Expert Opinion on Validity of Noble Energy Report

December 20th, 2019

David Broday[1] & Uri Dayan[2],

[1]*Faculty of Civil and Environmental Engineering, Technion, Haifa, Israel*

[2]*Department of Geography, The Hebrew University of Jerusalem, Israel*

Author CV & Statements

Uri Dayan is an Emeritus Professor and leading scientist in synoptic meteorology and climatology. His main research deals with the interaction between circulation in the atmosphere and the environmental processes taking place on the ground. His scientific interest focuses on three areas that are all related to atmospheric circulation in the synoptic scale: the study of extreme weather phenomena (such as the creation of stormy rains and lightning floods, dust storms); dispersion and transport of pollutants into the atmosphere and the behavior of the atmospheric boundary layer in different synoptic conditions.

David Broday is an Associate Professor of environmental engineering. Assoc. Professor Broday is an expert in the field of air pollution and aerosol physics, and has extensive experience in exposure assessment to different stressors. His research interests include physics of the atmosphere, air pollution, environmental aerosols, and exposure assessment to airborne pollutants.

To study these topics, he commonly uses enviroinformatics tools, sensor arrays, transport and dispersion models, and GIS-based models for exposure estimation.

Abstract

A number of problems are described in the preparation of the environmental impact assessment prepared by Noble Energy contractors to quantify atmospheric concentrations of benzene on the Carmel coast in the vicinity of the Leviathan gas processing platform during the system commissioning. We detail specific procedural shortcomings, oversights and invalid assumptions made in the preparation of this report.

Background

The Leviathan offshore gas processing platform has received from the MoEP an emission permit for routine operations. Conspicuous in its absence from this emission permit is any categorical approval of emissions in general and emissions of benzene in particular during the commissioning process which is currently underway. The said emission quantities, according to Noble Energy's own admission, will be larger than those approved for release during the first 2.5 years of operation, but will be released in two events lasting only 8 hours each. The operator, who presumably belatedly recognized this oversight has recently released a report titled

אסדת לוויתן - בחינת ריכוזי בנזן מרביים בסביבה בתקופת ההרצה

which is the primary topic of this expert opinion. The objective of the said report is nominally to predict atmospheric benzene pollutant levels at coastal receptor locations resulting from emissions emanating from the platform during the commissioning events. The report only addresses averaged concentrations over a period of 24 hours, since the only relevant Israeli environmental standard for benzene is a daily one. The shortcomings of the Moshel report will be highlighted in the following sections.

Non-physical Results

The only reference to the simulation results in the report is the statement that the maximum daily concentration resultant in the simulations was 0.135 μg/m^3 which is 3.46% of the Israeli standard – a daily average concentration of 3.9 μg/m^3. However, there is an isopleth map of the maximum daily average benzene concentrations, shown in Figure 1 below. In this map, the highest concentration of 0.135 μg/m^3 is indeed at the coast but with all the concentrations at sea in the vicinity of the platform significantly lower than this value. This is highly non-physical outcome and requires explanation and/or further investigation.

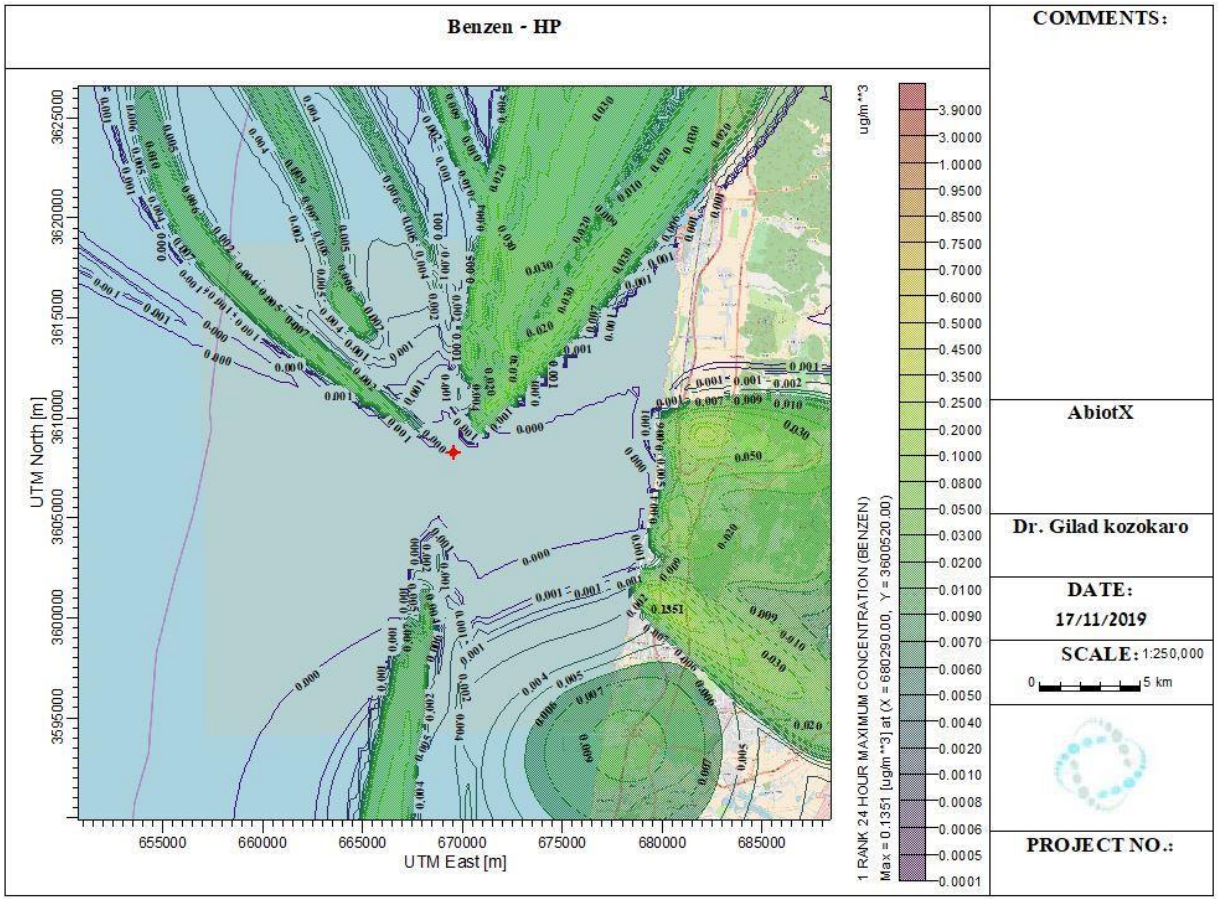


Figure 1: Isopleth benzene concentration map from Moshel report.

Benzene to NMVOC ratio

The rate of benzene release simulated by Moshel was 2.64 g/s, which is equivalent to 76 kg in 8 hours. According to Noble Energy press release, the amount of NMVOC released will be 24000 kg. So the benzene to NMVOC ratio that Moshel simulated was 76/24000 = 0.32%. This is a factor of 3.2 higher than the asserted ratio by Noble Energy in all prior releases regarding the Leviathan anticipated emissions, based on the condensate composition. The MoEP had previously asserted that a x10 safety factor had been required by the MoEP during previous simulation rounds, on top of the asserted benzene to NMVOC ratio of 0.1% proclaimed by Noble Energy as the benzene ratio in the condensate. So it appears that Moshel has reduced this safety factor from 10, to 3.2, ignoring the recommendation (demand?) of the MoEP.

Unrealistic Temporal Emission Profile

The assumption in the Moshel emission model was that the vented gases will be released in a uniform fashion, i.e. evenly distributed over the 8 hours period of the vent. However, according to information released by the MoEP and Noble Energy, the gas will not arrive for at least 2-3 hours and then the emission rate will slowly rise over 5 hour period as the well gas reaches the platform, and will reach its peak when the N_2 concentration reaches 5% at which time the flare will presumably be ignited. The emission temporal profile will therefore be quite different to that simulated by Moshel. A comparison of the Moshel profile with a more realistic profile is shown in Figure 2. This highly non-uniform emission profile may result in higher coastal concentrations, not simulated by Moshel. We estimate that the highest temporal emission can be up to 5-6 times higher than the uniform value used by Moshel. As the estimated ambient concentration are roughly linearly dependent on the emission rate, the maximum concentration may be 5-6 times higher than that reported by Moshel. Adding to this the background benzene levels measured in November 2019 in the area, the ambient benzene levels may reach a maximum value of about 1.4 $\mu g/m^3$

which is ~36% of the Israeli daily standard – about 10 times higher than reported in Mosel report (all these figures do not account for the x10 MoEP "safety factor", which of course will increase them by 10 fold).

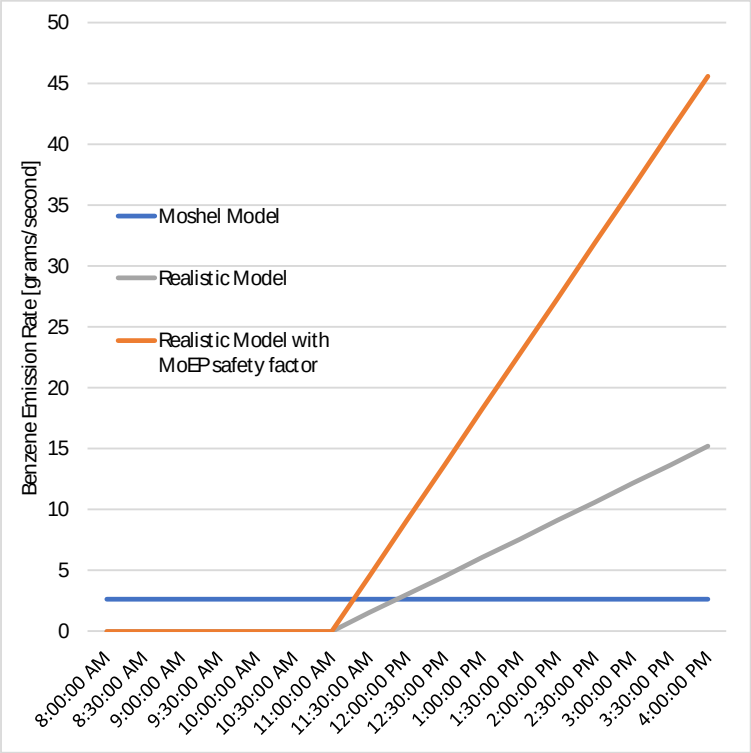


Figure 2: Temporal emission profile simulated by Moshel compared with a realistic emission profile as described by Noble Energy and the MoEP. The orange curve is a realistic emission profile including the safety factor as defined by the MoEP.

Lack of atmospheric dispersion model features

In a recent peer reviewed publication[i] we described three important atmospheric phenomena: fumigation, downwash and cold pools. While the first is unlikely to occur during winter months, the second is likely to occur all year round and the third is particularly likely during winter months. No indication is given that any of these phenomena were given consideration. In particular, the phenomena of cold pools can result in accumulation of pollutants in the shallow surface layer above the land (e.g. the Sharon-Carmel plains opposite the Leviathan platform). The Moshel report

indicates that all simulations were performed for a starting time of 8 am with emissions continuing only to 4 pm. Therefore, cold pooling will not be represented in the results of the simulation as it is predominantly an early morning phenomenon. Substantial uncertainty remains as to the exact time of the emissions and in another announcement it was stated that the procedure will begin at 2 am with emissions beginning several hours later.

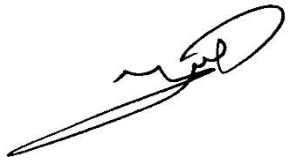
Other pollutants not modelled

In addition to the benzene modeled by Moshel, a number of additional pollutants are likely to be present in the 24 tons of NMVOC which is asserted to be released. These includes ethyl benzene (possibly carcinogenic), toluene and xylene which are likely to be present in the released gases at higher concentrations than that of benzene.

Conclusions

The Moshel report on the commissioning cold vents from the Leviathan platform include procedural shortcomings, oversights and questionable assumptions, any of which could significantly alter its results and conclusions. The precautionary principle [ii] demands that conservative assumptions should prevail in the performance of such models, which was definitively not the case in this report.

Prof. David Broday Prof. Uri Dayan



---

[i] Broday et. al, *Emissions from gas processing platforms to the atmosphere-case studies versus benchmarks*, Environmental Impact Assessment Review Volume 80, January 2020, 106313.

[ii] Kriebel D., et al., *The Precautionary Principle in Environmental Science*, Environmental Health Perspectives VOLUME 109 | NUMBER 9 | (2001).