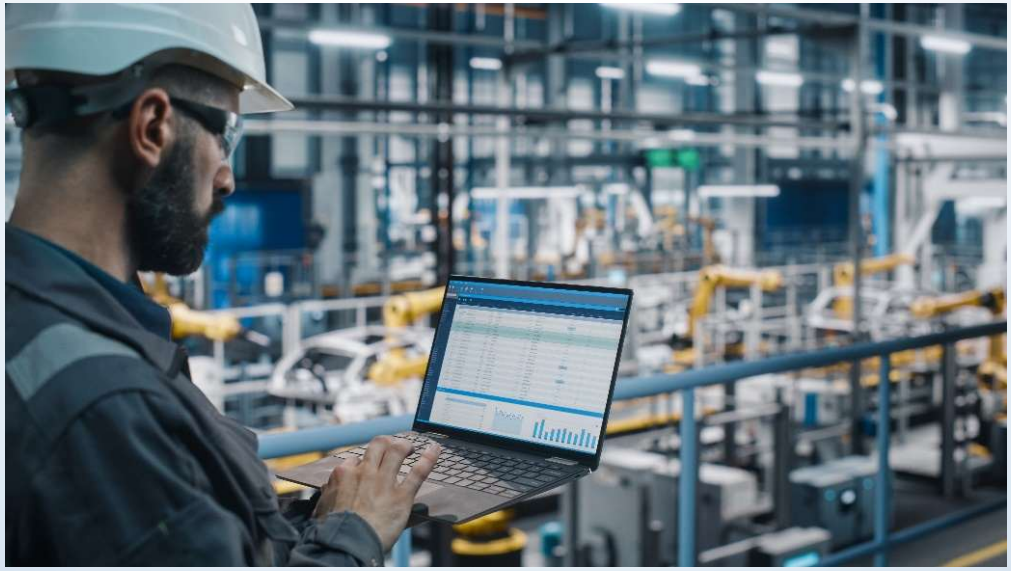
Hazardous Area Classification (Based on IEC 60079-10-1 Edition 3.0)

-To Expand Non-Explosion-Proof Areas and Promote Digital Transformation-

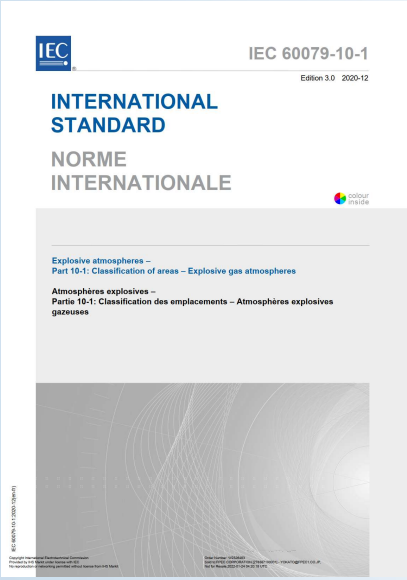


FPEC　Corporation

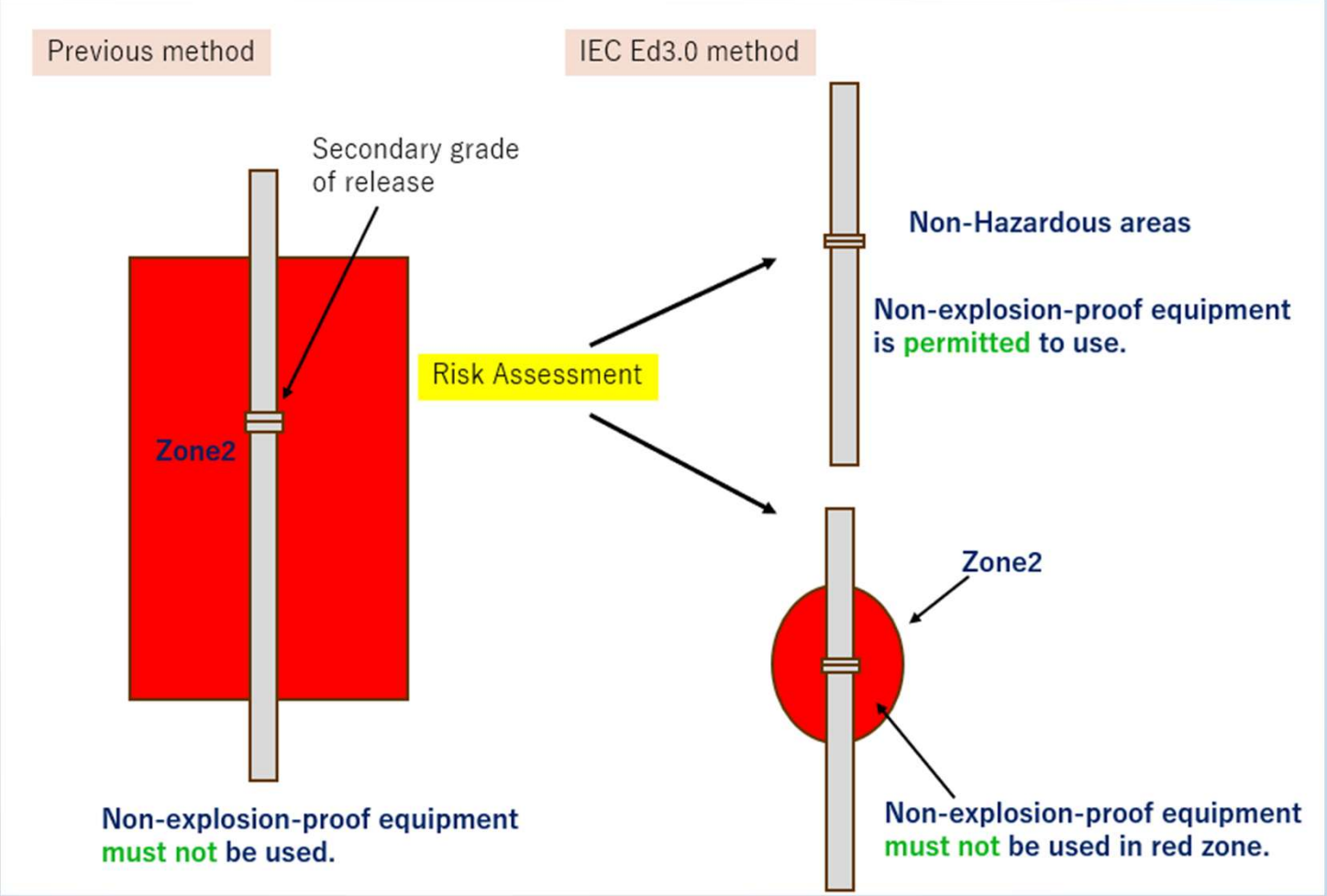
Hazardous Area Classification Based on IEC 60079-10-1 Edition 3.0

Summary

A detailed risk assessment for hazardous areas involves calculating and assessing risks in a more detailed and quantitative method than previous evaluation methods, based on the latest IEC 60079-10-1 Edition3.0, for areas where flammable vapors or combustible gases may reach concentrations posing an explosion hazard. This allows hazardous areas to be defined more closely aligned with actual operational conditions.



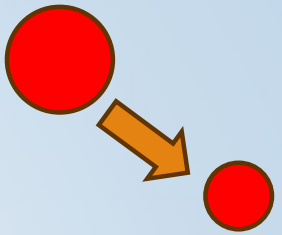
IEC 60079-10-1 Edition 3.0 2020-12, Part 10-1: Classification of areas- Explosive gas atmospheres

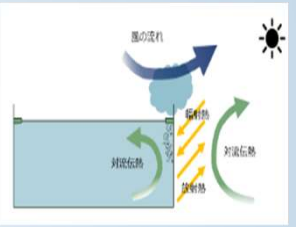


Benefit of risk assessment

Benefits of Risk Assessment

Reduction of Hazardous Area	A reasonable hazard distance can be set based on actual risk conditions, enabling the reset and reduction of hazardous areas.
Evaluation of primary grades of releases	For primary grades of releases, although specific calculation methods are not described in IEC Ed 3.0, it is possible to determine reasonably classify hazardous areas by considering risk assessment method and actual phenomena.
Securing non-hazardous areas in indoor facilities	Risk assessments for indoor facilities shall be conducted based on IEC60079-10-1 Edition3.0. It is also possible to specify ventilation system requirements for establishing non-hazardous areas.
Enhancing safety awareness and Effective implementation of safety training	By comprehensively identifying release sources and conducting quantitative risk assessments, hazardous areas can be visualized, enabling awareness of these areas and effective implementation of safety training.





What can be achieved by securing non-hazardous areas

Enhanced **operational efficiency** through the expanded use of **smartphones and tablets**

Automation and **labor-saving** through **sensor and camera** installation, and accident prevention

Fixed equipment that cannot be made explosion-proof can be installed due to securing non-hazardous areas through out all zones

Expansion of **hot work areas** and leveling of **maintenance work**

Reduced purchase costs through switching from explosion-proof equipment to non-explosion-proof equipment, and **reduced maintenance costs** through replacement

Ensuring safety in inspection tasks through **drone utilization**, **remote diagnostics** via image analysis

Experiences

The industries that we have supported and consulted with so far are as follows.

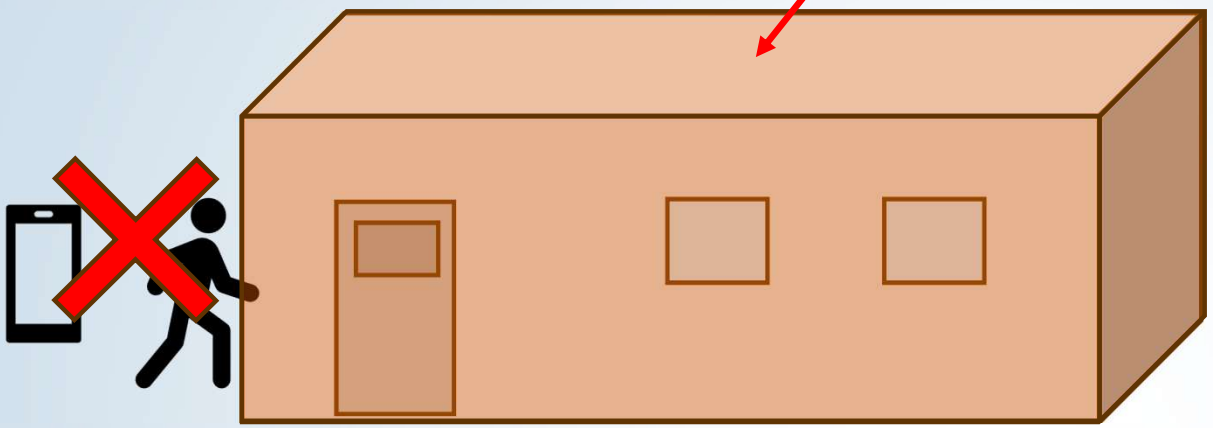
1. Petroleum Products Plant
2. Petrochemical Plants
3. Petroleum Reserve Base
4. Oil Terminals
5. Various Chemical Manufacturing Plants
6. Plastic Molding Plants
7. Semiconductor factory
8. GX-related (hydrogen, etc.)
9. Pharmaceutical plants
10. Coating Plants
11. Paints, inks, printing Plant
12. Cleaning process with organic solvents
13. Airport fueling facilities
14. Research institutes and experimental facilities, etc.

Reducing Hazardous Areas Through Risk Assessment (Example)

Indoor Facilities

Previous

The entire area is a hazardous area.



Non-explosion-proof smartphones, tablets and robots cannot be installed.

IEC Ed.3.0

Changing from a hazardous area to a non-hazardous area

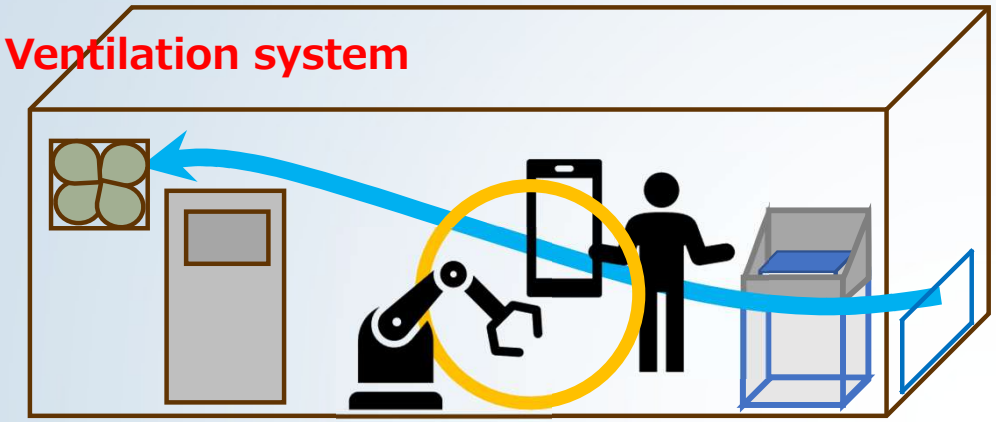
Some hazardous areas remain.

The reduction in hazardous areas has expanded the areas where non-explosion-proof equipment can be used.

And more

Indoor Facilities

Ventilation Review



Improvements to ventilation system requirements enable the entire building to be designated a non-hazardous area.

The entire building is designated a non-hazardous area.

Installation of local exhaust ventilation

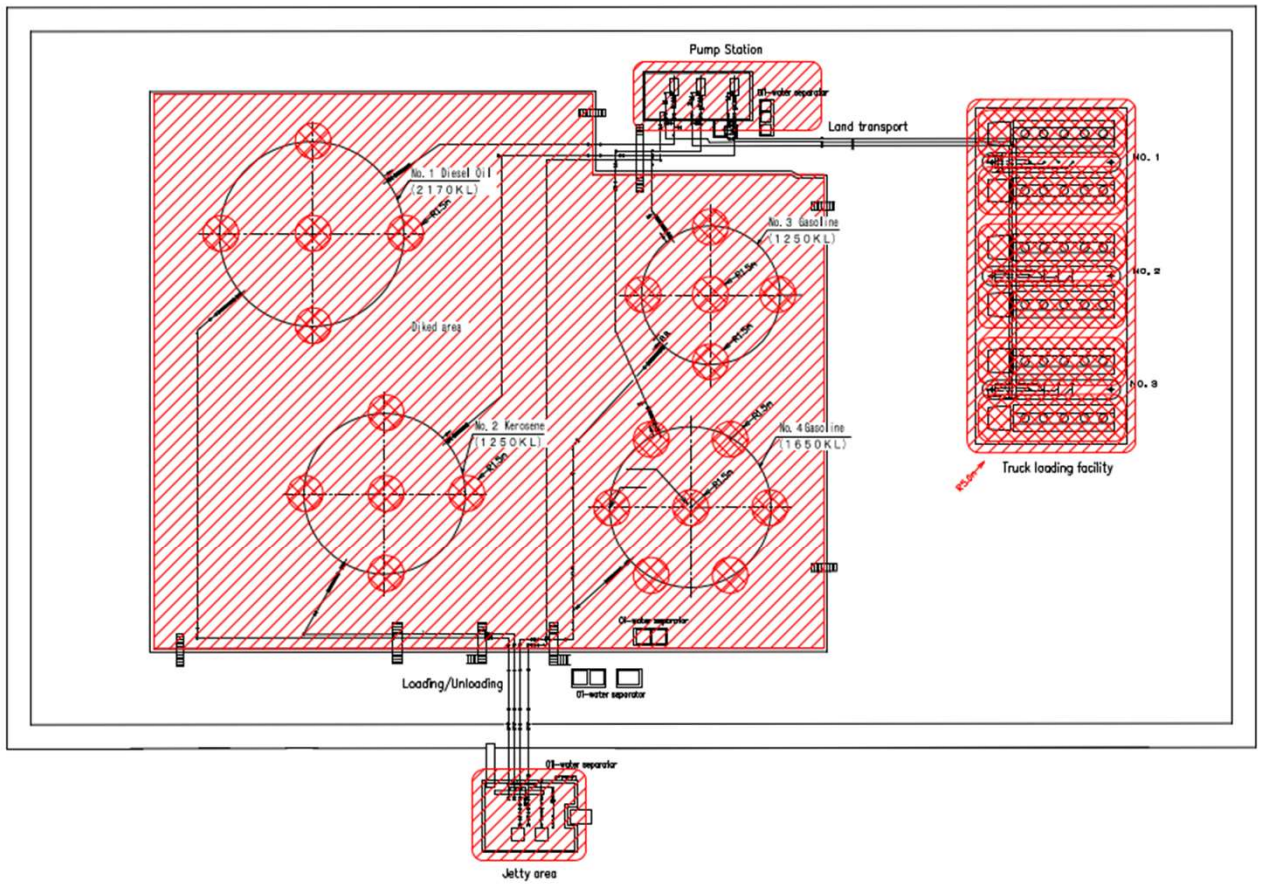
The installation of additional local exhaust ventilation enables the creation of non-hazardous zones.

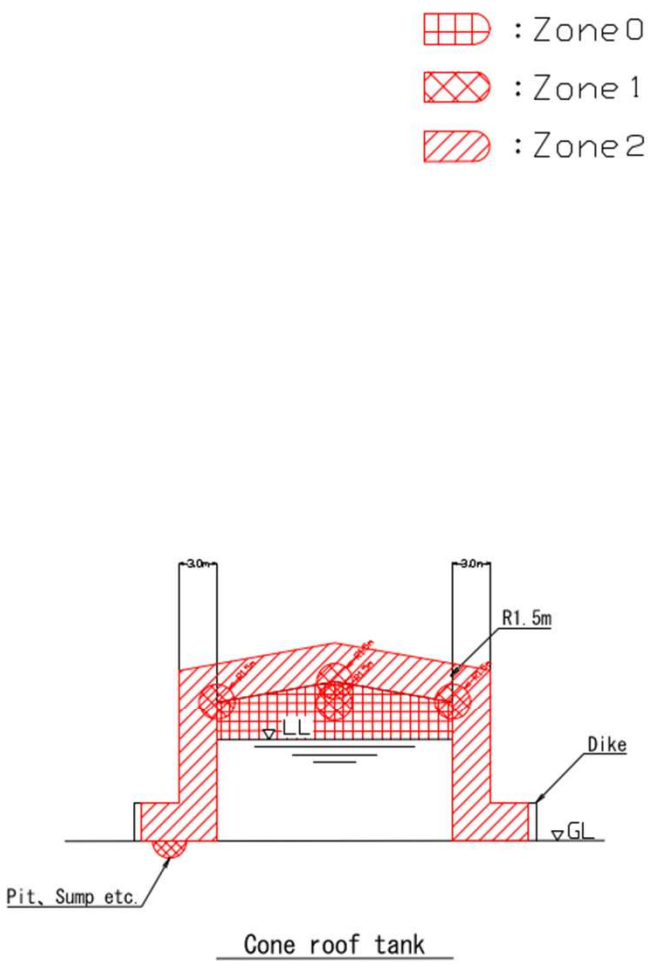
Local exhaust ventilation to create a non-hazardous area

Outdoor facilities

Previous

Regardless of the substances handled or operating conditions, the entire facility is uniformly designated as a hazardous area.



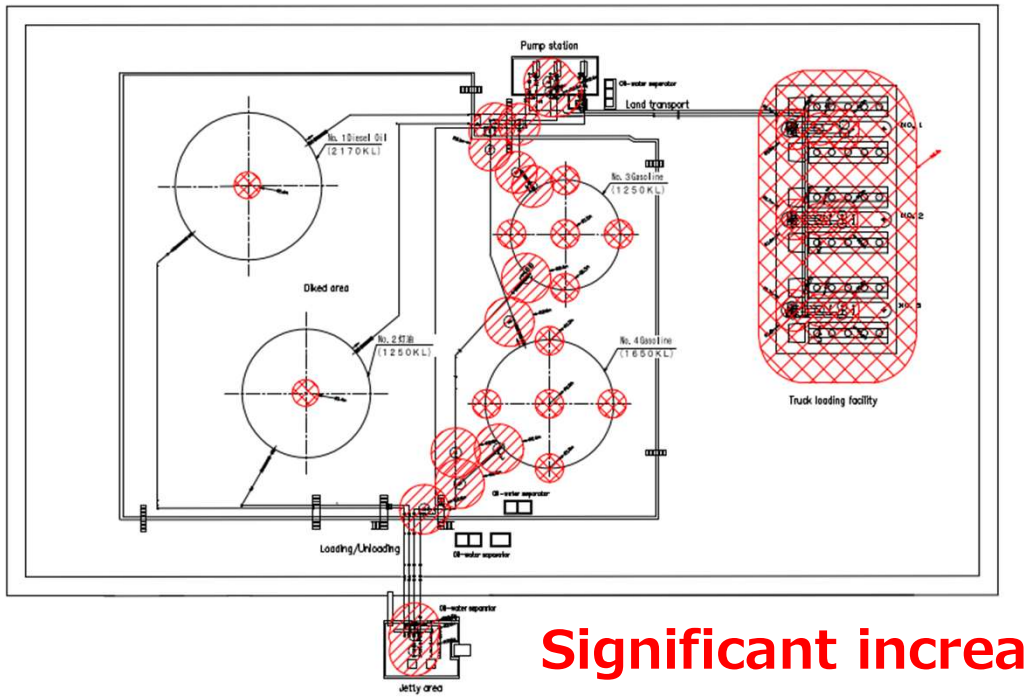


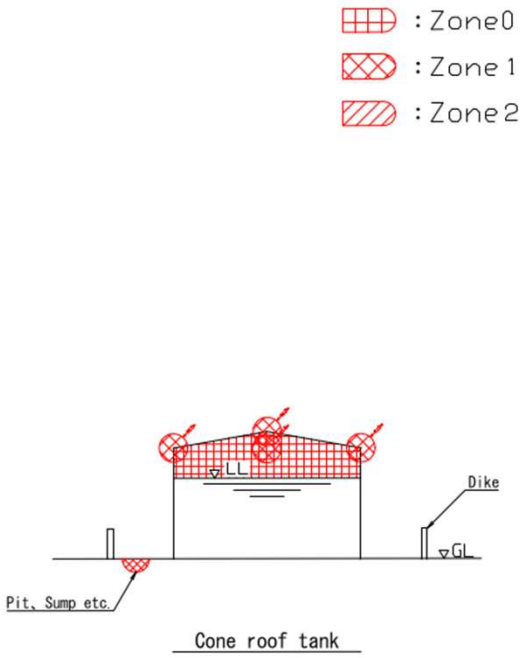
IEC Ed.3.0

Outdoor Facilities

【Key points for non-hazardous areas】

- **Chemical properties of substances**
  Most areas become non-hazardous areas depending on the fluid handled (e.g. kerosene).
- **Within oil dike of oil terminals and refuelling facilities**
  Most areas within the dike become non-hazardous areas, excluding areas around fittings, vents and pits.
- **Adoption of equipment designed to prevent leakage**
  Adoption of equipment such as leak-proof canned pumps and bellows-type valves.



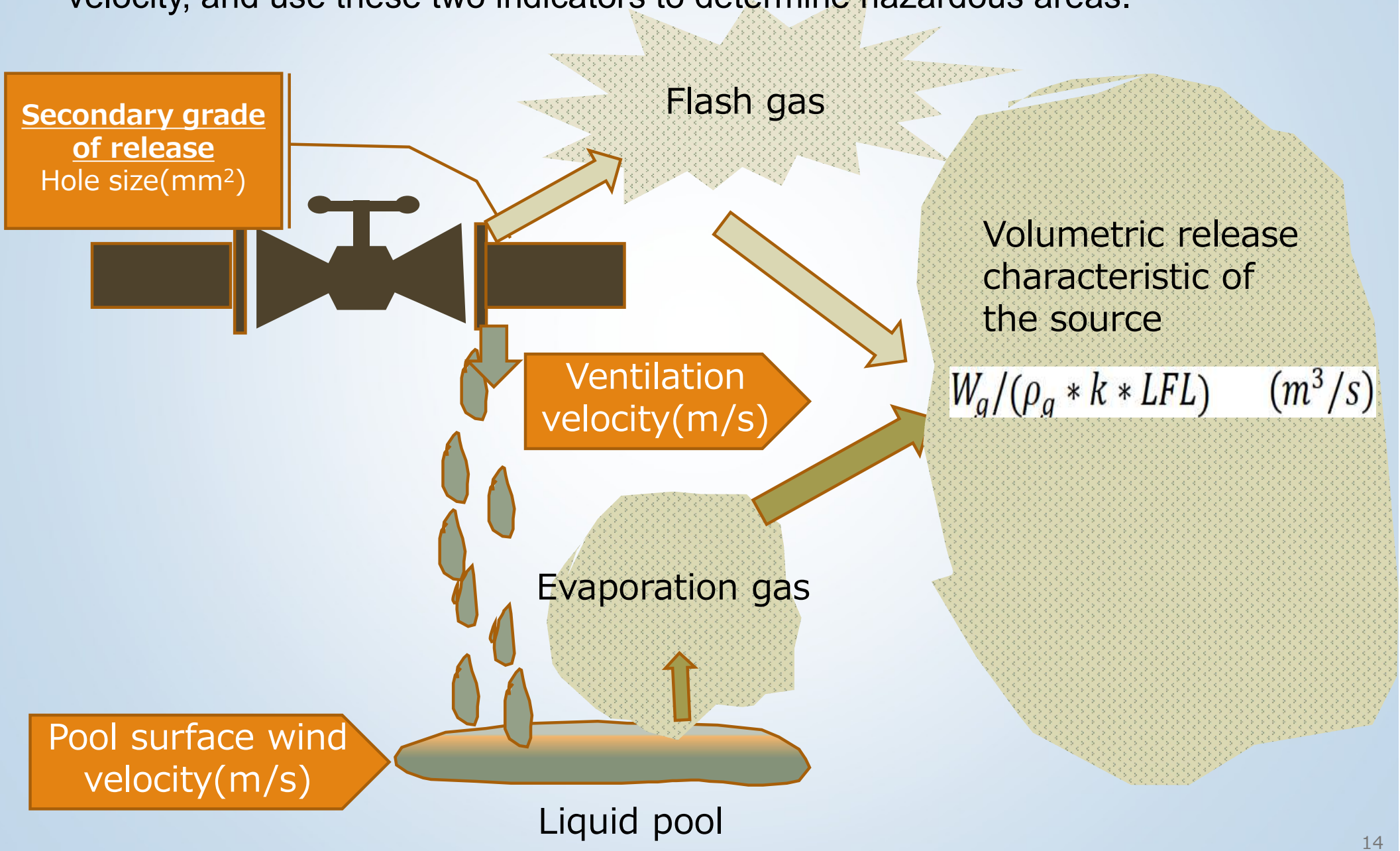


Significant increase in non-hazardous areas

IEC Ed3.0 Method
for Hazardous Area Classification

IEC Ed3.0 method

Calculate the release characteristics (based on gas release rate) and ventilation velocity, and use these two indicators to determine hazardous areas.



Assessment example

Risk evaluation for hazardous area classification (1/2)

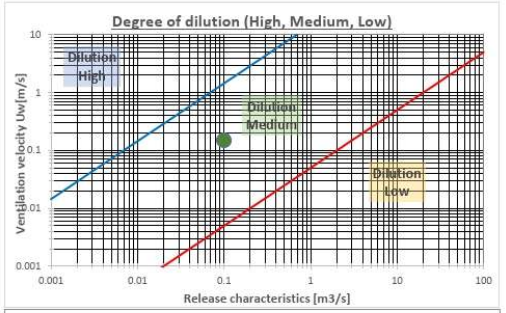
Study case ; A5-PRP-P3-L1-H1-E2

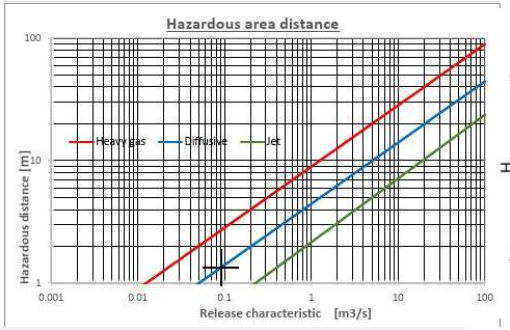
	Data	Unit	Remarks
Flammable material			
Name	Propane		Pure material
Condition	Liquid		Liquefied gas by pressure(pure material)
Physical property			
Molecular weight M	44.10	[kg/kmol]	
Lower explosive limit LFL	2.00	[vol%]	
Specific heat ratio γ		(-)	
Compressibility factor Z 1		(-)	
Liquid density ρ@T	483.94	[kg/m3]	At operation press. and temp.
Operating condition			
Fluid pressure	1004.2	[KPag]	Rated press.－1930[KPag]
Fluid temperature Ts	30	[°C]	Design temp.－93[°C]、boiling temp.=-42.04 [°C]
Source of release			
Release point	Flange with compressed fibre gasket		Tank Roof Area, Receiving Pipeline
Grade of release	secondary grade of release		
Hole crosss section; S	0.175	[mm2]	Considering (operating press./rated press.)－0.52,select from the range [Typical values for the conditions at which the release opening will not expand]
Discharge Coefficient; Cd	0.75	(-)	
Release rate of liquid; WL	0.0041	[kg/s]	
Flash rate; F	78.9	[wt%]	
Flashed gas rate; Wfg	0.00323	[kg/s]	
Liquid pool area; Ap	0.43	[m2]	It is calculated on conditions of60minutes of leakage time and 1cm of pool depth.
Wind velocity on the pool	0.105	[m/s]	Pool temp.Tp－-42.04[°C]、partial press. of gas－104.49KPa
Pool evaporation rate; We	0.00033	[kg/s]	
Gas/release amount; Ec	NA	[wt%]	Sum of gas from flash and evaporation is86.8wt% of leakage amount
Total gas release rate; Wg	0.00355	[kg/s]	Sum of gas from flash and evaporation
safety factor for LFL; k	1	[-]	LFL of the pure material is obtained from the piblished phisically property data.
Release gas density; ρ@Ta	1.77	[kg/m3]	
Area to be evaluated			
Outdoor or indoor	Outdoors with obstructions to ventilation		
Elevation	1	[m]	
Exhaust ventilation capacity	NA	[m3/s]	
Atomospheric condition			
Atomospheric pressure; Pa	101.325	[KPa]	
Surrounding temperature;Ta	30	[°C]	
Background concentration in building			
Background conc. ; Xb		Vol%	
Desired/critical conc. ;Xcrit		Vol%	
Dilution time from Xb to Xcrit		[s]	

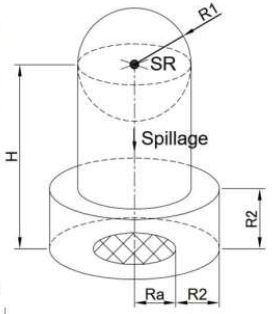
Risk evaluation for hazardous area classification (2/2)

Study case ; A5-PRP-P3-L1-H1-E2

	Data	Unit	Remarks
Ventilation characteristic			
Relative density of gas (pool)	2.00	[-]	(gas density at Tp)/(air density at Ta)
Relative density of gas at Ta	1.52	[-]	(gas density at Ta)/(air density at Ta)
Ventilation velocity	0.15000	[m/s]	To apply IEC Table C.1,[heavier than air gas/vapour]&[Obstructed areas].
Availability of ventilation	[Fair]	[-]	Where wind velocity (not ventilation velocity) is 0.5m/s or higher and ventilation is suppressed by objections
Evaluation			
Release characteristic	0.10022	[m3/s]	
Effectiveness of ventilation	[Dilution medium]		By IEC Figure C.1 (refer to the figure [Degree of dilution]
Hazardous area classification	[Zone 2]		By IEC Table D.1
Gas release charact.	0.09100	[m3/s]	
Hazardou distance R1	1.34	[m]	By[Diffusive](with obstructions of jet release) line of the figure [Hazardous area distance]
Evaporation gas release charact.	0.00922	[m3/s]	
Radius of liquid pool Ra	0.37	[m]	
Hazardous distance R2	0.86	[m]	By[Heavy gas] line of the figure [Hazardous area distance]



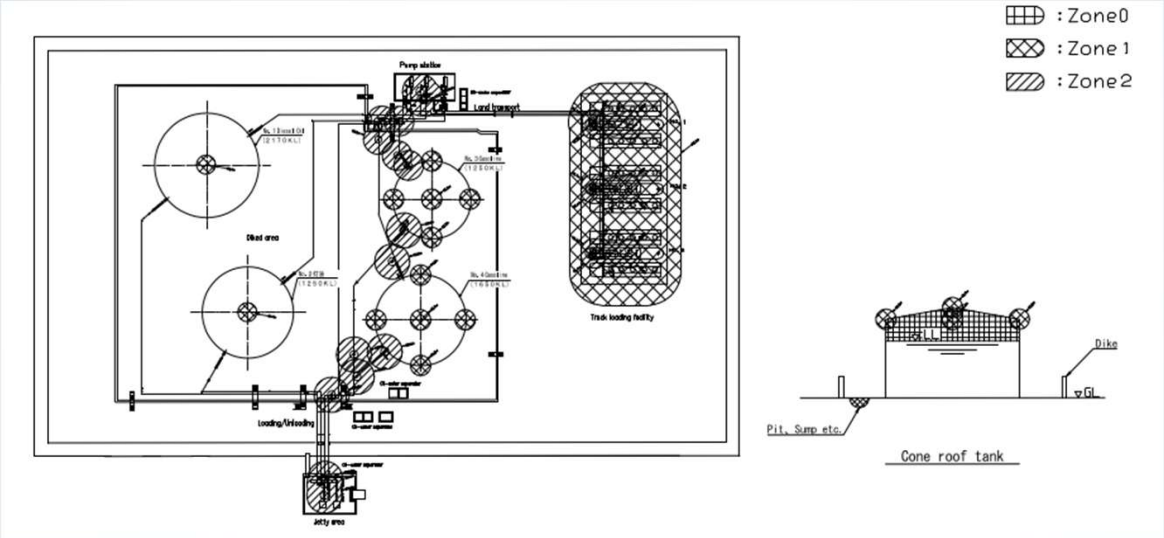




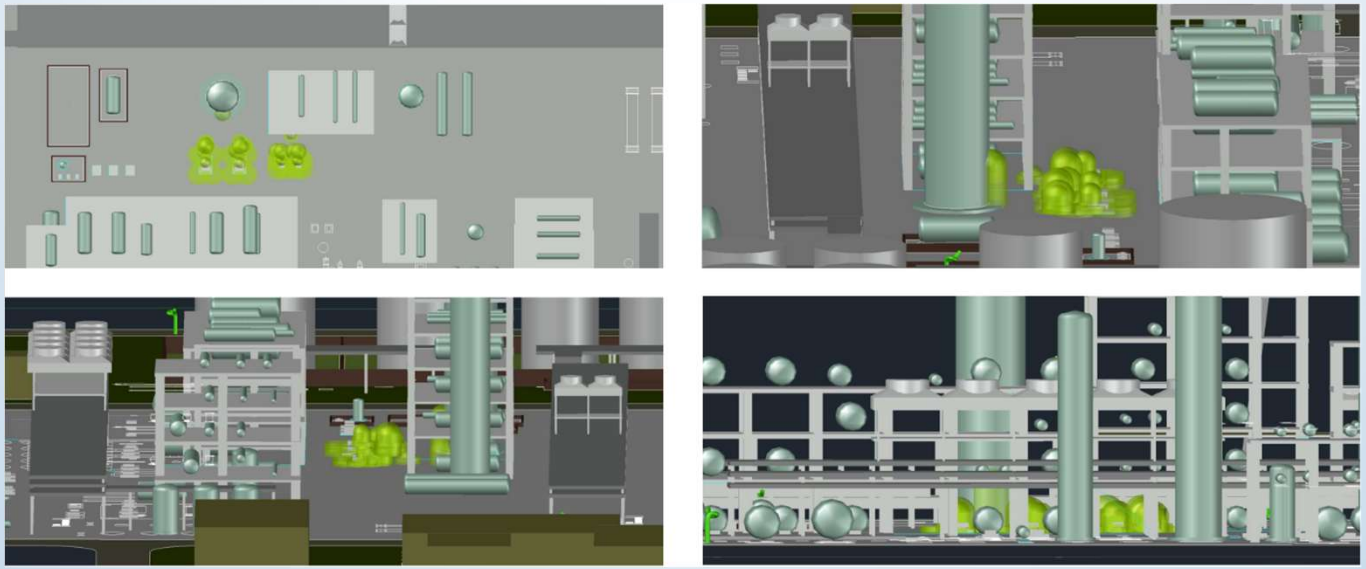
- Individual risk assessment results shall be prepared for each assessment case, and the data used in the assessment shall be clearly stated along with its basis.
- Spatial hazard zones can be clearly marked on drawings.
- For sources of release that become hazardous zones during specific periods, such as tank vents that repeatedly exhaust and intake air, it is possible to indicate those periods as well.

Evaluation example
Hazardous Area Map

Display in plot plans and elevations



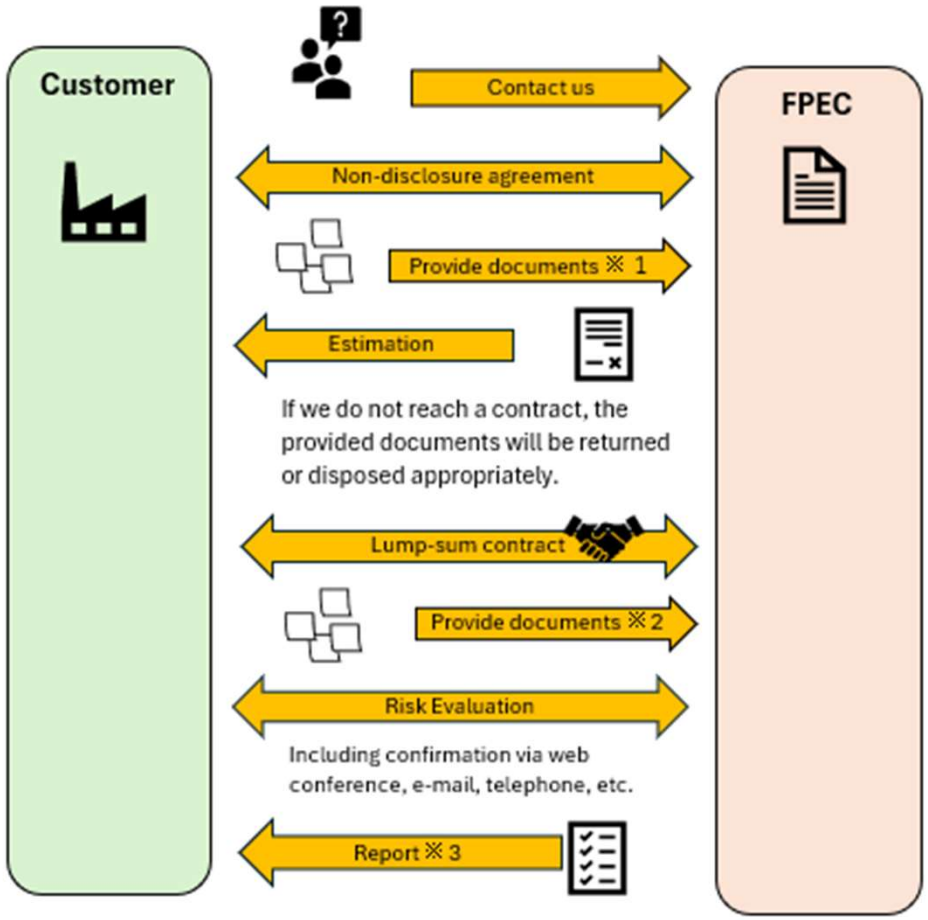
Superimposed display of 3D shapes



Work Flow

Work Flow

The workflow for HAC is shown in the figure below. We will proceed with the analysis based on the documents you provide. If we have any questions, we will confirm the details by web conference, telephone, e-mail, etc. and then request photos for additional information as necessary.



※1 Documents you need to provide

1. Plot plan
2. Information on the hazardous materials to be assessed
3. P&IDs
4. Operating conditions
5. Equipment list for rotating machinery such as pumps
6. Datasheets of tanks or Tank list
7. The number of buildings to be assessed and Exhaust system diagram

4. through 6. is not necessary if the data is described in 3.
If you do not have these documents at hand, please contact us.

※2 Documents you need to provide

In addition to the above ※1

8. Piping service classes
9. Any materials showing the ventilation in buildings.
10. Overall drawings or flow sheets of local exhaust system
11. Others (We may ask you to provide additional materials depending on what is being considered.

※3 Report

1. Evaluation results report which may be used as documentation for submission to jurisdictional authorities
2. Summary table of evaluation results
3. Individual evaluation result
4. Area classification Diagram

For inquiries, please contact us here.

https://fpec1.co.jp/en/contact-us.html

FPEC
Health Safety Environment

F P E C Corporation

La-tour Kuo Fan 7F, 195 Yamashita-Cho, Naka-ku,
Yokohama 231-0023
TEL +81-45-222-8870 FAX +81-45-222-8869
https://fpec1.co.jp/en/.jp