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November 8, 2017

Julie Thompson
Executive Director, Program Development and Engagement Division
Environment and Climate Change Canada
Gatineau, Quebec K1A 0H3

Via email: eccc.substances.eccc@canada.ca

Dear Ms. Thompson:

Re: Canada Gazette, Part I, September 9, 2017 — Draft Screening Assessment re Hydrogen Sulfide (H₂S), Sodium Sulfide (Na(SH)) and Sodium Sulfide (Na₂S) (“Draft Screening Assessment”)

Ecojustice Canada, the Canadian Environmental Law Association, Environmental Defence, the Canadian Association of Physicians for the Environment, and Prevent Cancer Now (the “**Organizations**”) write to provide comments in response to the above-noted Draft Screening Assessment, which proposes to conclude that hydrogen sulfide (“**H₂S**”), sodium bisulfide (“**Na(SH)**”), and sodium sulfide (“**Na₂S**”) do not meet any of the criteria under subsections 64(a), (b) or (c) of the *Canadian Environmental Protection Act, 1999*, SC 1999, c. 33 (“**CEPA**”). These comments outline our opposition to the proposed conclusion that H₂S does not meet the requirements set out in subsection 64(c).

We are concerned that the government has failed to adopt a science-based, precautionary approach to the screening assessment of H₂S health risks in Canada. The Draft Screening Assessment must examine the very real risks H₂S releases pose to the health of many Canadians, especially those living or working near oil and gas facilities and infrastructure, or impacted by geological fracturing. Such an analysis would find that H₂S does meet the threshold be considered toxic to human health under paragraph 64 (c) of CEPA, as described further below in our comments.

Hydrogen Sulfide Is Toxic

That H₂S is toxic should be beyond debate. The effects of a release of H₂S can range from unpleasant odour to significant health consequences or death. An acknowledgement of the dangers

of H₂S can be found, for example, in the FAQ of the Alberta Energy Regulator (“AER”), which states:

H₂S is the chemical formula for hydrogen sulphide, a toxic gas formed by the breakdown of organic materials. It can be found in natural gas, oil, sewage, swamps, and stockyards and in the processing of pulp and paper. The gas is colourless, but you can recognize its “rotten egg” smell even at low concentrations.

At higher concentrations, it stops people and animals from breathing, so if it’s not handled properly, it can be deadly.¹

The Supreme Court of Canada has noted that hydrogen sulfide “is toxic and poses unacceptable safety and environmental risks” and observed that it cannot be transported by pipeline through heavily populated areas.²

Hydrogen sulfide should be classified as toxic, as it meets the requirements of s. 64(c) of CEPA, which provides that:

...a substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that ... constitute or may constitute a danger in Canada to human life or health. [Emphasis added]

Flaws in the Draft Screening Assessment

The Organizations’ comments focus on four areas of the Draft Screening Assessment that we find to be flawed:

1. health risks of H₂S to communities near oil and gas operations (vulnerable communities);
2. olfactory nuisance as an adverse effect;
3. neurological and respiratory human health risks from low level exposure to H₂S; and
4. margins of exposure (MOEs) within a range where policy requires further analysis of need for action.

1. Health risks to communities near oil and gas operations

Releases of H₂S are causing adverse health effects in vulnerable communities near oil and gas operations, as documented by the numerous media stories and government studies, a few of which are summarized below.

A recent media investigation³ documents deadly encounters with H₂S gas from oil and gas operations in Saskatchewan. The media report explains that after a terrifying brush with sour gas on October 30, 2012 that caused a teenager to become very sick, the Saskatchewan government

¹ Alberta Energy Regulator, EnerFAQs Sour Wells, online: <<http://www.aer.ca/about-aer/enerfaqs/enerfaqs-sour-wells#whatgas>>.

² *Westcoast Energy Inc. v. Canada (National Energy Board)*, [1998] 1 S.C.R. 322 at para 70.

³ National Observer, “Screams from the yard”, online: <<https://www.nationalobserver.com/2017/10/01/inside-saskatchewan-failure-stop-silent-killer>>.

conducted 11 random audits of oil and gas facilities, and all 11 facilities failed with serious infractions.

The media report refers to a memo by a member of the Canadian Association of Petroleum Producers board of governors, quoting, “[f]acilities in the area are venting H₂S concentrations that may be exceeding 150,000 ppm.” That is 150 times the amount that would cause instant death, according to the report. Measurements taken during the October 30, 2012 incident found H₂S at 100 ppm behind the home where the teenager fell ill.

Industry self-reported incident reports provided to Ecojustice show that H₂S has been released from Saskatchewan oil and gas operations at least 11 times in the last 5 years due to malfunctions or ruptures at flares, wells or pipelines, creating a public health risk, and in some cases, the need for an evacuation of local residents.

Although these releases are episodic, the frequency of seriousness of these failures indicates the need for greater regulatory oversight. A screening assessment under CEPA is intended to analyse the risk a substance poses to the environment and human health so that regulatory measures can be put into place to address those risks.

A 2015 CBC news story reported that the Saskatchewan government tested 43 facilities in southeast Saskatchewan that were leaking sour gas “with average concentrations at 30,000 ppm” — 30 times higher than the level that is fatal to humans. The report noted that in one case, a well emitted 150,000 ppm.⁴ Another 2015 news story reported on the death of a Saskatchewan oil and gas worker from H₂S exposure⁵ and further reported of 43 facilities in southeast Saskatchewan that were leaking sour gas “with average concentrations at 30,000 ppm.” That is 30 times higher than the level that is fatal to humans. The news story also linked H₂S leaks to livestock deaths.⁶

Concerns regarding health impacts from oil and gas operations that emit H₂S have also been raised in British Columbia, leading to at least one multiyear study.⁷

The Aamjiwnaang First Nation community near Sarnia, Ontario experienced health impacts when H₂S and other reduced sulphur compounds were released from a refinery. A 2013 spill at the Shell refinery caused acute health effects in the neighboring community, including children at the

⁴ CBC, “Sour gas from oil wells a deadly problem in southeast Saskatchewan”, April 23, 2015, online: <<http://www.cbc.ca/news/canada/saskatchewan/sour-gas-from-oil-wells-a-deadly-problem-in-southeast-saskatchewan-1.3042939>>.

⁵ CBC, “Sask oil industry worker dies from sour gas poisoning”, April 22, 2015, online: <<http://www.cbc.ca/news/canada/saskatchewan/sask-oil-industry-worker-dies-from-sour-gas-poisoning-1.3043186>>.

⁶ CBC, “Sour gas from oil wells a deadly problem in southeast Saskatchewan”, April 23, 2015, online: <<http://www.cbc.ca/news/canada/saskatchewan/sour-gas-from-oil-wells-a-deadly-problem-in-southeast-saskatchewan-1.3042939>>.

⁷ Prepared for the British Columbia Minister of Health by Intrinsik, “Final Screening Level Risk Assessment Phase 2 Human Health Risk Assessment of Oil and Gas Activity in Northeastern British Columbia”, online: <<http://www.health.gov.bc.ca/library/publications/year/2014/health-risk-assessment-screening-level-assessment.pdf>>.

community daycare centre.⁸ Samples taken by a citizen on her front lawn after another incident at the same refinery found H₂S in the air in excess of Ontario air standards.⁹

It is plain that releases of H₂S may occur as a result of oil and gas operations, including the drilling of gas and oil wells in which H₂S is encountered, pipelines transporting sour gas and sour gas treatment plants. It is equally plain that a release may constitute a danger in Canada to human life or health. While current regulations in place for oil and gas activities may make the likelihood of a release low, the potentially severe or even catastrophic consequences of a release dictate that strong vigilance, oversight and caution in relation to potential releases of H₂S is warranted, as is a classification of the compound as toxic.

While releases of H₂S in higher concentrations from oil and gas facilities are generally due to failures or mishaps, such releases do occur, and consequences can certainly constitute a danger to human life or health. The Draft Screening Assessment characterization of hazardous levels of H₂S as industrial is countered by reports over decades of people, cattle and wildlife being killed after H₂S pooled in low-lying areas during calm weather.

Recommendation 1: It is recommended that the Minister of Health and the Minister of the Environment (the “Ministers”) acknowledge the existing and longstanding consensus that H₂S is toxic, and potentially deadly, in sufficient concentrations and that (as history amply demonstrates) it may enter the environment in a quantity or concentration or under conditions that it may constitute a danger in Canada to human life or health.

2. Olfactory nuisance as an adverse effect

The Draft Screening Assessment states that “[o]lfactory nuisance is not considered to be adverse for the purpose of this screening assessment and therefore is not taken into account in terms of calculating a margin of exposure for hydrogen sulfide.”¹⁰ The Draft Screening Assessment provides no scientific or legal justification for this exclusion of olfactory nuisance and is contrary to how olfactory nuisance (or odour) from H₂S has been assessed in other instances.

Odours caused by H₂S and other reduced sulphur compounds (i.e. mercaptans) have been considered adverse effects in other legal analyses, and should be so considered in a CEPA screening assessment. The following are examples where odours have been considered to have adverse health effects.

(a) Ontario Environmental Protection Act

Odours have been found to constitute “adverse effects” within the meaning of the Ontario *Environmental Protection Act*, R.S.O. 1990, c. E.19 (“EPA”). In *Timco Foods Ltd. v. Ontario (Ministry of the Environment)*, the Environmental Review Tribunal (“ERT”) found that odours from an edible oils production facility which caused repulsion, nausea, headaches, and raised levels of stress had created “adverse health effects” which resulted in “danger to health” of persons

⁸ Ian Miron and Elaine MacDonald, “Charge laid against Shell Canada for refinery spill in “Chemical Valley”, Ecojustice blog, November 24, 2015, online: <<https://www.ecojustice.ca/charge-laid-against-shell-canada-for-refinery-spill-in-chemical-valley/>>.

⁹ Ecojustice Press Release, “Hydrogen sulphide detected on Aamjiwnaang First Nation Reserve”, May 16, 2013, online: <<https://www.ecojustice.ca/pressrelease/hydrogen-sulphide-detected-on-aamjiwnaang-first-nation/>>.

¹⁰ Draft Screening Assessment, s. 10.3.1 at p 59.

within the meaning of s. 143(3)(a) of the EPA. The ERT also concluded that the odours had made parts of nearby properties periodically uninhabitable, and therefore constituted an “impairment or serious risk of impairment of the quality of the natural environment for any use that can be made of it”, within the meaning of s. 143(3)(b).¹¹

The Shell refinery in Sarnia was convicted in 2013 for the “discharge of a contaminant, namely an odour containing mercaptan, into the natural environment that caused an adverse effect, contrary to the Environmental Protection Act”.¹²

(b) British Columbia Environmental Appeal Board

In *Fleischer v. British Columbia (Ministry of Environment, Lands and Parks)*, the British Columbia Environmental Appeal Board accepted expert evidence that “unpleasant odours can have a negative impact on human health”, and found that the emissions at issue had created an odour problem which, at a minimum, had resulted in an anxiety and irritation problem among some members of the community, and had had an impact on the quality of life of some of the residents living in the vicinity.¹³

(c) Alberta Energy Regulator

In 2016, the AER conducted an inquiry into odour impacts upon residents from the Peace River region’s heavy oil production.¹⁴ The AER retained its own independent experts to provide evidence of toxicology and human health impacts from odour from the oil which contained high levels of sulphur and aromatic compounds. The following excerpt from the AER’s March 2014 Final Report describes the evidence provided by an expert in toxicology and human health, who testified on the toxicological effects of unpleasant odours:

[54] Dr. Davies referred to mounting evidence in the published literature of people experiencing physical and psychological and neurobehavioral symptoms in response to unpleasant odours. Dr. Davies reported that there is a difference between the irritant sensations that can be caused by odours and irritation that occurs as a toxicological effect. Based on this information, Dr. Davies noted that it appears that odours may cause certain symptoms at concentrations of the odourants well below those known to cause acute symptoms by recognized toxicological mechanisms. This means that people are not being “poisoned,” but that the symptoms are a response to the odours associated with the emissions. Not all people are affected and the range of effects is very diverse, with some people not being affected at all. It will depend very much on the individual’s circumstances, both personal and situational.

[55] Dr. Davies suggested that to further characterize odours from chemicals expected to be present in emissions and their possible effects on health, further

¹¹ *Timco Foods Ltd. V. Ontario (Ministry of the Environment)*, [2013] OERTD No 16 at para 32.

¹² Ontario Ministry of the Environmental and Climate Change, Court Bulletin, “Refinery, Shell Canada fined \$500,000 for Permitting a Discharge of Odour into the Environment”, November 27, 2015, online: <<https://news.ontario.ca/ene/en/2015/11/refinery-shell-canada-fined-500000-for-permitting-a-discharge-of-odour-into-the-environment.html>>.

¹³ *Fleischer v. British Columbia (Ministry of Environment, Lands and Parks)*, [2000] BCEA No 1 at paras 79-80.

¹⁴ Peace River Inquiry website, online: <<http://www.aer.ca/about-aer/spotlight-on/proceeding-1769924>>.

assessment beyond the screening level is required. Dr. Davies also stated that he personally noticed odours within the Reno area during a site visit.¹⁵

The AER accepted that the odours had the potential to cause the symptoms and health effects being experienced by the residents:

[87] The Panel accepts the residents' credible submissions that they are experiencing a variety of symptoms and health effects. These symptoms have interfered with the quality of life for many of the residents in the area.

[88] Accordingly, the Panel concludes that heavy oil operations are causing odours in the area and that these odours have the potential to cause some of the symptoms of area residents. Therefore, the Panel finds that odours need to be eliminated to the extent possible.

Further to the AER Panel summary report, evidence was submitted by Dr. Martin Fowler that the subject formations contain the highest concentrations of sulphur among petroleum resources in the province of Alberta.¹⁶ Certainly the significant H₂S levels merit attention, but it is not the most common reduced sulphur compound in bitumen emissions. Carbonyl sulphide (COS) and carbon disulphide (CS₂) are much more common in heavy oil deposits and are poor in hydrogen. These chemicals do not have the same noxious odour typical of H₂S and mercaptans, but are well absorbed, are converted to H₂S within the body, and are similarly neurotoxic and exert multi-systemic toxicities. A review led by Dr. Sheldon Roth¹⁷ identified sulphur binding with metal ions at the active sites of enzymes as a key fundamental mechanism of multi-system toxicities. Inter-individual genetic variability results in orders of magnitude variation in health impacts among individuals – large MOEs are intended to cover such variability.

It is unclear why the current consultation would include sulphide salts, but not other 3-atom reduced sulphur compounds that are toxicologically similar (albeit slower acting) and may pose risks to larger numbers of workers and residents of rural and industrialized areas. Reduced sulphur compounds were not addressed in any of the petroleum streams assessments to date, either. This is a large gap.

(d) Common Law Public and Private Nuisance

Odorous emissions have been held by Canadian courts to constitute public and private nuisances.¹⁸ In *Newmarket (Town) v. Halton Recycling Ltd.*, the Ontario Superior Court concluded that residents and individuals living and working within the zone of influence of sulphur-based odours emitted from an organic waste processing facility had been “adversely affected” by the odorous

¹⁵ Albert Energy Regulator, Report of Recommendations on Odours and Emissions in the Peace River Area March 31, 2014, online: <<http://www.aer.ca/documents/decisions/2014/2014-ABAER-005.pdf>> accessed November 5, 2017.

¹⁶ Peace River Proceeding No. 1769924, November 25, 2013 Experts Volume at pp 335-356, online: <<https://www.aer.ca/documents/applications/hearings/1769924-ExpertsVolume-Amended-20131205.pdf>>.

¹⁷ Dr. Sheldon Roth and Verona Goodwin, “Health Effects of Hydrogen Sulphide: Knowledge Gaps”, online: <<https://ia800502.us.archive.org/32/items/healtheffectsofh00roth/healtheffectsofh00roth.pdf>>.

¹⁸ See *eg Appleby v Erie Tobacco Co*, (1910) 22 OLR 533 (Div Ct); *Atwell v Knights*, [1967] 1 OR 419 (HCJ); *Plater v Collingwood (Town)*, [1968] 1 OR 81 (HCJ).

emissions,¹⁹ and that the odours constituted a public nuisance.²⁰ The odours had caused physical discomfort, including headaches, nausea, gagging, sore throats, and burning eyes; affected complainants' sleep and appetite; and affected office morale and productivity.²¹ Justice Bryant found that the odours had affected "the physical wellbeing of some of the residents and individuals who work[ed] in the area and caused stress to the adjacent neighbourhood and workplace alike."

Recommendation 2: It is recommended that the Ministers recognize and accept the growing body of regulatory and common law findings that human health is or may be detrimentally affected, hence endangered, by odours and chronic inhalational exposures, and such a recognition provides additional support for a classification of H₂S as toxic pursuant to subsection 64(c) of CEPA.

3. Human health risks analysis

(a) Neurological effects

The Draft Screening Assessment notes that neurological effects observed from H₂S exposure include coma, seizures, dizziness, dementia, decreased ability to communicate, decreased attention and concentration and memory impairment.

The Draft Screening Assessment identifies an acute respiratory effect level of 2 ppm (2.8 mg/m³) on the basis of biologically significant increases in airway resistance observed in asthmatic volunteers in a 30 minute chamber study. At H₂S concentrations as low as 0.05 ppm, significant decline in cognitive recall through auditory verbal learning is observed, according to studies cited in the Draft Screening Assessment, although the study authors suggested that the decline in verbal learning could be due to fatigue.

However, rather than set the neurological no observable adverse effect concentration ("NOAEC") at a precautionary level of 0.05 ppm based on the observations from these studies, the Draft Screening Assessment used a NOAEC of 30 ppm derived from a study on rats.

The California Office of Environmental Health Hazard Assessment ("OEHHA") uses an acute reference exposure level ("REL") of 42 µg/m³ (0.03 ppm) based on neurological effects of headache, nausea and physiological responses to odour in a panel study of 16 people.²² No uncertainty factors were applied to obtain the REL. The OEHHA acute reference level is 1000-fold lower than the NOAEC used in the Draft Screening Assessment. The OEHHA level of 0.03 ppm is within the range of H₂S ambient air concentrations of 0.001–0.031 ppm as reported in the Draft Screening Assessment.

The Draft Screening Assessment does not apply the precautionary principle, despite the government's duty to do so under subsections 2(1)(a) and 76(1) of CEPA.

¹⁹ *Newmarket (Town) v Halton Recycling Ltd*, 2006 CanLII 33316 (ON SC) at para 60.

²⁰ *Ibid* at para 70.

²¹ *Ibid* at paras 27, 29, 30, 32, 34.

²² OEHHA, Appendix D.2 Acute RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines (1999) at p 146, online: <<https://oehha.ca.gov/chemicals/hydrogen-sulfide>>.

Recommendation 3: It is recommended that the Ministers lower the neurological acute NOAEC to reflect the neurological adverse health effects of odour. Ambient H₂S concentrations in Canada have been measured above the concentration that causes neurological health impacts. H₂S should therefore be designated as toxic pursuant to subsection 64(c).

(b) Respiratory effects

For longer-term (chronic) inhalation exposure risk characterization, the inhalation NOAEC of 10 ppm (14 mg/m³) was identified in the Draft Screening Assessment on the basis of nasal olfactory neuronal loss observed in rats and mice. The California OEHHA set a chronic inhalation REL of 10 µg/m³ (0.007 ppm) based on a chronic inhalation NOAEL of 30 ppm with the application of uncertainty factors for subchronic, interspecies, intraspecies and cumulative effects totalling 6000.²³

No uncertainty factors were applied to the inhalation NOAEC in the Draft Screening Assessment even though it is based on animal studies, contrary to common practice in risk assessments that embed precaution into the analysis. The Draft Screening Assessment compares the NOAEL of 10 ppm directly to ambient air concentrations to assess the margin of exposure (“MOE”) at 970 to 30,000. Applying the OEHHA uncertainty factors to the chronic inhalation NOAEC would result in a REL of 0.0017 ppb, which is well within H₂S ambient air concentrations in Canada, which are reported to range from 0.001–0.031 ppm. Even if only the interspecies and intraspecies factors of 10 were applied, the REL would be 0.01 ppm which is also well within ambient air concentrations. This analysis shows that the MOEs are insufficient to ensure protection of human health given the uncertainty in the NOAEC.

Recommendation 4: It is recommended that the Ministers apply uncertainty factors to the chronic inhalation NOAEC to set a chronic inhalation REL. Ambient H₂S concentrations in Canada have been measured above an REL derived from the chronic inhalation NOAEC with uncertainty factors applied. H₂S should therefore be designated as toxic pursuant to subsection 64(c).

4. Margins of Exposure are within risk range

Even without the addition of uncertainty factors or the other considerations above, the MOEs determined under the Draft Screening Assessment are found to range from 60 to 200 for acute respiratory effects, and 320 to 10,000 for chronic inhalation. The Health Canada policy²⁴ with respect to screening assessments states that “[g]enerally, margins greater than 1000 are adequate as a basis for recommending no further action for substances where the databases on exposure and effects are relatively complete.” For MOEs below 1000, the policy requires further analysis. Although the policy is marked “archived”, it is still found on Health Canada’s website and no other

²³ OEHHA, Appendix D.3 Chronic RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines (1999) at p 325, online: <<https://oehha.ca.gov/media/downloads/cnr/appendixd3final.pdf>>.

²⁴ Health Canada, ARCHIVED - Screening Health Assessment of Existing Substances Under the Canadian Environmental Protection Act, 1999, online: <<https://www.canada.ca/en/health-canada/services/environmental-workplace-health/environmental-contaminants/existing-substances/screening-health-assessment-existing-substances/screening-health-assessment-existing-substances-under-canadian-environmental-protection-act-1999.html>>.

policy could be found to replace it. Without further analysis, it is incorrect to suggest these MOE ranges are acceptable.

Recommendation 5: The MOEs determined in the Draft Screening Assessment are within the range that requires further analysis, according to Health Canada's policy. The Ministers should therefore reassess their proposed conclusion under subsection 64(c) and conclude that H₂S is toxic.

Conclusion

We submit that H₂S should be classified as toxic pursuant to subsection 64(c) of CEPA. We would welcome the opportunity to answer any questions with respect to these comments, and remain committed to working with the Government of Canada to ensure the health of Canadians and our environment are protected now and in the future from the unnecessary and serious risks posed by H₂S. Given the Organizations' interest in the regulation of H₂S in Canada, we request to be informed of any future decisions regarding this substance. We extend our thanks to you and to the Ministers for your consideration of the foregoing.

Yours truly,

Elaine MacDonald
Program Director and Senior Staff Scientist
Ecojustice

Kurt Stilwell
Lawyer
Ecojustice

Bronwyn Roe
Staff Lawyer
Ecojustice

Muhannad Malas
Toxics Program Manager
Environmental Defence

Joseph Castrilli
Counsel
Canadian Environmental Law Association

Fe de Leon
Researcher
Canadian Environmental Law Association

Kim Perrotta
Executive Director
Canadian Association of Physicians for the Environment

Meg Sears
Chair
Prevent Cancer Now