BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	**)**	
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	)	
STANDARDS FOR THE DISPOSAL OF	**)**	**R20-19**
COAL COMBUSTION RESIDUALS	**)**	**(Rulemaking – Land)**
IN SURFACE IMPOUNDMENTS:	**)**	
PROPOSED NEW 35 ILL. ADM. CODE 845	**)**	

NOTICE OF FILING

To: ALL PARTIES ON THE ATTACHED SERVICE LIST

PLEASE TAKE NOTICE that I have today electronically filed with the Office of the Clerk of the Illinois Pollution Control Board the attached **Prefiled Responses of Dr. Lisa Bradley**, copies of which are herewith served upon you.

/s/ Ryan C. Granholm
Ryan C. Granholm

Dated: September 24, 2020

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NOW COME Dynegy Midwest Generation, LLC, Electric Energy, Inc., Illinois Power Generating Company, Illinois Power Resources Generating, LLC, and Kincaid Generation, LLC, (collectively, "Dynegy"), by their attorneys, Schiff Hardin LLP, pursuant to the Hearing Officer's July 14, 2020 Order and submit the below responses.

Prefiled Responses of Dr. Lisa Bradley

Illinois Pollution Control Board:

20. On page 27, you state, "it is my opinion that to ensure that corrective action is initiated based on sound statistical interpretation of both upgradient and downgradient groundwater monitoring results, the text in Section 845.650 (d) should be revised to be consistent with the federal CCR Rule and refer to a "statistically significant increase above the groundwater protection standard." Please comment on whether triggering of corrective action based on a statistically significant increase above a groundwater protection standard rather than a single exceedence would be consistent with the corrective action protocols under 35 Ill. Adm. Code 620 groundwater quality standards.

RESPONSE: The trigger for corrective action protocols under 35 Ill. Adm. Code 620 appears to arise if there is a release of a contaminant. It is my understanding that for CCR surface impoundments, the point of compliance under Part 620 is 25 feet from the waste boundary. [IEPA Response to Prefiled Questions, Board Q. 48, p. 167-68 (Aug. 3, 2020)] In contrast, under proposed Part 845, the point of compliance is at the waste boundary. Since

the two programs have different points of compliance, it would be appropriate for them to have different corrective action triggers. As discussed on pages 25 to 28 of my testimony, because the point of compliance is at the waste boundary, corrective action under Part 845 should arise only when there is a statistically significant increase above the groundwater protection standard. Furthermore, I believe a more appropriate comparison is the Board's regulations governing landfills. See e.g., 35 Ill. Adm. Code 811.318(b)(5) ("An observed statistically significant increase above the applicable groundwater quality standards of Section 811.320 in a well located at or beyond the compliance boundary shall constitute a violation."). See also 35 Ill. Adm. Code 811.320(a)(2) and 35 Ill. Adm. Code 812.317.

21. On pages 32-33, you recommend units that receive only de minimis amounts of CCR do not present a risk warranting regulation. Please clarify whether CCR accumulated in these units receiving de minimis amounts is removed periodically. If not, comment whether accumulation of CCR in such units over a long period of time poses a threat of groundwater contamination.

RESPONSE: USEPA does not provide a quantitative definition of "de minimis" in the federal CCR Rule, but it does describe the types or features of at least some of the ponds that are excluded from its rule as de minimis ponds. USEPA's discussion of "de minimis" ponds and amounts of CCR is referenced on page 32 of my testimony:

> **"EPA reviewed the risk assessment and the damage cases to determine the characteristics of the surface impoundments that are the source of the risks the rule seeks to address. Specifically, these are units that contain a large amount of CCR managed with water, under a hydraulic head that promotes the rapid leaching of contaminants…" and "that units containing only truly ''de minimis'' levels of CCR are unlikely to present the significant risks this rule is intended to address." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357.]**

As noted in my testimony, USEPA then identified examples of ponds that would be excluded as de minimis ponds, such as "cooling" water and "process" water ponds. Finally, USEPA implemented its de minimis exclusion in the rule language, noting in the next paragraph of the preamble to the federal CCR Rule:

> **"EPA has therefore revised the definition to provide that a CCR surface impoundment as defined in this rule must meet three criteria: (1) The unit is a natural topographic depression, manmade excavation or diked area; (2) the unit is designed to hold an accumulation of CCR and liquid; and (3) the unit treats, stores or disposes of CCR." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357.]**

Note that the management of units that do not meet this definition of a "CCR surface impoundment" is beyond the scope of my testimony, and I have not assessed whether there is periodic removal of CCR from such units.

The results of USEPA's CCR Risk Assessment, however, suggest an answer to the question of "whether accumulation of CCR in such [de minimis] units over a long period of time poses a threat of groundwater contamination." USEPA concluded:

> **"that units *containing* only truly ''de minimis'' levels of CCR are unlikely to present the significant risks this rule is intended to address." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357 (emphasis added).]**

All of the impoundments included in USEPA's CCR Risk Assessment are disposal units containing an accumulation of CCR for disposal or storage – the risks identified by US EPA were not associated the amount of CCR being placed in the unit, but with the amount of CCR contained in the unit.

Risks to groundwater (as drinking water) were identified by USEPA at the upper-bound/90th percentile level of the distribution of risk results, but not at the average or 50th percentile level. The risk assessment evaluated many factors associated with these disposal units – but the case of the "average" pond (one that contained an accumulation of CCR) on the continuum of factors did not pose a risk to human health (or an ecological risk) above the USEPA risk targets. Because by definition units that may contain de minimis amounts of CCR are managing amounts of CCR far less than an average disposal unit, these de

minimis units would not be expected to pose a risk to human health or the environment, now or over time.

<u>Illinois Environmental Protection Agency</u>:

Based on my review of Illinois EPA's written questions, there may be a misunderstanding about the purpose or scope of my testimony. I want to make it clear that I am not testifying as to or questioning the requirements or the applicability of OSHA in the workplace. In fact, my opinion #6 states: "OSHA regulations are applicable to work conducted under the proposed Part 845 and are effective for worker and community protection." The constituents identified in Illinois EPA's questions addressed below can be present in coal ash, and per OSHA, the presence of OSHA regulated substances triggers certain OSHA requirements; my report is not intended to dispute or undermine this.

The purpose of Section 2.4 of my testimony is to provide context for understanding the potential toxicity of coal ash. In particular, community groups are concerned about the presence of constituents in coal ash that are classified as carcinogens by the USEPA, and such groups have asked for regulatory requirements that go beyond those proposed by IEPA.

As Section 2.4 of my testimony summarizes, testing of coal ash as a whole material (not component by component) has been conducted in the EU under the REACH program – a program that requires such testing to allow a material to be used in commerce. The REACH results presented in my testimony were not developed by me, but rather are those published in accordance with the REACH program. The testing was robust and followed

specific EU guidelines. REACH is not a program to regulate materials in a work place, it is a program to evaluate materials put into commerce in the EU.

The results of "No Hazard" for all of the REACH testing demonstrates that although coal ash contains some components that are classified as carcinogens by the USEPA and components that can cause other health effects at high enough exposure levels, these components are not present in coal ash at levels in the whole material that can cause toxicity under REACH test conditions designed to identify toxicity after ingestion, inhalation, and dermal routes of exposure.

In my testimony I am reporting what USEPA and REACH have done to assess risk—those are not my risk assessments or my toxicological assessments. I am not offering this opinion to say that Illinois should not regulate surface impoundments, or that OSHA is not applicable at these facilities. This information is offered to demonstrate that the federal CCR Rule is sufficiently protective and appropriate for use by Illinois.

1. In Table 2-1, you equate coal with ashes or coal ash residue.

   a. How are these the same when one is the parent material and the other is the portions of the parent material that cannot be incinerated?

<u>RESPONSE:</u> Tables 2-1 and 2-2 on pages 9-10 of my testimony present the summarized results of testing conducted under the EU's REACH program (more detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal." This term refers to the ashes or residues of coal, not both ashes and coal. In this nomenclature, the word "coal" specifies the source of the "ashes (residues)." It would be similar if we were to use the term "combustion residuals, coal." Thus, the results in these tables are from studies conducted on coal ash, as a whole material, and not on coal.

b. Aren't the chemical compositions and portions of silica verses the entire mass hugely different?

RESPONSE: I'm sorry that I don't understand this question. I can say that the concentrations of individual constituents in coal ash are generally 10-fold higher than in the parent coal; this is because the majority of coal is made up of carbon-based compounds that are burned off in the combustion process, leaving the incombustible inorganic constituents we refer to as coal ash. Because silica is one component of coal, its mass in coal ash will be similarly concentrated.

2. In Table 2-1, you state that no part of the ash residuals are carcinogenic. The Illinois EPA notes the individual constituents to be evaluated include arsenic, beryllium, cadmium, chromium, cobalt, and lead. These constituents are listed as either known or reasonably anticipated to be carcinogens by the United States Department of Health and Human Services National Toxicology Program (NTP). In addition, radium 226 and 288 are listed by the International Agency for Research on Cancer (IARC) as carcinogenic to humans. Further, silica, a common component of coal ash residue, is listed as a known carcinogen for inhalation exposure in both publications, NTP in 2000 and IARC in 2012. Did Dynegy consider carcinogenicity of the individual constituents when developing the conclusion of "No Hazard" for coal ash residue?

RESPONSE: I do not state in Table 2-1 that no part of the coal ash residuals are carcinogenic. Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal" as a whole for assessing risks associated with coal ash , for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts. In addition, these are not my results or my conclusions. Instead, they are those provided in the REACH dossier for "Ashes (Residues), Coal."

The purpose of the REACH program is to test materials that are considered for commerce in the EU. There are four hazard categories in the REACH program each based on the amount of a material that elicits a toxic response in the testing protocol. Above a

certain exposure level, defined for each type of test – ingestion, inhalation, etc., if toxicity has not been demonstrated then the material is not classified for a hazard category and is, therefore, considered not to pose a hazard.

Each of the studies summarized in Tables 2-1 and 2-2 of my testimony were conducted on coal ash, as a whole material, not by constituent or component. The conclusion from all of the tests, "no hazard," are significant because constituents classified by USEPA as carcinogens are present in coal ash. I agree with this conclusion based on the studies and analysis provided in the REACH dossier.

I want to clarify that Table 2-1 does not say that "no part of the ash residuals are carcinogenic." What the results in Table 2-1 indicate are that under the test conditions specified by EU protocols to identify if a material poses a toxic hazard in commerce, coal ash as a whole material does not pose a toxic hazard under these test conditions, even though some of its constituents are classified as carcinogens.

3. Silica is listed as a cause of lung cancer among a number of other health issues 29 CFR 1910.1053. When creating Table 2-1 did you account for 29 CFR 1910 in its entirety as it pertains to the individual heavy metals and silica composition that is known to exist in coal ash?

RESPONSE: I am not testifying about the requirements or applicability of OSHA, and Table 2-1 does not address OSHA requirements. Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal." The REACH assessment evaluated the risks associated with coal ash as a whole, for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts. In addition, these are not my results or my conclusions. Instead, they are those provided in the REACH dossier for "Ashes (Residues), Coal."

The REACH results do not address the individual constituents or components within the chemical composition of coal ash, they address the material as a whole. Table 2-1 should not be interpreted as saying that respirable silica or any specific metals cannot cause cancer or other health effects, nor should the results be interpreted to evaluate the presence of silica or the appropriateness of 29 CFR1910. Table 2-1 summarizes the results of toxicity studies conducted under REACH on coal ash as a whole material, and under the conditions of the REACH inhalation toxicity studies, both acute and chronic, no hazard was identified. Please refer to the more detailed tables in Exhibit B of my testimony for additional context.

4. In Table 2-1, you state that there is no repeated dose ingestion or inhalation toxicity.

a. The Illinois EPA notes the U.S. EPA has provided ingestion toxicity data for most of the individual constituents, inhalation toxicity data for the following individual constituents: antimony, barium, beryllium, boron, cadmium, chromium, cobalt, fluoride, lead, mercury and selenium. In addition, inhalation toxicity data is available for silica. Where individual constituents considered when the developing the conclusion of "No Hazard" for coal ash residue?

RESPONSE: Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal" as a whole for assessing risks associated with coal ash for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts. In addition, these are not my results or my conclusions. Instead, they are those provided in the REACH dossier for "Ashes (Residues), Coal."

Generally speaking, and based on my experience, coal ash contains a variety of inorganic constituents. While there are toxicity data for the individual components of coal ash, including those listed in the question, it does not mean that coal ash is toxic under all exposure conditions. USEPA, as well as other organizations such as WHO and IARC,

provide toxicity testing data on a wide variety of single constituents. These data help us to understand if a constituent present in a product or environmental situation could pose a health risk. However, there are several points to consider when translating such single component toxicity data to real world situations.

First, most of the toxicity testing is conducted using a single constituent via a single route of exposure. Real world exposures are complex and involve a mixture of constituents—either in soil or water or air or food. Second, constituents can behave differently in a mixture than alone. This has been a concern for coal ash, with the public wondering if the mixture of these constituents together would be more toxic in coal ash than alone. And finally, as for all constituents, risk is a function of dose (how much one is exposed to, and how one is exposed) and toxicity.

The elegance of the REACH studies is that coal ash has been studied as a whole mixture of all of its component constituents, thus, the results account for potential additivity, synergy, and antagonism amongst the components. And the results indicate that even as a complex mixture of constituents that have a wide range of potential toxicities, at the levels present in the coal ash, coal ash does not pose a hazard under the test conditions for the routes of exposure that have been studied.

b. 29 CFR 1910.1053 requires a respirator for workers that will only receive one dose of silica by inhalation.

RESPONSE: I am not testifying about OSHA or 29 CFR 1910.1053 or its applicability to the workplace. Thus, I have not reviewed this provision.

i. Is Dynegy claiming that silica derived from coal (listed as having a crystalline silica composition) has been chemically altered and is no longer crystalline silica?

RESPONSE: I am not testifying about the presence or nature of silica in coal ash, or about what Dynegy might claim, if anything, about the presence of silica in coal ash.

ii. What measures are taken by Dynegy at their CCR surface impoundments to comply with 29 CFR 1910.1053?

RESPONSE: I am not familiar with nor testifying about Dynegy's compliance with OSHA regulations, nor am I providing testimony about the applicability of any OSHA requirement. The REACH results as discussed above are important in the consideration of risk assessment for coal ash, but the results have no bearing on the identification of the presence of any constituent in coal ash, or requirements or applicability of OSHA regulations in a workplace.

5. In Table 2-1, you state that there is no hazard for worker epidemiology. How does Dynegy ensure that they are compliant with does 29 CFR 1910.1053, 29 CFR 1910.1018, 29 CFR 1910.1024, 29 CFR 1910.1025 and 29 CFR 1910.1027?

RESPONSE: I am not familiar with nor testifying about Dynegy's compliance with OSHA regulations, nor am I providing testimony about the applicability of any OSHA requirement, including those that address the presence of respirable silica, arsenic, beryllium, lead, and/or cadmium in the workplace.

Further, Table 2-1 does not present my conclusions; instead, Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal." The REACH assessment evaluated the risks associate with coal ash as a whole for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts.

The REACH results as discussed above in the response to Question #4(a) are important in the consideration of risk assessment for coal ash, but the results have no bearing on the requirements or applicability of OSHA regulations in a work place.

6. In Table 2-1, you state that there is no hazard for acute ingestion or inhalation toxicity. The Illinois EPA notes that the United States Health and Human Services Agency for Toxic Substances and Disease Registry has evaluated several of the individual constituents of coal ash residue for acute toxicity and developed acute toxicological data for some of the individual constituents.

a. Did Dynegy consider any other source than the 2006 study, especially when Silica has been listed as a carcinogen since 2000 by the National Toxicology Program and added to the federal register for OSHA regulations in 2016 as 29 CFR 1910.1053?

RESPONSE: I am not sure what the "2006 study" is referencing. I am not testifying about the requirements or applicability of OSHA, and Table 2-1 does not address OSHA requirements. Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal." The REACH assessment evaluated the risks associated with coal ash as a whole for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts. In addition, these are not my results or my conclusions. Instead, they are those provided in the REACH dossier for "Ashes (Residues), Coal."

I am not providing testimony about the applicability of any OSHA requirement to the workplace, or what Dynegy may or may not consider in connection with OSHA.

Please see my response to Question #4(a) above with respect to the difference in toxicology between constituents and whole materials.

b. What measures has Dynegy taken to monitor and ensure that silica is not air borne above established PEL (by OSHA)?

RESPONSE: I am not familiar with nor testifying about Dynegy's compliance with OSHA regulations, nor am I providing testimony about the applicability of any OSHA requirement.

7. In Table 2-1, you state that there is no genetic or reproductive hazard for coal ash or ash residue. However, arsenic (29 CFR 1910.1018), lead (29 CFR 1910.1025), and cadmium (29 CFR 1910.1027) are known to OSHA to be hazardous. They are also known teratogens according to the NBCI. Please explain how and why they are not teratogens when ingested or inhaled at a CCR surface impoundment?

RESPONSE: I am not providing testimony about the applicability of any OSHA requirement to the workplace or the genetic toxicity, reproductive toxicity, or the teratogenicity of these constituents when tested alone. Table 2-1 on page 9 of my testimony presents the summarized results of testing conducted under the EU's REACH program (detailed tables are provided in Exhibit B of my testimony) on "Ashes (Residues), Coal." The REACH assessment evaluated the risks associated with coal ash as a whole for the purpose of evaluating the material to put into commerce, not the risks that may be associated with any of its components in other contexts. In addition, these are not my results or my conclusions. Instead, they are those provided in the REACH dossier for "Ashes (Residues), Coal." Please see my response to Question #4(a) above with respect to the difference in toxicology between constituents and whole materials.

8. On page 11 of your testimony, you state that the constituents in CCR are naturally occurring. Does the fact that a constituent occurs naturally mean that it is non-toxic?

RESPONSE: I point out in my testimony that all of the constituents in coal ash are naturally occurring to underscore the fact that just because a constituent is present in one's environment, and one is exposed to that constituent in the environment, it does not necessarily mean that a toxic reaction will result. Risk is a function of both the level/route/frequency of exposure and toxicity.

9. On page 18 of you testify that CCR could become airborne if it is dry. If it is dry and becomes airborne, are you suggesting that even though there is a potential for exceedance of the NAAQS standard cited on page 21386 of the federal register for the Preamble of Part 257, 35 micrograms per meter cubed, is not relevant to CCR surface impoundments?

RESPONSE: The conceptual model components listed on pages 18 and 19 are those developed and published by USEPA in its CCR Risk Assessment. I included these in my testimony to demonstrate the thoroughness of the USEPA CCR Risk Assessment. I am not testifying as to the compliance with or the applicability of the NAAQS standard. See also my response to Question #10(b), below.

10. On page 18 of your testimony, you list the potential human exposures to CCR for risk assessments.

a. Why are site workers for CCR surface impoundments and site workers at the power generation facilities that are associated with some of the CCR Surface Impoundments omitted from the conceptual model for risk assessment to humans?

RESPONSE: The conceptual model components listed on pages 18 and 19 are those developed and published by USEPA in its CCR Risk Assessment. Thus, USEPA made that determination. In general, and in my experience, in risk assessments for operating facilities, on-site workers are assumed to be covered by OSHA regulations.

b. Wouldn't this omission of site workers render the entire "Section 3.1.3 Risk Assessment is Comprehensive and Thorough" incomplete and the antithesis of comprehensive and thorough?

RESPONSE: The conceptual model components listed on pages 18 and 19 are those developed and published by USEPA in its CCR Risk Assessment. After conducting a conservative screening risk assessment for the pathways listed on pages 18 and 19, the USEPA CCR Risk Assessment focused on the groundwater pathway. USEPA's screening risk assessment determined that the other pathways are not of concern.

While a worker receptor was not identified in the USEPA CCR Risk Assessment, one of the pathways evaluated in the conservative screening assessment used to identify pathways

and constituents to include in the full USEPA CCR Risk Assessment was the inhalation pathway. Based on how USEPA structured this pathway evaluation, it does have applicability to on-site workers. In developing the screening step, USEPA states:

> **"Relevant exposure pathways include human inhalation of particulate matter and any COPCs contained therein. The greatest source of these pathways are landfills during operation, as water cover for impoundments and postclosure cap for landfills will limit the release of particulate matter. Therefore, EPA screened these pathways for landfills and the results were also used to identify any COPCs for surface impoundments." [Section 3.2 p3-4, CCR Risk Assessment.] [emphasis added.]**

USEPA first identified the 90th percentile concentrations in in CCR—the "whole waste" concentrations—and identified appropriate emission factors for work at a CCR landfill including wind erosion, vehicular activity, loading/unloading, and spreading/compaction activities, for both uncontrolled operations and controlled operations (where dust suppression is employed). The emission factors were then summed (essentially assuming that all of these activities occur at the same time). [Section 3.2 p3-5, CCR Risk Assessment.] An air dispersion model was used to estimate particulate air concentrations at specific distances from the CCR landfill. USEPA notes:

> **"The specific distances (25 m, 50 m, 75 m, 150 m, 300 m, 500 m, 1,000 m, and 2,000 m) were selected to ensure complete coverage in the air estimates, particularly near the source of the emissions." [Appendix F, pF-3, CCR Risk Assessment]**

Thus, the inhalation evaluation can apply both to workers and to off-site receptors, depending on the configuration of a facility. USEPA concluded for this landfill air pathway assessment:

> **"EPA calculated ambient air concentrations that result from windblown dust from landfills under uncontrolled and controlled management scenarios. Risks were estimated for based on short-term (i.e., acute) and long-term (i.e., chronic) exposures. Under the uncontrolled management scenario, concentrations of arsenic were found to pose acute risks and PM2.5 was found to exceed the 24-hour NAAQS. However, all risks fell below selected criteria under the controlled management scenario. Based on these results, EPA did not retain exposures to ambient air for**

further analysis. Even with the conservative assumptions used here, risks fell below selected criteria when dust controls were considered. Thus, these screening results are sufficient to characterize high-end risks for this pathway, and the controls required by the rule are considered protective." [Section 3.5.1, p3-24, CCR Risk Assessment]

Based on this, I maintain that USEPA's risk assessment is comprehensive and thorough.

11. In Table 3-4, human health is evaluated only as an ingestion of the listed constituents. Why is inhalation omitted from the Table?

RESPONSE: Table 3-4 summarizes the constituents retained by USEPA for quantitative evaluation in the CCR Risk Assessment after initial screening. The risk assessment focused on the leaching to groundwater pathway for CCR surface impoundments and landfills, after all other potential exposure pathways, including inhalation, were eliminated from quantitative analysis through a detailed and conservative screening process. Inhalation is not a route of exposure associated with a groundwater pathway for CCR units.

12. Section 3.1.4 is named "Risk Assessment was Conservative". The Illinois EPA notes the 2014 Risk Assessment conducted for CCR used a 1 in 100,000 (1.0E-05) target cancer risk. The Illinois EPA requires risks to be evaluated at a more conservative 1 in 1,000,000 (1.0E-06) target cancer risk.

a. Was Illinois EPA's target cancer risk of 1.0E-06 taken into consideration when stating the risk assessment was conservative?

RESPONSE: The USEPA CCR Risk Assessment was conservative in its breadth of evaluation, use of a wide range of input data for the various parameters included in the risk assessment, and the fact that single point estimates were used for toxicity values. The purpose of a risk assessment is to over-estimate rather than under-estimate risk, and in that context, the risk assessment is conservative.

As I note in my testimony on page 15,

"For national risk assessments conducted under RCRA, USEPA uses a "point of departure" for decision making of a target for noncancer and ecological risk of one (1), and a target excess cancer risk of one in one hundred thousand (1 in 100,000 or $1x10^{-5}$). To understand the USEPA target risk in context, it is important to

recognize that the background cancer risk in the U.S. is generally between one in two (0.5 or $5x10^{-1}$) to one in three (0.33 or $3.3x10^{-1}$) for men and women based on statistics published annually by the American Cancer Society (ACS, 2020). Thus, the RCRA point of departure for risk for regulatory rulemaking of $1x10^{-5}$ is 4 orders of magnitude lower than the background cancer rates in the U.S."

This is one of the bases for my conclusion.

b. Were mixtures of similar-acting chemicals evaluated?

RESPONSE: The USEPA CCR Risk Assessment followed agency guidance and calculated potential risks and hazards per chemical. However, the REACH studies summarized in Table 2-1 and 2-2 of my testimony evaluate coal ash as a whole material, i.e., a mixture of many chemicals, with a conclusion of No Hazard for all of the routes of exposure evaluated.

c. If airborne contaminants and inhalation hazards are omitted from the risk assessment, how is the Risk Assessment "conservative"?

RESPONSE: The USEPA CCR Risk Assessment focused on the leaching to groundwater pathway for CCR surface impoundments and landfills, after all other potential exposure pathways, including inhalation, were eliminated from quantitative analysis through a detailed and conservative screening process. See my response to Question #10(b) above for more detail. Inhalation is not a route of exposure associated with a groundwater pathway for CCR units.

13. In Section 3.2.2, you state several times that the CCR surface impoundments are a part of RCRA. How is federal regulation for worker safety (29 CFR 1910.120 and 29 CFR 1926.65) and airborne hazards (29 CFR 1910 Subpart Z) with respect to RCRA omitted from your risk assessment and toxicology assessments?

RESPONSE: This is not my risk assessment or my toxicological assessment – I am reporting what USEPA and REACH have done to assess risk. I am not offering this opinion to say that Illinois should not regulate CCR surface impoundments, or that OSHA is not

applicable at these facilities. My testimony is offered to demonstrate that the federal CCR Rule is sufficiently protective and appropriate for use by Illinois.

14. Page 16 of your testimony notes the use of a probabilistic risk assessment, when Illinois EPA uses a single point approach when conducting risk assessments. How would using the single point approach affect the risk assessment?

RESPONSE: The USEPA CCR Risk Assessment was conducted as a national assessment to evaluate surface impoundments and landfills at utilities across the U.S., and as such, it was necessary to conduct it as a probabilistic risk assessment to capture the full breadth and variability in the data inputs. A single point estimate approach could only be conducted for a single impoundment and would not be appropriate for the national rule-making purposes. Thus, I cannot offer an opinion on how the results would differ between a point estimate and probabilistic risk assessment.

15. Using the probabilistic risk assessment, Table 3-1 indicates an exceedance of Illinois EPA 1.0E-06 target cancer risk for 1 chemical. Where other carcinogens risks calculated at levels between 1.0E-05 and 1.0E-06?

RESPONSE: Based on USEPA's results, and the sensitivity and uncertainty analysis presented in Section 5 of the CCR Risk Assessment, Arsenic III and Arsenic V are the only carcinogens with results within that risk range.

16. Table 3-1 indicates the target hazard quotient of 1 is exceeded with 3 chemicals of coal ash. How does this information coordinate with earlier statements that coal ash is not hazardous to human health?

RESPONSE: The USEPA CCR Risk Assessment focused on the leaching to groundwater pathway. The direct contact pathways with CCR, including ingestion and inhalation, were eliminated in USEPA's screening process. The REACH data address the lack of toxicity for those direct contact pathways.

17. Your testimony states that the human health risk assessment evaluated inhalation exposure. However, the testimony does not discuss the risks associated with air-borne constituents. Why does the testimony not discuss the risks associated with inhalation exposure?

RESPONSE: **The USEPA CCR Risk Assessment focused on the leaching to groundwater pathway. The direct contact pathways with CCR, including ingestion and inhalation, were eliminated in USEPA's screening process. After conducting a conservative screening risk assessment for the pathways listed on pages 18 and 19, the USEPA CCR Risk Assessment focused on the groundwater pathway. USEPA's screening risk assessment determined that the other pathways are not of concern. The response to Question #10(b), above, provides more detail about USEPA's screening risk assessment for the inhalation pathway. The REACH data address the lack of toxicity for those direct contact pathways, including inhalation.**

18. Was chromium evaluated as a mutagen in the risk assessment? Where mutagenic age-adjustment factors used when determining a risk for chromium?

RESPONSE: **The USEPA did not retain chromium as a constituent of potential concern for human health in the CCR Risk Assessment for human health pathways; see Table 3-4 on page 21 of my testimony. USEPA did not provide information in the CCR Risk Assessment as to whether mutagenic age-adjustment factors were used in the screening risk assessment.**

19. How do Opinions 4 and 5 ensure compliance with 12(a) and 12(d) of the Illinois Environmental Protection Act? Further, how does an "imminent threat" correlate with effects from chronic exposure?

RESPONSE: **I am not offering an opinion regarding the scope or application of Sections 12(a) and 12(d) of the Illinois Environmental Protection Act to Illinois EPA's proposed Part 845. As noted in Section 5.1 of my testimony on page 29, Category 1 in the prioritization tiers addresses "imminent threats" via impacts to an existing water supply or to the setback of an existing water supply. That threat would exist whether the potential adverse effects are due to acute or chronic duration exposures.**

20. On Page 25 of your testimony, you cite Part 257.96(g), which appears to be a typographical error.

a. Was the correct citation Part 257.95(g)?

RESPONSE: Yes.

b. When Part 257.95(g) was initially adopted was there a numerical GWPS for all of the Appendix IV constituents, or only those that had a corresponding MCL?

RESPONSE: When Part 257.95(g) was initially adopted numerical GWPS were published only for those Appendix IV constituents that had a corresponding MCL.

c. Did USEPA subsequently adopt numerical values for all of the Appendix IV constituents?

RESPONSE: Yes. As noted in Section 2.3.3.2 on page 7 of my testimony, the Final Rule identified as Amendments to the National Minimum Criteria, Phase One, Part One, adopted risk-based screening levels for cobalt, lead, lithium, and molybdenum as GWPS, and at that time US EPA did not alter the mechanism for triggering groundwater corrective action – a statistically significant level above a groundwater protection standard.

d. Does Part 257.95(h) list the numerical GWPS that USEPA adopted and cite to the MCL for constituents with an MCL?

RESPONSE: Yes.

e. If the calculated background concentration for a constituent is lower than MCL or the numerical value listed in Part 257.95(h), isn't that a statistically significant level?

RESPONSE: No. The GWPS is defined as the higher of the MCL and the background level [40 CFR 257.95(h)] 40 CFR Part 257(g) states that "(g) If one or more constituents in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the

constituents in appendix IV to this part that have exceeded the groundwater protection standard." [Emphasis added.]

21. On Page 31 of your testimony, you discuss CCR surface impoundments that capped or otherwise maintained.

a. Isn't the citation to the Federal Register in your foot note (CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21342) from the preamble of the original October 2015 CCR rule?

RESPONSE: Yes, and I am not aware of any subsequent regulatory action changing that applicability characterization.

b. Didn't USEPA vacate Part 257.100(b), and require all inactive CCR surface impoundments to meet all of the Part 257 requirements?

RESPONSE: I am not aware of USEPA vacating Part 257.100(b). It is my understanding that USEPA amended 257 deleting and "reserving" Part 257.100(b). It is also my understanding that USEPA's determination that units that were capped or otherwise maintained prior to the effective date of the CCR Rule do not meet the definition of a "CCR surface impoundment" did not change after USEPA amended Part 257.100(b).

c. Wasn't the cited Federal Register text written before the USWAG decision which found that inactive ponds at inactive facilities should also be regulated by Part 257?

RESPONSE: Yes, but that issue differs from USEPA's position on previously capped or otherwise maintained units.

22. On Page 32 of your testimony, you discuss the inclusion of CCR surface impoundments that contain de-minimis quantities of CCR.

a. Does Part 257 define de-minimis?

RESPONSE: USEPA does not provide a quantitative definition of "de minimis" in the federal CCR Rule, but it does describe the types or features of at least some of the ponds that are excluded from its rule as de minimis ponds. USEPA's discussion of "de minimis" ponds and amounts of CCR is referenced on page 32 of my testimony:

> **"EPA reviewed the risk assessment and the damage cases to determine the characteristics of the surface impoundments that are the source of the risks the rule seeks to address. Specifically, these are units that contain a large amount of CCR managed with water, under a hydraulic head that promotes the rapid leaching of contaminants…" and "that units containing only truly ''de minimis'' levels of CCR are unlikely to present the significant risks this rule is intended to address." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357.]**

As noted in my testimony, USEPA then identified examples of ponds that would be excluded as de minimis ponds, such as "cooling" water and "process" water ponds. Finally, USEPA implemented its de minimis exclusion in the rule language, noting in the next paragraph of the preamble to the federal CCR Rule:

> **"EPA has therefore revised the definition to provide that a CCR surface impoundment as defined in this rule must meet three criteria: (1) The unit is a natural topographic depression, manmade excavation or diked area; (2) the unit is designed to hold an accumulation of CCR and liquid; and (3) the unit treats, stores or disposes of CCR." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357.]**

USEPA also concluded:

> **"that units *containing* only truly ''de minimis'' levels of CCR are unlikely to present the significant risks this rule is intended to address." [CCR Rule. EPA-HQ-RCRA-2009-0640-11970; p21357 (emphasis added).]**

All of the impoundments included in USEPA's CCR Risk Assessment are disposal units containing an accumulation of CCR for disposal or storage – the risks identified by US EPA were not associated the amount of CCR being placed in the unit, but with the amount of CCR contained in the unit.

Risks to groundwater (as drinking water) were identified by USEPA at the upper-bound/90th percentile level of the distribution of risk results, but not at the average or 50th percentile level. The risk assessment evaluated many factors associated with these disposal units – but the case of the "average" pond (one that contained an accumulation of CCR) on the continuum of factors did not pose a risk to human health (or an ecological risk) above the USEPA risk targets. Because by definition units that may contain de minimis amounts

of CCR are managing amounts of CCR far less than an average disposal unit, these de minimis units would not be expected to pose a risk to human health or the environment, now or over time.

b. Did the preamble to Part 257 provide any guidance as to how to differentiate between a man-made excavation storing CCR and a man-made excavation storing a de-minimis quantity of CCR?

RESPONSE: Yes, including examples of some excluded ponds, such as cooling water, process, and wastewater treatment ponds. [80 Fed. Reg. p21357] Please also see my answer to your Question #22(a) above.

c. Do you have a position on what de-minimis quantity of CCR is?

RESPONSE: Please see my answer to above Questions #22(a) and (b).

d. Does the liquid in a CCR surface impoundment that may contain dissolved constituents from CCR, which then flows to a secondary or tertiary impoundment that may only contain de-minimis quantities of CCR, also exert hydraulic head on the bottom of that impoundments?

RESPONSE: Yes. Please also see my answer to above Questions #22(a) and (b).

City Water, Light & Power:

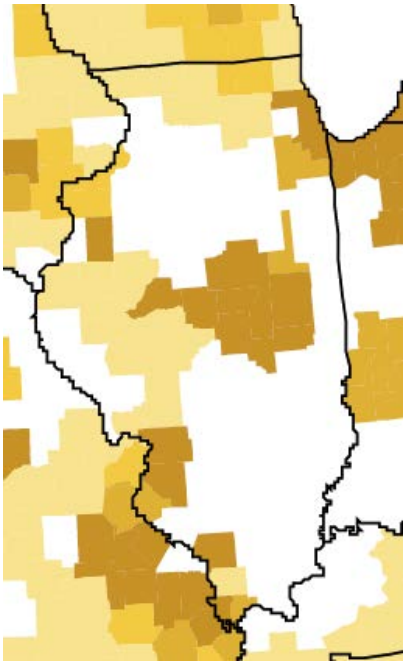
1. In your discussion of toxicity of CCR as a whole and individual metal components, you do not specifically mention boron. What is your opinion of the relative risks and toxicity from boron in coal ash?

RESPONSE: The constituents listed on page 20 of my testimony are those evaluated as trace elements in coal ash by the United States Geological Survey (USGS). The USGS included boron in a 1984 evaluation of background soils in the U.S., but not in any later publications of soil or coal ash, thus, boron is absent from the evaluations I have conducted on later USGS data. Based on the 1984 USGS data, the background concentration of boron in U.S. soils in general is

30 mg/kg. [https://pubs.er.usgs.gov/publication/pp1270] The risk-based screening level published by USEPA for boron in residential soil is 16,000 mg/kg; and for boron in industrial soil the risk-based screening level is 230,000 mg/kg. [https://semspub.epa.gov/work/HQ/200043.pdf] The 10th to 90th percentile range of boron concentrations in coal ash is approximately 100 to 1,000 mg/kg, based on published EPRI data. [https://www.epri.com/research/products/000000000001020556] Thus, based on these data direct contact with boron in coal ash does not pose a risk to human health.

2. On pages 26-27 you testify that "In the middle of the state, where background concentrations of arsenic in groundwater are high, the background variability could result in a single downgradient result that is above the groundwater protection standard {whether based on background or a CCR surface impoundment) in one round of downgradient groundwater sampling but not in another." What geographic region specifically are you referring to when you state "in the middle of the state, where background concentrations of arsenic in groundwater are high"?

RESPONSE: The map on page 27 of my testimony is from the USGS and shows areas of arsenic in groundwater across the U.S. An excerpt from that map that shows Illinois is provided below. Based on a county map of Illinois, the central area of counties with "generally highest arsenic concentrations" are Mason, Logan, McLean, De Witt, Macon, Piatt, Moultrie, Champaign, and Douglas.



ELPC, Prairie Rivers Network, and Sierra Club:

1. Please refer to Section 2.2 of your testimony (pp. 5-6):

a. What is your basis for stating that coal ash fails the 40 CFR 261.24 test for toxicity on p. 5? Please provide citations to your factual support for making this claim.

RESPONSE: I do not say this; I say the opposite, which is that coal ash does not fail the 40 CFR 261.24 test for toxicity. Based on my experience, coal ash does not meet any of the characteristics of hazardous waste as defined in 40 CFR § 261.21-24. This is obviously USEPA's conclusion too, as it finalized the federal CCR Rule under Subtitle D of RCRA, rather than Subtitle C.

b. Are you aware of any other way that wastes can be regulated as hazardous waste under EPA's RCRA regulations than by meeting the hazardous criteria in 40 CFR §§ 261.21-24?

RESPONSE: Yes. The entirety of 40 CFR § 261 addresses "Identification and Listing of Hazardous Waste."

c. Is the TCLP a single-point test pH test? If your answer is "no" please provide a basis for your answer.

RESPONSE: Yes.

d. What pH condition is used in the TCLP?

RESPONSE: The test conditions for TCLP are defined in SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure. [https://www.epa.gov/hw-sw846/sw-846-test-method-1311-toxicity-characteristic-leaching-procedure] The pH for TCLP is 4.93, which is meant to mimic the acidic conditions of a municipal waste landfill. Materials for which TCLP results are greater than the values published in "Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic" of 40 CFR § 261.24(b) are considered not suitable for disposal in a solid waste or municipal waste landfill. TCLP is designed to test the suitability of the disposal of a material in a solid waste or municipal waste landfill.

e. What is the range of pH conditions found in CCR impoundments? Please cite your source(s).

RESPONSE: EPRI reports the range of pH in ash leachate samples as 4.3 – 12, with a median value of 7.9 (n=64). [EPRI. 2006. Characterization of Field Leachates at Coal Combustion Product Management Sites. [https://www.epri.com/research/products/000000000001012578] The pH range for the surface impoundment porewater samples used in the USEPA 2014 CCR Risk Assessment is 2 – 11.87 (n= 34). [Attachment C-2, CCR Risk Assessment]

f. Are you aware of any criticisms of the TCLP by EPA scientists regarding its use for studying leaching from CCR?

RESPONSE: Yes, for example, "Characterization of Mercury-Enriched Coal Combustion Residues from Electric Utilities Using Enhanced Sorbents for Mercury Control," 2006, EPA-600/R-06/008. This report states in footnote 7 on page 12:

"[7] TCLP was not included as part of this study for two reasons. First, EPA previously made a waste status determination under RCRA that coal combustion residues are non-hazardous (65 FR 32214, May 22, 2000). Therefore, use of TCLP was not required as indicated under the RCRA toxicity characteristic regulation for determination of whether or not CCRs were hazardous. Second, TCLP was developed to simulate co-disposal of industrial waste with municipal solid waste as a mismanagement scenario and to reflect conditions specific to this scenario. However, the vast majority of CCRs are not being managed through co-disposal with municipal solid waste, and the test conditions for TCLP are different from the actual management practices for most CCRs."

[https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=147063&subject=Air%20Research&showCriteria=0&searchAll=Air%20and%20Measurement%20and%20Emissions&actType=Product&TIMSType=PUBLISHED+REPORT&sortBy=revisionDate]

g. Has EPA stated that the TCLP may underestimate the actual leach rates of toxic constituents from CCR under different field conditions? If your answer is "no," please provide the basis for your answer.

RESPONSE: Please see the answer to Question #1(f) above.

h. Have EPA scientists stated that single-point pH tests like the TCLP do not reflect the range of actual conditions under which wastes are plausibly managed, such as changing environmental conditions, especially pH? If your answer is "no," please provide the basis for your answer.

RESPONSE: Please see the answer to Question #1(f) above.

i. Are you familiar with the Leaching Environmental Assessment Framework (LEAF) test, which is an alternative testing method to the TCLP?

RESPONSE: Yes.

j. If yes, does the LEAF test evaluate leaching under a wider range of environmental conditions? If your answer is "no," please provide the basis for your answer.

RESPONSE: Essentially yes, however, the test evaluates leaching under a wider range of *laboratory* conditions.

k. EPA has encouraged the use of the LEAF test for evaluating the potential for adverse impacts to human health or the environment that may result from uses of materials such as coal ash, correct? If your answer is "no," please provide the basis for your answer.

RESPONSE: **LEAF measures the constituents that can release from materials under certain conditions; USEPA has encouraged its use, but its use is not required under any federal regulation.**

l. Please refer to the bullet pointed list in Section 2.4, p. 8 of your testimony. For each bullet point, please identify which exposure pathways those statements refer to.

RESPONSE: **Each of my statements in the referenced section are quoted below followed by the relevant exposure pathways.**

"When evaluating the material as a whole, there is a wealth of information on the toxicity testing of CCR in mammalian and aquatic species that demonstrates that CCR is not toxic." The associated exposure pathways are listed in Tables 2-1 and 2-2 of my testimony:

Acute oral
Acute inhalation
Acute dermal
Skin irritation
Eye irritation
Skin sensitization
Chronic inhalation
Chronic oral
Genetic toxicity (cell studies generally applicable to oral or inhalation)
Reproductive toxicity (applicable to oral or inhalation)
Epidemiology – worker exposure which can include inhalation and oral
Aquatic toxicity studies – exposure to water by aquatic organisms

"The constituents in coal, and CCR, are naturally occurring in the world around us."

Oral, inhalation, dermal

"When looking at the trace elements present in CCR on an individual basis, comparison of concentrations to screening levels developed by the USEPA for a child's and adult's daily exposure to soil in a residential setting demonstrates that all are below the screening levels with the exception of the upper bound concentrations of a few constituents."

Oral, inhalation, dermal

"Adverse health effects can only be caused by the constituents in CCR, or CCR itself, if one is (a) exposed to the material, and (b) exposed at a level high enough to elicit a response."

Oral, inhalation, dermal

2. Please refer to Section 2.4.1 concerning the EU REACH Program. On pp. 8-9, you state "Studies have been conducted to address 10 different toxicity endpoints, for acute (short-term) and chronic (long-term) exposure durations considering oral (ingestion), dermal, and inhalation pathways. As shown on Table 2-1, a total of 47 mammalian toxicity studies have been conducted on CCR – as a whole material." Please also refer to Table 2-1 and Exhibit B, which purport to show the relevant REACH data.

RESPONSE: Many of the questions presented below seek study details that can readily be found in Exhibit B and/or a publicly available database. Specifically, more detail on each study is provided in the tables in Exhibit B, and as noted in my testimony in footnote 22 on page 8: https://echa.europa.eu/registration-dossier/-/registered-dossier/15573/7/1 and https://echa.europa.eu/brief-profile/-/briefprofile/100.151.318 – ECHA – REACH – Ashes (residues), coal. I refer the reader to this publicly available information in several answers below.

The following are excerpts from the ECHA (European Chemicals Agency) REACH webpages that describe the registration process in more detail. Emphasis is provided where the text is relevant to the following questions.

[https://echa.europa.eu/regulations/reach/understanding-reach]

How does REACH work?

REACH establishes procedures for collecting and assessing information on the properties and hazards of substances. Companies need to register their substances and to do this they need to work together with other companies who are registering the same substance. ECHA receives and evaluates individual registrations for their

compliance, and the EU Member States evaluate selected substances to clarify initial concerns for human health or for the environment. Authorities and ECHA's scientific committees assess whether the risks of substances can be managed. Authorities can ban hazardous substances if their risks are unmanageable. They can also decide to restrict a use or make it subject to a prior authorisation.

Registration

Companies are responsible for collecting information on the properties and uses of the substances they manufacture or import above one tonne a year. They also have to assess the hazards and potential risks presented by the substance. This information is communicated to ECHA through a registration dossier containing the hazard information and, where relevant, an assessment of the risks that the use of the substance may pose and how these risks should be controlled. Registration applies to substances on their own, substances in mixtures and certain cases of substances in articles. Chemical substances that are already regulated by other legislations such as medicines, or radioactive substances are partially or completely exempted from REACH requirements. Registration is based on the "one substance, one registration" principle. This means that manufacturers and importers of the same substance have to submit their registration jointly. The analytical and spectral information provided should be consistent and sufficient to confirm the substance identity.

Evaluation

Given that registered substances are allowed to circulate freely on the internal market, companies must ensure that the information contained in their registration dossiers is correct at the time of registration and that any changes to this information are reported without delay. This stems from the principle of REACH that the registrants must ensure the substances used and placed on the market do not adversely affect human health or the environment. The REACH evaluation provisions give ECHA the responsibility to check whether registrations are in compliance with the requirements of this Regulation. ECHA and the Member States evaluate the information submitted by companies to examine the quality of the registration dossiers and the testing proposals and to clarify if a given substance constitutes a risk to human health or the environment. Evaluation under REACH focuses on three different areas:

Examination of testing proposals submitted by registrants
Compliance check of the dossiers submitted by registrants
Substance evaluation

Once the evaluation is done, registrants may be required to submit further information on the substance.

a. For the 47 mammalian toxicity studies summarized in Table 2-1 and Exhibit B, please provide the following information:

i. Did you review the underlying study or only the summary available in the REACH dossier?

RESPONSE: I reviewed the dossier – which provides an entry for each of the 47 studies.

ii. Please provide the underlying study in its entirety.

RESPONSE: Please see the general response to #2 above.

iii. Was the study peer-reviewed?

RESPONSE: Please see the general response to #2 above.

iv. Was the study independently reviewed by a governmental entity, and if so which ones?

RESPONSE: Please see the general response to #2 above.

v. What is the date of the study?

RESPONSE: Please see the general response to #2 above.

vi. Please specify which mammals were tested.

RESPONSE: Please see the general response to #2 above.

vii. The EU REACH dossier gives each study a reliability rating. Please identify any studies that received a rating other than "1 (reliable without restriction)."

RESPONSE: Please see the general response to #2 above.

b. For studies of repeated dose toxicity endpoints (Repeated Dose Inhalation Toxicity and Repeated Dose Oral Toxicity), please answer the following: what animal, what gender animal, how many doses, over what interval, what was the dose, and how was it administered?

RESPONSE: Please see the general response to #2 above.

c. For studies of Genetic Toxicity and Reproductive Toxicity, how long was the study period?

RESPONSE: Please see the general response to #2 above.

d. For studies of Genetic Toxicity and Reproductive Toxicity, did the studies look for chronic and sub-chronic effects as well as acute effects?

RESPONSE: **Please see the general response to #2 above.**

e. For Worker Epidemiology (or Epidemiology for Workers in Exhibit B) please provide more information about the methodology of the study and the risks to workers that were assessed.

i. In Exhibit B, for "Epidemiology for Workers," under "Conclusion," you state, "The results of all these studies indicate that pulverized fuel ash is unlikely to give risk to pneumoconiosis under similar working conditions." Did all 5 studies address pneumoconiosis exclusively, or were additional health conditions that might impact workers studied?

RESPONSE: **Please see the general response to #2 above.**

f. Please explain why Table 2-1 lists "NA" under "Publications and Reports" next to "Carcinogenicity."

RESPONSE: **None of the results of the acute or chronic studies suggested that a full carcinogenicity study was necessary.**

g. Have there been no EU REACH studies of carcinogenicity of coal ash?

RESPONSE: **Not to my knowledge; as noted above, none of the results of the acute or chronic studies suggested that a full carcinogenicity study was necessary.**

h. Does the EU REACH dossier for "Ashes (residues), coal" fulfill all REACH testing requirements? If "yes," please provide a basis for your response.

RESPONSE: **Based on my understanding, the dossier is "registered" and published only after it has received review and approval by ECHA. Please see the general response to Question #2 above.**

3. On p. 9, you state: "The REACH system classifies materials by hazard category – if no hazards are identified, based on their classification system definitions, then the conclusion is that no classification is warranted due to 'data conclusive but not sufficient for classification.' The terminology is a bit cumbersome but means there is no hazard to classify. In other words, when that label is used, it means that testing shows the material does not pose a hazard, or 'no hazard.'"

a. Please clarify what you mean by "no hazard" in Table 2-1: do you mean that no hazard was identified by each of the EU REACH studies, or do you mean that that the studies prove that coal ash poses no hazard? Or do you mean something else?

RESPONSE: **The results indicate that "no hazard" was identified based on the classification system developed for the REACH program, which in turn is based on the lack of or low toxicity identified in each of the studies.**

b. For all studies that you characterize as "no hazard," please state whether any effects on the mammalian test subjects were observed after dosing and describe the effects.

RESPONSE: **Please see the general response to Question #2 above.**

4. Section 2.4.2 of your testimony on page 10 refers to EPA's RCRA regulation 40 CFR 261.11(a)(2) and describes that section as the definition of "acutely toxic."

a. Is it true that 40 CFR § 261.11(a)(2) provides a criterion for EPA listing of waste described as "acute hazardous waste, not "acutely toxic," as you state in your testimony? If your response is "no," please state the basis for your answer.

RESPONSE: **I included the entirety of 40 CFR § 261.11(a)(2) in my testimony on page 10, including that "Waste listed in accordance with these criteria will be designated Acute Hazardous Waste." The criteria that are described in that section to define Acute Hazardous Waste are levels of exposure that define acute oral, inhalation, and dermal toxicity:**

> **"It has been found to be fatal to humans in low doses or, in the absence of data on human toxicity, it has been shown in studies to have an oral LD 50 toxicity (rat) of less than 50 milligrams per kilogram, an inhalation LC 50 toxicity (rat) of less than 2 milligrams per liter, or a dermal LD 50 toxicity (rabbit) of less than 200 milligrams per kilogram or is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness. (Waste listed in accordance with these criteria will be designated Acute Hazardous Waste.)"**

In my summary of this section I was speaking as a toxicologist, as the definition of Acute Hazardous Waste is based on these definitions of acute toxicity.

b. Is there a third criterion that can be met for listing hazardous waste under 40 CFR 261.11(a)(3) for wastes to be "designated as Toxic wastes," which is not mentioned in your testimony? If your response is "no," please state the basis for your answer.

RESPONSE: Yes. 40 CFR 261.11(a)(3) provides additional information on criteria for listing hazardous waste. Note that USEPA is obviously aware of 40 CFR 261 and in its CCR rule making process it nonetheless determined that coal ash was appropriately regulated as a solid waste under Subtitle D, and not as a hazardous waste under Subtitle C, of RCRA.

5. Please refer to your testimony on p. 11 in which you state, "News stories commonly refer to CCR as 'toxic coal ash,' and commonly list elements it contains, for example, arsenic, mercury, selenium, chromium, and lead, as though that is proof of CCR toxicity. However, all of these elements are naturally occurring, and the USGS has a map for their occurrence in soils in the U.S. for each of them."

a. Are you aware of any materials that are both naturally occurring and harmful to human health? Please explain.

RESPONSE: Yes. As I note in Section 2.4.5 on page 12 of my testimony, "Every element on the periodic table can elicit an adverse effect if administered at high doses."

b. Are some elements present in coal ash in higher concentrations than they are in soil? Please list them.

RESPONSE: Constituent concentrations in coal ash can be above, in the same range as or below concentrations in background soil.

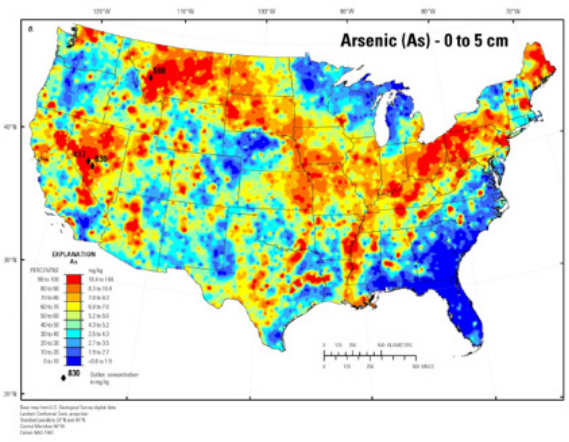
c. Can certain elements present together in CCR cause greater adverse effects on human health or the environment when they are found together than if each were alone? Please explain your answer and provide your source(s).

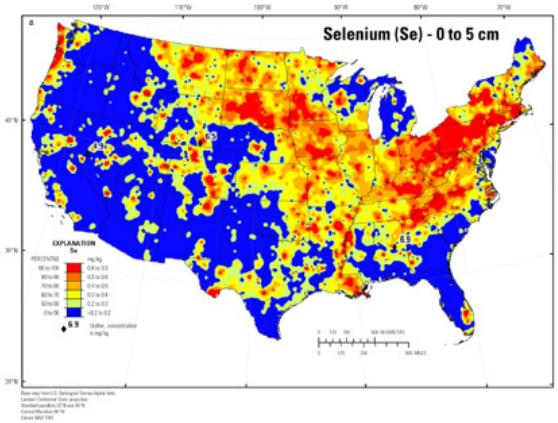
RESPONSE: In regulatory risk assessments in the U.S. (for example under Superfund guidance) it is typically assumed that all estimates of risk for carcinogens are additive, and that estimates of hazard for constituents that do not cause cancer are additive if they have the same target/toxic endpoint upon which their toxicity values are based. These assumptions are one of the many conservatisms in regulatory risk assessments. The elegance of the REACH studies presented in Section 2.4.1 of my testimony is that coal ash has been studied as a whole mixture of all of its component constituents, thus, the results account for

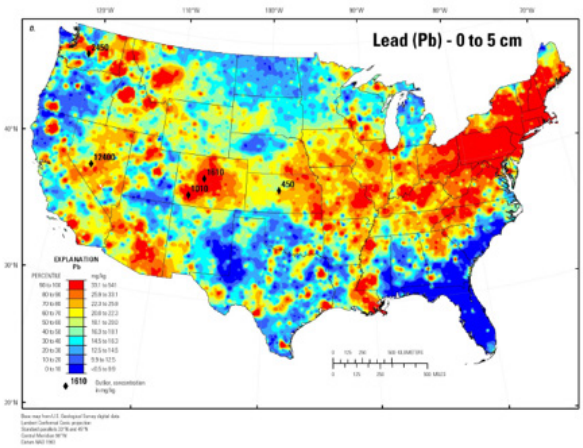
potential additivity, synergy, and antagonism amongst the components. And the results indicate that even as a complex mixture of constituents that each can have a wide range of potential toxicities, at the levels present in the coal ash, coal ash does not pose a hazard under the REACH test conditions for the routes of exposure that have been studied.

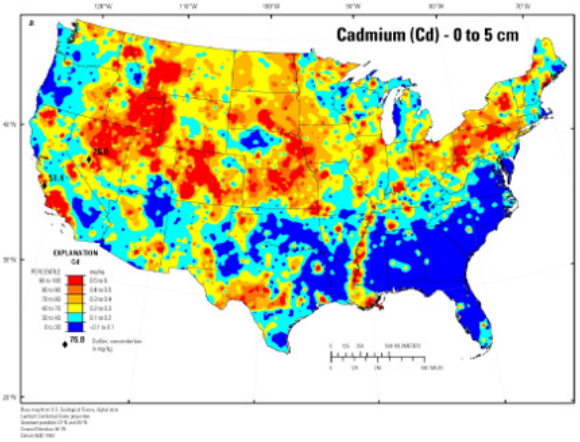
d. If certain elements present together in CCR can create greater adverse effects on human health if found together, have you evaluated whether they are likely to be present together in naturally occurring environments?

RESPONSE: The results of the REACH testing presented in my testimony suggest that if there are additive, synergistic or antagonistic they are not toxicologically significant. I have not evaluated the co-presence of these elements in the environment, per se, but they do occur together, as evidenced by the elemental soil maps produced by the USGS. Several such examples are provided below. [http://pubs.usgs.gov/of/2014/1082/]









i. If so, how does the likelihood that those elements are present together in the natural environment compare to the likelihood that those elements are together in CCR. Please provide your source(s).

RESPONSE: Quantifying the likelihood of co-occurrence is beyond the scope of my testimony.

e. Are you aware of whether any of these elements present in both coal ash and soil more likely to leach from coal ash than they are from soil? Please explain the basis for your answer and provide your source(s).

RESPONSE: Based on my experience, and generally speaking, many constituents in coal ash, and more so for fly ash than bottom ash, are more leachable from coal ash than from soils.

6. Please refer to your testimony on p. 11, where you state, "Because plants grow on soil and take up minerals (inorganics and elements) from the soil, these elements are also naturally present in the food we eat."

a. Are you aware of any materials that are both present in food and harmful to human health? Please explain.

RESPONSE: Yes. Harm to human health is defined by exposure - salt, sugar, ethanol, can each be present in our food, and at certain levels can be harmful. The Institute of Medicine of the National Academies provide Recommended Daily Allowances (RDAs) and Tolerable Upper Intake Levels (Uls) for essential minerals. [https://www.nap.edu/catalog/11537/dietary-reference-intakes-the-essential-guide-to-nutrient-requirements] The RDAs are "the average daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97-8 percent) of healthy individuals in a particular life stage and gender group." Thus, these are levels of essential nutrients that we need in our diet for good health. The Uls are "the highest average daily nutrient intake level that is likely to pose no risk of adverse health effect to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects may increase." Thus, there are levels of these essential minerals that can also be harmful to human health. The minerals for which the Institute of Medicine provides RDAs and ULs are: cadmium, chromium, copper, fluoride, iodine, magnesium, manganese, molybdenum, phosphorus, potassium, selenium, sodium and chloride, sulfate, and zinc. All of these are present in coal ash according to the USEPA, Attachment C-4 of the CCR Risk Assessment; with the exception of iodine—I have never seen any coal ash data for iodine, and am not sure that it has been analyzed.

b. For the contaminants that are present in both CCR and food, can any of them be present in higher concentrations in CCR or CCR leachate than they are in food? If so, please list them.

RESPONSE: It is difficult, and misleading, to equate the concentrations of these constituents in coal ash and food—the issue is not the concentration but the total level of exposure. USEPA assumes incidental contact with soils on a daily basis via ingestion, inhalation, and dermal contact—the level of ingestion is 200 mg/day for a child, and 100 mg/day for an adult. (These exposure assumptions are the basis of the risk-based screening levels published by the USEPA [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables].) However, our daily ingestion of food is much higher than 200 mg/day. Our daily exposure to the constituents via the diet is based on what the concentration is in a foodstuff and how much of it we eat. Whereas, the vast majority of people are not directly exposed to coal ash.

7. Please refer to your testimony on p. 12, where you state, "The detailed compositional data for fly ashes and bottom ashes from the USGS can be compared to the USEPA risk-based screening levels for residential soil, which can be used to assess their relative potential 'toxicity. . . . A detailed report on this comparison [between CCR and residential soil] is available from the American Coal Ash Association (ACAA), and a summary of the analysis was presented in an article in the trade journal Ash at Work."

a. Were you the lead author on either or both publications?

RESPONSE: Yes, I am the lead author on both.

b. Were either of these publications peer-reviewed?

RESPONSE: No. They are simple comparisons of data and not novel experiments worthy of a scientific journal.

c. Are you aware of any studies other than the ACAA report you cited that perform the same comparative analysis? If so, please cite them.

RESPONSE: EPRI conducted a similar evaluation using data it collected from its utility industry members, titled "Comparison of Coal Combustion Products to Other

Common Materials." That report had similar conclusions and is publicly available at: https://www.epri.com/research/products/000000000001020556.

d. Did either of the reports you cited consider exposure pathways other than ingestion or wind inhalation of CCR constituents?

RESPONSE: The reports evaluated the data on coal ash published by the USGS [https://pubs.usgs.gov/ds/635/], and the USEPA risk-based screening levels [https://semspub.epa.gov/work/HQ/200043.pdf] to which the data were compared include evaluation of the ingestion, dermal, and inhalation pathways.

e. Did either of these reports consider exposure related to leaching of materials into water? If "yes," please also answer the following:

RESPONSE: No. Accordingly, question subparts (i) through (iii) below are inapplicable.

i. Did the studies account for variability in the pH of CCR and how that can affect leaching from the CCR?

RESPONSE: NA.

ii. Did the studies account for the variability in the pH of CCR and how that could mobilize constituents already in an aquifer?

RESPONSE: NA.

iii. Did the studies account for the "residence time" of water in CCR?

RESPONSE: NA.

f. Did the study consider impacts on more sensitive populations, such as babies?

RESPONSE: The reports did not expressly address this issue. However, please note that the toxicity values developed by USEPA for human health risk assessment do account for sensitive sub-populations, including children, and I have used these toxicity values and the risk-based screening levels based on them in my reports.

g. Did either of these reports consider exposure pathways and levels in an occupational setting, such as for workers handling coal ash?

i. If your answer is "no," please explain why these exposure pathways were not included in your study.

RESPONSE: No. The risk-based screening levels used in my reports are for residential soil. This is a more conservative exposure scenario, as the risk-based screening levels for industrial soils are generally higher than for residential soils.

8. Please refer to your testimony on p. 12, where you state, "Only the upper end of the range of the measured concentrations of five constituents in the coal ashes studied are above the residential soil screening level in some but not all of the coal ashes: arsenic, chromium, cobalt, thallium, and vanadium. Moreover, these concentrations are only slightly above the screening levels" (emphasis in original).

a. Are you familiar with EPA's Superfund investigation of Town of Pines, Indiana, and resultant removal of ash-contaminated soil?

RESPONSE: Yes.

b. Are you familiar with the levels of arsenic detected in Town of Pines during that investigation?

RESPONSE: Yes.

c. One removal action in Pines followed the discovery of arsenic levels in a public playground above 340 ppm, correct?

RESPONSE: Yes. Note, this concentration is not for groundwater but for fill material used by the town in this area (so 340 ppm here equates to 340 mg/kg).

d. What is US EPA's regional screening level (RSL) for residential soil?

RESPONSE: From [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables]

At one in one million cancer risk level: 0.68 mg/kg

At one in one hundred thousand cancer risk level: 6.8 mg/kg

At one in ten thousand, cancer risk level: 68 mg/kg

At a noncancer hazard index of one: 35 mg/kg

9. Please refer to your testimony on p. 12, where you state, "This comparison demonstrates that there would be no basis for health risk for incidental contact with CCR on a daily or less frequent basis."

a. Please explain what you mean by the phrase "basis for health risk."

RESPONSE: I meant to say "no basis for health risk concern."

b. Does this statement ("there would be no basis for health risk…") also apply to non-incidental contact with CCR on a daily basis, such as contact with CCR by workers at coal ash facilities? If your answer is "no," please provide factual support for your answer.

RESPONSE: I have not quantitatively evaluated a worker scenario at a facility – worker health and safety is addressed by OSHA, which is beyond the scope of my testimony.

c. Are you familiar with the illnesses and health effects reported by over 400 workers who were employed to clean up the Tennessee Valley Authority coal ash spill in Kingston, Tennessee?

RESPONSE: Only what I have seen in news accounts.

d. Have you evaluated the reports of illnesses and health effects from those workers?

RESPONSE: No.

e. Are those illnesses and health effects related to CCR? If your answer is "no," please provide a basis for your answer.

RESPONSE: I have not conducted such an evaluation.

10. Please refer to your testimony on p. 12, Section 2.4.5, in which you state. "The graphic is even more misleading because it suggests that any exposure to CCR (and, really, soil) will result in these adverse health effects" (emphasis in original). Please provide a citation to the graphic or graphics your testimony describes.

RESPONSE: The graphic can be found here:

https://earthjustice.org/sites/default/files/files/coal-ash-man_COMPLETE_2017-07-20_light.pdf

11. Please refer to your testimony on p. 12, Section 2.4.5, in which you state, "[t]here are safe levels of exposure to each of the constituents in CCR (and in soil), as defined by USEPA . . . ."

a. Is lead one of the constituents of CCR? If your answer is "no," please provide a basis for your answer.

RESPONSE: Yes.

b. Has US EPA defined a safe level of exposure to lead? If your answer is "no," please provide a basis for your answer.

RESPONSE: USEPA provides a risk-based screening level for lead in residential soils of 400 mg/kg. This target lead concentration is based on a biokinetic model for children's exposure to lead, although USEPA states: "It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold."

[https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0277_summary.pdf #nameddest=rfd]

However, the lead concentration of 400 mg/kg for residential soil is used by USEPA for the evaluation of soil and as the basis for remediation decisions.

c. Is arsenic one of the constituents of CCR? If your answer is "no," please provide a basis for your answer.

RESPONSE: Yes.

d. What is the Maximum Contaminant Level Goal (MCLG) for arsenic in drinking water? If your answer is "no," please provide a basis for your answer.

RESPONSE: The MCLG is defined by the USEPA as "A non-enforceable health benchmark goal which is set at a level at which no known or anticipated adverse effect on the health of persons is expected to occur and which allows an adequate margin of safety. The MCLG for arsenic is zero. [https://www.epa.gov/dwstandardsregulations/2018-drinking-water-standards-and-advisory-tables

e. Is Thallium one of the constituents of CCR? If your answer is "no," please provide a basis for your answer.

RESPONSE: Yes.

f. What is the MCLG for thallium in drinking water? If your answer is "no," please provide a basis for your answer.

RESPONSE: The MCLG for thallium is 0.0005 mg/L.

12. Please refer to your testimony on p.13, in which you state, "This is supported by the legislative and regulatory history of the federal CCR Rule which demonstrates that Congress and the USEPA do not regulate, nor intend to regulate, CCR as hazardous waste but as a solid waste."

a. Please state your professional experiences that qualify you to evaluate and characterize the legislative and regulatory history of the federal CCR rule.

RESPONSE: As a toxicologist that works with environmental rules and statutes I am required to read and apply them on a regular basis from a technical perspective, which is true as well for environmental engineers and other technical experts that regularly work with rules and statutes. Regarding the CCR rule in particular, I have been studying and working with that rule and its history for many years as a toxicologist and risk assessor.

b. Are you familiar with the Bevill Amendment, which requires US EPA to determine whether to regulate coal ash as a hazardous waste under RCRA Subtitle C?

RESPONSE: Yes.

c. Are you familiar with US EPA's statement regarding the Bevill Amendment in the 2015 CCR Rule?

RESPONSE: Yes.

d. If so, what did US EPA say regarding its final Bevill Determination?

RESPONSE: "EPA is deferring its final decision on the Bevill Regulatory Determination because of regulatory and technical uncertainties that cannot be resolved at this time." [CCR Final Rule; FR 80: 21302] And "This rule defers a final Bevill Regulatory Determination with respect to CCR that is disposed in CCR landfills and CCR surface

impoundments until additional information is available on a number of key technical and policy questions. This includes information needed to quantify the risks of CCR disposal, and the potential impacts of recent Agency regulations on the chemical composition of CCR. The Agency also needs further information on adequacy of the state programs." [CCR Final Rule; FR 80: 21309]

13. On p. 14 of your testimony, Section 3.1, you state, "The federal CCR Rule was based on a national human health and ecological risk assessment of CCR disposal units that identified only one scenario as a risk driver."

a. What was the scenario that US EPA "identified . . . as a risk driver" in its CCR assessment?

RESPONSE: The risk driver is defined as the 90th percentile risk level for unlined surface impoundments for the use of groundwater as drinking water pathway.

b. Have you reviewed the model US EPA used in its CCR risk assessment?

RESPONSE: I have reviewed the CCR risk assessment to assess whether the federal rules are protective for the identified risks. There are several models in the risk assessment. I have reviewed the models and inputs in general but I have not checked the models in detail.

c. Did you review in detail what assumptions the model relied on?

RESPONSE: I have reviewed the CCR risk assessment to assess whether the federal rules are protective for the identified risks. There are several models in the risk assessment. I have reviewed the models and inputs in general but I have not checked the models in detail.

d. Are you familiar with any limitations of the model?

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. USEPA discusses certain model uncertainties in Section 5 and Appendix K of the CCR Risk Assessment.

e. Do you know whether the model used by US EPA in its CCR risk assessment simulated scenarios where CCR is disposed within an underlying aquifer? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. EPACMTP is the fate & transport model used by USEPA in the CCR Risk Assessment. The model incorporates a vadose (unsaturated) zone based on the depth below grade of the unit and the groundwater table. As noted by USEPA in the CCR Risk Assessment for the depth below grade,

> **"The selected value was constrained to be no deeper than the water table present in that model iteration." [CCR Risk Assessment, p4-9]**

USEPA also states,

> **"The probabilistic analysis limited the depth of every WMU to the boundary of the water table because EPACMTP is not designed to solve for leaching from within the water table." [CCR Risk Assessment, p5-10]**

With respect to the uncertainty about this treatment of impoundments, EPA states,

> **"Thus, the probabilistic analysis may over- or underestimate risk on a case-by-case basis. The exact magnitude of this uncertainty is unknown. However, even with greater depths to ground water, risks above cancer and noncancer criteria were still identified. Given that there is potential for both higher and lower risks than modeled, this uncertainty is unlikely to have an appreciable effect on the principal findings of the probabilistic analysis." [CCR Risk Assessment, p5-10,11]**

f. Do you know whether the model used by US EPA in its CCR risk assessment simulated groundwater flow through fractured rock? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. Bedrock was included in the hydrogeologic environments included in the risk assessment—see Table B-2 on page B-4—but the term 'fractured" is not used. When constructing the drinking water scenario for the Highly Exposed Individual within the probabilistic model, the drinking water well was assumed to draw water from the top of the water table to the full saturated thickness of the

shallow aquifer, but limited the depth to not more than 10 meters. [p4-11] It is not clear how much overlap there may have been between that depth and the assumed presence of bedrock for any model run.

g. Do you know whether CCR mineralogy and leachate chemistry evolve over time, as leaching continues? If so, please state whether it does and explain your answer.

RESPONSE: As a toxicologist, this question is beyond the scope of my expertise.

h. Do you know whether the model used by US EPA in its CCR risk assessment simulated more than a single leachate composition from an operating or closed impoundment? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As noted by USEPA in Section 5.1.7 [p5-28] of its CCR Risk Assessment:

"Constant Leachate Concentrations

The nonlinear fate and transport solution used for inorganic constituents in the unsaturated zone module of EPACMTP requires constituent concentrations leached from the bottom of WMUs to remain constant for the entire duration of leaching (U.S. EPA, 2003b). However, empirical evidence reported in U.S. EPA (2009a) indicates that constituents can exhibit a leaching profile that changes over time. EPA conducted a sensitivity analysis to estimate the potential magnitude of error introduced by modeling a single, high-concentration pulse for washout constituents. This analysis, presented in Appendix I, found that there was a negligible (< 1 percent) difference in the peak time-averaged drinking water concentrations using a single, high-concentration pulse until depletion, or two pulses representing a high concentration followed by a low-concentration pulse until depletion. Although a leaching profile that changes over time may be more realistic, the simplified leaching profile used by the model provides very good approximations for peak ground water concentrations overall, and thus has a minimal effect on the risk results."

i. Do you know whether the model used by US EPA in its CCR risk assessment assumes that there is no net addition of ash into the impoundment over its operating life? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As described by USEPA in Section 2.2.1 of its CCR Risk Assessment [p2-3], it was assumed that any dredging losses of

CCR in an impoundment were offset by continued loading form the facility; thus, it was assumed that the amount of CCR would remain constant during its operating lifetime, and there was an assumed constant ponding of depth of water throughout the impoundment's operational life.

j. Do you know whether the model used by US EPA considered climate data that is more recent than 1990? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. USEPA states the following in Section B.4 of Appendix B of its CCR Risk Assessment:

> **"To assign the EPACMTP/HELP climate centers to each facility, GIS software was used to determine the three climate centers closest to the facility and to get the long-term (1961–1990) annual average precipitation rate at each facility from a USGS coverage for the contiguous U.S. (www.nationalatlas.gov; Figure B-1)."**

Unfortunately, the National Atlas Service was discontinued in 2014, so the link is no longer functional. USEPA goes on to state,

> **"The long-term average precipitation for each of the three closest EPACMTP climate centers was then compared with the precipitation for each facility location to select the climate station with the closest precipitation to the facility. Attachment B-3 lists the climate center assigned to each CCR disposal facility along with the five-year average precipitation and HELP soil-specific infiltration/recharge rates for each station."**

Based on my response to (k) below, it is likely that the 5-year average was the last 5 years of the 1961-1990 interval.

k. Do you know whether the model used by US EPA considered the potential effects of climate change, such as changes in rainfall, temperature, or episodic rainfall events? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. USEPA states on page 5-16 of its CCR Risk Assessment,

"The climate data used in this risk assessment was collected for a period from 1961 through 1990. Therefore, some uncertainty is introduced because any potential effects from climate change that have occurred since 1990 are not reflected in this data set. The National Climate Assessment Report documents region-specific changes in rainfall, temperature and episodic rainfall events over recent decades (Melillo et al., 2014). This may result in an increase or decrease in risk on a case-by-case basis. The potential effect of this uncertainty on modeled risks is unknown."

l. Can CCR be highly alkaline?

RESPONSE: Yes. USEPA states the following:

"The pH of CCR wastes as managed range from around 3 to 13. Although the total pH range is wide, the majority of wastes are more basic, with a median value between 10 and 11. CCR wastes managed with coal refuse can be substantially more acidic, which accounts for some of the distribution far below a pH of 7. Similarly, FGD materials can be very basic, which accounts for some of the distribution above a pH of 11." [CCR Risk Assessment, p5-7]

USEPA considered these three types of CCR separately in the uncertainty analysis presented in Section 5 of its CCR Risk Assessment [p5-7,8]. In this analysis, additional constituents were identified as above risk targets. However, USEPA identifies the effect of pH and waste type as of "low potential to affect the probabilistic analysis results" in Table 5-9.

m. Can CCR create pH plumes downgradient of the CCR impoundment?

RESPONSE: I have not evaluated this personally, and I did not find reference to it in the USEPA CCR Risk Assessment.

n. Do you know whether the model used by US EPA in its CCR risk assessment simulated scenarios where CCR leachate changes the chemistry of the aquifer receiving the leachate? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As a toxicologist, this question is beyond the scope of my expertise.

o. Do you know whether the model used by US EPA in its CCR risk assessment simulated variable oxidation/reduction potential (Eh) conditions in either leachate or leachate-impacted groundwater? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As a toxicologist, this question is beyond the scope of my expertise.

p. Do you know whether the model used by US EPA in its CCR risk assessment evaluated the effect of contaminant-plume mobilization of non-waste related metals from the aquifer due to altered aquifer water quality? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As a toxicologist, this question is beyond the scope of my expertise.

q. Do you know whether the model used by US EPA in its CCR risk assessment considered either the pre-existing occupation of adsorption sites in the aquifer by naturally occurring metals or competition for remaining sites by multiple contaminants migrating from the waste disposal area? If so, please state whether it did and provide the basis for your answer.

RESPONSE: As noted above, there are multiple models used in the risk assessment, and it is unclear which model this question is asking about. As a toxicologist, this question is beyond the scope of my expertise.

14. On p. 25 of your testimony, Section 4, you state "proposed Part 845 inappropriately uses a single, confirmed exceedance of a groundwater protection standard during assessment monitoring as a trigger for the initiation of corrective action."

a. What does "single, confirmed exceedance" mean?

RESPONSE: Proposed Part 845 specifically uses the following language: "If one or more constituents are detected, and confirmed by an immediate resample, in exceedance of the groundwater protection standards…." [Section 845.650(d)]

b. If monitoring shows an exceedance of groundwater protection standards due to natural variation in groundwater quality, does the owner/operator of an impoundment have the option to make an Alternative Source Demonstration? If your answer is no, please provide the basis for your answer.

RESPONSE: Based on my understanding, yes. However, the demonstration may be onerous and time consuming while the schedule for developing an Alternative Source Demonstration is extremely short, and may not be long enough to fully evaluate the environmental situation. The use of statistics to determine if a Statistically Significant Levels (SSL) exists, as defined in the federal CCR Rule, ensures that corrective action is not initiated by a single, confirmed exceedance that is not confirmed over time.

c. Does the owner/operator have to complete assessment of corrective action if the Agency agrees with the owner/operator regarding the Alternate Source Demonstration?

RESPONSE: Based on my understanding, no.

d. Have you evaluated whether, in Illinois EPA's past practice of relying on a sample followed by a confirmation to trigger corrective action (see Aug. 13 transcript at p. 129), the Agency has required any corrective action that was later found to be based on "false positives" or sources other than the source of contamination that the Agency found? If so, please describe your findings.

RESPONSE: I have not evaluated any such Illinois practice or its results and note that Illinois EPA's landfill program uses a statistical approach. See e.g., 35 Ill. Adm. Code 811.318(b)(5) ("An observed statistically significant increase above the applicable groundwater quality standards of Section 811.320 in a well located at or beyond the compliance boundary shall constitute a violation.") See also, 35 Ill. Adm. Code 811.320(a)(2) and 35 Ill. Adm. Code 812.317.

15. On page 26, you state: "Moreover, this 'simplification' in Section 845.650 is not any easier to implement because such statistics on the downgradient well data are currently required under the federal CCR Rule."

a. Is "simplification" your word, or are you quoting another source? If another source, please provide a citation.

RESPONSE: **I am using language similar to that used by Lynne E. Dunaway of Illinois EPA in his pre-filed testimony dated 06/01/2020, as on page 5, where he states, "using an absolute numerical concentration as the metric by which corrective action is either initiated or terminated is a simple comparison."**

b. If Illinois EPA obtains approval from US EPA to administer its state permit program, will owners/operators of ash impoundments need to follow the specific requirements in Illinois's rule or the federal CCR rule?

RESPONSE: **This question is better directed to counsel. It is my understanding that if USEPA approves Part 845, owners/operators of CCR surface impoundments will have to follow Illinois' rule and not the federal CCR rule.**

c. Would it be impossible to comply with both the requirements of the proposed Illinois CCR rule and the existing federal CCR Rule?

RESPONSE: **It is unclear to which requirements this question refers. Both the federal rule and the proposed state rule have a multitude of requirements, and I have not reviewed all of them to determine which, if both rules were in effect, would create conflicts or be inconsistent with one another. I note though that, based on my understanding, attempts to comply with both would be at least onerous and cumbersome, and not all activities would be aligned, such as the use of an SSL or not as a trigger for corrective action.**

16. On page 29-30, Section 5, you state your opinion that closure prioritization Category 2 in proposed Section 845.700(g) should be revised "to address only conditions that could pose an imminent threat."

a. Please state your expertise that qualifies you to evaluate the threat posed by the location of an impoundment relevant to groundwater, drinking water supplies, or the areas identified as location restrictions in the federal CCR Rule. Do you have expert qualifications in engineering, hydrogeology, or similar fields?

RESPONSE: **My expertise is that of a toxicologist and risk assessor who develops conceptual site models for exposure for the evaluation of the potential risk posed by a facility**

or environmental situation. I do not have academic qualifications in engineering or hydrogeology, but as a risk assessor I have a basic understanding of hydrogeology.

b. You state that Category 1 already "addresses the imminent threat" related to impacts to a potable water supply. Does Category 1 address conditions where drinking water supply or setback of an existing potable water supply well has already been impacted by pollution?

RESPONSE: Based on my understanding, yes.

c. Does Category 1 address a condition where a drinking water supply is threatened by pollution from a coal ash impoundment, but no contamination has yet been detected within the drinking water supply or well setback?

RESPONSE: Category 1 as proposed by IEPA addresses impacts to an existing water supply or to the setback of an existing water supply. It is not clear what is meant by "threatened" in the question. Categories 4 and 5 address instances where there is an exceedance of a groundwater protection standard.

17. Referring to your list of published articles from the last 10 years in Exhibit A, please identify which articles were peer-reviewed, if any.

RESPONSE: As noted above, these publications are communications pieces that synthesize available data and provide them with risk-based context; as such, they are not necessarily suitable for a peer-reviewed publication and they were not peer reviewed. I have published several peer-reviewed articles in the past.

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 24th day of September, 2020, I have electronically served the attached **Prefiled Responses of Dr. Lisa Bradley**, upon all parties on the attached service list. I further certify that my email address is rgranholm@schiffhardin.com; the number of pages in the email transmission is 56; and the email transmission took place today before 5:00 p.m.

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