Base Load Power Hub (BLPH)

Hazardous Area Classification Schedule

Document Number: 123A90-DDL-SAF-RE-30013

Document Class: I

Rev.	Date	Description	Prepared	Reviewed	Approved
05	08/05/2025	Accepted for Construction (AFC)	E.Carminati	C. Caracciolo	C. Giunchi
04	14/01/2025	Accepted for Construction (AFC)	E.Carminati	C. Caracciolo	D. Lo Sterzo
03	13/11/2024	Accepted for Construction (AFC)	E.Carminati	C. Caracciolo	D. Lo Sterzo
02	15/05/2024	Accepted for Construction (AFC)	H. Arshad	C. Caracciolo	D. Lo Sterzo
01	01/02/2024	Issue for Acceptance (IFA)	H. Arshad	C. Caracciolo	D. Lo Sterzo
00	19/12/2023	Issue for Acceptance (IFA)	H. Arshad	C. Caracciolo	D. Lo Sterzo

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Revision / Change Log

Rev.	Description
00	Issue for Acceptance (IFA
01	Issue for Acceptance (IFA)
02	Accepted for Construction (AFC)
03	Accepted for Construction (AFC)
04	Accepted for Construction (AFC)
05	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Table of contents

1 INTRODUCTION 5
1.1 PROJECT OVERVIEW 5
1.1.1 Project Location 5
1.1.2 Project Concept 6
2 DOCUMENT SCOPE 8
2.1 REFERENCES 8
2.2 DEFINITIONS AND ABBREVIATIONS 9
3 Methodology 10
3.1 ZONES 10
3.2 Grades of release 10
3.3 Secondary release frequency levels 11
3.4 Standard catagories of flamabile fluids 12
3.5 Equipment Intended for use in Explosive Atmospheres 12

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

List of Figures

Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map 5
Figure 2 - Wind Park Details 6
Figure 3 – BLPH Concept 7
Figure 4 – C2 Release frequency level 11

List of tables

Table 1 - Reference Documents 9
Table 2 - Definitions and Abbreviations 9
Table 3 – Hazardous Areas Division 10
Table 4 - Definitions and Abbreviations 10
Table 5 – Categorisation of release frequency 11
Table 6 – Fluid Categories according to EI15:2015 12
Table 7 – Hazardous Area Classification 14

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

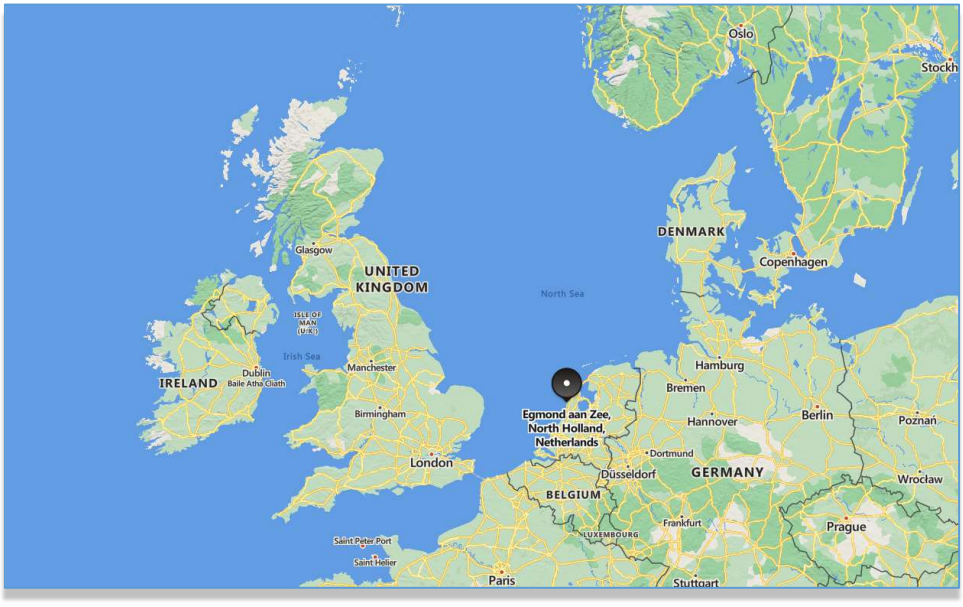


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

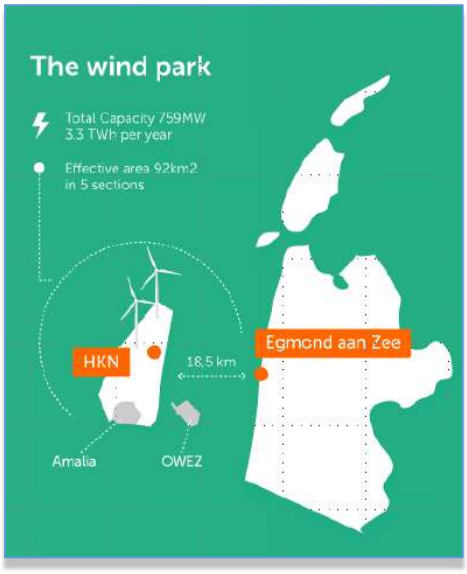


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

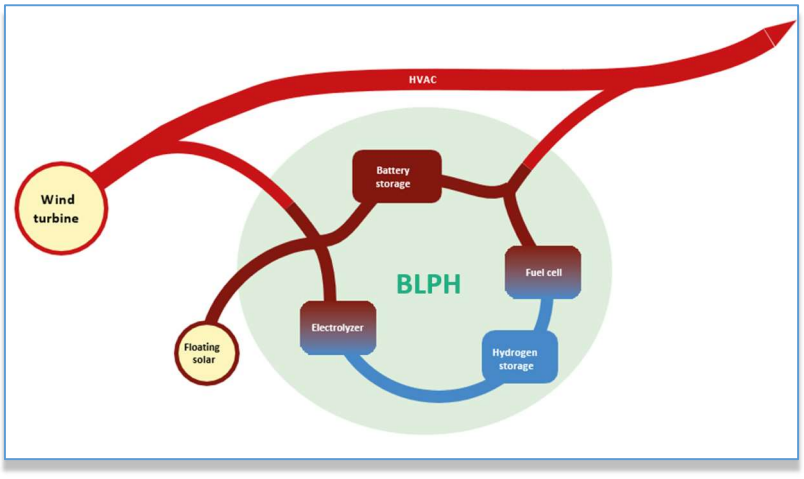


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

2 DOCUMENT SCOPE

This document illustrates the qualitative typology and extension of the areas with explosion risk relating to the offshore platform.

The objective of hazardous area classification is to identify the hazardous areas with respect to the presence of flammable/explosive atmosphere, in order to establish the requirements for electrical equipment and other equipment to be located within the classified area.

The reasons for classifying the installations are the following:

- To define the extent of flammable atmospheres in the event of non-catastrophic releases of flammable gas/vapours to atmosphere;
- To ensure that electrical apparatuses design and selection is appropriate for the area;
- To ensure that sources of ignition are adequately segregated from potential presence of flammable gas;
- To identify suitable non-hazardous areas for the location of firefighting or lifesaving appliances and of emergency control points;
- To provide background for the correct location of flammable gas detectors.

This document does not address the ignition of major releases of flammable materials due to catastrophic failure of plant such as the bursting of pipelines or vessel/pumps. Such events have a very low probability of occurrence in properly maintained facilities. The incidence of such releases must be kept within acceptable limits by appropriate design, construction, maintenance and operation of the facilities.

2.1 REFERENCES

Doc. No.	Description
Model Code of Safe Practice IP 15	Area classification for installations handling flammable fluids
123A90-DDL-PR-BL-80002	Heat and Mass Balance
123A90-DDL-SAF-DL-30022	Hazardous Area Classification - Lower deck & Upper deck Revision
123A90-DDL-SAF-DL-30024	Hazardous Area Classification - Elevation looking North and East
123A90-DDL-PR-RE-80030	Relief, Vent and Blowdown Report
K559-2254-SE-LST-002	Hazardous Area Classification Schedule
K559-2254-CWIWP4202202-B01-001	BLPH Project - General Arrangements – page 9/15
K559-2254-CWIWP4202201-E99-002	STATRON – BESS - Hazardous Area Layout
C63–DUO–001	ELOGEN - ATEX Area Presentation
C63-PCX-001/002	ELOGEN – ATEX Zoning

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
AIT	Auto Ignition Temperature
LEL	Lower Explosive Limit
LFL	Lower Flammable Limit
UEL	Upper Explosive Limit
UFL	Upper Flammable Limit
T_{Auto}	Autoignition temperature

Table 2 - Definitions and Abbreviations

3 METHODOLOGY

Classification of hazardous areas is based on the Energy Institute Model Code of Safe Practice Part 15 Area Classification for Installations Handling Flammable Fluids. Area classification for installations handling flammable fluids (amendments/supplements to EI 15 and chapter 3 of EI 1)

3.1 ZONES

Hazardous areas are divided into following zones based on likelihood of occurrence and duration of a flammable atmosphere.

Zones	Description
Zone 0	That part of a hazardous area in which a flammable atmosphere is continuously present or present for long periods.
Zone 1	That part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation.
Zone 2	That part of a hazardous area in which a flammable atmosphere is not likely to occur in normal operation and if it occurs will exist only for a short period.
Non-Hazardous Area	Areas that do not fall into any of the above.

Table 3 – Hazardous Areas Division

3.2 GRADES OF RELEASE

There are three grades of release, as listed below in order of decreasing likelihood of the explosive gas atmosphere being present:

Grade	Description
Continuous Grade Release	A release that is continuous or nearly so, or that occurs frequently and for short periods.
Primary Grade Release	A release that is likely to occur periodically or occasionally in normal operation.
Secondary Grade Release	A release that is unlikely to occur in normal operation and in any event will do so only infrequently and for short periods

Table 4 - Definitions and Abbreviations

3.3 SECONDARY RELEASE FREQUENCY LEVELS

The release frequency level is used based on exposure individuals to flammable releases and their probability.

Level	Release source yr
Level I	Greater than 1.0E-2/release source/year
Level II	1.0E-2 to 1.0E-3/release source/year
Level III	1.0E-3 to 1.0E-4/release source/year

Table 5 – Categorisation of release frequency

Based on EI 15, Annex C, Part 1, Level I have been calculated and used in the assessment of the hazardous area. The Exposure is calculated as 0.6 (assuming low six-monthly visits of 10 POB maximum manning level in hazardous area and 8 average number of release sources in range). The Ignition Probability is taken as 0.2. According to Figure C2, the release frequency is located in Level II zone.

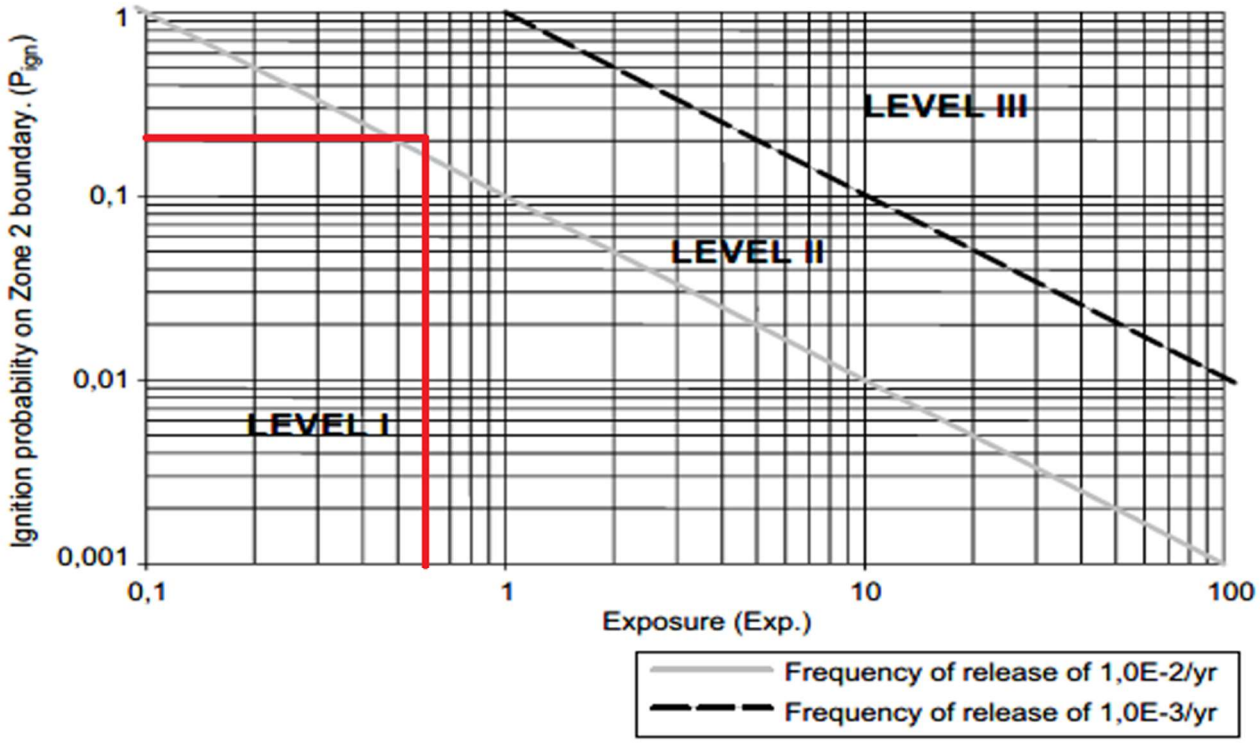


Figure C2: Release frequency (LEVEL) to achieve an Individual Risk (IR) criterion of 1,0E-5 (or lower) given Exp and P_{ign}.

Figure 4 – C2 Release frequency level

Release frequency

3.4 STANDARD CATAGORIES OF FLAMABILE FLUIDS

The fluid categories according to standard used are divided in 5 categories as following;

Fluid Category	Description
A	A flammable liquid that, on release, would vaporise rapidly and substantially: (a) Any liquefied petroleum gas or lighter flammable liquid (b) Any flammable liquid at a temperature sufficient to produce, on release, more than 40% volume vaporisation with no heat input except from the surroundings.
B	A flammable liquid, not in Category A, but at a temperature sufficient for boiling to occur on release.
C	A flammable liquid, not in Categories A or B, but which can, on release, be at a temperature above its flash point, or form a flammable mist or spray.
G(i)	A typical methane rich natural gas
G(ii)	Refinery hydrogen

Table 6 – Fluid Categories according to EI15:2015

Data for flammable gases or vapours is taken from IEC 60079-2:2000: Data for Flammable Gases and Vapours Relating to the use of Electrical Apparatus. Apparatus gas group IIC, temperature class T1, zone 2 has been selected for the standardisation of general electrical equipment and instruments in hazardous area.

3.5 EQUIPMENT INTENDED FOR USE IN EXPLOSIVE ATMOSPHERES

All equipment shall be certified for use in hazardous areas. Design shall comply with IEC 60079 and be ATEX rated for IIC or rated for IIB + H2. All equipment specified for use in a hazardous area shall be suitable for hydrogen production and storage. Items located in the hazardous area (hydrogen environment) shall be explosion-proof Ex-d certified. Ex-i technique should be limited to only low voltage /low current consumers (e.g. transmitters). Junction boxes in the hazardous area shall be Ex-e or Ex-d certified. ATEX marking shall be on all ATEX certified equipment.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Hazardous Area Classification

Tag No.	Equipment Tag	Description	Material	Ventilation Type	Flash Point °C	T_{Auto} °C	Operating Condition		Source of Release		Frequency Level of Release	Equivalent Hole Size (mm)	Fluid Cat.	Apparatus Subgroup	Equipment Temperature Class	Zone	Zone Extent (m)		Remark
							Temperature °C	Pressure barg	Description	Grade							Horizontal	Vertical	
01	P-50001 A/B	Sea Water Lift Pumps	sea water	Natural (open area)	< ambient temperature		22.4	14.0	Classified as non-hazardous										
02	A-64000	Nitrogen System	nitrogen	Natural (open area)	< ambient temperature		23	atm	Classified as non-hazardous										
03	A-50000	Water treatment package	sea water/ fresh water	CONTAINER	< ambient temperature		24.7	5.0	Classified as non-hazardous										
03.a	T-50008	Fresh Water Tank	fresh water	inside container	< ambient temperature		25	atm	Classified as non-hazardous										
03.b	T-55001	Wastewater Tank	Wastewater	inside container	< ambient temperature		35	atm	Classified as non-hazardous										
03.c	A-50003	Sea Water Package	sea water	inside container	< ambient temperature	>200	1.3 - 22.5	9.5	Classified as non-hazardous										
03.d	A-50005	Ultra Filtration Unit	sea water	inside container	< ambient temperature	>200	1.3 - 22.6	7.5	Classified as non-hazardous										
03.e	A-50007	Desalination Unit	sea water	inside container	< ambient temperature		1.3 - 22.7	atm	Classified as non-hazardous										
04	V-25001 A/B/C/D/E/F	Hydrogen Storage Vessels	hydrogen	Natural (open area)	< ambient temperature	>200	20.0	30.0	Valves/Flanges	Secondary	I	1	G(ii)	IIC	T1	2	2.0	2.0	HAC based on Table C4 of EI 15. 1-2 mm leak hole size for Level II release frequency as per Table C13 of EI 15. Internal space of H2 storage is **non-classified**, since the design of the storage vessel is to allow entrance of hydrogen or nitrogen only. No oxygen is foreseen in any situation for the 2 years of design and operation of the vessel. For that reason only external area is classified and not internal
05	V-43001	Hydrogen Vent KO Drum	hydrogen	Natural (open area)	< ambient temperature	>200	25	atm	Valves/Flanges	Secondary	I	1	G(ii)	IIC	T1	2	1.0	1.0	HAC based on Table C4 of EI 15. 1-2 mm leak hole size for Level II release frequency as per Table C13 of EI 15.
06	Q-43004	Hydrogen Vent	hydrogen	Natural (open area)	< ambient temperature	>200	25	1 atm	tip	Primary for the electrolyzer package and Secondary for emergency or manual depressurization scenarios	I	1	G(ii)	IIC	T1	1 2 2	1 1 to 5 5 to 18	1 1 to 3 3 to 27	In this case, specific dispersion modeling was performed to determine the vertical and horizontal extension of the hazardous area. The maximum release flow rate from the vent was considered around 15000 kg/h, as per Relief, Vent and Blowdown Report [3] which is the worst case. Detail model is shown at appendix 1.
07	A-50010	UV Water Filter	sea water	Natural (open area)	< ambient temperature		24.7	5	Classified as non-hazardous										
08	A-63000	Instrument Air package	air	CONTAINER	< ambient temperature		25	9	Classified as non-hazardous										
09	A-20000	Electrolyser package				Refer to ELOGEN document C63–DUO–001 ATEZ zone presentation and C63-PCX-001/002 ATEX Zoning													The Electrolyzer package is classified only internally. the Fuel Cell package has a small area at valves outside container The BESS is considered a safe area.
10	A-80000	Fuel Cell Package				Refer to BALLARD document K559-2254-CWIWP4202202-B01-001													
11	A-85000	BESS Package				Refer to K559-2254-CWIWP4202201-E99-002 – all safe area													

Table 7 – Hazardous Area Classification

ANNEX 1 – Vent dispersion case

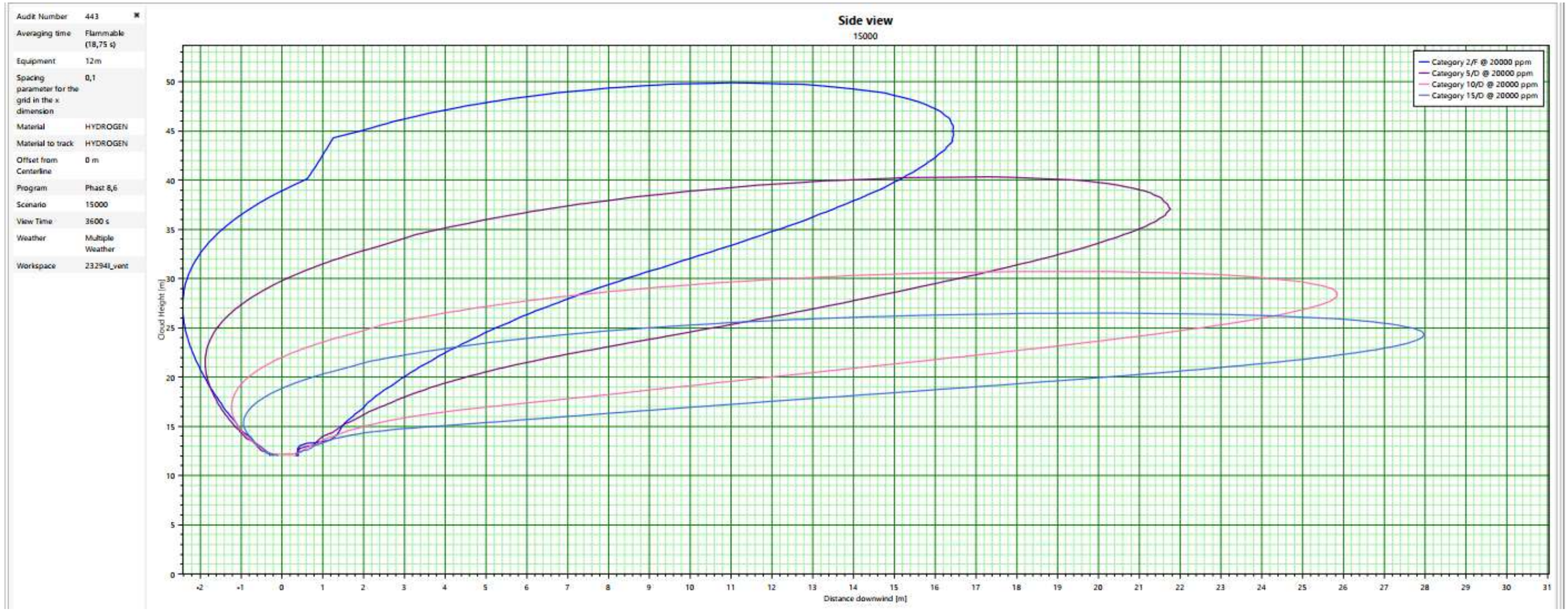


Figure 5 –Vent Release LFL/2 – flowrate 15000 kg/h

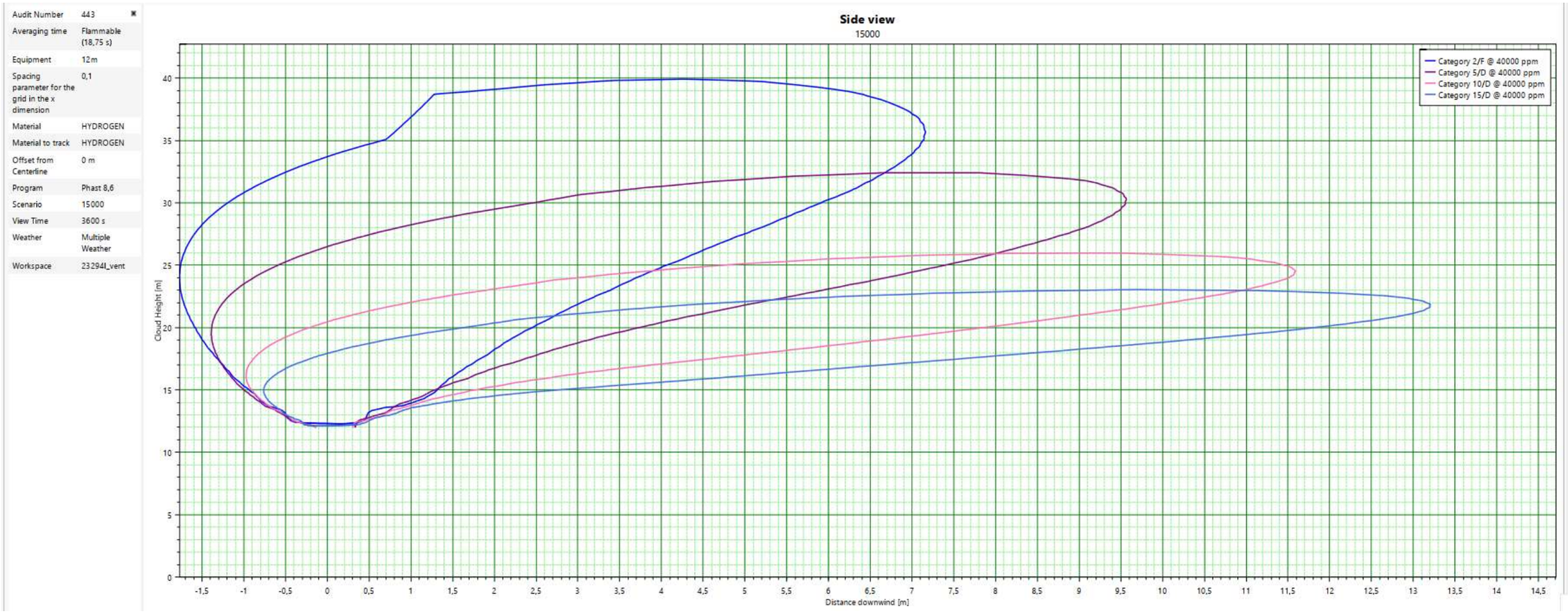


Figure 6 –Vent Release LFL – flowrate 15000 kg/h