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ROSETTI MARINO

Site of Ravenna

Vent Gas Dispersion and Potential Radiation Study for BLPH platform on Ravenna construction site



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1. INTRODUCTION AND SCOPE

The BLPH platform is currently under construction at the Rosetti Marino yard in Ravenna. The BLPH platform is designed to address the intermittent nature of renewable energy production, particularly from offshore wind farms. The platform will convert excess wind energy into green hydrogen using an electrolyzer. This hydrogen will be stored and can later be converted back to electricity using a fuel cell when needed, making it a crucial tool for energy storage and management. The BLPH will also feature battery storage for short-term power retention, ensuring a more stable energy supply even when wind conditions are unfavorable.

1.1 Scope of the report

The purpose of the vent gas dispersion and radiation study is to evaluate the flammable gas dispersion and the expected thermal radiation in case of ignition during depressurization activities of the platform.

Based on the damage distances from dispersion scenarios and the effects of radiation, the workplace positions will be assessed to determine whether they are acceptable or not.

2. ABBREVIATION AND MAIN REFERENCES DOCUMENTATIONS

2.1 Abbreviation

BESS	Battery energy storage system
BLPH	Base Load Power Hub
DNV	Det Norske Veritas
HKN	Hollandse Kust Noord
LFL	Lower Flammable Limit
MW	MegaWatt
PHAST	DNV software for modelling discharge, dispersion, fires, explosion and toxic effects of a wide range of loss of containment scenarios.
RP	Receptor point
VDM	Via del Marchesato

2.2 Main references

No.	REFERENCE DOCUMENTS
[1]	123A90-DDL-PR-RE-80030_01, Relief, Vent and Blowdown Report, 01, 05/02/2024
[2]	Risk assessment data directory, document no. IOGP 434_14 – 2013 - Vulnerability of humans
[3]	123A90-DDL-SAF-RE-30021 Vent Gas Dispersion and Potential Radiation Study
[4]	Layout Cantiere
[5]	API Standard 521 Pressure-relieving and Depressuring Systems, 2020

3. METHODOLOGY

The study is developed according to the following main steps:

- Identification of reference case: identification of plant depressurization scenarios.
- Reference thresholds: identification of reference thermal radiation/flammable concentration thresholds.
- Consequences evaluation: development of fire and flammable gas dispersion scenario for the reference case.

The application of the methodology described above is reported in the following sections.

3.1 Identification of reference cases

According to the operative phases during construction and tests with hydrogen, following cases which potentially requires the activation of the vent are identified:

- venting during electrolyzer in service;
- depressurization of single storage vessel;
- depressurization of six storage vessels.

These scenarios are taken into account and thermal radiation and flammable gas dispersion was investigated with software simulation. The main data is summarized below.

Case	Scenario description	Total Flowrate (kg/h)
Venting during test	Venting during electrolyzer in service	44
Emergency depressurization	Discharge of one storage vessel	2300
	Simultaneous discharge of all storage vessel	13485

3.2 Reference thresholds

The purpose of the vent gas dispersion and radiation study is to evaluate the risk during vent operation for operators which can be present in the platform during construction phases or in the construction site.

Two reference scenarios are considered:

- An ignition of H_2 after the release, leading to the formation of a flame in the top of the stack;
- A H_2 flammable gas dispersion from the stack (without ignition).

Reference thresholds below are reported.

Fire scenario

And the following heat radiation threshold values have been considered [5]:

- The radiation of 4.73 kW/m² (including solar radiation) shall not be reached in location where people presence can be possible. According to API, 4.73 kW/m² is "*the maximum radiant heat intensity in areas where emergency actions lasting 2 min to 3 min can be required by personnel without shielding, but with appropriate clothing*";
- The radiation of 1.5 kW/m² (including solar radiation) is the "*the mmaximum radiant heat intensity in any location where personnel with appropriate clothing can be continuously exposed".*

Note regarding Seveso directive

The Seveso Directive (Directive 2012/18/EU), implemented in Italy through Legislative Decree 105/2015, establishes thresholds for assessing the risk of major accidents involving hazardous substances. Among these are the thresholds for thermal radiation exposure, which are categorized based on the intensity of heat flux (measured in kW/m²) and their effects on human health:

- 5 kW/m² is representative for irreversible damage to exposed individuals (e.g. causes second-degree burns on unprotected skin after a few seconds of exposure).
- 3 kW/m² is representative for Reversible effects, to exposed individuals (e.g. causes first-degree burns on unprotected skin after prolonged exposure / Potential discomfort due to heat stress.)

In the present report, using 1.58 kW/m² as the reference threshold is considered a conservative approach. This value represents the level at which no significant physical damage occurs but may cause discomfort or mild heat stress, ensuring a cautious margin of safety in risk assessments and protective measures.

Flammable Gas Dispersion

In case of dispersion without ignition (normal case), a hydrogen flammable gas cloud will be released from the stack. The stack height will be designed in order to ensure that the flammable envelopes corresponding to LFL and ½ LFL concentrations shall not reach areas where ignition sources could be present.

3.3 Consequences evaluation

Fire scenario

Calculation of thermal radiation from the stack was performed by means of Flaresim Software (revision 2023.3.131, last release) by Schlumberger. The results are reported in the tables and figures shown in chapter 4. The software has dedicated formulas to calculate the thermal radiation from H_2. In particular, the flame length and the heat radiation reached at the critical receptor points have been indicated.

Flammable Gas Dispersion

Modelling is performed by means of PHAST - DNV Technica software release 9 (last release), to determine physical effects in terms of flammable gas cloud dispersion on the basis of the threshold values detailed in chapter 3.2.

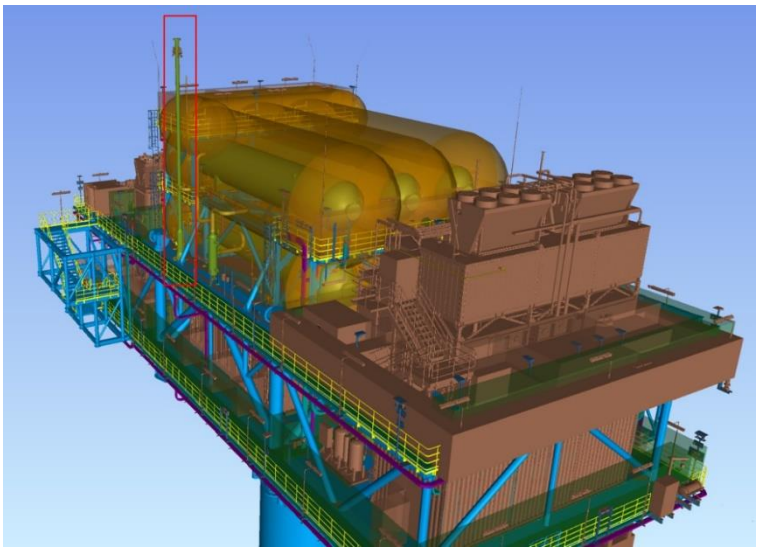
Climatic conditions

The climatic conditions used for the heat radiation and flammable gas dispersion studies are summarized in the table below.

Case	Scenario description
Ambient temperature (nom)	25°C
Solar Radiation	0.79 kW/m^2
Stability class/wind speed	2F, 5D, 10D

Stack location and design

The stack base is located at the upper deck, in the west side, near the platform above storage vessel, as indicated in the figure below.



The main characteristic of the stack are as follows [1]:

- Stack height: 3.2 meters.
- Stack diameter: 20 inches.
- Tip height: 5 meters.
- Tip Type: pipe.
- Tip diameter: 12 inches.

Please note that these heights are referred to the top deck platform above hydrogen storage vessel. Considering the upper deck elevation, the total structure of the vent is equal to:

- 16.5 meters height from the upper deck.

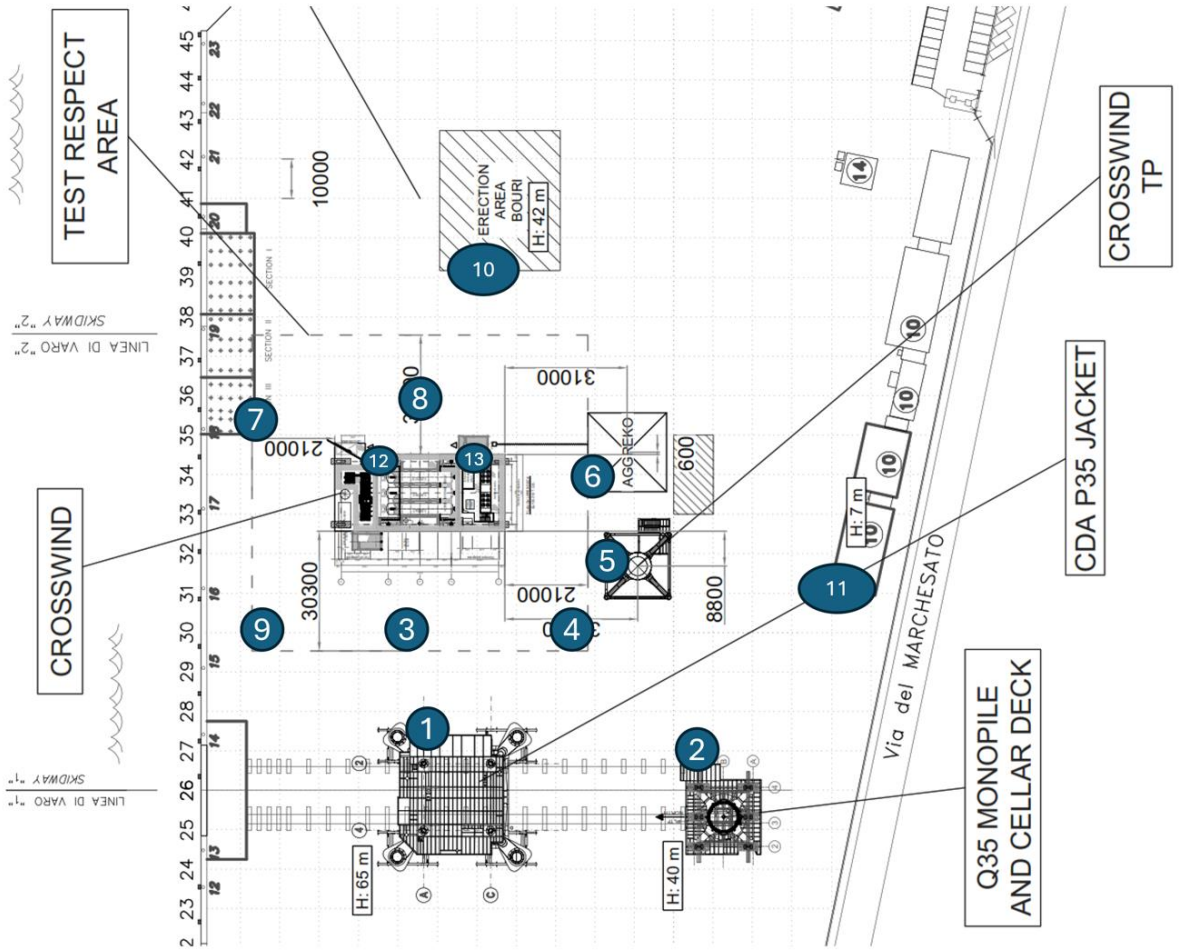
Receptor Points: Location of operators

The following table reports the coordinates of the receptor points used for the assessment of the thermal radiation impact on the construction yard. Point coordinates were selected based on the available layout of the operational area; several heights of interest were considered.

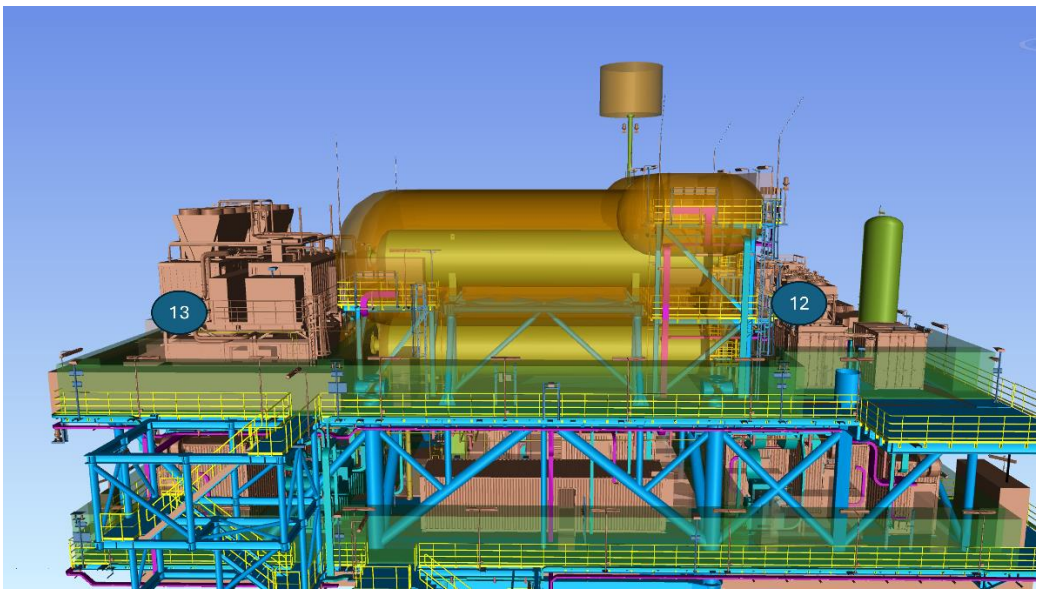
RP	*Description*	*Distance from the stack E (m)*	*Distance from the stack N (m)*	*Elevation (m) from the ground*
0	*Stack origin*	*0*	*0*	*+10.4*
1	*Operator on structure CDA P35 JACKET*	*0*	*-51*	*+2.0 (+2.0m of operator) +9.0 (+7.0m of building +2.0m of operator) +42.0 (+40.0m of building +2.0m of operator) +67.0 (+65.0m of building +2.0m of operator)*
2	*Operator on structure Q35 MONOPILE AND CELLAR DECK*	*70*	*-62*	*+2.0 (+2.0m of operator) +9.0 (+7.0m of building +2.0m of operator) +42.0 (+40.0m of building +2.0m of operator)*
3	*Operator on TEST AREA*	*0*	*-32*	*+2.0 (+2.0m of operator)*
4	*Operator on TEST AREA*	*45*	*-32*	*+2.0 (+2.0m of operator)*
5	*Operator on structure CROSSWIND TP*	*51*	*-7*	*+2.0 (+2.0m of operator)*
6	*Operator on structure AGGREKO*	*46*	*8*	*+2.0 (+2.0m of operator)*

RP	Description	Distance from the stack E (m)	Distance from the stack N (m)	Elevation (m) from the ground
7	Operator on SECTION III	-38	22	+2.0 (+2.0m of operator)
8	Operator on TEST AREA	3	26	+2.0 (+2.0m of operator)
9	Operator on TEST AREA	-38	-32	+2.0 (+2.0m of operator)
10	Operator on YS and ASSEMBLY PREFAB BOURI	12	64	+2.0 (+2.0m of operator) +9.0 (+7.0m of building +2.0m of operator) +35.0 (+35.0m of point of interest)
11	Operator on BUILDINGS VDM	115	-7	+2.0 (+2.0m of operator) +9.0 (+7.0m of building +2.0m of operator)
12	Operator on BLPH platform (fuel cell package area)	-10	15	+15.5 (+15.5m of point of interest)
13	Operator on BLPH platform (electrolyzer package area)	18	15	+16.0 (+16.0m of point of interest)

A graphical representation of the receptor points disposition is reported in the following figure.



The figure below reports the detailed location of receptor points #12 and #13 positioned on BLPH platform (fuel cell package area and electrolyzer package area respectively).



4. RESULTS

The results of the calculations related to the heat radiation and flammable gas dispersions are presented in the following chapters.

- Chapters 4.1 and 4.2 reports the thermal radiation results for selected receptors points representative for equipment/main expected work position for operators in the area.
- Chapter 4.3 depicts the results of flammable gas dispersion.

4.1 Thermal radiation evaluation: receptors points

Regarding the assessment of the impact of thermal radiation for operators, the following meteorological conditions have been evaluated:

- Solar radiation: 0,79 kW/m^2;
- 2F;
- 10D.

Calculations for 5D meteorological condition were not executed as deemed not significant and representative as the 10D condition, which was used as reference in evaluating the horizontal elongation of the flammable clouds.

For each meteorological condition, four wind directions were considered:

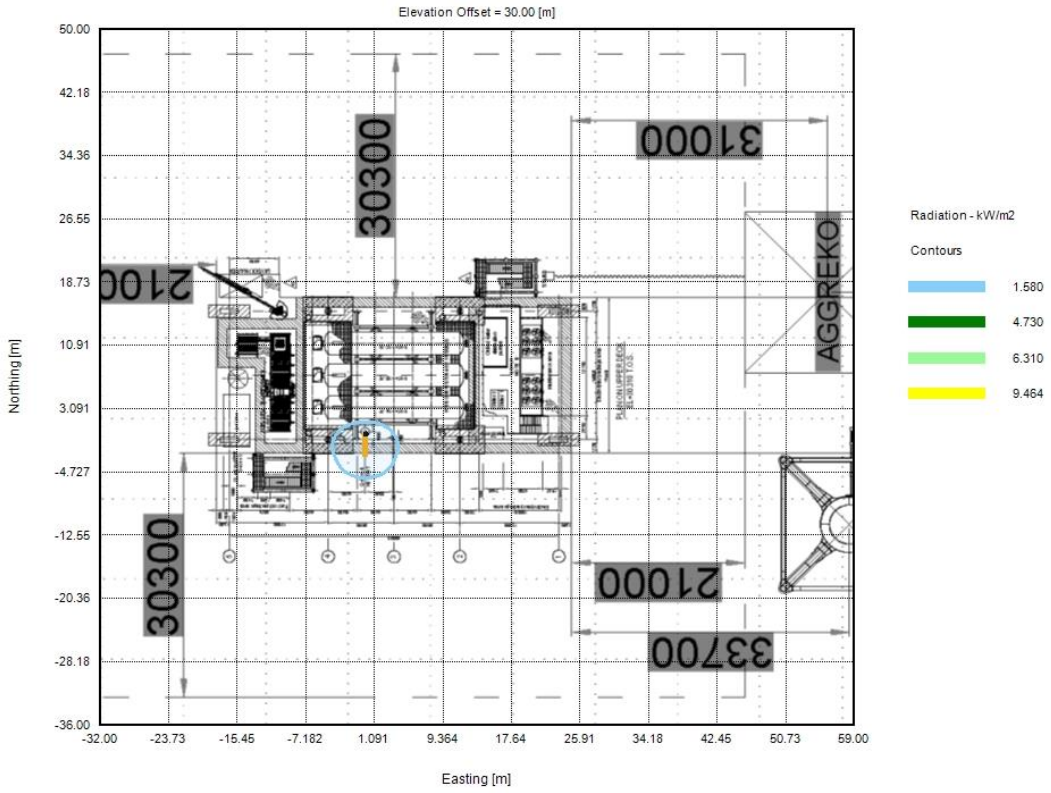
- Case 1: wind blowing from North to South (from Bouri erection area to BLPH);
- Case 2: wind blowing from East to West (from via Marchesato to BLPH)
- Case 3 wind blowing from South to North (from Q35 to BLPH)
- Case 4: wind blowing from West to East (from sea to BLPH)

As an example, the following figures report the distribution of the thermal irradiance effects on the ground (elevation + 2.0 m) in case of 10D Condition (higher bending of the flame) for three scenarios of interest:

1. venting during electrolyzer in service;
2. discharge of one storage vessel;
3. simultaneous discharge of all storage vessels.

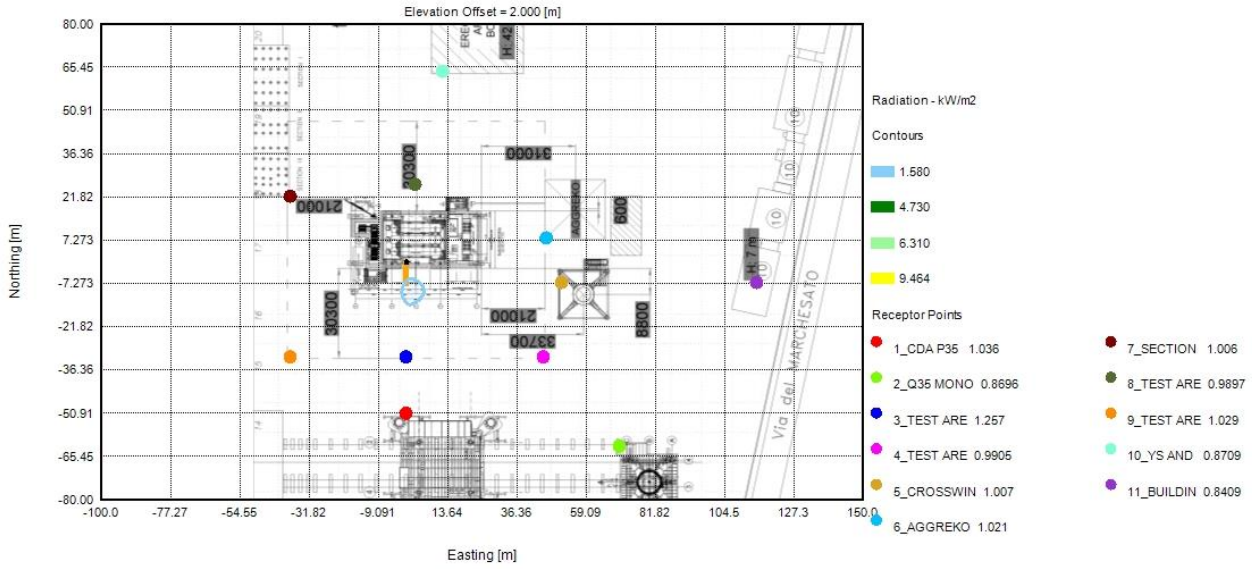
Chapter 4.3 reports tables summarizing the thermal threshold reached by each receptor point for all the scenarios of interest.

10D - Venting during electrolyzer in service (wind blowing from North to South)



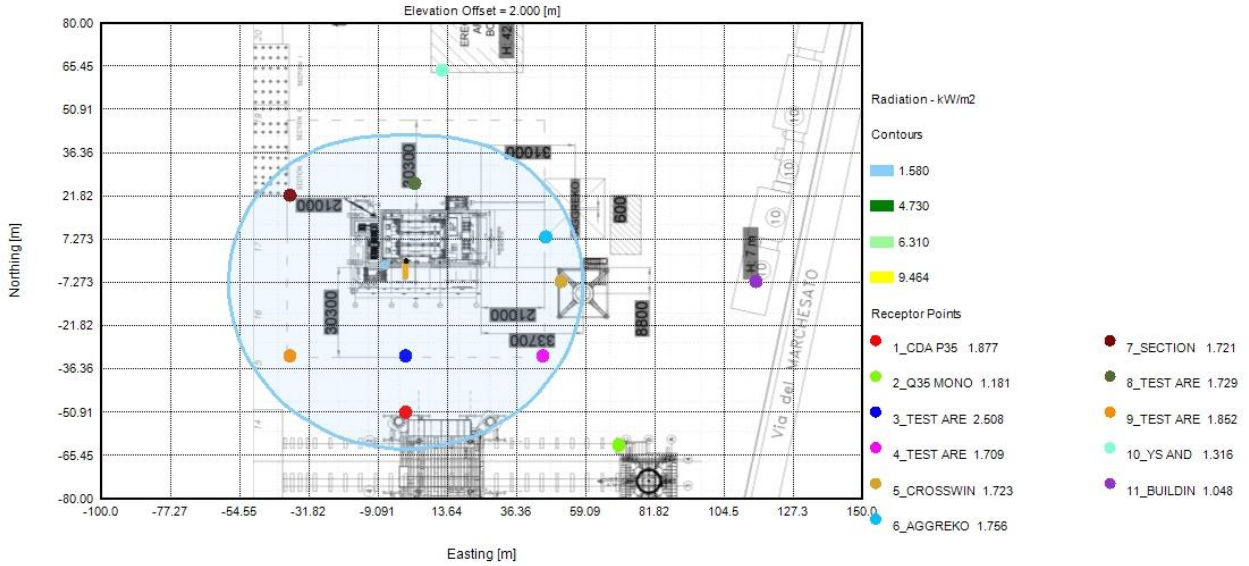
The threshold of 1.58 kW/m2 involves only a small area in the immediate nearby of the stack base, not affecting the receptor points (note that the present figures are elaborated at about 30 meters of elevation, which is the flame location). As emerges from the related contour plot, this scenario is characterized by a negligible irradiance at 2 m of elevation (refer to RP tables).

10D - Discharge of one storage vessel



Similarly to the venting during the electrolyzer service, this scenario is characterized by a highly limited thermal irradiance at 2 m of elevation. Also in this case, the threshold of 1.58 kW/m2 involves only a small area in the immediate nearby of the stack base, not affecting the receptor points.

10D - Simultaneous discharge of all storage vessels



Differently from the previous cases, the simultaneous depressurization of all the storage vessels generates a wider dispersion for the thermal threshold of 1.58 kW/m2. The affected area involves most of the receptor points located in the test area and on the buildings/installations located in the construction yard.

4.2 Summary of results from thermal radiation: receptors point

The Flaresim software calculates the expected thermal radiation on location where the operator presence is expected. The following tables summarize the calculated thermal radiation value of each receptor point for all the wind directions previously presented in 10D and 2F conditions. To simulate several operator dispositions, various combination of height of interest have been considered for all the receptor points. In particular, the scenarios were modelled considering the operators inside the test area always on the ground (+2m of height), while for the other on the structures, different elevation were evaluated.

4.2.1 Venting during electrolyzer in service

In case of venting during the electrolyzer service, none of the receptor points is subjected to a thermal irradiance equal or higher than 1.58 kW/m2, even considering different height of interest.

2m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [1]	0.79	0.80	0.79	0.80	0.80	0.80	0.79	0.80
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [1]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
3_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.80
4_Operator on TEST AREA [1]	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.80
5_Operator on structure CROSSWIND TP [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
6_Operator on structure AGGREKO [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
7_Operator on SECTION III [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.79
8_Operator on TEST AREA [1]	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80
9_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.79
10_Operator on YS and ASSEMBLY PREFAB BOURI [1]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
11_Operator on BUILDINGS VDM [1]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
12_Operator on BLPH platform [2]	0.82	0.84	0.83	0.83	0.81	0.83	0.83	0.82
13_Operator on BLPH platform [3]	0.81	0.81	0.82	0.82	0.81	0.81	0.82	0.82

Note 1: Receptor points 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11 are at 2m of height.

Note 2: Receptor point 12 is at 15.5m of height.

Note 3: Receptor point 13 is at 16m of height.

9m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [2]	0.79	0.80	0.79	0.80	0.80	0.80	0.79	0.80
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [2]	0.79	0.79	0.79	0.79	0.79	0.80	0.79	0.79
3_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.80
4_Operator on TEST AREA [1]	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.80
5_Operator on structure CROSSWIND TP [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
6_Operator on structure AGGREKO [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
7_Operator on SECTION III [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.79
8_Operator on TEST AREA [1]	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80
9_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.79
10_Operator on YS and ASSEMBLY PREFAB BOURI [2]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
11_Operator on BUILDINGS VDM [2]	0.7913	0.79	0.79	0.79	0.79	0.79	0.79	0.79
12_Operator on BLPH platform [3]	0.82	0.84	0.83	0.83	0.81	0.83	0.83	0.82
13_Operator on BLPH platform [4]	0.81	0.81	0.82	0.82	0.81	0.81	0.82	0.82

Note 1: Receptor points 3; 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 1; 2; 10; 11 are at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

42m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [6]	0.79	0.80	0.79	0.80	0.80	0.80	0.80	0.80
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	0.79	0.80	0.79	0.79	0.79	0.79	0.79	0.79
3_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.80
4_Operator on TEST AREA [1]	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.80
5_Operator on structure CROSSWIND TP [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
6_Operator on structure AGGREKO [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
7_Operator on SECTION III [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.79
8_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
9_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.79
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
11_Operator on BUILDINGS VDM [2]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
12_Operator on BLPH platform [3]	0.82	0.84	0.83	0.83	0.81	0.83	0.83	0.82
13_Operator on BLPH platform [4]	0.81	0.81	0.82	0.82	0.81	0.81	0.82	0.82

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

Note 6:Receptor points 1; 2 are at 42m of height.

67m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [7]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
3_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.80
4_Operator on TEST AREA [1]	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.80
5_Operator on structure CROSSWIND TP [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
6_Operator on structure AGGREKO [1]	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80
7_Operator on SECTION III [1]	0.80	0.80	0.80	0.79	0.80	0.80	0.80	0.79
8_Operator on TEST AREA [1]	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80
9_Operator on TEST AREA [1]	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.79
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
11_Operator on BUILDINGS VDM [2]	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
12_Operator on BLPH platform [3]	0.82	0.84	0.83	0.83	0.81	0.83	0.83	0.82
13_Operator on BLPH platform [4]	0.81	0.81	0.82	0.82	0.81	0.81	0.82	0.82

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

Note 6: Receptor points 2 is at 42m of height.

Note 7: Receptor points 1 is at 67m of height.

4.2.2 Discharge of one storage vessel

Similarly to the previous case, for the discharge of one storage vessel none of the receptor points is subjected to a thermal irradiance equal or higher than 1.58 kW/m2, even considering different height of interest.

2m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [1]	1.04	1.01	0.89	1.01	0.99	0.97	0.95	0.97
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [1]	0.87	0.85	0.85	0.87	0.87	0.86	0.86	0.87
3_Operator on TEST AREA [1]	1.26	1.12	0.96	1.21	1.11	1.07	1.02	1.07
4_Operator on TEST AREA [1]	0.99	0.92	0.94	1.01	0.97	0.94	0.94	0.97
5_Operator on structure CROSSWIND TP [1]	1.01	0.89	0.99	1.05	0.97	0.95	0.97	0.99
6_Operator on structure AGGREKO [1]	1.02	0.91	1.04	1.10	0.99	0.96	1.00	1.02
7_Operator on SECTION III [1]	1.01	1.08	1.08	0.94	0.99	1.03	1.02	0.98
8_Operator on TEST AREA [1]	0.99	1.22	1.37	1.31	1.03	1.09	1.15	1.10
9_Operator on TEST AREA [1]	1.03	1.03	0.96	0.94	0.99	1.00	0.96	0.96
10_Operator on YS and ASSEMBLY PREFAB BOURI [1]	0.87	0.93	0.95	0.94	0.91	0.92	0.93	0.93
11_Operator on BUILDINGS VDM [1]	0.84	0.82	0.84	0.84	0.84	0.84	0.84	0.84
12_Operator on BLPH platform [2]	1.40	2.30	2.48	1.69	1.41	1.63	2.48	1.69
13_Operator on BLPH platform [3]	1.41	1.34	1.96	2.08	1.38	1.36	1.96	2.08

Note 1: Receptor points 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11 are at 2m of height.

Note 2: Receptor point 12 is at 15.5m of height.

Note 3: Receptor point 13 is at 16m of height.

9m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [2]	1.07	1.03	0.92	1.04	1.03	1.01	0.98	1.01
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [2]	0.87	0.86	0.86	0.88	0.87	0.86	0.86	0.87
3_Operator on TEST AREA [1]	1.26	1.12	0.96	1.21	1.11	1.07	1.02	1.07
4_Operator on TEST AREA [1]	0.99	0.92	0.94	1.01	0.97	0.93	0.94	0.97
5_Operator on structure CROSSWIND TP [1]	1.01	0.89	0.99	1.05	0.97	0.95	0.97	0.99
6_Operator on structure AGGREKO 1	1.02	0.91	1.04	1.10	0.99	0.96	1.00	1.02
7_Operator on SECTION III [1]	1.01	1.08	1.08	0.94	0.99	1.03	1.02	0.98
8_Operator on TEST AREA [1]	0.99	1.22	1.37	1.31	1.03	1.09	1.15	1.10
9_Operator on TEST AREA [1]	1.03	1.03	0.96	0.94	0.99	1.00	0.96	0.96
10_Operator on YS and ASSEMBLY PREFAB BOURI [2]	0.88	0.94	0.97	0.95	0.92	0.93	0.95	0.94
11_Operator on BUILDINGS VDM [2]	0.84	0.8268	0.84	0.84	0.84	0.84	0.84	0.84
12_Operator on BLPH platform [3]	1.40	2.30	2.48	1.69	1.41	1.63	2.48	1.69
13_Operator on BLPH platform [4]	1.41	1.34	1.96	2.08	1.38	1.36	1.96	2.08

Note 1: Receptor points 3; 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 1; 2; 10; 11 are at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

42m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [6]	1.08	1.06	1.01	1.06	1.10	1.07	1.07	1.07
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.88
3_Operator on TEST AREA [1]	1.26	1.12	0.96	1.21	1.11	1.07	1.02	1.07
4_Operator on TEST AREA [1]	0.99	0.92	0.94	1.01	0.97	0.94	0.94	0.97
5_Operator on structure CROSSWIND TP [1]	1.01	0.89	0.99	1.05	0.97	0.95	0.97	0.99
6_Operator on structure AGGREKO [1]	1.02	0.91	1.04	1.10	0.99	0.96	1.00	1.02
7_Operator on SECTION III [1]	1.01	1.08	1.08	0.94	0.99	1.03	1.02	0.98
8_Operator on TEST AREA [1]	0.99	1.22	1.37	1.31	1.03	1.09	1.15	1.10
9_Operator on TEST AREA [1]	1.03	1.03	0.96	0.94	0.99	1.00	0.96	0.96
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	0.93	0.96	0.98	0.96	0.97	0.96	0.97	0.97
11_Operator on BUILDINGS VDM [2]	0.84	0.83	0.84	0.84	0.84	0.84	0.84	0.84
12_Operator on BLPH platform [3]	1.40	2.30	2.48	1.69	1.41	1.63	2.48	1.69
13_Operator on BLPH platform [4]	1.41	1.34	1.96	2.08	1.38	1.36	1.96	2.08

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

67m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [7]	0.95	0.99	0.96	0.97	1.01	1.01	0.99	1.01
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.88
3_Operator on TEST AREA [1]	1.26	1.12	0.96	1.21	1.11	1.07	1.02	1.07
4_Operator on TEST AREA [1]	0.99	0.92	0.94	1.01	0.97	0.94	0.94	0.97
5_Operator on structure CROSSWIND TP [1]	1.01	0.89	0.99	1.05	0.97	0.95	0.97	0.99
6_Operator on structure AGGREKO [1]	1.02	0.90	1.04	1.10	0.99	0.96	1.00	1.02
7_Operator on SECTION III [1]	1.01	1.08	1.08	0.94	0.99	1.03	1.02	0.98
8_Operator on TEST AREA [1]	0.99	1.22	1.37	1.31	1.03	1.09	1.15	1.10
9_Operator on TEST AREA [1]	1.03	1.03	0.96	0.94	0.99	1.00	0.96	0.96
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	0.93	0.96	0.98	0.96	0.97	0.96	0.97	0.97
11_Operator on BUILDINGS VDM [2]	0.84	0.83	0.84	0.84	0.84	0.84	0.84	0.84
12_Operator on BLPH platform [3]	1.40	2.30	2.48	1.69	1.41	1.63	2.48	1.69
13_Operator on BLPH platform [4]	1.41	1.34	1.96	2.08	1.38	1.36	1.96	2.08

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

Note 6: Receptor points 2 is at 42m of height.

Note 7: Receptor points 1 is at 67m of height.

4.2.3 Simultaneous discharge of all storage vessels

In case of simultaneous discharge of all the storage vessels, the thermal irradiance of the receptor points presents higher values compared to the others, especially in case of 10D condition. All the receptor points Which were subjected to a thermal irradiance higher than 1,58 kw/m2 were highlighted in bold.

2m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [1]	**1.88**	**1.71**	1.47	**1.76**	**1.60**	1.55	1.51	1.55
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [1]	1.18	1.13	1.13	1.19	1.15	1.13	1.14	1.15
3_Operator on TEST AREA [1]	**2.51**	**2.14**	**1.69**	**2.31**	**1.86**	**1.79**	**1.71**	**1.79**
4_Operator on TEST AREA [1]	**1.71**	1.47	1.52	**1.82**	1.52	1.47	1.48	1.53
5_Operator on structure CROSSWIND TP [1]	**1.72**	1.47	**1.67**	**1.96**	1.55	1.51	1.54	**1.59**
6_Operator on structure AGGREKO [1]	**1.76**	1.53	**1.84**	**2.14**	**1.60**	1.56	**1.62**	**1.66**
7_Operator on SECTION III [1]	**1.72**	**2.06**	**1.98**	1.48	**1.62**	**1.70**	**1.67**	**1.60**
8_Operator on TEST AREA [1]	**1.73**	**2.22**	**2.69**	**2.58**	**1.74**	**1.81**	**1.90**	**1.83**
9_Operator on TEST AREA [1]	**1.85**	**1.88**	**1.59**	1.47	**1.60**	**1.61**	1.54	1.53
10_Operator on YS and ASSEMBLY PREFAB BOURI [1]	1.32	1.44	1.54	1.51	1.35	1.38	1.41	1.38
11_Operator on BUILDINGS VDM [1]	1.05	1.01	1.05	1.07	1.04	1.03	1.04	1.05
12_Operator on BLPH platform [2]	**3.25**	**4.94**	**5.27**	**3.61**	**2.82**	**3.07**	**3.12**	**2.88**
13_Operator on BLPH platform [3]	**3.29**	**3.15**	**4.56**	**5.69**	**2.82**	**2.80**	**3.03**	**3.04**

Note 1: Receptor points 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11 are at 2m of height.

Note 2: Receptor point 12 is at 15.5m of height.

Note 3: Receptor point 13 is at 16m of height.

9m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [2]	**2.05**	**1.86**	**1.61**	**1.91**	**1.75**	**1.70**	**1.65**	**1.70**
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [2]	1.20	1.15	1.15	1.21	1.18	1.16	1.16	1.18
3_Operator on TEST AREA [1]	**2.51**	**2.14**	**1.69**	**2.31**	**1.86**	**1.79**	**1.71**	**1.79**
4_Operator on TEST AREA [1]	**1.71**	1.47	1.52	**1.82**	1.52	1.47	1.48	1.53
5_Operator on structure CROSSWIND TP [1]	**1.72**	1.47	**1.67**	**1.96**	1.55	1.51	1.54	**1.59**
6_Operator on structure AGGREKO [1]	**1.76**	1.53	**1.84**	**2.14**	**1.60**	1.56	**1.62**	**1.66**
7_Operator on SECTION III [1]	**1.72**	**2.06**	**1.98**	1.48	**1.62**	**1.70**	**1.67**	**1.60**
8_Operator on TEST AREA [1]	**1.73**	**2.22**	**2.69**	**2.58**	**1.74**	**1.81**	**1.90**	**1.83**
9_Operator on TEST AREA [1]	**1.85**	**1.88**	**1.59**	1.47	**1.60**	**1.61**	1.54	1.54
10_Operator on YS and ASSEMBLY PREFAB BOURI [2]	1.39	1.51	**1.61**	**1.59**	1.43	1.45	1.49	1.46
11_Operator on BUILDINGS VDM [2]	1.06	1.03	1.06	1.08	1.05	1.05	1.05	1.06
12_Operator on BLPH platform [3]	**3.25**	**4.94**	**5.27**	**3.61**	**2.82**	**3.07**	**3.12**	**2.88**
13_Operator on BLPH platform [4]	**3.29**	**3.15**	**4.56**	**5.69**	**2.82**	**2.80**	**3.03**	**3.04**

Note 1: Receptor points 3; 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 1; 2; 10; 11 are at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

42m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [6]	**2.51**	**2.28**	**2.13**	**2.26**	**2.39**	**2.34**	**2.29**	**2.34**
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	1.24	1.21	1.21	1.26	1.23	1.23	1.23	1.23
3_Operator on TEST AREA [1]	**2.51**	**2.14**	**1.69**	**2.31**	**1.86**	**1.79**	**1.71**	**1.79**
4_Operator on TEST AREA [1]	**1.72**	1.47	1.52	**1.82**	1.52	1.47	1.48	1.53
5_Operator on structure CROSSWIND TP [1]	**1.72**	1.47	**1.67**	**1.96**	1.55	1.51	1.54	**1.59**
6_Operator on structure AGGREKO [1]	**1.76**	1.53	**1.84**	**2.14**	**1.60**	1.56	**1.62**	**1.66**
7_Operator on SECTION III [1]	**1.72**	**2.06**	**1.98**	1.48	**1.62**	**1.70**	**1.67**	**1.60**
8_Operator on TEST AREA [1]	**1.73**	**2.22**	**2.69**	**2.58**	**1.74**	**1.81**	**1.90**	**1.83**
9_Operator on TEST AREA [1]	**1.85**	**1.88**	**1.59**	1.47	**1.60**	**1.61**	1.54	1.54
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	**1.61**	**1.69**	**1.79**	**1.71**	**1.68**	**1.70**	**1.73**	**1.71**
11_Operator on BUILDINGS VDM [2]	1.06	1.03	1.06	1.08	1.05	1.05	1.05	1.06
12_Operator on BLPH platform [3]	**3.25**	**4.94**	**5.27**	**3.61**	**2.82**	**3.07**	**3.12**	**2.88**
13_Operator on BLPH platform [4]	**3.29**	**3.15**	**4.56**	**5.69**	**2.82**	**2.80**	**3.03**	**3.04**

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

67m of elevation:

Receptors	10 D condition (kW/m2)				2 F condition (kW/m2)			
	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)	Case 1 (Wind from North)	Case 2 (Wind from East)	Case 3 (Wind from South)	Case 4 (Wind from West)
1_Operator on structure CDA P35 JACKET [7]	**1.96**	**1.93**	**1.79**	**1.89**	**2.11**	**2.07**	**2.02**	**2.07**
2_Operator on structure Q35 MONOPILE AND CELLAR DECK [6]	1.24	1.21	1.21	1.26	1.23	1.23	1.23	1.23
3_Operator on TEST AREA [1]	**2.51**	**2.14**	**1.69**	**2.31**	**1.86**	**1.79**	**1.71**	**1.79**
4_Operator on TEST AREA [1]	**1.71**	1.47	1.52	**1.82**	1.52	1.47	1.48	1.53
5_Operator on structure CROSSWIND TP [1]	**1.72**	1.47	**1.67**	**1.96**	1.55	1.51	1.54	**1.59**
6_Operator on structure AGGREKO [1]	**1.76**	1.53	**1.84**	**2.14**	**1.60**	1.56	**1.62**	**1.66**
7_Operator on SECTION III [1]	**1.72**	**2.06**	**1.98**	1.48	**1.62**	**1.70**	**1.67**	**1.60**
8_Operator on TEST AREA [1]	**1.73**	**2.22**	**2.69**	**2.58**	**1.74**	**1.81**	**1.90**	**1.83**
9_Operator on TEST AREA [1]	**1.85**	**1.88**	**1.59**	1.47	**1.60**	**1.61**	1.54	1.54
10_Operator on YS and ASSEMBLY PREFAB BOURI [5]	**1.61**	**1.69**	**1.79**	**1.71**	**1.68**	**1.70**	**1.73**	**1.71**
11_Operator on BUILDINGS VDM [2]	1.06	1.03	1.06	1.08	1.05	1.05	1.05	1.06
12_Operator on BLPH platform [3]	**3.25**	**4.94**	**5.27**	**3.61**	**2.82**	**3.07**	**3.12**	**2.88**
13_Operator on BLPH platform [4]	**3.29**	**3.15**	**4.56**	**5.69**	**2.82**	**2.80**	**3.03**	**3.04**

Note 1: Receptor points 3, 4; 5; 6; 7; 8; 9 are at 2m of height.

Note 2: Receptor points 11 is at 9m of height.

Note 3: Receptor point 12 is at 15.5m of height.

Note 4: Receptor point 13 is at 16m of height.

Note 5: Receptor point 10 is at 35m of height.

Note 6: Receptor points 2 is at 42m of height.

4.3 Impact on BLPH platform

For all the scenario of interest, the impact of the thermal irradiance on the operators located directly on the structure of the BLPH platform has been performed. In particular, the most significant effects were observed for both the events of depressurization in case of 10D atmospheric condition. The figures below report the results of this assessment for the “emergency cases” identified:

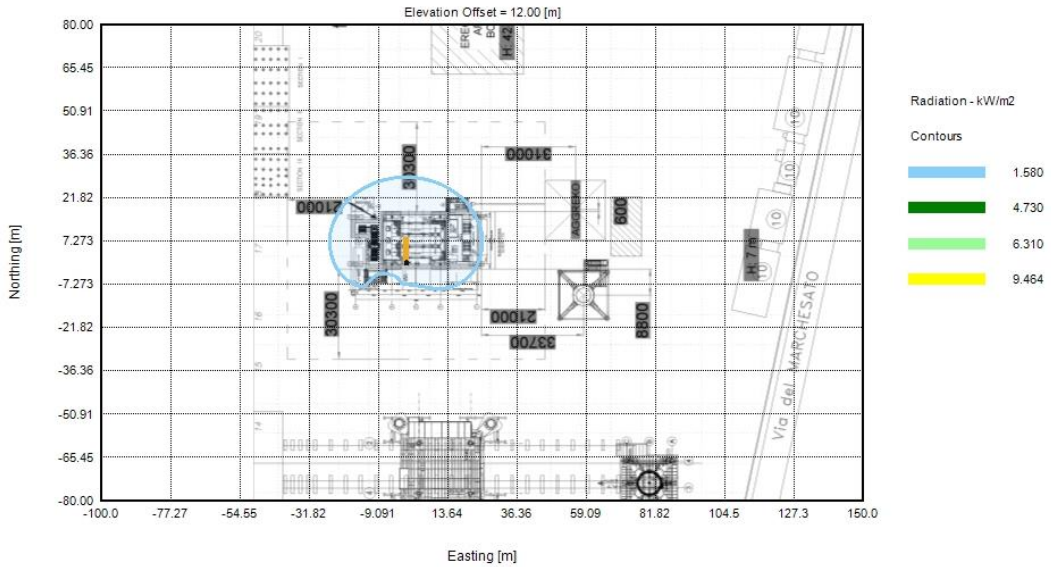
- Discharge of one storage vessel
- Simultaneous discharge of all storage vessel

The purpose of this chapter is to evaluate the thermal radiation levels on the BLPH platform, specifically in the platform above the storage vessel and on the upper deck, to determine whether the radiation levels are within acceptable limits for operator presence.

As discussed in Chapter 4.1, in the case of "Venting during electrolyzer in service," the thermal radiation expected on the platform above the storage vessel and on the upper deck remains consistently below 1.58 kW/m², indicating that no impediments for operators.

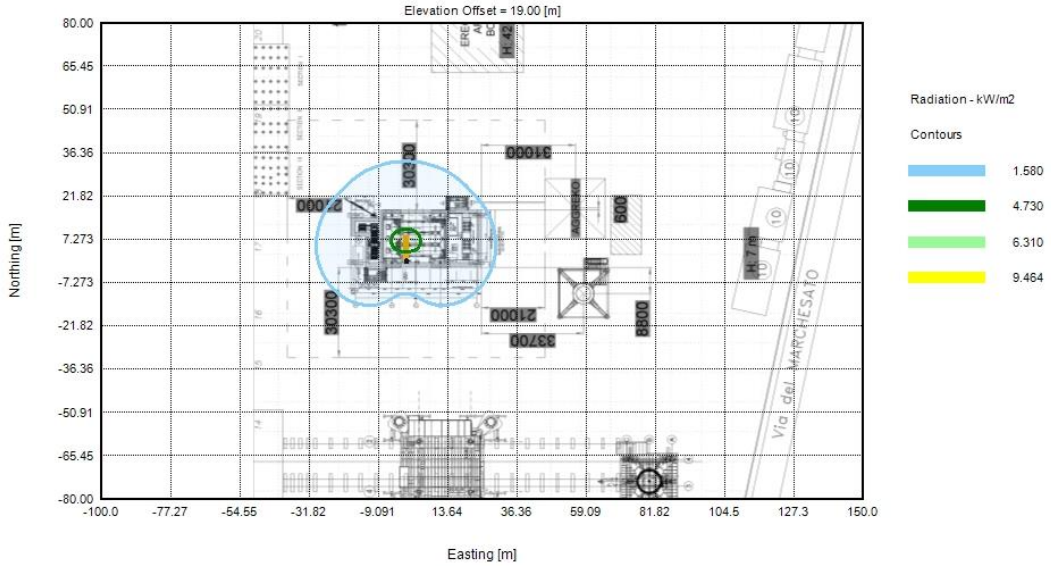
4.3.1 Discharge of one storage vessel

Upper deck (12m)



At a height of 12 meters, representative of the operator's presence on the upper deck of the BLPH platform, the threshold of 1.58 kW/m² is exceeded across the entire structure. However, the 4.73 kW/m² threshold is not reached, indicating that, in the event of operator presence, exposure of approximately 4 minutes is acceptable to allow for evacuation from the platform.

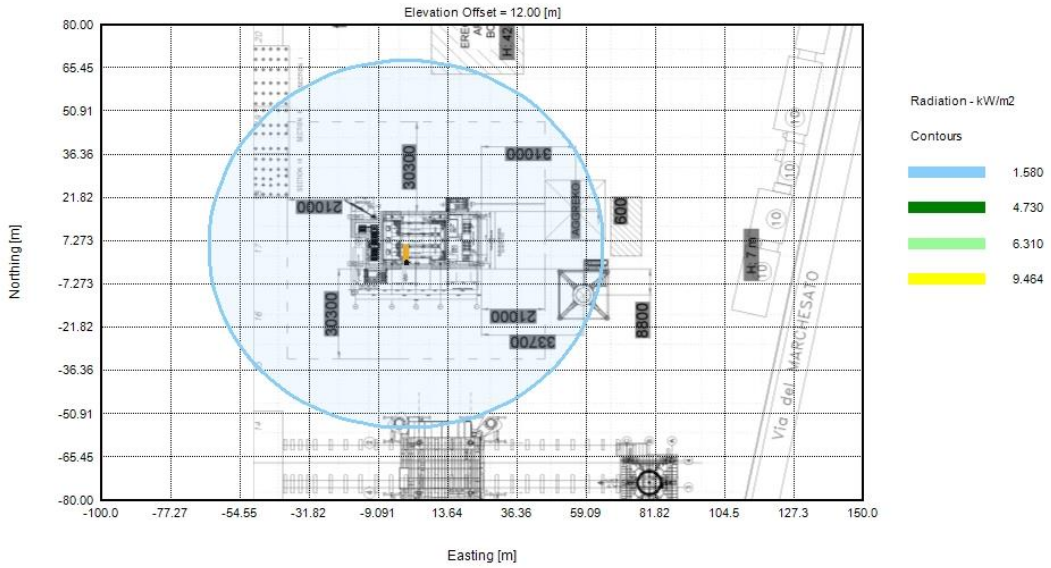
Platform above storage vessel (19m)



At a height of 19 meters, representing the operator's presence on the platform above the storage vessel, the 4.73 kW/m² threshold is slightly exceeded. This indicates that, in the event of operator presence during vent activation and subsequent ignition, the exposure level is not acceptable.

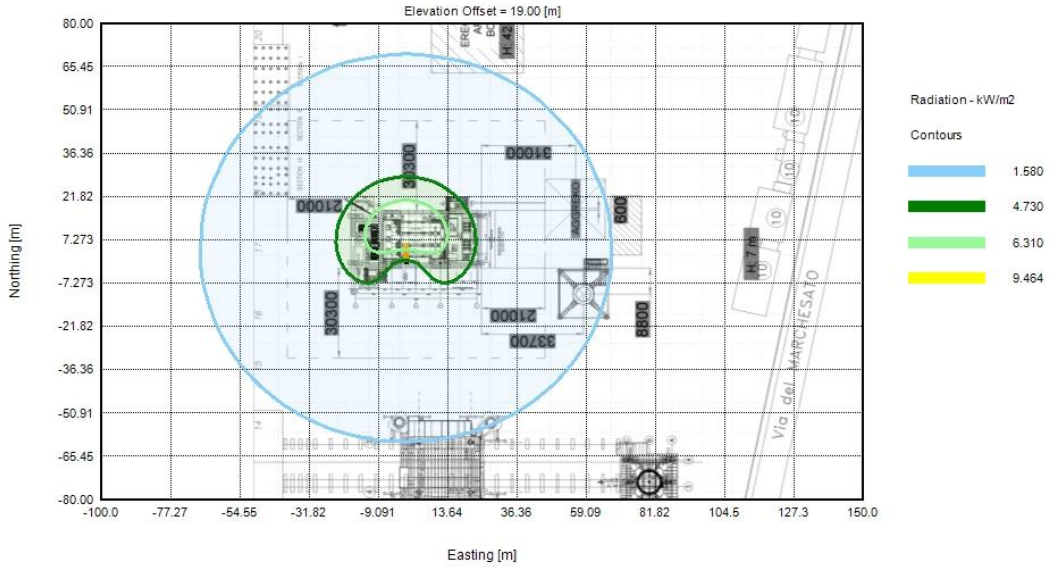
4.3.2 Simultaneous discharge of all storage vessels

Upper deck (12m)



At height of 12 meters, representative of the operator's presence on the upper deck of the BLPH platform, the threshold of 1.58 kW/m² is exceeded across the entire structure. However, the 4.73 kW/m² threshold is not reached, indicating that, in the event of operator presence, exposure of approximately 4 minutes is acceptable to allow for evacuation from the platform.

Platform above storage vessel (19m)



At a height of 19 meters, representing the operator's presence on the platform above the storage vessel, the 6.31 kW/m² threshold is slightly exceeded. This indicates that, in the event of operator presence during vent activation and subsequent ignition, the exposure level is not acceptable.

4.4 Verification of flammable gas dispersion

The flammable gas dispersions are assessed by means of the software PHAST for the three atmospheric conditions (Pasquill classes 10D, 5D and 2F, in order to maximize gas cloud dispersion). The results are reported in the table below. In particular, the LFL values and the maximum downwind distances reached by flammable envelope curve corresponding to ½ LFL are reported. The simulations are performed considering the stack design and the three cases as for chapter 3. The results in the below table are summarized.

Case		Weather condition	LFL (m)	LFL/2 (m)
Venting during test	Venting during electrolyzer service	2F	5	8
		5D	8	13
		10D	11	18
Emergency depressurization	Discharge of one storage vessel	2F	13	24
		5D	21	36
		10D	32	53
	Simultaneous discharge of all storage vessel	2F	13	29
		5D	18	39
		10D	26	55

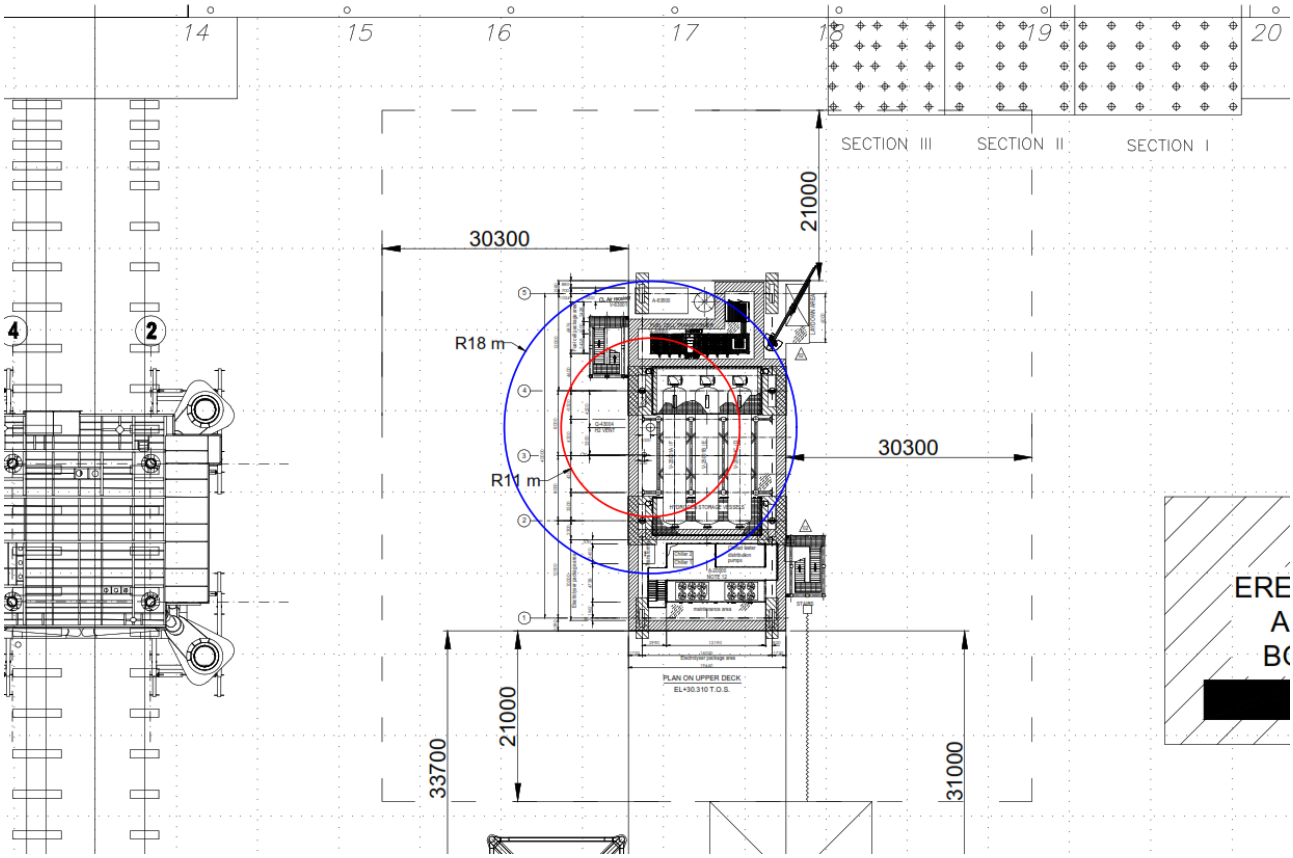
From the results of flammable gas dispersion, it is possible to highlight following points:

1. **Elevation of Gas Clouds**: In all cases analyzed, the gas clouds remain elevated with respect to the release point. No impact with the ground surface is observed, indicating that the dispersion behavior is dominated by the buoyant nature of the gas (hydrogen) and the dynamics of its release (vertical direction).
2. **Influence of Wind Direction and Flow Characteristics**: The orientation and elongation of the gas clouds are heavily influenced by the release flow rate and velocity, as well as prevailing wind conditions. These factors drive the horizontal displacement of the clouds, leading to significant directional elongation consistent with wind orientation. In particular, for all scenarios, the atmospheric condition characterized as 10D serves as the reference point for horizontal elongation: strong winds bend the gas clouds, causing them to elongate horizontally in the direction of the prevailing wind.

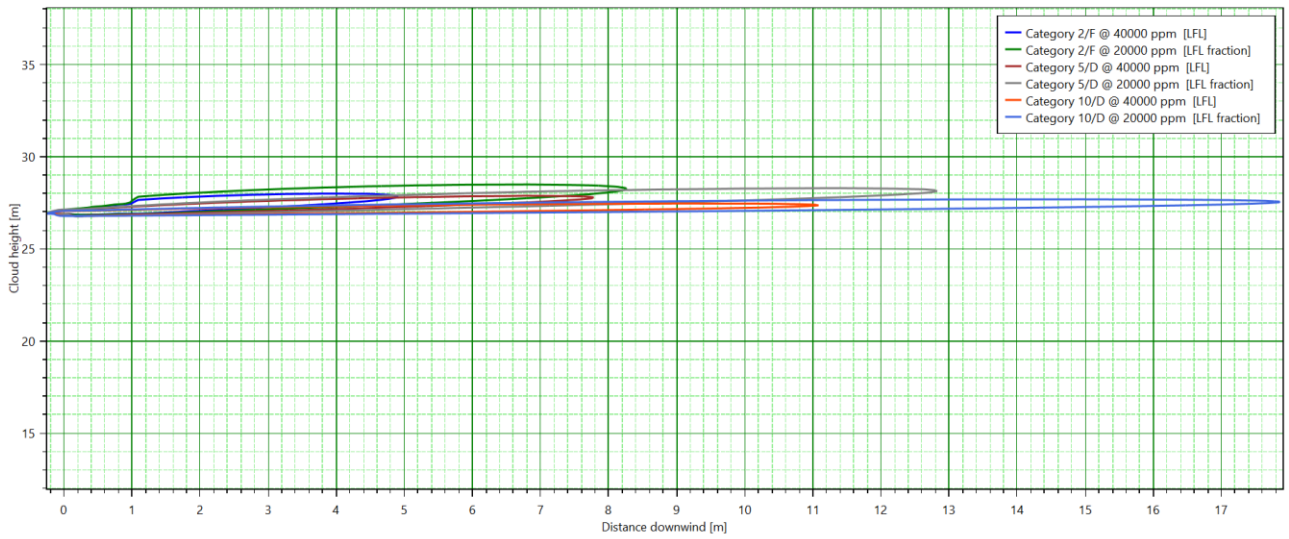
To evaluate the potential impact of the gas cloud, it is crucial to overlay the maximum horizontal distance of the dispersion and its corresponding elevation. This approach allows for the identification of potential targets or structures that could be affected by the dispersion. In the following figure is reported the area involved by LFL and LFL/2 in 10D condition for all cases, as well as the sideview of the gas clouds.

Venting during electrolyzer in service

The maximum horizontal distances are reported in the following figure (blue line: LFL/2, red line: LFL).

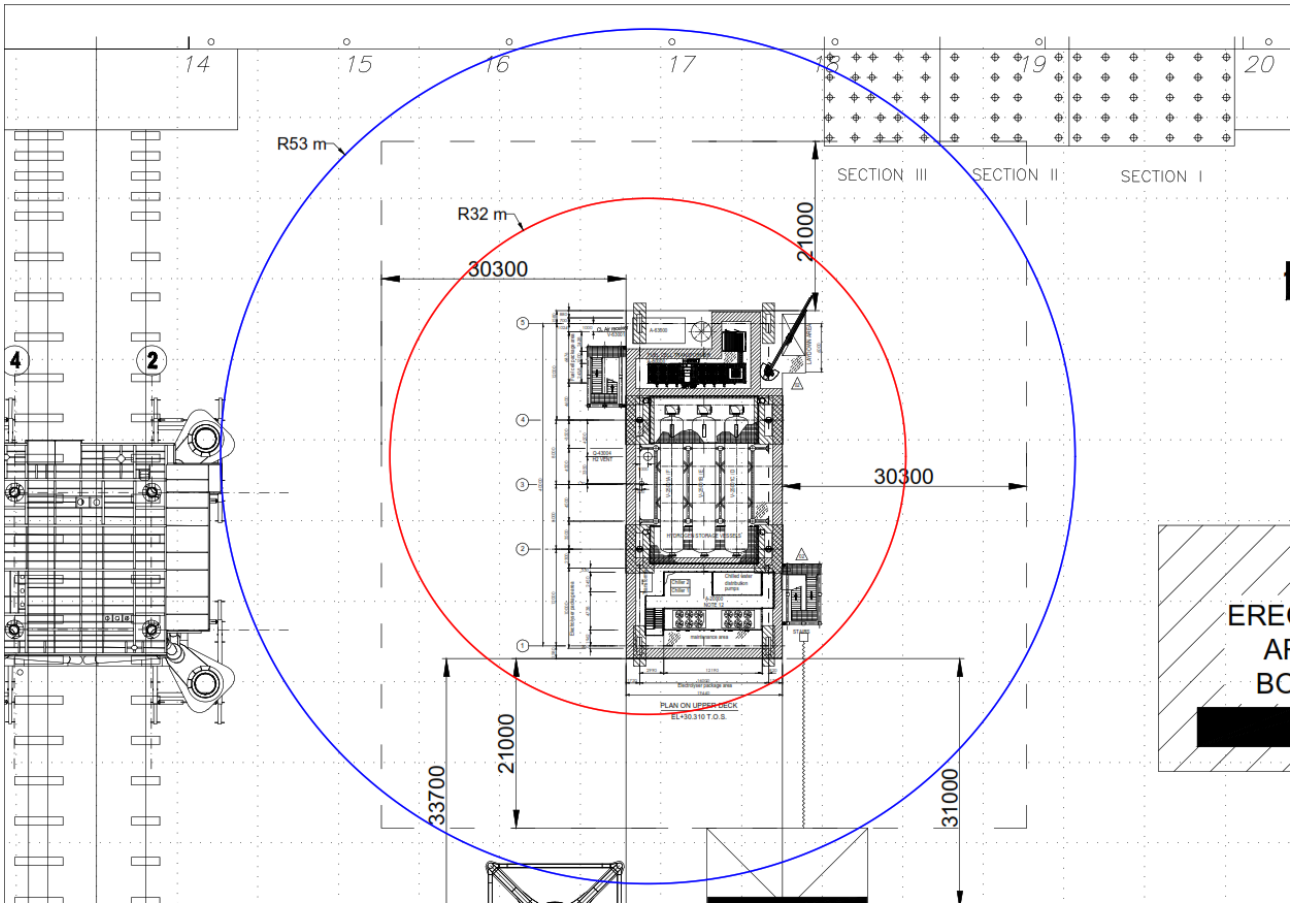


The side view of the dispersion in the below figure is reported.

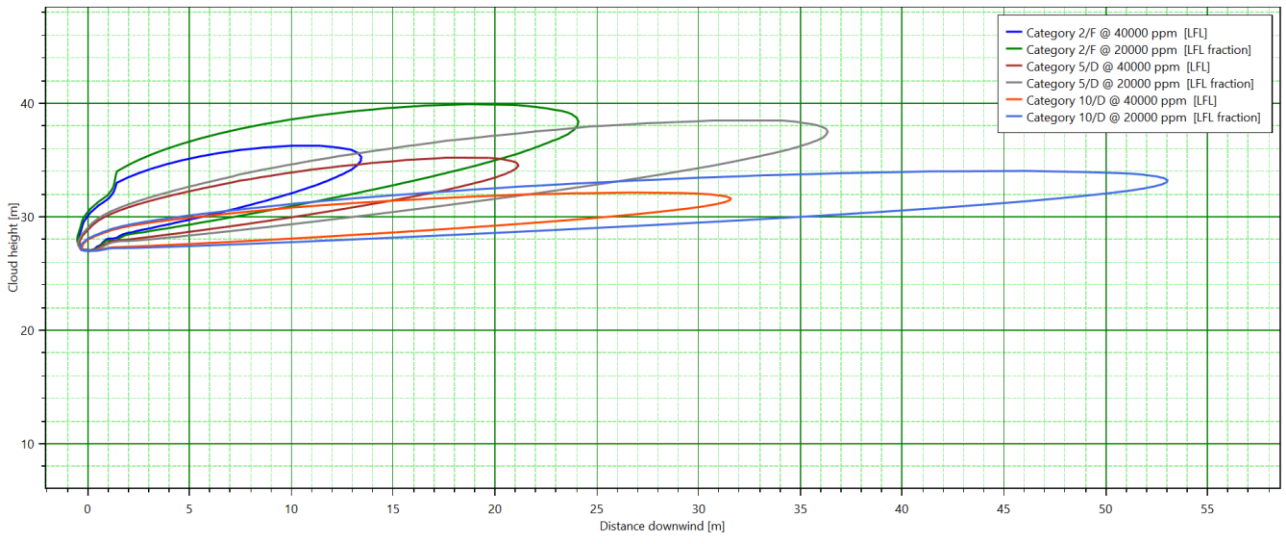


Emergency depressurization: Discharge of one storage vessel

The maximum horizontal distances are reported in the following figure (blue line: LFL/2, red line: LFL).

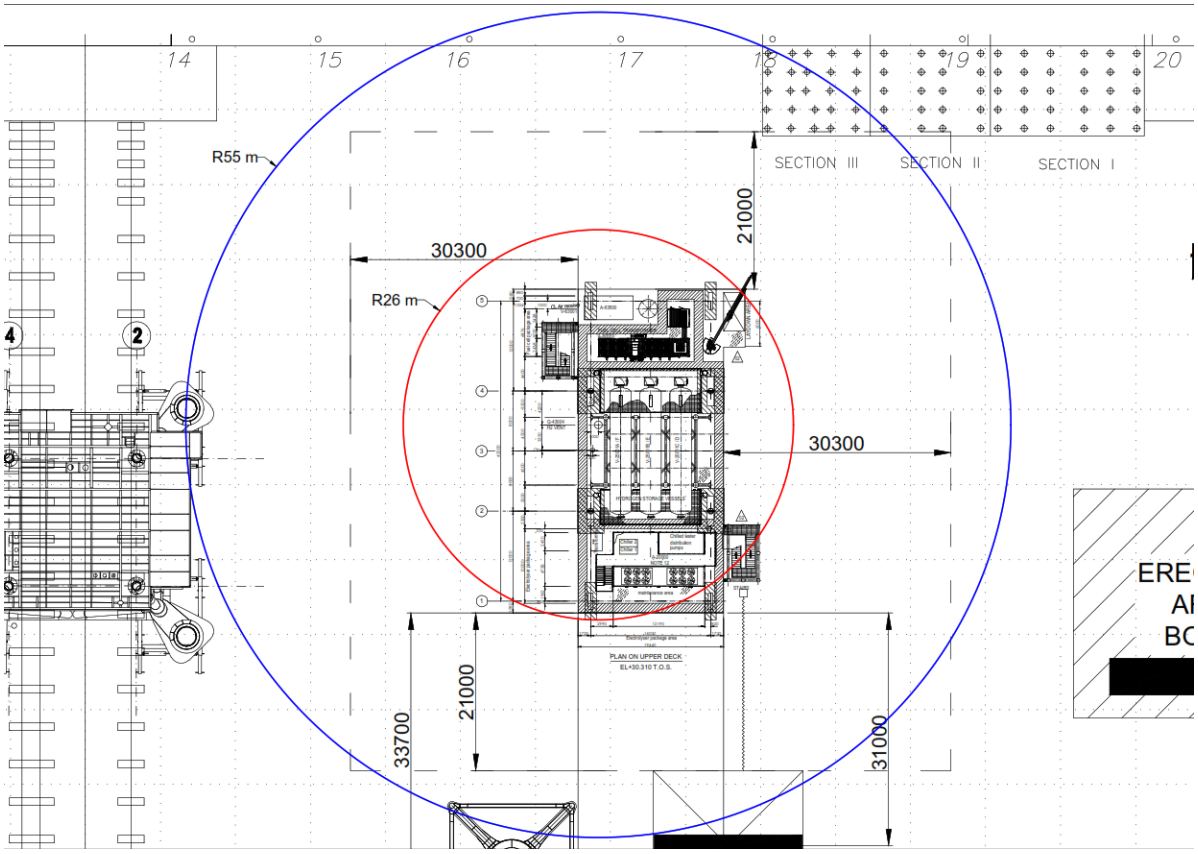


The side view of the dispersion in the below figure is reported.

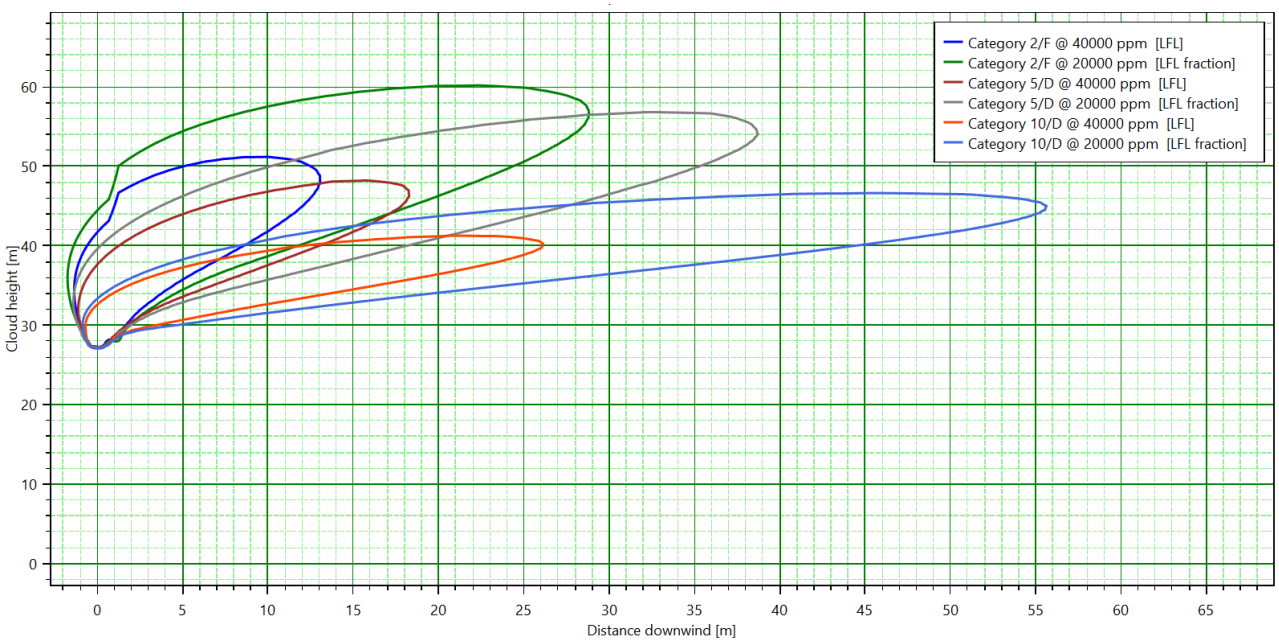


Emergency depressurization: Simultaneous discharge of all storage vessel

The maximum horizontal distances are reported in the following figure (blue line: LFL/2, red line: LFL).



The side view of the dispersion in the below figure is reported.



5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

According to the operative phases during construction and tests with hydrogen, following cases which potentially requires the activation of the BLPH vent are identified:

- venting during electrolyzer in service;
- depressurization of single storage vessel;
- depressurization of six storage vessels.

Via FLARESIM software was investigate if the thermal radiation will exceed the values of 1.58 kW/m^2 at receptors point where people presence should be possible during working activities on BLPH platform and adjected area. Regarding flammable gas dispersion, via PHAST was possible to calculate the LFL and LFL/2 concentrations of dispersion in order to evaluate possible involvement of receptors. Result of the present study are obtained considering vent characteristic already installed on BLPH platform [3].

Regarding thermal radiation of receptors on location where operators' presence is foreseen, it is possible to conclude that:

- Case 1: venting during electrolyzer in service:
    - Thermal radiation, for all receptors, show values radiation lower than 1.58 kW/m^2, meaning that no restriction to all working position of operators is expected, inside and outside the BLPH platform.

- Case 2: depressurization of single storage vessel:
    - Thermal radiation for all receptors located outside BLPH platform show values radiation lower than 1.58 kW/m^2, meaning that no restriction to working position of operators is expected.
    - Thermal radiation all receptors located on BLPH platform (RP 12, 13) show values radiation higher than 1.58 kW/m^2 but lower than 4.73 kW/m^2 threshold. This indicates that, in the event of operator presence, exposure of approximately 4 minutes is acceptable to allow the evacuation from the platform.
    - For the upper deck of BLPH platform, the threshold of 1.58 kW/m^2 is exceeded across the entire structure. However, the 4.73 kW/m^2 threshold is not reached, indicating that, in the event of operator presence, exposure of approximately 4 minutes is acceptable to allow the evacuation from the platform.
    - For the platform above the storage vessels the 4.73 kW/m^2 threshold is slightly exceeded. This indicates that, in the event of operator presence during vent activation and subsequent ignition, the exposure level is not acceptable.

Thus, for this case, it is recommended to limit the access to the platform above storage vessels on upper deck when one vessel is in operation.

- Case 3: Simultaneous discharge of all storage vessel
    - Thermal radiation for all receptors located outside BLPH platform show values radiation between 1.58 kW/m^2 and 4.73 kW/m² depending on relative position. For receptors with thermal radiation higher that 1.58 kW/m^2, considering that 4.73 kW/m² are not exceeded, in the event of operator presence exposure of approximately 4 minutes is acceptable to allow the evacuation from the platform.
    - Thermal radiation all receptors located on BLPH platform (RP 12, 13) show values radiation higher than 4.73 kW/m² threshold. This indicates that, in the event of operator presence during vent activation and subsequent ignition, the exposure level is not acceptable, and the presence of operators need to be avoided.
    - For the upper deck of BLPH platform, the threshold of 1.58 kW/m² is exceeded across the entire structure. However, the 4.73 kW/m² threshold is not reached, indicating that, in the event of operator presence, exposure of approximately 4 minutes is acceptable to allow the evacuation from the platform.
    - For the platform above the storage vessels the 4.73 kW/m² threshold is significantly exceeded. This indicates that, in the event of operator presence during vent activation and subsequent ignition, the exposure level is not acceptable.

Thus, for this case, it is recommended to limit the access to the platform above storage vessels and in the position of receptor points 12,13 on upper deck when six vessel is in operation.

Regarding flammable gas dispersion, for each meteo condition and wind direction, both the concentration of LFL and LFL/2 shows negligible impact on platform equipment/structures : according to characteristic of H_2, the gas clouds move towards the wind direction but always at elevation higher than the stack. As the vent is the highest structure on the upper deck, the release from the vent is vertical upwards and H2 is lighter than air, there is no impairment from dispersion to any other structure.

5.2 Recommendations

Based on the results, several recommendations have been proposed to restrict operator access in certain areas. These recommendations are summarized in the table below

Scenario description	#	Recommendations
Discharge of one storage vessel AND Simultaneous discharge of all storage vessel	1	Ensure that the access to the second level of the platform above storage vessel on upper deck will be limited, in order to avoid excessive thermal radiation on operator in case of accidental ignition of gas released during an emergency depressurization.
Simultaneous discharge of all storage vessel	2	Ensure that the access to the location of receptors point 12,13 on upper deck will be limited, in order to avoid excessive thermal radiation on operator in case of accidental ignition of gas released during an emergency depressurization
Flammable gas dispersion	3	Ensure that in the area involved in the LFL concentration (considering the clouds profile and elevation) no ignition sources are located.