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By E-mail and by First Class Mail

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Re: Riverview Energy Corporation
New Source Construction and Part 70 Operating Permit
No. T147-39554-00065

Dear Mr. Logan:

Southwestern Indiana Citizens for Quality of Life, Valley Watch, Sierra Club, Citizens Action Coalition, and Earthjustice submit the following comments regarding the draft New Source Construction and Part 70 Operating Permit published by the Indiana Department of Environmental Management ("IDEM") for Riverview Energy Corporation's proposed direct coal hydrogenation plant in Dale, Spencer County, Indiana ("Refinery").

Introduction

"Riverview" suggests a gentle, bucolic setting. However, the "Riverview" Energy proposal for Dale, Spencer County is not for a farmhouse or country cabin. Instead, the "Riverview" development would be a massive industrial complex, spewing toxic chemicals on neighbors and a nearby elementary school in a county that is already in the worst one percent of counties in the nation for toxic pollution.

This Refinery for coal would be dumped on Dale by a Connecticut hedge fund and a Texas construction behemoth, using a technology that has never been used in the United States. If built, the Refinery would emit massive amounts of hazardous air pollution *every year*. Dale residents would bear the brunt of the environmental consequences from this pollution and serve as guinea pigs—all to benefit out-of-state interests.

Beyond its hazardous air pollution, the Refinery also would exacerbate climate change in our rapidly warming planet.[1] While the world desperately needs a clean energy future, Riverview's proposal is stuck in the past. Constructing a refinery that could "crack" over two million tons of coal[2] and emit over two million tons of greenhouse gases[3] *every year* is a plan for a bygone era, and one that does not make sense today.

Against this backdrop, IDEM is charged with a rigorous analysis of such a novel and dangerous proposal, and must reject the air quality application if it does not meet statutory and regulatory standards. To date, IDEM has failed to discharge this duty in its review of the application by Riverview Energy Corporation, and thus has proposed an unlawful permit.

These comments are submitted on behalf of Southwestern Indiana Citizens for Quality of Life, Valley Watch, Sierra Club, Citizens Action Coalition, and Earthjustice. These comments demonstrate that:

- The permit is unlawful because IDEM has no basis for approving the Refinery's use of the VEBA Combi Cracking technology.
- The permit is unlawful because it relies on deficient and erroneous calculations, and inaccurate air quality modeling.
- The permit is unlawful because it does not require the Refinery to use the Best Available Control Technology for certain pollutants.
- The permit is unlawful because it does not adequately address emissions from flares at the Refinery.
- The permit is unlawful because it was issued in violation of public participation requirements.
- The permit is unlawful because it allows pollution that would injure the public health and welfare.
- The Refinery is considered a petroleum refinery under federal regulations, despite Riverview Energy Corporation's contrary claims.

[1] The severe and wide-ranging consequences of climate change were recently highlighted again in United States Global Change Research Program, Fourth National Climate Assessment, Vol. II: Impacts, Risks, & Adaptations in the United States (2018), *available at* https://nca2018.globalchange.gov/downloads/NCA4_Report-in-Brief.pdf (last visited Dec. 7, 2018).

[2] *See* Prevention of Significant Deterioration (PSD)//New Source Construction and Part 70 Operating Permit, T147-39554-00065 at 56 ("Draft Permit").

[3] IDEM Technical Support Document for a PSD/New Source Construction and Part 70 Operating Permit ("TSD"), App. A, at 2 of 43.

For these reasons, the proposed permit is unlawful under the Clean Air Act, Indiana Code Title 13, Article 17, and the Indiana State Implementation Plan, and should be withdrawn.

Factual Background

Riverview Energy Corporation ("Applicant") is proposing to construct a direct coal hydrogenation facility ("Refinery") in Spencer County, Indiana that would convert coal to liquid fuels through the process of petroleum refining.[4] IDEM has proposed a draft construction and operation permit for the Refinery, open for comments until December 10, 2018.[5]

The Refinery would be a "major source" as defined in the Clean Air Act and Indiana's State Implementation Plan ("Indiana Plan") and would be required to comply with the Clean Air Act and the Indiana Plan, including the Prevention of Significant Deterioration program.[6] A key purpose of the program, as defined by Congress, is to "protect public health" and "assure that any decision to permit increased air pollution . . . is made only after careful evaluation of all the consequences of such a decision."[7]

EPA data shows that Spencer County remains one of the most polluted counties in the country for hazardous air pollution. If built, the Refinery will emit tons of new toxic pollutants in a county that already ranks among the worst one percent of U.S. counties in terms of toxic releases.[8] In other words, the Refinery will worsen air quality in a place where residents are already exposed to high levels of toxic pollutants.

Commenting Organizations

Southwestern Indiana Citizens for Quality of Life is an organization of members living in and around Dale, Indiana. The organization's mission is to promote engagement with local governments on permitting decisions and to ensure that local industry respects residents' health and safety and preserves the beauty and charm of the region.

Valley Watch, Inc. is an Indiana not-for-profit corporation, created in 1981 to protect the public health and environment of the lower Ohio Valley. Since that time, Valley Watch has

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[4] *See* Draft Permit at 12; *see also* Riverview Energy Corporation, Application to the Indiana Department of Environmental Management for a Construction Permit to Build a Direct Coal Hydrogenation Facility to be located in Spencer County, Near Dale, Indiana (Jan. 25, 2018) ("Application").

[5] IDEM, Notice of Period for Public Comment for Riverview Energy Corporation in Spencer County (Oct. 24, 2018).

[6] 326 Ind. Admin. Code 2-7-1(22) (defining "major source"); *see also* Draft Permit at 31 (defining the Facility as a "major source" subject to Indiana's Part 70 Permit program); TSD at 25 of 112 (noting that the Facility is required to obtain an air permit because of its potential to emit certain pollutants). Major sources located in counties that are in attainment with National Ambient Air Quality Standards for so-called criteria pollutants, or are unclassifiable as to these standards, are subject to the Prevention of Significant Deterioration Program under the Clean Air Act. 42 U.S.C. § 7475; 40 C.F.R. § 52.21(a)(2); 326 Ind. Admin. Code 2-2-2(b); *see also* 40 C.F.R. § 81.315 (Spencer County attainment status).

[7] 42 U.S.C. § 7470.

[8] *See* EPA, Toxic Release Inventory, TRI Explorer, Geography US County Report, *available at* https://iaspub.epa.gov/triexplorer/release_geography?p_view=UCGO&trilib=TRIQ1&sort=RE_TOLBY&sort_fmt=2&state=All+states&county=All+counties&chemical=_ALL_&industry=ALL&year=2017&tab_rpt=1&fld=RELLBY&fld=TSFDSP (last visited Dec. 7, 2018) (listing Spencer County, IN as the 30th worst U.S. county in terms of toxic releases). Further, Indiana's failure to reduce infant mortality demonstrates overall health risks to Indiana children. Kreilein, Norma, MD FAAP, "Are Defective Science and Ineffectual Bureaucracy Killing Babies?" abstract and poster, Courage in Medicine National Education Conference, 2014.

fought to keep high-polluting industry from locating in the region and worked with government and the private sector to improve existing industry.

Sierra Club is a non-profit grassroots environmental organization dedicated to the protection and preservation of the environment. Sierra Club has approximately 800,000 members nationwide, including 10,000 members in Indiana.

Citizens Action Coalition works to improve the quality of life of all inhabitants of the State of Indiana through principled advocacy of public policies to preserve democracy, conserve natural resources, protect the environment, and provide affordable access to essential human services.

Earthjustice is a non-profit public interest law firm dedicated to protecting the magnificent places, natural resources, and wildlife of this earth, and to defending the right of all people to a healthy environment.

Regulatory Background

All new, major stationary sources of air pollution are required to apply for both a construction and operating permit under Title V of the Clean Air Act.[9] Permits issued pursuant to Title V must provide for all federal and state regulations in one legally enforceable document, thereby ensuring that all Clean Air Act requirements are applied to the facility and that the facility is compliant with those requirements.[10] It is unlawful for any person to violate any requirement of a Title V operating permit.[11]

States can seek federal approval to administer the Title V permit program through a "State Implementation Plan," or SIP. To gain EPA approval, a SIP must "include enforceable emission limitations and other control measures, means, or techniques . . . as may be necessary or appropriate to meet the applicable [Clean Air Act] requirements" and to "assure that national ambient air quality standards are achieved."[12] SIPs also must "contain emission limitations and such other measures as may be necessary . . . to prevent significant deterioration of air quality."[13]

EPA has authorized Indiana, through IDEM, to administer Title V operating and construction permits to proposed major stationary sources within the state.[14] In Indiana, operating permits for sources subject to the Prevention of Significant Deterioration program are called Part 70 Permits.[15] IDEM allows new major stationary sources to obtain a new source

[9] 42 U.S.C. § 7475(a)(1) (construction permit requirements); 42 U.S.C. § 7661a(a) (operating permit requirements); 326 Ind. Admin. Code 2-2-2(c) (construction permit requirements), 2-7-2 (operating permit requirements).
[10] 42 U.S.C. §§ 7661a(a), c(a); 326 Ind. Admin. Code 2-7-1(6) (defining "applicable requirements" to include Clean Air Act and Indiana Plan requirements), 2-7-5(1) (requiring Part 70 Permits to contain limitations and standards that "assure compliance with all applicable requirements"); 40 C.F.R. § 70.6(a)(1).
[11] 42 U.S.C. § 7661a(a); 326 Ind. Admin. Code 2-7-5(6).
[12] 42 U.S.C. § 7410(a)(2); *see also* 40 C.F.R. § 70.1.
[13] 42 U.S.C. § 7471; *see also* 40 C.F.R. §§ 51.166, 52.21.
[14] 67 Fed. Reg. 34, 844 (May 16, 2002). The Title V permit program is found at Title 326, Articles 1-11, 13-16, 19-20, 24, and 26 of the Indiana Administrative Code. *See* 326 Ind. Admin. Code 1-2-78 (defining "SIP"); *see also* EPA, EPA Approved Regulations and Statutes in the Indiana SIP, *available at* https://www.epa.gov/sips-in/epa-approved-regulations-and-statutes-indiana-sip (last visited Dec. 7, 2018). Permits issued under Indiana's operating permit program are federally enforceable. *See* 326 Ind. Admin. Code 1-2-28.5, 2-7-7.
[15] 326 Ind. Admin. Code 2-7-3.

construction and Part 70 permit in a single, combined permit, like the one proposed for the Refinery.[16]

Permits issued under Indiana's Part 70 operating permit program to sources in attainment or unclassifiable areas must comply with "all applicable requirements" under Title V of the Clean Air Act, the Prevention of Significant Deterioration program, and the Indiana Plan.[17] These requirements include emission limitations, monitoring, recordkeeping, and reporting requirements.[18] IDEM is only authorized to issue permits to sources that "will not cause, or contribute to, air pollution in excess of any . . . maximum allowable increase or maximum allowable concentration for any pollutant" or any National Ambient Air Quality Standard.[19]

To ensure that its permits will not violate these air quality standards, IDEM must model the air quality impacts of a proposed new source of air pollution according to federal regulations before it can issue a permit to that source. These regulations require IDEM to model the air quality impacts of a new source using meteorological data that is "representative" of the proposed source site.[20] IDEM also must model all emissions at the levels allowed in the proposed permit.[21]

I. The Permit Is Unlawful Because IDEM Has No Basis to Determine the Impacts of an Untested Technology.

As proposed, the Refinery would use VEBA Combi Cracking technology, which is not used by any other facility in the United States. Through this technology, the Refinery would pollute the surrounding community with hazardous air pollutants, volatile organic compounds, particulate matter, and many other pollutants.[22]

Indiana law requires IDEM to base its decisions on "substantial evidence"[23] and prohibits IDEM from issuing an air permit until it has "approved the plans and specifications" and "determined that the facility, equipment, or device meets the requirement[s]" of Indiana's air permit regulations.[24] Thus, if IDEM decides that a new source will satisfy the requirements of Indiana's air permit regulations and that issuing a permit is lawful, IDEM must support that

[16] *See* IDEM Air Permitting Background, *available at* https://www.in.gov/idem/airquality/2649.htm (last visited Dec. 7, 2018).
[17] 40 C.F.R. § 70.6(a)(1); 326 Ind. Admin Code. 2-7-5(1), 2-7-1(6) (defining "applicable requirements"); *see also* 326 Ind. Admin. Code 2-7-2(d)(1), 2-7-8(a)(4).
[18] *See* 40 C.F.R § 70.6(a)(1), (a)(3), and (c)(2); *see also* 326 Ind. Admin. Code 2-7-6(1).
[19] 42 U.S.C. § 7475(a)(3).
[20] 40 C.F.R. Pt. 51, App. W at 8.4.1(b) (EPA Guideline on Air Quality Models).
[21] *Id.* at Table 8-2.
[22] *See* TSD, App. A at 2, 7 of 43.
[23] Ind. Code. Ann. § 4-21.5-5-14(d)(5).
[24] *Id.* § 13-15-3-5.

decision with substantial evidence.[25] Failure to do so is grounds for reversing IDEM's decision.[26]

Federal law and sound approaches to air quality permitting require no less. Congress designed the Prevention of Significant Deterioration program with the goal of "assur[ing] that any decision to permit increased air pollution . . . is made *only after careful evaluation of all the consequences of such a decision*."[27] In furtherance of that goal, EPA permitting guidance requires state agencies to make independent determinations about necessary emissions controls and not to rely solely on applicant information.[28] EPA retains oversight authority over state permitting decisions.[29]

Here, the stark challenge presented by the Refinery—tons of toxic pollution—requires an exacting and detailed response from IDEM in order to comply with Indiana's "substantial evidence" standard. IDEM must understand the air quality impacts and technology choices at the Refinery, and not abdicate air quality modeling or engineering evaluations to the applicant.

Instead, the proposed permit is based on incomplete plant design. Dr. Ranajit Sahu, whose report is Attachment A to these comments ("Sahu Report"), has identified many examples from the permit application and related communications demonstrating that the plant design is not mature enough to support the permit and its underlying analysis, including:

- Coal size reduction processes for which "detailed engineering or equipment procurement for the Riverview plant has not been initiated," and the definition of additives to be used "will be established during later engineering studies";[30]
- For acid gas and natural gas burners "there will be one burner, however there could be multiple burners";[31]
- "Formal engineering and procurement activities to solicit multiple equipment bids and supporting the next refined level of project scope and cost estimation will be initiated in the next phase of engineering";[32]
- "The cooling water treatment program is not defined";[33]

[25] *See id.*; *Breitweiser v. Ind. Office of Envtl. Adjudication*, 810 N.E.2d 699, 702 (Ind. 2004); *Jennings Water, Inc. v. Ind. Office of Envtl. Adjudication*, 909 N.E.2d 1020, 1025 (Ind. Ct. App. 2009) ("In reviewing an administrative decision, we must determine whether substantial evidence, together with any reasonable inferences that flow from such evidence, support the [agency's] findings and conclusions.") (internal citations omitted).
[26] Ind. Code. Ann. § 4-21.5-5-14(d)(5).
[27] 42 U.S.C. § 7470 (emphasis added).
[28] EPA, New Source Review Workshop Manual, at B.53-54 (Draft Oct. 1990) ("NSR Workshop Manual"), *available at* https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf (last visited.Dec. 10, 2018).
[29] *Alaska Dep't of Envtl. Conservation v. E.P.A.*, 540 U.S. 461 (2004) (affirming EPA's reversal of a state permitting decision) ("ADEC").
[30] Sahu Report at 2-3.
[31] *Id.* at 3.
[32] *Id.*
[33] *Id.*

- Modeling was based on a list of structures and their physical parameters "at the time of permit application drafting";[34]
- Emissions estimates regarding the hydrogen plant were based on the "vendor's initial conceptual approach. Discussion regarding hydrogen plant design are not finalized";[35]
- Emissions estimates "will be refined with vendor information as it becomes available";[36]
- Firing rates for natural gas were uncertain;[37]
- The plant did "not have a good estimate of expected flare events such as startups, shutdowns, etc."[38]

These many examples demonstrate that with the plant's design far from complete, and processes and emission levels unknown, IDEM had no basis to issue the permit. Further, as demonstrated in the Sahu Report, this incomplete information and other errors have led to underestimates of expected emissions.[39] The predicted emissions from the Refinery are in some cases barely below applicable regulatory thresholds that, if reached, would trigger additional pollution control requirements.[40] But the current emissions predictions are dependent upon certain aspects of the Refinery's design that have not yet been determined, like those identified in the examples above.[41] That means IDEM's emissions predictions are unreliable and susceptible to significant changes.

IDEM has no basis for issuing a permit to the Refinery until the Refinery's design specifications are finalized. Yet, after processing Riverview's permit application for nearly a year, IDEM still has neglected to make a full assessment of the existing technology choices for, and air quality impacts of, the Refinery. IDEM has delayed making several key decisions about which pollution controls are necessary to comply with applicable requirements under the Clean Air Act and the Indiana Plan, and has instead used unsupported assumptions about the Refinery's design specifications and technologies to support its conclusion that the Refinery would not degrade Spencer County's air quality.[42] IDEM also has yet to incorporate into its permit the monitoring requirements necessary to ensure compliance with the Refinery's permitted emissions limits.[43]

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[34] *Id.* at 4.
[35] *Id.*
[36] *Id.*
[37] *Id.* at 4-5.
[38] *Id.* at 5.
[39] *Id.* at 11-14.
[40] *See* KBR, Air Dispersion Modeling Report for PSD Permit Application (June 2018) at tbls. 2-1, 2-2 at 5-6 of 21 ("Air Quality Analysis") (annual particulate matter 2.5 emissions at 80.6% of the national ambient air quality standard (NAAQS); total 1-hour NO_2 emissions at 76.8% of NAAQS; total 1-hour SO_2 emissions at 84.3% of NAAQS).
[41] *Id.* at 1-2.
[42] *See* D. Howard Gebhart, Technical Comments – Riverview Energy Draft PSD Permit and Associated Air Dispersion Modeling ("Gebhart Report") at 8 (Attachment B) (noting that the permit does not require the control technologies necessary to support IDEM's assumption that 100% of VOC emissions will be controlled).
[43] *Id.* at 5, 8 (noting that the permit lacks sufficient monitoring for the Refinery's fugitive dust control plan and fugitive leaks of hazardous air pollutants).

As Dr. Sahu notes in his report, complete information on these issues could result in emissions impacts over regulatory thresholds.[44] Such information is especially important where, as here, the technology proposed for this massive Refinery has no precedent in the United States. Thus, the permit must be withdrawn and reconsidered based on the plant's final technology, process design, and emissions impacts.

II. The Permit Is Unlawful Because It Relies on Deficient and Erroneous Calculations.

Similarly, the permit must accurately analyze plant processes and emissions to provide a complete and accurate picture of what activities the permit is regulating and the impacts on the surrounding community. IDEM's Technical Support Document fails to support a valid permit by offering deficient and incorrect calculations in many regards, including the following issues identified by Dr. Sahu:

- Describing emissions of particulate matter fractions that exceed the total particulate matter emissions, which is impossible;[45]
- Describing controlled emissions of sulfur dioxide that are greater than uncontrolled emissions, which again makes no sense;[46]
- Using outdated global warming potentials for greenhouse gas emissions, and failing to apply the correct time period for the impacts of these emissions.[47]

Further, the permit application and IDEM's Technical Support Document make several fundamental errors with their use of EPA guidance for calculating emissions, known as AP-42.[48] Many of the emission calculations contained in Appendix A of IDEM's Technical Support Document rely on AP-42 as the source of emission factors used to develop the Refinery's potential-to-emit calculations.[49] This reliance on AP-42 is in error because AP-42 provides long-term average emissions for plants in a source category as opposed to estimates of the maximum emissions that could result from a particular facility. Thus, wherever the application or IDEM's analysis rely on AP-42 for potential to emit calculations, this is wrong and the resulting emission levels are underestimates, with important consequences for potential emission controls.[50]

Second, the application and IDEM fail to mention the reliability ratings of the AP-42 factors on which they rely. These ratings provide information on the robustness of emission factors; lower ratings rely on data from fewer facilities, which may not be a random and thus more reliable sample of the industry. Here, as Dr. Sahu demonstrates in his report, the

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[44] Sahu Report at 1; *see also supra* note 40.
[45] Sahu Report at 5.
[46] *Id.*
[47] *Id.* at 5-6.
[48] EPA, AP-42: Compilation of Air Emission Factors, *available at* https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors (last visited Dec. 7, 2018).
[49] *See, e.g.*, TSD, App. A at 12, 17-18, 22, 25, 29 of 43 (calculating the Refinery's emissions potential using AP-42 for the coal dryer heater, feed heater and fractionation heater, treat gas and vacuum column feed heater, natural gas combustion in the flare pilots, and boiler); Sahu Report at 7-8.
[50] Sahu Report at 7.

application and KBR, the Texas construction company that prepared the application, rely on emission factors that EPA itself has rated as having little or no reliability.[51]

Similar to the AP-42 errors, the application and IDEM incorrectly use average emission factors to calculate potential to emit for volatile organic compounds from fugitive leaks, a significant portion of overall plant emissions of this type of pollutant.[52] Additionally, in relying on an EPA estimate of control efficiency, IDEM does not consider the significant caveats in an EPA guidance document, resulting in a considerable understating of emissions from component leaks.[53] Further, IDEM has improperly underestimated emissions from tanks by making improper assumptions about vapor pressure and by using obsolete AP-42 factors.[54]

Finally, the application and IDEM attempt to address flaring scenarios based on the sort of incomplete plant engineering information discussed in Section I above.[55] KBR concedes that determining the duration of flaring events is "problematic." When IDEM then attempts to model flaring events, it relies on a series of unsupported assumptions, including the number of events, how long they last, the flow rate of the flare, and properties of the flare gas. As Dr. Sahu notes, it is "impossible to reconcile the lack of design detail with the highly detailed assumptions on flare gases used by IDEM in its emissions calculation and modeling."[56]

The erroneous and deficient emissions calculations described in the preceding paragraphs currently serve as the basis for IDEM's conclusions regarding the Refinery's environmental and health effects. That means IDEM's conclusions are at best insufficiently supported, and at worst, inaccurate.

The consequences of reaching inaccurate conclusions with respect to the Refinery are significant. First, as stated in the preceding section, even small changes to IDEM's potential-to-emit calculations could mean that the Refinery would in fact cause Spencer County to exceed national ambient air quality standards (NAAQS). Second, inaccuracies in the Refinery's emissions projections for certain hazardous air pollutants could mean that Spencer County residents and Refinery workers would be at an elevated risk of developing cancer, compared to current IDEM estimates.[57] Because the Refinery has the potential to emit certain pollutants with significant carcinogenic potential, like benzene, errors in cancer risk assessment pose special concerns.[58] Currently, some of these cancer-causing pollutants, like polycyclic aromatic hydrocarbons, are entirely excluded from IDEM's cancer assessment.[59]

By basing its conclusions in incomplete and potentially inaccurate emissions information, IDEM cannot ensure that the Refinery will not cause Spencer County to fall out of attainment or

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[51] *Id.* at 7-8.
[52] *Id.* at 9-10.
[53] *Id.* at 10-11.
[54] *Id.* at 11.
[55] *Id.* at 11-13.
[56] *Id.* at 13.
[57] *See* Air Quality Analysis at 13-14 of 21 (noting the cancer-causing potential of certain pollutants emitted from the Refinery and estimating the Refinery's additive cancer risk).
[58] *See, e.g.*, EPA, Carcinogenic Effects of Benzene: An Update, ii (April 1998), *available at* https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=2806 (confirming that "benzene is a 'known' human carcinogen by all routes of exposure") (last visited Dec. 10, 2018); 29 C.F.R. § 1910.1028 (c)(1) (limiting workplace exposure to benzene to an 8-hour time-weighted average of one part of benzene per million parts of air).
[59] *See* Air Quality Analysis at 13-14 of 21.

cause serious harm to the public. IDEM therefore has failed to satisfy its obligations under state and federal law and must withdraw the permit so that it can address these fundamental errors in its emissions projection.

III. The Permit Unlawfully Relies on Deficient and Inaccurate Air Quality Modeling.

IDEM's air quality modeling analysis for the proposed Refinery is also incomplete and inadequate. In contravention of federal regulations on air quality modeling, IDEM has modeled the air quality impacts of the Refinery using data that is not representative of the proposed Refinery site.[60] Specifically, the meteorological data and data on background concentrations of pollutants that are used in IDEM's models comes from monitors that are far away from the proposed Refinery site—in some cases from South Bend, roughly *270 miles* from the site—and from locations with different wind-flow patterns than the site.[61] These air quality monitoring sites also fail to account for the fact that the Refinery would be constructed near a major highway with vehicle traffic emitting significant amounts of NAAQS pollutants.[62] All of these factors undermine the accuracy of IDEM's modeling results.[63]

IDEM's models also include inaccurate emissions data for several pollutants and sources of emissions. First, because a reasonably advanced design does not yet exist for the Refinery, all of the modeling inputs for the Refinery's projected pollutant emissions are—at best—guesses as to the Refinery's actual potential to emit such pollutants.[64] Second, there are inconsistencies between the modeling inputs and the actual permitted emissions limits for certain pollutants. For example, IDEM modeled the Refinery's SO_2 emissions from its tail gas stacks and other emissions units using numbers that were lower than the SO_2 emissions limits contained in the permit, meaning the models showed less impact on air quality from the Refinery's SO_2 emissions than what would occur in reality.[65] Third, IDEM incorrectly modeled emissions from certain nearby sources of significant air pollution by modeling a snapshot of the sources' observed emissions rather than the maximum allowable emissions of such sources.[66] Finally, IDEM's air quality models entirely failed to account for significant emissions of NO_x and SO_2 from start-up, shutdown, and malfunction events, which can cause significant short-term emissions and accompanying health risks, and from rail and truck traffic and several nearby power plants.[67]

Additional inaccuracies and oversights in IDEM's modeling are highlighted in the commenting organizations' modeling report, which is Attachment B to these comments.[68] One especially troubling oversight is IDEM's failure to use consistent emissions values for PM_{10} in its modeling, which has left the commenting organizations' air modeling expert, Dr. Gebhart, with "zero confidence that the PM_{10} modeling has been done correctly."[69]

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[60] Gebhart Report at 2-3, 7-8; Sahu Report at 15-16.
[61] Sahu Report at 15-16.
[62] *Id.* at 16.
[63] Gebhart Report at 2-3, 7-8; Sahu Report at 15-16.
[64] Sahu Report at 15.
[65] Gebhart Report at 3-4.
[66] Sahu Report at 17.
[67] Gebhart Report at 4, 8-9.
[68] *See id.* at 5, 9 (identifying flaws in IDEM's MERPs assessment for secondary PM 2.5 and VISCREEN modeling).
[69] *Id.* at 6-7.

Under federal and Indiana law, IDEM must make its decisions and determinations based on substantial evidence and careful evaluation, not guesswork. In the absence of such evidence and evaluation, neither the public nor IDEM can be sure that the Refinery will meet all applicable requirements under the Clean Air Act and the Indiana Plan. Because IDEM has failed in its fundamental duty to determine *based on substantial evidence and careful evaluation* that the Refinery will not contribute to the deterioration of Spencer County's air quality, the Permit is unlawful under Sections 7475 and 7661a of the Clean Air Act and Title 326, Article 2 of the Indiana Code, and must be withdrawn.

The incompleteness of IDEM's data and analysis are sufficient to warrant the withdrawal of the draft permit. However, even the deficient decision-making record reveals flaws that render the permit illegal under the Clean Air Act and the Indiana Plan, as detailed below.

IV. The Permit is Unlawful Because It Does Not Require BACT for Certain Regulated Pollutants.

a. IDEM Must Select The "Most Stringent" Technology for Controlling Regulated Pollutants at The Refinery or Reasonably Explain Its Decision Not to Do So.

Major stationary sources regulated by the Prevention of Significant Deterioration program must apply the "Best Available Control Technology," or BACT, for all regulated pollutants that the source has the potential to emit in "significant amounts."[70] Major stationary sources are sources that have the "potential to emit" one hundred tons per year (or in some cases two hundred and fifty tons per year) of any regulated air pollutant.[71] Regulated pollutants are those "for which a national ambient air quality standard has been promulgated" or that are "subject to regulation" under the Clean Air Act."[72] The amount of emissions that is considered "significant" is determined by regulation on a pollutant-by-pollutant basis.[73] BACT applies to each regulated pollutant that a major source has the potential to emit in significant amounts.[74]

BACT is "an emission limitation based on the maximum degree of reduction of each [regulated] pollutant" emitted from a major stationary source, "which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is *achievable* for such [source]."[75] As this definition suggests, "Congress intended BACT to perform a technology-forcing function."[76]

The proposed Refinery must comply with BACT requirements because it qualifies as a major stationary source and will be located in an attainment or otherwise unclassifiable area

[70] 42 U.S.C. § 7475(a)(4); 326 Ind. Admin. Code 2-2-3(2).
[71] 326 Ind. Admin. Code 2-2-1(ff); *see also* 42 U.S.C. § 7479(1).
[72] 326 Ind. Admin. Code 2-2-1(ss).
[73] 40 C.F.R. § 52.21(b)(23)(i) (defining "significant"); 326 Ind. Admin. Code 2-2-1(ww)(1)(B) (same).
[74] 42 U.S.C. § 7479(3); 326 Ind. Admin. Code 1-2-6.
[75] *Id.* (emphasis added).
[76] EPA, Transmittal of Background Statement on "Top-Down" Best Available Control Technology (BACT) (June 13, 1989) at 5 ("EPA Background Statement on BACT"), *available at* https://www.epa.gov/sites/production/files/2015-07/documents/topdawn.pdf (last visited Dec. 9, 2018).

subject to the Prevention of Significant Deterioration program.[77] Thus, the Refinery must apply BACT to each pollutant that it has the potential to emit in significant amounts.

IDEM applies EPA's "top-down approach" for determining BACT for regulated pollutants.[78] The first step in this approach requires IDEM to identify all available control technologies for regulated pollutants by reviewing a variety of sources, including technical articles, EPA and state air permits, and EPA's RACT/BACT/LAER Clearinghouse ("Clearinghouse"), among others.[79]

IDEM must do its homework by consulting a variety of sources, and cannot rely solely on EPA's Clearinghouse to identify available technologies. This requirement is due in part to the forward-looking, "technology-forcing" aspect of an adequate BACT analysis.[80] Because the Clearinghouse only contains examples of what technology has been applied in the past, it provides insufficient information about what technology is *currently achievable* for a particular facility, as the BACT analysis requires. Moreover, the information contained in the Clearinghouse is notoriously incomplete. Indeed, EPA itself has noted "incomplete data" as an "ongoing problem" with the Clearinghouse, and IDEM has commented with respect to data in the Clearinghouse "that obtaining [BACT] information from other states can be difficult."[81] EPA and IDEM agree that agencies must diligently consult other sources to obtain a full picture of technology options.[82]

After identifying all available control technologies for regulated pollutants, IDEM then must rank those technologies in descending order and select the most stringent option as BACT "unless the applicant demonstrates, and [IDEM] in its informed judgment agrees, that technical considerations, or energy, environmental or economic impacts justify a conclusion that the most stringent technology is not achievable."[83] Once IDEM determines that an emission unit is subject to BACT and that the most stringent technology is technologically and economically

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[77] Draft Permit at 33 (defining the Facility as a "major source"); TSD at 25 of 112 (noting that the Facility is required to obtain an air permit because of its potential to emit certain pollutants); 40 C.F.R. § 81.31 (noting that Spencer County is in attainment or unclassifiable).

[78] TSD, App. B at 20 of 132 (stating that IDEM "conducts BACT analyses in accordance with the 'Top-Down'" approach outlined in EPA's 1990 draft New Source Review Workshop Manual").

[79] *See* NSR Workshop Manual at B.5, B.11.

[80] *See* EPA Background Statement on BACT at 5; Sahu Report at 13-14.

[81] *See* EPA, RACT/BACT/LAER Clearinghouse Control Technology Center, Annual Report for 2005, at 25 (Sept. 2006), *available at* https://www3.epa.gov/ttncatc1/dir1/rblc_05.pdf (last visited Dec. 9, 2018); EPA, FY 2016 Review of Indiana's New Source Review and Title V Operating Permit Programs, at 6 (Aug. 4, 2016), *available at* https://www.epa.gov/sites/production/files/2016-08/documents/in-prog-evaluation.pdf (last visited Dec. 9, 2018).

[82] *See* TSD, App. B, at 20 of 132 (noting that the Clearinghouse is only one of the sources that permitting authorities must consult); NSR Workshop Manual at B.11 (instructing permit applicants to "identify all demonstrated and potentially applicable control technology" by consulting sources "*include[ing]*" the Clearinghouse) (emphasis added).

[83] NSR Workshop Manual at B.5, B.11; *see also id.* at B. 53-54 ("[T]he BACT selection essentially should default to the highest level of control for which the applicant could not adequately justify its elimination based on energy, environmental and economic impacts. If the applicant is unable to provide to the permit agency's satisfaction an adequate demonstration for one or more control alternatives, the permit agency should proceed to establish BACT and prepare a draft permit based on the most effective control option for which an adequate justification for rejection was not provided.").

feasible, the Prevention of Significant Deterioration program does not allow IDEM to impose a less stringent technology.[84]

If IDEM does *not* select the "most stringent" technology as BACT, it must develop a sufficient record to support the reasonableness of its determination that such technology is not achievable.[85] Failure to provide a reasoned justification is grounds for federal intervention in IDEM's permitting decisions.[86]

The U.S. Supreme Court addressed this very issue in *Alaska Department of Environmental Conservation v. EPA* ("ADEC"), when it upheld EPA's decision to halt issuance of an air permit on grounds that Alaska's Department of Environmental Conservation unreasonably rejected selective catalytic reduction as BACT for NO_x emissions. In that case, the Department followed EPA's top-down approach for determining BACT and concluded that selective catalytic reduction was the most stringent control technology for NO_x emissions and was both technically and economically feasible.[87] Despite this conclusion, the Department ultimately rejected selective catalytic reduction in its permit and allowed the source to control NO_x emissions through low-NO_x burners instead.[88] EPA found this decision unreasonable, and the Supreme Court affirmed EPA's conclusion. In its reasoning, the Supreme Court explained that the Department provided no record evidence that selective catalytic reduction was infeasible and therefore the Department "lacked cause for selecting Low NO_x as BACT" instead.[89]

b. IDEM's BACT Analysis for the Refinery Does Not Meet State and Federal Requirements.

Despite the requirements for a proper BACT analysis enumerated above, IDEM's BACT analysis[90] is a backward-looking, incomplete assessment of the pollution-control options that are currently achievable for the Refinery. As the commenting organizations' engineering expert, Dr. Sahu, explained, IDEM's BACT analysis for the Refinery relies entirely on information from EPA's Clearinghouse and "seems to begin and end with a discussion of what BACT determinations have been made in the past."[91] This approach leads to an incomplete BACT analysis that contravenes the goal of BACT requirements, which seek to ensure that new sources of air pollution adopt the best pollution-control technologies that are available *and achievable* for the source. Moreover, IDEM's analysis contains no assessment of the cost-effectiveness of available pollution controls, which is a central requirement of a proper BACT analysis.[92]

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[84] *ADEC*, 540 U.S. at 478 (citing EPA).
[85] *Id.* at 487-88, 495 (deferring to EPA's interpretation that the Clean Air Act requires state permitting authorities to provide a reasoned justification, supported on the record, for their BACT determinations); EPA, Procedures for EPA to Address Deficient New Source Permits Under the Clean Air Act (July 15, 1988), *available at* https://www.epa.gov/sites/production/files/2015-07/documents/defcient.pdf (last visited Dec. 9, 2018) (noting that a "BACT determination not based on a reasoned analysis" is sufficient to render a permit "deficient").
[86] *See ADEC*, 540 U.S. at 490, 502.
[87] *Id.* at 497.
[88] *Id.*
[89] *Id.* at 498-99, 502 (holding that EPA "did not act arbitrarily or capriciously in finding that ADEC's BACT decision in this instance lacked evidentiary support").
[90] *See generally* TSD, App. B.
[91] Sahu Report at 13.
[92] 42 U.S.C. § 7479(3) (requiring permitting authorities to take "economic impacts and other costs" into account in BACT analyses).

Because of these significant flaws, IDEM's BACT analysis is insufficient under federal and state law and EPA guidelines.

c. IDEM Did Not Select the Most Stringent Technology for Controlling Fugitive VOC Emissions or Flaring Emissions and Did Not Explain This Decision.

As explained above, IDEM is obligated to adopt the most stringent available control technologies that are achievable at the Refinery, or explain its decision to adopt less effective alternatives. IDEM has failed to adhere to these requirements.

With respect to fugitive Volatile Organic Compound ("VOC") emissions, the most stringent available control technology is a combination of an enhanced Leak Detection and Repair program and Optical Gas Imaging technologies.[93] Enhanced Leak Detection and Repair programs include lower leak thresholds, more frequent inspections, and quicker repair times for leaking components.[94] Optical Gas Imaging also represents the state of the art technology for detecting leaking components.[95] Together, enhanced Leak Detection and Repair Programs and Optical Gas Imaging indisputably provide the maximum degree of fugitive VOC reduction that is achievable at the Refinery.

As for flaring emissions, the most stringent available control technology is flare gas recovery, which reutilizes flare gases in the refinery process or as fuel in order to minimize flaring emissions.[96]

Despite the fact that these technologies and programs are available for controlling fugitive VOC and flaring emissions from the Refinery, IDEM does not require the Refinery to apply these technologies and opts instead for outdated and less-effective alternatives.[97]

Critically, neither the Permit nor the technical support documents provide any reasoned justification for IDEM's decision to adopt less stringent pollution controls. Indeed, IDEM does not even include Optical Gas Imaging in its list of potential control technologies. and simply proclaims that BACT for fugitive VOCs emissions "shall be" the less-efficient, standard Leak Detection and Repair Program without Optical Gas Imaging.[98]

In addition, IDEM provides an entirely unreasonable explanation for its conclusion that flare gas recovery is not achievable for the Refinery and justifies its decision on a baseless assumption that flare gas recovery only applies to certain flares. IDEM's BACT analysis rejects flare gas recovery as "not a feasible option" on grounds that the Refinery's flares would "not operate constantly" and thus "there would not be anything to recover,"[99] but this conclusion relies entirely on the assumption that flare gas recovery is viable for only those flares that operate constantly.[100] As Dr. Sahu notes, that assumption is "unsupported and, frankly, astounding."[101]

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[93] Sahu Report at 14-15.
[94] *Id.*
[95] *Id.*
[96] *Id.* at 14.
[97] *See* TSD, App. B at 69-84, 127-29 of 132.
[98] *See id.* at 127-29.
[99] TSD, App. B at 70 of 132.
[100] Sahu Report at 14.
[101] *Id.*

Moreover, because almost every flare gas stream has hydrocarbons (which in turn have heating value as fuel), the Refinery would almost always have flare gas streams that could be reutilized.[102]

Because IDEM has failed to provide any reasoned justification for its adoption of less-stringent pollution controls, IDEM must require the Refinery to adopt enhanced Leak Detection and Repair and Optical Gas Imaging for its fugitive VOC emissions and flare gas recovery for its flaring emissions. IDEM's failure to do so renders the permit unlawful.[103]

V. The Permit is Unlawful Because It Does Not Adequately Address Emissions from Flares.

As detailed above, operating permits issued in Indiana must comply with "all applicable requirements" of Title V of the Clean Air Act, the Prevention of Significant Deterioration program, and the Indiana Plan.[104] These requirements include emission limitations, monitoring, recordkeeping, and reporting requirements.[105] Pursuant to both federal and state law, IDEM is only authorized to issue permits to sources that "will not cause, or contribute to, air pollution in excess of any . . . maximum allowable increase or maximum allowable concentration for any pollutant" or any National Ambient Air Quality Standard.[106] That means IDEM can issue permits only if they contain emissions limitations and other requirements that ensure compliance with state and federal laws.

With respect to flaring emissions, federal and state law require sources to comply with certain reporting requirements. Specifically, federal New Source Performance Standards and Indiana law require petroleum refineries constructed after May 14, 2007 to "report excess emissions [from flares] no less frequently than quarterly" *unless a "permit specifies or a rule requires more frequent reports.*"[107] In order to implement these reporting requirements, the federal standards empower IDEM to determine on a case-by-case basis whether "more frequent reporting is necessary to accurately assess the compliance status of the source."[108]

If built, the Refinery would have three flares servicing overpressure, two of which will also service emergency relief from the Refinery's VEBA Combi Cracking and Sulfur Recovery units.[109] The permit sets emissions limit for all three flares that are achievable only if the

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[102] *Id.*
[103] *See ADEC*, 540 U.S. at 498-99, 502 (upholding EPA's conclusion that ADEC was required to adopt the "most stringent" pollution-control technology absent a reasoned justification for selecting a less efficient alternative).
[104] 40 C.F.R. § 70.6(a)(1); 326 Ind. Admin Code. 2-7-5(1), 2-7-1(6) (defining "applicable requirements"); *see also* 326 Ind. Admin. Code 2-7-2(d)(1), 2-7-8(a)(4).
[105] *See* 40 C.F.R § 70.6(a)(1), (a)(3), and (c)(2); *see also* 326 Ind. Admin. Code 2-7-6(1).
[106] 42 U.S.C. § 7475(a)(3).
[107] 40 C.F.R §§ 60.108(a); 326 Ind. Admin. Code 3-5-1 (stating that rule applies to "any emissions unit required to perform continuous monitoring under 326 IAC 12"), 12-1-1 (stating that rule applies to stationary sources subject to 40 C.F.R. § 60); 325 Ind. Admin. Code 3-5-7(b) (emphasis added).
[108] *See* 40 C.F.R § 60.7(c); 40 C.F.R. § 60.108a(d) (requiring new petroleum refineries to comply with reporting requirements contained at 40 C.F.R. § 60.7(c)).
[109] Draft Permit at 91.

overpressure and emergency relief events occur in infrequent, emergency-like situations.[110] For example, the permit sets flaring emissions levels based on the assumption that the flares will process certain streams only once or twice—or at most, six times—per year for a limited number of hours.[111] IDEM also makes assumptions about the flow rate of the flares and the flare gas properties of the flares.[112]

In addition, the permit's emissions limits for flares are based upon inaccurate air quality modeling data that omits critical emissions data for start-up, shutdown, and malfunction events at the Refinery. IDEM's modeling data reveals that the agency modeled SO_2 emissions from the Refinery's flares, but not NO_x or carbon monoxide emissions. This is a significant oversight, and a violation of federal air quality monitoring regulations,[113] because the Refinery's flares will emit NO_x and carbon monoxide during start-up.

Compounding concerns with the permit's flawed assessment of the Refinery's flaring events, the Permit also does not require the Refinery to report emissions exceedances from these flares more frequently than quarterly.[114]

IDEM's assumptions regarding the annual number of flaring events at the Refinery and the resulting emissions are unsupported.[115] Indeed, as Dr. Sahu notes, it is "simply impossible to reconcile the lack of design detail [for the Refinery] with the highly detailed assumptions on flare gases used by IDEM in its emissions calculations and modeling." [116] What is more, IDEM's quarterly reporting schedule for excess flaring emissions would preclude IDEM from correcting its baseless assumptions about the Refinery's flaring events and instituting the necessary pollution controls until it is too late to prevent or mitigate unauthorized flaring events.

Unless IDEM makes a more reasonable and supported estimate of the likely number of annual flaring events from the Refinery, IDEM cannot satisfy its obligation to ensure the Refinery will comply with state and federal laws. IDEM must revise its estimates of flaring scenarios based on the Refinery's design specifications if and when those specifications exist. Only then can IDEM properly asses the flares' emissions potential and determine what pollution controls are necessary. IDEM also must require the Refinery to submit reports on excess emissions more frequently than quarterly so that IDEM can ensure "continuous compliance" with the Refinery's permitted emissions limits for its flares.[117] Without making these changes, neither IDEM nor the public can be certain that the Refinery will not violate air quality standards. Therefore, issuing the permit is a violation of the Clean Air Act[118] and the Indiana Plan.[119]

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[110] *See, e.g., id.* at 92 (stipulating that the two emergency relief flares "shall operate with no visible emissions, except for periods not to exceed a total of five [] minutes during any two [] consecutive hours when flaring a process stream.").
[111] TSD, App. A. at 23 of 43.
[112] *Id.*
[113] *See* 40 C.F.R. Pt. 51, App. W at tbl. 8-2 (requiring modeling of all permitted emissions limits).
[114] Draft Permit at 96.
[115] Sahu Report at 12.
[116] *Id.*
[117] *See also* 40 C.F.R. §§ 60.7(c), 60.108a(d), 60.70; 326 Ind. Code Admin. 3-5-7(b).
[118] 42 U.S.C. § 7475(a)(3).
[119] 326 Ind. Admin Code. 2-7-5(1) (requiring compliance with all "applicable requirements" of the Clean Air Act), 2-7-1(6) (defining "applicable requirements").

It is worth noting that continuous, unauthorized flaring is a practice that refineries frequently use to avoid pollution control requirements.[120] Indeed, EPA has singled out petroleum refineries as sources that frequently violate new source performance standards for their "routine reliance on flaring to control" emissions.[121] Even the Applicant and IDEM have expressed concerns about the Refinery's ability to use its flares for only infrequent emissions relief.[122] Sustained, unauthorized flaring events can have profound environmental and public health consequences.[123]

Given the frequency and risks of unauthorized flaring, and the Applicant's and IDEM's knowledge that such events are likely to happen, IDEM's failure to require the Refinery to report excess flaring emissions more frequently than *once a quarter* is an "abuse of discretion" under Ind. Code Ann. § 4-21.5-5-14 in addition to the aforementioned violations of federal and state air quality laws. The Permit's existing reporting schedule would prevent IDEM from discovering excess flaring emissions until long after those excess emissions have polluted the surrounding community.

VI. The Permit Is Unlawful Because Its Issuance Violated Public Participation Requirements.

Indiana regulations require IDEM to provide the public with "information sufficient to notify the public as to the emissions implications" of an air permit prior to issuing that permit.[124] For the many reasons identified in these comments, including (among others) missing plant information and erroneous calculations, the "emission implications" of the Refinery are not clear. Therefore, the permit should be withdrawn until the public is notified.

Additionally, IDEM has not fully responded to the commenting organizations' records requests. The commenting organizations filed requests regarding the Riverview Energy Corporation on June 19, 2018 and November 14, 2018 (Attachments C and D). While IDEM has posted some documents regarding the Refinery to the Virtual File Cabinet, IDEM has never sent

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[120] *See, e.g.*, EPA Enforcement Alert, Frequent, Routine Flaring May Cause Excessive, Uncontrolled Sulfur Dioxide Releases (Oct. 2000) ("EPA Enforcement Alert"), *available at* https://nepis.epa.gov/Exe/ZyNET.exe/500003NY.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C00thru05%5CTxt%5C00000002%5C500003NY.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL (last visited Dec. 9, 2018) (stating that "flaring frequently occurs in routine, nonemergency situations or is used to bypass pollution control equipment" and noting particular concern with non-emergency flaring at petroleum refineries).

[121] *Id.*

[122] *See, e.g.*, Lang-Acker Email on Aug. 27, 2018 (Virtual File Cabinet Doc. No. 82608135, AI ID No. 120104) (noting that "Riverview will at some time need to address minimizing" non-emergency flaring events "using a Flare Management Plan or event reporting as a special term or condition of the Air permit."); Logan-Lang Email on Sept. 26, 2018 (Virtual File Cabinet Doc. No. 82624040, AI ID No. 120104) (expressing further concern about flaring scenarios).

[123] *See, e.g.*, EPA Enforcement Alert.

[124] 326 Ind. Admin. Code 2-7-17(c)(1)(B)(iv).

requestors a complete response or a description of documents withheld. Further, as we noted in our letter to IDEM of November 21, 2018:

> [N]o notes, including from meetings and telephone calls, have been posted in the Virtual File Cabinet, despite the fact that IDEM has been preparing the proposed permit and other documents throughout 2018, and has been in contact with representatives of Riverview Energy Corporation during that time. By this omission, and possibly others, IDEM fails to respond to our request. IDEM's omission impairs our ability to gather information regarding the basis for IDEM's action that is necessary to fully prepare our comments on the proposed permit.

Attachment E. Our letter requested that IDEM: (1) provide a complete and final response to our requests, including a full description of each document withheld, if any; (2) for any documents (including but not limited to notes) responsive to our request that had not yet been posted in the Virtual File Cabinet, provide these documents or post them in the Virtual File Cabinet; (3) extend the comment period on the permit by 20 days from (a) the date a complete and final response to our request is provided, or (b) the date the last document is provided or posted, whichever is later.

On November 15, 2018, we received a communication from IDEM suggesting that we submit detailed search terms for an e-mail search in response to our records request. We submitted such search terms by letter to IDEM dated November 21, 2018. However, we have not received a response to our two letters dated November 21, 2018, nor, as noted above, a complete response to our records requests of June 19, 2018 or November 15, 2018.

Finally, IDEM updated its air quality monitoring analysis of PM-10 after the start of the public comment period and has failed to make the corresponding data publicly available.[125] Thus, IDEM has not provided sufficient information to the public regarding the emissions implications of the Refinery.

For these reasons, the permit should be withdrawn until IDEM discharges its duty to notify the public of its emissions implications in accordance with Title 326 of the Indiana Code. The commenting organizations reserve the right to supplement our comments if IDEM responds to our record requests in compliance with its obligations under Indiana's Code.

VII. The Permit Is Unlawful Because It Allows the Refinery to Emit Pollution That Will Injure the Public Health and Welfare.

IDEM ignores the fact that the Refinery will produce odor, noise, and other pollutants that will injure residents' health and welfare, and incorrectly states in its public notice that it "does not have legal authority to regulate [] odor or noise."

Indiana law prohibits "nuisances," which are "[w]hatever is injurious to health; indecent; offensive to the senses; or an obstruction to the free use of property; so as essentially to interfere with the comfortable enjoyment of life or property."[126] Businesses that subject neighbors to

[125] *See* Gebhart Report at 6.
[126] Ind. Code Ann. § 32-30-6-6.

odors or hazardous air pollutants can be liable for nuisance.[127] This is true even if those businesses conduct their operations in accordance with regulations.[128]

Just as regulators cannot excuse nuisances, IDEM also cannot issue air permits that will create a nuisance. A key purpose of Indiana's environmental laws is to maintain Indiana's air quality "consistent with protection of the public health and welfare and the public enjoyment of the air resource, physical property and other resources."[129] In furtherance of this goal, Indiana law prohibits any person from emitting or threatening to emit "any contaminant or waste, including any noxious odor" into the air "in any form that causes or would cause pollution that violates or would violate rules, standards, or . . . emission requirements" contained in environmental regulations.[130] Environmental regulations prohibit IDEM from issuing permits unless those permits contain emissions limitations that assure "the public health will be protected."[131] Contrary to IDEM's claim, then, IDEM is *obligated* to regulate odor, noise, and other emissions in the process of issuing an air permit when the permitted source will cause emissions that injure public health or otherwise undermine the public's welfare and enjoyment of natural resources.

Despite its obligation, IDEM entirely failed to consider how the odor,noise, and toxic pollution from the Refinery would injure nearby residents. The permit currently allows the Refinery to emit roughly 60 tons per year of hazardous air pollutants ("HAPs"), including carcinogenic substances like polycyclic aromatic hydrocarbons and benzene.[132] The permit also allows the Refinery to emit five tons of hydrogen sulfide per year,[133] which is an "extremely hazardous gas" that produces a "rotten egg" smell and significant health effects.[134] On top of that, the permit approves significant increases in local truck traffic, which will churn up dust and cause substantial, near-continuous noise.[135]

This noise, odor, and hazardous air pollution will be emitted within feet of Dale residents' doorsteps,[136] subjecting residents to an onslaught of emissions that will injure their health and interfere with the enjoyment of the environment. Because the permit allows the Refinery to emit these pollutants, it does not contain the requisite emissions limits to ensure "the public health will be protected" and therefore is unlawful under Title 326, Article 2 of Indiana's Administrative Code.

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[127] *See Bonewitz v. Parker*, 912 N.E.2d 378, 384 (Ind. Ct. App. 2009) (concluding that noise, dust and odors emitted from a plant constituted a nuisance under Indiana law).
[128] *Id*.
[129] Ind. Code Ann. § 13-12-3-1.
[130] *Id*. § 13-30-2-1.
[131] 326 Ind. Admin. Code 2-5.1-3(e)(1)(C).
[132] TSD, App. A at 6-7 of 43; *see also* Agency for Toxic Substances and Disease Registry (ATSDR), Case Studies in Environmental Medicine, Toxicity of Polycyclic Aromatic Hydrocarbons, 34 (July 1, 2009), *available at* https://www.atsdr.cdc.gov/csem/pah/docs/pah.pdf; EPA, Health and Environmental Effects of Hazardous Air Pollutants, *available at* https://www.epa.gov/haps/health-and-environmental-effects-hazardous-air-pollutants (last visited Nov. 28, 2018).
[133] TSD, App. A at 2 of 43.
[134] *See* OSHA, Hydrogen Sulfide (H_2S), *available at* https://www.osha.gov/Publications/hydrogen_sulfide.html (last visited Dec. 9, 2018).
[135] *See* Application, Fugitive Dust Control Plan, Attachment A at 2-3.
[136] *See* Application, Attachment B at B-11 (noting that several Dale residents would live less than 1000 feet from Riverview's proposed plant site).

VIII. The Refinery Qualifies as a Petroleum Refinery, Contrary to the Applicant's Claims.

IDEM has categorized correctly the Refinery as a petroleum refinery, despite the Applicant's contrary claims in the decision-making record. Pursuant to federal New Source Performance Standards, a "petroleum refinery" is "any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, or other products through distillation of petroleum or through redistillation, cracking or reforming of unfinished petroleum derivatives."[137] Naphtha and vacuum gas oil are both considered unfinished petroleum derivatives.[138] The Refinery will "hydro-crack" vacuum gas oil in its VEBA Combi Cracking unit to produce naphtha and diesel products, and therefore will create products through the cracking of a petroleum derivative.[139] Because the Applicant's VEBA Combi Cracking technology renders the Refinery a petroleum refinery under federal regulations, any subsequent permits must retain the provisions in the draft permit that require compliance with the federal standards for petroleum refineries.

Conclusion

For these reasons, the draft permit for Riverview Energy Corporation's Refinery is unlawful under applicable standards, and must be withdrawn.

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[137] 40 C.F.R. § 60.101(a).
[138] *See, e.g., Petro Star Inc. v. FERC*, 835 F.3d 97, 99 (D.C. Cir. 2016) (defining VGO as a "cut" of crude oil created through distillation); *Valero Mktg. & Supply Co. v. Greeni Oy*, 242 Fed. Appx. 840, 842 (3rd Cir. 2007) (referring to VGO and naphtha as petroleum products).
[139] Draft Permit at 130; Application at 9.

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Attachment A

Comments on the Proposed Riverview Energy Corporation (REC) New Source Construction and Part 70 Operating Permit No. T147-39554-00065

by

Dr. Ranajit (Ron) Sahu, Consultant[1]

Introduction

The aforementioned proposed permit by the Indiana Department of Environmental Management (IDEM) is to allow Riverview Energy Corporation (REC) to construct and operate a new stationary direct coal hydrogenation plant to be located at 4702 East 2000 North, Dale, Indiana 47532.

This comment report addresses some of the more glaring and major technical errors and deficiencies noted in the draft permit and additional documents such as IDEM's Technical Support Document (TSD), including emission calculations and air dispersion modeling.

As it stands, the proposed permit should not be issued unless the items noted in this review are addressed/corrected, as applicable.

Issues

IDEM's proposal to issue the permit rests wholly on the air quality analyses presented by REC (and its consultants) and IDEM's staff technical review of those analyses. In basic terms, these air analyses include: estimates of the proposed facility's potential-to-emit (PTE) emissions before and after controls, including Best Available Control Technology (BACT) and other applicable regulations; and air dispersion modeling, which relies on the emissions estimates and, in addition, requires inputs such as background concentrations of various pollutants, representative meteorological data, and source characteristics. As is clear from the record, the current predicted impacts from the proposed facility, in some cases, are barely below applicable standards and thresholds in some instances. It is my opinion that if the issues I identify in these comments are properly addressed, then certain applicable thresholds will be exceeded, requiring additional emissions controls or better work practices to reduce emissions further than required by the proposed permit.

[1] Resume provided in Attachment A.

1. The Proposed Permit is Not Reliable Because it is Based on Incomplete Plant Design

While it may seem like an obvious statement, key items noted above, including the emissions estimates and source characteristics are completely dependent on the design of the facility: including the facility layout; the sizes of various equipment proposed at the facility; the compositions of many of the underlying process streams; the count of various fugitive volatile organic compound (VOC) release points; operational details which, in turn, drive emissions due to flaring; and individual source characteristics such as release heights, temperatures, velocities, etc. Thus, if the facility design is not complete or stable – i.e., it might change in the future before the plant is actually constructed – current estimates of emissions and source characteristics will also change, rendering the analyses supporting permit issuance obsolete.

Unfortunately, a review of the record makes it clear that the facility's design is far from complete – thus, making it more than likely that what is being proposed in the permit will, in all likelihood not be what is actually constructed once additional engineering design, equipment selection, and equipment procurement are completed. It is not enough therefore to simply rely on a very preliminary version of the design, often just conceptual, as a basis for the permit, as is the present case.

I present examples below confirming that the facility design is not mature enough to support the permit and its underlying analyses – especially when predicted air impacts are barely below applicable thresholds. As noted above, it is entirely likely that if the analyses are done after facility design is completed that the impacts would be greater than certain applicable thresholds. Of course, additional technical deficiencies, which I discuss below, further undermine confidence in the supporting analyses.

Example (a)

From a March 28, 2018 email from KBR [REC's consultant], discussing coal piles:

> "The modeling of fugitive PM from the coal stacks was proposed in our Modeling Protocol provided to IDEM as a "volume source" for analyses and diameter is not an input for those dispersion calculations. Note there are other designs which could reduce the diameter of each circle further, which will be evaluated during later engineering phases. Thus consider the circles as "indicative" for any general discussion of size of coal storage." (emphasis added)

Example (b)

From another March 28, 2018 email from KBR:

> "While detailed engineering or equipment procurement for the Riverview plant has not been initiated, I assume a vertical mill with a static classifier could be specified as a 3rd party engineered package unit for the coal size reduction process." (emphasis added)

> "It should be noted that the fine and coarse additives can be a variety of materials, as may be discovered in open literature, see attached patent. The definition of the best fine and coarse additives to be used at the Riverview VCC will be established during later engineering studies. As fine additive may be the same material as coarse additive, i.e., only differing in size distribution, a 'Fine Additive Production System' package was provided in the scope as backup for separate direct delivery. This 3rd party engineered package unit is currently envisioned to have an independent emission point for intermittent startup and shutdown service, however it should be able to be controlled during normal operations by the additive transfer baghouse (an edit is needed to the Block Flow Diagram)." (emphasis added)

By its own admission above, some two months after the late-January 2018 submission of the permit application, KBR notes that detailed engineering has not been initiated.

Example (c)

From a March 29, 2018 email from KBR:

> "One (1) burner, identified as A-602a burner, combusting acid gas and natural gas. [SAL [Steven A Lang] Comment: Depending on expected supplier offering there will be one burner, however there could be multiple burners, one for start-up heating on natural gas and one for normal firing of the SRU's H2S/H2O gaseous feed.]" (emphasis added)

Example (d)

From a May 7, 2018 email from KBR:

> "Please note that at the present stage of engineering for the DCH Facility, there are preferred equipment suppliers, i.e., those whom have supplied information and aided in Riverview's 'project definition,' but none have been selected. Formal engineering and procurement activities to solicit multiple equipment bids and supporting the next refined level of project scope and cost estimation will be initiated in the next phase of engineering." (emphasis added)

Example (e)

From a May 9, 2018 email from KBR:

> "In regard to Q7, addressing cooling tower issues, I must first note that the cooling tower makeup supply is not likely to be entirely fresh Ohio River water. There may be both lower and higher TDS content streams recycled to the cooling tower as makeup, i.e., from Block 6500 Water Supply and Treatment and perhaps from Block 8000 NPDES Wastewater Facilities which will impact water usage and disposal. Also, at this time the cooling water treatment program is not defined and it will add to TDS levels in the cooling tower as well." (emphasis added)

Example (f)

From the June 2018 Modeling Protocol (p. 14):

> "A list of buildings, large tanks, and other major structures which will be modeled and assessed for downwash effects is given in Attachment G; modeled input is based on available definition of each structure's physical parameters at the time of permit application drafting." (emphasis added)

The above statement rightly recognizes that all of the information relied upon in the modeling can change – once detailed engineering, equipment procurement, etc., are conducted.

Example (g)

Footnote 4 to the updated Table 1 Emissions Inventory sent from KBR to IDEM on June 4, 2018 states:

> "Hydrogen plant emission information has been provided by an outside vendor, based upon vendor's initial conceptual approach. Discussion regarding hydrogen plant design are not finalized." (emphasis added)

Table 1 itself is titled as "Preliminary." I note that the permit application had been submitted to IDEM by KBR in late January 2018.

Example (h)

Footnote 8 to the updated Table 1 Emissions Inventory sent from KBR to IDEM on June 4, 2018 states:

> "Emissions estimates utilize AP-42 emission factors extensively. These factors provide conservatively high emissions estimates that will be refined with vendor information as it becomes available." (emphasis added)

Setting aside the fact that the characterization of AP-42 emission factors in footnote 8 above is flat wrong (i.e., that they provide "conservatively high emissions estimates"), it is clear that even as late as June 2018, actual emissions data for the processes at the proposed plant were not available from vendor(s).

Example (i)

IDEM asked the following to KBR on July 2, 2018:

> "Steve's March 29 email about the sulfur recovery units indicated that the burner arrangement in the acid gas furnace stage was not finalized at that time. Can you provide capacities for the startup heating burner now? Will there be any capacity for firing natural gas during normal operations and if so, what is that expected to be?"

KBR's Mr. Lang, reply included the statement that:

> "[T]he firing rates will have to come from the vendor/supplier or I will have to calculate or try to find a default value from other similar projects."

Clearly, KBR's statement above confirms that the answers to IDEM's questions were not available because vendor selection had not been completed by July 2018 even though the permit application had been submitted by KBR to IDEM in late January 2018.

Example (j)

From a July 27, 2018 email from KBR

> "At this stage of the project we do not have a good estimate of expected flare events such as startups, shutdowns, etc., however we are developing a default basis, using the attached template which will be revised in later phases of engineering. Any comments or suggestions on the format are welcome." (emphasis added)

The above statement regarding flaring is particularly instructive. While KBR later provided a laundry list of potential flaring scenarios, some of which were modeled by IDEM, it is clear that the underlying bases of almost all of the flaring scenarios are nothing more than guesswork, given the preliminary process design used in the permit application.

In sum, on this point and based on the examples provided above, it is inarguable that important and central aspects of the permit such as emissions estimates and air dispersion modeling, which have been used as the basis of permit issuance, simply cannot be relied upon.

2. There are Numerous Deficiencies in the Emissions Calculations Supporting the Proposed Permit

Here again, I provide examples of technical deficiencies rather than an exhaustive list of each and every deficiency.

Example (a)

IDEM's TSD Appendix A Emissions Summary (page 2 of 43 – "PTE After Controls") shows that the facility's annual PM, PM_{10}, and $PM_{2.5}$ emissions, excluding fugitives, are, respectively, 53.04 tons/year, 66.51 tons/year, and 66.03 tons/year.

PM_{10} and $PM_{2.5}$ are, respectively, the mass fractions of overall PM emissions, with sizes below 10 and 2.5 microns. Therefore, PM_{10} and $PM_{2.5}$ mass cannot exceed the PM mass.

Example (b)

Comparing IDEM's Appendix A Emissions Summary provided on pages 1 of 43 (Uncontrolled PTE) and 2 of 43 (Controlled PTE), SO_2 PTE emissions are estimated to be 208.2 tons/year for the uncontrolled case and 225.13 tons/year for the controlled case. How can uncontrolled PTE emissions be smaller than controlled PTE emissions? Again, on its face this makes no sense.

Example (c)

Greenhouse gas (CO_2, CH_4, and N_2O) emissions are estimated from various combustion (and fugitive VOC) processes. As is customary, the collective emissions as CO_2-equivalent (or CO_2e)

are then estimated using the so-called Global Warming Potentials (GWP) for CH_4 and N_2O (the CO_2 GWP is assumed to be 1).

In all cases, the emissions calculations (see, for example, TSP Appendix A page 12 of 43), assume that the GWP of CH_4 is 25 and for N_2O is 298. These are 100-year GWP values and they are outdated.

First, I note that these are now outdated values since they are based on older assessments of climate science by the Intergovernmental Panel on Climate Change (IPCC). Second, I note that these are the so-called 100-year GWP values, although there is literally no mention or discussion of this. GWP values depend on the future time horizon of interest – typically either 20 or 100 years. Recent consensus GWP values for CH_4 are different: 34 (100-year) and 86 (20-year).[2]

Given the short half-life of methane as compared to CO_2, GHG CO_2e emissions should be calculated on both a short-term (i.e., 20-year) as well as a long-term (100-year) basis, using the current and not older values of the respective GWP.

Example (d)

The emission calculations (whether by KBR in its application or by IDEM in its TSD, Appendix A) rely, on many occasions, on AP-42 as the source of emission factors. As noted earlier, KBR seems to think that using AP-42 emission factors results in conservative (i.e., higher) estimates of emissions.

They are mistaken. There are at least two major problems with using AP-42 inappropriately as has been done in the proposed permit action, discussed below.

First, AP-42 emission factors are inappropriate for developing PTE estimates, since PTE, by design, is supposed to represent the "potential" or high-end emission estimate value while AP-42 emission factors represent "average" and not maximum emission rates. AP-42 makes this very clear:

> "In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i. e., a population average)."[3] (emphasis added)

[2] These are based on the 2013 Intergovernmental Panel on Climate Change (IPCC) AR5 estimates. See, for example, Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang (2013) "Anthropogenic and Natural Radiative Forcing". In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.

[3] AP-42 Introduction, p. 1. Available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

> "Emission factor ratings in AP-42 (discussed below) provide indications of the robustness, or appropriateness, of emission factors for estimating average emissions for a source activity."[4] (emphasis added)

Thus, in each instance that REC's or IDEM's PTE calculations rely on AP-42 emission factors, they are simply wrong and the resultant PTE emissions (all other criticisms aside) are underestimates. This has material consequences, especially for estimating short-term impacts. For example, NO_x emissions, when underestimated, result in underestimated 1-hour NO_x modeled impacts from the facility, etc. Again, exceeding such impacts will require better and more stringent controls to limit short term NO_x emissions, which have not been discussed in the record.

Clearly, KBR's statement earlier that use of AP-42 results in conservative emissions estimates has no basis in fact. In fact, it is the opposite when AP-42 is used to calculate PTE values.

Second, neither the KBR nor IDEM emissions calculations mention or discuss the reliability (i.e., accuracy) of AP-42 emission factors. AP-42 uses a rating system, quoted below, to provide the user with a sense of how accurate a particular emission factor is:

> "Each AP-42 emission factor is given a rating from A through E, with A being the best. A factor's rating is a general indication of the reliability, or robustness, of that factor. This rating is assigned based on the estimated reliability of the tests used to develop the factor and on both the amount and the representative characteristics of those data. In general, factors based on many observations, or on more widely accepted test procedures, are assigned higher rankings. Conversely, a factor based on a single observation of questionable quality, or one extrapolated from another factor for a similar process, would probably be rated much lower….
>
> The AP-42 emission factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source. Higher ratings are for factors based on many unbiased observations, or on widely accepted test procedures. For example, ten or more source tests on different randomly selected plants would likely be assigned an "A" rating if all tests are conducted using a single valid reference measurement method. Likewise, a single observation based on questionable methods of testing would be assigned an "E", and a factor extrapolated from higher-rated factors for similar processes would be assigned a "D" or an "E".

AP-42 emission factor quality ratings are thus assigned:

[4] *Ibid*., p. 2.

A — Excellent. Factor is developed from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.

B — Above average. Factor is developed from A- or B-rated test data from a "reasonable number" of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with an A rating, the source category population is sufficiently specific to minimize variability.

C — Average. Factor is developed from A-, B-, and/or C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.

D — Below average. Factor is developed from A-, B- and/or C-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.

E — Poor. Factor is developed from C- and D-rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population."[5]

Note, in particular, the very poor reliabilities of "D" and "E" rated factors.

Consider IDEM's TSD Appendix A calculations, for example, for all combustion equipment. These include: the coal dryer heater (p. 12/43); feed heater and fractionation heater (p. 17/43); treat gas heater and vacuum column feed heater (p. 18/43); natural gas combustion in the flare pilots (p. 22/43 and p. 25/43); and boiler (p. 29/43). For each of these sources, IDEM relied on AP-42 emission factors for criteria pollutants and hazardous air pollutants (HAP). The TSD Appendix A calculations pages in each instance reference AP-42, Chapter 1.4 [for Natural Gas combustion], Tables 1.4-1, 1.4-2, and 1.4-3, as well as metal HAP emission factors in Table 1.4-4.

I show, in Attachment B, these very tables relied upon by IDEM, taken directly from AP-42, Section 1.4. In Attachment B, I have highlighted the emission factor ratings for most of the pollutants – and they are generally rated at C, D, or E – indicating little to no accuracy.

Yet, without commentary, KBR and IDEM have used these poor/useless emission factors to estimate PTE emissions, no less, and then used those emission estimates as input to the air dispersion modeling.

[5] *Ibid*., pp. 8-10.

There is simply no reason to believe that the air dispersion modeling results are at all reliable.

Example (e)

Similar to the inappropriateness of using average emission factors (of little reliability) to estimate PTE emissions, as discussed above, the KBR and IDEM calculations make the same error in estimating fugitive VOC emissions. I note that 176.22 tons/year of controlled "PTE" emissions are attributed to fugitive leaks by IDEM – not an insignificant portion of the overall 484 tons/year overall facility VOC emissions for this controlled PTE case. Details of the emission calculations are provided on page 40/43 of the TSD, Appendix A. The source of the emission factors is stated as "*Emission factor source Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, November 1995), Table 2-2 (Refinery), except as noted."* I have excerpted this table below for ease of reference.

TABLE 2-2. REFINERY AVERAGE EMISSION FACTORS[a]

Equipment type	Service	Emission factor (kg/hr/source)[b]
Valves	Gas	0.0268
	Light liquid	0.0109
	Heavy liquid	0.00023
Pump seals[c]	Light liquid	0.114
	Heavy liquid	0.021
Compressor seals	Gas	0.636
Pressure relief valves	Gas	0.16
Connectors	All	0.00025
Open-ended lines	All	0.0023
Sampling connections	All	0.0150

First, a simple comparison of the emission factors noted in the referenced table above with those used in the IDEM calculations (excerpted below from page 40/43 of the TSD Appendix A) shows that they are identical.

Second, as noted in the very title of the referenced document table above, these are ALL average emission factors – confirming that their use in estimating VOC PTE emissions is simply wrong.

Fugitive Equipment	Physical Service	Emisssio (NMOC tak (kg/hr/source) (
Valves	Gas	0.0268
	Light liquid	0.0109
	Heavy liquid	0.00023
Pump seals	Light liquid	0.114
	Heavy liquid	0.021
Flanges/connectors	All	0.00025
Pressure Relief Valves[3]	Gas	0.16
	Liquid	0.16
Compressor seals	Gas	0.636
Open-Ended Lines/Valves[4]	All	0.023
Sampling Connections[5]	all	0.015
Water Seal Process Drains[6]	all	

Example (f)

Sticking to the VOC emission estimate from leaking fugitives, IDEM compounds its error in calculating the PTE by using control efficiencies (likely due to the assumed effectiveness of a Leak Detection and Repair (LDAR) program proposed as BACT for these fugitive components), as follows:

1. VOC

Fugitive Equipment	Physical Service	Emisssion Factor[1] (NMOC taken as VOC) (kg/hr/source)	(lb/hr/source)	Control Efficiency[2] %	count
Valves	Gas	0.0268	0.059	70%	3
	Light liquid	0.0109	0.024	61%	32
	Heavy liquid	0.00023	0.001		153
Pump seals	Light liquid	0.114	0.251	45%	18
	Heavy liquid	0.021	0.046		19
Flanges/connectors	All	0.00025	0.00055		1036
Pressure Relief Valves[3]	Gas	0.16	0.353	70%	19
	Liquid	0.16	0.353	61%	90
Compressor seals	Gas	0.636	1.402	0%	1
Open-Ended Lines/Valves[4]	All	0.023	0.051	100%	90
Sampling Connections[5]	all	0.015	0.033	100%	205
Water Seal Process Drains[6]	all		0.07	0%	205
Total	-		-		

IDEM states that the control efficiency values are taken from Tables 5-1 and 5-3 of EPA's 1995 document I reference above. However, IDEM does not consider the considerable caveats in the EPA document, footnoted in each of the tables it relies upon. For example, in Table 5-3 in this

reference, EPA notes that it has no available data to estimate the control effectiveness for connectors while still arriving at a numerical value of control effectiveness. Similarly, Table 5-1 states that control effectiveness for pressure relief devices may be lower than stated. It is therefore incorrect to simply use a control effectiveness value from a reference forgetting attached restrictions and caveats. The net result is that fugitive emissions from component leaks at the facility are considerably understated.

Of course, given the conceptual nature of the design as noted earlier, the fact that the component counts noted in the table above will change as the design matures makes these calculations even more suspect.

Example (g)

Tank emission calculations are provided by IDEM in the TSD Appendix A on page 27/43. Curiously, the emissions table does not provide a critical parameter, namely the vapor pressure of the stored compounds on that table. And, even more curiously, emissions from many of the tanks are simply noted as zero.

What IDEM does not explicitly discuss as part of the tank calculation is the information provided to IDEM in a May 9 email from Mr. Lang of KBR, which simply states "TBD" for the vapor pressure for many of the tanks – likely because of the preliminary status of the design.

If IDEM has simply equated TBD to be zero, and thereby clearly underestimated tank VOC emissions, that is obviously an error.

Example (h)

An additional and significant error related to tank emission calculations discussed above is the very method KBR and IDEM have used to estimate such emissions – i.e., by using EPA's TANKS program – see page 27/43 of the TSD Appendix A.[6]

It is now well known (and has been for almost a decade) that VOC emissions calculated using equations provided in AP-42 (or in the EPA TANKs program), underpredict actual emissions from storage tanks by multiples as high as 3 to 7 or even more depending on the properties of the material being stored and the type of tank.[7] Therefore, IDEM needs to enhance the TANKs-based PTE emission estimates to account for the greater emissions from tanks at the facility.

Example (i)

Like most of the emissions estimates discussed above, I also note that estimated emissions from flaring are likely significantly underestimated.

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[6] IDEM states that emissions were estimated "from EPA TANKS 4.0.9d", which is a computer program available on EPA's website.

[7] EPA, Critical Review of DIAL Emissions Test Data for BP Petroleum Refinery in Texas City, Texas, EPA 453/R-10-002, ES-2, Table 1 (Nov. 2010), p. ES-4.
Available at https://www3.epa.gov/airtoxics/bp_dial_review_report_12-3-10.pdf

Of course, to reiterate the point once again, estimates of process gases that will need to be flared at each of the flares – especially the HP and LP flares at the proposed facility – can only be properly assessed after completion of detailed engineering, which has simply not been done at this time. The inability to properly assess the many potential flaring scenarios is made explicit by KBR, REC's consultants, in an August 27, 2018 email (which is over 7 months after submittal of the late-January 2018 permit application). KBR states:

> "In regard to Flaring scenarios, we've built a listing, but didn't get a chance to discuss with Doug how the air permit was going to handle the expected event types beyond meeting NSPS and the Refinery Sector Rule guidance. We assume that Riverview will at some time need to address minimizing event types listed below, using a Flare Management Plan or event reporting as a special term or condition of the Air permit." (emphasis added)

KBR concedes:

> "The flaring scenarios that are expected include those listed below. Establishing flare event durations is very problematic… ." (emphasis added)

It is absolutely clear from the above that KBR is figuratively throwing up its hands with regards to flaring and its emissions. Note the reference to "will at some time need to address…" and the reference to a "Flare Management Plan" as yet undeveloped, for understandable reasons, given the immaturity of the whole process design.

Yet, the significant uncertainty notwithstanding, IDEM seems to have modeled a few difference flaring scenarios as noted in Appendix C to the TSD.

> "The consultant for the source, KBR, has stated that when the flares are operating, the rest of the facility will be at a diminished operating capacity. IDEM has modeled the facility at or near full capacity for NO2 and CO. The consultant presented a worst case flaring scenario for SO2 during which the facility will be at partial capacity. The consultants' worst case SO2 flaring scenario is reflected in Table 2."

Digging deeper, despite the complete absence of design information and purely in an attempt to model some aspect of flaring, IDEM (whether or not with the assistance of KBR) seems to have made a wide range of unsupported assumptions with regards to the various flares and their likely uses as shown. I provide an excerpt below from the TSD Appendix A, page 23/43 (please see original for the full table):

2. Flare Operations[1]

				Flare Operating Conditions					
Plant Area	Source	Stream Type	Routed to	Events #/yr	Duration hr/event	Annual Period hr/yr	Flow Rate lb/hr	Stream Mol. Wt. lb/lbmol	Heating Value Btu/scf
Block 2000	VCC CCSU - 50 Bar Case Leak Test	N2	HP Flare EU-4004	2	2.5	5	96595	28.0	5
	VCC CCSU - 150 Bar Case Leak Test	N2 + H2	HP Flare EU-4004	2	7.5	15	45982	19.4	94
	VCC CCSU - 225 Bar Case Leak Test	N2 + H2	HP Flare EU-4004	2	11.25	22.5	21068	13.5	157
	VCC CCSU - 300 Bar Case Leak Test	N2 + H2	HP Flare EU-4004	2	15	30	12565	10.7	189
	VCC CCSU - Emergency Fast Depressure Test -	N2 + H2	HP Flare EU-4004	1	15	15	106231	4.3	368

This includes unsupported assumptions on the number of flaring events per year, the event duration, the flow rate of the flare, and flare gas properties such as molecular weight and heating value. But not a single process support document is provided as the source of these many variables.

It is simply impossible to reconcile the lack of design detail with the highly detailed assumptions on flare gases used by IDEM in its emissions calculations and modeling.

In sum, as shown via the many examples above (and remembering that these are in fact, just examples, and the above is not meant to be a comprehensive critique of each and every technical deficiency), it is without question that the emissions calculations provided in the TSD (which were used in modeling air impacts) are completely unreliable and significantly understate the likely PTE for the various pollutants that will be emitted from this facility.

3. The Emissions Calculations Supporting the Proposed Permit Rely on Many Assumptions and Each Assumption Should be Made Enforceable in the Permit

As noted in the previous discussion, the emission calculations provided in the record by KBR and IDEM are unreliable. And, as even a cursory glance at the details of these calculations in Appendix A of the TSD will show, they rely on myriad and many assumptions.

The criticisms noted above notwithstanding, if the IDEM emissions estimates (and modeling, which relies, in part, on these emissions estimates) are to have any meaning at all, each of the underlying assumption for each emission estimate needs to be made enforceable in the permit. This means, a thorough listing identifying each assumption – whether explicit or implicit. Next, for each assumption the permit needs to have a method of compliance – whether based on recordkeeping, testing, monitoring, or similar, depending on the assumption.

Only then is there any continuity between the emissions estimated and the modeled impacts.

Since the proposed permit does not provide even an identification of all of the assumptions that IDEM has made, and simply does not include practical enforceability provisions for each such assumption, it is fatally deficient.

4. The BACT Analysis is Significantly Flawed

As with the other critiques above, I will provide examples of flawed BACT analyses that IDEM has relied upon in the proposed permit.

First, however, a general critique, applicable to all sources and pollutants, is in order. The entire BACT analysis, in each instance, seems to begin and end with a discussion of what BACT determinations have been made in the past for similar sources – as available in EPA's RACT/BACT/LAER Clearinghouse. However, this approach, in which BACT is simply determined based on what BACT was (in the past) at a different facility – misses the point. BACT is not merely what has been achieved; its very definition includes the word "achievable." In addition, it is my experience that the RBLC database is often incomplete.

By using a methodology that simply looks backward, IDEM's BACT analysis completely misses the critical, forward-looking, technology-forcing aspect of a proper BACT analysis. In fact, in many instances, IDEM reverts to an applicable NSPS limit or standard and simply declares that to be BACT, without any effort at justifying a more stringent level that might also be cost-effective.

In fact, the entire BACT analysis provided in Appendix B of the TSD contains no cost-effectiveness analysis, which is critical to setting a BACT level at a proper level of stringency – i.e., at the point just below when it is not cost-effective.

Thus, IDEM's BACT analysis, based on a methodology which is constrained and backwards-looking, is simply flawed and therefore cannot result in a correct BACT determination.

I provide a few examples below.

Example (a)

As noted earlier, flaring emissions have been understated. In fact, like in most operating chemical plants and refineries, etc., significant emissions from flaring occur not from the routine pilot flame, but when large quantities of flare gases are generated during planned or unplanned outage events at process units. Since, by nature, these are stochastic events, the best method of minimizing flaring emissions is to develop and implement a flare management plan (alluded to earlier by KBR). Most flare management plans rely on preventing flaring to the maximum extent possible using flare gas recovery – i.e., reutilizing flare gases (which have heating value) in the process or as fuel, supplemented as need be by natural gas, etc. Yet, surprisingly, and in somewhat incomprehensible words, IDEM dismisses flare gas recovery in its TSD Appendix B page 70/132 as follows:

> "Flare gas recovery is not a feasible option. These flares do not operate constantly; only the pilot flame does. There would not be anything to recover except in the rare case of a process upset – which would preclude the use of any heat recovered."

IDEM's assumption that flare gas recovery only applies to continuous flares (i.e., those that operate constantly) is unsupported and, frankly, astounding. And, IDEM's statement that "[T]here would not be anything to recover…" makes little sense. Almost every flare gas stream has hydrocarbons, which have heating value as fuel – so, yes, there is always something to recover.

IDEM's reasoning rejecting flare gas recovery makes no sense.

Example (b)

For fugitive VOC emissions from leaking components, IDEM discusses the BACT analysis starting on page 127/132 in Appendix B of its TSD, and notes that LDAR with 98% effectiveness is the top rank BACT (see page 128/132). Yet, as discussed earlier, IDEM does not use 98% as the control efficiency for its various VOC controls for specific fugitive components.

As far as the type of LDAR that would be BACT, IDEM simply states (see page 129/132) that the LDAR provided in NSPS Subpart GGGa shall be BACT. IDEM does not provide any further discussion as to why more stringent ("enhanced") LDAR – with lower leak thresholds, more

frequent inspections, and quicker repair times for components that are found to be leaking – would not be BACT.

Going further, IDEM literally provides zero discussion on Optical Gas Imaging (OGI) technologies that represent the current state of the art for efficiently detecting leaking components and their recognized superiority over LDAR methods.[8] It is my opinion that OGI, using IR cameras, would be far more effective as BACT for leaking fugitive components than LDAR of any type. If need be, LDAR can be used as a secondary means of verification that components are not leaking.

As such, IDEM's BACT determination for leaking components, a large source of VOC emissions, is incomplete and deficient.

Again, these are but two examples, cited to make the general point that IDEM's BACT analysis is methodologically so flawed that it cannot possibly result in a proper BACT determination for any of the source/pollutant combinations. At the very least, without addressing what is "achievable," IDEM impermissibly constrains the BACT analysis.

5. IDEM's Air Dispersion Modeling Analysis is Flawed

As noted earlier, proper PTE emissions, supported by a reasonably advanced engineering design, is one of the key inputs for any air dispersion modeling. And, since neither the proper design basis nor the PTE emissions are available, that alone renders the modeling analysis flawed.

In this section, I will address some additional modeling assumptions that are either unsupported or are simply incorrect, further exacerbating the errors in the modeling analysis.

Example (a)

Use of representative meteorological (hereafter "met") data – i.e., that properly represents the wind field at the proposed plant site – is a critical input for the modeling analysis. PSD rules therefore rightly require the collection of at least 1 year of onsite met data, unless representative met data is otherwise available.

In the present instance, KBR and IDEM have made no showing whatsoever that the surface met data from Evansville, some 40-50 miles distant from the site, with considerable terrain differences, which was used in the modeling, is representative of site conditions. No onsite data (even for periods of less than a year, which could have been collected to show comparisons to Evansville data) was required to be collected.

[8] https://www.flir.com/instruments/optical-gas-imaging/; see also https://www.epa.gov/natural-gas-star-program/optical-gas-imaging-innovations-and-industry-results; https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=309773&subject=Health%20Research&showCriteria=0&searchAll=Environmental%20Justice&sortBy=revisionDate

In a circular argument, REC justifies not collecting onsite met data by noting that specified preconstruction monitoring thresholds were not exceeded – forgetting to state that this very exercise used met data from Evansville. KBR's justification for avoiding pre-construction onsite monitoring is therefore unavailing.

It is impossible to simply assume (as KBR has done and as IDEM has accepted), by fiat, that Evansville met data is representative of the Dale plant site. IDEM should provide a technical basis for this fundamental assumption. Since it likely cannot, IDEM should require the applicant to conduct the requisite one year of onsite met data collection and then use that data, properly validated, in the dispersion model.

Example (b)

Another fatal flaw in the modeling analysis is the use of unsupported background data (i.e., current concentrations of various pollutants, over specified averaging times) representative of the Dale plant site. Here is the relevant discussion:

> "Representative background concentrations used in the NAAQS analysis are listed in Table 4. The background monitors used for the NAAQS analysis were monitor ID number 18-141-0015, located in South Bend, IN for 1-hour NO2, monitor ID number 18-163-0021, located in Evansville, IN, for 1-hour, 3-hour, 24-hour, and annual SO2 and finally monitor number 18-147-0009 located in Dale, IN, for annual and 24-hour PM2.5. The latest 3-year design value (2015-2017) for each of these monitors was used in the modeling analysis. These sites are considered the most representative sites with complete data relative to REC. For NO2 background values, there are only two monitors within the state that have complete and quality assured data, both of which are in northern Indiana. The monitor in South Bend, Indiana is located in a more rural area than the Gary IITRI monitor industrialized area. The more rural location of the NO2 monitor in South Bend is comparable to the proposed location for REC."

The Dale site is located near a major highway (Hwy 64), as shown in the figures provided in the Modeling Protocol. Significant emissions of relevant pollutants including NO_x, $PM_{10}/PM_{2.5}$, SO_2, VOCs, CO, and others obviously affect the site due to emissions from the highway. Given this, it is completely improper to simply use data from Evansville as being representative of the Dale site. Compounding the error, using data from South Bend, far from the Dale site for the 1-hour NO_x background level simply makes no sense.

As with pre-construction met data collection, the applicant should be required to collect onsite pollutant data for a sufficient period of time – at least one year – which should be used in the modeling analysis. It is clear that there is no justification for simply grabbing available monitoring data from other sites, with no regard to representativeness at the Dale site.

Example (c)

The modeling analysis attempts to include the impacts of existing, nearby large sources. The table below shows how such sources were handled (from a KBR email dated April 13, 2018):

Emission Source Characterization Basis for NAAQS Modeling					
Facility	Source	SO2 Emission Factor Source	NO2 Emission Factor Source	Operating Heat Release Rate Source	Remarks
AEP Rockport	MB1	EIA-923	Permit	EIA-923	SO2 EF from EIA
	MB2	EIA-923	Permit	EIA-923	SO2 EF from EIA
Alcoa Generation, Warrick	Boiler 1	EIA-923	Permit	EIA-923	SO2 EF from EIA
	Boiler 2	EIA-923	Permit	EIA-923	SO2 EF from EIA
	Boiler 3	EIA-923	Permit	EIA-923	SO2 EF from EIA
	Boiler 4	EIA-923	EIA-923	EIA-923	SO2 EF from EIA NO2 EF from EIA
IPL Petersburg	Boiler 1	Permit	Permit	EIA-923	
	Boiler 2	Permit	EIA-923	EIA-923	NO2 EF not in permit. EF based on EIA-923 reflecting use of SCR
	Boiler 3	Permit	EIA-923	EIA-923	
	Boiler 4	Permit	Permit	EIA-923	

Emissions from sources above are based on Department of Energy, Energy Information Administration form EIA-923 data – that is they are not maximum or allowable emissions but rather snapshot actual emissions.

This is incorrect. Maximum allowable emissions from these nearby large sources should have been modeled instead of actual emissions, per the appropriate regulatory guidance.[9]

In summary, there are significant and fatal flaws associated with the modeling analysis that accompanies the proposed permit.

[9] 82 FR 5220, January 17, 2017.

Attachment A

RANAJIT (RON) SAHU, Ph.D, QEP, CEM (Nevada)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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EXPERIENCE SUMMARY

Dr. Sahu has over twenty eight years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over twenty five years of project management experience and has successfully managed and executed numerous projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past twenty five years include various trade associations as well as individual companies such as steel mills, petroleum refineries, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, and various entities in the public sector including EPA, the US Dept. of Justice, several states, various agencies such as the California DTSC, various municipalities, etc.). Dr. Sahu has performed projects in all 50 states, numerous local jurisdictions and internationally.

In addition to consulting, Dr. Sahu has taught numerous courses in several Southern California universities including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management) for the past seventeen years. In this time period he has also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.) public sector (such as the US Department of Justice) and public interest group clients with project management, air quality consulting, waste remediation and management consulting, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena. Responsible for the management of a group of approximately 24 air quality and environmental professionals, 15 geoscience, and 10 hazardous waste professionals providing full-service consulting, project management, regulatory compliance and A/E design assistance in all areas.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department. Responsibilities included multimedia regulatory compliance and permitting (including hazardous and nuclear materials), air pollution engineering (emissions from stationary and mobile sources, control of criteria and air toxics, dispersion modeling, risk assessment, visibility analysis, odor analysis), supervisory functions and project management.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department. Responsibilities included permitting, tracking regulatory issues, technical analysis, and supervisory functions on numerous air, water, and hazardous waste projects. Responsibilities also include client and agency interfacing, project cost and schedule control, and reporting to internal and external upper management regarding project status.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, Caltech, Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

“Thermodynamics and Heat Transfer,” Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years since 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992-present.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-present.

Air and Waste Management Association, West Coast Section, 1989-present.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, since 2000.

CEM, State of Nevada (#EM-1699). Expiration 10/07/2017.

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

“From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada,” with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

“The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants,” with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).

6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).

7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc*., 5:04-cv-00034-KSF (Eastern District of Kentucky).

9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of

Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc*., 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority,* Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.,* Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.,* Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et. al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).

53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association,* Case No. 11-417-MJP (Western District of Washington).

54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency,* Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.,* Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Respondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*

85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et. al., (Petitioners) v. EPA et. al., Utility Air Regulatory Group (Petitioners) v. EPA et. al., National Mining Association et. al., (Petitioner) v. EPA et. al.,* (Supreme Court of the United States).

87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.

89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;" Declaration (October 2015) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners' Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.

93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.

95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.,* ERAC Case No. 14-256814.

96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.

97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.

100. Declaration (December 2016) relating to EPA's refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180.* (D.C. Circuit Court of Appeals).

101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).

107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant), Case No. 4:16-CV-1544-BYP*, (US District Court for the Northern District of Ohio, Eastern Division).

108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant),* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.

111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.

113. Expert Report (Harm Phase) (January 2018) and Rebuttal Expert Report (Harm Phase) (May 2018) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).

115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

C. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

117. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

118. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

119. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

120. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

121. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

122. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

123. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

124. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

125. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

126. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

127. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

128. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al*.

129. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

130. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

131. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

132. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

133. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

134. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

135. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

136. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

137. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs)

in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

138. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

139. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

140. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

141. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

142. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

143. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

144. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

145. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

146. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

147. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

148. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

149. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

150. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

151. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

152. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

153. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

154. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

155. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

156. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

157. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

158. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

159. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

160. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

161. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

162. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

163. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

164. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).

165. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

166. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

167. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

168. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

169. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

170. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

171. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

172. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

173. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

174. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

175. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.

176. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

177. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

Attachment B to Sahu Report

1.4 Natural Gas Combustion

1.4.1 General[1-2]

Natural gas is one of the major combustion fuels used throughout the country. It is mainly used to generate industrial and utility electric power, produce industrial process steam and heat, and heat residential and commercial space. Natural gas consists of a high percentage of methane (generally above 85 percent) and varying amounts of ethane, propane, butane, and inerts (typically nitrogen, carbon dioxide, and helium). The average gross heating value of natural gas is approximately 1,020 British thermal units per standard cubic foot (Btu/scf), usually varying from 950 to 1,050 Btu/scf.

1.4.2 Firing Practices[3-5]

There are three major types of boilers used for natural gas combustion in commercial, industrial, and utility applications: watertube, firetube, and cast iron. Watertube boilers are designed to pass water through the inside of heat transfer tubes while the outside of the tubes is heated by direct contact with the hot combustion gases and through radiant heat transfer. The watertube design is the most common in utility and large industrial boilers. Watertube boilers are used for a variety of applications, ranging from providing large amounts of process steam, to providing hot water or steam for space heating, to generating high-temperature, high-pressure steam for producing electricity. Furthermore, watertube boilers can be distinguished either as field erected units or packaged units.

Field erected boilers are boilers that are constructed on site and comprise the larger sized watertube boilers. Generally, boilers with heat input levels greater than 100 MMBtu/hr, are field erected. Field erected units usually have multiple burners and, given the customized nature of their construction, also have greater operational flexibility and NO_x control options. Field erected units can also be further categorized as wall-fired or tangential-fired. Wall-fired units are characterized by multiple individual burners located on a single wall or on opposing walls of the furnace while tangential units have several rows of air and fuel nozzles located in each of the four corners of the boiler.

Package units are constructed off-site and shipped to the location where they are needed. While the heat input levels of packaged units may range up to 250 MMBtu/hr, the physical size of these units are constrained by shipping considerations and generally have heat input levels less than 100 MMBtu/hr. Packaged units are always wall-fired units with one or more individual burners. Given the size limitations imposed on packaged boilers, they have limited operational flexibility and cannot feasibly incorporate some NO_x control options.

Firetube boilers are designed such that the hot combustion gases flow through tubes, which heat the water circulating outside of the tubes. These boilers are used primarily for space heating systems, industrial process steam, and portable power boilers. Firetube boilers are almost exclusively packaged units. The two major types of firetube units are Scotch Marine boilers and the older firebox boilers. In cast iron boilers, as in firetube boilers, the hot gases are contained inside the tubes and the water being heated circulates outside the tubes. However, the units are constructed of cast iron rather than steel. Virtually all cast iron boilers are constructed as package boilers. These boilers are used to produce either low-pressure steam or hot water, and are most commonly used in small commercial applications.

Natural gas is also combusted in residential boilers and furnaces. Residential boilers and furnaces generally resemble firetube boilers with flue gas traveling through several channels or tubes with water or air circulated outside the channels or tubes.

1.4.3 Emissions[3-4]

The emissions from natural gas-fired boilers and furnaces include nitrogen oxides (NO_x), carbon monoxide (CO), and carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), volatile organic compounds (VOCs), trace amounts of sulfur dioxide (SO_2), and particulate matter (PM).

Nitrogen Oxides -

Nitrogen oxides formation occurs by three fundamentally different mechanisms. The principal mechanism of NO_x formation in natural gas combustion is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most NO_x formed through the thermal NO_x mechanism occurs in the high temperature flame zone near the burners. The formation of thermal NO_x is affected by three furnace-zone factors: (1) oxygen concentration, (2) peak temperature, and (3) time of exposure at peak temperature. As these three factors increase, NO_x emission levels increase. The emission trends due to changes in these factors are fairly consistent for all types of natural gas-fired boilers and furnaces. Emission levels vary considerably with the type and size of combustor and with operating conditions (e.g., combustion air temperature, volumetric heat release rate, load, and excess oxygen level).

The second mechanism of NO_x formation, called prompt NO_x, occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible when compared to the amount of NO_x formed through the thermal NO_x mechanism. However, prompt NO_x levels may become significant with ultra-low-NO_x burners.

The third mechanism of NO_x formation, called fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Due to the characteristically low fuel nitrogen content of natural gas, NO_x formation through the fuel NO_x mechanism is insignificant.

Carbon Monoxide -

The rate of CO emissions from boilers depends on the efficiency of natural gas combustion. Improperly tuned boilers and boilers operating at off-design levels decrease combustion efficiency resulting in increased CO emissions. In some cases, the addition of NO_x control systems such as low NO_x burners and flue gas recirculation (FGR) may also reduce combustion efficiency, resulting in higher CO emissions relative to uncontrolled boilers.

Volatile Organic Compounds -

The rate of VOC emissions from boilers and furnaces also depends on combustion efficiency. VOC emissions are minimized by combustion practices that promote high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air. Trace amounts of VOC species in the natural gas fuel (e.g., formaldehyde and benzene) may also contribute to VOC emissions if they are not completely combusted in the boiler.

Sulfur Oxides -

Emissions of SO_2 from natural gas-fired boilers are low because pipeline quality natural gas typically has sulfur levels of 2,000 grains per million cubic feet. However, sulfur-containing odorants are added to natural gas for detecting leaks, leading to small amounts of SO_2 emissions. Boilers combusting unprocessed natural gas may have higher SO_2 emissions due to higher levels of sulfur in the natural gas. For these units, a sulfur mass balance should be used to determine SO_2 emissions.

Particulate Matter -

Because natural gas is a gaseous fuel, filterable PM emissions are typically low. Particulate matter from natural gas combustion has been estimated to be less than 1 micrometer in size and has filterable and condensable fractions. Particulate matter in natural gas combustion are usually larger molecular weight hydrocarbons that are not fully combusted. Increased PM emissions may result from poor air/fuel mixing or maintenance problems.

Greenhouse Gases -[6-9]

CO_2, CH_4, and N_2O emissions are all produced during natural gas combustion. In properly tuned boilers, nearly all of the fuel carbon (99.9 percent) in natural gas is converted to CO_2 during the combustion process. This conversion is relatively independent of boiler or combustor type. Fuel carbon not converted to CO_2 results in CH_4, CO, and/or VOC emissions and is due to incomplete combustion. Even in boilers operating with poor combustion efficiency, the amount of CH_4, CO, and VOC produced is insignificant compared to CO_2 levels.

Formation of N_2O during the combustion process is affected by two furnace-zone factors. N_2O emissions are minimized when combustion temperatures are kept high (above 1475°F) and excess oxygen is kept to a minimum (less than 1 percent).

Methane emissions are highest during low-temperature combustion or incomplete combustion, such as the start-up or shut-down cycle for boilers. Typically, conditions that favor formation of N_2O also favor emissions of methane.

1.4.4 Controls[4,10]

NO_x Controls -

Currently, the two most prevalent combustion control techniques used to reduce NO_x emissions from natural gas-fired boilers are flue gas recirculation (FGR) and low NO_x burners. In an FGR system, a portion of the flue gas is recycled from the stack to the burner windbox. Upon entering the windbox, the recirculated gas is mixed with combustion air prior to being fed to the burner. The recycled flue gas consists of combustion products which act as inerts during combustion of the fuel/air mixture. The FGR system reduces NO_x emissions by two mechanisms. Primarily, the recirculated gas acts as a dilutent to reduce combustion temperatures, thus suppressing the thermal NO_x mechanism. To a lesser extent, FGR also reduces NO_x formation by lowering the oxygen concentration in the primary flame zone. The amount of recirculated flue gas is a key operating parameter influencing NO_x emission rates for these systems. An FGR system is normally used in combination with specially designed low NO_x burners capable of sustaining a stable flame with the increased inert gas flow resulting from the use of FGR. When low NO_x burners and FGR are used in combination, these techniques are capable of reducing NO_x emissions by 60 to 90 percent.

Low NO_x burners reduce NO_x by accomplishing the combustion process in stages. Staging partially delays the combustion process, resulting in a cooler flame which suppresses thermal NO_x formation. The two most common types of low NO_x burners being applied to natural gas-fired boilers are staged air burners and staged fuel burners. NO_x emission reductions of 40 to 85 percent (relative to uncontrolled emission levels) have been observed with low NO_x burners.

Other combustion control techniques used to reduce NO_x emissions include staged combustion and gas reburning. In staged combustion (e.g., burners-out-of-service and overfire air), the degree of staging is a key operating parameter influencing NO_x emission rates. Gas reburning is similar to the use of overfire in the use of combustion staging. However, gas reburning injects additional amounts of natural gas in the upper furnace, just before the overfire air ports, to provide increased reduction of NO_x to NO_2.

Two postcombustion technologies that may be applied to natural gas-fired boilers to reduce NO_x emissions are selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR). The SNCR system injects ammonia (NH_3) or urea into combustion flue gases (in a specific temperature zone) to reduce NO_x emission. The Alternative Control Techniques (ACT) document for NO_x emissions from utility boilers, maximum SNCR performance was estimated to range from 25 to 40 percent for natural gas-fired boilers.[12] Performance data available from several natural gas fired utility boilers with SNCR show a 24 percent reduction in NO_x for applications on wall-fired boilers and a 13 percent reduction in NO_x for applications on tangential-fired boilers.[11] In many situations, a boiler may have an SNCR system installed to trim NO_x emissions to meet permitted levels. In these cases, the SNCR system may not be operated to achieve maximum NO_x reduction. The SCR system involves injecting NH_3 into the flue gas in the presence of a catalyst to reduce NO_x emissions. No data were available on SCR performance on natural gas fired boilers at the time of this publication. However, the ACT Document for utility boilers estimates NO_x reduction efficiencies for SCR control ranging from 80 to 90 percent.[12]

Emission factors for natural gas combustion in boilers and furnaces are presented in Tables 1.4-1, 1.4-2, 1.4-3, and 1.4-4.[11] Tables in this section present emission factors on a volume basis ($lb/10^6$ scf). To convert to an energy basis (lb/MMBtu), divide by a heating value of 1,020 MMBtu/10^6 scf. For the purposes of developing emission factors, natural gas combustors have been organized into three general categories: large wall-fired boilers with greater than 100 MMBtu/hr of heat input, boilers and residential furnaces with less than 100 MMBtu/hr of heat input, and tangential-fired boilers. Boilers within these categories share the same general design and operating characteristics and hence have similar emission characteristics when combusting natural gas.

Emission factors are rated from A to E to provide the user with an indication of how "good" the factor is, with "A" being excellent and "E" being poor. The criteria that are used to determine a rating for an emission factor can be found in the Emission Factor Documentation for AP-42 Section 1.4 and in the introduction to the AP-42 document.

1.4.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section are summarized below. For further detail, consult the Emission Factor Documentation for this section. These and other documents can be found on the Emission Factor and Inventory Group (EFIG) home page (http://www.epa.gov/ttn/chief).

Supplement D, March 1998

- Text was revised concerning Firing Practices, Emissions, and Controls.
- All emission factors were updated based on 482 data points taken from 151 source tests. Many new emission factors have been added for speciated organic compounds, including hazardous air pollutants.

July 1998 - minor changes

- Footnote D was added to table 1.4-3 to explain why the sum of individual HAP may exceed VOC or TOC, the web address was updated, and the references were reordered.

Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NO_x) AND CARBON MONOXIDE (CO) FROM NATURAL GAS COMBUSTION[a]

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO_x[b]		CO	
	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-006-01, 1-03-006-01]				
Uncontrolled (Pre-NSPS)[c]	280	A	84	B
Uncontrolled (Post-NSPS)[c]	190	A	84	B
Controlled - Low NO_x burners	140	A	84	B
Controlled - Flue gas recirculation	100	D	84	B
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]				
Uncontrolled	100	B	84	B
Controlled - Low NO_x burners	50	D	84	B
Controlled - Low NO_x burners/Flue gas recirculation	32	C	84	B
Tangential-Fired Boilers (All Sizes) [1-01-006-04]				
Uncontrolled	170	A	24	C
Controlled - Flue gas recirculation	76	D	98	D
Residential Furnaces (<0.3) [No SCC]				
Uncontrolled	94	B	40	B

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. Emission factors are based on an average natural gas higher heating value of 1,020 Btu/scf. To convert from $lb/10^6$ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. SCC = Source Classification Code. ND = no data. NA = not applicable.

[b] Expressed as NO_2. For large and small wall fired boilers with SNCR control, apply a 24 percent reduction to the appropriate NO_X emission factor. For tangential-fired boilers with SNCR control, apply a 13 percent reduction to the appropriate NO_X emission factor.

[c] NSPS=New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction modification, or reconstruction after June 19, 1984.

TABLE 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION[a]

Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
CO_2[b]	120,000	A
Lead	0.0005	D
N_2O (Uncontrolled)	2.2	E
N_2O (Controlled-low-NO_X burner)	0.64	E
PM (Total)[c]	7.6	D
PM (Condensable)[c]	5.7	D
PM (Filterable)[c]	1.9	B
SO_2[d]	0.6	A
TOC	11	B
Methane	2.3	B
VOC	5.5	C

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $lb/10^6$ scf to 1b/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. TOC = Total Organic Compounds. VOC = Volatile Organic Compounds.

[b] Based on approximately 100% conversion of fuel carbon to CO_2. $CO_2[lb/10^6 scf] = (3.67) (CON) (C)(D)$, where CON = fractional conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.76), and D = density of fuel, $4.2x10^4$ $lb/10^6$ scf.

[c] All PM (total, condensible, and filterable) is assumed to be less than 1.0 micrometer in diameter. Therefore, the PM emission factors presented here may be used to estimate PM_{10}, $PM_{2.5}$ or PM_1 emissions. Total PM is the sum of the filterable PM and condensible PM. Condensible PM is the particulate matter collected using EPA Method 202 (or equivalent). Filterable PM is the particulate matter collected on, or prior to, the filter of an EPA Method 5 (or equivalent) sampling train.

[d] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content is natural gas of 2,000 grains/10^6 scf. The SO_2 emission factor in this table can be converted to other natural gas sulfur contents by multiplying the SO_2 emission factor by the ratio of the site-specific sulfur content (grains/10^6 scf) to 2,000 grains/10^6 scf.

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION[a]

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
91-57-6	2-Methylnaphthalene[b, c]	2.4E-05	D
56-49-5	3-Methylcholanthrene[b, c]	<1.8E-06	E
	7,12-Dimethylbenz(a)anthracene[b,c]	<1.6E-05	E
83-32-9	Acenaphthene[b,c]	<1.8E-06	E
203-96-8	Acenaphthylene[b,c]	<1.8E-06	E
120-12-7	Anthracene[b,c]	<2.4E-06	E
56-55-3	Benz(a)anthracene[b,c]	<1.8E-06	E
71-43-2	Benzene[b]	2.1E-03	B
50-32-8	Benzo(a)pyrene[b,c]	<1.2E-06	E
205-99-2	Benzo(b)fluoranthene[b,c]	<1.8E-06	E
191-24-2	Benzo(g,h,i)perylene[b,c]	<1.2E-06	E
207-08-9	Benzo(k)fluoranthene[b,c]	<1.8E-06	E
106-97-8	Butane	2.1E+00	E
218-01-9	Chrysene[b,c]	<1.8E-06	E
53-70-3	Dibenzo(a,h)anthracene[b,c]	<1.2E-06	E
25321-22-6	Dichlorobenzene[b]	1.2E-03	E
74-84-0	Ethane	3.1E+00	E
206-44-0	Fluoranthene[b,c]	3.0E-06	E
86-73-7	Fluorene[b,c]	2.8E-06	E
50-00-0	Formaldehyde[b]	7.5E-02	B
110-54-3	Hexane[b]	1.8E+00	E
193-39-5	Indeno(1,2,3-cd)pyrene[b,c]	<1.8E-06	E
91-20-3	Naphthalene[b]	6.1E-04	E
109-66-0	Pentane	2.6E+00	E
85-01-8	Phenanathrene[b,c]	1.7E-05	D
74-98-6	Propane	1.6E+00	E

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION (Continued)

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
129-00-0	Pyrene[b, c]	5.0E-06	E
108-88-3	Toluene[b]	3.4E-03	C

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $1b/10^6$ scf to lb/MMBtu, divide by 1,020. Emission Factors preceeded with a less-than symbol are based on method detection limits.

[b] Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

[c] HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of the Clean Air Act.

[d] The sum of individual organic compounds may exceed the VOC and TOC emission factors due to differences in test methods and the availability of test data for each pollutant.

TABLE 1.4-4. EMISSION FACTORS FOR METALS FROM NATURAL GAS COMBUSTION[a]

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
7440-38-2	Arsenic[b]	2.0E-04	E
7440-39-3	Barium	4.4E-03	D
7440-41-7	Beryllium[b]	<1.2E-05	E
7440-43-9	Cadmium[b]	1.1E-03	D
7440-47-3	Chromium[b]	1.4E-03	D
7440-48-4	Cobalt[b]	8.4E-05	D
7440-50-8	Copper	8.5E-04	C
7439-96-5	Manganese[b]	3.8E-04	D
7439-97-6	Mercury[b]	2.6E-04	D
7439-98-7	Molybdenum	1.1E-03	D
7440-02-0	Nickel[b]	2.1E-03	C
7782-49-2	Selenium[b]	<2.4E-05	E
7440-62-2	Vanadium	2.3E-03	D
7440-66-6	Zinc	2.9E-02	E

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. Emission factors preceeded by a less-than symbol are based on method detection limits. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by l6. To convert from $lb/10^6$ scf to 1b/MMBtu, divide by 1,020.

[b] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

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Attachment B

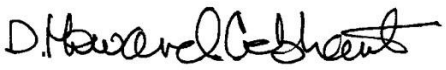
TECHNICAL COMMENTS – RIVERVIEW ENERGY DRAFT PSD PERMIT AND ASSOCIATED AIR DISPERSION MODELING EXPERT REPORT

Prepared for

Southwestern Indiana Citizens for Quality of Life
Valley Watch
Earthjustice

Prepared by

D. Howard Gebhart



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December 5, 2018

This report presents technical comments on the proposed draft Prevention of Significant Deterioration (PSD) permit issued by the Indiana Department of Environmental Management (IDEM) to Riverview Energy Corporation (Riverview); see: New Source Construction and Part 70 Operating Permit No. T147-39554-00065. Air Resource Specialists, Inc. (ARS) provides these comments on behalf of Southwestern Indiana Citizens for Quality of Life, Valley Watch, and Earthjustice.

ARS' technical comments focus on the air quality dispersion modeling and associated data inputs.

Executive Summary

The major issues with the Riverview air quality modeling are summarized below.

- The air quality modeling analysis is based on meteorological inputs from the Evansville Regional Airport (EVV) and there has not been a demonstration as per the EPA Guideline on Air Quality Models that the EVV data are adequately representative of the Riverview project site.

- There are serious concerns with the air quality modeling, in particular the emission inputs and resulting concentration estimates for SO_2, PM-10, and PM-2.5. For consistency with the EPA Guideline, emission inputs need to represent the maximum allowable emissions at all units, including during times of emergency flaring. Also, the PM-10 and PM-2.5 modeling does not adequately address peak fugitive dust emissions and the emissions credit claimed for the fugitive dust control plan is inconsistent with the specific legal requirements of that plan. Lastly, because the PM-10 modeling results also appear to be internally inconsistent, there are serious credibility issues with the modeling as a whole.

- The modeling also fails to address formation of secondary PM-2.5/PM-10 using the worst-case short-term emission rates. When the secondary PM-2.5/PM-10 formation is added to the modeling results, the PM-10 concentrations appear to exceed the significant impact level (SIL).

- Other than flaring for SO_2 emissions, the modeling fails to address startup, shutdown, and malfunction (SSM) events.

- IDEM should correct the air quality modeling demonstration based on the detailed technical comments provided herein. Furthermore, IDEM should provide an updated air quality analysis and associated air quality modeling files and allow for adequate review by the public and other interested parties. A final permit should not be issued until all modeling issues are resolved and there is an accurate demonstration that the National Ambient Air Quality Standards (NAAQS) and PSD increments will be protected.

Detailed Technical Comments

1. **The Meteorological Data Inputs to the AERMOD Dispersion Model are not Representative of the Proposed Project Site**

The dispersion modeling relies upon meteorological data inputs from the Evansville Regional Airport (EVV), located more than 30 miles (50 km) from the proposed project site. EVV is located in Vanderburgh County, while the Riverview project site is in Spencer County.

The IDEM modeling fails to conform to the US Environmental Protection Agency (EPA) Guideline on Air Quality Models (USEPA 2017), codified at 40 CFR 51 Appendix W (Guideline) in part because the modeling report submitted on behalf of the applicant and the associated IDEM technical review of the modeling failed to provide any documentation that the EVV data are adequately representative of the Riverview project site. Air dispersion modeling that does not conform to the Guideline cannot be used to support issuance of a PSD permit.

The requirements for meteorological data inputs are described at Section 8.4 of the Guideline. For data representativeness, the Guideline states:

> *The meteorological data used as input to a dispersion model should be selected on the basis of spatial and climatological (temporal) representativeness as well as the ability of the individual parameters to characterize the transport and dispersion conditions in the area of concern.*

The documentation in the IDEM file supporting the Riverview AERMOD dispersion modeling is silent on the topic of data representativeness.

In this situation, the EVV data representativeness is negatively influenced by two factors: 1) the EVV meteorological data are not in proximity to the proposed project site, and 2) the EVV meteorological data are measured at or near the surface whereas the major emission points at Riverview have stack heights of up to 200 feet.

As noted before, the EVV meteorological data are from the Evansville Regional Airport, located more than 30 miles (50 km) from the proposed plant site. As per the Guideline*: the spatial representativeness of the data can be adversely affected by large distances between the source and receptors of interest.* In this case, there are micrometeorological features at the proposed Riverview site which are not captured by the EVV data, namely a creek drainage that extends to the south of the plant site that induces local windflow patterns which tend to follow these drainages. The local project area also has rolling terrain that does not occur at or near the EVV airport site, with some of the intervening terrain occurring between the project site and EVV airport. These local topographic features influence the on-site meteorology. Since these features are not captured by the EVV data, my professional opinion as a meteorologist is that EVV data are not adequately representative of the Riverview project site.

Another problem with the EVV data is that the data are collected at or near ground level, whereas the major emission stacks at Riverview extend upwards of 200 feet in the air. Wind speed and wind direction are key parameters for accurately describing atmospheric transport and dispersion. Important meteorological parameters such as wind speed, wind direction, and others vary in their vertical profile, and data collected at or near the surface mischaracterize the atmospheric conditions that influence turbulence and dispersion from elevated stack sources. The surface-based meteorological data from EVV introduces an unknown error into the results.

Fortunately, a remedy to this problem exists under the PSD regulations and the associated EPA Guideline on Air Quality Models (Guideline), which allows for the applicant to collect site-specific meteorological data for a period on one year or more to be used as input to the air dispersion modeling. IDEM should withhold final approval of the Riverview PSD permit until on-site meteorological data is collected and then used in an adequate modeling demonstration. In order to collect the required meteorological data at or near the stack height level (200ft), the on-site monitoring program should either utilize a tall tower or Doppler acoustic SODAR.

2. The SO_2 Emission Inputs to the Modeling are Inconsistent with the Allowable Permit Limits

For the Riverview tail gas treatment unit stacks, the sulfur dioxide (SO_2) emissions limit proposed in the draft PSD permit is 26.3 lb/hr at each stack. In the modeling files, these units are identified as EU3001 and EU3002.

However, after reviewing the accompanying modeling files in the record, there were no modeling runs where the tail gas SO_2 emissions were input at the allowable emissions rate (26.3 lb/hr). All of the AERMOD modeling runs listed the EU3001 and EU3002 SO_2 emissions at something less than 26.3 lb/hr. For this analysis, I have relied on the IDEM-conducted modeling that matches the concentrations reported in IDEM's Air Quality Analysis (IDEM 2018a), which is appended to the Riverview Technical Support Document (TSD), i.e., the IDEM "sharepoint" directory files.

Based on my review of the record, IDEM addressed SO_2 modeling by including emissions during occasional flaring episodes, which is appropriate since such episodes produce higher short-term emissions. The IDEM analysis also indicates that Riverview would operate some sources at less than maximum rates during emergency flaring. However, there does not appear to be any limitation in the draft permit that would restrict Riverview's SO_2 emissions from the tail gas treatment stacks and other emission points to a lower emissions rate during flaring. Absent such a limit, the modeling should have been conducted assuming SO_2 emissions at the maximum allowable rate (i.e., 26.3 lb/hr at the tail gas treatment stacks), even during flaring episodes.

Also troubling is that the modeling files, even during non-flaring operating scenarios, have not modeled the tail gas treatment stacks at the maximum allowable SO_2 emissions rate (26.3 lb/hr). The file SO2_5yrs_SO2.LST within folder SO2_IDEM_1hr_NAAQS appears to be the AERMOD output for the "Normal Operations" modeling scenario listed in Appendix A of the IDEM Air Quality Modeling Report (Max SO_2 1-hour concentration = 23.57 micrograms per cubic meter).

However, in this file, the modeled SO_2 emissions for EU3001 and EU3002 are 2.4003 g/sec, which converts to approximately 19.0 lb/hr, not the maximum allowable SO_2 permit limit of 26.3 lb/hr. There is no explanation or justification for modeling SO_2 emissions at 19.0 lb/hr for the 'normal operations" scenario modeling. As per EPA's Guideline (USEPA 2017, Table 8-2), all emissions need to be modeled at their federally enforceable emissions limit.

IDEM should correct this error and perform new AERMOD modeling using the enforceable SO_2 emissions limit (26.3 lb/hr) at the tail gas stacks and other emission units, or the SO_2 permit limit should be reduced to match the modeled emissions rate (e.g., 19.0 lb/hr for the tail gas stacks). Similar restrictions would also be required at any other source which was not modeled at its maximum allowable SO_2 emissions rate. Even during flaring, SO_2 emissions should be modeled at the maximum allowable emissions rate, unless a more restrictive permit limit is added to the permit for these events.

3. **Peak Emissions during Flaring for Pollutants Other than SO_2 were not Addressed in the Modeling.**

Based on the modeling files provided by IDEM in the "sharepoint" directory, no modeling for flaring scenarios was conducted for pollutants other than SO_2. However, my understanding is that there are flaring scenarios that produce short-term elevated emissions for both carbon monoxide (CO) and nitrogen oxides (NOx). Based on data in the Docket, elevated CO emissions occur during flaring of reformer vent gasses to the LP flare during commissioning and/or cold startup of the hydrogen plant. Also, elevated NOx emissions can occur during flaring of purge gasses to the HP flare during commissioning and/or cold startup of the VCC Unit.

Similar to the SO_2 flaring analysis, modeling that addressed peak NOx and CO emissions during flaring should have been performed by IDEM. Without such an analysis, there is no confidence that the short-term NAAQS for NOx and CO will be protected. Please note that any comments above related to the SO_2 flaring analysis would also be applicable to any NOx and CO flaring analysis; i.e., all sources should be modeled at their maximum allowable emissions rates, even during flaring, unless the permit otherwise restricts such emissions during flaring events.

4. **Other than Flaring, There is no Accounting for Peak Short-Term Emissions tied to Startup, Shutdown, and Malfunction events.**

Like flaring, startup, shutdown, and malfunction (SSM) events can lead to elevated emissions over short-term periods. The modeling analysis fails to address possible short-term emissions from SSM outside of the flaring analysis discussed previously. Examples of a possible SSM event would be during startup of equipment where the NOx emissions are controlled using selective catalytic reduction (SCR). Because the SCR unit does not come on-line until the catalyst beds reach the proper temperature, NOx emissions normally bypass the SCR emission controls during startup. At Riverview, SCR NOx emissions control will be employed at the Hydrogen Plant. The modeling analysis needs to address these types of SSM events; otherwise, there is no confidence that the short-term NAAQS will be protected.

5. The MERPS Assessment for Secondary PM-2.5 Formation should be based on the Peak Daily Emissions Scenario (e.g., Flaring)

IDEM has included the formation of secondary PM-2.5 from precursor emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx) in the Riverview modeling analysis. The procedure appears to follow the EPA Modeled Emission Rates for Precursors (MERP) Guidance (USEPA 2016). However, the IDEM assessment appears to be based on the annual average emissions rates for SO_2 and NOx. For SO_2 and NOx, the peak daily emissions are influenced by episodic flaring and SSM events, when short-term emissions will be significantly higher.

Since PM-2.5 is evaluated on a 24-hour basis, the secondary PM-2.5 formation needs to be based on the peak short-term emissions during flaring. This can be done using the MERPs approach applied by IDEM; however, the SO_2 and NOx emissions input should instead reflect the worst-case daily emissions and not the annual emissions. The IDEM analysis already recognized the importance of periodic episodes of flaring when evaluating NAAQS/PSD increment compliance for SO_2 and the same concept should also be applied for the PM-2.5 modeling. SSM events should also be considered when applying the MERPs if the duration of the SSM event approaches 24-hours and/or otherwise significantly impacts the peak daily emission totals.

6. The Fugitive Dust Control Plan is Inadequate and does not support the Claimed 90% Reduction Credit.

The air emissions inventory and supporting dispersion modeling have a claimed 90% reduction credit for fugitive dust emissions on paved roads leading in and out of the proposed Riverview plant. Based on the fugitive dust mitigation measures described in the applicant's Fugitive Dust Control Plan, the proposed mitigation measures would only be applied "as needed". However, the 90% mitigation credit is a very high level of fugitive dust control. If a 90% credit is assumed for the purposes of the emissions inventory and modeling, then the Fugitive Dust Control Plan needs to specify an appropriate frequency that fugitive dust controls would be applied by Riverview. Given the level of emissions credit assumed, the permit should require that fugitive dust mitigation measures be applied on a daily basis and not "as needed". Also, some measurement of the effectiveness of the fugitive dust controls should be required, such as monitoring for the silt content of the dust material on the roads. Only through frequent application of mitigation measures, backed by actual compliance monitoring of the resulting silt loading, can the public be assured that the road dust emissions will be minimal, as implied by the draft permit.

Also, in terms of the fugitive dust calculations, the assumed "silt loading" for the emission calculations is 9.7 g/sq meter, which is the mean value from AP-42 for plant roads in the iron and steel industry. However, the IDEM emissions documentation incorrectly implies that its calculations used a "worst-case" AP-42 value. If the "worst-case" AP-42 value were used from the iron and steel industry, the silt loading value would have been 79 g/sq mater. If all industry groups listed in AP-42 were considered, the worst-case silt loading value would be 400 g/sq meter. Given the wide range of potential silt loading values, a silt loading value higher than 9.7 g/sq meter should have been used for the Riverview calculations.

Also, the IDEM record does not indicate whether Riverview intends to apply sand and other measures for traction control during wintertime driving conditions, nor does the permit prohibit or restrict such applications. Any such material applied to plant roads for traction control increases the silt loading for those periods and must be accounted for in the permit.

7. The IDEM PM-10 and PM-2.5 Modeling does not Account for Peak Short-Term Fugitive Dust Emissions.

In the IDEM modeling included in the Docket, I discovered that the PM-10/PM-2.5 road dust emission inputs for the 24-hour modeling appeared to be higher than the same emission inputs for the annual average modeling. After calling this to IDEM's attention, I received updated modeling information from IDEM covering the annual mean PM-10 concentrations (IDEM 2018b). Although IDEM provided the updated modeling results, the backup AERMOD modeling files were not provided, nor could I find any corresponding PM-10 modeling files in the IDEM "sharepoint" directory. IDEM should provide access to any updated PM-10 modeling files and provide sufficient time for public review of any new modeling information which was posted after the public comment period started.

Based on my understanding of the updated modeling information provided, IDEM's PM-10 and PM-2.5 modeling now uses the same fugitive dust traffic emissions inputs in the annual average and 24-hour average modeling. However, this is not technically appropriate. The worst-case 24-hour emissions should be higher than the respective annual mean emissions. For example, the "silt loading" value for the 24-hour modeling should represent a worst-case value including the effects of any traction mitigation that might be applied by the source. Also, the road traffic volumes (i.e., vehicle miles travelled) should represent a worst-case day. In its emissions calculations, IDEM included an assumption that a small percentage (5%) of the plant inputs and output would leave by truck, which accounts for possible interruptions in rail service to the plant. However, any rail interruptions are likely to extend over only a limited number of days, so the truck traffic volumes should account for a sharp increase in potential daily traffic and not be spread out evenly over the year. In the case of Riverview, the traffic volumes for the worst-case day are likely to be substantially higher than the long-term average. Lastly, the precipitation mitigation factor should be excluded when computing 24-hour fugitive dust emissions, e.g., the worst-case day would have no precipitation. IDEM needs to correct the 24-hour fugitive dust calculations as described above and repeat the dispersion modeling effort using the revised emission inputs.

8. The IDEM Updated PM-10 Modeling for Annual Average Generates Inconsistent Results when compared to the IDEM 24-hour Average PM-10 Modeling.

As noted above, IDEM corrected the annual mean PM-10 modeling, apparently because when asking for additional modeling data from IDEM in the preparation of these comments, my questions identified a potential modeling input error, i.e., inconsistent emission inputs for the fugitive dust sources between the 24-hour and annual mean PM-10 modeling.

However, my findings is that the new annual mean PM-10 modeling results provided by IDEM are inconsistent with the 24-hour average PM-10 modeling files previously posted by IDEM in the docket. These inconsistencies are such that I have little confidence that the PM-10 modeling as updated by IDEM provides accurate and realistic results.

Specifically, IDEM's updated PM-10 annual mean modeling (IDEM 2018b) identified a concentration of 0.993 micrograms per cubic meter, with the "ROAD251 source" contributing up to about 0.85 micrograms per cubic meter to the annual mean total. In the original IDEM modeling presented in the Docket, the annual mean PM-10 concentration was listed at 0.41 micrograms per cubic meter. Also, the supporting modeling files for the PM-10 annual mean modeling showed virtually zero contribution from the fugitive dust sources.

By comparison, the peak 24-hour average PM-10 concentration is listed by IDEM as 2.18 micrograms per cubic meter (IDEM 2018a, Table 2). To my knowledge, IDEM has not revised the 24-hour PM-10 modeling. However, in the supporting modeling files found in the "sharepoint" directory, the ROAD251 contribution is listed as having a maximum 24-hour value of 0.078 micrograms per cubic meter. This is about one order of magnitude less than the contribution of ROAD251 to the annual mean PM-10 concentration. The maximum 24-hour concentration should never be less than the annual mean concentration in the modeling. IDEM needs to recheck the emission inputs for the annual mean and 24-hour mean PM-10 modeling and resolve this inconsistency. Until this occurs and the modeling results are internally consistent, I have zero confidence that the PM-10 modeling has been done correctly.

Likewise, IDEM should also review the PM-2.5 modeling inputs to assure that a similar error is not present in the PM-2.5 modeling.

With respect to both Comment #7 and #8, IDEM should review the daily PM-10/PM-2.5 data for fugitive dust emissions to ensure that the emission inputs are correct and that the worst-case daily PM-10/PM-2.5 emissions are appropriately captured. IDEM should also provide the basis for its revised calculations to the public and allow an opportunity for public comment and review prior to finalizing the permit. Lastly, because the updated annual PM-10 modeling listed concentrations at over 99% of the SIL, the SIL would likely be exceeded after any secondary PM-10 formation is considered following the MERPs approach. Exceeding the SIL would trigger a cumulative PM-10 modeling analysis, which to date has not been performed by IDEM or the applicant.

9. The Background Concentrations were not taken from the most Representative Monitoring Location.

Based on the IDEM Air Quality Analysis (IDEM 2018a, Table 4), the background concentration for nitrogen dioxide (NO_2) was taken from an IDEM monitor located near South Bend, IN. My understanding is that IDEM also monitors NO_2 at its Evansville monitoring site (1110 West Buena Vista Road). The Evansville site also appears to be the location for the background SO_2 monitoring data selected by IDEM. Furthermore, IDEM's website indicates that NO_2 data at the Evansville site date back to July 2009 and the IDEM website also suggests the availability of historical NO_2 monitoring data for a location near Hope, IN.

IDEM should reevaluate the background NO_2 concentrations and use a more representative site, or at least provide some explanation as to why the South Bend data was the best choice for the Riverview project site.

In lieu of background data from monitoring collected some distance from the Riverside site, IDEM should instead require that the applicant install on-site monitoring to collect one year of ambient concentration data for all pollutants where the Riverview project exceeds the PSD "significance" levels. This monitoring could coincide with the meteorological monitoring recommended previously in my comments. I note that since VOC emissions exceed 100 tpy, Riverside does not qualify for the "deminimis" monitoring exemption for ozone allowed under 40 CFR 52.21(i)(8). Compliance with 40 CFR 51.21(i)(8) has not been addressed by IDEM in its air quality analysis.

10. The VOC Emissions Calculations need to be Supported by Appropriate Permit Conditions

In the volatile organic compound (VOC) emission calculations for fugitive leaks (TSD Appendix A, Page 40 of 43), a 100% control efficiency is assigned on the basis of installing specific emission mitigation strategies for selected equipment, such as closed loop sampling on sampling connections and installation of blinds, caps, plugs, or second valves on open ended lines.

IDEM claims that the 100% control value is supported by other documentation (EPA 1995). However, a 100% control level is by all common sense measures, unrealistic. All equipment is subject to failure and potential leaks, even when such equipment is designed to high engineering standards. IDEM should choose a realistic control level other than 100% to account for the potential that leaks will occur in the future, especially as equipment ages.

Notwithstanding the above concerns, if a VOC control factor at or near 100% is assigned in the IDEM permit review, the permit itself needs to also specifically require that any mitigation practices assumed in the emission calculations will actually be installed by Riverview, i.e., closed loop sampling on sampling connections and installation of blinds, caps, plugs, or second valves on open ended lines. Also, any failure of the equipment that results in <u>any</u> leakage of VOCs/HAPs to the environment should constitute a permit violation if the 100% control value is retained.

11. The HAP Emission Calculations for Fugitive Leaks Need to be Supported through Permit Monitoring, Reordkeeping, and Reporting.

The VOC calculations for HAPs are based on the assumed weight percent of the VOCs for selected HAPs. In fact, the HAP emissions from fugitive leaks total up to around 20 tons per year, making such emissions potentially significant. How will the HAP percentage assumptions used in the emission calculations be verified? The final permit should require appropriate sampling and monitoring to assure that the HAP emissions for leaking equipment do not exceed the calculated values.

12. The VISCREEN Modeling is not based on a Reasonable Worst-Case Condition

The IDEM Air Quality Analysis (Table 9) lists the results of a local (Class II) visibility analysis performed by IDEM. Upon request, IDEM provided the VISCREEN model output files upon which Table 9 was based. The background visual range used in the IDEM VISCREEN modeling was 25 km, which implies a very hazy background visual condition. Using a background visual range of only 25 km underestimates the true visibility effects from any new emission sources.

IDEM provided a citation for their background visual range (USEPA 1992). However, this document is outdated and the information presented does not reflect current visibility conditions, which have improved greatly over the last 20-plus years as emission controls have been instituted on coal-fired electric generating units and other large emission units.

My recommendation is to use a mean visual range based on nearby visibility monitoring data. There is an IMPROVE visibility monitor at Mammoth Cave National Park that provides such information for the current environmental conditions. Based on IMPROVE visibility data obtained at https://views.cira.colostate.edu, the mean visual range at Mammoth Cave NP is around 70 km. Any visibility analysis should use the mean visual range (70 km), otherwise the data are meaningless in terms of describing the actual visibility impact from the proposed Riverview project.

13. The Air Quality Modeling Analysis Should Include all nearby NOx and SO_2 emission Sources, including Secondary Emissions from Mobile Sources.

The air quality modeling analysis must include all project-related emissions and other nearby emission sources, including any secondary emissions from mobile sources. While mobile source emissions are not regulated by the Riverview PSD permit, they do impact local ambient air quality levels and as such, need to be addressed in the modeling. Based on the EPA Toxic Release Inventory (TRI) Explorer (https://iaspub.epa.gov), Spencer County Indiana ranks as the 30th highest county in the United States for toxic releases to the environment. This fact demonstrates that other nearby sources contribute to local environmental contamination and that a comprehensive cumulative impact analysis is critical to the NAAQS/PSD compliance demonstration.

In the case of the proposed Riverview project, mobile source emissions of significance include rail and/or truck traffic entering and leaving the facility. These emissions are new and will occurr subsequent to the PSD minor source baseline date. Based on information from IDEM (2018b), the PSD minor source baseline date was triggered in 1996, except for SO_2 where the current Riverview application becomes the PSD minor source baseline date trigger. For background information on minor source baseline dates and PSD increment consumption, please refer to USEPA (1990), aka "The Puzzle Book".

Based on USEPA (1990), PSD increment consumption includes *actual emission increases at any stationary source, area source, or mobile source occurring after the minor source baseline date*. That definition means that any new source, including any mobile sources, consumes PSD increment if these emissions were new and subsequent to the minor source baseline date.

Riverview plans to supply raw materials and ship out resulting products via rail. The rail traffic emissions are also new and subsequent to the applicable PSD baseline date (including any associated SO_2 emissions) and as such, the rail traffic emissions consume PSD increment. IDEM needs to quantify the associated rail traffic emissions and include these emissions in a revised air dispersion modeling effort. This modeling also needs to address "worst-case" hourly SO_2 and NOx emissions tied to rail/truck traffic in order to adequately assess compliance with the 1-hour average SO_2 and NO_2 NAAQS. Furthermore, the increased rail traffic at Riverview constitutes "secondary emissions" under the PSD regulations and any PSD source impact analysis must include any impacts from "secondary emissions". To date, this analysis has not been done by the applicant or by IDEM.

Because these rail/truck traffic SO_2 and NOx emissions consume PSD increment, the associated air quality impacts cannot be accounted for using only background concentration measurements.

Lastly, there are several very large coal-fired electric generating stations and other large sources of SO_2 and NOx emissions which were not included in the cumulative IDEM modeling assessment for NAAQS and PSD increment compliance, specifically:

- Duke Energy Gibson Station
- TVA Paradise Plant
- Big Rivers DB Wilson Plant
- Vectren's AB Brown plant
- Big Rivers Reid and Henderson MPL
- Big Rivers Coleman Plant

References

EPA, 1990. New Source Review Workshop Manual. US Environmental Protection Agency, Office of Air Quality Planning and Standards, October 1990.

EPA, 1992. Workbook for Plume Visual Impact Screening and Analysis. US Environmental Protection Agency, Office of Air Quality Planning and Standards, October 1992, EPA-454/R-92-023.

EPA, 1995. Protocol for Equipment Leak Emission Estimates. US Environmental Protection Agency, Office of Air Quality Planning and Standards, November 1995, EPA-453/R-95-017.

EPA, 2016. Guidance on the Development pf Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and PM-2.5 under the PSD Permitting Program. Memorandum from Richard Wayland, Division Director, Air Quality Assessment Division, US Environmental Protection Agency, Office of Air Quality Planning and Standards, December 2, 2016

EPA, 2017. Guideline on Air Quality Models, Codified at 40 CFR 51 Appendix W. Federal Register, January 17, 2017.

IDEM, 2018a. Air Quality Analysis, Riverview Energy Corporation, Dale, IN (Spencer County), Tracking and Plant ID 147-39554-00065.

IDEM, 2018b. Personal Communication. Email from Doug Logan, IDEM Office of Air Quality to Howard Gebhart dated November 29, 2018.

D HOWARD GEBHART

Environmental Compliance Section Manager

EDUCATION

M.S. Meteorology, University of Utah 1979
B.S. Professional Meteorology, Saint Louis University 1976

MEMBERSHIPS

Air & Waste Management Association
National Weather Association
Colorado Mining Association
Nebraska Industrial Council on Environment

EXPERIENCE SUMMARY

Mr. Gebhart has over 35 years' experience in air quality permitting and compliance specializing in issues technical and regulatory affecting regulated industries. Howard manages the environmental compliance section at ARS, where he provides technical studies and evaluations; and prepares models, client permit applications, air emission calculations, and performs multi-discipline environmental audits. He is very experienced in working with the federal Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act (RCRA), and similar programs enacted in states throughout the U.S.

Howard also acts as an Expert Witness in legal proceedings involving the Clean Air Act and is a recognized technical expert in air dispersion modeling.

PROJECT EXPERIENCE

- Manages the Environmental Compliance Section team.
- Produces and manages quality assurance documents including quality management plans and quality assurance project plans.
- Provides technical studies and evaluations, including air dispersion modeling, permit application preparation, emissions inventories, regulatory analysis and interpretation, and environmental audits.
- Prepares applications for new source permits under federal Prevention of Significant Deterioration (PSD) and state construction and operating permit programs.
- Provides technical studies supporting Environmental Impact Statements (EISs) and Environmental Assessments (EAs) under the National Environmental Policy Act (NEPA).
- Performs air pathway evaluations for releases of hazardous air pollutants from Superfund sites, hazardous waste sites, and incinerators. Models the potential consequences of accidental releases of hazardous materials.
- Performs multi-discipline environmental audits at regulated industrial facilities.
- Manages air quality and environmental permitting studies for biofuel (ethanol and biodiesel), oil & gas exploration and production, mining and minerals, general manufacturing, and a variety of other industries with experience representing both government and private-sector clients.

Attachment C

REQUEST FOR PUBLIC RECORD

State Form 55542 (R / 2-17)
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Date (*month, day, year*)	IDEM Program Area (*Check all that apply, if known.*)
June 19, 2018	☐ Air ☐ Land ☐ Program services ☐ Water

Requester Name			
Charles McPhedran			
Requester Firm/Organization (*if applicable*)			
Earthjustice			
Requester Address (*number and street*)	City	State	ZIP Code
1617 JFK Boulevard, Suite 1130	Philadelphia	PA	19103
Requester Telephone Number (*e.g. business, home, cell*)	Requester E-mail Address		
215-717-4521	cmcphedran@earthjustice.org		

*Please indicate the name and e-mail address **or** mailing address where the record(s) should be sent, if different from the requester above.*
Same as above

Identify in **detail** the record(s)/document(s) that you are requesting: (*Use additional pages if necessary.*)

All records regarding Riverview Energy Corporation, including but not limited to: all correspondence, including letters and e-mails (keyword "Riverview Energy"); all permit applications and other permit submissions; notes, including from meetings and telephone calls; all materials regarding Veba Combi Cracker (VCC) technology; and all air quality modeling information including modeling inputs.

Prior to submitting this request, we have searched the Virtual File Cabinet for "Riverview Energy".

Please send responsive documents by e-mail as they are identified.

Documents will be shared with Valley Watch, Evansville. Fee waiver requested.

Mail/Fax/E-mail/Drop off your public record request to:

IDEM Office of Records Management (ORM)
Indiana Government Center North, Room 1207
100 North Senate Avenue, MC 60-01
Indianapolis, Indiana 46204

Telephone Number: (317) 232-8667
Fax Number: (317) 233-6647
E-mail Address: IDEMFILEROOM@idem.IN.gov

Please Note:
The ORM will not charge any requester for copying and printing the first 100 black and white 8.5" x 11" paper pages or less produced within one (1) calendar year per requester, for e-mailing electronic records or for retrieving records from the Virtual File Cabinet (VFC). IDEM maintains the VFC, which is a searchable online repository for the vast majority of the Agency's public records. It is a free service and can be accessed at http://vfc.idem.in.gov/.

Fees:

There is no fee for inspection and viewing of records within the VFC. Records obtained through the ORM could be subject to fees. Please see the back of this form for more information.

Requests for Disclosure of Public Records Guidelines:

General Rule: All records of a public agency are public records and must be disclosed upon request, unless the request falls under an exception provided by the Access to Public Records Act (APRA) of Indiana (codified in Indiana Code § 5-14-3). A public agency must state that a record falls under an identified APRA exception in order to withhold a specific record.

All Requests: The APRA requires that all requests for inspection or copying of public records must identify those records with "reasonable particularity." This means a request must include a description of a record with enough detail to allow agency staff to locate and produce the requested record.

Response by Agency: The APRA requires a public agency to respond to requests within a specified time.

> Important Note: This response does not mean that the requested record must be produced at that time. First, the agency must, at a minimum, acknowledge receipt of a request. Second, the record(s), if disclosable, must be produced within a "reasonable time" after the request is received.

Request for E-mails: The requester must provide enough information to allow IDEM to search for, locate, and retrieve the records requested. The requester should list the sender(s) and recipient(s), keywords or subject matter, and limit the request to a reasonable timeframe. Listing a specific entity and/or IDEM branch as sender and/or recipient may be sufficient for IDEM to locate and retrieve the records. Please be advised that the general retention period for IDEM e-mails is three (3) years, unless otherwise required under another retention schedule or pursuant to statute. If your request for e-mails is not sufficiently specific, IDEM reserves the right to deny it or seek further clarification.

Records That Do Not Exist: Under the APRA, an agency is not required to create any record(s) in response to a public record request. An agency is only required to disclose existing records.

Fees: Public agencies may charge fees for copies. No fees may be charged for inspection.

The fee schedule for copying or printing records, including scanning records to produce an electronic version, is as follows:

- $.10 per one-sided page for standard sized 8.5″ x 11″ paper records after the first 100 pages;
- $5.00 per compact disc, digital video disc or diskette for copying of records onto an electronic storage medium; and
- $.70 per one-sided black and white copy page for non-standard sized paper records (larger than 8.5″ x 11″).

> Important Note: The fees set forth above are pursuant to Indiana Code § 5-14-3-8. The ORM requires payment for fees in advance. Acceptable forms of payment are: check, money order, Visa and MasterCard. The processing service charge fee for all credit card payments is $1 plus 2%. You will be notified in advance if there is a fee to fulfill your public record request.

ORM Office Hours: ORM office hours are 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding State holidays.

Attachment D

REQUEST FOR PUBLIC RECORD

State Form 55542 (R / 2-17)
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Date (*month, day, year*)	IDEM Program Area (*Check all that apply, if known.*)
November 14, 2018	☐ Air ☐ Land ☐ Program services ☐ Water

Requester Name			
Charles McPhedran			
Requester Firm/Organization (*if applicable*)			
Earthjustice			
Requester Address (*number and street*)	City	State	ZIP Code
1617 JFK Boulevard, Suite 1130	Philadelphia	PA	19103
Requester Telephone Number (*e.g. business, home, cell*)	Requester E-mail Address		
215-717-4521	cmcphedran@earthjustice.org		

*Please indicate the name and e-mail address **or** mailing address where the record(s) should be sent, if different from the requester above.*
Same as above

Identify in **detail** the record(s)/document(s) that you are requesting: (*Use additional pages if necessary.*)

All records regarding Riverview Energy Corporation, including but not limited to: all correspondence, including letters and e-mails (keyword "Riverview Energy"); all permit applications and other permit submissions; notes, including from meetings and telephone calls; all materials regarding Veba Combi Cracker (VCC) technology; and all air quality modeling information including modeling inputs.

Prior to submitting this request, we have searched the Virtual File Cabinet for "Riverview Energy".

Please send responsive documents by e-mail as they are identified. Documents will be shared with Valley Watch, Evansville, and Southwestern Indiana Citizens for Quality of Life, Dale. Fee waiver requested.

Mail/Fax/E-mail/Drop off your public record request to:

IDEM Office of Records Management (ORM)
Indiana Government Center North, Room 1207
100 North Senate Avenue, MC 60-01
Indianapolis, Indiana 46204

Telephone Number: (317) 232-8667
Fax Number: (317) 233-6647
E-mail Address: IDEMFILEROOM@idem.IN.gov

Please Note:
The ORM will not charge any requester for copying and printing the first 100 black and white 8.5" x 11" paper pages or less produced within one (1) calendar year per requester, for e-mailing electronic records or for retrieving records from the Virtual File Cabinet (VFC). IDEM maintains the VFC, which is a searchable online repository for the vast majority of the Agency's public records. It is a free service and can be accessed at http://vfc.idem.in.gov/.

Fees:

There is no fee for inspection and viewing of records within the VFC. Records obtained through the ORM could be subject to fees. Please see the back of this form for more information.

Requests for Disclosure of Public Records Guidelines:

General Rule: All records of a public agency are public records and must be disclosed upon request, unless the request falls under an exception provided by the Access to Public Records Act (APRA) of Indiana (codified in Indiana Code § 5-14-3). A public agency must state that a record falls under an identified APRA exception in order to withhold a specific record.

All Requests: The APRA requires that all requests for inspection or copying of public records must identify those records with "reasonable particularity." This means a request must include a description of a record with enough detail to allow agency staff to locate and produce the requested record.

Response by Agency: The APRA requires a public agency to respond to requests within a specified time.

> Important Note: This response does not mean that the requested record must be produced at that time. First, the agency must, at a minimum, acknowledge receipt of a request. Second, the record(s), if disclosable, must be produced within a "reasonable time" after the request is received.

Request for E-mails: The requester must provide enough information to allow IDEM to search for, locate, and retrieve the records requested. The requester should list the sender(s) and recipient(s), keywords or subject matter, and limit the request to a reasonable timeframe. Listing a specific entity and/or IDEM branch as sender and/or recipient may be sufficient for IDEM to locate and retrieve the records. Please be advised that the general retention period for IDEM e-mails is three (3) years, unless otherwise required under another retention schedule or pursuant to statute. If your request for e-mails is not sufficiently specific, IDEM reserves the right to deny it or seek further clarification.

Records That Do Not Exist: Under the APRA, an agency is not required to create any record(s) in response to a public record request. An agency is only required to disclose existing records.

Fees: Public agencies may charge fees for copies. No fees may be charged for inspection.

The fee schedule for copying or printing records, including scanning records to produce an electronic version, is as follows:

- $.10 per one-sided page for standard sized 8.5″ x 11″ paper records after the first 100 pages;
- $5.00 per compact disc, digital video disc or diskette for copying of records onto an electronic storage medium; and
- $.70 per one-sided black and white copy page for non-standard sized paper records (larger than 8.5″ x 11″).

> Important Note: The fees set forth above are pursuant to Indiana Code § 5-14-3-8. The ORM requires payment for fees in advance. Acceptable forms of payment are: check, money order, Visa and MasterCard. The processing service charge fee for all credit card payments is $1 plus 2%. You will be notified in advance if there is a fee to fulfill your public record request.

ORM Office Hours: ORM office hours are 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding State holidays.

Attachment E

EARTHJUSTICE

November 21, 2018

By E-mail to jlacker@idem.in.gov and DSchilli@idem.in.gov

Jenny Acker, Chief, Air Permits Branch
David Schilling, Office of Records Management
Indiana Department of Environmental Management
100 N. Senate Avenue
Indianapolis, IN 46204

Re: Request for Response to Records Request and for Extension of Comment Period
Riverview Energy Corporation
Permit No. T147-39554-00065

Dear Ms. Acker and Mr. Schilling:

On behalf of Southwestern Indiana Citizens for Quality of Life and Valley Watch, I am writing to follow up on two records requests regarding the above-captioned permit submitted to your agency, one on June 19, 2018 and the other on November 14, 2018.

Both requests seek the following records:

> All records regarding Riverview Energy Corporation, including but not limited to: all correspondence, including letters and e-mails (keyword "Riverview Energy"); all permit applications and other permit submissions; notes, including from meetings and telephone calls; all materials regarding Veba Combi Cracker (VCC) technology; and all air quality modeling information including modeling inputs.

On October 10, 2018, we received a form response to our June 19, 2018 request stating that "[t]he Office of Records Management (ORM) is working on compiling and reviewing the available records that are responsive to your public record request" and directing us to the IDEM Virtual File Cabinet. On November 15, 2018, IDEM acknowledged our November 14, 2018 request.

Some documents responsive to the June 19, 2018 request have been posted in the Virtual File Cabinet. However, even after five months, no complete response to this request, or

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description of documents withheld, has been received. For example, no "notes, including from meetings and telephone calls" have been posted in the Virtual File Cabinet, despite the fact that IDEM has been preparing the proposed permit and other documents throughout 2018, and has been in contact with representatives of Riverview Energy Corporation during that time. By this omission, and possibly others, IDEM fails to respond to our request. IDEM's omission impairs our ability to gather information regarding the basis for IDEM's action that is necessary to fully prepare our comments on the proposed permit.

For these reasons, we request that IDEM:

1. Provide a complete and final response to our requests, including a full description of each document withheld, if any;
2. For any documents (including but not limited to notes) responsive to our request that have not yet been posted in the Virtual File Cabinet, provide these documents or post them in the Virtual File Cabinet;
3. So that we can consider these additional documents when preparing our comments, extend the comment period on the permit (now ending on December 10, 2018) by 20 days from (a) the date a complete and final response to our request is provided, or (b) the date the last document is provided or posted, whichever is later.

Thank you for your attention to this matter. Please contact me at (215) 717-4521 or cmcphedran@earthjustice.org if you have any questions.

Sincerely,

s/ Charles McPhedran

Charles McPhedran, Esq.
Earthjustice

cc (by e-mail): Doug Logan, IDEM