

Date: 30.07.2019

To,
The Director- IA Division (Industry: II),
Ministry of Environment, Forest and Climate Change
Indira Paryavaran Bhavan, Aliganj,
Jor Bag Road
New Delhi-110003

Subject: Submission of details sought as per Minutes of Meeting dated 6-8 May, 2019 for Environmental Clearance of the Manufacture of Pesticides (Aluminum Phosphide, Zinc Phosphide, and Magnesium Phosphide Technical & Its Formulation) located at Plot No. 4924, Notified Industrial Area, GIDC Sarigam, District - Valsad, Gujarat by Integrated Chemisol Pvt. Ltd.

Ref: 1. Proposal Number. IA/GJ/IND2/91857/2018
2. Detail Sought vide Minutes of Meeting dated 6-8 May, 2019.

Dear Sir,

With reference to aforesaid subject and above cited proposal number of the Project EIA/EMP of Integrated Chemisol Pvt. Ltd. was considered in 7th EAC (Industry-2) meeting held on 8th May, 2019 vide **agenda number 7.3.22** and as per Minutes of Meeting (Copy of the same is enclosed as **Annexure I**) following details are submitted for compliance:

Details Sought	Compliance
The Committee after deliberations and view of highly hazardous nature of the products insisted for process safety and risk assessment studies using advanced models, and mitigating measures to be suggested accordingly. The committee also desired for details regarding chemicals proposed as raw materials, risks involved, precautionary measures for occupational health, and the proposal for monitoring of Phosphine (PH ₃) emissions	Process safety and risk assessment studies using advanced model namely 3D-CFD Technology has been carried out along with mitigating measures by GEXCON. Details regarding chemicals proposed as raw materials, risks involved precautionary measures for occupational health, and the proposal for monitoring of Phosphine (PH₃) emissions have been incorporated in the report. Consequences Analysis Studies Report is attached as Annexure II.

We request you to consider our proposal and grant us environment Clearance for the same.

Thanking You,
Yours faithfully,
For: Integrated Chemisol Pvt. Ltd.

Encl: As Above

Annexure I

Minutes of Meeting dated 8th May, 2019.

Day Three: 8th May, 2019

Agenda No.7.3.22

Manufacturing of Pesticides (Aluminium Phosphide, Zinc Phosphide, Magnesium Phosphide Technical & Its Formulation) at Plot No. 4924, GIDC Industrial Area Sarigam, District Valsad (Gujarat) by M/s Integrated Chemisol Pvt Ltd- Environmental Clearance [IA/GJ/IND2/91857/2018, IA-J-11011/201/2018-IA-II(I)]

The project proponent and their accredited consultant M/s Eco Chem Sales and Services made a detailed presentation on the salient features of the project.

7.3.22.1 During deliberations, the EAC noted the following:

The proposal is for environmental clearance to the project for setting up pesticides and pesticide specific intermediates manufacturing unit of capacity 500 TPM by M/s Integrated Chemisol Pvt Ltd in an area of 2351.25 sqm located at Plot No. 4924, GIDC Industrial Area Sarigam, District Valsad (Gujarat).

Details of products are as under:

S. No.	Product	Quantity
1	Aluminium Phosphide / Zinc Phosphide / Magnesium Phosphide	500 TPM

The project/activities are covered under category A of item 5(b) 'Pesticides industry and Pesticide specific intermediates' of the Schedule to the Environment Impact Assessment Notification, 2006, and requires appraisal at central level by the sectoral EAC in the Ministry.

ToR for the project was granted on 22nd July, 2018. Public hearing is exempted as the project site is located inside the notified industrial area.

Land area available for the project is 2351.25 sqm. Industry will develop greenbelt in an area of 801.25 sqm covering 34% of total project area. The estimated project cost is Rs. 6 crore. Total capital cost earmarked towards environmental pollution control measures is Rs.10 lakh and the recurring cost (operation and maintenance) will be about Rs.5 lakh per annum. Employment opportunity will be for 45 persons directly & 30 persons indirectly.

There are no National Parks, Wildlife Sanctuaries, Biosphere Reserves, Tiger/Elephant Reserves and Wildlife Corridors etc within 10 km distance from the project site. Darohta river is flowing at a distance of 9.1 Km in NE direction.

Total water requirement is estimated to be 9.3 cum/day, which includes fresh water requirement of 6.3 cum/day, proposed to be met from GIDC Sarigam water supply.

Industrial effluent of 2.8 cum/day will be treated through ETP. Treated water will be utilized for scrubber. Domestic effluent 0.8 cum/day was now proposed to treat through STP in place of dispose through septic tank. There will be no discharge of treated/untreated waste water from the unit, and thus ensuring Zero Liquid Discharge.

Power requirement is estimated to be 125 kVA, proposed to be met from Dakshin Gujarat Vij Company Limited (DGVCL). DG set of 100 kVA shall be used as standby during power failure.

Stack (height 11 m) will be provided as per CPCB norms to the proposed DG set. Natural gas fired steam boiler of 0.2 TPH shall be installed with a stack of height of 11 m.

Ambient air quality monitoring was carried out at 8 locations during October to December 2018 and the baseline data indicates the ranges of concentrations as: PM₁₀ (61.9-86.1 µg/m³), PM_{2.5} (32-47.1 µg/m³), SO₂ (9.4 -17.6 µg/m³) and NO₂ (16.2- 23.0 µg/m³). AAQ modeling study for point source emissions indicates that the maximum incremental GLCs after the proposed project would be 3.91 µg/m³, 0.0088 µg/m³, 0.0050 µg/m³ and 0.0046 µg/m³ with respect to NO_x, P₂O₅, PM and SO₂. The resultant concentrations are within the National Ambient Air Quality Standards (NAAQS).

7.3.22.2 *The EAC, after deliberations and in view of highly hazardous nature of the products, insisted for process safety and risk assessment studies using advanced models, and mitigating measures to be suggested accordingly. The Committee also desired for details regarding chemicals proposed as raw materials, risks involved, precautionary measures for occupational health, and the proposal for monitoring of Phosphine (PH₃) emissions.*

The proposal was therefore deferred.

Agenda No.7.3.23

Floating Storage Unit (FSU)/Floating Storage and Regasification Unit (FSRU) based Liquefied Natural Gas (LNG) Terminal at Hooghly Estuary, West Bengal by M/s Bengal Concessions Private Limited - Environmental Clearance

[IA/WB/IND2/69588/2017, IA-J-11011/472/2017-IA-II(I)]

The project proponent and their accredited consultant M/s ERM India Pvt Ltd made a detailed presentation on the salient features of the project.

7.3.23.1 During deliberations, the EAC noted the following: -

The proposal is for environmental clearance to the project for setting up LNG storage and re-gasification terminal of capacity 5 MMTPA by M/s Bengal Concessions Private Limited in an area of 48.5 acres on the banks of Hooghly Estuary at Kukrahati, District East Medinipur (West Bengal).

The project/activity is covered under category A of item 6(a) 'Oil & gas transportation pipe line (crude and refinery/ petrochemical products), passing through national parks /sanctuaries/coral reefs /ecologically sensitive areas including LNG Terminal' of schedule to the Environment Impact Assessment (EIA) Notification, 2006, and requires appraisal at central by the sectoral EAC in the Ministry.

The project earlier involved installation of floating storage unit/floating storage and re-gasification unit (FSRU) of capacity 4 MMTPA based Liquefied Natural Gas in an area of 37 acres, and accordingly standard ToR was granted on 16th November, 2017. The scope of the project was later changed to LNG storage and re-gasification terminal of capacity 5 MMTPA with 600 m long jetty in an area of 48.5 ha. The same was discussed during the EAC meeting held on 24-26 September 2018, wherein the Committee confirmed that the ToR dated 16th November, 2017 shall remain applicable to the modified project description. Public hearing was conducted by the SPCB on 15th February 2019. The main issues raised during the public

Annexure II

Compliance of Minutes of Meeting

DRAFT REPORT

Consequence Analysis Studies – Using 3D Computational Fluid Dynamics (CFD) Technology for Proposed Plant of Integrated Chemisol Pvt. Ltd. at GIDC Sarigam, Valsad, Gujarat

Client
ICPL, Valsad

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Classification

Confidential (F)

Title

**Consequence Analysis Studies – Using 3D Computational Fluid Dynamics (CFD) Technology for
Proposed Plant of Integrated Chemisol Pvt. Ltd. at GIDC Sarigam, Valsad, Gujarat**

Extract

Gexcon India Pvt. Ltd. were requested to perform a 3D Consequence Analysis for Proposed Plant of
Integrated Chemisol Pvt. Ltd. at GIDC Sarigam, Valsad, Gujarat, India**Project Info**

Client

ICPL, Valsad

Clients ref.

Mr. Dhaval Jhaveri.

Gexcon Project No.

700075

Gexcon Project Name

**Consequence Analysis Studies – Using 3D
Computational Fluid Dynamics (CFD)
Technology for Proposed Plant of Integrated
Chemisol Pvt. Ltd. at GIDC Sarigam, Valsad,
Gujarat****Revision**

Rev.	Date	Author	Checked by	Approved by	Reason for revision
00	25.07.2019	Gokul Mahajan	Marutha Muthu Venkatraman	Raj Narkhede	-

Disclaimer

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Executive Summary

Gexcon India Pvt. Ltd. were requested to perform a consequences analysis studies using 3D CFD technology for proposed plant facility of Integrated Chemisol Pvt. Ltd. (ICPL), Sarigam, Valsad district, Gujarat.

Following **Two scenarios** had been identified to carry out CFD Analysis:

1. Accidental loss of containment for Phosphine from Aluminium Phosphide Reaction Pot Assembly.
2. Accidental loss of containment for Phosphoric Acid from Phosphoric Acid tank.

Terrain Modeling has been included in this study. It is important to account for the topography in the FLACS modelling for scenarios, where the terrain may significantly influence the flow. The results were obtained and represented in form of 2D and 3D plots. (section-3). The 3D consequence analysis study was concluded as given below.

The Phosphine gas, after the leak from the reaction pot assembly, dispersed with the wind and cloud travelled up to **138 meters** length with subsequent dilution in concentration. Thus, the toxic fumes travelled, crossed the plant boundary. **The Phosphine gas behaves as “Neutrally buoyant gas”** so IDLH concentration gas cloud reaches up-to maximum height of **11 meters**. The maximum concentration of Phosphine gas that can be retained within the facility is more than 1000 ppm, closer to the ground.

On the contrary, the Phosphoric Acid (toxic) vapour cloud will remain contained in the plant boundary. **The evaporation rate of spilled Phosphoric acid is found to be very less due to which Phosphoric acid vapour cloud stabilized very quickly in 55 seconds after the leak.** The Phosphoric Acid vapour cloud travelled up-to **17 meters** length from leak source. **As Phosphoric acid vapours are heavier than air**, the maximum height of IDLH concentration gas cloud reaches up-to **2.5 meters** only.

Since the clouds of Phosphine and Phosphoric Acid are toxic to the health and wind direction is North-East to South-West, there is a possibility that employees and contract workers near **Oxidation chamber, Scrubber, Gate, Plant area, Lab, Passage, Office, R.M. & F.G. Storage Area, Green area** in the downwind can be exposed to toxic gases.

The following safety measures are suggested for the Phosphine and Phosphoric Acid scenarios. The consequences can be minimized having these mitigation measures.

Phosphine:

- As Phosphine is highly toxic to the human being, it is advisable to have an effective gas detection system Typical detector types suitable for Phosphine are:
 - Photo-absorption;

- Photo-ionization
- Thermal conductivity
- Phosphine is flammable and explosive in air and can auto ignite at ambient temperatures. Flame detectors suitable for Phosphine service shall be located to detect fire in potential Phosphine leak areas. Whenever flame detection occurs, immediate shutdown of the process is required. Automatic valves controlled with nitrogen instead of air can achieve it in the best way. An alarm should be transmitted so authorized personnel/parties can act on the condition. **The use of ultraviolet/infrared (UV/IR) flame detectors is suitable for phosphine service. Temperature Rate of Rise (ROR) indicators can also be suitable for indoor use.^[5]**
- In case of emergency, Personnel shall wear protective clothing and self-contained breathing apparatus (SCBA) when fighting Phosphine fires. Only trained personnel should respond to Phosphine fires.
- Try to stop Phosphine release. Reduce vapour with **fog or fine water spray**.

Phosphoric Acid:

- As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids. [ERG Guide 154, Substances - Toxic and/or Corrosive (Non-Combustible)].

1 Background

1.1 Company Profile

M/s. Integrated Chemisol Pvt. Ltd., established in 2018, is managed by the promoters and whole time Managing Director Mr. Bhargav Desai. He has more than a decade of experience of the pesticides manufacturing industry with a strong track record for executing business turnarounds and manufacturing.

1.2 Location and Surrounding

Integrated Chemisol Pvt. Ltd. proposed to establish Greenfield Technical grade pesticides manufacturing plant at Plot No. 4924, Notified Industrial Area, GIDC Sarigam, District - Valsad, Gujarat. The plan layout is as shown below

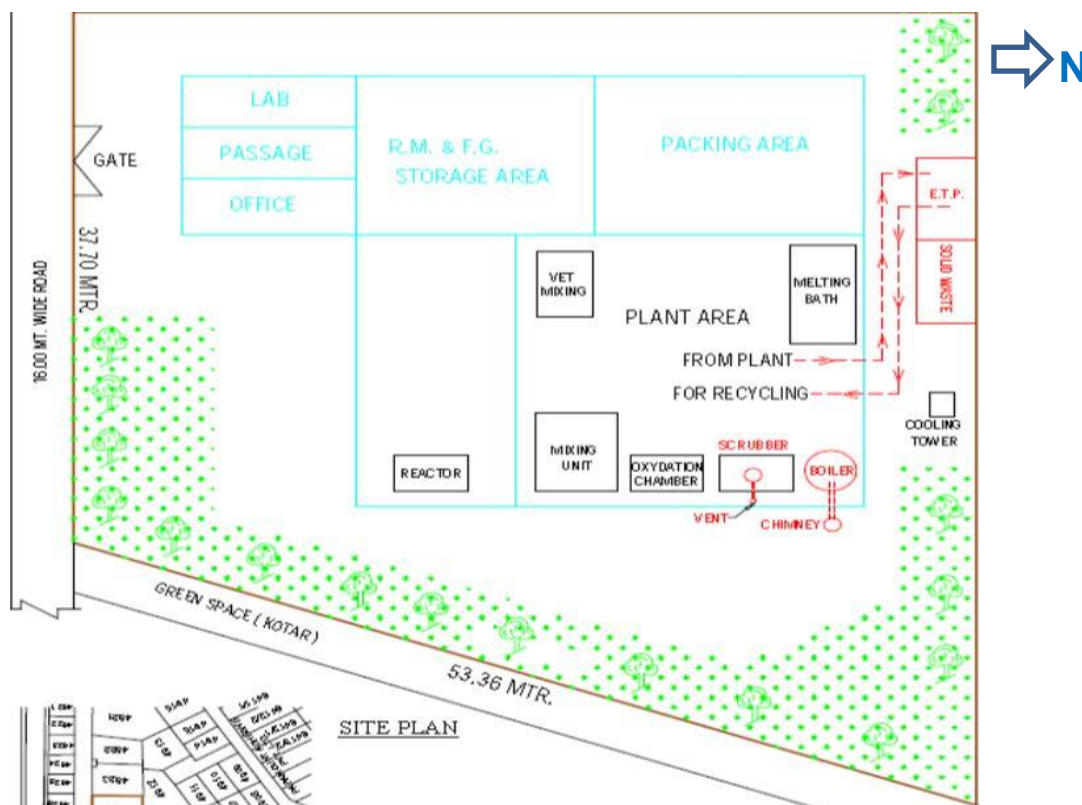


Figure 1-1 Plant facility showing all the storages, manufacturing plant area and the buildings.

Abbreviations

ASTER	Advanced Space Thermal Emission and Reflection Radiometer
CFD	Computational Fluid Dynamics
CASD	Computer Aided Scenario Design
EIA	Environment Impact Assessment
FLACS	Flame Acceleration Simulator
GDEM	Global Digital Elevation Maps
ICPL	Integrated Chemisol Pvt. Ltd.
IDLH	Immediate Dangerous to Life and Health
KL	Kilo Litre
NIOSH	National Institute of Occupational Safety and Health
PPM	Parts Per Million
RA	Risk Assessment
SRTM	Shuttle Radar Topography Mission

1.3 Project Scope and Overview

Gexcon India Private Limited were requested to perform a 3D Consequence Analysis to assess the impact on the proposed plant of Integrated Chemisol Pvt. Ltd., Sarigam, Valsad.

Modeling was conducted using the software tool FLACS, developed by Gexcon. Considering the IDLH (Immediately Dangerous to Life and Health) values for toxicity, inventory, molecular weight of the gas and their leak locations are the main parameters to select the accident scenarios. The predominant focus was on toxic releases of **Phosphine** and **Phosphoric Acid**.

Based on the issued Assumption Register from Gexcon and input data provided by the Client, following toxic gas release scenarios are decided to be modelled using 3D CFD technology for detailed dispersion analysis.

3. Accidental loss of containment for Phosphine from Aluminium Phosphide Reaction Pot Assembly.
4. Accidental loss of containment for Phosphoric Acid from Phosphoric Acid tank.

To conduct consequence analysis studies using computational fluid dynamics (CFD), it is required to represent the relevant sections of the plant facilities in 3-dimensional format.

The Gexcon team was provided with the required plot plan, building dimensions and the other relevant technical details as an input from client via email dated 13th June 2019 to prepare 3-dimensional geometry.

2 FLACS Simulations

This chapter describes the terrain modelling, geometry model and the scenario investigated in the FLACS simulation.

All simulation results presented in this report are obtained with the CFD code FLACS version 10.9 r1.

2.1 Terrain Modeling

It is important to account for the topography in the FLACS modelling for scenarios, where the terrain may significantly influence the flow. FLACS can import digital elevation maps (DEM), which can be used for modelling the effects of terrain on the simulations, and for visualising elevations both within and outside the simulation domain. The US Geological survey (USGS) hosts the Earth Explorer website, which is straightforward to use and supports interactive searching and downloading of a wide range of publicly available DEM data, including shuttle radar topography mission (SRTM) and advanced space thermal emission and reflection radiometer (ASTER) global digital elevation maps (GDEM).

The terrain around ICPL facility is shown in Figure 2-1 and Figure 2-2.

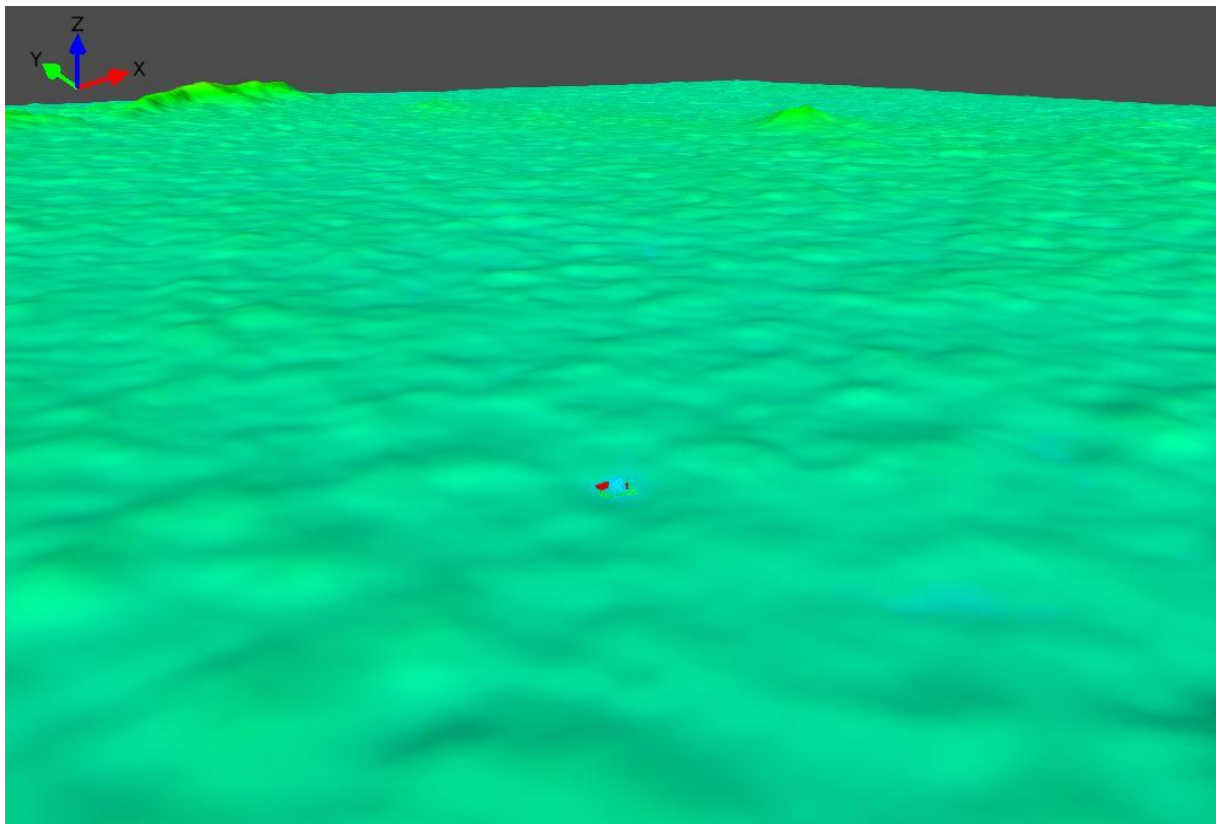


Figure 2-1: Top view of overall Terrain model

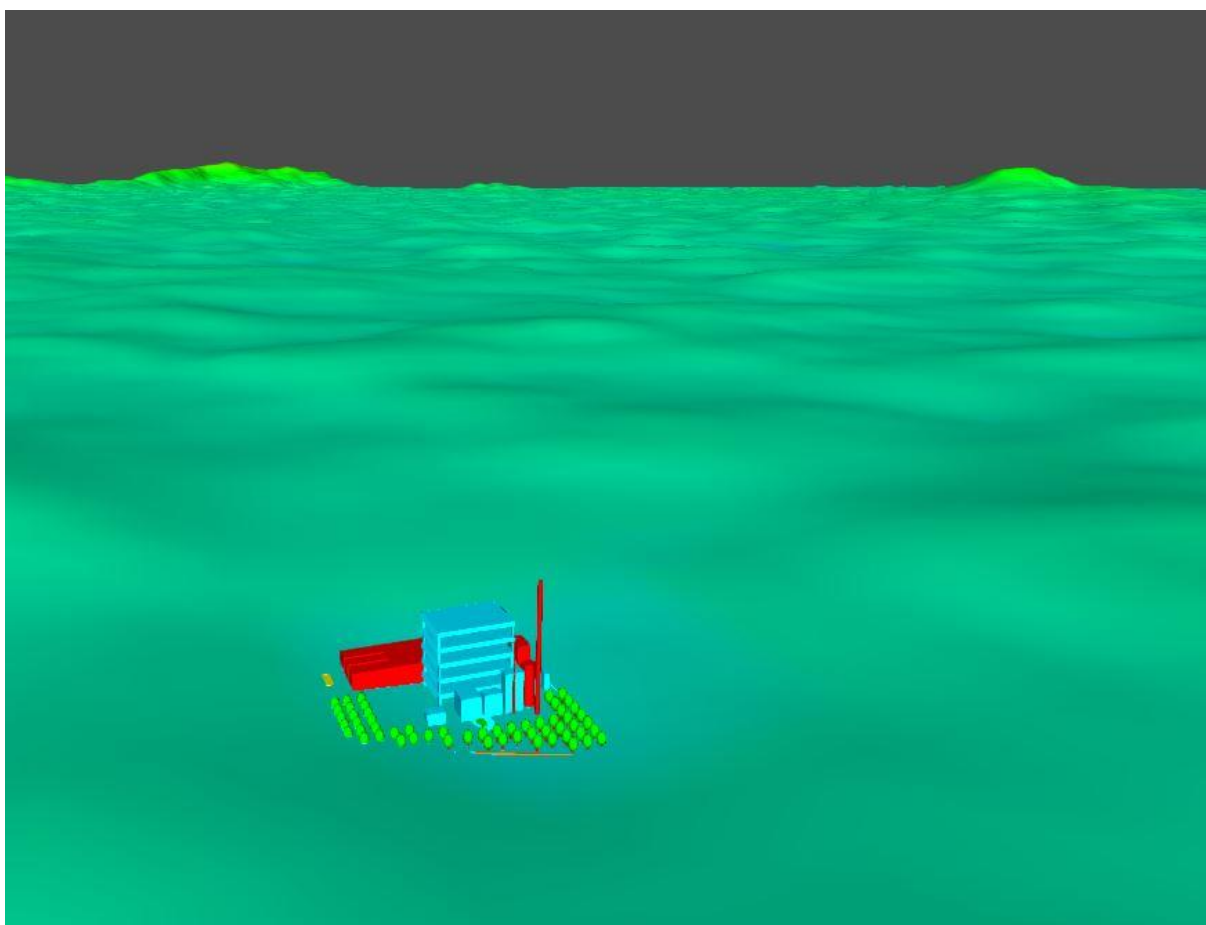


Figure 2-2: Isometric view of Terrain model including the ICPL geometry

2.2 Geometry and grid

Proposed plot plan for the facility shown in Figure 1-1 was selected and included in the CFD simulations. The 3D model has been developed from the plot plan, where the dimensions of the layout, tank farms and buildings were obtained. The elevation details, dike dimensions and tank heights were additionally provided by the client (via email dated 13th June 2019). CASD is an acronym for Computer Aided Scenario Design. The pre-processor CASD for the CFD simulator FLACS is used to prepare the input data, or job data, that defines a FLACS simulation. This comprises the geometry model, computational grid, porosities, and scenario description. ^[1] The implemented geometry was based on drawings and other details provided by ICPL.

- Figure 2-3 shows selected domain extents and buildings to be represented in the CFD model.
- Figure 2-4 shows geometry view from North side.
- Figure 2-5 shows geometry view from Southside.
- Figure 2-6 shows geometry view from East side.
- Figure 2-7 shows geometry view from West side.

- Figure 2-8 and Figure 2-9 shows the grid used in the entire domain used to capture wind and the dispersion coverage in the domain of interest.

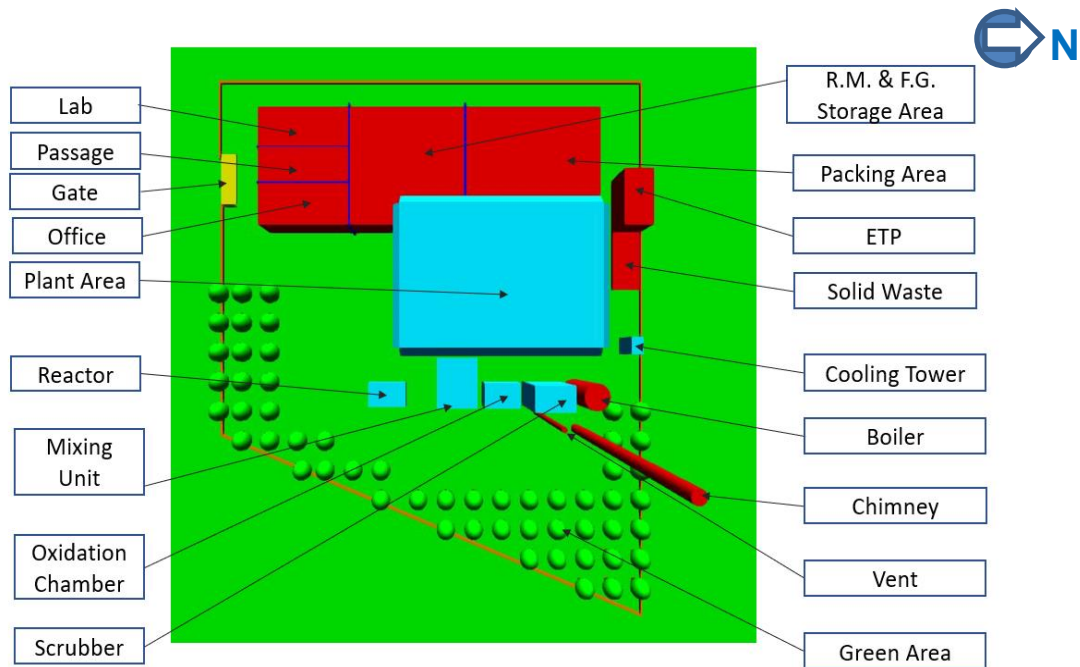


Figure 2-3: Selected domain extents and buildings represented in the CFD model.

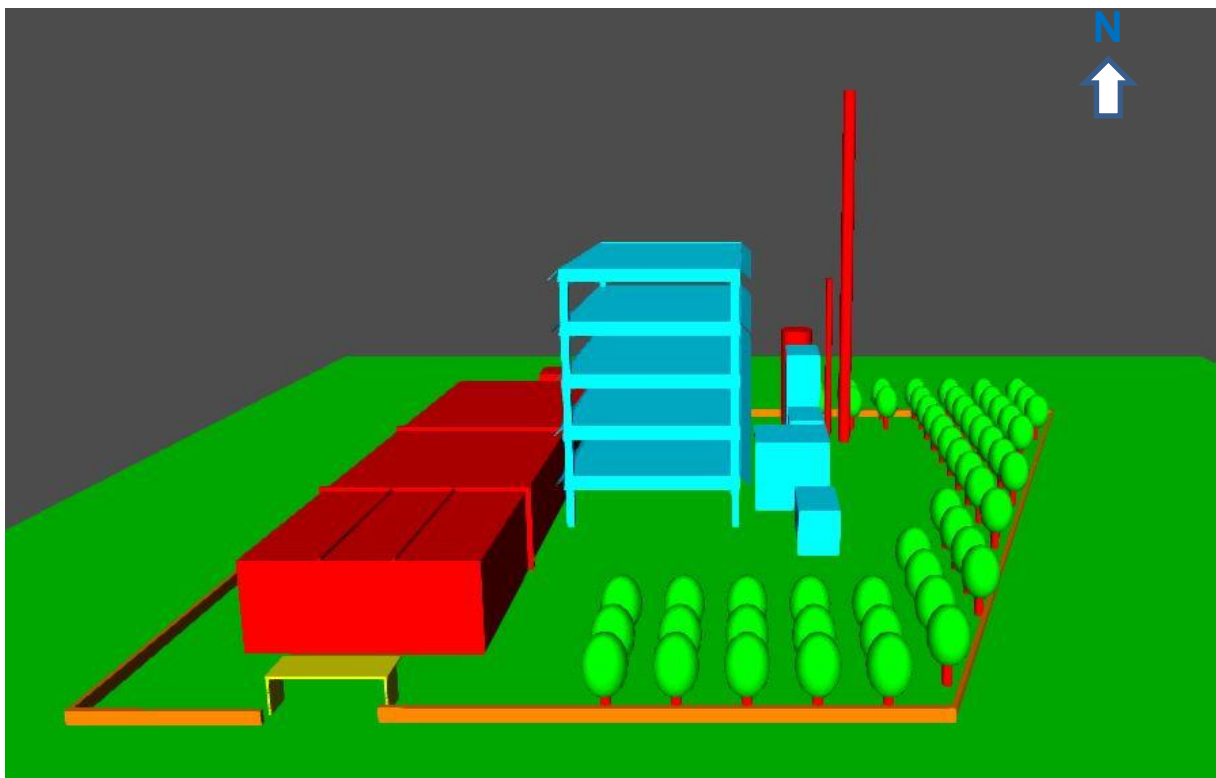


Figure 2-4: Geometry view from North side

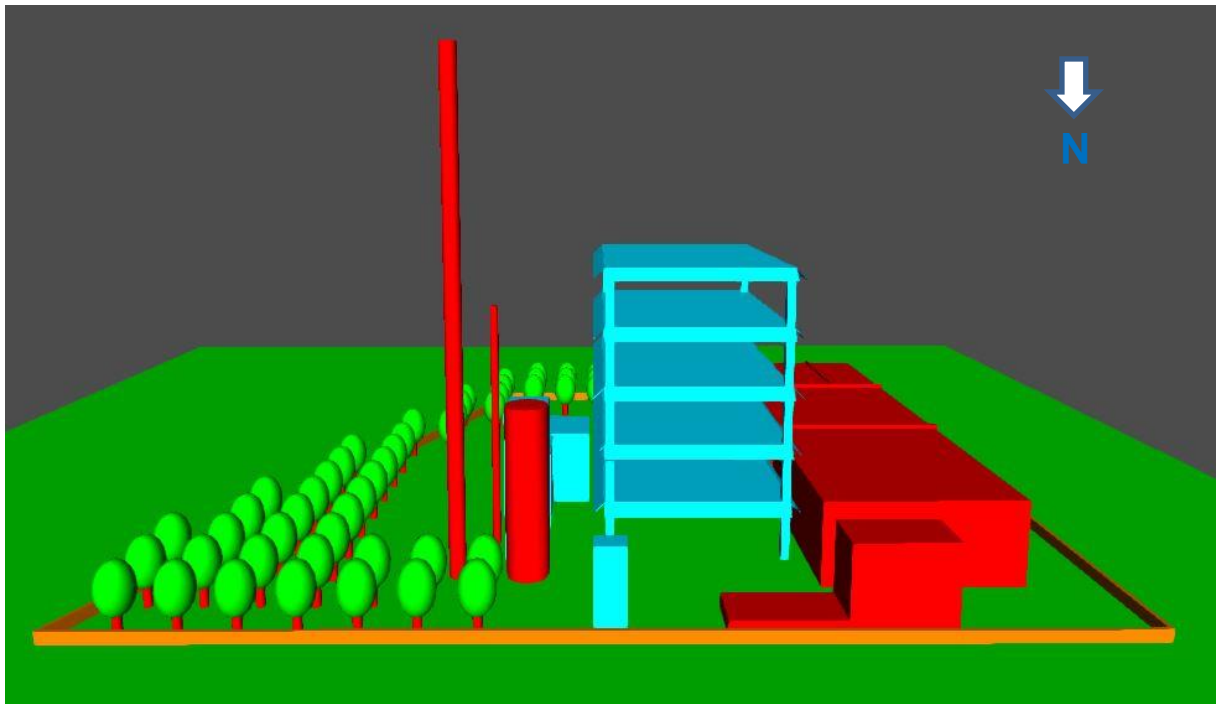


Figure 2-5: Geometry view from South side

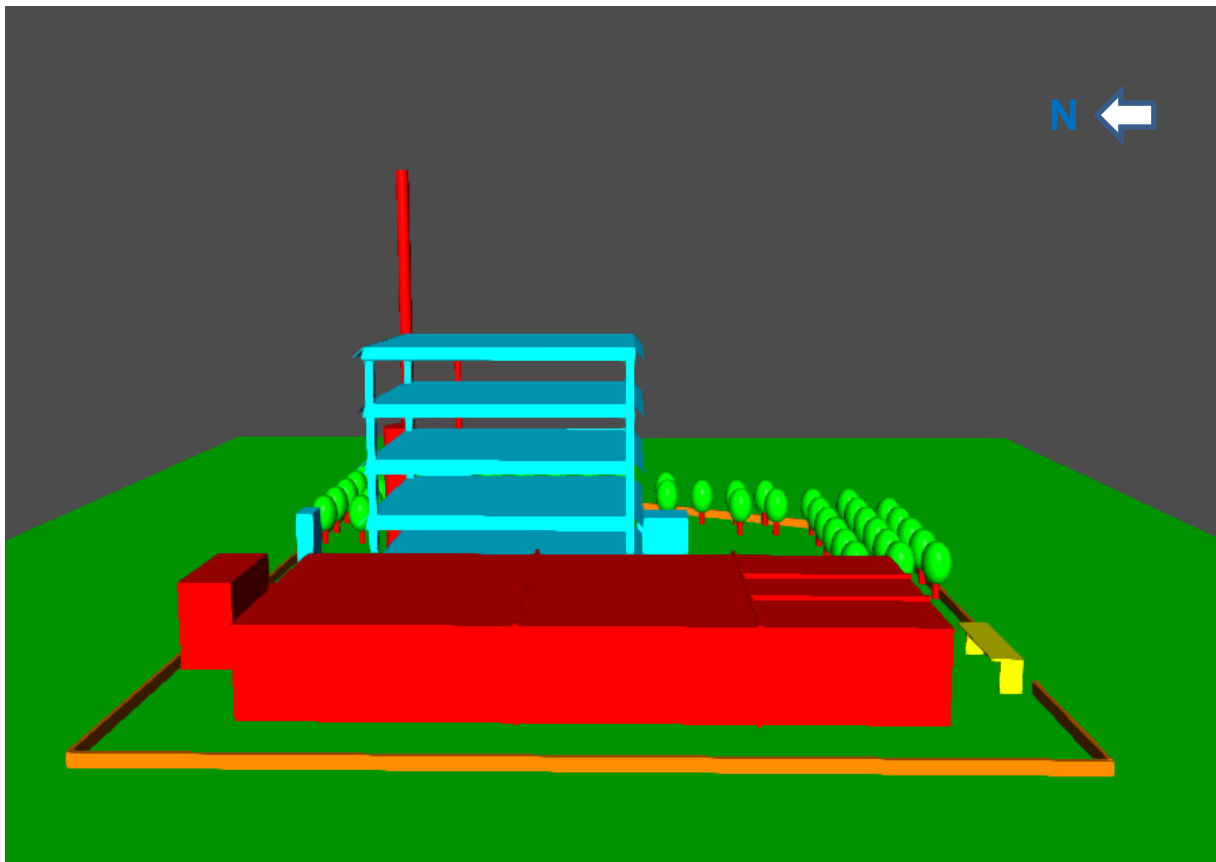


Figure 2-6 : Geometry view from East side

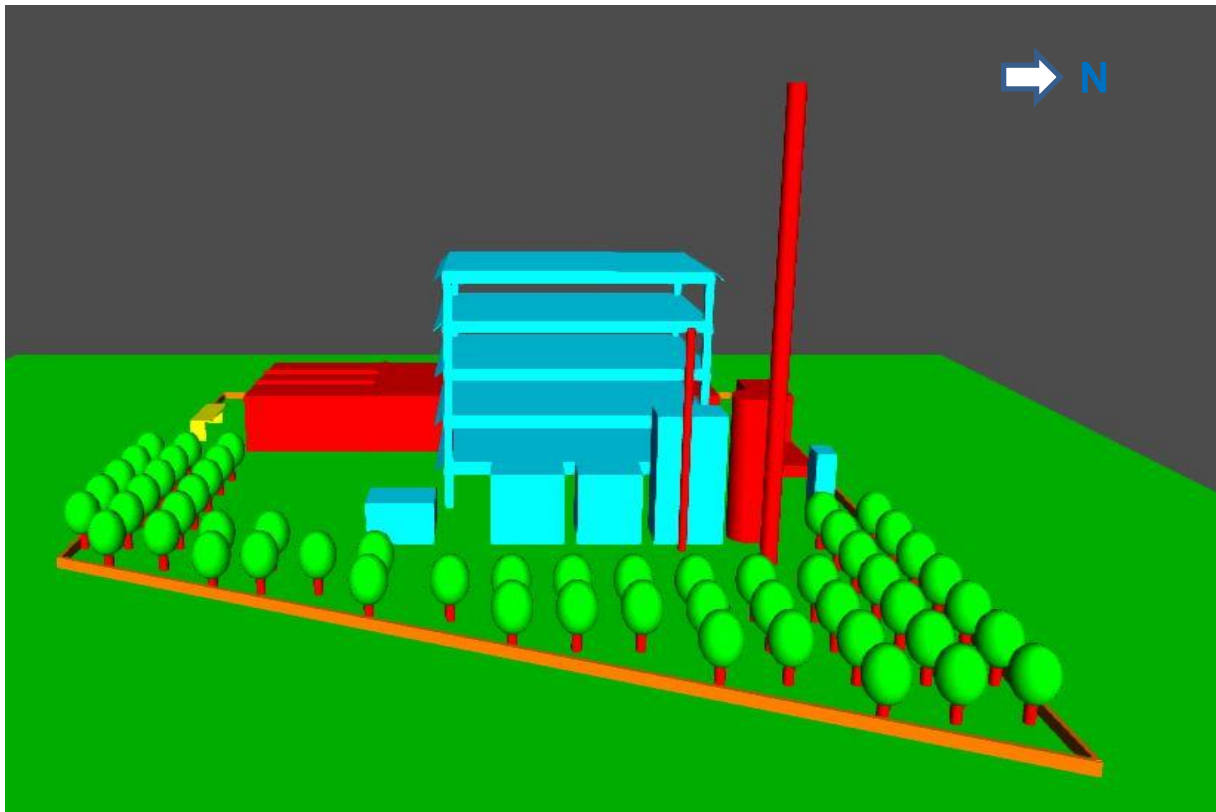


Figure 2-7 : Geometry view from West side

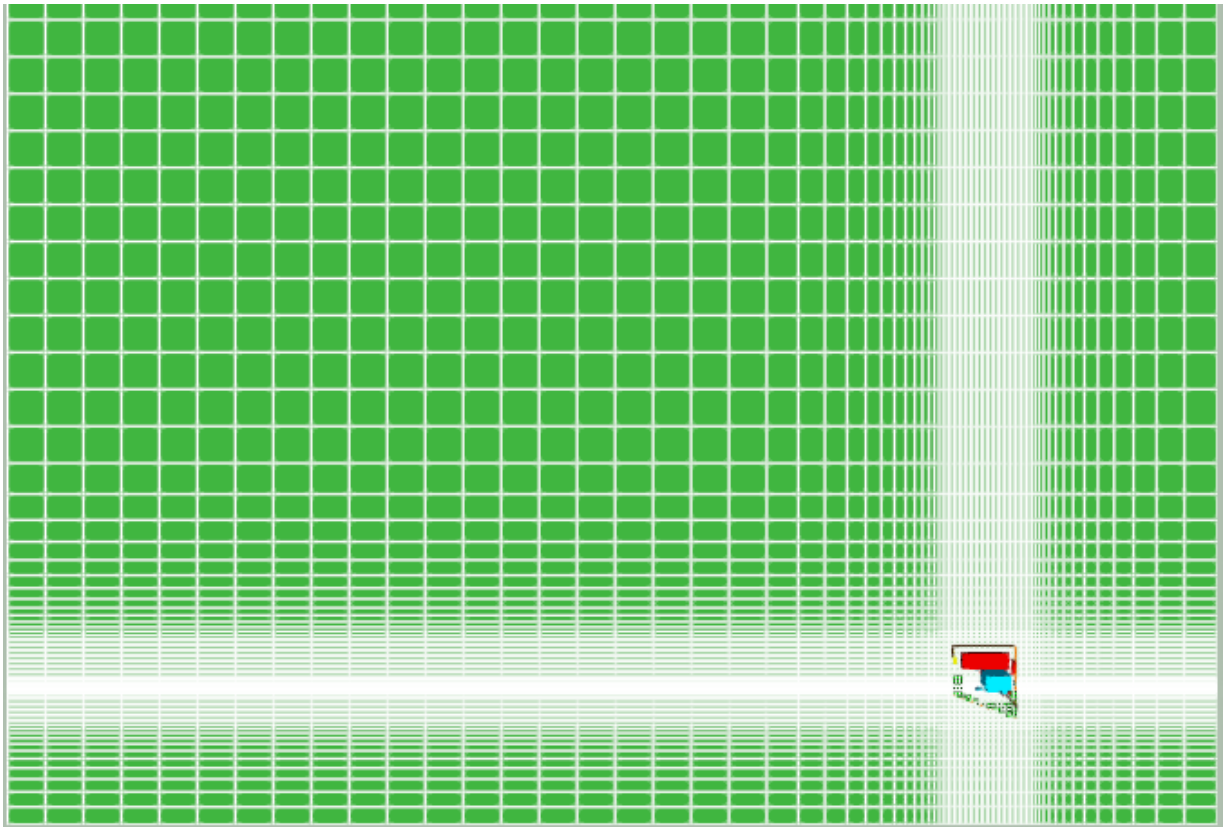


Figure 2-8: Numerical grid used in the entire domain to capture the wind flow around the buildings and the gas dispersion from leak in the domain of interest- Top View

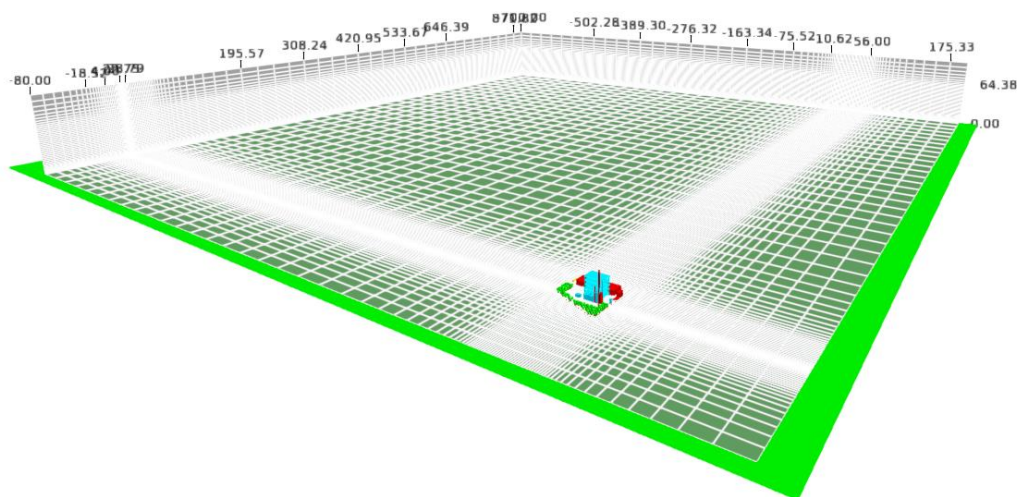


Figure 2-9 Numerical grid used in the entire domain to capture the wind flow around the buildings and the gas dispersion from leak in the domain of interest- Isometric view of full geometry

A representative grid for all the leak scenarios is shown in Figure 2-8 and Figure 2-9 to capture the toxic releases of Phosphine and Phosphoric Acid.

The 2 m grid cells were used within the plant facility. The grid is stretched by factor of 1.2 for overall domain outside the plant facility. The grid was refined by incorporating cell at each 0.25 meter from 0 to 2 meters distance in Z direction. This refinement for cells which are very close to ground provides an efficient grid size for leaks. The overall computational domain dimensions are 900 x 980 x 100 (L x B x H) meters.

2.3 Wind Rose

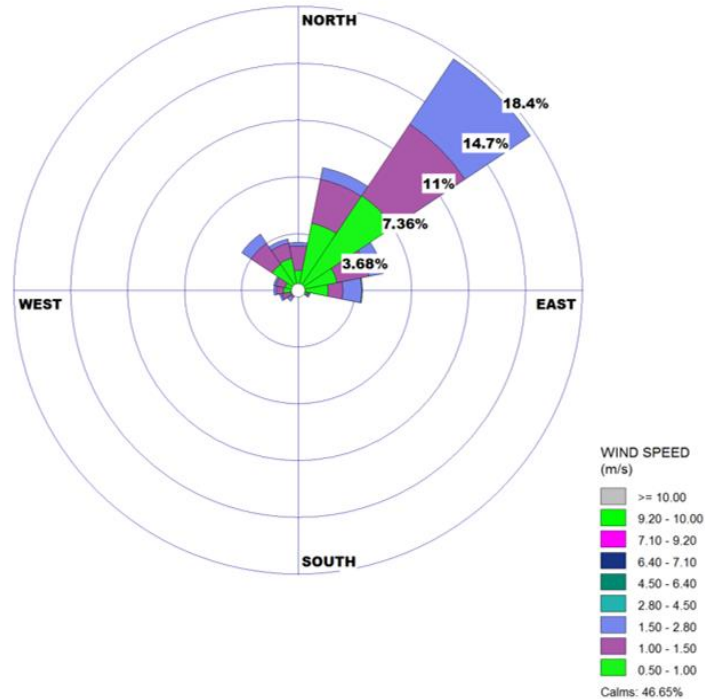


Figure 2-10: Wind Rose for Sarigam location [2]

As shown in Figure 2-10, the wind rose is obtained for Sarigam, Valsad district location. The annual probable wind Speed is 2.0 m/s and wind direction at project site is from North-East to South-West direction. For all the dispersion scenarios defined in section 2.3, North-East to South-West direction is taken as probable wind direction.

2.4 Simulation scenarios

Two scenarios are considered for consequence analysis using CFD simulations.

- 1) Leakage of Phosphine gas from Ammonium Phosphide reaction pot assembly has been considered for 3D CFD modelling to predict the toxic dispersion of Phosphine within and around the plant boundary.
- 2) Leakage of Phosphoric Acid (85%) vapours from Phosphoric Acid tank has been considered for 3D CFD modelling to predict the toxic dispersion of Phosphoric Acid.

2.5 Case 1:Phosphine Dispersion Scenario

For Phosphine dispersion scenario, following input data were considered

Table 2-1:Modeling of Phosphine leak in FLACS

Quantity [Kg]	Leak Size [mm]	Mass flow rate [kg/s]	Wind Direction	Wind Speed [m/s]
586	25	0.046	NE to SW	2.0

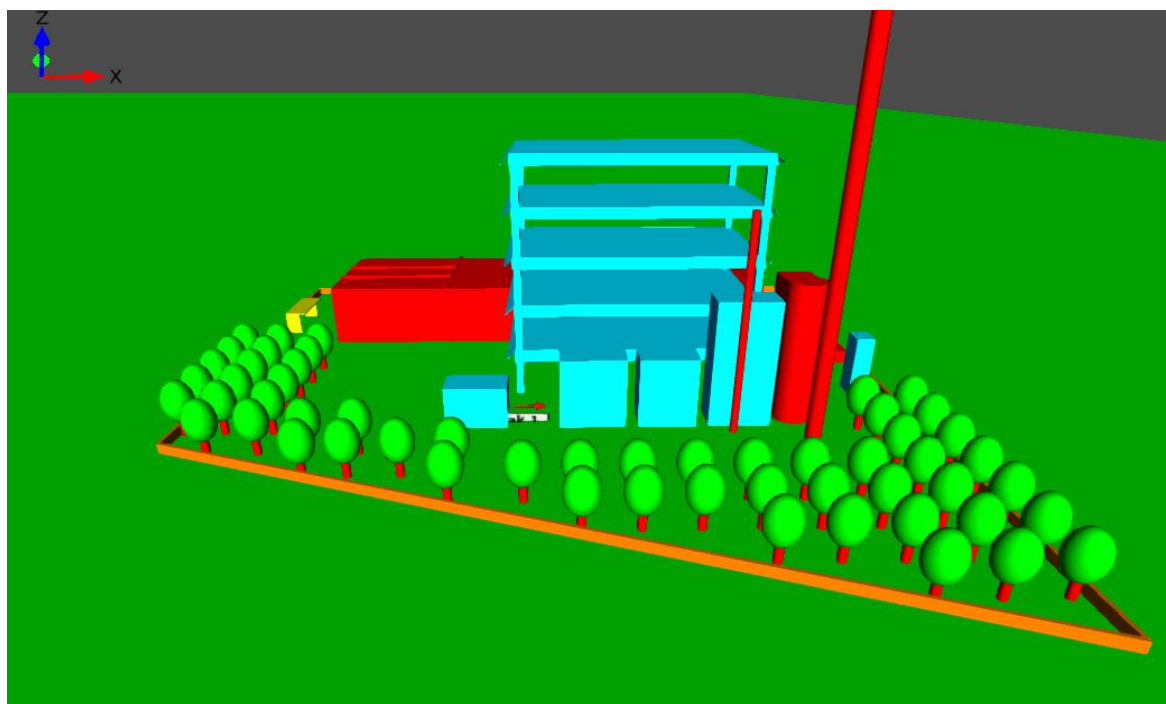


Figure 2-11: Leak location for Phosphine dispersion at Aluminium Phosphide reactor pot assembly

2.6 Case 2: Phosphoric Acid Dispersion Scenario

For Phosphoric acid dispersion scenario, following input data were considered

Table 2-2: Modeling of Phosphoric Acid leak in FLACS

Quantity/Volume [KL]	Bund dimension (L x W x H) m	Evaporation rate [kg/s]	Wind Direction	Wind Speed [m/s]
10	3.25 x 3.25x1	0.0106	NE to SW	2.0

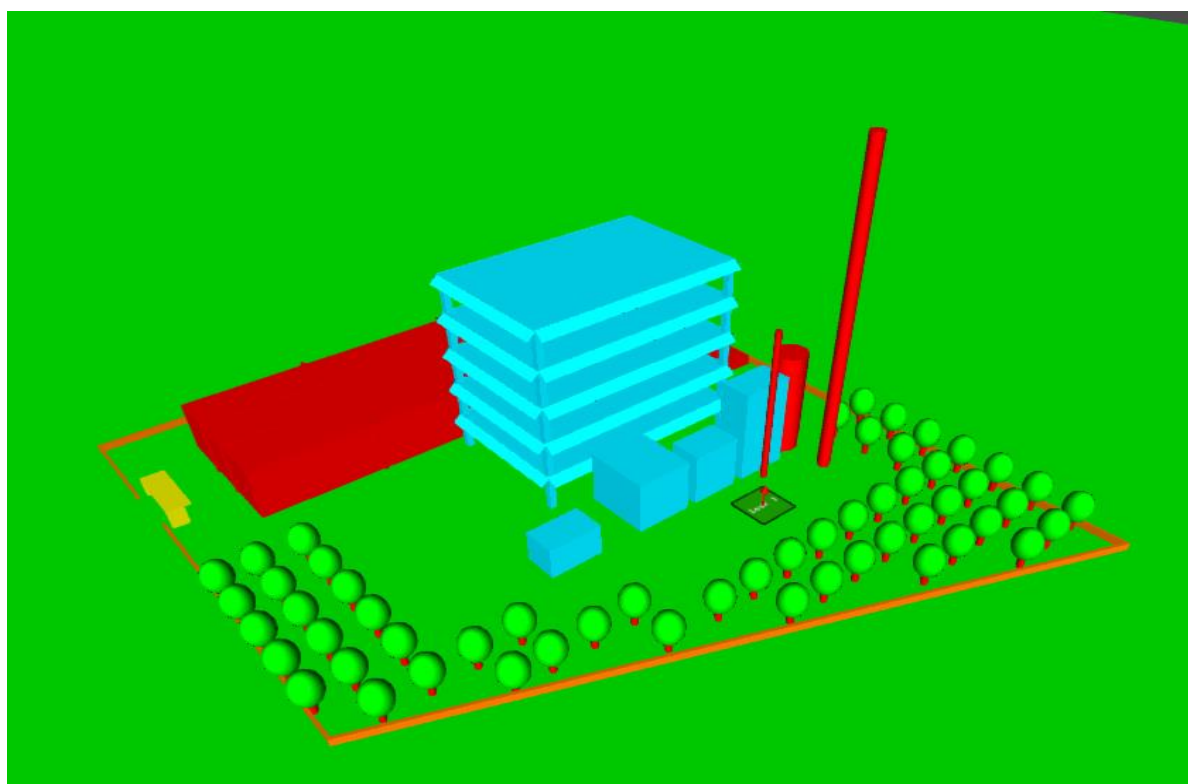


Figure 2-12: Leak location for Phosphoric acid at Phosphoric Acid tank.

A summary of all the scenarios simulated using FLACS is provided in Table 2-3 and Table 2-4.

Table 2-3: Summary of Phosphine Dispersion scenario simulated using FLACS.

Case No.	Case Type	Wind Direction	Wind Speed [m/s]	Pasquill Class
1	Phosphine Dispersion	NE to SW	2.0	F

Table 2-4: Summary of Phosphoric Acid Dispersion scenario simulated using FLACS

Case No.	Case Type	Wind Direction	Wind Speed [m/s]	Pasquill Class
2	Phosphoric Acid Dispersion	NE to SW	2.0	F

3 Results

This section represents an overview of the results for the simulation scenarios mentioned in section 2.4.

Plot description

Simulated data are collected and presented in two types of plots, 2D cut plane plots and 3D volume plots. 2D cut plane plots show the variable value for every grid cell (in the selected 2D plane) at selected times and 3D volume plots show the boundaries of the concentration for the specified value.

2D cut plane plots have been used to illustrate the toxic and flammable gas concentration at various time instances on vertical and horizontal planes.

3D volume plots have been used to show the propagation of the concentrated cloud with wind at various time instances.

3.1 Results from Phosphine Dispersion Simulation

The accidental leak scenario described in the section 2.4 was simulated. Simulations were performed to capture the dispersion of the Phosphine gas, its mixing with air, dilution process and cloud movement based on prevailing wind condition.

The resulting cloud was simulated for **800 seconds** after the leak. The leak started at **50 seconds** of simulation time. The Phosphine gas exits the plant facility at **115 seconds** after the leak as shown in Figure 3-1. The Phosphine gas cloud is stabilised at **530 seconds**. Figure 3-2 indicates that the toxic Phosphine gas with IDLH gas concentration has covered a maximum distance of **138 meters** in **530 seconds** towards South-West direction.

The term immediately dangerous to life or health (IDLH) is defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that is "likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. Based on NIOSH reference, this value was taken as 50 ppm.^[3]

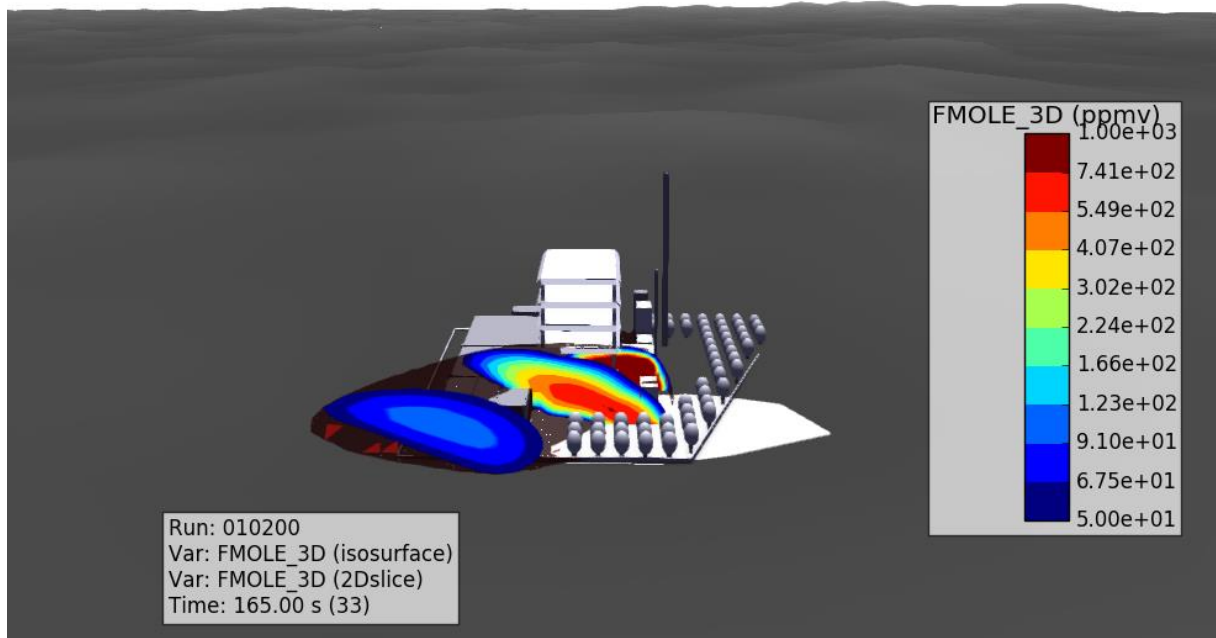


Figure 3-1: Phosphine cloud for IDLH 50 ppm at 165 seconds for wind direction from North-East to South-West, wind speed 2.0 m/s .

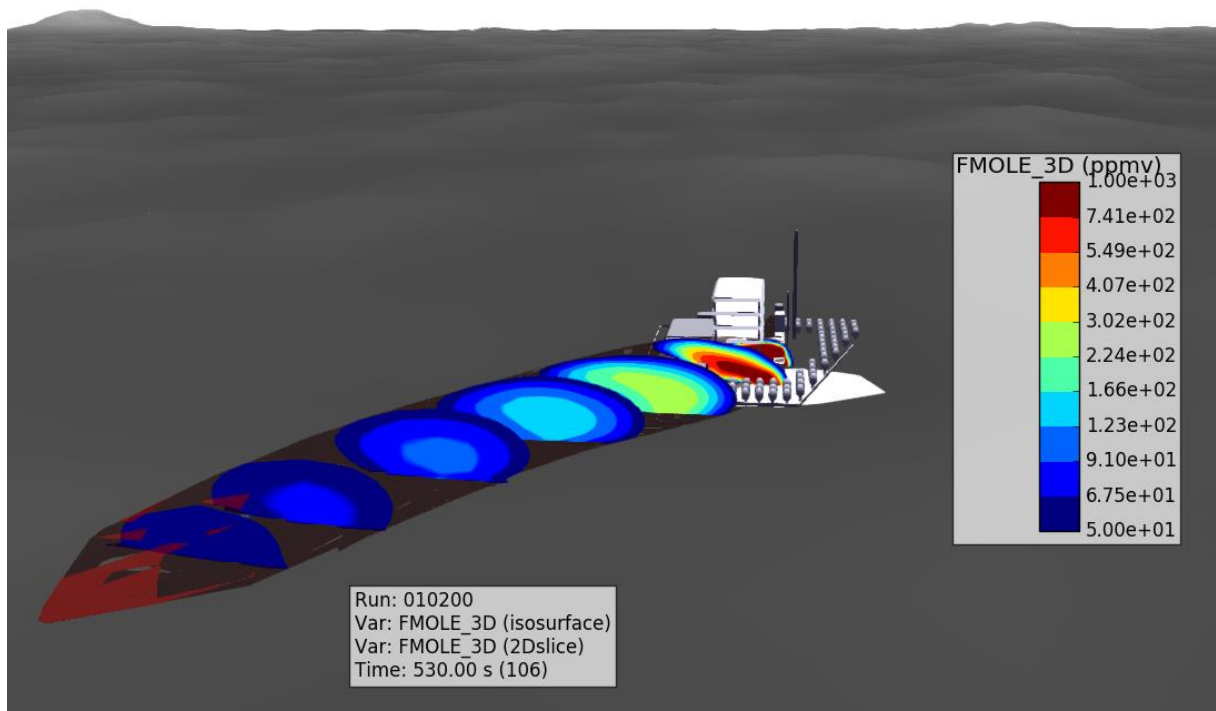


Figure 3-2: Phosphine cloud for IDLH 50 ppm at 530 seconds for wind direction from North-East to South-West, wind speed 2.0 m/s.

3.1.1 2D Cut Plane of a Steady Phosphine Gas Cloud

In figures, the 2D cut planes for Phosphine dispersion scenario are plotted on XY plane & YZ plane. The Figure 3-3 and Figure 3-4 show the Phosphine gas cloud of 50-1000 ppm, for a given wind direction and wind speed. The Phosphine gas cloud is stabilised at **530 seconds** and the stabilised Phosphine gas cloud length is up-to **138 meters** as shown in Figure 3-3. The maximum height is **11 meters** with concentration equal to IDLH value of Phosphine as shown in Figure 3-4.

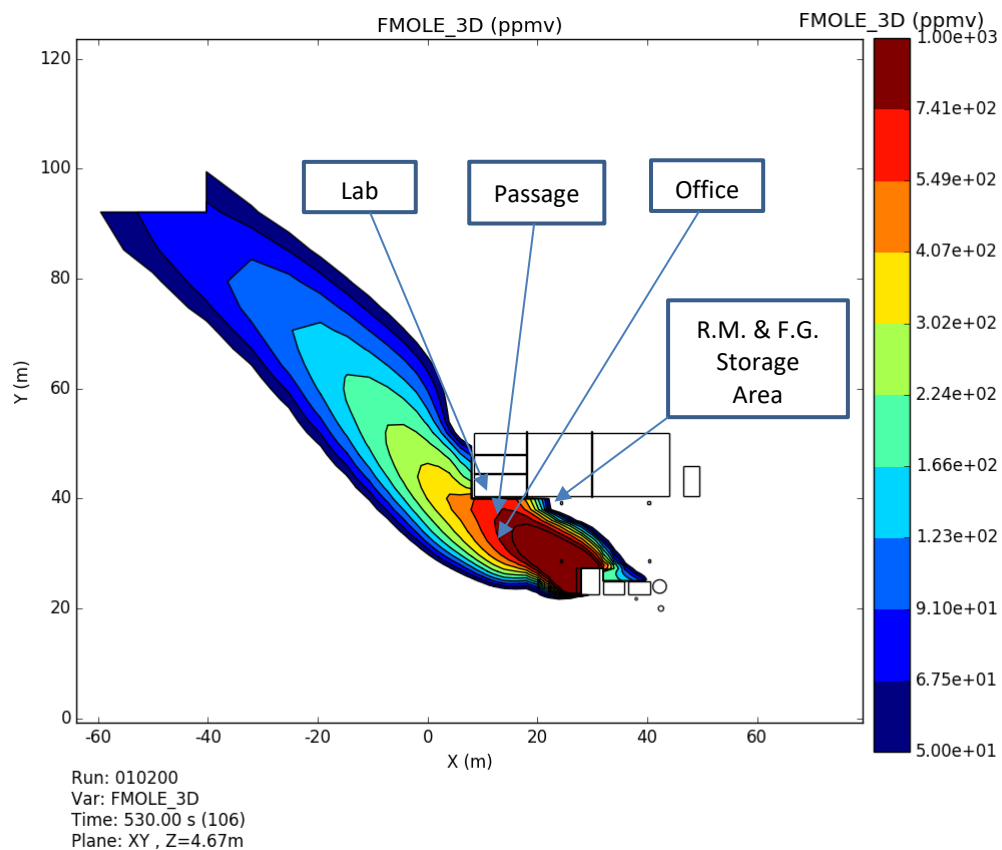


Figure 3-3: Phosphine stabilized cloud at 530 seconds at wind speed 2.0 m/s shown in XY plane at Z= 4.67 meters.

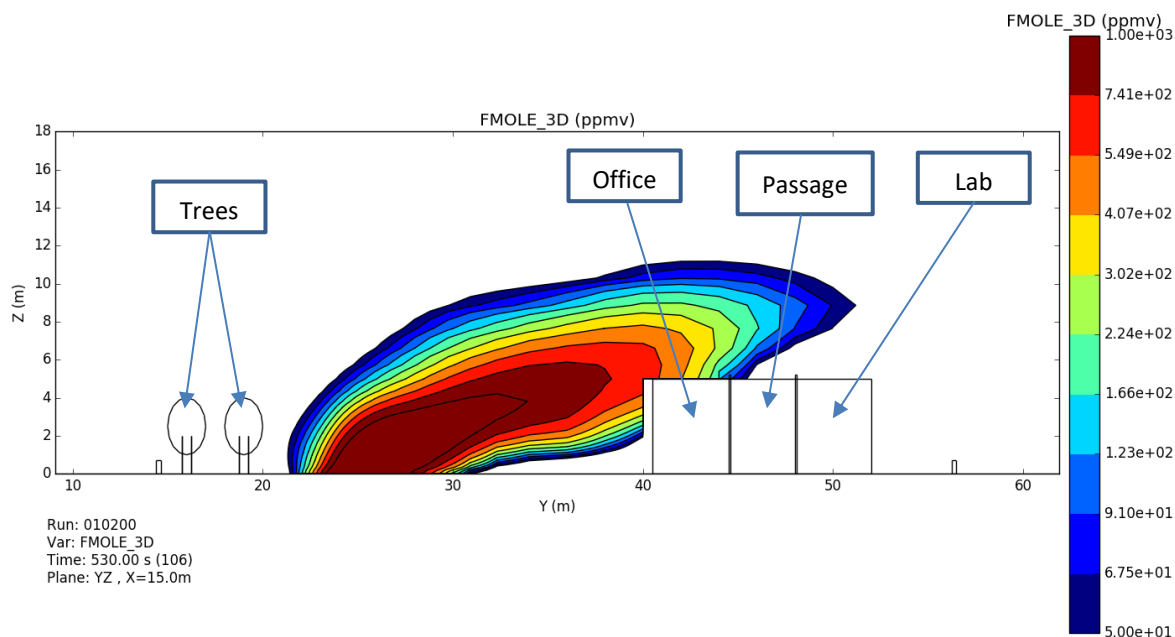


Figure 3-4: Phosphine cloud at 530 seconds at wind speed 2.0 m/s shown in YZ plane at X= 15 meters.

3.2 Results from Phosphoric Acid Dispersion Simulation

The leak scenario described in the section 2.4 was simulated. Simulations were performed to capture the dispersion of the Phosphoric Acid vapours, its mixing with air, dilution process and cloud movement based on the prevailing wind condition.

The resulting cloud was simulated for **300 seconds** after the leak. The leak started at **50 seconds** of simulation time. The IDLH concentration Phosphoric Acid vapour cloud is stabilised at **105 seconds** and the stabilised Phosphoric Acid vapour cloud length is up-to **17 meters** towards South-West. The toxic vapour cloud stays within the plant boundary and spread towards the Green area in South-West direction.

The term immediately dangerous to life or health (IDLH) is defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that is "likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. Based on NIOSH reference, this value was taken as 250 ppm.^[4]

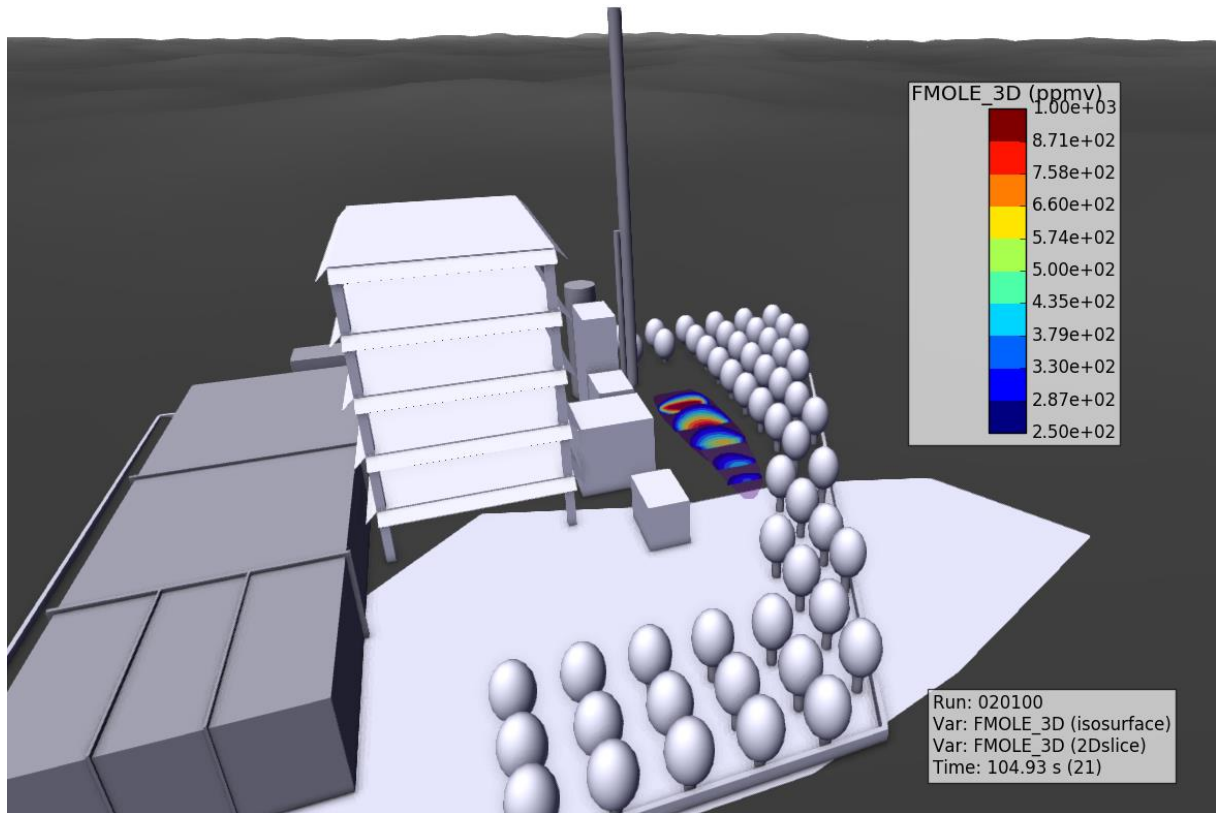


Figure 3-5: Phosphoric Acid cloud at 105 seconds for wind direction North-East to South-West, wind speed 2.0 m/s

3.2.1 2D Cut Plane of a Phosphoric Acid Vapour Cloud

In figures, the 2D cut planes for Phosphoric Acid dispersion scenario are plotted on XY plane & YZ plane. The Figure 3-6 and Figure 3-7 show the Phosphine gas cloud of 250-1000 ppm, for a given wind direction and wind speed. The Phosphoric Acid vapour cloud is stabilised at **105 seconds** and the stabilised Phosphine gas cloud length is up-to **17 meters** as shown in Figure 3-6. The maximum height of IDLH concentration Phosphoric Acid vapour cloud is **2.5 meters**, as shown in Figure 3-7.

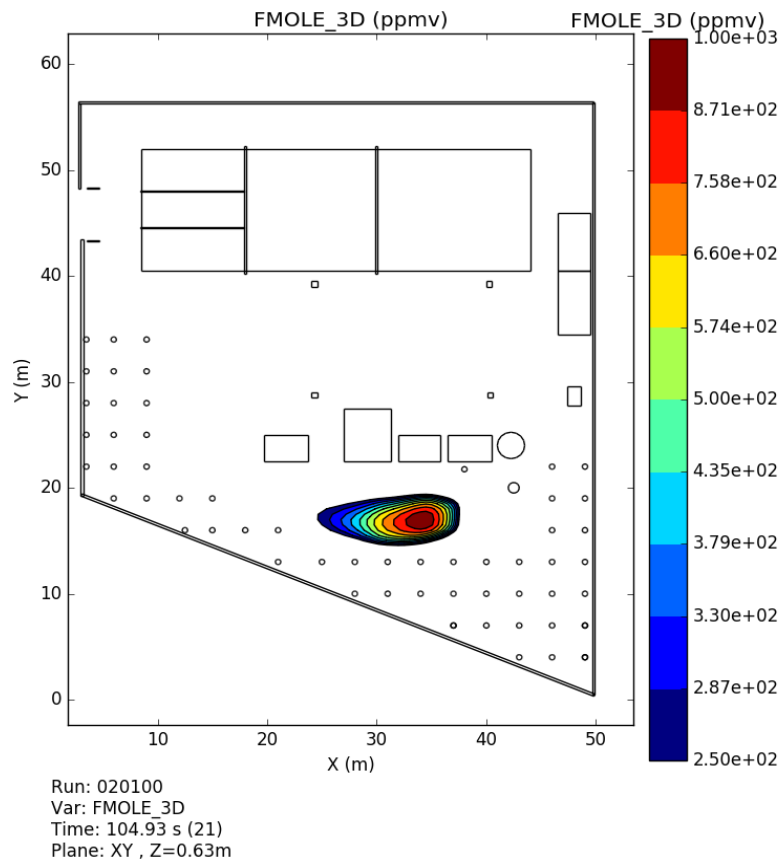


Figure 3-6: Phosphoric Acid cloud at 105 seconds for wind direction North-East to South-West, wind speed 2.0 m/s shown in XY plane at Z= 0.63 meter.

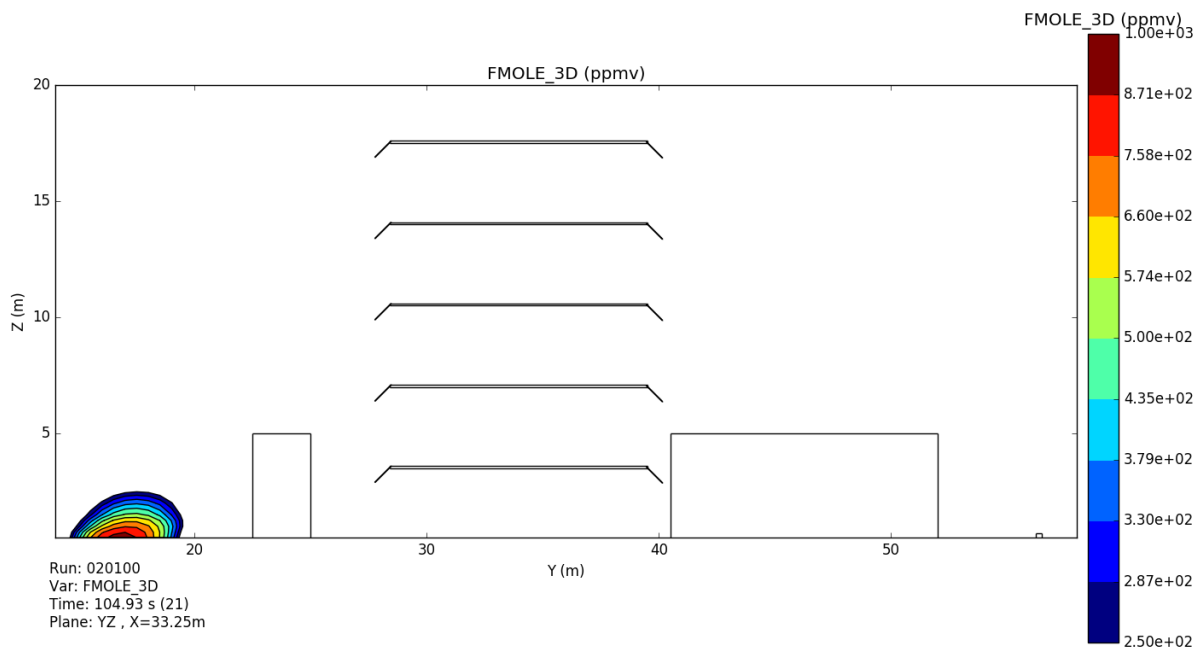


Figure 3-7: Phosphoric Acid cloud at 105 seconds for wind direction North-East to South-West, wind speed 2.0 m/s shown in YZ plane at X= 33.25 meters.

3.3 Velocity Vector Plot for Toxic Dispersions

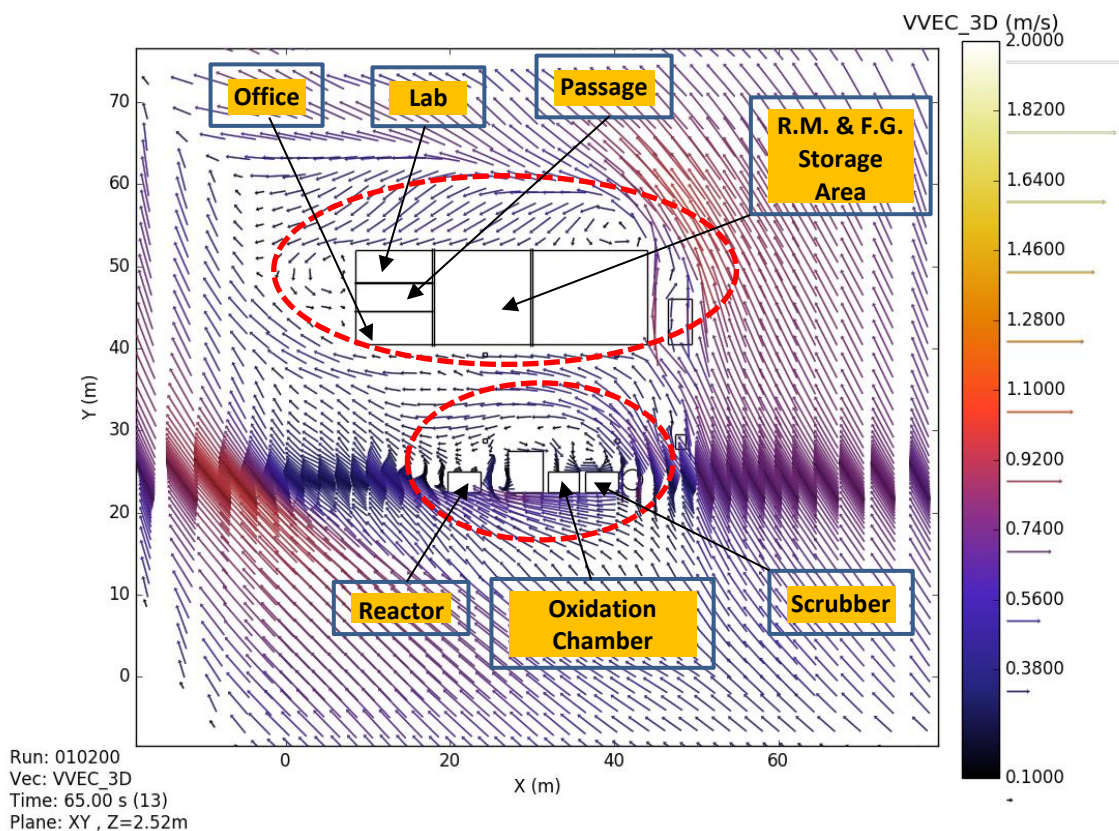


Figure 3-8: Velocity vector plot for toxic dispersions at 65 seconds at wind speed 2.0 m/s.

At wind speeds 2.0 m/s (light wind), the mixing of air - gas mixture is largely dominated by the diffusion process and hence a large gas clouds were formed. In addition, the wake flow behind the **Packing area**, **Oxidation chamber**, **Scrubber** and at the corner of **Lab** obstructing the wind flow that further slows down the speed and results in less dilution of the toxic gas cloud as shown by dotted circle in Figure 3-8. At higher wind speed (strong winds), the concentrated gas clouds will be relatively smaller due to dilution by the wind.

3.4 Analysis and discussion

Case-1: Dispersion of Phosphine:

Consequences of failure of Ammonium Phosphide reaction pot assembly releasing Phosphine at ICPL, Sarigam plant was studied using 3D CFD software FLACS. This accident scenario was studied with probable wind direction i.e. wind transmitted towards plant from North-East to South-West wind direction and 2.0 m/s wind speed. The dispersion of Phosphine cloud was simulated up-to 800 seconds and maximum distance travelled by Phosphine cloud is 138 meters in 530 seconds. The result of this simulation is presented in this chapter earlier.

Based on the results that are obtained and presented above, the Phosphine cloud with concentrations above the IDLH concentrations spread to **Oxidation chamber, Scrubber, Gate, Plant area, Lab, Passage, Office and R.M. & F.G. Storage Area** in the downwind, depending on the wind direction and the wind velocity. The harmful concentrations are present at ground level and up to the height of the buildings in the plant. Thus, any personnel present in these regions can be exposed to dangerous levels of Phosphine cloud. A mitigation strategy is needed to ensure safety of personnel in such an accident event.

Case-2: Dispersion of Phosphoric Acid:

Consequences of loss of containment of Phosphoric Acid from Phosphoric Acid tank at ICPL, Sarigam plant was studied using 3D CFD software FLACS. This accident scenario was studied with worst wind direction i.e. wind flowing towards plant from North-East to South-West wind direction and 2.0 m/s wind speed. The dispersion of Phosphoric Acid vapour cloud was simulated up-to 300 seconds and maximum distance travelled by Phosphine cloud is 17 meters in 105 seconds. The result of this simulation is presented in this chapter earlier.

Based on the results that are obtained and presented above, the Phosphoric Acid cloud with concentrations above the IDLH concentrations spread to **Green area**, depending on the wind direction and the wind velocity. A mitigation strategy is needed to ensure safety of personnel in such an accident event.

4 Conclusion

This project report describes CFD simulations carried out as a part of consequence analysis study for loss of containment of Phosphine and Phosphoric Acid at Integrated Chemisol Pvt. Ltd., Sarigam, Valsad district, Gujarat, India.

Based on the 3D CFD consequences analysis, the Phosphine gas, after the leak from the reaction pot assembly, dispersed with the wind and cloud travelled up to **138 meters** length with subsequent dilution in concentration. Thus, the toxic fumes travelled, crossed the plant boundary. **The Phosphine gas behaves as “Neutrally buoyant gas”** so IDLH concentration gas cloud reaches up-to maximum height of **11 meters**. The maximum concentration of Phosphine gas that can be retained within the facility is more than 1000 ppm, closer to the ground.

Based on the 3D CFD consequences analysis, the Phosphoric Acid (toxic) vapour cloud will remain within the plant boundary. **The evaporation rate of spilled Phosphoric acid is found to be very less due to which Phosphoric acid vapour cloud stabilized very quickly in 55 seconds after the leak.** The Phosphoric Acid vapour cloud travelled up-to **17 meters** from leak source. **As Phosphoric acid vapours are heavier than air**, the maximum height of IDLH concentration gas cloud reaches up-to **2.5 meters** only.

Since the clouds of Phosphine and Phosphoric Acid are toxic to the health and wind direction is North-East to South-West, there is a possibility that employees and contract workers near **Oxidation chamber, Scrubber, Gate, Plant area, Lab, Passage, Office, R.M. & F.G. Storage Area, Green area** in the downwind can be exposed to toxic gases.

Following are the safety measures for the Phosphine and Phosphoric Acid. The consequences can be minimized having these mitigation measures.

A. PHOSPHINE

HEALTH HAZARDS

- Phosphine is highly toxic to the human respiratory system and organs. Phosphine has an odour of decaying fish or welding grade acetylene. The odour of phosphine depends on the impurities it contains and the environment into which it is released.
- Phosphine can be corrosive to the respiratory tract and primarily attacks the cardiovascular and respiratory systems causing Central Nervous System (CNS) depression, peripheral vascular collapse, cardiac arrest and failure, and pulmonary oedema.

	Preventive Safeguards (controls)	Mitigative safeguards (controls)
1	Use only non-sparking tools	- Advised a gas detection system. Typical detectors are: - Photo- absorption - Photo- ionisation - Thermal conductivity
2	Check (periodically - scheduled) the entire gas system for if any possible leakage.	- Locate flame detectors to detect fires in potential Phosphine leak areas. - Ultraviolet /infrared (UV/IR) flame detectors is suitable for phosphine service. - Temperature Rate of Rise (ROR) indicators can also be suitable for indoor use. [5]
3	Recommend installation of a cross purge assembly between the container and the regulator.	Prepare an emergency Shutdown procedure to stop the process immediately in case of fire.
4	Purge gas system with inert gas (eg. Helium or Nitrogen) before Phosphine gas is introduced and whenever the system is out of service.	Provide Nitrogen to operate automatic control valves instead of instrument air.
5	Avoid suck back of water, Acid or Alkali.	Provide an automatic alarm system to make plant personnel and visitors to act upon.
6		Train the personnel for wearing protective clothing and use of self-contained breathing apparatus (SCBA) while fighting Phosphine emergencies.
7		Act to stop Phosphine release. Reduce vapour in atmosphere by fine water spray, if a Phosphine is already leaked.

B. PHOSPHORIC ACID**HEALTH HAZARDS**

- Phosphoric Acid is a corrosive chemical and contact can irritate and burn the eyes.
- Long-term exposure to the liquid may cause drying and cracking of the skin.
- Breathing Phosphoric Acid can irritate the nose, throat and lungs causing coughing and wheezing.

	Preventive Safeguards (controls)	Mitigative safeguards (controls)
1	• For solid Phosphoric Acid, use a vacuum to reduce dust during clean-up. Do not try dry sweep.	• As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids. [ERG Guide 154, Substances - Toxic and/or Corrosive (Non-Combustible)]
2	• Although phosphoric acid is not combustible, it can react with metals to liberate hydrogen, a flammable gas, so store it away from incompatible materials.	

A 1 Appendix A: Material Safety Data for the Chemicals Studied

Material Safety Data Sheets for the Chemicals studied are attached herewith.



Phosphine
MSDS.pdf



Phosphoric Acid
MSDS.pdf

SAFETY DATA SHEET**Airgas**

Phosphine

Section 1. Identification

GHS product identifier	: Phosphine
Chemical name	: phosphine
Other means of identification	: Trihydrogen phosphide; Hydrogen phosphide; Phosphorus trihydride; PH ₃ ; Phosphene; Phosphorus hydride; Celphos; Delicia; Detia; Detia gas ex-B; Fosforowodor; Gas-ex-B; Phosphorwasserstoff; Rcra waste number P096; UN 2199
Product use	: Synthetic/Analytical chemistry.
Synonym	: Trihydrogen phosphide; Hydrogen phosphide; Phosphorus trihydride; PH ₃ ; Phosphene; Phosphorus hydride; Celphos; Delicia; Detia; Detia gas ex-B; Fosforowodor; Gas-ex-B; Phosphorwasserstoff; Rcra waste number P096; UN 2199
SDS #	: 001070
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Emergency telephone number (with hours of operation)	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Compressed gas PYROPHORIC GASES ACUTE TOXICITY (inhalation) - Category 1 SKIN CORROSION/IRRITATION - Category 1 SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1 AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements**Hazard pictograms****Signal word****Hazard statements**

- : Danger
- : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
Catches fire spontaneously if exposed to air.
Fatal if inhaled.
Causes serious eye damage.
Causes severe skin burns and eye damage.
Very toxic to aquatic life.

Precautionary statements

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Phosphine

Section 2. Hazards identification

General	: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use only with equipment purged with inert gas or evacuated prior to discharge from cylinder. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Approach suspected leak area with caution.
Prevention	: Never Put cylinders into unventilated areas of passenger vehicles. Wear protective gloves. Wear eye or face protection. Wear respiratory protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe gas. Wash hands thoroughly after handling. Use and store only outdoors or in a well ventilated place.
Response	: Collect spillage. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
Storage	: Store locked up. Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.
Disposal	: Dispose of contents and container in accordance with all local, regional, national and international regulations.
Supplemental label elements	: Keep container tightly closed. Keep away from heat, sparks, open flames and hot surfaces. - No smoking.
Hazards not otherwise classified	: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture	: Substance
Chemical name	: phosphine
Other means of identification	: Trihydrogen phosphide; Hydrogen phosphide; Phosphorus trihydride; PH ₃ ; Phosphene; Phosphorus hydride; Celphos; Delicia; Detia; Detia gas ex-B; Fosforowodor; Gas-ex-B; Phosphorwasserstoff; Rcra waste number P096; UN 2199

CAS number/other identifiers

CAS number	: 7803-51-2
Product code	: 001070

Ingredient name	%	CAS number
phosphine	100	7803-51-2

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

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Phosphine

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.
- Inhalation** : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
- Skin contact** : Get medical attention immediately. Call a poison center or physician. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Causes serious eye damage. Contact with rapidly expanding gas may cause burns or frostbite.
- Inhalation** : Fatal if inhaled. May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.
- Skin contact** : Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : May cause burns to mouth, throat and stomach. As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:
pain
watering
redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur
- Ingestion** : Adverse symptoms may include the following:
stomach pains

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.

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Phosphine

Section 4. First aid measures

- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures**Extinguishing media**

- Suitable extinguishing media** : Use dry chemical powder.

- Unsuitable extinguishing media** : Do not use water jet.

- Specific hazards arising from the chemical** : Spontaneously flammable in air. Contains gas under pressure. Extremely flammable gas. May re-ignite itself after fire is extinguished. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Runoff to sewer may create fire or explosion hazard. This material is very toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

- Hazardous thermal decomposition products** : Decomposition products may include the following materials: phosphorus oxides

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures**Personal precautions, protective equipment and emergency procedures**

- For non-emergency personnel** : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

- For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

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Phosphine

Section 6. Accidental release measures

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.
- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Do not breathe gas. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. This product should be handled using appropriate techniques that avoid exposure to atmospheric oxygen and moisture. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Use non-sparking tools. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Store locked up. Keep under an inert atmosphere. Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
phosphine	ACGIH TLV (United States, 3/2012). STEL: 1.4 mg/m³ 15 minutes. STEL: 1 ppm 15 minutes. TWA: 0.42 mg/m³ 8 hours. TWA: 0.3 ppm 8 hours. NIOSH REL (United States, 1/2013). STEL: 1 mg/m³ 15 minutes. STEL: 1 ppm 15 minutes. TWA: 0.4 mg/m³ 10 hours. TWA: 0.3 ppm 10 hours. OSHA PEL (United States, 6/2010). TWA: 0.4 mg/m³ 8 hours. TWA: 0.3 ppm 8 hours. OSHA PEL 1989 (United States, 3/1989). STEL: 1 mg/m³ 15 minutes. STEL: 1 ppm 15 minutes.
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Phosphine

Section 8. Exposure controls/personal protectionTWA: 0.4 mg/m³ 8 hours.
TWA: 0.3 ppm 8 hours.**Appropriate engineering controls**

- : Use only with adequate ventilation. Engineering controls may be required to control the primary or secondary risks associated with this product. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

- : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures**Hygiene measures**

- : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

- : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection**Hand protection**

- : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

- : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection

- : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

- : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

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Phosphine

Section 9. Physical and chemical properties**Appearance**

Physical state	: Gas. [Compressed gas.]
Color	: Colorless.
Molecular weight	: 34 g/mole
Molecular formula	: H ₃ -P
Boiling/condensation point	: -87.7°C (-125.9°F)
Melting/freezing point	: -133°C (-207.4°F)
Critical temperature	: 51.556°C (124.8°F)
Odor	: Fish. Garlic.
Odor threshold	: Not available.
pH	: Not available.
Flash point	: Not available.
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Lower: 1.8% Upper: 98%
Vapor pressure	: Not available.
Vapor density	: 1.17 (Air = 1)
Specific Volume (ft³/lb)	: 11.4286
Gas Density (lb/ft³)	: 0.0875 (20°C / 68 to °F)
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: 38°C (100.4°F)
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not applicable.

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Hazardous reactions or instability may occur under certain conditions of storage or use. Conditions may include the following: contact with air Reactions may include the following: spontaneous flammability
Conditions to avoid	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow contact with air.

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Phosphine

Section 10. Stability and reactivity**Incompatibility with various substances** : Highly reactive or incompatible with the following materials: oxidizing materials.**Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.**Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.**Section 11. Toxicological information****Information on toxicological effects****Acute toxicity**

Product/ingredient name	Result	Species	Dose	Exposure
phosphine	LC50 Inhalation Gas. LC50 Inhalation Gas.	Rat Rat	22 ppm 11 ppm	1 hours 4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.**Potential acute health effects**

- Eye contact** : Causes serious eye damage. Contact with rapidly expanding gas may cause burns or frostbite.
- Inhalation** : Fatal if inhaled. May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.
- Skin contact** : Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.

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Phosphine

Section 11. Toxicological information

Ingestion : May cause burns to mouth, throat and stomach. As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

Delayed and immediate effects and also chronic effects from short and long term exposure**Short term exposure**

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity**Acute toxicity estimates**

Not available.

Section 12. Ecological information**Toxicity**

Not available.

Persistence and degradability

Not available.

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Phosphine

Section 12. Ecological information**Bioaccumulative potential**

Not available.

Mobility in soil**Soil/water partition coefficient (K_{oc})** : Not available.**Other adverse effects** : No known significant effects or critical hazards.**Section 13. Disposal considerations****Disposal methods** : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.**United States - RCRA Acute hazardous waste "P" List**

Ingredient	CAS #	Status	Reference number
Phosphine; Hydrogen phosphide	7803-51-2	Listed	P096

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN2199	UN2199	UN2199	UN2199	UN2199
UN proper shipping name	PHOSPHINE	PHOSPHINE	PHOSPHINE	PHOSPHINE	PHOSPHINE
Transport hazard class(es)	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	Yes.	No.
Additional information	Inhalation hazard zone A Reportable quantity 100 lbs / 45.4 kg Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable)	Special provisions 38	-	The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.	The environmentally hazardous substance mark may appear if required by other transportation regulations. Passenger and Cargo Aircraft Quantity limitation: 0 Forbidden Cargo Aircraft Only
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Powered by IHS

Phosphine

Section 14. Transport information

	quantity) transportation requirements.				Quantity limitation: 0 Forbidden
	Limited quantity Yes.				
	Packaging instruction Passenger aircraft Quantity limitation: Forbidden.				
	Cargo aircraft Quantity limitation: Forbidden.				
	Special provisions 1				

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated toxic substances: phosphine

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
phosphine	100	Yes.	500	-	100	-

SARA 304 RQ : 100 lbs / 45.4 kg

SARA 311/312

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Phosphine

Section 15. Regulatory information

Classification : Fire hazard
Sudden release of pressure
Immediate (acute) health hazard

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
phosphine	100	Yes.	Yes.	No.	Yes.	No.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	phosphine	7803-51-2	100
Supplier notification	phosphine	7803-51-2	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.
New York : This material is listed.
New Jersey : This material is listed.
Pennsylvania : This material is listed.
Canada inventory : This material is listed or exempted.

International regulations

International lists : **Australia inventory (AICS)**: This material is listed or exempted.
China inventory (IECSC): This material is listed or exempted.
Japan inventory: This material is listed or exempted.
Korea inventory: This material is listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.
Philippines inventory (PICCS): This material is listed or exempted.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).

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Section 15. Regulatory information**CEPA Toxic substances:** This material is not listed.**Canadian ARET:** This material is not listed.**Canadian NPRI:** This material is not listed.**Alberta Designated Substances:** This material is not listed.**Ontario Designated Substances:** This material is not listed.**Quebec Designated Substances:** This material is not listed.**Section 16. Other information**

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).

Hazardous Material Information System (U.S.A.)

Health	4
Flammability	4
Physical hazards	3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

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Phosphine

Section 16. Other information**Key to abbreviations**

: ATE = Acute Toxicity Estimate
 BCF = Bioconcentration Factor
 GHS = Globally Harmonized System of Classification and Labelling of Chemicals
 IATA = International Air Transport Association
 IBC = Intermediate Bulk Container
 IMDG = International Maritime Dangerous Goods
 LogPow = logarithm of the octanol/water partition coefficient
 MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
 UN = United Nations
 ACGIH – American Conference of Governmental Industrial Hygienists
 AIHA – American Industrial Hygiene Association
 CAS – Chemical Abstract Services
 CEPA – Canadian Environmental Protection Act
 CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
 CFR – United States Code of Federal Regulations
 CPR – Controlled Products Regulations
 DSL – Domestic Substances List
 GWP – Global Warming Potential
 IARC – International Agency for Research on Cancer
 ICAO – International Civil Aviation Organisation
 Inh – Inhalation
 LC – Lethal concentration
 LD – Lethal dosage
 NDSL – Non-Domestic Substances List
 NIOSH – National Institute for Occupational Safety and Health
 TDG – Canadian Transportation of Dangerous Goods Act and Regulations
 TLV – Threshold Limit Value
 TSCA – Toxic Substances Control Act
 WEEL – Workplace Environmental Exposure Level
 WHMIS – Canadian Workplace Hazardous Material Information System

References

: Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

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Infosafe No™ 1CH4S Issue Date : September 2014 RE-ISSUED by CHEMSUPP

Product Name : **PHOSPHORIC ACID 85%**

Classified as hazardous

1. Identification

GHS Product Identifier	PHOSPHORIC ACID 85%														
Company Name	CHEM-SUPPLY PTY LTD (ABN 19 008 264 211)														
Address	38 - 50 Bedford Street GILLMAN SA 5013 Australia														
Telephone/Fax Number	Tel: (08) 8440-2000 Fax: (08) 8440-2001														
Recommended use of the chemical and restrictions on use	Fertilizer; manufacturer of phosphate fertilizers and salts, polyphosphates, soil stabiliser, detergents, pharmaceutical chemicals, activated carbon, animal feed, ceramics, food additive, food processing, soap, rust inhibitors, wax and rubber latex; also used in electropolishing, engraving and photoengraving, printing, opal glasses, cotton dyeing, metal cleaning, sugar refining and water treatment. Petrol additive, soft drinks, and laboratory reagent.														
Other Names	<table border="1"> <thead> <tr> <th>Name</th><th>Product Code</th></tr> </thead> <tbody> <tr> <td>PHOSPHORIC ACID 85% AR</td><td>PA000</td></tr> <tr> <td>PHOSPHORIC ACID 85% LR</td><td>PL000</td></tr> <tr> <td>PHOSPHORIC ACID 85% FCC</td><td>PP000</td></tr> <tr> <td>PHOSPHORIC ACID 85% TG</td><td>PT000</td></tr> <tr> <td>PHOSPHORIC ACID 25% w/w AR</td><td>PA384</td></tr> <tr> <td>Orthophosphoric Acid</td><td></td></tr> </tbody> </table>	Name	Product Code	PHOSPHORIC ACID 85% AR	PA000	PHOSPHORIC ACID 85% LR	PL000	PHOSPHORIC ACID 85% FCC	PP000	PHOSPHORIC ACID 85% TG	PT000	PHOSPHORIC ACID 25% w/w AR	PA384	Orthophosphoric Acid	
Name	Product Code														
PHOSPHORIC ACID 85% AR	PA000														
PHOSPHORIC ACID 85% LR	PL000														
PHOSPHORIC ACID 85% FCC	PP000														
PHOSPHORIC ACID 85% TG	PT000														
PHOSPHORIC ACID 25% w/w AR	PA384														
Orthophosphoric Acid															
Other Information	EMERGENCY CONTACT NUMBER: +61 08 8440 2000 Business hours: 8:30am to 5:00pm, Monday to Friday.														

Chem-Supply Pty Ltd does not warrant that this product is suitable for any use or purpose. The user must ascertain the suitability of the product before use or application intended purpose. Preliminary testing of the product before use or application is recommended. Any reliance or purported reliance upon Chem-Supply Pty Ltd with respect to any skill or judgement or advice in relation to the suitability of this product of any purpose is disclaimed. Except to the extent prohibited at law, any condition implied by any statute as to the merchantable quality of this product or fitness for any purpose is hereby excluded. This product is not sold by description. Where the provisions of Part V, Division 2 of the Trade Practices Act apply, the liability of Chem-Supply Pty Ltd is limited to the replacement of supply of equivalent goods or payment of the cost of replacing the goods or acquiring equivalent goods.

2. Hazard Identification

GHS classification of the substance/mixture	Corrosive to Metals: Category 1 Skin Corrosion/Irritation: Category 1A
Signal Word (s)	DANGER
Hazard Statement (s)	H290 May be corrosive to metals. H314 Causes severe skin burns and eye damage.
Pictogram (s)	Corrosion



Precautionary statement – Prevention	P234 Keep only in original container. P261 Avoid breathing dust/fume/gas/mist/vapours/spray. P264 Wash thoroughly after handling.
Precautionary statement – Response	P280 Wear protective gloves/protective clothing/eye protection/face protection. P301+P330+P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting. P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P310 Immediately call a POISON CENTER or doctor/physician.

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Product Name : **PHOSPHORIC ACID 85%**

Classified as hazardous

Precautionary statement – Storage
P363 Wash contaminated clothing before reuse.
P405 Store locked up.
P406 Store in corrosive resistant/container with a resistant inner liner.

3. Composition/information on ingredients

Chemical Characterization	Liquid				
Ingredients	Name	CAS	Proportion	Hazard Symbol	Risk Phrase
	Phosphoric acid	7664-38-2	85 %	C	R34
	Water to make a total of 100%	7732-18-5	-		

4. First-aid measures

Inhalation	If inhaled, remove from contaminated area to fresh air immediately. Apply artificial respiration if not breathing. If breathing is difficult, give oxygen. Immediately obtain medical aid if cough or other symptoms appear.
Ingestion	DO NOT INDUCE VOMITING. Wash out mouth with water, afterwards drink plenty of water. Seek immediate medical attention.
Skin	Remove contaminated clothing and wash before re-use. Wash affected areas with copious quantities of water immediately. Seek immediate medical advice.
Eye contact	Seek immediate medical assistance. Immediately irrigate with copious quantity of water for at least 15 minutes. Eyelids to be held open.
First Aid Facilities	Maintain eyewash fountain and safety shower in work area.
Advice to Doctor	Treat symptomatically as for strong acids. Consult Poisons Information Centre.
Other Information	For advice, contact the National Poisons Information Centre (Phone Australia 13 11 26; New Zealand 0800 764 766) or a doctor.

5. Fire-fighting measures

Hazards from Combustion Products	Phosphoric acid forms toxic phosphorous oxide fumes on combustion.
Specific Methods	Use extinguishing media most appropriate for the surrounding fire. No limitations to the type of extinguishing media. Small fire: Use dry chemical, CO2 or water spray. Large fire: Use water spray, fog or foam - Do NOT use water jets. If safe to do so, move undamaged containers from the fire area. Cool containers with flooding quantities of water until well after the fire is out. Avoid getting water inside the containers.
Specific hazards arising from the chemical	Material does not burn. Fire or heat will produce irritating, poisonous and/or corrosive gases. Containers may explode when heated.
Hazchem Code	2R
Precautions in connection with Fire	Wear SCBA and chemical splash suit. Fully encapsulating, gas-tight suits should be worn for maximum protection. Structural firefighter's uniform is NOT effective for these materials.

6. Accidental release measures

Personal Precautions	Avoid inhalation and ingestion. Avoid contact with skin, eyes and clothing. Evacuate the area of all non-essential personnel.
Personal Protection	Wear protective clothing specified for normal operations (see Section 8)
Clean-up Methods - Small Spillages	Absorb or contain liquid with sand, earth or spill control material. Shovel up using non sparking tools and place in a labelled, sealable container for subsequent safe disposal. Put leaking containers in a labelled drum or overdrum.
Clean-up Methods - Large Spillages	Seek expert advice on handling and disposal.
Environmental Precautions	Avoid release to the environment.

7. Handling and storage

Precautions for Safe Handling	Avoid prolonged or repeated contact with skin, eyes and clothing. Wash hands and face thoroughly after working with material. Use with adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when
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Product Name : **PHOSPHORIC ACID 85%**

Classified as hazardous

Conditions for safe storage, including any incompatibilities

possible. Keep away from incompatibles. Store in well ventilated area. Store away from foodstuffs. Keep containers securely sealed and protected against physical damage. Store away from sources of heat or ignition. Keep dry and protect from direct sunlight. Protect from freezing.

Corrosiveness

Extremely corrosive in presence of copper, brass and stainless steel. Highly corrosive in presence of aluminium. Mild corrosive effect on bronze. Corrosive to ferrous metals and alloys. Non-corrosive in presence of glass.

Storage Regulations Refer Australian Standard AS 3780 - 1994 'The storage and handling of corrosive substances'.

8. Exposure controls/personal protection

Occupational exposure limit values	Name	STEL		TWA		Footnote
		mg/m3	ppm	mg/m3	ppm	
	Phosphoric acid	3		1		
Other Exposure Information	STEL: 3 mg/m3 - - Worksafe Aust. A time weighted average (TWA) has been established for Phosphoric acid (Safe Work Australia) of 1 mg/m3. The corresponding STEL level is 3 mg/m3. The STEL (Short Term Exposure Limit) is an exposure value that should not be exceeded for more than 15 minutes and should not be repeated for more than 4 times per day. There should be at least 60 minutes between successive exposures at the STEL. The exposure value at the TWA is the average airborne concentration of a particular substance when calculated over a normal 8 hour working day for a 5 day working week.					
Appropriate engineering controls	Provide sufficient ventilation to ensure that the working environment is below the TWA (time weighted average). In industrial situations maintain the concentrations values below the TWA. This may be achieved by process modification, use of local exhaust ventilation, capturing substances at the source, or other methods.					
Respiratory Protection	Where ventilation is not adequate, respiratory protection may be required. Avoid breathing dust, vapours or mists. Respiratory protection should comply with AS 1716 - Respiratory Protective Devices and be selected in accordance with AS 1715 - Selection, Use and Maintenance of Respiratory Protective Devices. Filter capacity and respirator type depends on exposure levels. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.					
Eye Protection	The use of a face shield, chemical goggles or safety glasses with side shield protection as appropriate.					
Hand Protection	Must comply with Australian Standards AS 1337 and be selected and used in accordance with AS 1336. Avoid skin contact when removing gloves from hands, do not touch the gloves outer surface. Dispose of gloves as hazardous waste. Hand protection should comply with AS 2161, Occupational protective gloves - Selection, use and maintenance. Recommendation: rubber or plastic gloves.					
Personal Protective Equipment	Final choice of personal protective equipment will depend on individual circumstances and/or according to risk assessments undertaken.					
Footwear	Safety boots in industrial situations is advisory, foot protection should comply with AS 2210, Occupational protective footwear - Guide to selection, care and use.					
Body Protection	Clean clothing or protective clothing should be worn, preferably with and apron. Clothing for protection against chemicals should comply with AS 3765 Clothing for Protection Against Hazardous Chemicals.					
Hygiene Measures	Always wash hands before smoking, eating or using the toilet. Wash contaminated clothing and other protective equipment before storing or re-using.					

9. Physical and chemical properties

Form	Liquid
Appearance	Clear, colourless, syrupy liquid.
Odour	Odourless.
Melting Point	21 °C
Boiling Point	158 °C
Solubility in Water	Soluble in water.
Specific Gravity	1.685

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Product Name : **PHOSPHORIC ACID 85%**

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pH	1 (100 g/l, H ₂ O, 20 °C)
Vapour Pressure	2.2 hPa
Vapour Density (Air=1)	3.4 (pure)
Flammability	Non combustible material.
Molecular Weight	98.0

10. Stability and reactivity

Chemical Stability Stable under normal use conditions.**Conditions to Avoid** Incompatibles.**Incompatible Materials** Acetulides, alcohols, aldehydes, amides, amines, ammonia or bleach, azo-compounds, carbides, carbamates, caustics, chlorides, combustible materials, cyanides, esters, epoxides, fluorides, glycols, halogenated organics, ketones, mercaptans, nitromethane, organic peroxides, organophosphates, phenols and cresols, phosphides, silicides, sodium tetrahydroborate, strong caustics, stainless steel, sulfides and unsaturated halides.**Possibility of hazardous reactions** Phosphoric acid decomposes under formation of toxic fumes on contact with alcohols, cyanides, ketones, phenols, esters, sulfides, mercaptans and halogenated organic compounds. Liberates explosive hydrogen gas when reacting with chlorides and stainless steel. Exothermic reactions with aldehydes, amines, amides, alcohols and glycols, azo-compounds, carbamates, esters, caustics, phenols and cresols, organophosphates, epoxides, explosives, combustible materials, unsaturated halides, sodium tetrahydroborate, organic peroxides.**Hazardous Polymerization** Will not occur.

11. Toxicological Information

Acute Toxicity - Oral LD50 (rat): 1,530 mg/kg (anhydrous) (IUCLID)**Acute Toxicity - Dermal** LD50 (rabbit): 2,740 mg/kg (anhydrous) (IUCLID)**Ingestion** Harmful if swallowed and absorbed through membranes. Burns to the mouth, throat and stomach. Symptoms include sour acid taste, coughing, difficult breathing and swallowing, conjunctivitis, severe gastrointestinal irritation, nausea, vomiting, bloody diarrhoea, severe abdominal pains, extreme thirst, convulsions.**Inhalation** Harmful if inhaled. Vapour or mist can cause irritation of the nose, throat, and upper respiratory tract. Severe exposures can lead to a chemical pneumonitis.**Skin** Harmful if absorbed through skin. Corrosive. Concentrated acid solutions can cause redness, pain, itching, scaling, occasional blistering, and severe skin burns.**Eye** Harmful if contact the eyes. Mists may cause eye irritation. Symptoms include of redness, pain, tearing, eyelid spasms, blurred vision, chemical conjunctivitis, burns and permanent eye damage. risk of blindness!**Carcinogenicity** No evidence of carcinogenic properties.**Chronic Effects** Dermatitis may occur from prolonged or repeated skin contact. Prolonged or over exposure to phosphoric acid can increase fluid levels in the lungs (pulmonary oedema). May cause clammy skin and dermatitis, weak and rapid pulse, shallow respiration, very little urine, bronchitis, shortness of breath. Severe exposure to phosphoric acid can lead to shock, circulatory collapse and death.**Mutagenicity** No evidence of mutagenic effects.

12. Ecological information

Ecotoxicity Quantitative data on the ecological effect of this product are not available.**Bioaccumulative Potential** Phosphate (formed when phosphoric acid is dissolved) is unlikely to bioaccumulate in most aquatic species.**Information on Ecological Effects** Excessive amounts of phosphoric acid can affect the pH shift leading to a potential risk to aquatic organisms.

13. Disposal considerations

Disposal Considerations Whatever cannot be saved for recovery or recycling should be disposed of according to relevant local, state and federal government regulations.**Container Disposal** Dispose container as hazardous waste.

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Product Name : **PHOSPHORIC ACID 85%**

Classified as hazardous

14. Transport information

Transport Information	Dangerous goods of Class 8 (Corrosive) are incompatible in a placard load with any of the following: Class 1, Class 4.3, Class 5, Class 6, if the Class 6 dangerous goods are cyanides and the Class 8 dangerous goods are acids, Class 7; and are incompatible with food and food packaging in any quantity.
U.N. Number	1805
UN proper shipping name	PHOSPHORIC ACID
Transport hazard class(es)	8
Hazchem Code	2R
Packaging Method	3.8.8RT8
Packing Group	III
EPG Number	8A1
IERG Number	37

15. Regulatory information

Regulatory Information	Listed in the Australian Inventory of Chemical Substances (AICS).
Poisons Schedule	S6

16. Other Information

Date of preparation or last revision of SDS September 2014.

Literature References 'Standard for the Uniform Scheduling of Medicines and Poisons No. 4', Commonwealth of Australia, June 2013.
Lewis, Richard J. Sr. 'Hawley's Condensed Chemical Dictionary 13th. Ed.', Rev., John Wiley and Sons, Inc., NY, 1997.
National Road Transport Commission, 'Australian Code for the Transport of Dangerous Goods by Road and Rail 7th. Ed.', 2007.
'Labelling of Hazardous Workplace Chemicals, Code of Practice' Safe Work Australia.
Standards Australia, 'SAA/SNZ HB 76:2010 Dangerous Goods - Initial Emergency Response Guide', Standards Australia/Standards New Zealand, 2010.
Safe Work Australia, 'Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)]'.
Safe Work Australia, 'Hazardous Substances Information System, 2005'.
Safe Work Australia, 'National Code of Practice for the Labelling of Safe Work Hazardous Substances (2011)'.
Safe Work Australia, 'National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]'.
Contact Person/Point Paul McCarthy Ph. (08) 8440 2000 **DISCLAIMER STATEMENT:**
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Empirical Formula & Structural Formula H3 P O4
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A 2 Appendix B: References

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