RISK ASSESSMENT STUDY REPORT

FOR

M/S. EARTH INTERMEDIATE PRIVATE LIMITED

Block No. 905, Sub Plot No.: 3 & 4, Opp. Golden Estate,
Chhatral-Kadi Road, Village: Chhatral, Ta: Kalol, Dist: Gandhinagar

PREPARED BY

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CHAPTER: 1

INTRODUCTION

M/s. Earth Intermediate Private Limited is a proposed unit located at Block No. 905, Sub Plot No.: 3 & 4, Opp. Golden Estate, Chhatral-Kadi Road, Village: Chhatral, Ta – Kalol, Dist: Gandhinagar, Gujarat In their proposed unit, they will manufacture Synthetic Organic Chemical (Dye Intermediates) @ 100 MT/M.

Company's purpose is to start production activity for range of products to meet supply demand of specific market segment with the objective to be the most reliable manufacturer in the market.

Proposed unit is not located in GIDC Estate, but this is small scale unit, water consumption more than 25 KLPD, So, according to EIA notification dated 14th September 2006 and its vide amendment, by Ministry of Environment & Forest (MoEF), Government of India, their Proposed manufacturing activity is falls under Synthetic Organic Chemicals – Schedule 5(f)) & cat -A. For that unit needs Environment clearance from Ministry of Environment & Forest (MoEF) Delhi.

The Risk Assessment with following emphasis is required to be carried out:

Purpose

The purpose of this risk assessment is to evaluate the adequacy of the proposed unit for production of products and usage of raw materials. Products have application in dyes industries. This risk assessment provides a structured qualitative assessment of the operational environment. It addresses sensitivity, threats, vulnerabilities, risks and safeguards. The assessment recommends cost-effective safeguards to mitigate threats and associated exploitable vulnerabilities.

Scope

The scope of this risk assessment assessed the system's use of resources and controls (implemented or planned) to eliminate and/or manage vulnerabilities exploitable. This Risk Assessment Report evaluates the confidentiality (protection from unauthorized disclosure of system and data information), integrity (protection from improper modification of information), and availability (loss of system access) of the system. Recommended security safeguards will allow management to make decisions about security-related initiatives.

Geographical Information of Project Site

Latitude : 23.275969 N
Longitude : 72.415842 E

Google Image of Project Site

CHAPTER: 2

RISK ASSESSMENT PROCESS

RISK ASSESSMENT

Identification analysis and assessment of hazard and risk are very useful in providing information to risk management. It provides basis for what should be type and capacity of its on-site and off-site emergency plan also what types of safety measures are required. Risk and consequence analysis is carried out considering storage and handling of various hazardous raw materials, intermediates and product as well as manufacturing process.

This section details the risk assessment process performed during this effort. The process is divided into pre-assessment, assessment, and post assessment phases.

PHASE I – PRE-ASSESSMENT

Step 1: Define the Nature of the Risk Assessment

This initial risk assessment provides an independent review to help Centers for Disease Control and Prevention (CDC) determine the appropriate level of security required for the system to support the development of a System Security Plan for intermediate chemical plant. The risk assessment is based on interviews, documentation and, as necessary, some automated technical review.

Step 2: Data Collection

The data collection phase included identifying and interviewing key personnel within the organization and conducting document reviews. Interviews focused on the operating environment. Document reviews provided the risk assessment team with the basis on which to evaluate compliance with policy and procedure.

Step 3: Templates

The following templates were used by the risk assessment team and are
Included in the appendices:

- **Security Baseline Worksheet:**
  Completed by the analysts using information extracted from questionnaires and interviews.
- **Risk Calculation Worksheet:**
  Converts the raw vulnerabilities into risks based on the following methodology:
- **Risk Mitigation Worksheet:**
  Lists the risks and the associated recommended controls to mitigate these risks for the Business Steward to review.

PHASE II – ASSESSMENT

Step 1: Document Review

The assessment phase began with the review of documents provided by the members of the various Dye Intermediates manufacturing system team. Detailed interviews with members of the Dye Intermediates manufacturing system team allowed completion of the system questionnaire and identification of specific threats inadequately identified in the Enterprise Threat Statement.

Step 2: System Characterization

In this step, the analyst defined the boundaries of the IT system, along with the resources that constitute the system, its connectivity, and any other elements necessary to describe the system. Dependencies were clarified. Sensitivity of the system and data was discussed in the final section of the characterization.

Step 3: Threat Identification

Through the interview process, it also identified “most likely” system and location-specific threats.

Step 4: Vulnerability Identification

In this step, the risk assessment team developed a list of system vulnerabilities (flaws or weaknesses) that could be exploited by the potential threat vectors.

Step 5: Risk Determination (Calculation/Valuation)

In this step, the risk assessment team determined the degree of risk to the system. In some cases, a series of vulnerabilities combined to create the risk. In other cases, a single vulnerability created the risk. The determination of risk for a particular threat source was expressed as a function of the following:

- Likelihood Determination:
- The following governing factors were considered when calculating the likelihood of the probability that a potential vulnerability might be exploited in the context of the associated threat environment:
- Threat source motivation and capability
- Nature of the vulnerability, Existence and effectiveness of current controls

The following table defines the likelihood determinations.

Table1. Likelihood Definition

Level	Likelihood Definition
High	The threat source is highly motivated and sufficiently capable, and controls to prevent the vulnerability from being exercised are ineffective.
Moderate	The threat source is motivated and capable, but controls are place that may impede successful exercise of the vulnerability.
Low	The threat source lacks motivation or capability, or controls are in place to prevent, or at least significantly impede, the vulnerability from being exercised.

Impact Analysis:

The next major step in measuring level of risk was to determine the adverse impact resulting from successful exploitation of vulnerability. The adverse impact of a security event can be described in terms of loss or degradation of any, or a combination of any, of the following three security goals:

- Loss of Confidentiality – Impact of unauthorized disclosure of sensitive information (e.g., Privacy Act).
- Loss of Integrity – Impact if system or data integrity is lost by unauthorized changes to the data or system.
- Loss of Availability – Impact to system functionality and operational effectiveness.
-

Table 2. Impact Definition

Magnitude of Impact	Impact Definition
High	Exercise of the vulnerability (1) may result in the highly costly loss of major tangible assets or resources; (2) may significantly violate, harm, or impede an organization's mission, reputation, or interest; or (3) may result in human death or serious injury.
Moderate	Exercise of the vulnerability (1) may result in the costly loss of tangible assets or resources; (2) may violate, harm or impeded an organization's mission, reputation, or interest; or (3) may result in human injury.
Low	Exercise of the vulnerability (1) may result tangible assets or resources; (2) may organization's mission, reputation, or interest. in the loss of some noticeably affect an

- **Risk Determination:**
  The following were used to assess the level of risk to the IT system:
  - The likelihood of a given threat source's attempting to exercise a given vulnerability.
  - The magnitude of the impact should a threat-source successfully exercise the vulnerability.
  - The adequacy of planned or existing security controls for reducing or eliminating risk.

The following table provides a definition for the risk levels. These levels represent the degree or level of risk to which an IT system, facility, or procedure might be exposed if a given vulnerability were exercised.

Table 3. Risk Level Definition

Magnitude of Impact	Risk Level Definition
High	There is a strong need for corrective measures. An existing system may continue to operate, but a corrective action plan must be put in place as soon as possible.
Moderate	Corrective actions are needed and a plan must be developed to incorporate these actions within a reasonable period of time.
Low	The system's Authorizing Official must determine whether corrective actions are still required or decide to accept the risk.

Step 6: Risk Mitigation Recommendations:
During this step of the process, controls that could mitigate or eliminate the identified risks, as appropriate to the organization's operations, were provided. The goal of the recommended controls is to reduce the level of risk to the IT system and its data to an acceptable level. The risk assessment team considered the following factors when recommending controls and alternative solutions to minimize or eliminate identified risks:

- Sensitivity of the data and the system
- Effectiveness of recommended options
- Legislation and regulations
- Organizational policy
- Operational impact
- Safety and reliability

PHASE III – POST ASSESSMENT

Risk Mitigation

The elimination of all risk is usually impractical, senior management and business stewards should assess control recommendations, determine the acceptable level of residual risk, and implement those mitigations with the most appropriate, effective, and highest payback.

CHAPTER: 3

BASIC ENVIRONMENT

Details of Products:

LIST OF PRODUCTS

Sr. No.	Name of Product	CAS No.	Quantity
1	PAPSA	98-37-3	100 MT/Month
2	C-ACID	131-27-1	
3	Sulpho-C-Acid	27310-25-4	
4	2-R-Acid	90-40-4	
5	K-Acid	118-03-6	
6	PNCBOSA	946-30-5	
7	4-NADPSA	91-29-2	
8	4-NAP	99-57-0	
9	4-CAP	95-85-2	
10	METANILIC ACID	121-47-1	
11	PERI ACID	82-75-7	

PACKING AND FINAL APPLICATION OF PRODUCTS

Sr. No.	Name of Product	Type of Packing	Final Application of Product
1	PAPSA	HDPE Bags packing of 25 Kg/50 Kg With inner liner & 500 kg jumbo bags	Used In Dyes Manufacturing
2	C-ACID		
3	Sulpho-C-Acid		
4	2-R-Acid		
5	K-Acid		
6	PNCBOSA		
7	4-NADPSA		
8	4-NAP		
9	4-CAP		
10	METANILIC ACID		
11	PERI ACID		

NAME AND QUANTITY OF RAW MATERIAL CONSUMPTION

1) PAPSA:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1	Aniline	0.15	15
2	Formaldehyde	0.1	10
3	Sodium Bi Sulphate	0.05	5
4	Sulphuric Acid	0.2	20
5	Hydrochloric Acid	0.2	20
6	Sodium Nitrite	0.1	10
7	Sodium Bicarbonate	0.2	20

2) C Acid:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1	Sulphuric Acid	0.18	18
2	Naphthalene	0.25	25
3	Oleum	0.25	25
4	Nitric Acid	0.12	12

5	Lime Stone	0.04	4
6	Iron powder	0.05	5
7	Hydrogen Chloride	0.1	10
8	Magnesium Oxide	0.08	8

3) Sulpho C Acid:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	Sulphuric Acid	0.15	15
2.	Oleum	0.3	30
3.	C-Acid	0.5	50

4) 2R Acid:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	K-Acid	0.25	25
2.	Sulphuric Acid	0.45	45
3.	Caustic lye	0.25	25

5) K Acid:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	Sulphuric Acid	0.4	40
2.	B-Naphthol	0.25	25
3.	Oleum	0.15	15
4.	Liq. Ammonia	0.15	15

6) PNCBOSA:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	PNCB	0.52	52
2.	Oleum	0.35	35
3.	Salt	0.2	20

7) 4-NADPSA:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	Hydrochloric Acid	0.15	15
2.	C.I Powder	0.5	50
3.	Para Nitro Aniline	0.2	20
4.	Soda Ash	0.2	20
5.	PNCBSA	0.2	20
6.	Sulphuric Acid	1	100
7.	Salt	0.1	10

8) 4-NAP :

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	2,4-DNCB	0.15	15
2.	Sodium Hydrosulphide (NaHS)	0.2	20
3.	Hydrochloric Acid	0.15	15
4.	Sulphuric Acid	0.05	5
5.	Soda Ash	0.2	20
6.	Caustic lye	0.15	15
7.	Salt	0.1	10

9) 4-CAP :

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	2,4-DNCB	0.3	30
2.	Hydrochloric Acid	0.35	35
3.	Caustic lye	0.2	20
4.	Salt	0.15	15

10) Metanilic Acid :

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	Nitro Benzene	0.3	30
2.	Oleum	0.35	35
3.	Calcium Hydroxide	0.3	30
4.	Hydrochloric Acid	0.15	15
5.	Iron powder	0.6	60
6.	Sulphuric Acid	0.25	25
7.	Soda Ash	0.15	15

11) Peri Acid:

Sr. No.	Name of Raw Material	MT/MT	MT/Month
1.	Sulphuric Acid	0.22	22
2.	Naphthalene	0.23	23
3.	Nitric Acid	0.15	15
4.	Magnesium	0.05	5
5.	Lime Stone	0.05	5
6.	Iron Powder	0.05	5
7.	Hydrochloric Acid	0.3	30

CHAPTER: 4

STORAGE AND HANDLING OF HAZARDOUS CHEMICALS

The safety precautions to be taken to prevent an accident are detailed in 'Material Safety Data Sheets'.
The details of storage of Hazardous chemicals along with measures taken during storage are given in Table.

HAZARDOUS CHEMICALS

Details of raw material, which are termed as Hazardous Chemicals as per Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules 2000 are given in the **below table**

Toxicity details of raw materials are given in the below **Table.**

TABLE
DETAILS OF HAZARDOUS CHEMICALS

Sr. No.	Name of Hazardous Chemical	Reference The Manufacturer, storage & Import of Hazardous chemical Rules 1989	Maximum quantity that can be stored at a time (MT)
1	Aniline	Sr. No. 37(Part II, Sch. 1 of MSIHCR, 1989)	5
2	Formaldehyde	Sr. No. 285(Part II, Sch. 1 of MSIHCR, 1989)	3
3	Sulphuric Acid	Sr. No. 591(Part II, Sch. 1 of MSIHCR,1989)	20
4	HCl	Sr. No. 313(Part II, Sch. 1 of MSIHCR,1989)	10
5	Naphthalene	Sr. No. 417(Part II, Sch. 1 of MSIHCR,1989)	5
6	Oleum	Sr. No. 444(Part II, Sch. 1 of MSIHCR,1989)	10
7	Nitric Acid	Sr. No. 423(Part II, Sch. 1 of MSIHCR,1989)	5
8	Ammonia	Sr. No. 31(Part II, Sch. 1 of MSIHCR,1989)	5

9	Nitro Benzene	Sr. No. 425 (Part II, Sch. 1 of MSIHCR,1989)	10
10	Sodium Hydroxide	Sr. No. 571 (Part II, Sch. 1 of MSIHCR,1989)	5

SAFETY PRECAUTIONS DURING STORAGE OF CHEMICALS

Storage & Handling of Hazardous Chemicals:

- Company will do planning to stock all the necessary material as minimum as possible.
- All containers with hazardous chemicals have labels indicating the contents and warning of the hazard.
- Necessary information on safe handling and first aid measures and antidotes of major hazardous material will be available on the label.
- Workers dealing with hazardous chemicals will be trained on health risks and safe handling.
- Exposure to hazardous chemicals will be minimized.
- Liquid Hazardous chemicals will be transferred in closed piping system.
- Separate storage section will be provided for storage of hazardous and non-hazardous raw materials.

Vessel and other Equipment related:

- Checking of process vessels and equipment is carried out regularly.
- Records related to maintenance and its planning schedule is maintained.

Fire related:

- Overhead water storage tank with adequate capacity is provided to ensure 24 hr. supply.
- Fire water tank with sufficient capacity of 100 KL will be provided with fire pump
- Fire hydrant system will be provided.
- Sprinkler system will be provided at raw material storage area and tank farm area.
- Fire extinguisher will be provided at production plant as per the requirement. Contact numbers of nearest fire agency will be provided.

- Unit will appoint qualified and trained fire personnel having qualification like B.Sc or Diploma in Fire and Safety.

Electrical related:

- All electrical fitting and motors in the storage areas will be flameproof.
- Checking of all earthings, wiring & connection will be carried out regularly.
- Proper earthing will be provided at all equipments and will be provided for additional equipment. Adequate Nos. of earth pits will be provided.

Safety related:

- Adequate types of personal protective equipment will be provided and also safety training will be provided to workers.
- Emergency showers and eye wash stations will be available at the worksite.
- Arrangement for 24 hr. medical facilities by contact with nearest health care centre/ hospital.
- Pre-employment medical check-up and annual medical check-up will be carried out and its records will be maintained properly.

CHAPTER: 5

HEALTH & SAFETY MEASURES

For handling hazardous chemicals and to take care of employees' health, M/s. Earth Intermediate Private Limited shall adopt a practice of preventive and predictive maintenance looking to the nature of hazardous chemicals being handled / processed. All the equipments in the plant areas shall be inspected/ tested by an outside agency.
The various safety equipments like breathing apparatus and critical instrumentation provided on various equipments will be inspected and tested frequently to ensure their operability all the time. Besides, all the first aid, fire fighting devices shall also be inspected, tested and maintained by a competent third party and kept all the time in ready to use condition.
Health of all the employees in plant area shall regularly monitor by outside physician. If any abnormality shall found necessary treatment shall be given. Necessary history cards, records will be maintained and up-dated time to time.
Some of the safety measures shall carry out by M/s. Earth Intermediate Private Limited to ensure prevention of occupational hazards is delineated below.

- Flame proof equipments and fittings will be provided for handling of hazardous chemicals.
- Tanks and all pump motors shall be earthed.
- Road tanker earthing lines shall provide near the unloading pumps.
- Independent dykes will provide for hazardous chemicals storage to contain leakages. Floors of the dyke area shall of impervious finish.
- Housekeeping of the plant shall as per prescribed norms. Floors, platforms, staircases, passages will be kept free of any obstruction.
- All hazardous operations shall explain to the workers. They will periodically trained on the hazardous processes.
- Dedicated supply of firewater shall available in the plant.
- Only authorized persons shall be allowed inside the plant.
- All instrument and safety devices will be checked and calibrated during installation. They will also be calibrated, checked at a frequent interval. Calibration records shall maintain.
- All electrical equipments will be installed as per prescribed standards.
- All the equipments of the plant shall periodically tested as per standard and results shall documented. All equipments undergo preventive maintenance schedule.
- The area will fence to isolate the same from all other departments.
- Flame arrestors shall provide on each tank.
- D.G. Set will be available which can supply power in case of grid power failure.

- In addition to fire hydrant system, nos. of fire extinguishers will be installed at different locations within premises.
- Adequate ventilation arrangement shall provide for safe and better working in the plant as per the standard.
- Process, equipments, plant involving serious fire hazards are designed as per prescribed guideline.
- Sufficient access for firefighting shall provide in the plant.
- Protection against lightning will be taken care in the plant.
- Precautions against ignition will be taken.

CHAPTER: 6

OCCUPATIONAL HEALTH SCHEME FOR THE WORKERS

M/s. Earth Intermediate Private Limited shall carry out following occupational health scheme for workers;

- Personal protective equipment such as safety shoes, safety goggles, hand gloves, gum boots, safety helmet, air line mask, Breathing Apparatus set kit have been given to each workers & staff and additional PPE's are kept in all related area, Fire fighting facilities, etc.
- Safety awareness training programmers are arranged regularly for staff & contractor workers working in the factory premises.
- On site – Off site emergency plan shall be available.
- Medical Examination as per GFR guidelines
- Work Permit system procedure shall be adopted.

CHAPTER: 7

RISK REDUCTION MEASURES

TRAINING AND EDUCATION OF EMPLOYEES:

Safety awareness training programmers are arranged regularly and safety-training programme are also arranged for workers & staff working in the factory premises.

M/s. Earth Intermediate Private Limited shall give training on the following subjects;

- Accident Prevention Technique
- Basic fire fighting
- Use of Respiration PPE
- Handling of Hazardous chemicals
- First Aid program
- Breathing Apparatus practical programme
- General safety regulation
- Work Permit system
- Electrical safety
- On site emergency plan training
- MSDS Awareness

Once in a month workmen shall be grouped together & practical classes shall be held to train them how to operate various types of fire extinguisher to wear the mask, SCBA apparatus, use of cylinder handling kits. Fire drill is also conducted regularly. Personal protective equipment such as safety shoes, safety goggles, hand gloves, gum boots, safety helmet have been given to each workers & staff.

RISK REDUCTION MEASURES:

Design:

- Plant operator and staffs shall be selected well experience and qualified for chemical plant operation.
- All key personals shall be trained for emergency handling procedures and regular Mock Drills will be conducted on various scenarios.
- At design stage adequate care shall be taken for design, selection, fabrication, erection and commissioning of facilities and other equipment piping, pipe fittings, electrical equipment etc.

Safety Devices at Storage Tanks:

- Level gauge on storage tank.
- Static bonding of pipeline flanges.
- Dyke wall shall be provided above ground storage tank.
- Safety valve rupture and other venting system will be provided on pressure storage vessels.
- All pumps shall be provided flame proof type and double mechanical seal type.
- All pipeline and tanks shall be painted as per IS color code.
- Caution note and material identification, capacity will be displayed on all storage tanks.

Safety at Pumps:

- Required outlet valve and NRV provided on pump outlet.
- Modular fire extinguisher shall be provided near of most of pumps.
- FLP type and mechanical seal type pump will be installed for flammable chemicals.

Safety at Pipelines:

- Jumper connections on flanges to prevent build up of static electricity charge.
- Proper supports and clamping are provided.
- Double earthing provided to all electrical motors.
- Color code as per IS standard will be maintained.

Safety during Operation & maintenance:

- Periodic testing of hoses for leakages and continuity.
- Earthing of all plant equipment and earthing of all vehicles of vehicles under unloading operation.
- Annual testing of all safety relief valves.
- Planned preventive maintenance of different equipment of their safety and reliable operations.
- Strict compliance of safety work permits system.
- Proper maintenance of earth pits.
- Periodic training and refresher courses to train the staff in safety, fire fighting and first aid.

CHAPTER: 8

FIRE FIGHTING SYSTEM

M/s. Earth Intermediate Private Limited will take into consideration fire prevention measures during the proposed project planning to avoid any outbreak of fire. But looking to the hazardous nature of process and the chemicals that are handled and processed, the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a situation a good well laid fire protection system will be provided in the factory.

The unit will provide fire extinguishers based on probability and type of fire hazards at strategic locations. The unit will install approximately 10 fire extinguishers (Dry powder type) to tackle the fire hazards of Class A, B & C at different levels of the plant.

- Overhead water storage tank with adequate capacity is provided to ensure 24 hr. supply.
- Fire water tank with sufficient capacity of 100 KL will be provided with fire pump
- Fire hydrant system will be provided.
- Sprinkler system will be provided at raw material storage area and tank farm area.
- Fire extinguisher will be provided at production plant as per the requirement. Contact numbers of nearest fire agency will be provided.
- Nearest fire station is Kalol. Time required to reach the project site is 15 minutes.
- Unit will appoint qualified and trained fire personnel having qualification like B.Sc or Diploma in Fire and Safety.
- Flame proof equipments and fittings will be provided for handling of hazardous chemicals.
- Tanks and all pump motors shall be earthed.
- Road tanker earthing lines shall provide near the unloading pumps.
- Independent dykes will provide for hazardous chemicals storage to contain leakages. Floors of the dyke area shall of impervious finish.
- Housekeeping of the plant shall as per prescribed norms. Floors, platforms, staircases, passages will be kept free of any obstruction.
- All hazardous operations shall explain to the workers. They will periodically trained on the hazardous processes.
- Dedicated supply of firewater shall available in the plant.
- Only authorized persons shall be allowed inside the plant.

- All instrument and safety devices will be checked and calibrated during installation. They will also be calibrated, checked at a frequent interval. Calibration records shall maintain.
- All electrical equipments will be installed as per prescribed standards.
- All the equipments of the plant shall periodically tested as per standard and results shall documented. All equipments undergo preventive maintenance schedule.
- The area will fence to isolate the same from all other departments.
- Flame arrestors shall provide on each tank.
- In addition to fire hydrant system, fire extinguishers will be installed at different locations within premises.
- Adequate ventilation arrangement shall provide for safe and better working in the plant as per the standard.
- Process, equipments, plant involving serious fire hazards are designed as per prescribed guideline.
- Sufficient access for fire fighting shall provide in the plant.
- Protection against lightning will be taken care in the plant.
- Precautions against ignition will be taken.

CHAPTER: 9

HAZARDS IDENTIFICATION, MAJOR HAZARDS & DAMAGE CRITERIA

HAZARDS IDENTIFICATION:

Hazard is defined as a chemical or physical condition that has a potential of causing damage to the people, property or the environment. Hazard identification is the first step in the risk analysis and entails the process of collecting information on:

- The types and quantities of hazardous substances stored and handled,
- The location of storage tanks & other facilities,
- potential hazards associated with the spillage and release of hazardous Chemicals.

Hazard is the associated term with material, which is a measure or the likely hood of the damage to human working with, or studying the material in question. The potential hazard and major risks associated with the plant will be identified using Hazard & operability study (HAZOP).

MAJOR HAZARDS:

A brief description of the following hazards generally encountered in handling hazardous chemicals is given in the section.

- Pool Evaporation
- Vapor Cloud Explosion
- Vapor Cloud Dispersion
- Pool Fire
- Jet Fire
- BLEVE
- Toxic Release

Pool Evaporation

If the fluid, which escapes from containment, is a liquid, then vaporization must occur before a vapor cloud is formed. The rate at which vaporization takes place determines the formation of such a vapor clouds.

Vaporization scenarios

Vaporization can occur when there is a leak in any of the following situations:

a) A liquid at atmospheric temperature and pressure.

b) A liquid under pressure and above normal boiling point. The rates of vaporization of the liquid are different for each of the two cases. In the case

- The liquid after spillage is approximately at equilibrium and evaporates relativity slowly.
- In the case, the liquid flashes off when released, and the liquid remaining then undergoes slow evaporation.

***(I)* Evaporation of a liquid at atmospheric temperature and pressure.**

Evaporation from a pool of liquid is essentially a mass transfer process that depends on the vapor pressure of the liquid, wind velocity across the surface of the pool and ambient weather condition.

A spillage of this kind constitutes a steady continuous source of vapor. Unless the rate of evaporation due to the combination of vapor pressure and wind velocity is high enough, it is usually assumed that the heat transfer from the air and the ground is sufficient to provide the latent heat of vaporization.

(II) Evaporation of a liquid under pressure and above normal boiling point

When a pressurized liquid is released from containment a portion flashes off. This heat is obtained by cooling the remaining liquid to its boiling point thus reaching a state of equilibrium from the high in equilibrium prevalent immediately on loss of containment. In practice, it frequently happens that there is a significant amount of spray formation caused by the sudden release of pressure and the violent boiling of liquid. This spray vaporizes rapidly by taking heat for vaporization from air. This spray liquid formation is assumed to equal to the gas fraction generated by flash. The proportion of liquid airborne is thus considerably high. Following flashing, the residual liquid is at its boiling point. Vaporization then continuous by gaining heat from surrounding as an essentially

heat or mass transfer limited process. This secondary stage of rate limited vaporization is usually relatively less important compared with the flash off, particularly with respect to formation of flammable gas clouds.

Vapor Cloud dispersion

Following a continuous leak and formation of gas cloud, if cloud does not ignite it undergoes atmospheric dispersion in accordance with the prevalent wind direction, speed and stability category. The objective of carrying out analysis of cloud dispersion is twofold. First, it provides the distance (from the leak) at which the concentration of flammable material falls below the lower flammability limit (LEL). Second it provides the concentration of the toxic substance to which people may be exposed for short time, at varying distance (from the leak).

Vapor cloud Explosion

Release of energy in a rapid and uncontrolled manner gives rise to explosion. Identified locations having explosion hazards shall in tank farm and storage area (warehouse). Extra care shall be taken by providing rupture disc, Pressure release valve, and temperature controller. In addition to that Fire and explosion hazard will identified as catastrophic failure of storage tanks in storage yard.

Explosion is a sudden and violent- release of energy which may be in the form of physical energy or chemical energy. In case where a major leak continues from some time without ignition a substantial mass of the gas from a vapor of cloud which on finding a source of ignition may result in an vapor cloud explosion (VCE) before a cloud is diluted to the concentration below the lower explosion limit in air. The explosion will cause overpressure resulting in to damage to the surrounding area.

Pool fire

Since the Stone Age term 'fire' is associated with fear. It is very dangerous if occurs in uncontrolled manner. It should be clearly understood that when a liquid is used having flash point below the normal ambient temperature, it could, in suitable circumstances, liberate a sufficient quantity of vapor to give rise to flammable mixtures with air.

Following an accidental release, chemicals will form either a confined pool within the bund area or an unconfined pool. Should the vapor above the pool ignite, the liquid will burn as a pool fire. The pool fire will result in thermal radiation. It cloud also damage all the storage tanks within the confined area of the dyke. In the present study, impact distances for various scenarios have been calculated.

Jet fire

After a minor or major loss of containment following hardware failure, chemicals which are stored under high pressure would escape as liquid/ gas spray or jet which undergoes flashing evaporation and forms a dense flammable gas could in the air. The cloud, which initially moves forward in the spatial direction of the spray till the kinetic energy, is lost and gravity slumping of cloud occurs if the gas is heavier than the air. Should the flammable jet ignite very soon after development of leak? A jet fire will commence. The jet fire could damage the neighboring tanks by direct flame impingement. It would also cause thermal radiation in the surrounding area.

Fire Ball / BLEVE

Any fire in the vicinity of storage tank containing a liquefied gas may cause Boiling Expanding Vapor Explosion (BLEVE). Due to simultaneous increase of pressure as well as weakening of the material of the vessel because of a fire in the vicinity the tank. It may fail resulting in release of the entire inventory suddenly and result in a BLEVE and fireball. BLEVE results in serious thermal radiation to the plant equipment and surroundings. Damage may also result to the debris of the shattered vessel being thrown about.

The major hazards in the M/s. Earth Intermediate Private Limited are described below.

- Toxic hazard due to leakage of hazardous chemicals.
- Fire hazard due to leakage of flammable chemicals.
- Electrical hazards due to the electrical major equipment/ machinery, operations, welding, motors, heavy lift devices, cabling, human intervention (short circuit possibility), maintenance work (due to machinery breakdown etc.), plant lighting related electrical hazards.
- Possibility of human injury due to working with mechanical machines, manual handling etc.
- Possibility of injury during chemicals handled, during operations and due to intoxication.
- Major dropped objects hazard due to large number of physical handling steps / operations involved with crane/ overhead lifting/ hoisting equipment.
- Fires in any part of the plant working areas – there is a possibility of rapid escalation if it is not brought under control quickly.

Toxic hazards

Toxic substances affect in three ways by ingestion, absorption & inhalation. Adequate provision of safety along with personal protective equipment will be made, breathing apparatus and emergency kit shall be provided at various locations of the installation.

Corrosion hazards

Corrosion is a chemical reaction-taking place at the surface of metal. Corrosive chemicals have their typical hazard when it comes in contact with human tissues. Most corrosive substances will produce chemical burns, while certain chemical produce deep ulceration. Other has detailing effect on skin and may cause dermatitis. This has also adverse effects on weakening the strength of material in contact.

M/s. Earth Intermediate Private Limited shall take due care to overcome the hazard. The complete structure of the manufacturing area shall be painted with special type of anticorrosive paint. Good quality materials will be used for transferring corrosives. Regular thickness testing of equipment, pipelines etc. shall carry out to have the exact picture of effect of corrosion.

Biological hazards

Effluent treatment process involves the biological activities so biological hazard's cannot be eliminated. The way of biological hazards is by hand to mouth contact during eating, drinking or by wiping the face with contaminated hands or gloves or by licking splashes from the skin or by breathing them in, as dust, aerosol or mist. The major source of biological hazard on site is biological sludge drying bed, filter press, biological storage sump etc. Practically, complete elimination of biological hazard cannot be possible but it will be reduce by adopting the safe practice guards.

DAMAGE CRITERIA:

Damage estimates due to thermal radiations and overpressure have been arrived at by taking in to consideration the published literature on the subject. The consequences can then be visualized by the superimposing the damage effects zones on the existing plan site and identifying the elements within the project site as well as in the neighboring environment, which might be adversely affected, should one or more hazards materialize in real life.

In consequence analysis, use is made of a number of calculation models to estimate the physical effects of an accident (spill of hazardous material) and to predict the damage (lethality, injury, material destruction) of the effects. The calculations can roughly be divided in three major groups:

a) Determination of the source strength parameters;
b) Determination of the consequential effects;
c) Determination of the damage or damage distances.

The basic physical effect models consist of the following.

Source strength parameters

* Calculation of the outflow of liquid, vapour or gas out of a vessel or a pipe, in case of rupture. Also two-phase outflow can be calculated.
* Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.
* Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.
* Source strength equals pump capacities, etc. in some cases.

Consequential effects

* Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.
* Intensity of heat radiation [in kW/ m^2] due to a fire or a BLEVE, as a function of the distance to the source.
* Energy of vapour cloud explosions [in N/m^2], as a function of the distance to the distance of the exploding cloud.
* Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

It may be obvious, that the types of models that must be used in a specific risk study strongly depend upon the type of material involved:

- Gas, vapour, liquid, solid
- Inflammable, explosive, toxic, toxic combustion products
- Stored at high/low temperatures or pressure
- Controlled outflow (pump capacity) or catastrophic failure?

Selection of Damage Criteria

The damage criteria give the relation between extent of the physical effects (exposure) and the percentage of the people that will be killed or injured due to those effects. The knowledge about these relations depends strongly on the nature of the exposure. For instance, much more is known about the damage caused by heat radiation, than about the damage due to toxic exposure, and for these toxic effects, the knowledge differs strongly between different materials.

In Consequence Analysis studies, in principle three types of exposure to hazardous effects are distinguished:

1. Heat radiation, from a jet, pool fire, a flash fire or a BLEVE.
2. Explosion
3. Toxic effects, from toxic materials or toxic combustion products.

In the next three paragraphs, the chosen damage criteria are given and explained.

<u>Heat Radiation</u>

The consequence caused by exposure to heat radiation is a function of:

- The radiation energy onto the human body [kW/m^2];
- The exposure duration [sec];

- The protection of the skin tissue (clothed or naked body).
- The limits for 1% of the exposed people to be killed due to heat radiation, and for second-degree burns are given in the table herein:

Damages to Human Life Due to Heat Radiation

Exposure Duration	Radiation for 1% lethality (kW/m^2)	Radiation for 2nd degree burns (kW/m^2)	Radiation for first degree burns, (kW/m^2)
10 Sec	21.2	16	12.5
30 Sec	9.3	7.0	4.0

Since in practical situations, only the own employees will be exposed to heat radiation in case of a fire, it is reasonable to assume the protection by clothing. It can be assumed that people would be able to find a cover or a shield against thermal radiation in 10 sec. time. Furthermore, 100% lethality may be assumed for all people suffering from direct contact with flames, such as the pool fire, a flash fire or a jet flame. The effects due to relatively lesser incident radiation intensity are given below.

Effects Due To Incident Radiation Intensity

RADIATION KW/m^2	DAMAGE TO EQUIPMENT	DAMAGE TO PEOPLE
0.7		Equivalent to Solar Radiation
1.2	Solar heat at noon	
1.6	***	No discomfort for long exposure , Minimum level of pain threshold
2.0	PVC insulated cables damaged	***
4.0	***	Causes pain if duration is longer than 20 secs. But blistering is unlikely.
6.4	***	Pain threshold reached after 8 secs. Second degree burns after 20 secs.
9.5	Minimum energy to ignite wood	Minimum energy required for piloted ignition of wood, melting plastic tubing etc. Pain threshold reached after 8 sec. second degree burns after 20 sec. 1% lethality in one minute.
12.5	With a flame; Melts plastic tubing.	First degree burns in 10 secs.
16.0	***	Severe burns after 5 secs.

25.0	Minimum energy to ignite wood at identifying long exposure without a flame.	100% lethality in 1 minute. Significant injury in 10 secs.
37.5	Severe damage to plant	100% lethality in 1 minute. 50% lethality in 20 secs. 1% lethality in 10 secs.

Explosion

In case of vapour cloud explosion, two physical effects may occur:

* a flash fire over the whole length of the explosive gas cloud;
* a blast wave, with typical peak overpressures circular around ignition source.

As explained above, 100% lethality is assumed for all people who are present within the cloud proper.

For the blast wave, the lethality criterion is based on:

* A peak overpressure of 0.1 bar will cause serious damage to 10% of the housing/structures.
* Falling fragments will kill one of each eight persons in the destroyed buildings.

The following damage criteria may be distinguished with respect to the peak overpressures resulting from a blast wave:

FATAL RADIATION EXPOSURE LEVELS:

RADIATION	**FATALITY**		
LEVEL			
kW/m^2	**1%**	**50%**	**99%**
	EXPOSURE IN SECONDS		
4.0	150	370	930
12.5	30	80	200
37.5	8	20	50

Damage Due To Overpressures

Peak Overpressure	Damage Type
0.83 bar	Total Destruction
0.30 bar	Heavy Damage
0.10 bar	Moderate Damage
0.03 bar	Significant Damage

0.01 bar	Minor Damage

OVER PRESSURE mbar	MECHANICAL DAMAGE TO EQUIPMENTS	DAMAGE TO PEOPLE
300	Heavy damage to plant & structure	1% death from lung damage >50% eardrum damage >50% serious wounds from flying objects
100	Repairable damage	>1% eardrum damage >1% serious wounds flying objects from
30	Major glass damage	Slight injury from flying glass
10	10% glass damage	***

From this it may be concluded that p = 0.17 E+5 pa corresponds approximately with 1% lethality. Furthermore it is assumed that everyone inside an area in which the peak overpressure is greater than 0.17 E+5 pa will be wounded by mechanical damage. For the gas cloud explosion this will be inside a circle with the ignition source as its centre.

Intoxication

The consequences from inhalation of a toxic vapour/gas are determined by the toxic dose.

This dose D is basically determined by:

- Concentration of the vapour in air;
- Exposure duration.

Furthermore, of course, the breathing rates of the victim, as well as the specific toxic mechanism unto the metabolism play an important role.

The dose is defined as $D = C^n.t$, with:

C = concentration of the toxic vapour, in [ppm] or [mg/m^3];
t = Exposure duration, in [sec] or [min];
n = exponent, mostly > 1.0; this exponent takes into account the fact that a high concentration over a short period results in more serious injury than a

low concentration over a relatively longer period of exposure. The value of n should be greater than zero but less than 5.

The given definition for D only holds if the concentration is more or less constant over the exposure time; this may be the case for a (semi) continuous source. In case of an instantaneous source, the concentration varies with time; the dose D must be calculated with an integral equation:

$D = \int C^n.dt$

For a number of toxic materials, so-called Vulnerability Models (V.M.) have been developed. The general equation for a V.M. (probit function) is:

$Pr = a + b.\ln (C^n.t)$, with

Pr = probit number, being a representation of the percentage of people suffering a certain kind of damage, for instance lethality

Pr = 2.67 means 1% of the population;

Pr = 5.00 means 50% of the population;

a and b material dependent numbers;

$C^n.t$ = dose D, as explained above.

The values for a and b are mostly derived from experiments with animals; occasionally, however, also human toxicity factors have been derived from accidents in past. In case only animal experiments are available, the inhalation experiments with rats seem to be best applicable for predicting the damage to people from acute intoxication. Although much research in this field have been done over the past decades, only for a limited number of toxic materials consequence models have been developed. Often only quite scarce information is available to predict the damage from an acute toxic exposition. Data transformation from oral intoxication data to inhalation toxicity criteria is sometimes necessary. Generally, in safety evaluations pessimistic assumptions are applied in these transformation calculations. The calculated damage (distance) may be regarded as a maximum. For the purposes of a response to a major incident, the IDLH value level has been chosen for the 'wounded' criteria. This type of injury will require medical attention.

Toxic Effects:

The effect of exposure to a toxic substance depends upon the duration of exposure and the concentration of the toxic substance. Short-term exposures to high concentration give Acute Effects while long term exposures to low concentrations result in Chronic Effects.

Only Acute Effects are considered under hazard analysis, since they are likely credible scenarios. These effects are:

a) Irritation (respiratory system skin, eyes)
b) Narcosis (nervous system)
c) Asphyxiation (oxygen deficiency)
d) System damage (blood organs)

Following are some of the common terms used to express toxicity of materials:

TLV: Threshold Limit Value – is the permitted level of exposure for a given period on a weighted average basis (usually 8 hrs. for 5 days in a week).
STEL: it is permitted Short Time Exposure Limit usually for a 15-minute exposure.

IDLH: Immediately Dangerous To Life & Health
LCLo: Lethal Concentration Low
TCLo: Toxic Concentration Low

CHAPTER: 10

CONSEQUENCE ANALYSIS & RISK ANALYSIS

CONSEQUENCE ANALYSIS

In a plant handling hazardous chemicals, the main hazard arises due to storage, handling & use of these chemicals. If these chemicals are released into the atmosphere, they may cause damage due to resulting fires or vapour clouds. Blast Overpressures depend upon the reactivity class of material between two explosive limits.

Operating Parameters
Potential vapour release for the same material depends significantly on the operating conditions. Especially for any liquefied gas, the operating conditions are very critical to assess the damage potential. If we take up an example of ammonia, if it is stored at ambient temperature, say about 28ºC, and then the vapour release potential of the inventory is much higher as compared to the case if it is stored at 0ºC.

Inventory
Inventory Analysis is commonly used in understanding the relative hazards and short listing of release scenarios. Inventory plays an important role in regard to the potential hazard. Larger the inventory of a vessel or a system, larger the quantity of potential release. The potential vapour release (source strength) depends upon the quantity of liquid release, the properties of the materials and the operating conditions (pressure, temperature). If all these influencing parameters are combined into a matrix and vapour source strength estimated for each release case, a ranking should become a credible exercise.

Loss of Containment
Plant inventory can get discharged to Environment due to Loss of Containment. Certain features of materials to be handled at the plant need to the clearly understood to firstly list out all significant release cases and then to short list release scenarios for a detailed examination. Liquid release can be either instantaneous or continuous. Failure of a vessel leading to an instantaneous outflow assumes the sudden appearance of such a major crack that practically all of the contents above the crack shall be released in a very short time. The more likely event is the case of liquid release from a hole in a pipe connected to the vessel. The flow rate is depending on the size of the hole as well as on the pressure, which was present, in front of the hole, prior to the accident. Such pressure is basically dependent on the pressure in the vessel. The vaporisation of released liquid depends on the vapour pressure and weather conditions. Such consideration and others have been kept in mind both during the initial listing as well as during the short listing procedure. In the study, Maximum Credible Loss accident

methodology is to be used, therefore, the largest potential hazard inventories have been considered for consequence estimation.

MAXIMUM CREDIBLE LOSS ACCIDENT SCENARIOS

A Maximum Credible Accident (MCA) can be characterised as the worst credible accident. In other words: an accident in an activity, resulting in the maximum consequence distance that is still believed to be possible. A MCA-analysis does not include a quantification of the probability of occurrence of the accident. Another aspect, in which the pessimistic approach of MCA studies appears, is the atmospheric condition that is used for dispersion calculations.

The Maximum Credible Loss (MCL) scenarios have been developed for the Facility. The MCL cases considered, attempt to include the worst "Credible" incidents- what constitutes a credible incident is always subjective. Nevertheless, guidelines have evolved over the years and based on basic engineering judgement, the cases have been found to be credible and modelling for assessing vulnerability zones is prepared accordingly. Only catastrophic cases have been considered and not partial or small failures (as is the case in Quantitative Risk Assessment where contributions from low frequency - high outcome effect as well as high frequency - low outcome events are distinguished). The objective of the study is emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

CONSEQUENCE ANALYSIS CALCULATIONS

The Consequence Analysis has been done for selected scenarios. This has been done for weather conditions having wind speed 3.055 m/s. In Consequence Analysis, geographical location of the source of potential release plays an important role. Consideration of a large number of scenarios in the same geographical location serves little purpose if the dominant scenario has been identified and duly considered.

6.7.3.1 SOFTWARE USED FOR CALCULATIONS

Aloha 5.4.4 is the most comprehensive software available for performing Process Hazard Analysis (PHA), Quantitative Risk Assessment (QRA) and Financial Risk Analysis (FRA). Our extensively validated software for consequence and risk analysis is used by governments and industry helping them to comply with local safety regulation and their own corporate best practice. **Aloha 5.4.4** contains all the discharge, dispersion, effects and risk models you will need to accurately assess all your major hazards and associated risks.

Aloha 5.4.4 Consequence provides you with comprehensive hazard analysis facilities to examine the progress of a potential incident from the initial release to its far-field effects.

6.7.4 SCENARIOS

TABLE - 6.5

POSSIBLE ACCIDENT SCENARIOS AT M/S. Earth Intermediate Private Limited

Sr. No.	Raw Material	Physical Form	Storage	Maximum Storage at a time (MT)
1.	Aniline	Liquid	Drum/Carboy	5
2.	Formaldehyde	Liquid	Drum	3
3.	Hydrochloric Acid	Liquid	Tank	10
4.	Liq. Ammonia	Liquid	Drum/Carboy	5
5.	Nitric Acid	Liquid	Drum	5
6.	Nitro Benzene	Liquid	Drum/Carboy	10
7.	Oleum (23 %)	Liquid	Tank * 2 (1 Empty)	10
8.	PNCB	Liquid	Drum	10
9.	Sulphuric Acid	Liquid	Tank	20

1. Leakages of Aniline from drum : 5 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: ANILINE
CAS Number: 62-53-3 Molecular Weight: 93.13 g/mol
AEGL-1 (60 min): 8 ppm AEGL-2 (60 min): 12 ppm AEGL-3 (60 min): 20 ppm
IDLH: 100 ppm LEL: 13000 ppm UEL: 110000 ppm
Carcinogenic risk - see CAMEO Chemicals
Ambient Boiling Point: 183.5° C
Vapor Pressure at Ambient Temperature: 0.0010 atm
Ambient Saturation Concentration: 1,035 ppm or 0.10%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Direct Source: 5000 kilograms Source Height: 0
Release Duration: 1 minute
Release Rate: 83.3 kilograms/sec
Total Amount Released: 5,000 kilograms

THREAT ZONE:
Model Run: Heavy Gas
Red : 2.9 kilometers --- (20 ppm = AEGL-3 [60 min])
Orange: 3.5 kilometers --- (12 ppm = AEGL-2 [60 min])
Yellow: 3.9 kilometers --- (8 ppm = AEGL-1 [60 min])

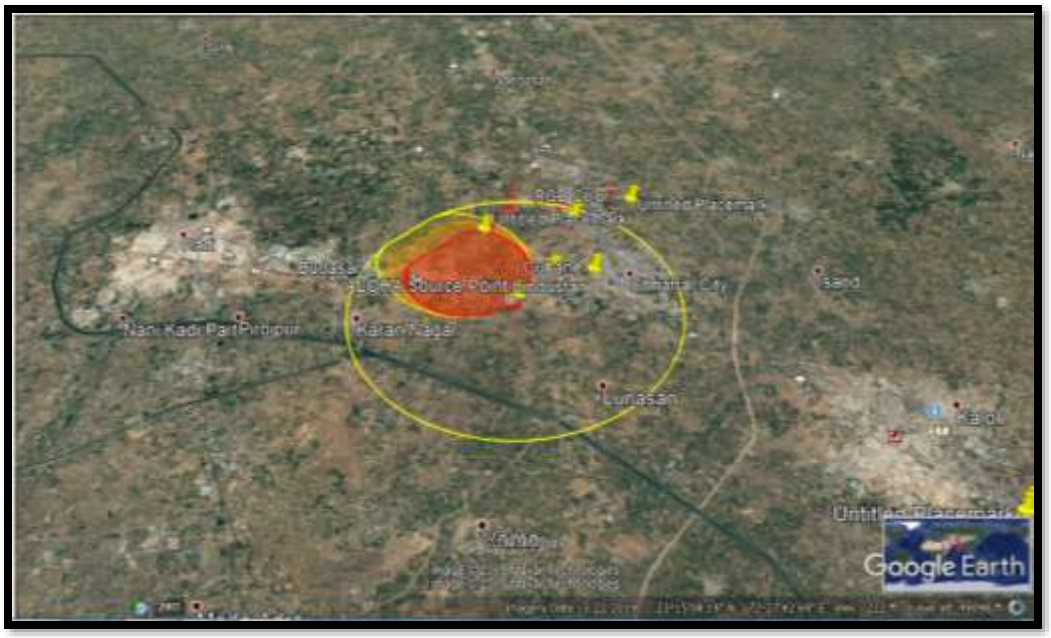
THREAT ZONE:
Threat Modeled: Flammable Area of Vapor Cloud
Model Run: Heavy Gas
Red : 389 meters --- (7800 ppm = 60% LEL = Flame Pockets)
Yellow: 754 meters --- (1300 ppm = 10% LEL)

Red Threat Zone 7800 ppm = 60% LEL = Flame Pockets

Time: December 12, 2019 1450 hours ST
Chemical Name: ANILINE
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : 389 meters --- (7800 ppm = 60% LEL = Flame Pockets)
Yellow: 754 meters --- (1300 ppm = 10% LEL)

Carcinogenic risk - see CAMEO Chemicals
Model: ALOHA Flammable Area of Vapor Cloud



Red Threat Zone 20 ppm = AEGL-3 (60 min)
Time: December 12, 2019 1450 hours ST
Chemical Name: ANILINE
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : 2.9 kilometers --- (20 ppm = AEGL-3 [60 min])
Orange: 3.5 kilometers --- (12 ppm = AEGL-2 [60 min])
Yellow: 3.9 kilometers --- (8 ppm = AEGL-1 [60 min])

Carcinogenic risk - see CAMEO Chemicals
Model: ALOHA Heavy Gas

2. Leakages of Formaldehyde from Drum: 3 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: FORMALDEHYDE Molecular Weight: 30.02 g/mol
AEGL-1 (60 min): 0.9 ppm AEGL-2 (60 min): N/A AEGL-3 (60 min): N/A
Normal Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Direct Source: 3000 kilograms Source Height: 0
Release Duration: 1 minute
Release Rate: 50 kilograms/sec
Total Amount Released: 3,000 kilograms

THREAT ZONE:
Model Run: Gaussian
Red : no recommended LOC value --- (N/A = AEGL-3 [60 min])
Orange: no recommended LOC value --- (N/A = AEGL-2 [60 min])
Yellow: 5.5 kilometers --- (0.9 ppm = AEGL-1 [60 min])

Yellow Threat Zone 0.9 ppm = AEGL-1 (60 min)
Time: December 12, 2019 1450 hours ST
Chemical Name: FORMALDEHYDE
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : no recommended LOC value --- (N/A = AEGL-3 [60 min])
Orange: no recommended LOC value --- (N/A = AEGL-2 [60 min])
Yellow: 5.5 kilometers --- (0.9 ppm = AEGL-1 [60 min])

Model: ALOHA Gaussian

3. Leakages of HCl from tank : 10 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 30% (by weight)
Ambient Boiling Point: 90.1° C
Partial Pressure at Ambient Temperature: 0.023 atm
Ambient Saturation Concentration: 22,879 ppm or 2.29%
Hazardous Component: HYDROGEN CHLORIDE
CAS Number: 7647-1-0 Molecular Weight: 36.46 g/mol
AEGL-1 (60 min): 1.8 ppm AEGL-2 (60 min): 22 ppm AEGL-3 (60 min): 100 ppm
IDLH: 50 ppm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Evaporating Puddle
Puddle Area: 1.0 square feet Puddle Volume: 10 cubic meters
Ground Type: Default soil Ground Temperature: 27° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.793 grams/min
(averaged over a minute or more)
Total Amount Hazardous Component Released: 47.6 grams

THREAT ZONE:
Model Run: Gaussian
Red : less than 10 meters(10.9 yards) --- (100 ppm = AEGL-3 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Orange: less than 10 meters(10.9 yards) --- (22 ppm = AEGL-2 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

Yellow: 10 meters --- (1.8 ppm = AEGL-1 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

4. Leakages of Ammonia liquor from carboys: 5 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: AQUEOUS AMMONIA
Solution Strength: 30% (by weight)
Ambient Boiling Point: 25.5° C
Partial Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
Hazardous Component: AMMONIA
CAS Number: 7664-41-7 Molecular Weight: 17.03 g/mol
AEGL-1 (60 min): 30 ppm AEGL-2 (60 min): 160 ppm AEGL-3 (60 min): 1100 ppm
IDLH: 300 ppm LEL: 150000 ppm UEL: 280000 ppm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Evaporating Puddle (Note: chemical is flammable)
Puddle Area: 1.0 square feet Puddle Volume: 5 cubic meters
Ground Type: Default soil Ground Temperature: 27° C
Initial Puddle Temperature: 25.5° C
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 85.5 grams/min (averaged over a minute or more)
Total Amount Hazardous Component Released: 4.89 kilograms

THREAT ZONE:
Model Run: Gaussian

Red : less than 10 meters(10.9 yards) --- (1100 ppm = AEGL-3 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Orange: 16 meters --- (160 ppm = AEGL-2 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Yellow: 37 meters --- (30 ppm = AEGL-1 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

5. Leakages of Nitric Acid from drum : 5 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Warning: NITRIC ACID, ANHYDROUS can react with water and/or water vapor.
This can affect the evaporation rate and downwind dispersion. ALOHA cannot accurately predict the air hazard if this substance comes in contact with water.
Chemical Name: NITRIC ACID, ANHYDROUS
CAS Number: 7697-37-2 Molecular Weight: 63.01 g/mol
AEGL-1 (60 min): 0.16 ppm AEGL-2 (60 min): 24 ppm AEGL-3 (60 min): 92 ppm
IDLH: 25 ppm
Ambient Boiling Point: 82.6° C
Vapor Pressure at Ambient Temperature: 0.092 atm
Ambient Saturation Concentration: 92,910 ppm or 9.29%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Direct Source: 5000 kilograms Source Height: 0
Release Duration: 1 minute
Release Rate: 83.3 kilograms/sec
Total Amount Released: 5,000 kilograms

THREAT ZONE:
Model Run: Heavy Gas
Red : 2.1 kilometers --- (92 ppm = AEGL-3 [60 min])
Orange: 3.2 kilometers --- (24 ppm = AEGL-2 [60 min])
Yellow: greater than 10 kilometers --- (0.16 ppm = AEGL-1 [60 min])

Yellow Threat Zone 0.16 ppm = AEGL-1 (60 min)
Time: December 12, 2019 1450 hours ST
Chemical Name: NITRIC ACID, ANHYDROUS
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : 2.1 kilometers --- (92 ppm = AEGL-3 [60 min])
Orange: 3.2 kilometers --- (24 ppm = AEGL-2 [60 min])
Yellow: greater than 10 kilometers --- (0.16 ppm = AEGL-1 [60 min])

Model: ALOHA Heavy Gas

6. Leakages of Nitro Benzene from drum : 10 MT

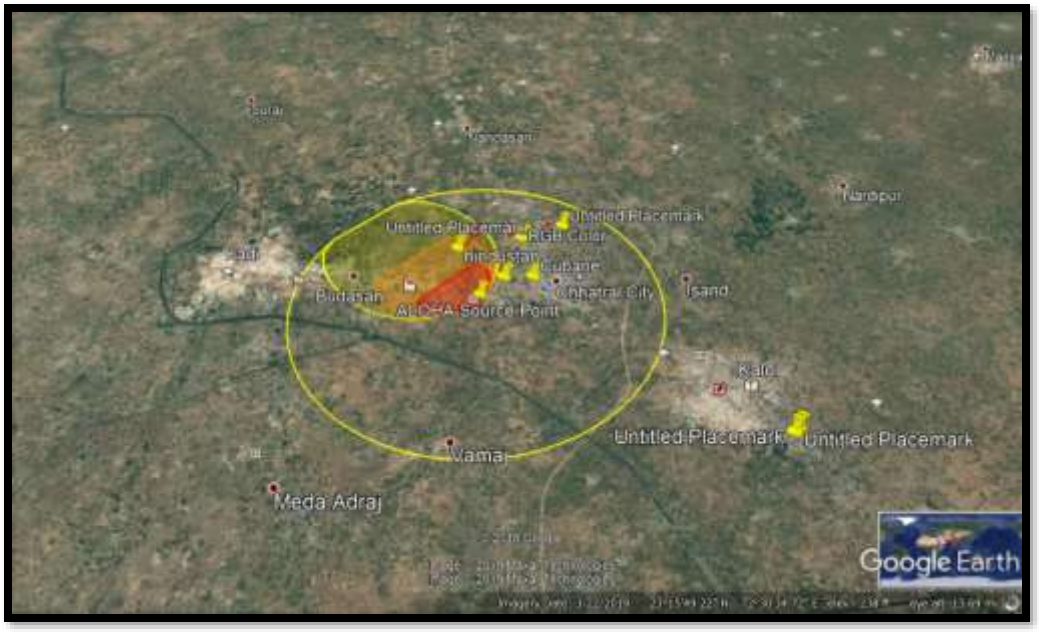
SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: NITROBENZENE
CAS Number: 98-95-3 Molecular Weight: 123.11 g/mol
PAC-1: 3 ppm PAC-2: 20 ppm PAC-3: 200 ppm
IDLH: 200 ppm LEL: 12000 ppm UEL: 300000 ppm
Ambient Boiling Point: 210.1° C
Vapor Pressure at Ambient Temperature: 3.86e-004 atm
Ambient Saturation Concentration: 389 ppm or 0.039%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Direct Source: 10000 kilograms Source Height: 0
Release Duration: 1 minute
Release Rate: 167 kilograms/sec
Total Amount Released: 10,000 kilograms

THREAT ZONE:
Model Run: Heavy Gas
Red : 1.7 kilometers --- (200 ppm = PAC-3)
Orange: 3.5 kilometers --- (20 ppm = PAC-2)
Yellow: 6.4 kilometers --- (3 ppm = PAC-1)



Yellow Threat Zone 3 ppm = PAC-1
Time: December 12, 2019 1450 hours ST
Chemical Name: NITROBENZENE
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : 1.7 kilometers --- (200 ppm = PAC-3)
Orange: 3.5 kilometers --- (20 ppm = PAC-2)
Yellow: 6.4 kilometers --- (3 ppm = PAC-1)

Model: ALOHA Heavy Gas

7. Leakages of Oleum 23 % from Tank : 10 MT

SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Warning: OLEUM can react with water and/or water vapor. This can affect the evaporation rate and downwind dispersion. ALOHA cannot accurately predict the air hazard if this substance comes in contact with water.
Chemical Name: OLEUM
Solution Strength: 23% (by weight)
Ambient Boiling Point: 131.4° C
Partial Pressure at Ambient Temperature: 0.0025 atm
Ambient Saturation Concentration: 2,537 ppm or 0.25%
Hazardous Component: SULFUR TRIOXIDE
CAS Number: 7446-11-9 Molecular Weight: 80.06 g/mol
AEGL-1 (60 min): 0.2 mg/(cu m) AEGL-2 (60 min): 8.7 mg/(cu m) AEGL-3 (60 min): 160 mg/(cu m)

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Evaporating Puddle
Puddle Area: 1.0 square feet Puddle Volume: 10 cubic meters
Ground Type: Default soil Ground Temperature: 27° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.14 grams/min
(averaged over a minute or more)
Total Amount Hazardous Component Released: 8.41 grams

THREAT ZONE:
Model Run: Gaussian
Red : less than 10 meters(10.9 yards) --- (160 mg/(cu m) = AEGL-3 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

Orange: less than 10 meters(10.9 yards) --- (8.7 mg/(cu m) = AEGL-2 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Yellow: 15 meters --- (0.2 mg/(cu m) = AEGL-1 [60 min])
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

8. Leakages of Sulphuric Acid from Tank : 20 MT

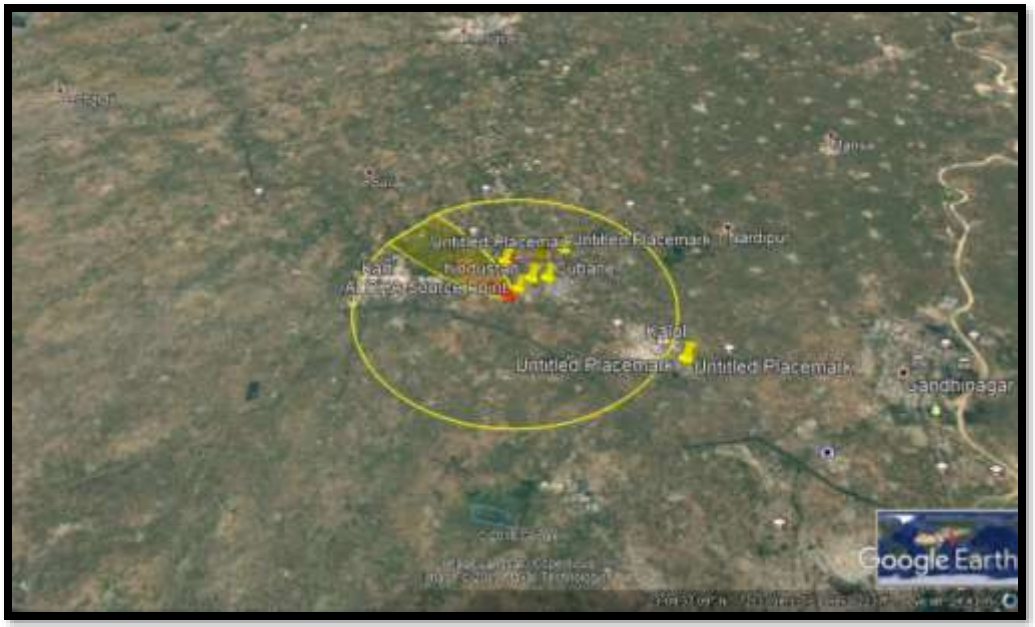
SITE DATA:
Location: EARTH INTERMEDIATES PVT LTD., INDIA
Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
Time: December 12, 2019 1450 hours ST (using computer's clock)

CHEMICAL DATA:
Chemical Name: SULPHURIC ACID Molecular Weight: 98.08 g/mol
AEGL-1 (60 min): 0.2 mg/(cu m) AEGL-2 (60 min): 8.7 mg/(cu m) AEGL-3 (60 min): 160 mg/(cu m)
Ambient Boiling Point: 269.9° C
Vapor Pressure at Ambient Temperature: 0 atm
Ambient Saturation Concentration: 0 ppm or 0%
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 0.85 meters/second from SE at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 27° C Stability Class: B
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Direct Source: 20000 kilograms Source Height: 0
Release Duration: 1 minute
Release Rate: 333 kilograms/sec
Total Amount Released: 20,000 kilograms

THREAT ZONE:
Model Run: Gaussian
Red : 2.0 kilometers --- (160 mg/(cu m) = AEGL-3 [60 min])
Orange: 5.2 kilometers --- (8.7 mg/(cu m) = AEGL-2 [60 min])
Yellow: greater than 10 km --- (0.2 mg/(cu m) = AEGL-1 [60 min])



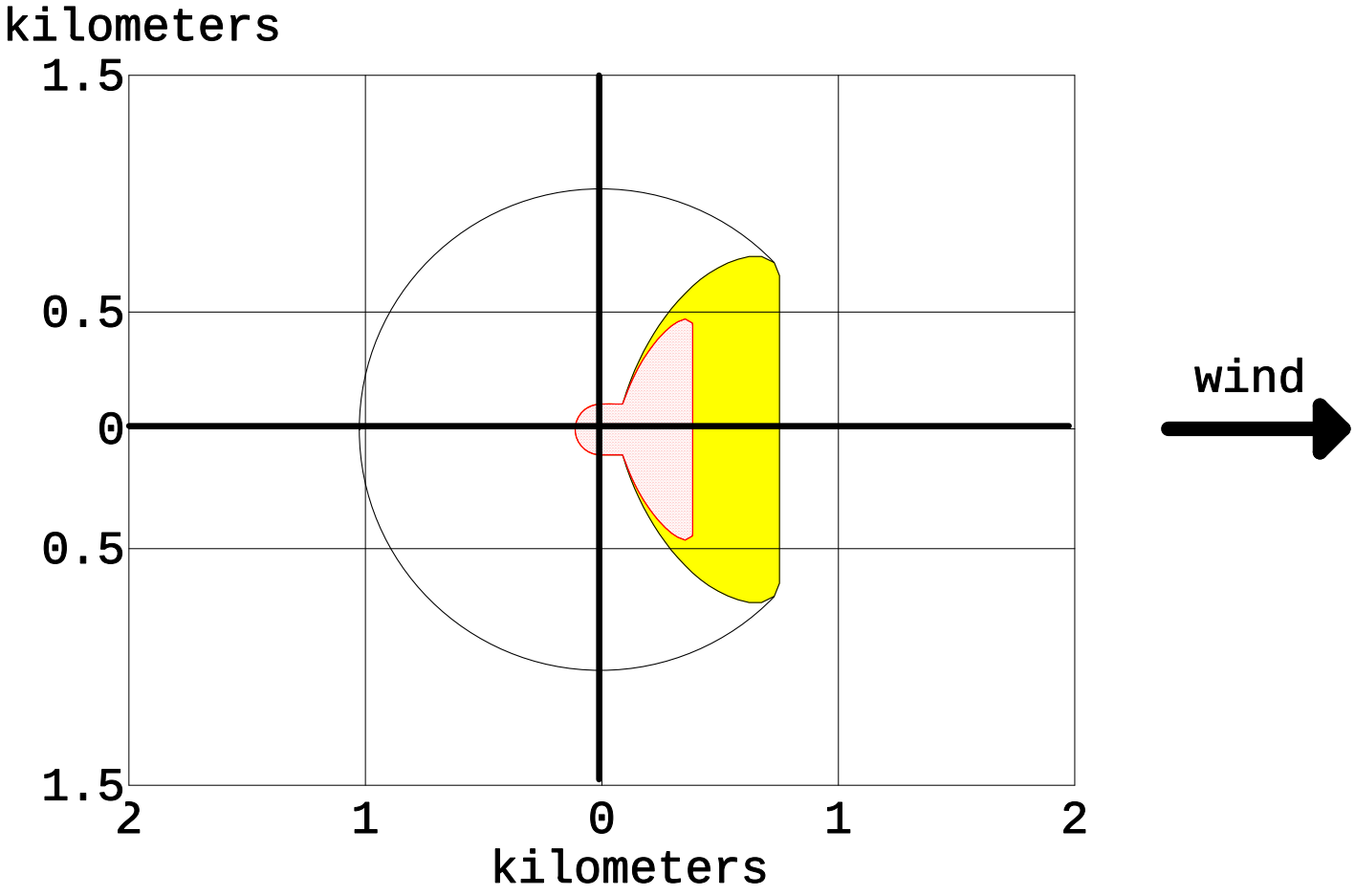
Yellow Threat Zone 0.2 mg/(cu m) = AEGL-1 (60 min)

Time: December 12, 2019 1450 hours ST
Chemical Name: SULPHURIC ACID
Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Red : 2.0 kilometers --- (160 mg/(cu m) = AEGL-3 [60 min])
Orange: 5.2 kilometers --- (8.7 mg/(cu m) = AEGL-2 [60 min])
Yellow: greater than 10 km --- (0.2 mg/(cu m) = AEGL-1 [60 min])

Model: ALOHA Gaussian

```
Time: December 12, 2019  1450 hours ST (using computer's clock)

Chemical Name: ANILINE
  Carcinogenic risk - see CAMEO Chemicals

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
  Threat Modeled: Flammable Area of Vapor Cloud
  Model Run: Heavy Gas
  Red    : 389 meters --- (7800 ppm = 60% LEL = Flame Pockets)
  Yellow: 754 meters --- (1300 ppm = 10% LEL)
```



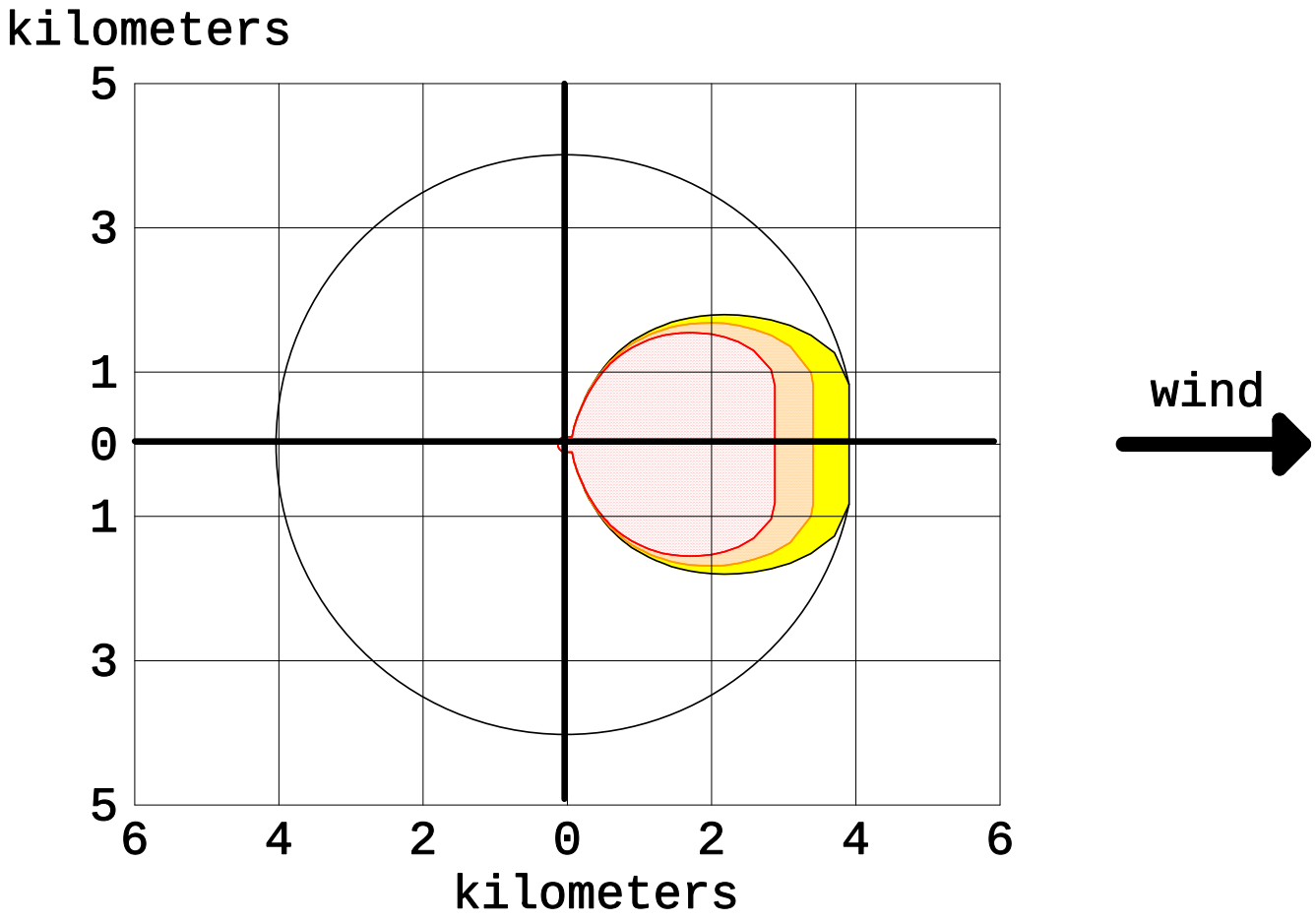
greater than 7800 ppm (60% LEL = Flame Pocket

greater than 1300 ppm (10% LEL)

wind direction confidence lines

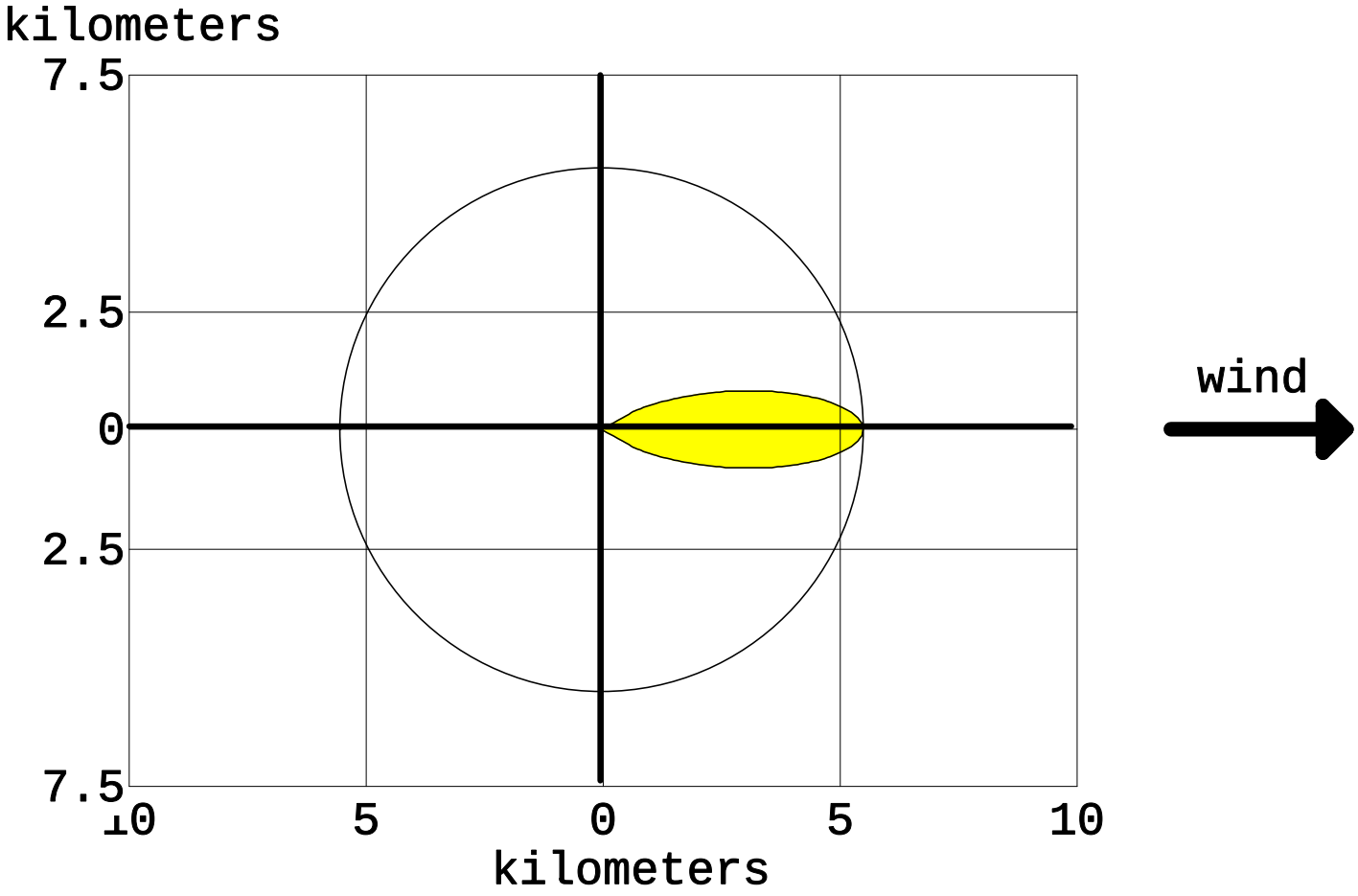
```
SITE DATA:
  Location: EARTH INTERMEDIATES PVT LTD., INDIA
  Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
  Time: December 12, 2019  1450 hours ST (using computer's clock)

CHEMICAL DATA:
  Chemical Name: ANILINE
  CAS Number: 62-53-3                    Molecular Weight: 93.13 g/mol
  AEGL-1 (60 min): 8 ppm   AEGL-2 (60 min): 12 ppm   AEGL-3 (60 min): 20 ppm
  IDLH: 100 ppm      LEL: 13000 ppm      UEL: 110000 ppm
  Carcinogenic risk - see CAMEO Chemicals
  Ambient Boiling Point: 183.5° C
  Vapor Pressure at Ambient Temperature: 0.0010 atm
  Ambient Saturation Concentration: 1,035 ppm or 0.10%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 0.85 meters/second from SE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 27° C                 Stability Class: B
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 5000 kilograms          Source Height: 0
  Release Duration: 1 minute
  Release Rate: 83.3 kilograms/sec
  Total Amount Released: 5,000 kilograms

THREAT ZONE:
  Threat Modeled: Flammable Area of Vapor Cloud
  Model Run: Heavy Gas
  Red   : 389 meters --- (7800 ppm = 60% LEL = Flame Pockets)
  Yellow: 754 meters --- (1300 ppm = 10% LEL)
```

```
Time: December 12, 2019  1450 hours ST (using computer's clock)

Chemical Name: ANILINE
  Carcinogenic risk - see CAMEO Chemicals

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
  Model Run: Heavy Gas
  Red    : 2.9 kilometers --- (20 ppm = AEGL-3 [60 min])
  Orange: 3.5 kilometers --- (12 ppm = AEGL-2 [60 min])
  Yellow: 3.9 kilometers --- (8 ppm = AEGL-1 [60 min])
```



```
SITE DATA:
  Location: EARTH INTERMEDIATES PVT LTD., INDIA
  Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
  Time: December 12, 2019  1450 hours ST (using computer's clock)

CHEMICAL DATA:
  Chemical Name: ANILINE
  CAS Number: 62-53-3                    Molecular Weight: 93.13 g/mol
  AEGL-1 (60 min): 8 ppm   AEGL-2 (60 min): 12 ppm   AEGL-3 (60 min): 20 ppm
  IDLH: 100 ppm      LEL: 13000 ppm      UEL: 110000 ppm
  Carcinogenic risk - see CAMEO Chemicals
  Ambient Boiling Point: 183.5° C
  Vapor Pressure at Ambient Temperature: 0.0010 atm
  Ambient Saturation Concentration: 1,035 ppm or 0.10%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 0.85 meters/second from SE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 27° C                 Stability Class: B
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 5000 kilograms          Source Height: 0
  Release Duration: 1 minute
  Release Rate: 83.3 kilograms/sec
  Total Amount Released: 5,000 kilograms

THREAT ZONE:
  Model Run: Heavy Gas
  Red   : 2.9 kilometers --- (20 ppm = AEGL-3 [60 min])
  Orange: 3.5 kilometers --- (12 ppm = AEGL-2 [60 min])
  Yellow: 3.9 kilometers --- (8 ppm = AEGL-1 [60 min])
```

```
Time: December 12, 2019  1450 hours ST (using computer's clock)

Chemical Name: FORMALDEHYDE

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
  Model Run: Gaussian
  Red   : no recommended LOC value --- (N/A = AEGL-3 [60 min])
  Orange: no recommended LOC value --- (N/A = AEGL-2 [60 min])
  Yellow: 5.5 kilometers --- (0.9 ppm = AEGL-1 [60 min])
```



no recommended LOC value for AEGL-3 (60 min) (not

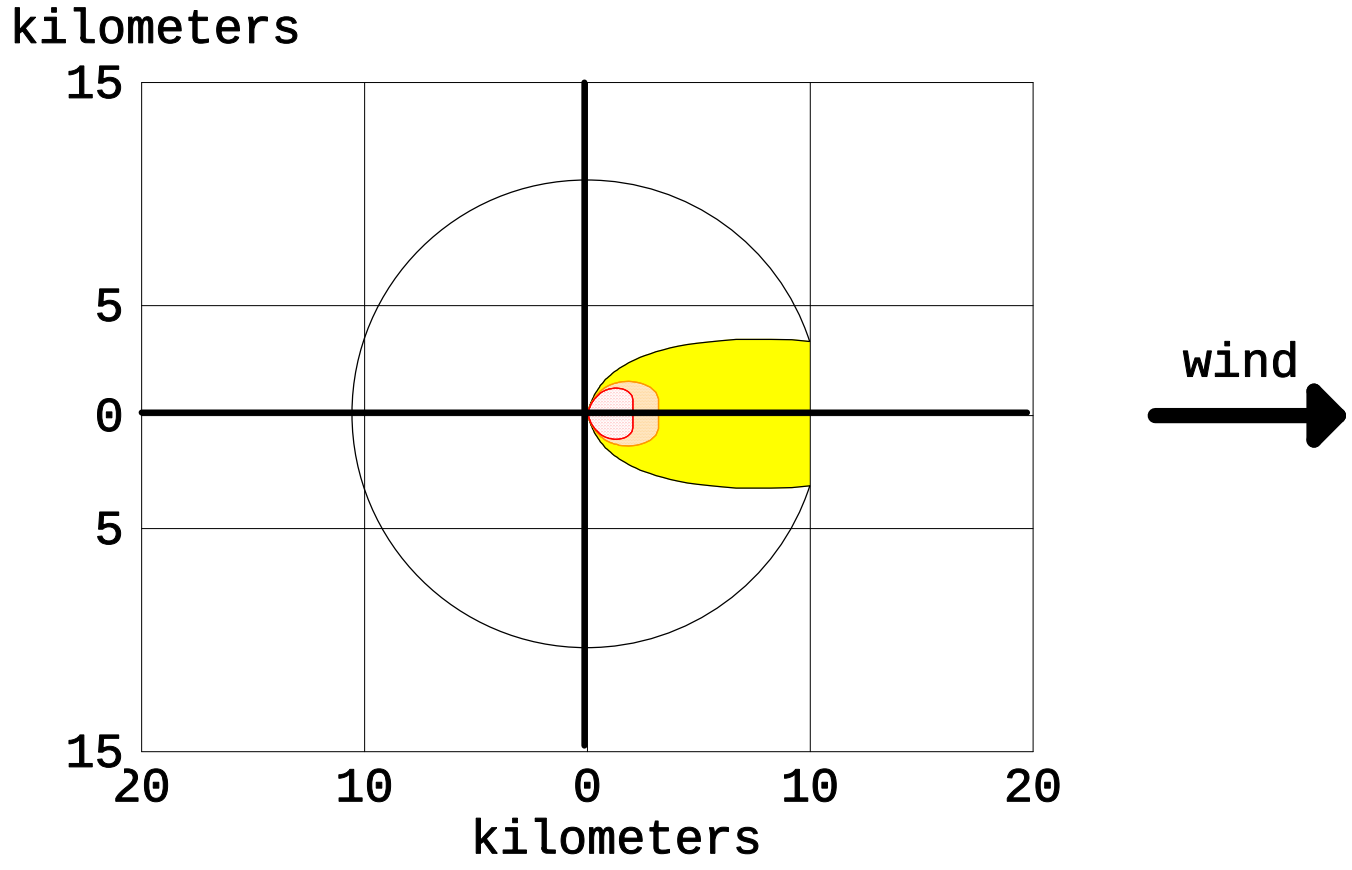
no recommended LOC value for AEGL-2 (60 min) (not

greater than 0.9 ppm (AEGL-1 [60 min])

wind direction confidence lines

```
SITE DATA:
  Location: EARTH INTERMEDIATES PVT LTD., INDIA
  Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
  Time: December 12, 2019  1450 hours ST (using computer's clock)

CHEMICAL DATA:
  Chemical Name: FORMALDEHYDE            Molecular Weight: 30.02 g/mol
  AEGL-1 (60 min): 0.9 ppm   AEGL-2 (60 min): N/A   AEGL-3 (60 min): N/A
  Normal Boiling Point: -unavail-
  Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 0.85 meters/second from SE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 27° C                 Stability Class: B
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 3000 kilograms          Source Height: 0
  Release Duration: 1 minute
  Release Rate: 50 kilograms/sec
  Total Amount Released: 3,000 kilograms

THREAT ZONE:
  Model Run: Gaussian
  Red   : no recommended LOC value --- (N/A = AEGL-3 [60 min])
  Orange: no recommended LOC value --- (N/A = AEGL-2 [60 min])
  Yellow: 5.5 kilometers --- (0.9 ppm = AEGL-1 [60 min])
```

```
Time: December 12, 2019  1450 hours ST (using computer's clock)

Chemical Name: NITRIC ACID, ANHYDROUS
  Warning: NITRIC ACID, ANHYDROUS can react with water and/or water vapor.
  This can affect the evaporation rate and downwind dispersion.  ALOHA
  cannot accurately predict the air hazard if this substance comes in
  contact with water.

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
  Model Run: Heavy Gas
  Red   : 2.1 kilometers --- (92 ppm = AEGL-3 [60 min])
  Orange: 3.2 kilometers --- (24 ppm = AEGL-2 [60 min])
  Yellow: greater than 10 kilometers --- (0.16 ppm = AEGL-1 [60 min])
```



greater than 92 ppm (AEGL-3 [60 min])

greater than 24 ppm (AEGL-2 [60 min])

greater than 0.16 ppm (AEGL-1 [60 min])

wind direction confidence lines

Note: Threat zone picture is truncated at the 10 km

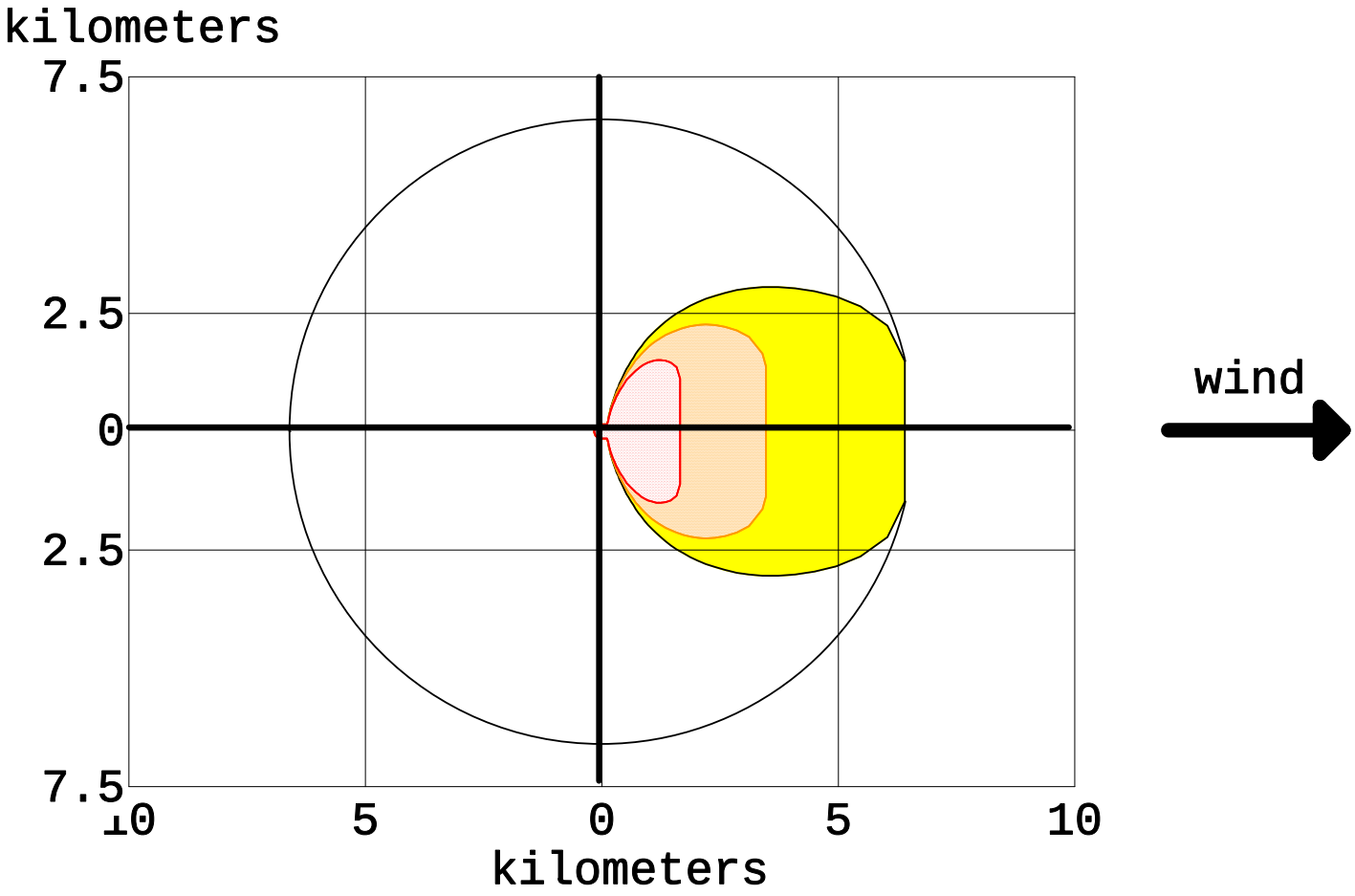
```
 SITE DATA:
   Location: EARTH INTERMEDIATES PVT LTD., INDIA
   Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
   Time: December 12, 2019  1450 hours ST (using computer's clock)

 CHEMICAL DATA:
   Warning: NITRIC ACID, ANHYDROUS can react with water and/or water vapor.
   This can affect the evaporation rate and downwind dispersion.  ALOHA
   cannot accurately predict the air hazard if this substance comes in
   contact with water.
   Chemical Name: NITRIC ACID, ANHYDROUS
   CAS Number: 7697-37-2                  Molecular Weight: 63.01 g/mol
   AEGL-1 (60 min): 0.16 ppm   AEGL-2 (60 min): 24 ppm   AEGL-3 (60 min): 92
ppm
   IDLH: 25 ppm
   Ambient Boiling Point: 82.6° C
   Vapor Pressure at Ambient Temperature: 0.092 atm
   Ambient Saturation Concentration: 92,910 ppm or 9.29%

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 0.85 meters/second from SE at 3 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 27° C                 Stability Class: B
   No Inversion Height                    Relative Humidity: 50%

 SOURCE STRENGTH:
   Direct Source: 5000 kilograms          Source Height: 0
   Release Duration: 1 minute
   Release Rate: 83.3 kilograms/sec
   Total Amount Released: 5,000 kilograms

 THREAT ZONE:
   Model Run: Heavy Gas
   Red   : 2.1 kilometers --- (92 ppm = AEGL-3 [60 min])
   Orange: 3.2 kilometers --- (24 ppm = AEGL-2 [60 min])
   Yellow: greater than 10 kilometers --- (0.16 ppm = AEGL-1 [60 min])
```

Time: December 12, 2019 1450 hours ST (using computer's clock)

Chemical Name: NITROBENZENE

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Model Run: Heavy Gas
Red : 1.7 kilometers --- (200 ppm = PAC-3)
Orange: 3.5 kilometers --- (20 ppm = PAC-2)
Yellow: 6.4 kilometers --- (3 ppm = PAC-1)



```
SITE DATA:
  Location: EARTH INTERMEDIATES PVT LTD., INDIA
  Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
  Time: December 12, 2019  1450 hours ST (using computer's clock)

CHEMICAL DATA:
  Chemical Name: NITROBENZENE
  CAS Number: 98-95-3                    Molecular Weight: 123.11 g/mol
  PAC-1: 3 ppm       PAC-2: 20 ppm       PAC-3: 200 ppm
  IDLH: 200 ppm      LEL: 12000 ppm      UEL: 300000 ppm
  Ambient Boiling Point: 210.1° C
  Vapor Pressure at Ambient Temperature: 3.86e-004 atm
  Ambient Saturation Concentration: 389 ppm or 0.039%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 0.85 meters/second from SE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 27° C                 Stability Class: B
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 10000 kilograms         Source Height: 0
  Release Duration: 1 minute
  Release Rate: 167 kilograms/sec
  Total Amount Released: 10,000 kilograms

THREAT ZONE:
  Model Run: Heavy Gas
  Red   : 1.7 kilometers --- (200 ppm = PAC-3)
  Orange: 3.5 kilometers --- (20 ppm = PAC-2)
  Yellow: 6.4 kilometers --- (3 ppm = PAC-1)
```

```
 Time: December 12, 2019  1450 hours ST (using computer's clock)

 Chemical Name: OLEUM
   Solution Strength: 23% (by weight)

   Hazardous Component: SULFUR TRIOXIDE   Warning: OLEUM can react with water
and/or water vapor.  This can affect
   the evaporation rate and downwind dispersion.  ALOHA cannot accurately
   predict the air hazard if this substance comes in contact with water.

 Wind: 0.85 meters/second from SE at 3 meters

 THREAT ZONE:
   Model Run: Gaussian
   Red   : less than 10 meters(10.9 yards) --- (160 mg/(cu m) = AEGL-3 [60
min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
   Orange: less than 10 meters(10.9 yards) --- (8.7 mg/(cu m) = AEGL-2 [60
min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
   Yellow: 15 meters --- (0.2 mg/(cu m) = AEGL-1 [60 min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
```


```
   Model Run: Gaussian
   Red   : less than 10 meters(10.9 yards) --- (160 mg/
   Note: Threat zone was not drawn because effects of n
      make dispersion predictions less reliable for sho
   Orange: less than 10 meters(10.9 yards) --- (8.7 mg/
   Note: Threat zone was not drawn because effects of n
      make dispersion predictions less reliable for sho
   Yellow: 15 meters --- (0.2 mg/(cu m) = AEGL-1 [60 mi
   Note: Threat zone was not drawn because effects of n
      make dispersion predictions less reliable for sho
```

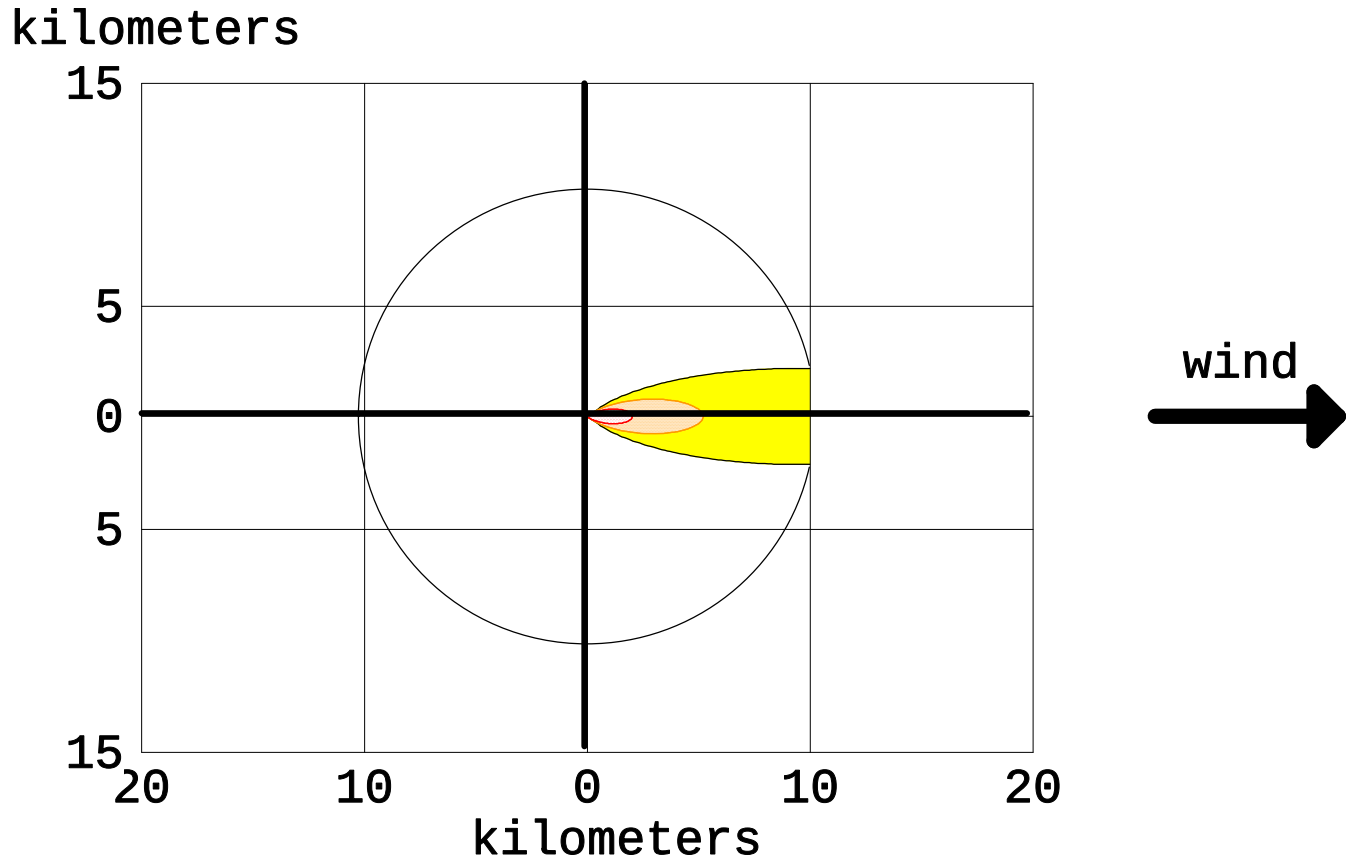
```
 SITE DATA:
   Location: EARTH INTERMEDIATES PVT LTD., INDIA
   Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
   Time: December 12, 2019  1450 hours ST (using computer's clock)

 CHEMICAL DATA:
   Warning: OLEUM can react with water and/or water vapor.  This can affect
   the evaporation rate and downwind dispersion.  ALOHA cannot accurately
   predict the air hazard if this substance comes in contact with water.
   Chemical Name: OLEUM
   Solution Strength: 23% (by weight)
   Ambient Boiling Point: 131.4° C
   Partial Pressure at Ambient Temperature: 0.0025 atm
   Ambient Saturation Concentration: 2,537 ppm or 0.25%
   Hazardous Component: SULFUR TRIOXIDE
   CAS Number: 7446-11-9                  Molecular Weight: 80.06 g/mol
   AEGL-1 (60 min): 0.2 mg/(cu m)   AEGL-2 (60 min): 8.7 mg/(cu m)   AEGL-3 (60
min): 160 mg/(cu m)

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 0.85 meters/second from SE at 3 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 27° C                 Stability Class: B
   No Inversion Height                    Relative Humidity: 50%

 SOURCE STRENGTH:
   Evaporating Puddle
   Puddle Area: 1.0 square feet           Puddle Volume: 10 cubic meters
   Ground Type: Default soil              Ground Temperature: 27° C
   Initial Puddle Temperature: Ground temperature
   Release Duration: ALOHA limited the duration to 1 hour
   Max Average Sustained Release Rate: 0.14 grams/min
      (averaged over a minute or more)
   Total Amount Hazardous Component Released: 8.41 grams

 THREAT ZONE:
   Model Run: Gaussian
   Red   : less than 10 meters(10.9 yards) --- (160 mg/(cu m) = AEGL-3 [60
min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
   Orange: less than 10 meters(10.9 yards) --- (8.7 mg/(cu m) = AEGL-2 [60
min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
   Yellow: 15 meters --- (0.2 mg/(cu m) = AEGL-1 [60 min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.
```

Time: December 12, 2019 1450 hours ST (using computer's clock)

Chemical Name: SULPHURIC ACID

Wind: 0.85 meters/second from SE at 3 meters

THREAT ZONE:
Model Run: Gaussian
Red : 2.0 kilometers --- (160 mg/(cu m) = AEGL-3 [60 min])
Orange: 5.2 kilometers --- (8.7 mg/(cu m) = AEGL-2 [60 min])
Yellow: greater than 10 km --- (0.2 mg/(cu m) = AEGL-1 [60 min])



greater than 160 mg/(cu m) (AEGL-3 [60 min])
greater than 8.7 mg/(cu m) (AEGL-2 [60 min])
greater than 0.2 mg/(cu m) (AEGL-1 [60 min])
wind direction confidence lines

Note: Threat zone picture is truncated at the 10 km

```
 SITE DATA:
   Location: EARTH INTERMEDIATES PVT LTD., INDIA
   Building Air Exchanges Per Hour: 0.22 (unsheltered double storied)
   Time: December 12, 2019  1450 hours ST (using computer's clock)

 CHEMICAL DATA:
   Chemical Name: SULPHURIC ACID          Molecular Weight: 98.08 g/mol
   AEGL-1 (60 min): 0.2 mg/(cu m)   AEGL-2 (60 min): 8.7 mg/(cu m)   AEGL-3 (60
min): 160 mg/(cu m)
   Ambient Boiling Point: 269.9° C
   Vapor Pressure at Ambient Temperature: 0 atm
   Ambient Saturation Concentration: 0 ppm or 0%
   Note: Not enough chemical data to use Heavy Gas option

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 0.85 meters/second from SE at 3 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 27° C                 Stability Class: B
   No Inversion Height                    Relative Humidity: 50%

 SOURCE STRENGTH:
   Direct Source: 20000 kilograms         Source Height: 0
   Release Duration: 1 minute
   Release Rate: 333 kilograms/sec
   Total Amount Released: 20,000 kilograms

 THREAT ZONE:
   Model Run: Gaussian
   Red   : 2.0 kilometers --- (160 mg/(cu m) = AEGL-3 [60 min])
   Orange: 5.2 kilometers --- (8.7 mg/(cu m) = AEGL-2 [60 min])
   Yellow: greater than 10 km --- (0.2 mg/(cu m) = AEGL-1 [60 min])
```