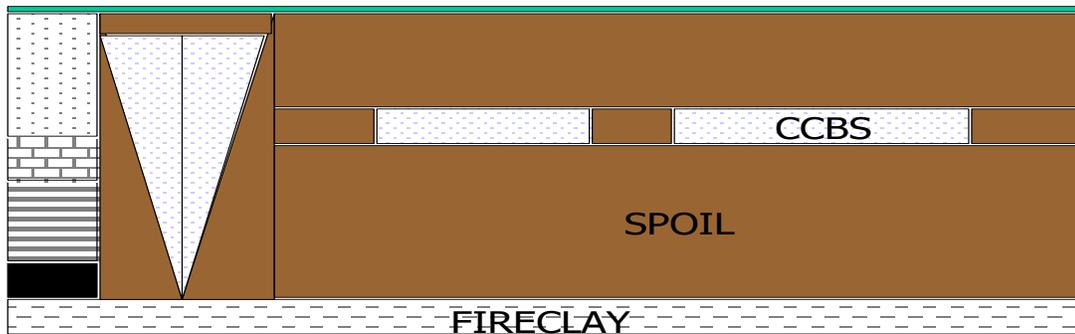


Figure 2 Typical cross-section of CCB placement at a reclaimed coalmine site illustrating placement within the spoil and placement within the final pit adjacent to the undisturbed geologic cross section on the left.

The data from EPA damage cases associated with leachate into ground water from historic landfills where disposal was unregulated is not relevant to SMCRA mines. Data from these sites are characterized by the lack of: (1) knowledge of all of the types and quantities of wastes that were disposed in addition to coal ash; and (2) a permitting process to require (a) characterization of the wastes, (b) characterization of the site; (c) determination of impact to the hydrology, and (d) establishment of a waste specific water quality monitoring program.

In any scientific investigation, it is essential that you establish how a set of data is representative of a given population. If the NAS is to use data from non-SMCRA landfills and impoundments as a substitute for water quality data from SMCRA mines then it is up to NAS to demonstrate how this data is representative of leachate characteristics of CCB placement on SMCRA mines.

- e. *comparatively little is known about the potential for mine-filling to degrade the quality of groundwater and/or surface waters particularly over longer time periods.*
- f. *there are insufficient data on the contamination of water supplies by placement of CCRs in coal mines, making human risk assessment difficult.*
- g. *Currently, there are very few data available to directly indicate that placement of CCRs in abandoned or active coal mines is either safe or detrimental.*

The author has found that there is a substantial body of evidence that CCB placement at active coal mines permitted under SMCRA have not caused detrimental effects to the environment or public health as evidenced by extensive research done by: (1) the U.S. Department of Energy's (DOE) Combustion By-Products Recycling Consortium; (2) the DOE researchers at the National Energy Technology Laboratory; (3) the Energy and Environment Research Center at the University of North Dakota; (4) the Center of Applied Energy Research at University of Kentucky; (5) The University of Ohio; (6) Southern Illinois University at Carbondale; (7) Penn State University; (8) West Virginia University; and (9) CCB scientists and mining experts who wrote 134 articles published in 6 technical interactive forum proceedings by the Office of Surface Mining over the period 1996 to 2005.

2. Potential Impacts

- a. *Of the three methods currently available for disposal of CCRs (surface impoundments, landfilling, and minefilling), comparatively little is known about the potential for minefilling to degrade the quality of ground water and/or surface waters particularly over longer periods. Additionally, there are insufficient data on the contamination of water supplies by placement of CCRs in coal mines, making human risk assessments difficult.*

All SMCRA permitted mines are required to conduct ground and surface water quality monitoring to protect the hydrologic balance, the existing water users, and to comply with all State and Federal Water laws and regulations as stated earlier. In the 29 years of SMCRA, there has been no documentation of proven EPA damage cases on SMCRA mines. The author is unaware of any State Regulatory Authority quarterly water monitoring data recording damage to a drinking water supply or damage to a surface aquatic ecosystem. All of this data has been reviewed by EPA and was offered to the NAS. This represents a substantial quantity of data that shows no degradation of water quality.

- b. *The committee concludes that the presence of high contaminant levels in many CCR leachates may create human health and ecological concerns at or near some mine sites over the long term.*

These concerns could be addressed by the research priorities identified by the NAS.

3. CCR Disposal and Use Options

- a. *The committee recommends that secondary uses of CCRs that pose minimal risks to human health and the environment be strongly encouraged.*

Agree.

- b. *With regard to CCR placement in minefills, the committee concludes that while potential advantages (beneficial use) should not be ignored, the full characterization of possible risks should not be cut short in the name of beneficial use.*

4. CCR Characterization

- a. *In order to contribute to evaluation of the risk of placing CCRs at mine sites, the committee recommends that CCRs be characterized prior to significant mine placement and with each new source of CCRs. CCR characterization should continue periodically throughout the mine placement process to assess any changes in CCR composition and behavior.*

In order to address the concern for uniformity among the States to maintain minimum environmental protection standards for placement of CCBs at SMCRA mines, the Office of Surface Mining has committed to writing specific Federal rules (Advance Notice of Public Rulemaking Published in the Federal Register 3/12/2007) that would address the minimum permitting, environmental performance requirements, and bonding of CCB placement at SMCRA mines.

- b. *The committee suggests some simple improvements to current leaching protocols. In particular, the CCR characterization methods used should provide contaminant leaching information for the range of geochemical conditions that will occur at the CCR placement site and in the surrounding area, both during and after placement. Samples that exceed pre-determined leaching criteria should be rejected for mine placement, although samples that meet the criteria may still need additional evaluation depending on the potential risks of CCR placement determined from the site characterization.*

The author agrees that there is a need for mining appropriate leachate tests standardized and endorsed by either EPA or a third party technical institution like the American Society of Testing Methods (ASTM). It is the responsibility of the permit applicant to demonstrate that the operational handling plan, reclamation plan, and monitoring program provide sufficient technical support so that the State Regulatory Authority can make the finding that all SMCRA water quality performance standards will be met. The State Regulatory Authority must determine whether certain leachate criteria must be met in order to ensure that the SMCRA water quality performance standards can be met. Because of the broad range of climatic and geologic settings and mining technologies where these materials are placed, the author believes that general statements like “*Samples that exceed pre-determined leaching criteria should be rejected for mine placement*” ignore the need for State specific expertise and responsibility for determining the measures necessary to meet SMCRA performance standards.

5. Site Characterization

- a. *Current site characterization requirements of SMCRA focus on assessing the potential impacts of coal mining and reclamation but do not specifically address the impacts of*

CCR placement. The committee recommends that comprehensive site characterization specific to CCR placement be conducted at all mine sites prior to substantial placement of CCRs.

Neither SMCRA nor the OSM regulations, specifically address the use or disposal of the by-products of electric power generation at surface coal mines. However, when the use or disposal of CCBs happens at surface coal mines, State coal mining regulators are involved to the extent that SMCRA requires:

1. the mine operator to ensure that all toxic materials are treated, buried, and compacted, or otherwise disposed of, in a manner designed to prevent contamination of the ground or surface water;
2. making sure the proposed land use does not present any actual or probable threat of water pollution; and
3. ensuring the permit application contains a detailed description of the measures to be taken during mining and reclamation to assure the protection of the quality and quantify of surface and ground water systems, both on and off-sites, from adverse effects of the mining and reclamation process also to assure that rights of present users of such water are protected (Henry, 1996).

All SMCRA permits are required to demonstrate how all aspects of mining and reclamation (including any associated CCB placement) will meet SMCRA environmental performance standards. A separate impact assessment for CCB placement is not required, because it can not be excluded from the comprehensive site specific characterization, operations plan, reclamation plan, and water quality monitoring plan already required by SMCRA. Each permit application must include a description of the existing, pre-mining environmental resources within the proposed permit area and adjacent areas that may be affected or impacted by the proposed surface mining activities. The permit application must include the following information upon which the mining and reclamation plan must be based:

- General Environmental Resources Information including the cultural, historic, and archeological resources, 30 CFR §779.12. (2005)
- Climatic Information, 30 CFR §779.18.
- Vegetation Information, 30 CFR §779.19.
- Soils Resource Information, 30 CFR §779.21.
- Maps: General Requirements, 30 CFR §779.24.
- Cross sections, maps and plans, 30 CFR §779.25.
- Fish and Wildlife Resources, 30 CFR §779.16.
- Hydrologic Information, 30 CFR §780.21, (including flood plains, critical receptors such as water wells, dams, streams, water intake structures, and wetlands) including:
 - o Sampling and Analysis methodology
 - o Ground water and surface water baseline information

- o Cumulative impact area information
- o Modeling or statistical analysis may be required
- o Alternate water sources
- o Probable Hydrologic Consequences (PHC)
- o Cumulative Hydrologic Impact Assessment (CHIA)
- o Hydrologic reclamation plan
- o Surface and Ground water monitoring plan
- Geologic Information, 30 CFR §780.22, including:
 - o All potential acid and toxic forming strata to just below coal seam
 - o Description of the geology (Detailed guidance is given in the OSM Permitting Hydrology reference including structural geologic features such as folding and faulting, strike and dip, and joints and fractures related to fault areas, seismic impact zones, and unstable areas) in the proposed permit and adjacent areas down to just below the coal seam or any lower aquifer impacted by mining. The description shall include the area and structural geology of the permit and adjacent areas, and other parameters which influence the required reclamation and the occurrence, availability, movement, quantity, and quality of potentially impacted surface and ground water based on information collected in 30 CFR 779 and:
 - Geologic literature. The geologic information is based on the following:
 - Analysis of samples collected from test borings and drill cores down to just below the coal seam or to the lowest aquifer affected by mining.
 - Logs showing the lithologic characteristics of each stratum and related ground water.
 - Chemical analysis of any acid, alkaline, or toxic strata including total and pyretic sulfur.
 - The regulatory authority may require additional information necessary to protect the hydrologic balance or meet the performance standards.

6. CCR Use in Reclamation

- a. *The disposal of CCRs in coal mines occurs under highly variable conditions, ranging from small quantities to massive minefills, from arid to wet regions, from remote to semiurban locations, from surface to underground mines, and from active to abandoned mines. Thus, the committee endorses the concept of site-specific management plans, including site-specific performance standards.*

Concerning the recommendation for “*site-specific management plans, including site-specific performance standards,*” the author agrees that this is important. All SMCRA permits require site-specific operations plans, reclamation plans, revegetation plans, and water quality monitoring plans. Incorporation of specific CCB regulations into the SMCRA regulations as committed to by OSM will reinforce the existing protections of SMCRA.

b. *Given the known impacts that can occur when CCRs react with water in surface impoundments and landfills, special attention should be paid in reclamation operations to the interactions of water with CCRs. Specifically, the committee recommends that CCR placement in mines be designed to minimize reactions with water and the flow of water through CCRs. Such methods include:*

(1) placement well above the water table

(2) compaction (in lifts)

(3) cementation (cement addition)

(4) use of impermeable liners, and

(5) use of low-permeability covers.

As stated in 2.d. above, the author has demonstrated the non-representative nature of data from surface impoundments and landfills.

The report recommends methods “*designed to minimize reactions with water and the flow of water through CCRs*” of “*(1) placement well above the water table; (2) compaction (in lifts); (3) cementation (cement addition); (4) use of impermeable liners; and (5) use of low-permeability covers.*” These methods are RCRA requirements for solid waste landfills and may or may not have applicability to SMCRA permits. Under SMCRA, it is the responsibility of the permit applicant to demonstrate that the operational mining and spoil handling plan, reclamation plan, and water quality monitoring program provide sufficient technical support so that the State Regulatory Authority can make the finding that all SMCRA water quality performance standards will be met. In each SMCRA permit, the regulatory authority will have to assess the physical/chemical characteristics of the CCBs to be placed, the hydrogeologic setting of the mine, the mining and reclamation plan, and the water quality monitoring plan in order to determine the safety and appropriateness of the application.

7. Post Reclamation Water Quality Monitoring

a. *Based on its reviews of CCR post-placement monitoring at many sites visited during the course of the study, the committee concludes that the number of monitoring wells, the spatial coverage of wells, and the duration of monitoring at CCR minefills are generally insufficient to accurately assess the migration of contaminants.*

b. *The committee found quality assurance and control and information management procedures for water quality data at CCR mine placement sites to be inadequate.*

c. *The committee believes that a more robust and consistent monitoring program is needed in situations involving CCR mine placement. The committee recommends that the number*

and location of monitoring wells, the frequency and duration of sampling, and the water quality parameters selected for analysis be carefully determined for each site, in order to accurately assess the present and potential movement of CCR-associated contaminants.

- d. Although monitoring plans should be site-specific, downgradient wells should be sited with an understanding of the travel times for contaminants to reach these monitoring points.*
- e. Depending on the individual site characteristics and the distances to downgradient wells, a longer duration of groundwater monitoring may be necessary at some sites to adequately assess the temporal release of contaminants, which can occur over several decades. To address these concerns, several monitoring points should be established along predicted flow paths that will yield early (prior to bond release) information that can be used to confirm predicted CCR leachate transport.*
- f. At least one well or lysimeter, and preferably two, should be placed directly in the CCR to assess the field leaching behavior and confirm predicted contaminant flux.*
- g. As part of the monitoring plan, quality assurance and control plans should be developed prior to CCR placement with clearly defined protocols for sampling and analysis, for data validation, and for managing systematic errors in analytical procedures.*

The post reclamation water quality monitoring concerns cited in the report make no distinction as to the regulatory program of the sites visited under the course of the NAS study. These sites included: (1) active coal mines (SMCRA Title V); (2) abandoned coal mines (SMCRA Title IV); (3) disposal in a coal mine final pit that has been released from SMCRA as an industrial area and is regulated under a State RCRA program; (4) abandoned coal mines under a State Regulatory Program other than SMCRA; and (5) unregulated waste dumps that were not in coal mines.

Under SMCRA, a ground water monitoring program should be done against a backdrop of site-specific background data. For that reason, extensive information is required on the hydrologic and geologic conditions of a proposed permit site. This information involves existing wells, seasonal rainfall amounts, stream flows, groundwater levels and other items that can be used in modeling and predicting impacts to the permit area and adjacent areas during and after mining. This is the PHC part of the permit document. The regulatory authority, as part of the process, is then required to develop a cumulative hydrologic impact assessment (CHIA).

The information collected allows determination of a site-specific monitoring plan for ground water and surface waters. Rather than using a “one size fits all” approach that may under sample one permit while over sampling another, the monitoring program can fit the site and the situation as known.

All known factors are required to be included in the PHC determination and the CHIA. Therefore, CCB placement as minefill is required in the analysis with adjustments to ground water monitoring on a site-specific basis.

SMCRA References: 30 CFR (2005)

Part 777.15 – Completeness of Application

Parts 779.11, 783.11 – Environmental Resources

Parts 779.18, 783.18 – Climatological Information

Parts 779.21(a), 783.21(a) – Soil Resources

Parts 779.24, 783.24 – General Features

Parts 779.24(g), 786.24(g) – Surface Water Movement

Parts 779.25(a)(6), 783.25(a)(6) – Ground Water

Parts 779.25(a)(7), 783.25(a)(7) – Surface Water Bodies And Structures

Parts 779.25(a)(9), 783.25(a)(9) – Identification Of Placement Areas

Parts 780.21, 784.14 – Hydrologic Information

Parts 780.22, 784.22 – Geologic Information

Parts 780.21(f) & 784.14(e) – Probable Hydrologic Consequences

Parts 780.21(g) & 784.14(f) – Cumulative Hydrologic Impact Assessment

Water Quality Monitoring: The required ground water monitoring (**including well design, location, installation, sampling, and maintenance**) is permit specific. A ground water monitoring plan is required that is based on the PHC determination and the analysis of **all (all includes all coal combustion material (CCB) placement)** hydrologic, geologic, and other information in the permit application. The plan shall provide for the monitoring of parameters (**including parameters necessary to evaluate the impact of CCB placement**) that relate to the suitability of the ground water for current and approved post-mining land uses and to the objectives for protection of the hydrologic balance. It will identify the quantity and quality parameters to be monitored, sampling frequency, and site locations. It shall describe how the data may be used to determine the impacts of the operation upon the hydrologic balance. The data is to be submitted to the Regulatory Authority (RA) at least every 3 months for each monitoring location. All water quality analysis must be conducted according to the methodology of the 15th edition of “Standard Methods for the Examination of Water and Wastewater,” or the methodology of 40 CFR Parts 136 and 434. The RA may require additional monitoring [30 CFR 780.21 and 816.41(c)].

SMCRA References: 30 CFR

Part 780.21 Hydrologic Information

Parts 780.21(i), 784.14(h) – Ground Water Monitoring Plan

Parts 816.41(c), 817.41(a) – Ground Water Monitoring

Parts 780.23(b), 784.15(b) – Post-Mining Land Use

Parameters: The required ground water monitoring (including identification of parameters) is permit specific. The plan must provide for the monitoring of parameters that relate to the suitability of the ground water for current and approved post-mining uses. The plan shall provide for the monitoring of parameters (**including parameters necessary to evaluate the impact of CCB placement**) that relate to the suitability of the ground water for current and approved post-mining land uses and to the objectives for protection of the hydrologic balance. Based on the PHC, it must identify the quantity and

quality parameters to be monitored, sampling frequency, and site locations (**including the parameters necessary to evaluate the impact of CCB placement**). It shall describe how the data may be used to determine the impacts (**including the potential toxicity levels of any CCB specific parameters that would impact the use of the ground water**) of the operation upon the hydrologic balance. The data is to be submitted to the RA at least every 3 months for each monitoring location. The RA may require additional monitoring [30 CFR 780.21 and 816.41(c)].

SMCRA References: 30 CFR

Parts 780.21(i), 784.14(h) – Ground Water Monitoring Plan

Parts 816.41(c), 817.41(a) – Ground Water Monitoring

Part 780.21 – Hydrologic Information

Parts 780.23(b), 784.15(b) – Post-Mining Land Use

Frequency: The required ground water monitoring (including frequency of sampling) is permit specific. The ground water monitoring plan will identify the quantity and quality parameters to be monitored, sampling frequency, and site locations (**including the sampling frequency necessary to evaluate the impact of CCB placement**). It shall describe how the data may be used to determine the impacts (**including the frequency of sampling of any CCB specific parameters that would impact the use of the ground water**) of the operation upon the hydrologic balance. The data is to be submitted to the RA at least every 3 months for each monitoring location. The RA may require additional monitoring [30 CFR 780.21 and 816.41(c)].

SMCRA References: 30 CFR

Parts 780.21(i), 784.14(h) – Ground Water Monitoring Plan

Parts 816.41(c), 817.41(a) – Ground Water Monitoring

Duration: Performance bond liability will be for the duration of the surface coal mining and reclamation operation and for a period which is coincident with the operator's period of extended responsibility for successful revegetation (10 years after establishment of vegetation in areas with less than 26" precipitation; 5 years after establishment of vegetation in areas with more than 26" precipitation) or until achievement of the reclamation requirements of the Act, regulatory programs, and permit, whichever is later (this would include determination of compliance with the hydrologic performance standards at 30 CFR 816.41(a, b, and h) and 816.42. Performance standards related to the protection of ground water must include that all mining and reclamation activities shall be conducted to minimize disturbance of the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area, to assure the protection or replacement of water rights, and to support the approved post-mining land uses in accordance with the terms and conditions of the approved permit. Any person who conducts surface mining activities shall replace the water supply of an owner of interest in real property who obtains all or part of his or her supply of water for domestic, agricultural, industrial, or other legitimate use from an underground or surface source, where the water supply has been adversely impacted by contamination, diminution, or interruption proximately (defined as a result that directly

produces and event and without which the event would not have occurred) resulting from the surface mining activities. Discharges of water from areas disturbed by surface mining activities shall be made in compliance with **all** applicable State and Federal water quality laws and regulations and with the effluent limitations for coal mining promulgated by the U.S. EPA set forth in 40 CFR Part 434.

SMCRA References: 30 CFR

Part 800.13 – Period of Liability

Parts 816.131(2)(i) & (3)(i) – Bonding Period And Annual Precipitation

Parts 816.41(a),(b) & (h) – Hydrologic-Balance Protection

Part 816.42 – Water Quality Standards and Effluent Limitations

8. Performance Assessment

- a. *The committee recommends that the disposal of CCRs in coal mines be subject to reasonable site-specific performance standards that are tailored to address potential environmental problems associated with CCR disposal.*

All SMCRA permits are required to demonstrate how all aspects of mining and reclamation (including any associated CCB placement) will meet all of the SMCRA environmental performance standards including the comprehensive site specific characterization, operations plan, reclamation plan, and water quality monitoring plan already required by SMCRA.

- b. *In areas where CCR leachate may interact with surface waters (directly or through groundwater interaction), more stringent requirements may be necessary to protect aquatic life.*

In the 29 years of SMCRA, there has not been documentation of a negative impact to aquatic life due to surface water contamination by CCB placement at a SMCRA mine. In order to consider more stringent requirements than what currently exist, a problem needs to be identified. The report did not identify any documented problems with surface water quality related to CCB placement at SMCRA mines.

- c. *Where violations of permit requirements or exceedences of performance standards occur, authority for appropriate penalties or corrective actions must be available to mitigate the damage and prevent future violations.*

SMCRA has authority to assess penalties and require corrective actions for any exceedences of performance standards or other violations of SMCRA based regulations.

SMCRA requires regular inspections and monitoring of the permit. Corrective actions may be required through notices of violation, cessation order, or required permit revision. The permittee is required to immediately notify the RA and take corrective actions as soon as a water quality non-compliance is determined. The permittee must take whatever steps are necessary to ensure that the public health and environment are protected based on compliance with applicable performance standards, permit terms and conditions.

SMCRA References: 30 CFR (2005)

Part 840 – State Regulatory Authority: Inspection and Enforcement

Part 842 – Federal Inspections and Monitoring

Part 843 – Federal Enforcement

Part 845 – Civil Penalties

Part 846 – Individual Civil Penalties

9. CCR Use in Abandoned Mine Lands and Re-mining Sites

- a. *In order to assure adequate protection of ecological and human health, the committee recommends that placement of CCRs in abandoned and re-mining sites be subject to the same CCR characterization, site characterization, and management planning standards recommended for active coal mines.*

Placement of CCBs at SMCRA abandoned mine lands is a low-volume low-risk activity where it is used to encapsulate or mitigate the effects of acid forming materials or acid mine drainage, backfill abandoned pits and eliminate highwalls, or in some cases as an agricultural amendment to encourage vegetative growth on low quality spoil materials. These sites are already environmentally degraded. In this context, it is always appropriate to physically and chemically characterize the CCBs to be used to determine if they have the appropriate characteristics for AML site mitigation. Requiring that this placement be subject to the same permitting and performance standards of active SMCRA mines, however, would result in the elimination of these materials as a low cost option. Because AML projects are done by State regulatory authorities using Federal funds, they are subject to the provisions of NEPA. As such, OSM should consider issuing guidance to the States regarding the evaluation of CCB placement risk assessment at AML sites as part of the NEPA review.

10. Research

- a. *The committee recommends that research be conducted to provide more information on the potential ecological and human health effects of placing CCRs in coal mines.*
- (1) *Environmental behavior of CCRs placed at coal mines for protracted time scales over a range of climates, hydrogeologic settings, CCR types, and mining and reclamation techniques.*
 - (2) *Fate and transport of contaminants from CCRs placed at coal mines and the potential for exposure by humans and biological communities for protracted time scales.*
 - (3) *Improvement and field validation of leaching tests to better predict the mobilization of constituents from CCRs in the mine settings for comparison with post reclamation water monitoring results.*

The author is in agreement with and has been an advocate of the NAS recommended research priorities for the last 15 years.

11. Public Participation

- a. *Government agencies responsible for regulating CCRs should ensure that the public receives adequate advance notice of any proposals to dispose of CCRs in mine sites.*

Public Notification: The SMCRA permit applicant must publish a local newspaper notice [with minimum info listed at 30 CFR 773.13(a)(1)] of availability of the application at

the country courthouse and the RA. The RA must notify Federal, State, and local agencies of the application. The RA must notify any persons submitting comment, parties involved in informal conferences, and appropriate agencies of permit issuance or renewal.

Public Access: Access to all permitting files, including **inspections and monitoring reports**, by the public must be made available by the RA.

Public Comments: The public may submit comments or written objections to the RA within 30 days of last newspaper notice. Any person with interest may request an informal conference with the RA.

Enforcement: The RA must provide for public participation in enforcement. The public may also request a Federal inspection.

SMCRA References: 30 CFR (2005)

Part 773.6 – Public Participation in Permit Processing

Part 773.6(a)(1) – Public Advertisement Of Permits

Part 773.6, 773.9, 774.15 – Notification Requirements

Parts 773.6, 840.14, 842.16 – Availability of Records

Part 773.6(d) – Public Availability of Permit Applications

Parts 840.15, 840.16, 842.11 – Public Participation in Enforcement

Part 842.12 – Requests for Federal Inspections

Part 842.14 – Review of Adequacy and Completeness of Inspections

For AML projects, the NEPA process is open to public participation

- b. *The committee recommends that any proposal to dispose of substantial quantities of CCRs in coal mines be treated as a “significant alteration of the reclamation plan” under SMCRA.*

Currently there is no requirement in SMCRA that specifically requires CCB placement activities to be designated as significant permit revisions requiring full permit application requirements as stated in 30 CFR 774.13(b)(2). SMCRA leaves it up to each State to determine what constitutes a significant permit revision requiring full public review. Current CCB rulemaking efforts by OSM will need to address this concern.

12. Alternatives for Regulatory Authority

- a. *Neither SMCRA nor its implementing regulations currently address the use or placement of CCRs in an explicit manner. As a consequence, States vary in their approach and in the rigor with which they address CCR use in mines.*
- c. *Some States have expressed concern that they do not have the authority to impose performance standards specific to CCRs. Therefore, the committee recommends that enforceable federal standards be established for the disposal of CCRs in minefills.*

- d. *The committee believes that OSM and its SMCRA State partners should take the lead in developing new national standards for CCR use in mines because the framework is in place to deal with mine related issues.*
- f. *In all cases, guidance documents will also be necessary to help States implement their responsibility for managing CCR.*

Neither SMCRA nor the OSM regulations, specifically address the use or disposal of the by-products of electric power generation at surface coal mines. When the use or disposal of CCBs happens at surface coal mines, coal mining regulators are involved to the extent that SMCRA requires:

- 4. the mine operator to ensure that all toxic materials are treated, buried, and compacted, or otherwise disposed of, in a manner designed to prevent contamination of the ground or surface water;
- 5. making sure the proposed land use does not present any actual or probable threat of water pollution; and
- 6. ensuring the permit application contains a detailed description of the measures to be taken during mining and reclamation to assure the protection of the quality and quantity of surface and ground water systems, both on and off-sites, from adverse effects of the mining and reclamation process also to assure that rights of present users of such water are protected (Henry, 1996).

See comment at 4.a. above.

- b. *The committee concludes that although SMCRA does not specifically regulate CCR placement at mine sites, its scope is broad enough to encompass such regulation during reclamation activities.*

Agree.

- e. *Regardless of the regulatory mechanism selected, coordination between OSM and EPA efforts is needed and would foster regulatory consistency with EPA's intended rulemaking proposals for CCR disposal in landfills and impoundments.*

OSM and EPA solid waste have agreed to work cooperatively to address the concern for uniformity among the States to maintain minimum environmental protection standards for placement of CCBs at SMCRA mines. The Office of Surface Mining has committed to writing specific Federal rules that would address the minimum permitting, environmental performance requirements, and bonding of CCB placement at SMCRA mines.

Information Missing from the Report

Information on the adequacy of water quality monitoring, CCB material characterization, site characterization, evaluation of risk, and environmental performance standards must be determined by the regulatory program in force at the time of mine placement. The report provides no discussion of: (1) the variety of regulatory environments under which CCB placement occurred; (2) the relative adequacy of technical data collected under that environment; and (3) how each of the NAS findings and recommendations would relate to these different environments. This information is of vital importance in understanding CCB mine placement

due to the extremes in regulatory environments that are involved. At one end of the regulatory spectrum is the totally unregulated waste disposal sites where fly ash and other materials have been historically placed in mine pits without any record of the volumes, characteristics, or types of wastes involved. At the other end of the spectrum is the comprehensive environmental permitting process under SMCRA at an active coal mine. In between these extremes are: (1) RCRA permitting of a mine final pit as a solid waste landfill after the area has been released from SMCRA as an industrial solid waste landfill; (2) the National Environmental Protection Act (NEPA) process at a SMCRA (Title IV) abandoned mine project; (3) a non-SMCRA State permitted CCB fill of an abandoned mine; and (4) impoundments and landfills permitted by electric utilities on non-mined lands under RCRA or the Clean Water Act. By not addressing the specific regulatory context where CCB placement occurred so that it could be correlated to monitoring data, research data, and potential resultant environmental harm or benefit, the NAS report has not established specific guidance as to the regulatory adequacy of each of these regulatory programs to be addressed by the appropriate State or Federal regulatory authorities.

Conclusion

The report lists 40 findings or recommendations under 12 categories. This paper addresses the merits of these findings on a case by case basis against existing regulatory requirements, the applicability of data evaluated, and consideration of extensive data and scientific studies relevant to the subject. The NAS has chosen to use the term “Coal Combustion Residues” where OSM has historically used the term “Coal Combustion By-Products.” The terms are interchangeable. The author is in agreement with the NAS findings that support: (1) the use of these materials in mine reclamation; (2) the need for specific Federal regulations under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) that spells out the minimum permitting, bonding, and environmental performance standard requirements when they are placed on active coal mines; (3) the research priorities to specifically address the hydrogeologic fate of CCBs and any leachate generated by those CCBs in relation to public health and environmental quality; and (4) to develop mining appropriate leachate tests. A limitation of the report is its inability to: (1) acknowledge the significant differences between regulatory programs that control placement of CCBs at mines; (2) evaluate available ground water monitoring data and scientific research within the context of the applicable regulatory programs; and (3) acknowledge the volumes of scientific studies and State regulatory data that shows no degradation of water quality due to placement of CCBs at SMCRA mines for the last 29 years.

References

- Title 30 Code of Federal Regulations Chapter VII Office of Surface Mining Reclamation and Enforcement. July 1, 2005. U.S. Government Printing Office, Washington, D.C. 731 pages.
- Chugh, Y.P., B.M. Sangunett, and K.C. Vories (eds.). 1996. **Proceedings of Coal Combustion By-Products Associated with Coal Mining Interactive Forum**. Southern Illinois University at Carbondale. 304 p.
- Henry, K.L. 1996. IN Chugh, Y.P., B.M. Sangunett, and K.C. Vories (eds.). 1996. Proceedings of Coal Combustion By-Products Associated with Coal Mining - Interactive Forum. Southern Illinois University at Carbondale. pp. 37-39.

- National Research Council. 2006. *Managing Coal Combustion Residues in Mines*. The National Academies Press. Washington, DC. 228 p.
- Vories, K.C. 2002. **Coal Mining and Reclamation with Coal Combustion By-Products: An Overview**. IN Proceedings of the Coal Combustion By-Products and Western Coal Mines: A Technical Interactive Forum. April 16-18, 2002, Golden Colorado. USDOJ Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale, Illinois. 15 p.
- Vories, K.C. and A. Harrington (eds.). 2005. **Proceedings of Regulation, Risk, and Reclamation with Coal Combustion by-Products at Mines: A Technical Interactive Forum**. April 13-14, 2005. Lexington, KY. USDOJ Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale Illinois. 240 p.
- Vories, K.C. and A. Harrington. (eds.). 2004. **Proceedings of State Regulation of Coal Combustion By-Product Placement at Mine Sites: A Technical Interactive Forum**. May 4-6, 2004. Harrisburg, PA. USDOJ Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale Illinois. 222 p.
- Vories, K.C. and D. Throgmorton. 2002. (eds.). **Proceedings of the Coal Combustion By-Products and Western Coal Mines: A Technical Interactive Forum**. April 16-18, 2002, Golden, Colorado. USDOJ Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale, Illinois. 341 p.
- Vories, K.C. and D. Throgmorton. 2000. (eds.). **Proceedings of The Use and Disposal of Coal Combustion By-Products at Coal Mines: A Technical Interactive Forum**. Held at Morgantown, WV. Southern Illinois University at Carbondale. 271p.