

Expert Report of Richard Hepp, President and CEO of eMission Software Inc.

Background

1. My name is Richard Hepp. I am the President & CEO of eMission Software Inc., a consulting company that designs software created for calculating and reporting emissions from oil and gas operators. I am also the co-lead designer on all new products and services and have been in these various roles for the last four years.
2. As detailed in my CV (attached as **Annex A** to this report), prior to developing eMission Software, I earned a bachelor's degree in economics from the University of Calgary and worked for 12 years in the energy sector providing technical consulting services in regulatory management and operations, including on emissions reporting.

Purpose of Report

3. This report and its attached spreadsheets detail what I believe to be numerous violations of reporting obligations for the calendar year 2022 to the National Pollutant Release Inventory (NPRI) as set out in the *Notice with respect to the substances in the National Pollutant Release Inventory for 2022, 2023 and 2024*.
4. As further detailed below, in assembling this report, I reviewed and compiled publicly available production and fuel consumption data from the Petrinex production accounting database as of August 2024, cross-referenced that data with NPRI reporting obligations and then checked the NPRI database to determine whether certain facilities operated by Canadian Natural Resources Limited ("CNRL") in Alberta had complied with those obligations in the 2022 calendar year. Due to time and resource constraints, the analysis also only covered facilities registered with the Alberta Energy Regulator (AER) with "F" or "W" AER I.D. numbers. Some facilities also did not have their AER I.D. number listed.
5. This report summarizes and details my findings. As summarized at paragraphs 22 and 28 of this report, it concludes that, in total, there are at least 119 non-bitumen CNRL facilities and potentially 412 bitumen CNRL facilities that are in violation of these NPRI reporting obligations. There are 54 non-bitumen sites and 373 bitumen sites that are likely violating the VOC and Benzene Reporting Requirements (Group 1) and 65 non-bitumen sites and 39 bitumen sites that are likely violating the Part 4 Substance and Benzene Reporting Requirements (Group 2). In addition, it also identifies an additional 34 non-bitumen CNRL facilities and 34 bitumen CNRL facilities for which there was inadequate information on the NPRI to determine compliance with NPRI reporting requirements. Of the Group 1 possible violators, 52 also hit the Group 2 reporting threshold. Of the Group 2 possible violators, 55 also hit the Group 1 reporting threshold.

Data Gathering & Analysis Sources

6. In preparing this report, I relied on three main sources for data, information, and analysis: 1) the Government of Alberta's Petrinex online database, 2) the Government of Canada's National Pollutant Release Inventory Data Search website, and 3) eMission Software Inc.'s software.

7. The Government of Alberta, along with other partners, operates the Petrinex database which provides monthly production data from oil and gas facilities and is accessible at www.petrinex.ca. According to its website, Petrinex facilitates the efficient, standardized, safe, and accurate management and exchange of 'data of record' information utilized in oil and gas royalty frameworks, regulatory enforcement and the commercial operation of the petroleum sector across Canada.¹ It further states that "stakeholder-driven business rules and control mechanisms ensure the information reported in Petrinex each month is accurate, verified and balanced across the four western provinces."² It is also a venue for providing public access to non-confidential data. All the oil and gas production volume and fuel consumption data set out in this report and in its attached spreadsheets was sourced from Petrinex. I can also confirm, based on my employment experience in the oil and gas industry, that Petrinex data is widely considered to be the most reliable publicly available record of production data from Alberta's oil and gas sector.

8. As a part of its operation of the NPRI, the Government of Canada has set up and runs a publicly accessible version of the National Pollutant Release Inventory database online at <https://pollution-waste.canada.ca/national-release-inventory/>. This website can be used to display facility data by location, sector and released substance and allows the public to search for detailed information on pollutant release as reported to the NPRI by facilities.

9. The proprietary software developed by me and eMissions Software Inc. takes oil and gas production and fuel consumption data from Petrinex and applies widely accepted emissions factors to calculate emissions from a given facility of certain pollutants, such as VOCs, benzene, PM 2.5 and others. Using this software, we can aggregate Petrinex production and fuel use data to determine whether NPRI reporting obligations for a given facility have been triggered, and then in turn, by checking the NPRI database, determine whether those reporting obligations have been satisfied.

NPRI Reporting Obligations

10. According to the *Notice with respect to the substances in the National Pollutant Release Inventory for 2022, 2023 and 2024* (the "Notice" or the "Ministerial Notice"), certain oil and gas facilities are obligated to report emission data to the NPRI.

¹ <https://www.petrinex.ca/overview/Pages/Overview.aspx>

² Id.

11. There are two types of NPRI reporting requirements I discuss in this report:
- a. **VOC and Benzene Reporting Requirements:** According to sections 11(3) and 15(2) of the Notice, operators of light or medium crude oil batteries with an annual oil throughput of 1900 m³ or more and where employees work less than 20,000 hours/year are required to report emissions of Volatile Organic Compounds (“VOC”) and benzene. In my report I refer to facilities that have NOT complied with the VOC and Benzene Reporting Requirements as **Group 1 Violations**.
 - b. **Part 4 Substance and Benzene Reporting Requirements:** According to sections 11(2) and 15(2) of the Notice, operators of facilities of oil and gas extraction facilities (other than oil sands facilities) with fewer than 20,000 employee hours/year are required to report emissions of NPRI Part 4 substances and benzene if that facility exceeded the reporting threshold of any Part 4 substance. For example, the Part 4 substance threshold for Particulate Matter (PM) 2.5 is 0.3 tonnes. If a given facility emits 0.3 tonnes or more of PM 2.5 during a given year, that facility must report its emissions data for all Part 4 substances and benzene. In my report I refer to facilities that have not complied with the Part 4 Substance and Benzene Reporting Requirements as **Group 2 Violations**.
12. If any of the above reporting requirements are triggered, operators are to report their emissions data from a given year to the NPRI by early June of the following year. For emissions reporting for the 2022 calendar year, operators were required to report by June 1, 2023.
13. In preparing my report, I was not able to access data showing employee hours worked at the various facilities I have identified. However, based on my experience as a Regulatory Coordinator and Program Manager working in the oil and gas industry, it is my informed opinion that the majority, if not all, the facilities identified in this report would almost certainly have less than 20,000 employee hours worked in a year (roughly 10 full-time employees). It is highly unlikely that any of the facilities I have identified (which all have relatively low production levels) could operate in an economically feasible manner with 10 full-time employees (or contractors). To be economically feasible, a facility that has 10 full-time employees would be producing exponentially more product than those included in our analysis (whether it be oil, condensate or gas). Therefore, the probability that any of the facilities identified in this report are not subject to the specific provisions mentioned in my report (Section 11(2) and 11(3) of the Ministerial Directive) because they are staffed with more than 20,000 employee hours a year is very unlikely.
14. In any event, if that opinion is incorrect, the number of employee working hours in a year has little effect on whether facilities must report in some way to the NPRI – oil and gas facilities are likely required to report, but with different applicable thresholds. None of the facilities listed

here reported to the NPRI database at all. As a general rule, facilities that have employees working over 20,000 employee hours in a year have reporting obligations that are *greater* than those facilities with fewer yearly employee hours and are generally required to report to the NPRI under different provisions of the Notice.³

15. Finally, for the facilities with Group 2 Violations, the thresholds for reporting substances listed in Part 4 of Schedule 1 are the same regardless of employee hours worked. Indeed, the PM 2.5 reporting obligations (which I rely upon) are the same under 11(2) (which applies to facilities under 20,000 employee hours) as the reporting obligations are under 1(b) and 11(1) (which applies to facilities over 20,000 employee hours). Both of those sections refer to the thresholds set forth in column 3 of Table 2 for the Part IV substances. While exceedance of the PM 2.5 threshold may not trigger an obligation to report all CAC substances and benzene, the obligation to report PM 2.5 emissions is still triggered – and in the case of all of the Group 2 facilities – it has not been complied with.

16. In preparing this report and its attached spreadsheets, I also included facilities listed under Petrinex as “Crude Bitumen Multiwell Group Batteries”, “Crude Bitumen Multiwell Proration Batteries”, and “Crude Bitumen Single-Well Batteries”.

17. Based on the information about these facilities available through Petrinex, it appears unclear whether these facilities are classified under the North American Industry Classification System (NAICS) code 211110 [Oil and gas extraction (except oil sands)]. Given that the reporting obligations may differ depending on that classification I have separated these facilities from the other facilities identified in my report. Throughout my report, when I refer to total numbers of Group 1 and Group 2 facilities, I refer to the number of non-bitumen facilities and the number of bitumen facilities in the event that their reporting obligations differ.

Group 1 Violations and Methodology

18. The first spreadsheet attached to my report is entitled “Group 1 Violations” and is labelled **Annex B** to this report.

19. This spreadsheet lists many CNRL facilities that I believe are in violation of the VOC and Benzene Reporting Requirements set out in sections 11(3) and 15(2) of the Ministerial Notice.

20. In preparing my Group 1 Violations spreadsheet I undertook the following steps:

³ Environment and Climate Change Canada, “Guide for Reporting to the National Pollutant Release Inventory 2022-2024” (2022) at 7, online (pdf): <<https://publications.gc.ca/site/eng/9.506026/publication.html>> [ECCC PDF Guide].

- a. I accessed and downloaded publicly available monthly production data relating to CNRL facilities in Alberta in 2022 from the PETRINEX database (described above).
- b. I aggregated the monthly data into one annual production figure for each separate facility.
- c. I removed any heavy oil licensed facilities given that they are not subject to the VOC and Benzene Reporting Requirements.
- d. I removed any facilities that did not meet the reporting threshold requirements. This means that I removed facilities with annual throughputs of less than 1,900 m³ based on the annual production figure I calculated and I ensured that the remaining facilities satisfied the criteria set out in sections 11(3) and 15(2) of the Ministerial Notice.
- e. Based on this analysis, I compiled a list of facilities I believe were subject to the VOC and Benzene Reporting Requirements.
- f. I then checked this list of licensed CNRL Alberta medium and light oil facilities with throughputs of 1,900 m³ and above with the NPRI database.
- g. Based on my cross referencing this list of facilities with the NPRI, I was able to group the facilities into three groups:
 - i. Group 1 Violations: Facilities for which there was no VOC and benzene emissions reporting in 2022 and which therefore appear to be in violation of the VOC and Benzene Reporting Requirements;
 - ii. Group 1 Non-Violations: Facilities which had reported their 2022 VOC and benzene emissions to the NPRI, which therefore do not appear to be in violation of the VOC and Benzene Reporting Requirements;
 - iii. Unable to Determine: Facilities for which I was unable to determine conclusively had reported their VOC and benzene emissions data to the NPRI in 2022 because there is no obligation for operators to use identical facility names or nomenclature in Petrinex as it does in the NPRI.
- h. The attached Group 1 Violations spreadsheet (Annex B) lists all of the facilities described in paragraph g(i) above for which there was no VOC and benzene emissions reporting in 2022 and records a “no” entry for that facility under the heading “Reported to NPRI in 2022” in column K.
- i. The facilities described in paragraph g(iii) above for which I was unable to determine conclusively whether they had reported their VOC and benzene

emissions are also listed in the Group 1 Violations spreadsheet but are denoted with a “?” under the heading “Reported to NPRI in 2022?” in column K.

- j. The facilities described in paragraph g(ii) above for which there was VOC and benzene emissions reporting in 2022 on the NPRI database were not included in the attached Group 1 Violations spreadsheet, as those are facilities that appear to be complying with the NPRI’s reporting requirements (although I did not confirm whether the amounts reported in the NPRI are correct).

21. The attached Group 1 Violations spreadsheet sets out identifying criteria for each operator such as the Alberta Energy Regulator Operator I.D. and operator name. It also provides identifying criteria for each facility including the Petrinex Facility Code, the Facility Name, the Facility Type, its location using the Alberta Township Survey System, along with details on its production and status. The information in these columns was pulled directly from Petrinex. I have also included the total annual 2022 Production Volume in cubic meters that I calculated as described at paragraph 20 a & b above.

22. The Group 1 Violations spreadsheet also includes my summary of the total number of facilities in violation of the VOC and Benzene Reporting Requirement. This summary indicates that there are 54 CNRL Group 1 non-bitumen facilities and 373 CNRL Group 1 bitumen facilities in violation of the VOC and Benzene Reporting Requirement. It also summarizes that there are 5 non-bitumen CNRL facilities and 28 bitumen CNRL facilities for which there was inadequate information on the NPRI to determine conclusively whether they were in compliance with, or in violation of, the VOC and Benzene Reporting Requirements.

Group 2 Violations and Methodology

23. The second spreadsheet attached to my report is entitled “Group 2 Violations” and is also attached as **Annex B** to this report.

24. This spreadsheet lists many CNRL facilities that I believe are in violation of the Part 4 Substance and Benzene Reporting Requirements set out in sections 11(2) and 15(2) of the Ministerial Notice.

25. In preparing my Group 2 Violations spreadsheet I undertook the following steps:

- a. I accessed and downloaded publicly available monthly fuel consumption data relating to CNRL facilities in Alberta in 2022 from the Petrinex website (described above).

- b. I aggregated the monthly data into one annual fuel consumption volume figure (in e3m3 units) for each separate facility.
- c. I also sorted this data to determine which of those CNRL facilities satisfied the criteria set out in sections 11(2) and 15(2) of the Ministerial Notice and thus, pursuant to the Notice, could be subject to the Part 4 Substance and Benzene Reporting Requirements in 2022 if those facilities exceeded any Part 4 reporting threshold.
- d. In order to determine whether these facilities would be subject to the Part 4 Substance and Benzene Reporting Requirements I first needed to determine whether, based on fuel consumption data, these facilities would have emissions levels above any of the Part 4 substance thresholds. This was achieved by working backwards through the emission calculation to determine what amount of marketable natural gas would need to be combusted to reach the minimum threshold of reporting PM2.5 of ≥ 0.3 tonnes as set out in the Notice. Although the actual number is closer to 600 e3m3 of natural gas combusted, I have built in a conservative buffer to ensure that there is a very low likelihood that any facilities will be incorrectly identified. Thus, I chose to only look at facilities with greater than 900 e3m3 to remove any doubt on gas composition or Higher Heating Value.
- e. Due to time, resource and practical constraints, I was only able to determine whether any of these facilities exceeded the PM 2.5 threshold, rather than looking at each threshold substance listed in the Notice.
- f. To determine whether there were any violations of this threshold, I used the software I developed for eMissions Software Inc. to determine the PM 2.5 emissions for each facility.
- g. The methodology utilized by my software is a straightforward application of widely accepted and utilized emissions factors. Specifically, it uses the following formula:

$$\text{Annual PM2.5 Emissions} = \text{Fuel Volume (e3m3)} \times 1000/37.245 \times \text{PM2.5 Emission factor}$$

- i. The “Volume” value is the annual fuel consumption for each facility calculated using the methodology describe at paragraph 25b above and expressed in e3m3 units. 1 unit of volume in e3m3 is the equivalent of 1000m3 in volume.
- ii. The “1000/37.245” fraction in the formula converts the annual fuel consumption data from volume in e3m3 to gigajoules (GJ). This relies on two universally accepted formulas:

1 e3m3 = 1000 m3; and

37.245 m3 = 1 GJ.

By multiplying the Volume by 1000 it converts the units of volume from e3m3 to m3. Second, by dividing this amount by 37.245 it converts m3 units of volume into gigajoules (GJ) of energy.

- iii. Finally, the formula multiplies this amount by the PM 2.5 emissions factor (0.00001837 tonne/GJ) I have sourced from the US Environmental Protection Agency's emissions factors,⁴ as recommended in the *Guide for Reporting to the National Pollutant Release Inventory 2022-2024*.⁵ In accordance with the conservative approach I have taken in this report and in order to minimize the misidentification of Group 2 violations, I have chosen the lowest PM 2.5 emissions factor within the range provided by the EPA meaning that PM 2.5 emissions from these identified facilities may be higher than my numbers suggest.⁶ Specifically, I used the PM emissions factors for Uncontrolled Emissions Factors for 2-Stroke Engines as a reasonable approximation. The EPA's emissions factors are listed in lb/MMBtu (0.03840000 lb/MMBtu) which I have converted to 0.00001837 tonne/GJ.
- iv. I calculated the Annual PM 2.5 Emissions for each of the facilities identified.
- h. I then compared the facilities which I calculated to have PM 2.5 emissions in 2022 of over 0.3 tonnes with available NPRI reporting data from 2022.
- i. Based on my cross referencing this list of facilities with the NPRI, I was able to group the facilities into three groups:

⁴ United States Environmental Protection Agency "AP 42 Section 3.2 Natural Gas-fired Reciprocating Engines – Related Information" <https://www.epa.gov/sites/default/files/2020-10/documents/b03s02.pdf> (see Table 3.4-2 at page 3.19). Note – Table 3.4-2 only lists the emissions factor for PM-10 but notes at page 3.9 that "total PM-10 and total PM-2.5 are equal".

⁵ Environment and Climate Change Canada "Guide for Reporting to the National Pollutant Release Inventory 2022-2024" https://publications.gc.ca/collections/collection_2022/eccc/En81-1-2022-eng.pdf Section B.7

⁶ See e.g., Matthew R. Johnson & Adam R. Coderre (2012) "Compositions and greenhouse gas emissions factors of flared and vented gas in the Western Canadian Sedimentary Basin", *Journal of the Air & Waste Management Assoc.*, 62:9, 992-1002, online < <https://doi.org/10.1080/10962247.2012.676954> >.

- i. Group 2 Violations: Facilities for which there was no Part 4 substance and benzene reporting in 2022 and which therefore appear to be in violation of the Part 4 Substance and Benzene Reporting Requirements;
 - ii. Group 2 Non-Violations: Facilities which had reported their 2022 Part 4 substance and benzene emissions to the NPRI, which therefore do not appear to be in violation of the Part 4 Substance and Benzene Reporting Requirements;
 - iii. Unable to Determine: Facilities for which I was unable to determine conclusively had reported their Part 4 substance and benzene emissions data to the NPRI in 2022 because there is no obligation for operators to use identical facility names or nomenclature in Petrinex as it does in the NPRI.
- j. The attached Group 2 Violations spreadsheet (Annex B) lists all the facilities described above for which there was no Part 4 substance and benzene emissions reporting in 2022 and records a “no” entry for that facility under the heading “Reported to NPRI in 2022” in column K. Under the “2022 Fuel Consumption Volume” heading in column I of this spreadsheet, I list the annual fuel consumption volume for each facility. Under the “PM2.5 (tonnes)” heading in column J of the spreadsheet, I list the PM2.5 emissions calculated for each facility using the formula described above.
 - k. The facilities described above for which I was unable to determine conclusively had reported their Part 4 substance and benzene emissions are also listed in the Group 2 Violations spreadsheet but are denoted with a “?” for under the heading “Reported to NPRI in 2022?” in column K.
 - l. The facilities described above for which there was Part 4 substance and benzene emissions reporting in 2022 on the NPRI database were not included in the attached Group 2 Violations spreadsheet, as those are facilities that appear to be complying with the NPRI’s reporting requirements (although I did not confirm whether the amounts reported in the NPRI are correct).

26. The Group 2 Violations spreadsheet (Annex B) lists each facility that I identified as being obligated to report its Part 4 substance and benzene emissions to NPRI, but which has failed to do so, or those facilities on which I was unable to conclude conclusively.

27. Like the Group 1 Violations spreadsheet, the Group 2 Violations spreadsheet sets out a number of identifying criteria for each operator such as the Alberta Energy Regulator Operator I.D. and operator name. It also provides identifying criteria for each facility including the PETRINEX Facility Code, the Facility Name, the Facility Type, its location using the Alberta

Township Survey System, along with details on its production and status. The information in these columns was pulled directly from Petrinex. I have also included the total annual 2022 Fuel Consumption I calculated based on monthly production data I accessed from Petrinex and described at paragraph 25(b) above

28. The Group 2 Violations spreadsheet also includes my summary of the total number of facilities in violation of the Part 4 Substance and Benzene Reporting Requirement. This summary indicates that there are 65 confirmed CNRL Group 2 non-bitumen facilities and 39 CNRL Group 2 bitumen facilities in violation of the Part 4 Substance and Benzene Reporting Requirement. It also concludes that there are 29 non-bitumen CNRL facilities and 6 bitumen CNRL facilities for which there was inadequate information on the NPRI to determine conclusively whether they were in compliance with, or in violation of, the Part 4 Substance and Benzene Reporting Requirements.

Overlap between Group 1 Violations and Group 2 Violations

29. In some cases the same facilities were identified on both spreadsheets. In the Group 1 Violations spreadsheet Column L “Also hit fuel threshold?” includes a “yes” entry for those facilities which also are listed in the Group 2 Violations spreadsheet. In the Group 2 Violations spreadsheet, Column L “Also hit production threshold?” includes a “yes” entry for those facilities which are also listed in the Group 1 Violations spreadsheet.

Signed: _____



Richard Hepp
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