GATEPOST
RISK ANALYSIS

ENVIRONMENTAL HEALTH IN RED HEAD: THE ENERGY EAST PROJECT

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SUMMARY OF KEY ENVIRONMENTAL HEALTH ISSUES

- Holistic impacts on health and community wellbeing are not evaluated for pipeline spill or marine spill scenarios. The current approach to EIAs is a poor model for addressing non-toxicological health impacts, for example risk perception, stress, sense of place, lifestyle and economic disruptions, and community resilience.
- Environmental health impacts of catastrophic events such as tank failures, explosions, or fire at the storage tank farm have not been evaluated. Potential toxicological and non-toxicological health impacts to downwind and downslope residences (for example, Anthony's Cove) should be identified and assessed. Modeling such scenarios from an individual and community perspective can enhance emergency planning and response related to possible events at the tank farm.
- Odour potential from fugitive emissions at the tank farm and related infrastructure should be evaluated more thoroughly. Odours and odour-related health issues are complex. Community concerns may be attenuated with commitment by TC to meaningfully address any future issues.

INTRODUCTION

In December 2015, GatePost Risk Analysis gave a high-level evaluation of environmental health issues related to the Energy East project that may affect Red Head residents. These concerns relate to the proposed tank farm, marine terminal, and associated connecting pipelines and operational activities. TransCanada (TC) made changes to infrastructure at the Red Head location, increasing the total storage capacity of the tank farm. In May 2016, TC submitted updated regulatory filings that include an updated human health assessment of the marine terminal complex and associated tank farm (Volume 17, Part A, Section 19).

LIMITATIONS OF THE HHRA APPROACH

The EIA process is by default a linear approach to the question of whether a project will cause significant adverse effects on the environment. The assessment is divided into many segments, and each are evaluated more or less independent of one another (i.e. a silo-based approach). In the context of this review (health), this silo-based approach does not address the holistic nature of individual and community health and wellbeing. Evaluation of health is typically restricted to chemical exposure and the limitations of single chemical - toxicity based HHRA. Meaningful interpretation and communication of what the results of an HHRA actually may mean to individuals and communities continue to be significant challenges.

More complexity and sophistication in the HHRA itself is unlikely to provide a better prediction of health effects of the project. Wellbeing depends upon many factors (e.g. Health Canada's determinants of health [1]), and exposure to environmental contaminants is only one consideration. Additionally, aside from factors such as education, employment, social support and culture, concepts such as trust and risk perception play a substantial role in a community's overall sense of wellbeing. In the context of a project's effects on health, few of these factors are considered in the EIA process.

HEALTH-RELATED APPLICATION VOLUME:

[1] Public Health Agency of Canada. "What Determines Health?" (http://www.phac-aspc.gc.ca/ph-sp/determinants/index-eng.php#determinants), accessed 17 November 2015.

HIGH-LEVEL REVIEW OF ASSUMPTIONS AND CONCLUSIONS, FOCUSING ON THE TANK TERMINAL AND MARINE TERMINAL IN RED HEAD.

The updated human health assessment submitted for the tank farm and marine terminal at Red Head is limited to a basic evaluation of airborne contaminant concentrations in the areas surrounding oil storage tanks and marine facilities, and whether those concentrations exceed relevant guidelines.

TC appears to have addressed the increased storage capacity of the proposed tank farm in the HHRA. They reported updated concentrations of criteria air contaminants, VOCs and odour compounds and re-calculated the ratios versus the identified guideline values. The conclusions remain as in the prior assessment – that concentrations of the identified chemicals of potential concern remain below guideline values, therefore health impacts are not expected to occur.

Specific HHRA concerns.

The set of compounds assessed remains the same as previously reported. It is limited to a small set of volatile organic carbons (VOCs) and reduced sulphur compounds (mercaptans). These are a small subset of chemical components of the heavy oil that TC expects to transport in the pipeline – a discussion of how the compounds to be evaluated were selected is not obvious. Other compounds or compound classes, for example polycyclic aromatic hydrocarbons (PAHs) from the tanks or from gas flaring may also be considered, or provide an explanation of why they are not considered.

TC continued use of the Alberta Ambient Air Quality Objectives [2] values for benzene (1 hr guideline = 30 $\mu g/m^3$; annual average guideline = 3 $\mu g/m^3$) rather than Ontario Ministry of Environment [3] (24 hr guideline = 2.3 $\mu g/m^3$; annual average guideline = 0.45 $\mu g/m^3$), and have not given the basis for this choice. It is possible that TC has opted to use the AAAQO because it is based on a general carcinogenic risk benchmark of 1E-05 or 1 in 100,000 over a lifetime of exposure, versus the OMOE guideline, which appears to be based on the US EPA benzene concentration range for a risk benchmark of 1E-06 or 1 in 1,000,000. The 1E-05 benchmark is consistent with Health Canada guidelines for chemical risk assessments. Clarification from TC on this issue would be helpful.

Further with respect to benzene, whereas the original human health assessment for the marine terminal and tanks listed the baseline 1-hr maximum concentrations of benzene as 3.9 $\mu g/m^3$, the updated assessment does not report a baseline 1-hr maximum, with a footnote in the table stating that data is unavailable. *Why was it reported previously, but is unavailable in the updated version?*

LIMITATIONS / UNCERTAINTIES OF SCIENTIFIC MODELING

Risk estimates are based on concentrations of airborne contaminants modeled at various locations near the facilities. From various discussions of the accuracy of the CALPUFF model used to estimate these concentrations, we know that the model can over- and under-estimate concentrations at any particular

[2] Alberta Ambient Air Quality Objectives and Guidelines Summary. August 2013. (http://environment.gov.ab.ca/info/library/5726.pdf)

[3] OMOE 2012. Ontario's Ambient Air Quality Criteria. Standards Development Branch, Ontario Ministry of the Envrionment. (http://www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf)

time/location by more than 2x (e.g. Wood and Blewitt 2012)[4]. Furthermore, emissions estimates for the crude oil storage tanks may introduce substantial uncertainty into the model. The US EPA TANKS program was used by TC to generate emissions factors for the storage tanks. The program estimates average emissions but not instantaneous emissions, which could result in significantly greater uncertainty for the 1-hr and 24-hr VOC estimates. A recent study of fugitive emissions from storage tanks showed that certain effects are not accounted for in the TANKS software, and odorous compounds such as H_2S and reduced sulfur compounds may not be reliably characterized [5].

TC changed the reporting in the updated atmospheric environment appendix to show fewer decimal places, possibly in response to GPRA's comments earlier. This helps to reduce the implied accuracy of the predictions. However, TC has not provided an analysis of the uncertainties in their modeling approach, and the possible implications of such uncertainties.

CATASTROPHIC EVENT ANALYSIS IN THE APPLICATION:

Scenarios covered:

TC evaluated leaks from an engineering risk perspective and assessment of historical pipeline leaks using the NEB and PHMSA [6] incident databases. TC calculated the risks of pipeline failure in terms of the odds per year per km of pipeline that an event would occur. Their conclusion was that the odds are very low of any particular km of pipeline failing, and if a failure occurred, it would most likely result in a small spill of minimal consequence. This evaluation is not affected by the changes to the tank farm, and is unchanged in the updated filing.

In Volume 19, Section 3.6, TC provides an HHRA for accidental crude oil spills on land, specifically aimed at pipeline spill scenarios. The assessment covers a 10,000 barrel spill, which they consider to be a credible worst-case event. For reference, the Michigan pipeline spill was over 3 million litres, or about 19,000 barrels. Enbridge assessed spills up to 3321 m^3 (21,000 barrels) for the Northern Gateway pipeline[7], based on full bore rupture, time to response, and volume between valve stations. The HHRA presented for pipeline spills for Energy East is much less extensive than that provided for both Northern Gateway and the urban scenarios assessed for the Kinder Morgan TransMountain pipeline. TC evaluated benzene as the main compound of concern due to its volatility and established toxicity, and focused the HHRA on short-term inhalation of benzene by nearby residents. After estimating downwind benzene immediately following a spill, they conclude that concentrations would not reach levels that would result in short-term effects (discomfort, irritation, dizziness, or headaches).

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[4] Wood, D. and Blewitt, D. 2012. "Are EPA regulatory models capable of providing accurate estimates of future air quality?" presented at the US EPA 10th Conference on Air Quality Modeling, Research Triangle Park, NC. March 13-15, 2012. http://www3.epa.gov/scram001/10thmodconf/presentations/3-18-modeling_policy_issues.pdf

[5] Pickard, D. 2011. "Evaluation of VOC emissions from crude oil and condensate storage tanks." Report for Petroleum Technology Alliance Canada. (http://www.ptac.org/projects/9)

[6] Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation.

[7] Stantec/RPS/AMEC 2012. Technical Data Report: Ecological and Human Health Risk Assessment for Pipeline Spills, Enbridge Northern Gateway Pipelines. Stantec Consulting Ltd; RPS ASA; AMEC Environment & Infrastructure. July 2012 (https://docs.neb-one.gc.ca/ll-eng/llisapi.dll?func=ll&objId=831412&objAction=browse)

Nevertheless, communities remain concerned about the consequences should a larger pipeline rupture occur. While direct toxicity-based health risks from the leaked oil remain small, the disruption to lives and livelihood, and concerns about issues such as property values and long-term effects on wellbeing remain. As I reported previously, a 2014 review (Eykelbosh 2014)[8] of reported health impacts of oil spills concluded that various short-term and long-term health effects can occur, particularly for residents living in the contaminated zone, and for those involved in clean-up (volunteers and professionals). In addition to toxicological effects, there is more evidence of mental health and broader community impacts of such spills. The reviewer found that "mental health impacts were more sensitive indicators of harm than physical impacts", and that perceived risks in particular were more harmful than actual toxicological effects.

In a much more extensive assessment, TC provided a comprehensive ecological and human health risk assessment for spills resulting from tanker incidents in the Saint John harbor, the Bay of Fundy, and the Island of Grand Manan. GPRA completed a high-level review of the human health conclusions, which is appended to this document.

Scenarios not covered:

TC has not evaluated catastrophic events at the expanded tank farm with respect to potential human health or community wellbeing impacts. As GPRA reported previously, other major pipeline project applications were required to undertake significantly more extensive human health and ecological risk assessments of various catastrophic pipeline spill scenarios. Given the significant increase of storage capacity at the site, the perception of risk of spills, catastrophic events, direct health impacts, and indirect impacts to wellbeing for nearby residents has increased.

POTENTIAL ODOUR ISSUES

Odour issues and concerns have not been discussed aside from the conclusions that H_2S and reduced sulfur compound emissions are expected to be too low to cause concern. In the chapter on Atmospheric Environment, TC states "Because the predicted concentrations of sulphur compounds (H_2S and mercaptans) are low, it is unlikely that perceivable odours would occur as a result of releases from the MTC." Vol 17 Part A Sec 2 p. 2-30. There are two problems with this conclusion:

- As identified earlier, Pickard[5] discussed the issues in characterizing the reduced sulfur compounds in the TANK software, which would subsequently introduce uncertainty in the CALPUFF model results. The model may under-predict reduced sulfur concentrations as a result of these issues.
- Odour events and subsequent wellbeing issues occur even in the absence of detecting H_2S or mercaptans, or when detecting these compounds or VOCs at low concentrations that should not trigger odour events.

The case study from the Peace River, Alberta area continues to be relevant, as landowners continue to be exposed to intermittent odour events that affect their wellbeing.

- The Alberta Energy Regulator (AER) investigated odour-related health and wellbeing effects

[8] Eykelbosh, A. 2014. Short- and long-term health impacts of marine and terrestrial oil spills. https://www.vch.ca/media/VCH-health-impacts-oil-spill.pdf

from heavy oil production [9] in a rural farming community near Peace River (AER 2014)[10]. This case is an example of the challenges associated with identifying odours and their relationship with impacts on wellbeing. Many volatile and known odour-causing compounds were monitored, however, all compounds remained well below Alberta Ambient Air Quality Objectives or below concentrations set by the Texas Commission on Environmental Quality (TCEQ).

- A recent case in Michigan[11] linked odours to an oil storage tank farm. As in the Peace River case, VOCs and known odour-causing compounds were either not detected or were below regulatory concentrations. This means the company is not in violation of any standards. In this instance, the company undertook significant efforts to identify and resolve the leaks.

The most important issue in cases like this is the acknowledgement that health and wellbeing impacts can occur even if regulatory guidelines are being met. Corporate willingness to address concerns even if they are not mandated by regulatory standards is an important aspect of risk perception in the community and corporate good will.

- Odours and odour assessment is more complex than modeling a single compound class and comparing to a standard.
  - The Clean Air Strategic Alliance in Alberta recently published the "Good Practices Guide for Odour Management in Alberta" [12]
  - The relationship between odours and health is complex. Individuals experience odours differently – some may find an odour offensive while others may not detect it or may find it pleasant. If health-related symptoms are present, different people may experience and describe symptoms in different ways, whether or not they can identify particular odour components.
  - Odours are also unlikely to be solely due to individual chemicals – chemical mixtures may interact in many different and unexpected ways. This aspect makes modeling and assessing odours a challenging issue. We currently understand chemical toxicity on a chemical-by-chemical basis; we currently have a poor understanding of the toxicology of mixtures with regard to odours and with regard to the majority of potential environmental contaminants.

REMAINING OUTSTANDING QUESTIONS:

- An addendum to Volume 6 (Accidents and Malfunctions) of the Application was referred to in the Health section. Has TC completed such an assessment? What is the scope of that assessment?

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[9] In this oil production area, producers pump an emulsion of oil and water from the wells and hold it in heated tanks while the emulsion breaks down and the oil and water separate. Because the tanks are heated, they must be vented. In this case, the tanks were vented to the outside atmosphere, rather than the vapours collected in a closed system.

[10] AER 2014. Proceeding 1769924. Odours and Emissions from Heavy Oil Operations in the Peace River Area. Alberta Energy Regulator. (https://www.aer.ca/applications-and-notices/hearings/proceeding-1769924)

[11] The Times Herald. "Mystery odor irritates neighbors." October 6, 2014.
(http://www.thetimesherald.com/story/news/local/2014/10/06/mystery-odor-irritates-neighbors/16824111/)

[12] CASA 2015. Good Practices Guide for Odour Management in Alberta: From prevention and mitigation to assessment and complaints. Clean Air Strategic Alliance, Edmonton, AB. (www.casahome.org)

Does it include reasonable worst-case scenarios for the Saint John oil storage tanks and marine terminal?

- Why was the Alberta guideline for benzene used rather than the more stringent Ontario guideline? This question remains outstanding, as a discussion was not found in the updated documents regarding this issue.
- Currently, a monitoring program related to human health concerns is considered unnecessary because the effects assessment concludes there will be no risks of health effects. The company should discuss their anticipated response to future community or individual concerns. As a starting point, CASA's guide[12] offers various tools for tracking odour character and health symptoms, prevention and mitigation, and on-going odour assessment tools.

ADDENDUM

COMMENTS ON VOLUME 24, PART B – DETERMINISTIC MODELING OF THE ECOLOGICAL AND HUMAN HEALTH CONSEQUENCES OF MARINE OIL SPILLS; SECTION 6.4.

INTRODUCTION

In the May 2016 updates to the Energy East project, TC submitted an Ecological and Human Health Risk Assessment (EHHRA) for various oil spill scenarios in the Bay of Fundy marine environment. The assessment was done in two primary stages: Part A is a stochastic (probabilistic) assessment of different spill scenarios and oil types, the results of which informed Part B – a deterministic assessment of three specific scenarios for ecological and human health impacts. The comments that follow are limited to the human health component of the deterministic assessment for a spill in the Saint John harbor.

SUMMARY OF HHRA

TC evaluated acute, short-term toxicological risks from the volatile components of Western Canadian Select (WCS), which is diluted bitumen, as well as longer-term risks from direct contact with spilled oil and exposures through the marine food chain (fish or shellfish). TC identified some cases in which the estimated exposures could exceed regulatory guidelines, resulting in a hazard quotient (HQ) benchmark greater than 0.2, or an incremental lifetime cancer risk (ILCR) greater than 1 in 100,000 (1E-05).

- For airborne contaminants immediately following the spill, benzene, toluene, volatile petroleum hydrocarbon fractions, and other volatile compounds could exceed the 1-hr or 24-hr exposure guidelines for either residential receptors or subsistence receptors. Anthony's Cove and Lower Rocky Corner were identified as having the greatest likelihood of concentrations exceeding risk-based toxic reference values. The model did not indicate that acute exposure guideline levels (AEGLs)[13] would be reached in any location.
- Direct contact with crude oil in intertidal sediments (eg. wading, digging, scavenging, sunbathing, etc. on beaches) gave HQs greater than 0.2 for high molecular weight aromatic crude components (>C_{16}-C_{50}) and ILCRs greater than 1E-05 for carcinogenic PAH components.
- Risks from consuming seafood from the Bay of Fundy were greater than HQ of 0.2 for high molecular weight aromatic crude components (>C_{16}-C_{50}) in herring, clam/snail, and lobster/crab from the intertidal zone at different elapsed times from 4 weeks to 2 years. ILCRs exceeded 1E-05 for carcinogenic PAH components for various fish and shellfish species from the intertidal zone.

All risk calculations are based on an assumption of no emergency response/clean-up activity, and no alteration of activities or diet by residents or subsistence users, so from that perspective the assessment evaluates a worst case scenario. TC also used skin-to-sediment assumptions that are likely a significant over-estimate based on typical weather and water temperature conditions on the Bay of

[13] AEGLs are airborne concentrations of substances that can cause the general population to experience effects ranging from transient and reversible effects (Level 1) to irreversible, serious, or disabling effects (Level 2) to life-threatening effects or death (Level 3).

Fundy; also, conservative consumption amounts were assumed for fish and shellfish (i.e. assume individuals eat more fish and shellfish than they actually consume).

COMMENTS ON HHRA

A high-level review of the problem formulation, modeling, and risk characterization revealed no obvious errors or omissions. As summarized above, TC identified some exceedances of risk benchmarks for exposure to volatile compounds immediately following a spill, and longer-term chronic or carcinogenic effects. None of the risk numbers calculated are worrisome on their own. As stated by TC and regulatory agencies that publish HHRA guidelines, HQs or ILCRs above the benchmarks do not mean that toxicological effects will occur. They indicate that further interpretation of the factors and assumptions that indicate higher risks need to be evaluated further. TC provided reasonably thorough reviews and discussions of the health risks that were above benchmarks. The combination of conservative exposure parameters and the assumption that no mitigation activities would take place following a catastrophic event result in substantially higher estimated risks than those that would be more likely to occur.

From a toxicological risk perspective, within the confines of the modeling presented for the marine spill near Saint John, the overall risks of adverse health impacts are likely very low.

OTHER ISSUES FOR COMMUNITY WELLBEING

Individual and community wellbeing, however, is not solely dependent on the presence or absence of toxicological risks. As discussed briefly with regard to the tank farm HHRA, there are various other issues related to oil spills or the potential for an oil spill that are not addressed in this EHHRA. A very thorough review[8] of health outcomes from major marine and terrestrial oil spills identified a number of health impacts other than toxicological effects. Most significantly, mental health issues including risk perception have a greater impact on overall health following a spill. Financial loss and litigation issues exacerbate stress and other mental health concerns, and rapid and satisfactory compensation can attenuate these concerns. Additionally, long-term recovery depends on family and community social networks, and promoting community resilience.

While these issues fall outside of the scope of this EHHRA exercise and what is normally included within an EIA Terms of Reference, they are critical issues to consider with respect to the overall health and wellbeing impacts of oil spills in either the marine environment or in urban/rural terrestrial areas.