Air Emissions from the Chevron North Burnaby Refinery

Appendix F

Peer reviewers’ comments and our responses

Date: 6 July 2002
A preliminary version of this report was reviewed by two external peer reviewers in May 2002. The reviewers were Dr. John Shortreed, Director, Institute for Risk Research, University of Waterloo and Dr. Steve Hrudey, Acting Chair, Department of Public Health Sciences, Professor and Director, Environmental Health Sciences Program. We acknowledge the valuable contribution of these reviewers. We reiterate that all statements, findings, and opinions in this report are solely those of the report authors.

The peer reviewers’ comments and our responses (in bold italics) are included below.
A Review of

Air Emissions from the Chevron North Burnaby Refinery

By John Shortreed, PhD, PEng.(ON),
Director, Institute for Risk Research, University of Waterloo
May 16, 2002

Introduction

The study report is an assessment of the health impacts of the North Burnaby Chevron Refinery based on existing air monitoring data and was specifically designed as a “risk communication” document for all stakeholders, particularly the residents of the community.

This reviewer has limited expertise in the areas of toxicology and epidemiology, which are central scientific disciplines in health risk assessment. However, the reviewer has considerable expertise in risk assessment and risk communications. On balance, having read the report and considering the objective of the report, the reviewer felt comfortable in reviewing the document.

Assessment of the Report and Its Findings

The report is comprehensive, well documented, thorough, and can be taken as a reasonable and accurate assessment of the health risks to residents of the area, given the limitations of working with existing ambient air quality data. The authors are to be congratulated on their work and in particular the informative structure of the report, with clear separation between descriptions of exposure to air pollutants, health impacts, and risk assessment. This reviewer found the following to be innovative and well done:

- Explanation of possible health effects using detailed descriptions of medical conditions and also specifics from the literature. This makes for a good understanding of the risks involved. Sufficient information was provided so most people could form their own opinions.
- Separation of pollutants into those with very low risks (usually not of concern) and those with risks of possible concern. This allowed for a focus on the risks of concern. A similar approach was used for focusing on peaking of exposure.
- Development of health exposure standards when there were none available. With the detail information from the literature provided in the report it made interpretation of the significance of the risks possible.
- A report written for stakeholders rather than the regulator.
One “bottom line” interpretation of the findings of the report are that there are likely health risks from the refinery but that these risks are small and similar to other risks in the GRVD urban area. Relative to other refinery locations in Canada, it would appear from the limited information provided by air quality monitoring data, that this refinery does not compare well with other refineries.

The authors on pages 10-11 argue that there is a separation between “risk assessment” and “risk management”. The ISO risk terminology would use “risk treatment” for the term “risk management” and this review will use the term risk treatment to refer to the taking of action to reduce the risks.

*We have now included the phrase “risk treatment” and reference to the ISO terminology in this section.*

This reviewer is of the opinion that risk assessment is not done unless there is the possibility of taking some actions to reduce the risk and that risk assessment usually leads to the examination of risk treatment options to reduce the risk. This means that this risk assessment report is a part of a larger process which will consider risk treatment options. Having said this, it is noted that to do so will likely involve the collection of additional data and more studies that focus on possible risk treatments. The report would benefit, in the view of the reviewer, in an expanded discussion in section 2.1 that would more directly relate the role of the report (which is basically a scientific health risk assessment report) to the larger issue of the risk decision process in the community.

*We agree and have added further comment on this in section 2.1.*

The assessment of risks involves the evaluation of the risks that are estimated and this evaluation can only be done by the stakeholders involved. It is clear from the report that the structure of the Advisory Committee represents a cross section of the stakeholders and has ensured that the report is balanced and comprehensive. One example of the complex nature of evaluating risks can be found on pages 75-77 in the discussion of 1,3-Butadiene, a “probable human carcinogen” where the exposures exceed the recommended health standards and the report concludes “exposure to 1,3-butadiene may be associated with a small increase in cancer risk over that expected in other GVRD residential areas”. The report makes clear that the uncertainty factor is large (i.e. standards are likely conservative), there are limited confirming epidemiology studies (measures of observed health effects on people), outdoor exposures in North Burnaby are likely lower than indoor exposures, background levels often exceed standards, and the substance is related to automobile usage, a ubiquitous fact in the GVRD as evidenced by exposure levels in downtown being similar to those at the tank farm location. In the view of the reviewer, only the Advisory Committee can adequately evaluate this and other risks and the Advisor Committee are encouraged to write their own consensus summary of the meaning of the study results. This clearly is outside the terms of reference of this report.
We concur. It would be useful for the advisory committee to attempt a consensus summary of the meaning of the study results, but agree that it is outside our terms of reference.

There are some communication difficulties with the draft report and these include:

- The use of yellow for the results. On both the paper copy and the computer screen (appendices were provided as PDF files) this was very difficult and sometimes impossible to read. *This problem has been fixed in the current version of the report.*

- In earlier tables in the report (E.G. Fables 3.5 and 3.6) the monitoring stations closest to the refinery were highlighted and this was helpful in reading the tables. In later tables this was not done. *Highlighting has been added to all tables where appropriate.*

- There is inconsistency in the provision of standards, odor, and other reference lines on Figures. These were found to be useful and should be included where possible. *We have added more ‘comparison’ or reference information on figures where reliable information could be found.*

- Figures that plot hourly data for several years (E.G. Figure 3.9) have, to the reviewer, little information content and the authors might consider some other form of summary. It is recognized that this is a difficult task. *We could not identify an alternate format for the figures. In order to provide information as clearly as possible, we included all summary information in tables as well as figures.*

- The report needs a “city” map showing the refinery, tank farm, and monitoring stations. Even local residents may find it useful to see the arrangement and relative locations. *This has been added.*

- The stakeholder comments in the Appendix B could be summarized as to the frequency of concerns. For example, a number of people indicated that the wind direction had an impact on their item of concern: this suggests that some data on dominant wind directions, speed and atmospheric stability would be useful to have in the report. On page 15, for instance, odors around the refinery are most noticeable in the early hours of the morning, which is one indication of the importance of wind speed and atmospheric stability. *These comments were not solicited as part of a systematic survey, but rather were volunteered by members of the community in response to our call for input. We believe they provide a valuable record of community concerns, and therefore have included a qualitative summary of the comments. However, we do not believe a quantitative summary would be appropriate. Regarding inclusion of meterologic data, this was clearly outside our terms of reference and we have made reference to this again in the “Limitations” section of the report.*
Review of

Air Emissions from the Chevron North Burnaby Refinery

Draft Final Report

Susan M. Kennedy, Ray Copes, Sarah Henderson, Sonia Na, Colin Mackay

11 April 2002

Review prepared by:

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General Comments

The Human Health Impact Assessment report provides a reasonable analysis of available, relevant data for the stated purpose of performing “an assessment of the potential human health impacts of current air emissions (scheduled and unscheduled) from the Chevron Burnaby refinery, tank farm, and associated facilities” (2.3. Objectives). Because there is no absolute and specific means that must be followed for performing such an assessment, it is important that the assessment be done in response to community consultation to make sure that the right questions are being addressed. Likewise, the report must be clear about how the analysis was done to ensure an accurate interpretation of the findings. Generally, these requirements have been done well and I judge the overall findings to be reasonable for the circumstances described. A number of specific comments or questions are listed below for the purposes of improving the overall understanding of the report by the various audiences you must serve.

Specific Comments

1. p. 3 I question whether the methods used justify the precision of estimating 27 days with possible SO₂ – induced asthma episodes. I would have thought that estimating between 25 and 30 days would more accurately express the level of confidence in the prediction based on the available data. We agree and have changed this section accordingly to include a range of values.

2. p.5 The discussion of metals that is provided in Section 6 is not mentioned in the Executive Summary. This has now been added to the Executive Summary.

3. p.5 The discussion on cancer predictions from risk assessment and those from the review of epidemiology literature could be elaborated to note that the lifetime probabilities¹ among all Canadians (not those specifically exposed to refinery emissions) of developing lung cancer (males 8.8 in 100, females 5.3 in 100) and leukemia (males 1.4 in 100, females 1 in 100) are high enough to make the extremely low cancer risks that might be attributed to these monitored air emissions essentially impossible to detect by any epidemiologic study. This challenge was observed in qualitative terms, but some quantitative perspective on the degree of difficulty encountered may be useful. The futility of doing a community health survey in these circumstances was wisely noted. We agree and are grateful to Dr. Hrudey for providing these comparative values, which have now been included in the report.

4. p.10 The Figure depicting the Health Canada risk assessment framework was far too small to be readable and thus added no value to the discussion. fixed

5. The Table in Section 2.6 was numbered Table 0.1, an apparent typo. fixed

6. p.26, etc. The colour figures starting with Fig.3.5 and continuing with 3.6, 3.9, 3.11, 3.12, 4.1, 4.2, 4.3, 4.4, 4.5, 5.1 to 5.12 all use yellow, which make those lines and symbols essentially invisible on the printed pages. **fixed**

7. P.26, etc. The UBC 10 minute guideline is introduced in Tables 3.15, 3.16 and 3.17 and Figure 3.8 without any prior explanation that I can find. Because this derived criterion plays a major role in the quantitative analyses that have been done on SO₂, a full explanation of where this came from and how it was developed is needed. **This section has been reorganized and expanded so that the explanation of how the UBC guideline was developed precedes its use in these tables and figures.**

8. p.100 The statement at the end of this page is very confusing. “This is partly because indoor sources of exposure to these substances are at least as important as outdoor source in contributing to disease risk and also partly because the health comparison value (ie the unit risk) is set deliberately at a level to be associated with very low population risk.” The intent of this statement is not clear and should be clarified. **This statement has been deleted and the section modified accordingly.**

9. p.99 There is also a problem with the results summarized in Table 1.4. As defined in footnote 2 to Table 1.2, the unit risk (the U.S. EPA gave this a poor name, admittedly) is an estimate of “excess cancers per million population per µg/m³.” For 1,3 butadiene, this is a plausible upper bound estimate of the cancer risk because the unit risk factor is derived from applying the q₁* slope factor derived from the linearized multistage model applied to rodent cancer bioassay results to determine a dose, which is then translated into an air concentration on the basis of typical breathing rates. The cancer risk estimates produced by the linearized multistage model and how they should be presented in risk assessments was described in the U.S. Federal Register document that established its use:² “It should be emphasized that the linearized multistage procedure leads to a plausible upper limit to the risk that is consistent with some proposed mechanisms of carcinogenesis. Such an estimate, however, does not necessarily give a realistic prediction of risk. The true value of the risk is unknown, and may be as low as zero. The range of risks, defined by the upper limit given by the chosen model and the lower limit which may be as low as zero, should be explicitly stated.” As a result, the cancer risk estimates shown in Table 1.4 as means or medians (based presumably on mean or median air concentrations) are in fact upper bound estimates because they rely on the upper bound estimates of the slope factor, q₁*. The values reported in Table 1.2 as upper 95% confidence bounds are in fact even higher extreme values. As noted in the above quote, the lower bound of zero should also be reported for this estimate of cancer risk. **The cancer risk for 1,3 butadiene was estimated using the product of the US EPA unit risk and a reasonable set of assumptions about exposures to 1, 3 butadiene in the vicinity of the Chevron refinery. The US EPA unit risk for 1, 3 butadiene is based on mathematical extrapolation from a rodent bioassay and represents a plausible upper limit for the true unit risk which may be as low as zero. We had noted in the report that the US EPA risk estimate was an upper**

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bound estimate. We have now added the comment that the risk may be as low as zero.

10. The benzene cancer risk estimate relies on extrapolation of occupational epidemiology data so that it is not as clear what the unit risk factor represents. The IRIS protocol describes the low dose extrapolation as being a maximum likelihood estimate, so the upper bound qualifier required for the butadiene cancer risk estimate does not apply to benzene. The US EPA unit risk for benzene is based on human data for groups of benzene exposed workers. While there is uncertainty associated with this unit risk, the limitations described above for the 1, 3 butadiene unit risk do not apply.

11. p.105-108. I find no difficulty with the conclusions of this section, but I believe that the target audience might benefit from a brief elaboration of the practical limitations encountered by the available epidemiologic study designs that could be applied to search for health effects in residents attributable to a nearby a petroleum refinery. We have elaborated as suggested.

12. p.109. The report ends with a description of limitations. While I agree totally with the limitations that have been described, I believe that the audience for this report would appreciate having the report reach conclusions, even though such conclusions will necessarily be limited by the many stated, practical factors. We agree and have added a conclusions and recommendations section. In particular, I believe that the odour problem needs to be addressed, notwithstanding the observation that a direct linkage between odour and health effects is not established. A direct linkage between odour and nuisance is clear and concerns about health effects will never be resolved in circumstances where substantial odour nuisance prevail. Consequently, odour nuisance reduction deserves attention in its own right. We agree and have added information about the odour threshold for gasoline vapour to the final report and commented further about the issue of odour annoyance in the report and in the summary.