Neptun Deep Project

Onshore Vent Air Dispersion Study

02	DRAFT	S Jivraj	04-07-23	N Yurek	04-07-23	S Jivraj	04-07-23
01	IFA	S Jivraj	03-07-23	N Yurek	03-07-23	S Jivraj	03-07-23
00	IDC	S Jivraj	03-07-23	N Yurek	03-07-23		
Rev	Reason for Issue	Author	Date	Checker	Date	Approver	Date

Document Classification	Document Number	Rev
confidential	ND-D-IO-00-EV-REIS-0017-0001	02

Revision history

Revision No	Section Ref	Description of Change
00	All	IDC
01	All	IFA
02	All	Issued with revised base map co-ordinate system and adjusted projections

Holds

Hold No	Section Ref	Description of Hold

Contents

Tables

Figures

1. Introduction

Neptun Deep is an offshore gas field development located in the Romanian sector of the Black Sea. The project combines a deepwater natural gas reservoir in the Domino field with a shallow water natural gas reservoir in the Pelican South field. The development plan for the project is based on 3 subsea drill centres; two located in ~1,000m water depth in the Domino field and one located in ~125m water depth in the Pelican South field.

Each drill centre will include a four-well production manifold tied back to the normally unattended Shallow Water Platform (SWP) on the shelf. Production from the wells will be separated, and the natural gas will be dehydrated on the SWP to achieve sales quality specification. Production will be transmitted through a ~160 km 30-inch gas production pipeline (GPP) to the Romanian coast where it will transfer to the Transgaz National Transportation System (NTS) at an onshore natural gas metering station (NGMS).

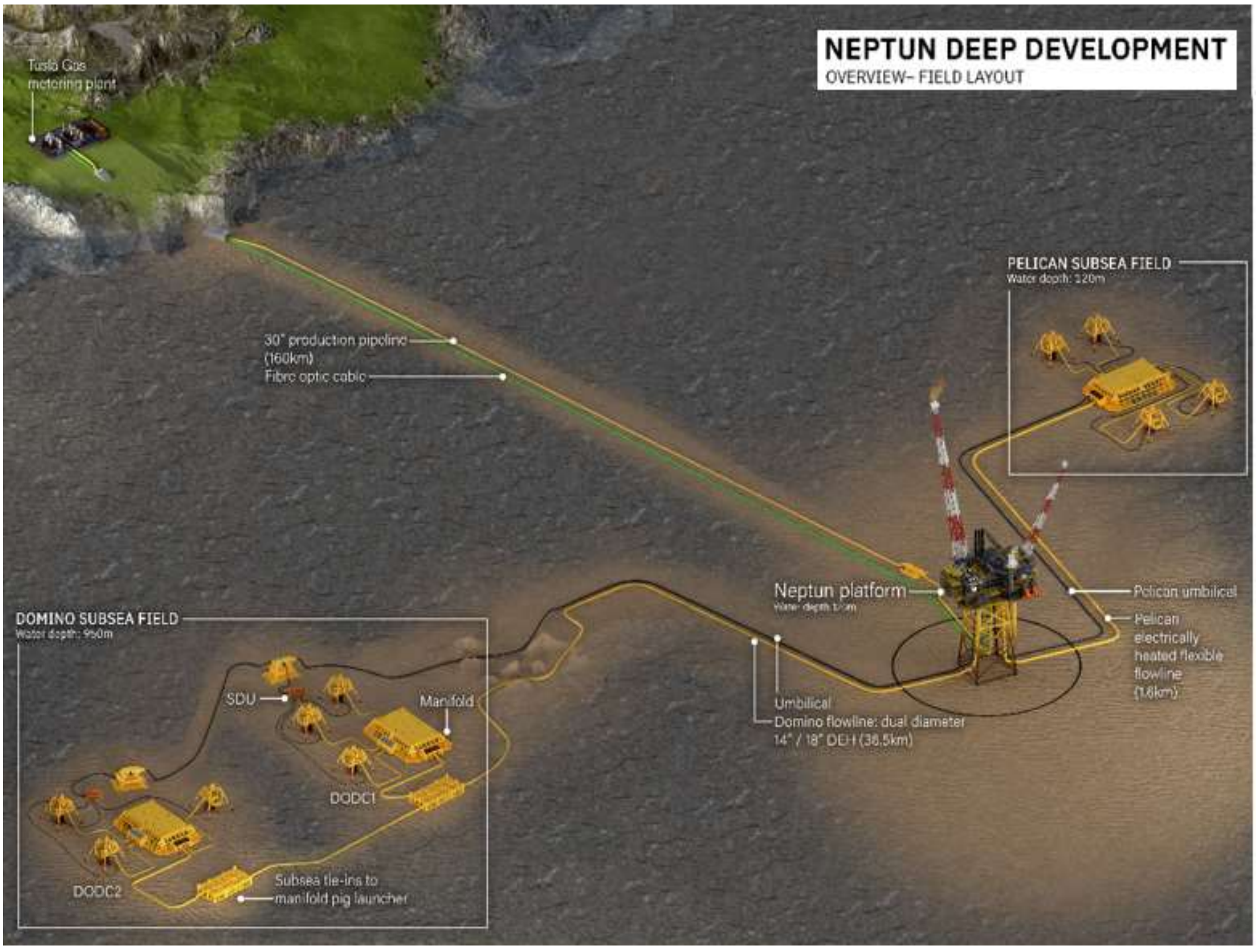

Figure 1-1 Overview Field Layout

The development concept as shown in Figure 1-1 includes the following:

Domino South Wells and Facilities:

- Six wells drilled from two 4-slot subsea manifolds.
- One direct electrically heated (DEH) 18/14-inch flowline tied back ~36 km to the SWP.
- Electrical and hydraulic control umbilical from the SWP to Domino drill centre 1 (DODC1) and from DODC1 to Domino drill centre 2 (DODC2)

Pelican South Wells and Facilities:

- Four wells drilled from one, 4-slot manifold at Pelican South (PSDC).
- One 10.75” heated flexible flowline tied back 1.4 km to the SWP from Pelican South.
- Electrical and hydraulic control umbilical from SWP to the PSDC.

Common Facilities:

- Normally unattended SWP for separation, gas dehydration, power generation, control and safety systems, and chemical treating.
- 160 km 30-inch Outside Diameter (OD) gas production pipeline from the SWP to onshore NGMS.
- Fibre optic cable from the SWP to onshore Central Control Room (CCR) for telecommunications and control; with satellite system (V-Sat) back-up.
- Onshore NGMS with pig receiver and connection to the Transgaz network.
- CCR is located at the NGMS.

Drilling:

- One thruster-assisted, moored Mobile Offshore Drilling Unit (MODU) to complete a minimum of five wells prior to start-up (approximately 80 days per well).
- Moderate-reach directional wells in normal pressure, non-sour environment.
- Open-hole sand control completions with 7” production tubing; some wells will also accommodate multi-zone hydraulic flow control of separate reservoir intervals in a single completion (intelligent well control).

2. Document Purpose

In support of the ESIA, the purpose of this report is to determine whether the project during plant turndown venting operations is expected to have any adverse impacts on nearby communities and determine how these can be mitigated. This objective is achieved by comparing the dispersion model results of vented gases with environmental and time weighted average exposure limits to determine impacts. The pollutants released during venting include particulates, nitrogen, carbon dioxide, methane, ethane, propane, butane, pentane, hexane. Currently no environmental exposure limits for these substances are in place in Romania (or internationally). There are only thresholds limits for occupational health for methane, carbon dioxide, nitrous oxide and/ or other greenhouse gas emissions.

No continuous emissions are expected at the NGMS, and therefore the worst blowdown case has been accounted for in this study, taken as the plant turn-around case. If it can be demonstrated that there is no impact associated with this case, then all the other releases will also demonstrate no impact as they are expected to be lower and less significant.

3. Scope

The air dispersion modelling study considers a stationary venting stack located at the onshore NGMS that operates only during abnormal events or for plant maintenance activities. Note that no gas from the offshore facilities including topsides, pipeline and flowlines will be vented onshore. In the event of depressurisation of the offshore facilities the gas will be flared from the platform [Ref.1].

This study is being conducted to determine the potential contribution and impact to communities and sensitive receptors in the near vicinity of the NGMS. The modelling scope excluded equipment operated on a regular short-term basis (e.g., testing of backup diesel systems) due to the minimal contribution of these systems. No other continuous releases to atmosphere are expected onshore at the NGMS.

Air pollution generated by transient activities such as drilling and construction activities, start-up/shutdowns periods, vehicle movements between shore base and SWP, helicopters and other equipment emissions are also excluded from this study. Further emissions modelling associated with SWP normal and blowdown cases are captured in [Ref. 2], and therefore also excluded from this report.

4. Methodology

4.1 Modelling Tool

The air dispersion model was built using the commercially available software BREEZE AERMOD v11 Pro Plus offered by Trinity Consultants. AERMOD is a next generation air dispersion model based on planetary boundary layer theory. It is a steady-state Gaussian model, in which the plume of emitted pollutants spread from multiple sources, both horizontally and vertically. The model is adapted for air pollutant dispersion in simple and complex terrain with the variability of vertical wind profile, temperature and considers turbulence.

AERMOD has “short term” and “long term” models referring to the meteorology used. The short-term model uses hourly meteorological conditions while the long-term version uses yearly average statistics.

AERMOD was developed by the US Environmental Protection Agency (US EPA) in conjunction with the American Meteorological Society and took 14 years to be accepted as the official regulatory tool of the US EPA. This model is now commonly used for air quality assessments, with examples in a Romania[1] context, in the UK[2], within the EU[3] and worldwide[4] [5] [6] [7] [8], hence has been selected as the modelling tool for use on the Neptun Deep Development.

4.2 Model Setup

There are two steps in determining the received ground level concentration of atmospheric pollutants:

- Step 1: involves determining the background concentration, mainly measured values, provided by installed monitoring stations (local to facility).
- Step 2: uses modelling to determine the additional contribution from industrial processes.

Together these form the predicted total ground level contribution, that is:

Ground Level Concentration = Background Concentration + Process Contribution

Measurements of background pollutant concentrations in the Project area for vented gases were not available at the time of writing this report.

For process contribution, AERMOD uses the following input parameters:

- Equipment coordinates.
- Pollutant mass emission rates.
- Vent stack height.
- Vent stack diameter.
- Stack gas temperature and exit velocity.

Emission sources represented in the model were based on the equipment list with emission rates of specific pollutants based on the calculations undertaken in the Emissions Inventory [Ref.3]. Emission source locations within the NGMS site were based on the overall plot plan [Ref.4] and layout [Ref.5].

[1] https://solacolu.chim.upb.ro/pg78-84.pdf
[2] https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports
[3] https://www.eurocontrol.int/sites/default/files/library/037_ALAQS_AERMOD_dispersion_modelling.pdf
[4] https://pubmed.ncbi.nlm.nih.gov/28160171/
[5] http://ijariie.com/AdminUploadPdf/PERFORMANCE_OF_AERMOD_SOFTWARE_IN_INDIAN_SCENARIO_ijariie12424.pdf
[6] https://www.epa.vic.gov.au/-/media/epa/files/publications/1551.pdf
[7] https://www.ontario.ca/document/guideline-11-air-dispersion-modelling-guideline-ontario-0
[8] http://tools.envirolink.govt.nz/dsss/aermod/

4.3 Scenarios

Only one case was modelled as part of this study and represented the worst blowdown scenario. The rationale behind using this case is if the large emission release case has no environmental consequence, then all other blow-down events (which are lower in volume) will also have no impact.

The case therefore being considered is:

- Plant turnaround venting case.

This case represents the entire onshore NGMS facility's physical volume of 170m^3, between inlet and outlet SDVs is depressurised at 55 Bar pressure. Details of this scenario are provided below.

4.3.1 Plant Turnaround Case

The NGMS facility has been provided with a manual depressurisation facility and emergency relief system to allow for safe disposal of a total gas inventory volume of 170 m^3. The vent stack is designed fit for purpose and is 12m high and 12'' wide [Ref.1]. The venting rate used for the onshore air dispersion model is based on the maximum relief case. The worst case is the emergency relief of the Filter Separator. The Filter Separator PSV is designed so that the peak relief rate does not exceed the maximum thermal radiation criteria level and that the unignited flammable gas plumes remain within the defined sterile area.

The emergency relief is expected to last for a maximum duration of 15 minutes to allow for the operator to analyse the situation and take immediate action. However, for the simulation it is assumed that the venting will continue for up to an hour. This conservative approach of air dispersion modelling demonstrates that no toxicity limits are exceeded at any time.

Note: the limitations of AERMOD, means that the modelling must be conducted in time steps of 1 hour. This is the minimal time-step allowance, as the pre-processed meteorological data is supplied as hourly sequential data over 3 years, so the pollutants emission rates for this depressurisation scenario is inputted into the model in g/s and assumed to be continuous for 1 hour.

4.4 Boundary Setting

Equipment and sensitive receptor locations are based on the Universal Transverse Mercator (UTM) projection using WGS84 TM30NE. The Project area is located in UTM zone 30N. Boundary coordinates for the NGMS are presented in Table 4-1 and highlighted in **Error! Reference source not found.** (as yellow dots).

Table 4-1 NGMS Site Boundary Coordinates

Coordinate Description	X co-ordinate	Y co-ordinate
	E	N
56	3036370	5382170
57	3036660	5382190
5	3036720	5382020
6	3036660	5382010
7	3036690	5381830
8	3036390	5381810

Figure 4-1 NGMS Site Boundary

The Area of Interest (AOI) for this study focused onshore extending 5.5 km by 5 km centred around the NGMS. This sets the boundaries of the model canvas (see Figure 4-2) and includes the following receptor grids:

- A receptor grid extends across the AOI with grid spacing of 120 m, allowing a 46 x 41 plot, and 1886 grid receptors in total over the area.
- Discrete receptors added are at the same locations as noise sensitive receptors [Ref.6] as these indicate nearby residents and communities, denoted in Figure 4-2 as N2, N6, N7, N8, N9, N10, N11 and N12.

The selected project discrete receptor locations represent communities onshore that could potentially be impacted by emissions from venting at the NGMS and thus it is important that the modelling results are compared against governing limits at these locations. It should be noted that no continuous onshore emissions at the NGMS are expected and therefore have not been presented in this work.

Figure 4-2 Sensitive Receptor Location

4.5 Emissions Rates

Emissions rates for sources were taken from the calculations undertaken in the Emissions Inventory [Ref.3] and these are listed in Table 4-2 for the vent relief case below. Other source parameters used in the models include:

- Stack height – for vent, stack height has been taken from [Ref. 1].
- Stack diameter – Inner diameters for vent stack was provided by Client [Ref.1]
- Exhaust temperature – provided by safety study [Ref. 7].
- Exhaust velocity – vent exhaust velocity (after atmospheric expansion) was calculated in safety studies [Ref. 7].

Table 4-2 NGMS Emissions Source

DESCRIPTION	WASTE	TYPE	AMOUNT (g/s)	PRODUCTION	Northing (X)	Easting (Y)	Elevation	Stack height	Effective height	Stack diameter	Exit Temp (K)	Exit velocity
Onshore Vent Stack	N_2	Fuel Gas	8.68	Continuous	5381960	3036540	0	12	0	0.30	228	447.0
	CO_2		7.28									
	H_2S		0.00									
	CH_4		3303.45									
	C_2H_6		4.35									
	C_3H_8		1.82									
	C_4H_{10}		1.20									
	C_5H_{12}		1.49									
	C_6H_{14}		3.56									

4.6 Meteorological Data

There are a number of meteorological assumptions associated with modelling of atmospheric emissions including the suitability of applied meteorological data, the incorporation of chemical processes (that, for instance, lead to removal of pollutants from the atmosphere) and the influence of cloud cover.

The air dispersion modelling work has been conducted using pre-processed hourly sequential meteorological data recorded at Tuzla (RTZ1921), circa 2.0 km from the NGMS Project location and 10km south of Constanta. The data set was collected from meteorological station number 15493 (surface station) and 15420 (upper-air station) and includes both surface air and upper air information provided by Trinity Consultants (hereafter known as Trinity) for specific use in AERMOD. The AERMOD ready data period for surface and upper air files are from 1st Jan 2019 to 31 Dec 2021.

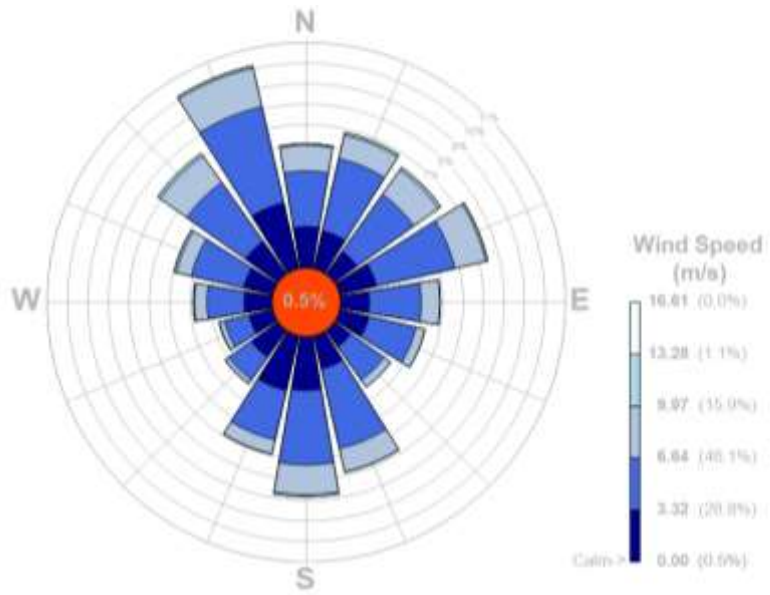

Figure 4-3 Windrose at Tuzla (from 2019 to 2021)

An important element to consider with this data is the number of calm periods recorded in any one-year timespan. Wind speeds below 1 m/s are considered as calm. AERMOD treats these calm periods as zero-wind speed and omits them from calculations. When more than 10% of an annual dataset is missing, it is recommended that the dataset is used with caution as it will not render representative results for the period being analysed. Calm periods represent 0.46% of the utilised dataset and therefore no problems are expected.

Missing hourly meteorological data within a one-year period of data collected is an important factor to consider, perhaps just as important as emissions rates, emission stack geometry and stack location. Meteorological parameters (on an hourly basis) required for the dispersion calculations included sensible heat flux, conventional and mechanical mixing heights, wind speed, wind direction, air temperature, precipitation rate, relative humidity, and cloud cover. If any of the meteorological parameters (including those listed above) are not collected on an hourly basis, it is recorded as missing hourly data and cannot be used. It is the same process that is applied to calm hours. Trinity recommends that if meteorological data has more than 10% of its hourly data set missing, it should only be used for analysis with caution as it will not render representative results for the year being analysed. On review of the Tuzla meteorological data from 2019 to 2021, missing data remains at 7.57% and therefore falls within the degree of accuracy.

4.7 Emission Limits

The dispersion results from the venting study were compared against the occupational exposure limits tabulated in Table 4-3 below as there are currently no ambient air quality limits for vented gases such as carbon dioxide, methane, ethane, propane, butane, pentane, hexane as they are not considered toxic. No limits exist for nitrogen and Neptun Deep processed gas does not contain any hydrogen sulphide.

Table 4-3 Governing Exposure Limits

No. crt.	EC(1) (EINECS)	Exposure limit value 8 hours(2)		Exposure limit value Short term(3) (15 min.)		References
		mg/m^3 (4)	ppm(5)	mg/m^3 (4)	ppm(5)	
N_2		n/a	n/a	n/a	n/a	No limits
CO_2	204-696-9	9000	5000	-	-	For CO_2: [Ref.8]
H_2S	231-977-3	7	5	14	10	For H_2S: [Ref.8]
CH_4 (TWA)	200-812-7	1200	1834	1500	2292	For CH_4: [Ref.8]
C_2H_6 (TWA)	200-814-8	1230	1000	-	-	For C_2H_6: [Ref.9]
C_3H_8 (TWA)	200-827-9	1400	778	1800	1000	For C_3H_8: [Ref.8]
C_4H_{10} (TWA)	203-448-7	1900	800	-	-	For C_4H_{10}: [Ref.10]
C_5H_{12} (TWA)	203-692-4	120	354	-	-	For C_5H_{12}: [Ref.11]
C_6H_{14} (TWA)	203-777-6	72	20	-	-	For C_6H_{14}: [Ref.8]

(1) EC (EINECS): European Inventory of Existing Chemical Substances registration number.
(2) Measured or calculated in relation to an eight-hour reference period as a time-weighted average (TWA).
(3) Level of short-term exposure. Limit value above which there must be no exposure beyond a fifteen minutes
(4) mg/m^3 : milligrams per cubic meter of air.
(5) ppm: parts per million, contaminant volumes per 10^6 volumes of air (ml/m^3).

It should be noted that the above occupational health 8-hour exposure limits are provided by [Ref.8, 9, 10], where the more stringent values have been taken and are therefore offered as guidance in lieu of better standards.

4.8 Model Set-up Assumptions

The model setup has made some assumptions regarding model boundaries, topography of the area, environmental conditions, receptor locations and heights, structural barriers, and emissions rates from each source. A summary of the set-up parameters is provided below:

- Topography: Project area is located at sea with an absence of any significant elevated natural or man-made obstructions nearby, so no topography details have been included in the model.
- Meteorological data: study has utilised 3-yrs of wind data from 2019 to 2021.
- Receiver calculation flagpole height: 2 m (head height).
- Receiver grids dimensions: a Uniform Cartesian grid receptor network centred across a mesh of 46 by 41 with 120m spacing for receptor grid.
- Base map: GIS map of project area with boundaries of NGMS.
- Selected sensitive receptors: as identified on Figure 4-2.
- Building downwash has not been considered in modelling as the stack is suitably placed away from a building structure greater than 1 storey high.
- Critical pollutants: carbon dioxide, methane, ethane, propane, butane, pentane, hexane Neptun Deep gas is expected to be dry and sweet (i.e., without H_2S); and nitrogen is not considered a pollutant given 78% of the earth's atmosphere is comprised of nitrogen.
- Averaging periods: emergency relief is expected to last for a maximum duration of 15 minutes to allow the operator to analyse the situation and take immediate action. For the simulation though it is assumed that the venting will continue up to an hour, taking a 1-hour average period.

The assumptions and data accuracy will be reviewed again at EPC, once vendor data becomes available.

5. Results

Table 5-1 Depressurisation: Plant Turndown Case

POLLUTANT	GOVERNING LIMIT (in µg/m^3)			NGMS 1hr CONTRIBUTION to AMBIENT AIR QUALITY (µg/m^3)		LOCATION		Notes
						NORTHING (X)	EASTING (Y)	
N_2	n/a			1st highest	193.26	3036425	5381865	No Excedance of 1 hour exposure limits
CO_2	8 h	TWA	9000000	1st highest	162.09	3036425	5381865	No Excedance of 1 hour exposure limits
H_2S	8 h	TWA	6973	1st highest	-	-	-	No Excedance of 1 hour exposure limits
CH_4 (TWA)	8 h	TWA	1200000	1st highest	73549.91	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	12455.01	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	17406.98	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	17754.99	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	11029.38	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	6424.67	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	6981.17	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	5715.71	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	5754.00	3035600	5384050	No Excedance of 1 hour exposure limits
C_2H_6 (TWA)	8 h	TWA	1229863	1st highest	96.851	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	16.401	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	22.922	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	23.380	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	14.524	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	8.460	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	9.193	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	7.526	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	7.577	3035600	5384050	No Excedance of 1 hour exposure limits
C_3H_8 (TWA)	8 h	TWA	1400000	1st highest	40.522	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	6.862	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	9.590	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	9.782	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	6.077	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	3.540	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	3.846	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	3.149	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	3.170	3035600	5384050	No Excedance of 1 hour exposure limits
C_4H_{10} (TWA)	8 h	TWA	1900000	1st highest	26.717	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	4.524	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	6.323	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	6.450	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	4.007	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	2.334	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	2.536	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	2.076	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	2.090	3035600	5384050	No Excedance of 1 hour exposure limits
C_5H_{12} (TWA)	8 h	TWA	120000	1st highest	33.174	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	5.618	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	7.851	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	8.008	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	4.975	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	2.898	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	3.149	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	2.578	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	2.595	3035600	5384050	No Excedance of 1 hour exposure limits
C_6H_{14} (TWA)	8 h	TWA	72000	1st highest	79.262	3036425	5381865	No Excedance of 1 hour exposure limits
				N2	13.422	3037670	5382260	No Excedance of 1 hour exposure limits
				N6	18.759	3037420	5381900	No Excedance of 1 hour exposure limits
				N7	19.134	3036770	5381110	No Excedance of 1 hour exposure limits
				N8	11.886	3036820	5380650	No Excedance of 1 hour exposure limits
				N9	6.924	3036680	5379900	No Excedance of 1 hour exposure limits
				N10	7.523	3034980	5383120	No Excedance of 1 hour exposure limits
				N11	6.160	3035230	5383850	No Excedance of 1 hour exposure limits
				N12	6.201	3035600	5384050	No Excedance of 1 hour exposure limits

Figure 5-1 Methane 1hr contour (units μg/m³)

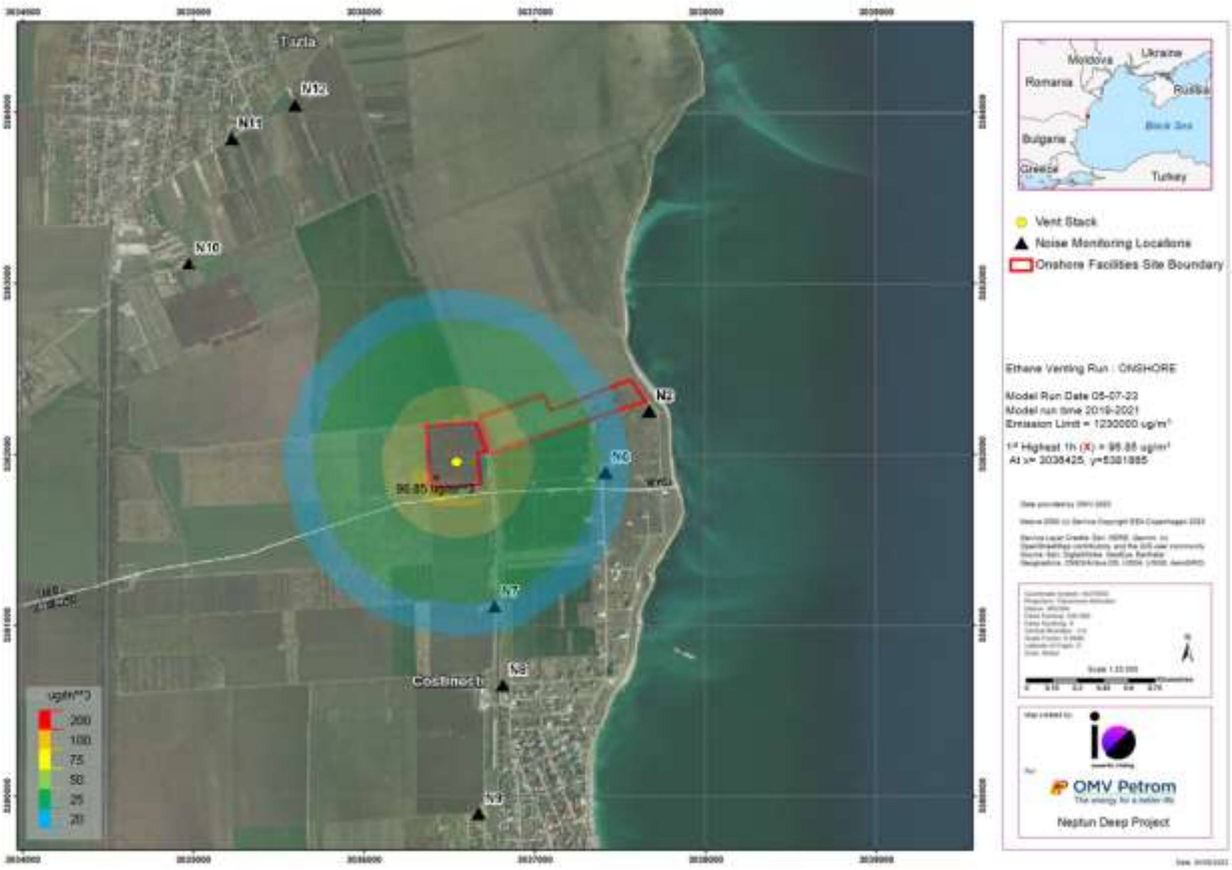

Figure 5-2 Ethane 1hr contour (units μg/m³)

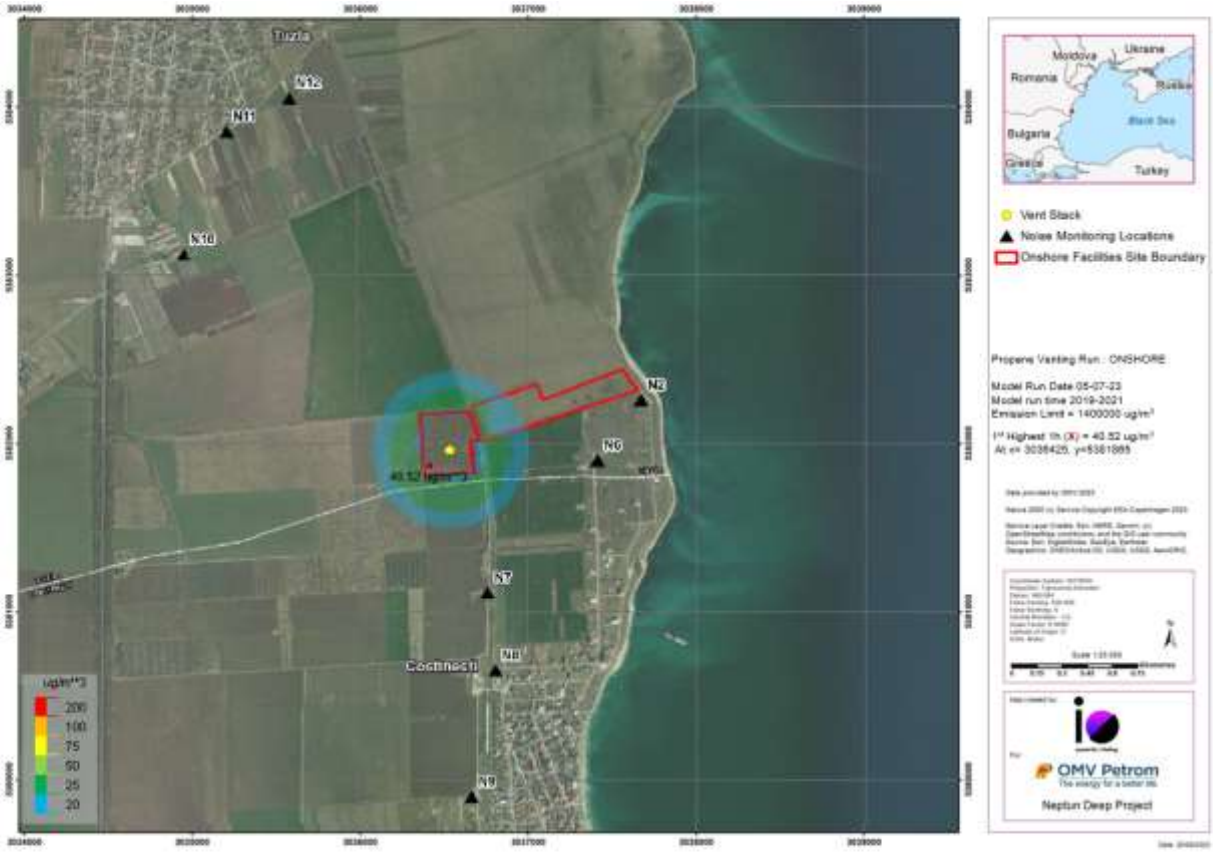

Figure 5-3 Propane 1hr contour (units μg/m³)

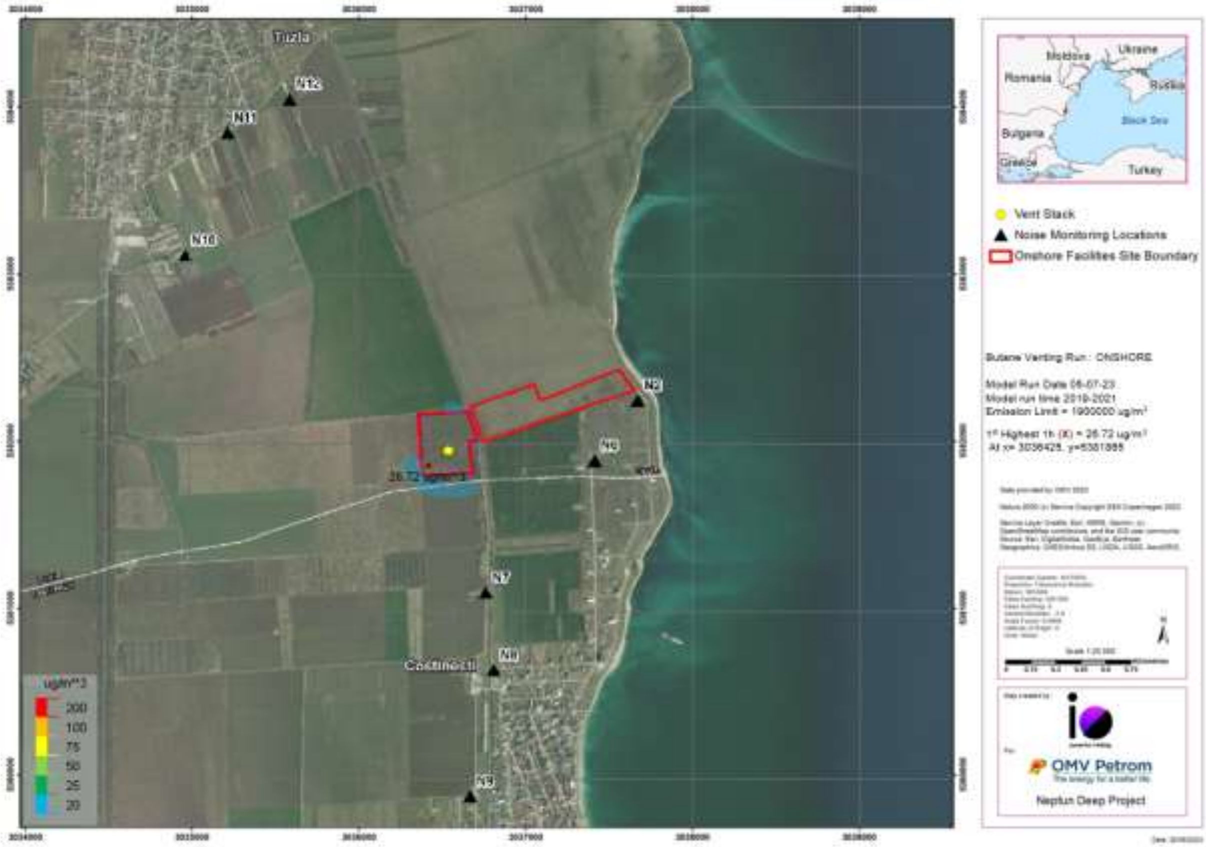

Figure 5-4 Butane 1hr contour (units μg/m³)

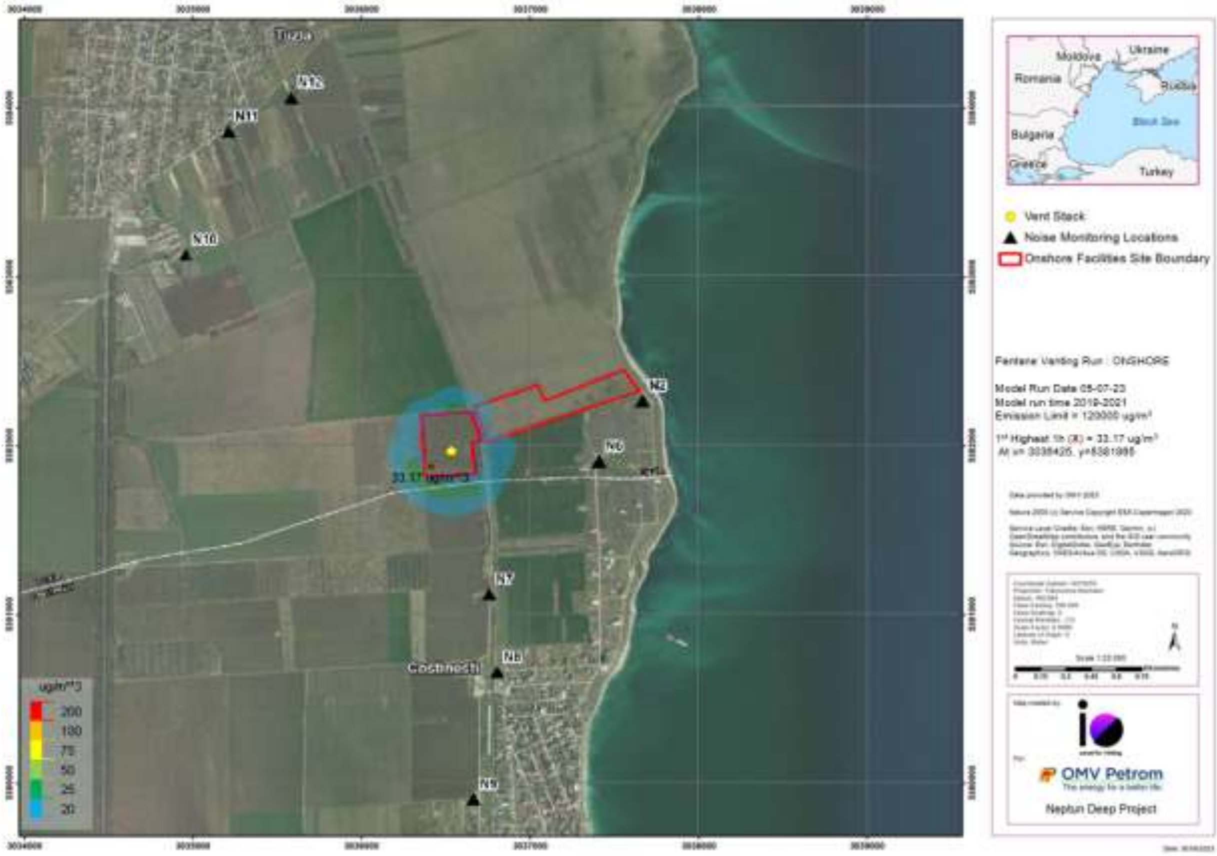

Figure 5-5 Pentane 1hr contour (units $\mu g/m^3$)

Figure 5-6 Hexane 1hr contour (units $\mu g/m^3$)

6. Modelling Analysis

Modelling of air emissions from industrial facilities is the first step in the design of industrial emission stacks and appropriate abatement systems. For the NGMS, the air dispersion modelling was undertaken using AERMOD v11.0 as a screening tool, to determine whether any emissions generated from the largest venting operation would have any consequential impact on the identified sensitive receptors, represented by residents, accommodation and communities located near the NGMS.

The worst case (largest venting release) from plant turndown was used as the reference depressurisation case, and the modelling work was conducted for this venting. The modelling predicted the impact of carbon dioxide, methane, ethane, propane, butane, pentane, and hexane from the Neptun Deep NGMS depressurisation case against the Romanian governing 8-hr occupational health limits which are shown in Table 4-3. Contour maps demonstrate the extent of plume from source at the NGMS, during this plant turndown operation and plume maps can be found Figure 5-1 to Figure 5-6. These will be referenced in the analysis below.

The 1st highest concentration for all pollutants over the 3-year modelling period occurs within the boundary fence line as can be seen in Figure 5-1 to Figure 5-6 for methane, ethane, propane, butane, pentane, and hexane respectively. This 1st high concentration occurs at x= 3036425, y=5381865 on 5th February 2020, at 24 hrs for all pollutants released. At this grid receptor location, concentrations of all pollutants are well within the governing 8-hour limits, occurring at microgram per cubic meter concentrations (i.e., $\mu g/m^3$) where the governing limits are expressed in milligrams per cubic meter concentrations (i.e., mg/m^3).

From Figure 6-1, representing pollutant contribution at the 1st highest grid receptor location (within the boundary fence), the primary emissions contributor is methane at 99.1%.

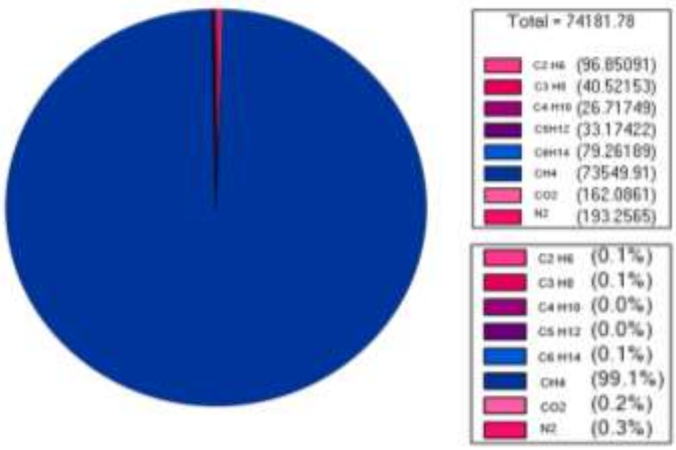

Figure 6-1 Pollutant contribution at 1st highest concentration

Methane contribution shown in Figure 6-1 should be expected as that is the point of release from the vent stack, and the concentration of methane is 99.6 mol% as it is the primary product being discharged to atmosphere.

Similar findings are reflected at the sensitive receptors denoted by N2, N6, N7, N8, N9, N10, N11 and N12, where concentrations at these locations are again well below the governing limits, with methane being the primary pollutant contributor. The depressurisation is a non-routine event that is expected to occur once every four years, and based on the results of the modelling, this event should not pose any health risks to nearby receptors, accommodations, or communities.

7. Conclusions

Emissions modelling was concluded using Breeze AERMOD v11 ProPlus software, provided by Trinity Consultants. The modelled scenario considered was the worst case non-routine venting operation (Plant turnaround), expected to occur once every 4 years.

The work was conducted to determine whether such a non-routine operation would result in any adverse impacts to nearby receptors, accommodation, and communities. The work has been conducted during FEED design, using emissions data provided within the Emission Inventory [Ref.3] and pre-formatted hourly sequential meteorological data for 2019 to 2021 (three years).

It is concluded that all the emissions from this worst case non-routine venting operation is well within the governing exposure limits for a 1-hr averaging period, at the specified sensitive receptors. On this basis, no additional mitigation measures are required to protect nearby communities from this non-routine event.

However, to improve certainty of results, collection of 1-hour background information related to venting pollutants including carbon dioxide, methane, ethane, propane, butane, pentane, and hexane is recommended as these were not available at the time of writing this report and could be useful in determining the NGMS's cumulative impact on these communities resulting from concurrent third-party operations and nearby industrial facilities.

Appendix A – References and acronyms

References

Table A-1 References

Ref	Description
1	ND-D-IO-90-PR-BPHY-0001-0001 P01 NGMS Venting Philosophy 16-12-2023
2	ND-D-IO-00-EV-REIS-0017-0001 P01 SWP Air Dispersion Study dated 28-06-2023
3	ND-D-IO-00-EV-REIS-0006-0001 P03 Emissions Inventory dated 22-06-2023
4	ND-D-IO-90-PI-DLAY-0001-0001 P01 Plot Plan dated 06-03-2023
5	ND-D-IO-90-CM-DLAY-0001-0001 P02 Overview Layout dated 08-03-2023
6	ND-D-IO-00-EV-REIS-0018-0001 P01 Neptun Deep Onshore Noise Study dated19-01-2023
7	Email provided by Jess Guzzetta-King dated 27-06-2023
8	Decision no. 1.218/2006
9	https://www.hess.com/docs/default-source/us-safety-data-sheets/ethane_sds_na2015_103018_final.pdf
10	https://www.cdc.gov/niosh/pel88/106-97.html
11	https://www.cdc.gov/niosh/pel88/109-66.html

Acronyms

Table A-2 Acronyms

Acronym	Definition
AERMOD	EPA Approved Dispersion Modelling Tool
AOI	Area of Interest
CCR	Central control room
DEH	Direct electrically heated
DODC1	Domino drill centre 1
DODC2	Domino drill centre 2
EC	European Community
EINECS	European Inventory of Existing Chemical Substances
EPC	Engineering Procurement and construction
ESIA	Environmental and Social Impact Assessment
EU	European Union
GIS	Geographic Information System
GPP	Gas production pipeline
$\mu g/m^3$	microgram per cubic meter
mg/m^3	milligram per cubic meter
MODU	Mobile Offshore Drilling Unit
NGMS	Natural gas metering station
NTS	Transgaz National Transportation System
OD	Outside diameter
PSDC	Pelican South Drill Centre
SWP	Shallow Water Platform
TWA	Time-weighted average
UK	United Kingdom
US EPA	US Environmental Protection Agency