White Paper

Dor Leviathan offshore platform Environmental Report Review and Simulation

ORION-Joint Research and Development Center

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1.	18/1/2020	A	Dr. George Zodiatis	Formal Release
2.				

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1 Introduction

The Leviathan project is a large scale energy program of the state of Israel in which gas and condensate from the Leviathan well are transferred via pipeline to an off shore platform at the proximity of 10 Km to the Israeli shoreline. The stakeholder of this project are Nobel Energy, a US company, Delek Drilling and Ratio.

The local communities concerned from the pollution implications that might occur in extreme malfunction of spillage and regular operation.

Hence the local council of Zichron Ya'akov asked ORION Joint Research and Development Center to perform an independent third party professional evaluation of the Amphibio Nobel-Energy Environmental Reports, LPP-ON-NEM-EHS-STY-0002 and LPP-ON-NEM-EHS-STY-0005, which were submitted to the Ministry of Energy and Ministry of Environment Protection of the state of Israel as a prerequisite of this program.

The assessments of the reports included review as well as counter simulations for spillage events and resultant evaporation due to the spillage. There are two comprehensive reports that were submitted: Dor Leviathan Offshore Platform Environmental Report Review and Simulation issued at August 4 2019, Doc number **LSR-OR-ZY-04-08-2019-R-A** and Dor Leviathan Offshore Platform Environmental Report Review and Simulation Supplementary Report issued at November 22 2019, Doc number **LPR-OR-ZY-22-11-2019-R-A**.

2 Main tasks

1. Review the environmental risk assessments and spill size documents ( ) provided by Noble Energy to the Ministry of Energy and Ministry of Environmental Protection,
2. Performing oil spillage evens (condensate and diesel) from the Leviathan offshore fixed platform rig located at the proximity of 10 km from the shoreline of Dor Israel within the Regional municipality of Hof-Carmel jurisdiction,
3. Performing oil spillage evens (condensate) from a pipe rupture located at the proximity of 1 km from the shoreline of Dor Israel within the Regional municipality of Hof-Carmel jurisdiction,
4. Performing grey water spillage evens from the Leviathan offshore fixed platform located at the proximity of 10 km from the shoreline of Dor Israel within the Regional municipality of Hof-Carmel jurisdiction,
5. Performing evaporation simulations evens based on the oil spillage from the Leviathan offshore fixed platform rig located at the proximity of 10 km from the shoreline of Dor Israel within the Regional municipality of Hof-Carmel jurisdiction,

6. Performing evaporation simulations evens based on the oil spillage events from a pipe rupture located at the proximity of 1 km from the shoreline of Dor Israel within the Regional municipality of Hof-Carmel jurisdiction,
7. Overview of the international standards concerning the maritime pollution from offshore platforms,
8. Conclusions for the reaction time to spillage event and identified the time where levels of contamination at shoreline crosses the threshold of 0.03 Ton/Km or 0.19 bbls/Km.
9. Explaining the discrepancies and disagreements between simulations performed on OSCAR solvers y Genesis and MEDSLIK performed by Prof. Steve Brenner.
10. Monitoring and readiness recommendations.

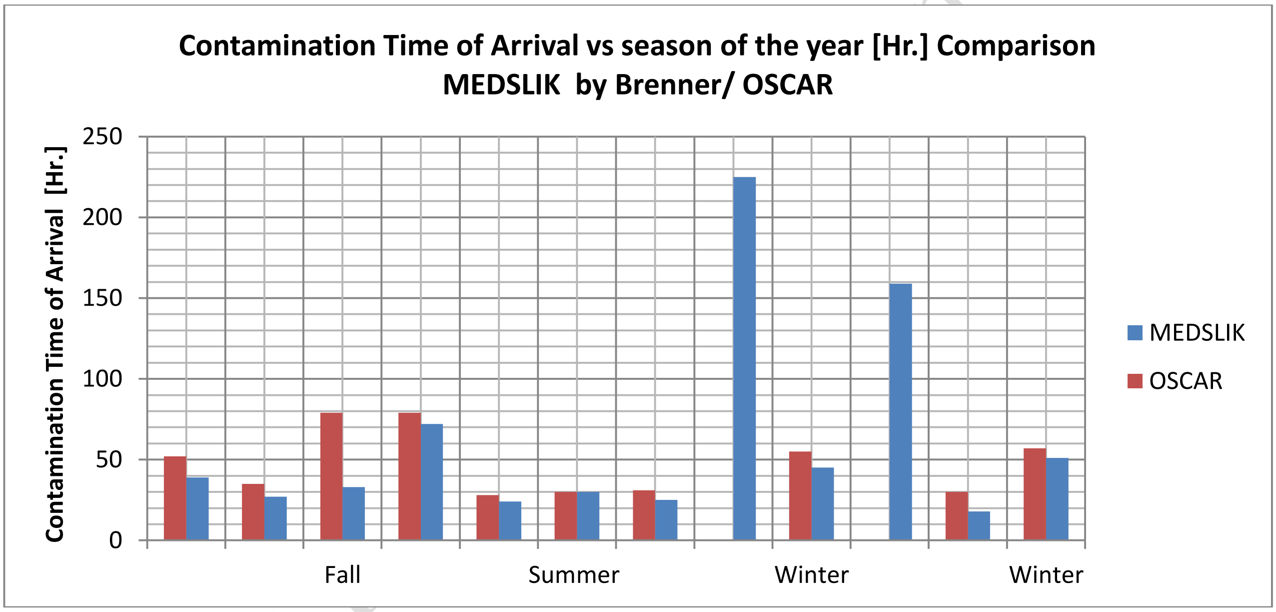

Figure 1: MEDSLIK-Brenner/OSCAR-Genesis disagreement time of arrival [Hr]

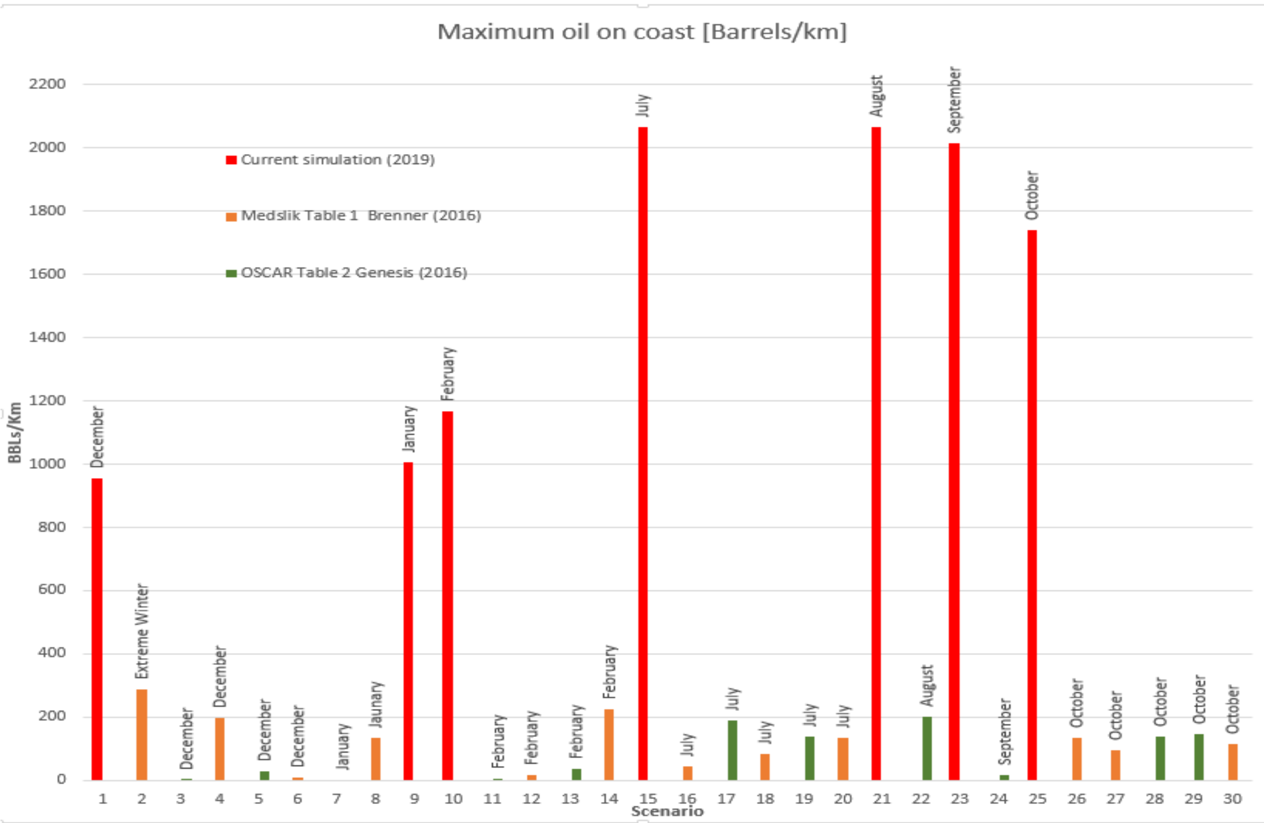

Figure 2: Max oil contamination comparison current simulation vs. Amphibio-Nobel report

The condensate for current simulations from the Dor fixed platform is **5300 bbls**, while for OSCAR runs by Genesis and MEDSLIK runs by Brenner is **1000 bbls**.

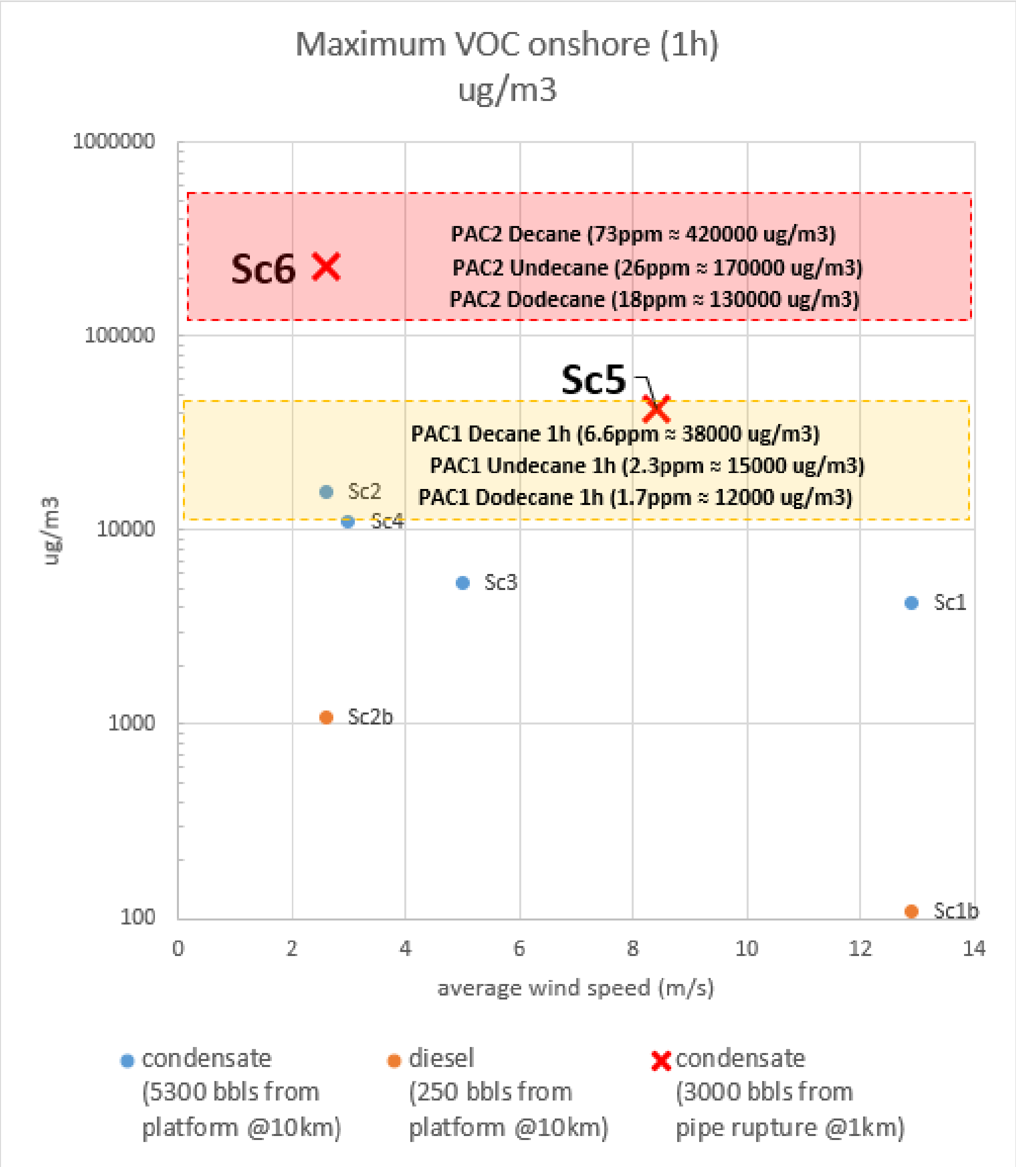

Figure 3: Condensate spill VOC PAC1 level violation. Comparison of estimated maximum onshore hourly concentrations for Total VOC and emergency PACs thresholds for selected alkanes (C10-C12)

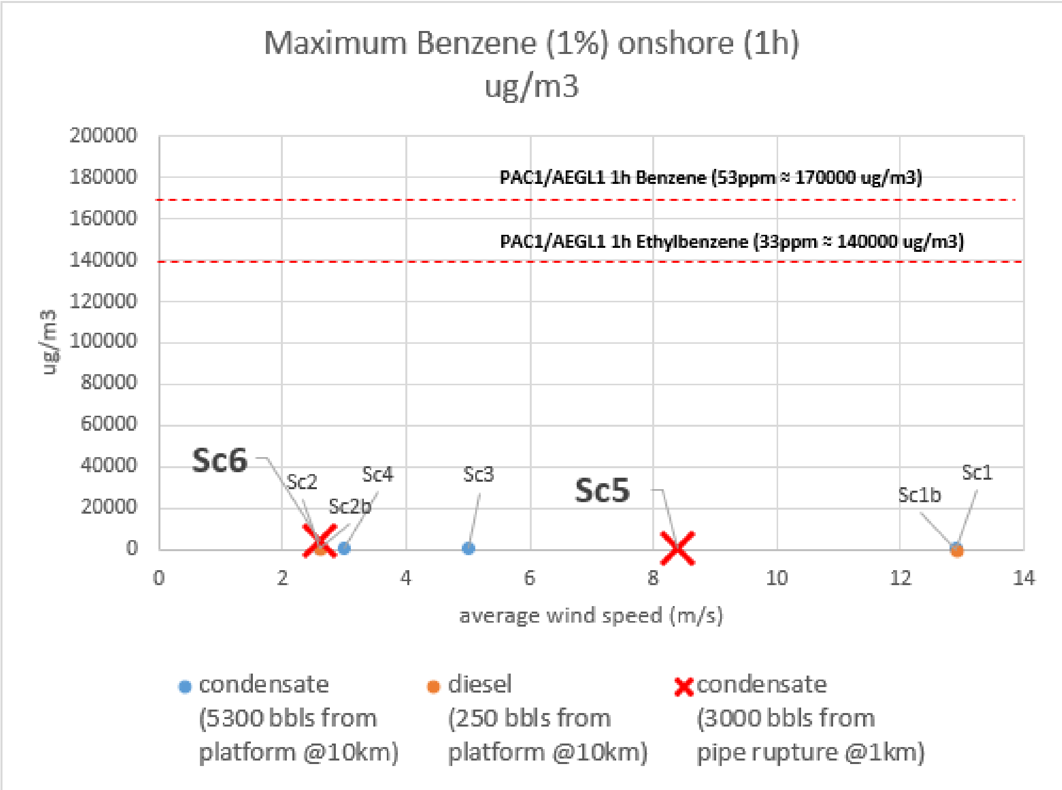

Figure 4: Condensate spill Benzene PAC1 level violation. Comparison of estimated maximum onshore hourly concentrations for Benzeneand emergency PACs thresholds for selected BTEX

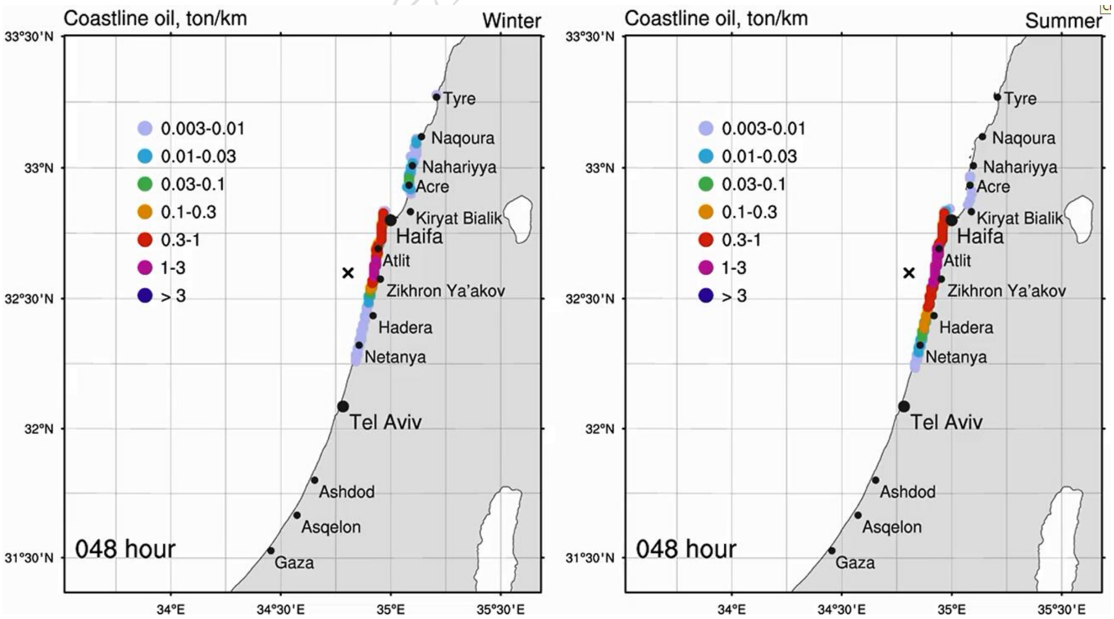

Figure 5: Winter and summer spatial-temporal evolution of ensemble average concentrations (tons/km) of beached condensate from the Dor platform after: 48h simulations.

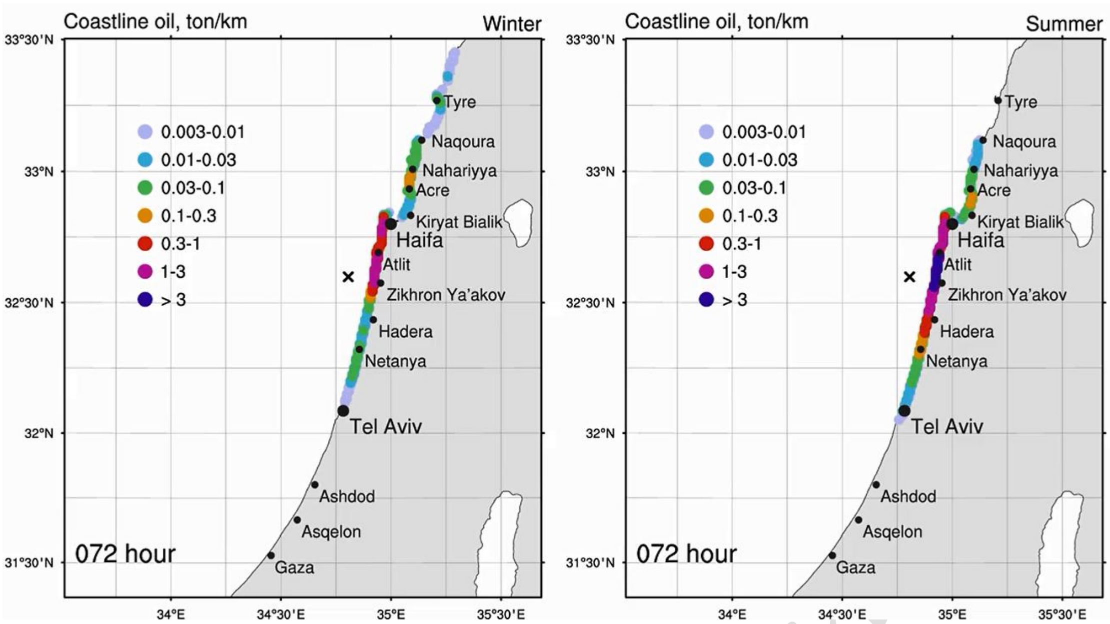

Figure 6: Winter and summer spatial-temporal evolution of ensemble average concentrations (tons/km) of beached condensate from the Dor platform after: 72h simulations.

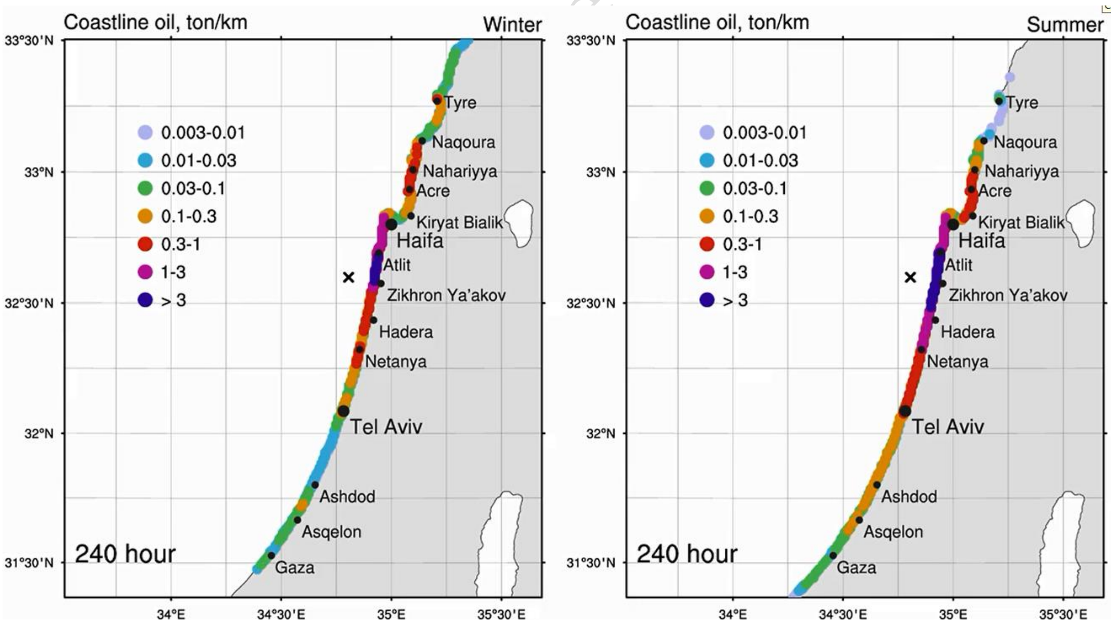

Figure 7: Winter and summer spatial-temporal evolution of ensemble average concentrations (tons/km) of beached condensate from the Dor platform after: 240h simulations.

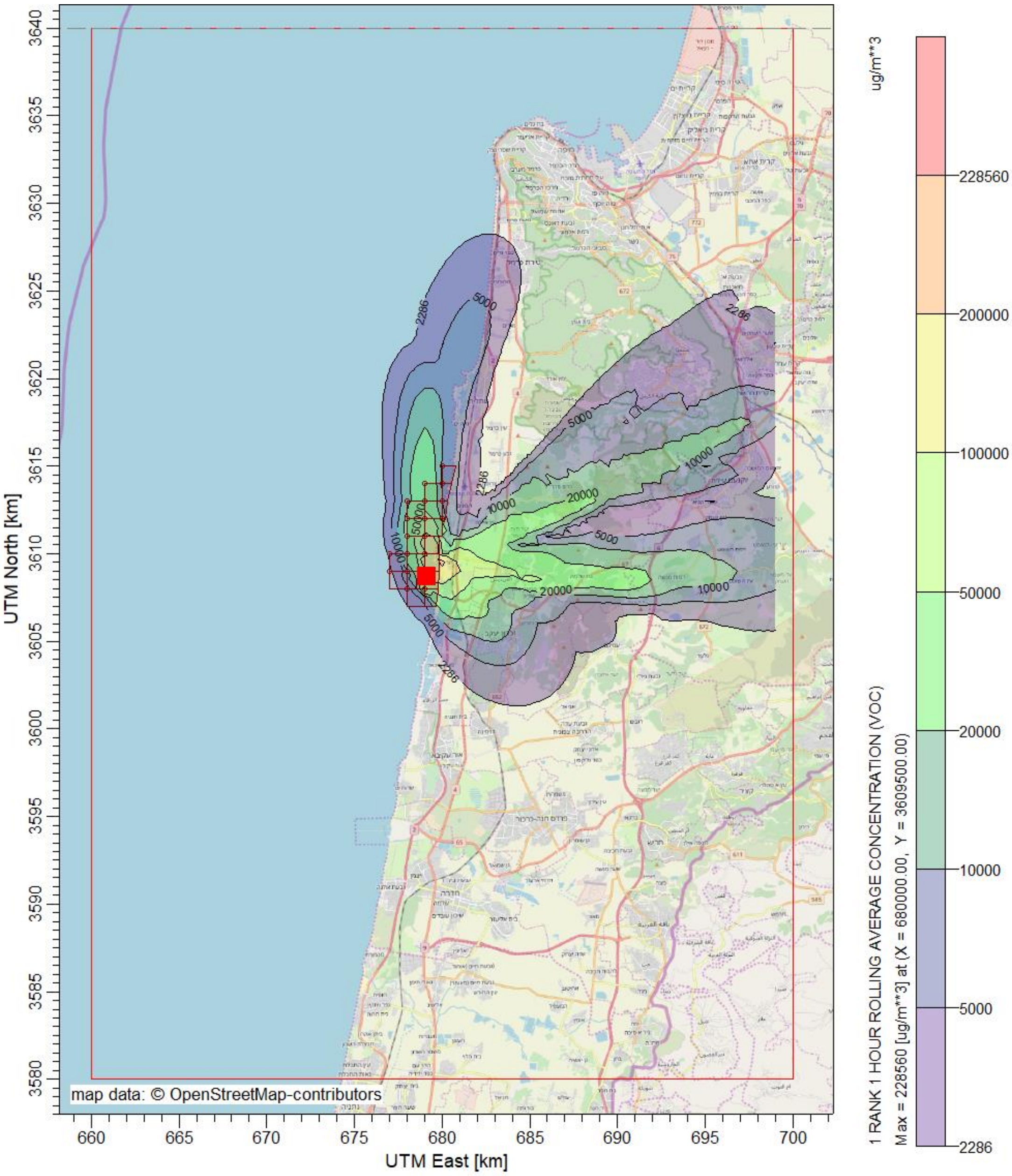

Figure 8: Scenario #6 pipe rupture condensate spill - maximum 1h-average concentration VOCs

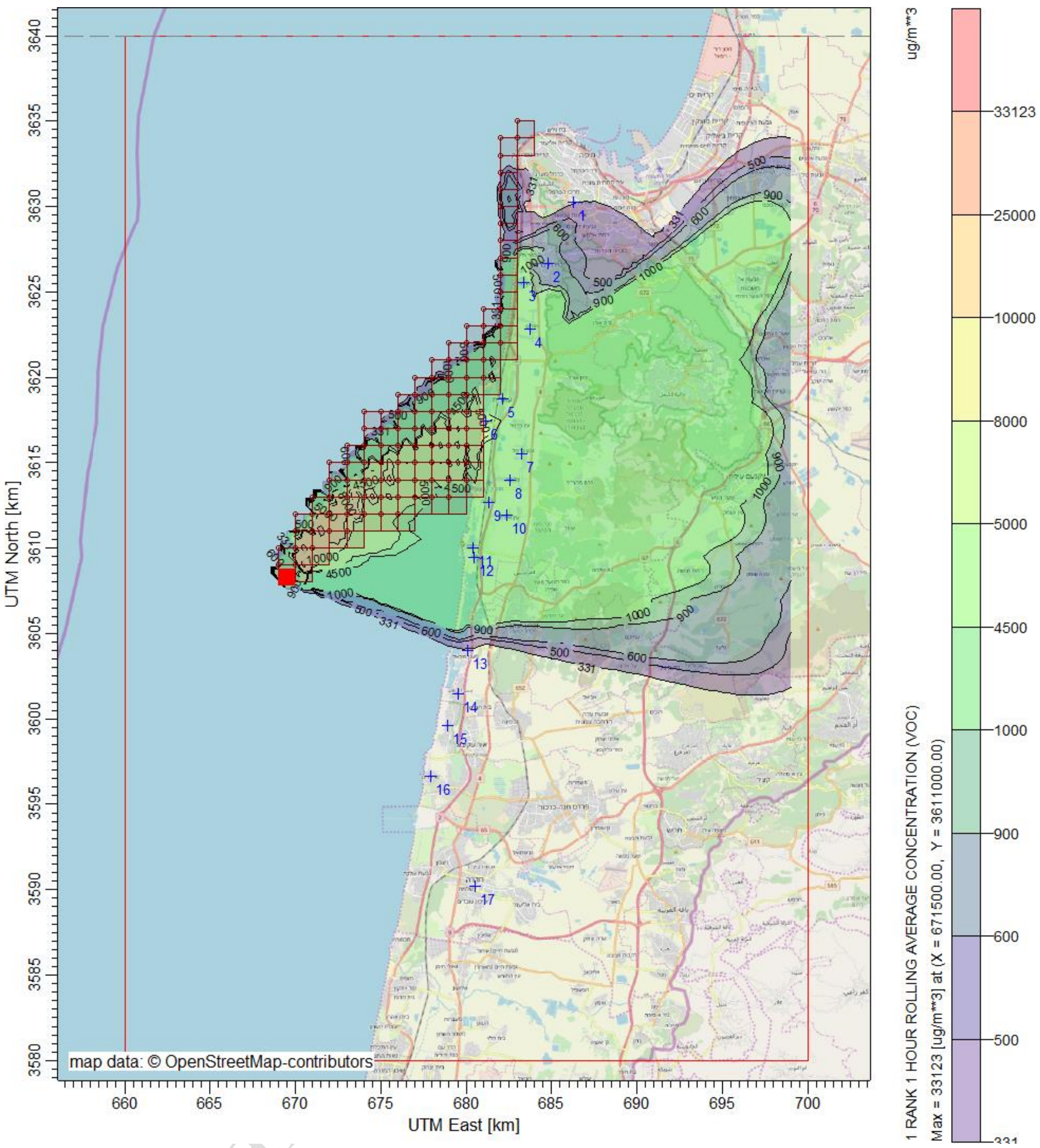

Figure 9: Scenario #3 offshore condensate spill - Maximum 1h-average concentration VOCs

3 Main Findings

1. The spillage scenarios from the offshore platform carried out within the framework of the Nobel Environmental Reports had underestimated by almost order of magnitude (1000bbls vs. ~6000bbpls content per design itself and documentation of permits). Therefore, the current simulations predicted a larger spillage quantities, much more above the TH affecting the pollution levels along extended coastline of Israel, compared to the aforementioned simulation documents of Genesis regardless the differences of the used spillage amount between the used models.

2. The pipeline rupture spillage scenarios that were carried out within the framework of Nobel Environmental Reports, are underestimating the spillage event by almost half order of magnitude, (1200bbls vs. ~3000bbls content per technical date in the report of Nobel). Therefore, the current simulations, which is based upon larger quantities defined in design permits issued by the Israeli government ministry of energy, predicted larger spillage quantities, much higher than the spillage levels demonstrated by the reports under review issued by Nobel. Hence affecting the pollution levels along extended coastline of Israel largely, compared to the aforementioned simulation documents of Nobel-Genesis, regardless the differences of the used spillage amount between the used models.

3. The evaporation effect and vapor cloud reaching the shoreline were not attributed in the Nobel Environmental Reports.
   3.1. At the event of spillage from the offshore platform, located 10km from shoreline, **there is almost violation of PAC1 threshold** level, due to evaporation.
   3.2. At the event of pipe rupture 1km from shoreline **there is a violation of PAC1 threshold level, due to evaporation**.

4. Monitoring plan and alert schemes demonstrating the means for continuous monitoring on the platform are examined in the current Evaluation of the Environmental studies report, while were not attributed in the Nobel Environmental Reports.

5. Gray water and spill effects on the Haderea desalination plant are examined in the current Evaluation of the Environmental studies report, while were not attributed in the Nobel Environmental Reports.

6. The current Evaluation of the Environmental studies report found a misleading conclusions of tranquility that was made by Amphibio that had attributed the relaxed results of OSCAR-Genesis report, while omitting severer results of MEDSLIK simulation performed by Prof. Steve Brenner. The current Evaluation of the Environmental studies report found out that the API value for the condensate is the main root cause for that difference, while this matter was not mentioned in the Nobel Environmental Reports.

7. In the framework of the current Evaluation of the Environmental studies report concerning the Leviathan offshore platform a robust statistics was made with **5844** spill simulation runs vs. **12** mentioned in the Nobel Environmental Reports, while for the pipe rupture a robust statistics was made with **104** spill simulation runs vs. **12** mentioned in the Nobel Environmental Reports.

4 Conclusions from counter spillage simulation Dor Platform

The following list describes major conclusions from the 10km counter simulation for the offshore spillage event:

1. First impact on the Israel coast from the Dor fixed platform spillage is predicted to be 8 hours in winter and at 11 hours during summer seasons but not earlier than 8 hours.
2. The first impacted area is predicted to be the coastline between Zichron/Dor and Atlit.
3. In winter on average, it is predicted that 17% of the spillage is beached, while in summer twice as higher, i.e. up to 35%. due to the prevailing SW winds.
4. Most affected area with maximum spill concentrations (> 3 ton/km) is the coastlines of Zichron/Dor and Atlit, as well as the coastline between Atlit and Haifa (Shikmona) and the coastline between Zichron/Dor and Hadera, regardless of the season.
5. Deposition of the condensate spills in the Hadera desalination plant is estimated to be the highest among the 5 desalination plants examined. increasing the risk for contaminating the coastal infrastructure. There is high possibility that the dissolved and dispersed fractions of Condensate and Diesel oil will contaminate the feed water of the desalination plant. This will result to the impairment of the membranes of the plant and the contamination of the desalt water. These water soluble fractions of the condensate and diesel oil contains mainly light Polycyclic Aromatic Hydrocarbons(PAH) several of them are known carcinogens.
6. Depositions of the condensate in the Sorek, Palmachim, Ashdod, and Ashkelon desalination plants are estimated to be a rather insignificant.
7. During winter seasons the condensate depositions on the coastline extend northern than Tire in Lebanon, while during summers seasons extend southern than Gaza, both with concentrations above the TH.

5 Conclusions from counter spillage simulation 1Km pipe rupture

The following list describes major conclusions from the 1km counter simulation for the pipeline spillage event:

1. First impact on the Israel coast from the pipe rupture spillage is predicted to be between 3-4 hours during summer periods and 5 to 6 hours during winter period after the spillage, with the worst case scenario to be predicted at half hour after the spillage.
2. The first impacted area is predicted to be the coastline between of Zichron towards Atlit.

3. The coastline of Zichron is predicted to be the epicenter of the highest condensate deposition up to 15 tons/km, regardless the season.
4. Due to the proximity of the pipe rupture to the shore, it is predicted that 38-40% of the condensate spillage washed up the nearby shore, without any seasonal or monthly variability, expect during October and November with a slightly less deposition on the coast (37.5%). Moreover, during the summer periods, the extend of the impacted coastline is mostly limited northward from the epicenter toward Haifa (Shikmona) and Acre, with less deposition levels (~0.5-1.0 tons/km), due to the prevailed SW winds, while during the winter periods the condensate depositions extended far south to Netanyya and far north, even to Type with insignificant levels of depositions.
5. The condensate spillage from the pipe rupture located 1 km from the shoreline will not impact the shoreline of the Palmachim, Ashdod, Ashkelon and Sorek desalination plans, neither within a period of 10 and 20 days of predictions. However, will affect mostly the Atlit, Ma'agan-Michael and Caesarea national parks coastlines and the Hadera Desalination coastline.

6 Major conclusions current simulations condensate spillage:

The following sensitive areas are affected by condensate according ORION simulations:

1. Spillage simulation for condensate will impact the Atlit national park coastline to a maximum mean of 1.6 ton/km +STD 4.2 ton/km (10 bbls/km +STD 27bbls/km) , within a period of 10 days.
2. Spillage simulation for condensate will impact the Hadera Desalination coastline to a maximum mean of 1.8 ton/km +STD 6 ton/km (11 bbls/km +STD 37 bbls/km), within a period of 10 days.
3. Spillage simulation for condensate will impact the Ma'agan-Michael national park shoreline to a maximum mean of 3.0 ton/km +STD 7.9 ton/km (19bbls/km+STD 50 bbls/km), within a period of 10 days.
4. Spillage simulation for condensate will impact the Caesareanational park shoreline to a maximum mean of 1.3 ton/km +STD 4.7 ton/km (8 bbls/km +STD 30 bbls/km), within a period of 10 days.
5. Spillage simulation for condensate will impact the shoreline of the Palmachim, Ashdod, Ashkelon and Sorek desalination plans to maximum mean of 0.1 ton/km + STD 0.7 ton/km (0.6 bbls/km + STD 4 bbls/km), within a period of 10 days.

7 Major conclusions current simulations diesel spillage:

The following sensitive areas are affected by diesel-oil according ORION simulations:

1. First impact on the Israel coast from the Dor fixed platform spillage is predicted at 21 hours but not earlier than 16hours, in winter, at 24 hours in transit seasons but not earlier than 20 hours and at 33 hours during summer seasons but not earlier than 24.
2. The first impacted area is predicted to be the coastline of Atlit, regardless of the season.
3. In winter on average, is predicted that 5% of the spillage is beached, while in summer as high as up to 45%.
4. Most affected area with maximum spill concentrations (>0.1 ton/km) is the coastlines between Zichron/Dor and Atlit, as well as the coastline between Atlit and Haifa (SW coast-Shikmona) and between Zichron/Dorand Hadera.
5. During the summer seasons the highest diesel depositions predicted at the coastline areas from Zichron/Dor northward up to Nahriyya, and secondly the coastline areas between Zichron/Dor southward to Netanya.
6. At the sea surface, the diesel oil tends to drift inside a symmetric area elongated along the coast with a northeastern shift in time
7. The dispersed diesel spill tends to follow the sea surface patterns forming narrower distributions than the sea surface ones.
8. Deposition of the diesel spill in the Hadera desalination plant is estimated to be the highest among the five desalination plants studied.
9. Depositions of the diesel spill in the Sorek, Palmachim, Ashdod, and Ashkelon desalination plants are estimated to be a rather negligible.
10. Three seasons are defined with respect to spatial-temporal behavior of the diesel spills: the winter (Nov-Feb), summer (Jun-Aug-Oct), and transitional season (Mar-May, Sep-Oct).
11. During winter and transit seasons diesel spills arrive at the coastline much quicker than during the summer seasons spills.
12. In the winter, the diesel spill widely spreads over the domain.
13. In the summer, the diesel spill predominantly drifts toward the coastline, due to the SW winds.
14. In the transitional season, the diesel spill shows an intermediate surface spreading: between the winter and summer seasons.
15. The highest levels of coastal diesel spills depositions are typical of the summer, while the lowest one are found in the winter. The transitional season demonstrates the intermediate ones.

8 Inter-comparison between current and previous condensate spillage simulations from the offshore platform

The current simulations is using the MEDSLIK and MEDSLIK II models. Simulation predicted larger spillage quantities based upon Israeli Ministry of Energy quantities documents. The spillage size is higher than the levels reported in the Nobel

Environmental reports waged by Amphibio, hence affecting the pollution levels along extended coastline, compared to the aforementioned simulation documents of Genesis performed OSCAR by Genesis and MEDSLIK by Steve Brenner, regardless the differences of the used spillage amount between the models.

In the Amphibio report, it is observed that level of the coastal pollution and the extent of the impacted coastline derived from the simulations performed by Steve Brenner is much higher compared to OSCAR by Genesis simulations. Thi observation is despite the fact that both models used the same meteo-ocean forcing, same simulation period and the same spillage size from the Dor fixed platform and the pipe rupture.

Moreover, it was identified substantial disagreement between the current simulations using the MEDSLIK and MEDSLIK II models and those performed by OSCAR, and less disagreement with those of MEDSLIK by Steve Brenner, regardless of the different used amount of the spillages.

The simulation baseline used the OSCAR model database called ‘Kristin 2006 13°C’, which is a Norwegian condensate from the Northern Sea, as mentioned in the reviewed reports. In the Genesis report there is not any precise reference for the used API or SG for the OSCAR simulations made by Genesis. However, the Genesis report is referred to the ‘Kristin 2006 13^{o}C’ with 4 different API numbers, varying between the values of 33 to 47.
In MEDSLIK by Steve Brenner simulations it was precisely stated that the used API=43.2.

The high rates of the condensate spillage evaporation (on averaged more than 60% for the Dor fixed platform spillage and on average more than 70% for the pipe rupture) predicted by OSCAR model indicate that the API number used, for the condensate type ‘Kristin 2006 13^{0}C’, was higher compared to the one used in MEDSLIK by Steve Brenner simulations. Therefore, the level of the depositions on the coastline in OSCAR simulations were predicted to be in most of the scenarios less than the TH and less than those predicted in MEDSLIK by Steve Brenner. Similarly, the extend of the impacted coastline in OSCAR predictions were few kilometers, i.e. much less compared to those predicted in MEDSLIK by Steve Brenner. Moreover, the reduced amount of the surface condensate spill during the first 48 hours, because of the high levels of evaporation in OSCAR simulations, caused the delay of the remained surface spills to impact the Israeli shoreline. Furthermore, the delay of the first impact on the coastline in OSCAR simulations resulted, in most of the 12 scenarios, the prediction of different impacted locations, compared with those predicted in MEDLIK by Steve Brenner.

The high rates of OSCAR evaporation results, lead to consider that the OSCAR model used a higher API number than that of the 43.2. the latter API number was used in the current simulations using the MEDSLIK and MEDSLIK II models, as well as in MEDSLIK by Steve Brenner simulations. The evaporation of an oil spill depends primarily on the density of the oil, i.e. the lighter the oil density the higher the evaporation, following the action of winds and SST. The API/ SG data used for the present simulations using the MEDSLIK and MEDSLIK II models, is based upon the applicable the Amphibio environmental reports mentioned in the *Introduction*. In addition, in the current report received samples compound data of the Leviathan condensate as mentioned in the ORION counter reports mentioned in the *Introduction* , which dated to the end of 2018, hence it does not coincide the Amphibio-Nobel reports under review. Furthermore, throughout our analysis it came to our notice, by the Local Council of Zichron-Ya'akov, that the API and SG for the Leviathan condensate defined have been modified Nobel. This change shows that Leviathan condensate API is ~29, therefore should be considered as Heavy Grade or Medium Heavy Grade oil type (in accordance. In contrary, for the current condensate simulations using MEDSLIK and MEDSLIK II models, as well as in MEDSLIK by Brenner simulations for the Leviathan condensate it was used an API=43.2,whichis considered to be a Very Light Grade oil type.

The chapter *"Oil spill forecasting (predictions)"*(Zodiatis et. al. 2018) [1] demonstrates that in the case of a Very Light Grade oil type with API=42, the evaporation is as high as 50%, while in the case of a Moderated Heavy Grade oil type with API=26, the evaporation is a low as 30%.

In the case the Leviathan condensate with an API ~ 29, considered as Heavy Grade or Medium Heavy Grade oil type and in such a case the expected evaporation will be much less compared to the current and previous simulations. Therefore, in the case of condensate with API~29, higher depositions of spills will be expected on the sea surface and on the coast, compared to the current and Steve Brenner results (both used an API=43.2 for the condensate spills).

Additional source for the substantial differences between the current and the previous simulations results is number of simulations runs. Previous simulations have limited number of simulation: 12 in total for each type of spillage carried out by OSCAR made by Genesis and MEDSLIK performed by Steve Brenner for 4 small time windows during the 4 examined years. This is compared to the high frequency simulations, 5844 in total for each type of spillage covering the entire period of the 4 years carried out by the current simulations. The time series of the impacted coastal length from the condensate spillage during the period 2015-2018,is superimposed with the time windows of the 12 OSCAR and MEDSLIK by Steve Brenner simulations for the period 2007-2010. This demonstrates that the small number of the 12 simulations scenarios does not provide good seasonal and inter-annual statistics of the fate parameters during the 4 years under examination, compared to the high frequency of more than 5 thousands scenarios covering the entire period of the 4 years carried out in the current simulations.

[1] http://peabody.yale.edu/scientific-publications/sea-journal-marine-research *The Sea: The Science of Ocean Prediction*

9 Condensate evaporation and vapor cloud for spillages from the offshore platform

Evaporation analysis of air contamination due to spillage event was not performed by previous Amphibio-Nobel report. Current ORION report examined evaporation due to spillage events.

Condensate spill simulations cover 4 different wind and seasonal conditions, (Scenario #1, #2, #3 and #4). Diesel spill simulations cover 2 different wind regimes (Scenario #1 and #2).

Each spill scenario is applied respectively to simulate the dispersion of total VOCs and Benzene's hourly estimated emissions resulting from MEDSLIK current simulations are provided.
Maximum 1h- 8h- and 24h-average onshore concentrations were compared with both Ambient Air Quality Values (as regulated by the National Clean Air Law) and international recognized thresholds for emergency condition (PACs defined by US DoE).

Massive condensate spills (5300 bbls) could result into temporary existence of the 24-hours Ambient Air Quality Value of Benzene (3.9 ug/m3), but within the permitted number of existence by the National Regulation (maximum 3 days of existence, against 7 yearly permitted events). In contrary, no existence of Acute Exposure Guidelines (PAC/AEGLs) are anticipated for Benzene and the other BTEXs, simulated levels being at least 1 order of magnitude lower than the relevant tier-1 thresholds (the lowest being: Benzene 8h: 9 ppm; Ethylbenzene 1h: 22 ppm) .

Low-wind conditions could result in high coastal concentrations of Total VOCs, with levels on the same order of magnitude of emergency public exposure guidelines (PAC1) for C10, C11 and C12 alkanes (respectively: 6.6 ppm, 2.3 ppm and 1.7 ppm) .

Temporary, non-disabling Tier-1 effects, (notable discomfort, irritation, or certain asymptomatic, no sensory effects) cannot be excluded for the exposed population in case of massive condensate spill event such as those under study.

Tier-2 effects (irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape), are not anticipated. Maximum onshore VOCs concentrations do not exceed referenced PAC2 levels (73 ppm, 26 ppm, 18 ppm respectively for C10, C11 and C12 alkanes).

Diesel spill scenarios do not result in any referenced PAC thresholds, although existence of Ambient Air Quality for Benzene cannot be excluded.

The Regional Council Hof Ha'Carmel especially (Dor and Ma'agan Michael) and Giser A'Zarka municipalities are the most affected areas by the vapor's cloud dispersion.
Maximum onshore hourly concentrations of total VOCs range from 5400 to 15700 ug/m3 for massive condensate spill.

Precautionary assumed equal to 1%w/w of the spilled oil, Benzene maximum onshore hourly concentrations range from 71 to 340 ug/m3.
Concentration's levels are mainly driven by wind speed. During low-wind conditions (scenario #2 and secondarily scenario #4), the vapor cloud is slightly dispersed during its travel from the spill location to the coast, allowing high coastal levels, even when the spill do not actually reach the coast, as per scenario #2.
Diesel spill simulations produce results more than 1 order of magnitude lower than the condensate's ones, accordingly to the lower evaporation rates resulting from the oil spill simulations.

10 Condensate evaporation and vapor cloud for spillages from the pipe rupture

It was identified that vapor analysis of air contamination due to spillage event was not performed by previous Amphibio-Nobel report. Current ORION report performed evaporation analysis.

Spill simulations for the pipe rupture cover 2 different wind and seasonal conditions, winter time with high wind (Scenario #5) and summer time with low velocity wind (Scenario #6).

Each spill scenario is applied respectively for simulate the dispersion of total VOCs and Benzene's hourly estimated emissions coming from MEDSLIK current outputs and taking into consideration the contribution of shored oil as well.

Each simulation was initialized with the hourly "oil-on-surface" and "oil-on-coast" outputs of the MEDSLIK experiments for selected spill start's dates. The same maximum spilled volumes are considered for the pipeline rupture case (3000 bbls).

Maximum 1h- 8h- and 24h-average onshore concentrations were compared with both Ambient Air Quality Values (as regulated by the National Clean Air Law) and international recognized thresholds for emergency condition (PACs defined by US DoE).

The lack of detailed data about hydrocarbon speciation of potential spilled condensate does not allow getting ultimate judgment on the harmfulness of VOC vapor mixture on potential exposed communities in case of Massive near coast condensate spills.

Maximum estimated onshore levels of Benzene are well below internationally recognized emergency thresholds (USEPA PACs/AEGLs) and maximum total VOCs do not reach available level-1 thresholds for hydrocarbon mixture (relevant to gasoline and jet fuels). Cautionary comparison of maximum onshore concentration of total VOCs with selected C10-C12 Alkanes threshold raise concerns, with onshore peaks on the same order of magnitude of level-2 emergency public exposure guidelines (PAC2).

Chemicals in combination may behave differently than when alone; predicting the toxic potential of a mixture is often very difficult[2]. A chemical mixture methodology (CMM) should be used for estimating the potential health impact of exposures involving multiple chemicals[3].

The speciation and concentration of airborne volatile compounds should be carefully monitored in case of spill. In the absence of additional data, a warning communication plan should also be activated in order to alert communities and minimize their exposure to vapor plumes in the area of major impact, especially in case of a near-coast spill with low-winds blowing towards coast.

11 Major conclusions for grey water simulation from the offshore platform

1. In assessing the impact of grey water two issues are elements should needed to be considered. The total suspended solids and nutrients and the bacterial load.
2. Taking in to account the small quantity of grey water discharged and the subsequent dilution there will be no impact from suspended solids on the feed water of the desalination plants and the coastal water quality in respect of these parameters.
3. Based on the results of the simulation of grey water discharged the grey water will reach shore only after 15 days for all tested periods with the exception during the extreme winter period that it will reach the shoreline within 10 days.
4. Considering the above mentioned and the short survival time TC 90 of most of the bacteria and viruses in the very saline and warm sea waters and high periods of sunshine, the risk of microbial pollution is restricted only during the extreme winter period.
5. Desalination feed water standards for microbial quality standards as defined in the Israeli Public Health Regulations of 2013 might be violated but the disaffection legally applied in all desalination plants under the these regulations where their produced water is used as drinking water will exclude any human heath impact.

12 Overall remarks and recommendation in case of condensate or diesel spillage from Dor fixed platform

1. Accidents resulting to condensate and light diesel oil releases to marine Environment from the LPP is an issue of major concern.

[2] Government of Alberta. (2017). *Protective Action Criteria: A Review of Their Derivation, Use, Advantages and Limitations*. Environmental Public Health Science Unit, Health Protection Branch, Public Health and Compliance Division, Alberta Health. Edmonton, Alberta.

[3] A chemical mixture methodology (CMM) has been developed by the US DOE SCAPA subcomitee for estimating the potential health impacts of exposures involving multiple chemicals. https://sp.eota.energy.gov/EM/SitePages/SCAPA-Home.aspx

2. Current oil spill model simulations show that large amounts of weathered Condensate and Diesel oil beached/washed/stranded on the shores despite the high level of evaporation of these type of oils.
3. Certain beaches, mostly sandy, were heavily impacted from the stranded oil. This will result in addition to aesthetic/social impact and the impairment of their habitatsmarine turtles and crabs and meiofauna.
4. Taking into account the 3 above 2006 Israeli coast spill sensitivity atlas in the Mediterranean Sea coast, should be updated to provide more details for most heavily impacted beaches.
5. An issue to be consider is the fact that their physicochemical characteristics the containment and dispersion and their recovery will be minimal.
6. Containment with sorbent booms and recovery with oleophilic disk skimmers and OilMop skimmers should be consider.
7. In order to minimize/control the unintentional and operations failure liquid discharges from LPP Relevant monitoring programs should be developed. These programs must be developed in advance and should be part of the Environmental Plan.

13 Overall recommendation on air monitoring strategies in case of spills

Air monitoring must be employed in case of oil release to measure concentrations of different constituents in the air during the response. Air Monitoring should be real-time, by the means of continuous or frequent air measurements.

Based on spilled oil characteristics, it is important to determine the potential chemicals of concern, which will require air monitoring during the oil release and the threshold levels to be compared with monitoring results.

Common examples of real-time instruments include:
- Non-specific multigas meters equipped with photoionization detectors (PID)
- Chemical-specific colorimetric detection tubes
- Chemical-specific real time instruments (e.g benzene and hydrogen sulfide monitors)

Real time measurements performed both offshore and onshore, are important in order to rapidly identify areas of potential concern and for comparison with screening criteria. Monitoring results should be used to calibrate a proper air dispersion modeling and forecast vapours' cloud evolution.

In addition, analytical air sampling should be performed in order to supplement real-time air monitoring efforts.