1. ADDITIONAL STUDIES

1.1 Risk Assessment

This section on Risk Assessment (RA) aims to provide a systematic analysis of the major risks that may arise from the CHRYSO India's proposed expansion of its Raigad unit in Maharashtra. The RA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures. The output of the RA will contribute towards strengthening of the Emergency Response Plan (ERP) in order to prevent damage to personnel, infrastructure and receptors in the immediate vicinity of the plant. Additionally, the results of the RA can also provide valuable inputs for keeping risk at As Low as Reasonably Practicable (ALARP) and arriving at decisions for mitigation of high risk events.

The following section describes the objectives, methodology of the risk assessment study and assessment for each of the potential risk separately. This includes identification of major hazards, hazard screening and ranking, frequency and consequence analysis for major hazards. The hazards have been quantitatively evaluated through a criteria base risk evaluation matrix. Risk mitigation measures to reduce significant risks to acceptable levels have also been recommended as a part of the risk assessment study.

1.2 RA Study Objective

The overall objective of this RA with respect to the proposed project involves identification and evaluation of major risks, prioritizing risks identified based on their hazard consequences and using the outcome to guide and strengthen both onsite and offsite ERP. Hence, in order to ensure effective management of any emergency situations that may arise from failure of isolated storages of flammable liquids and gases with respect to the proposed expansion operations, the following specific objectives need to be achieved.

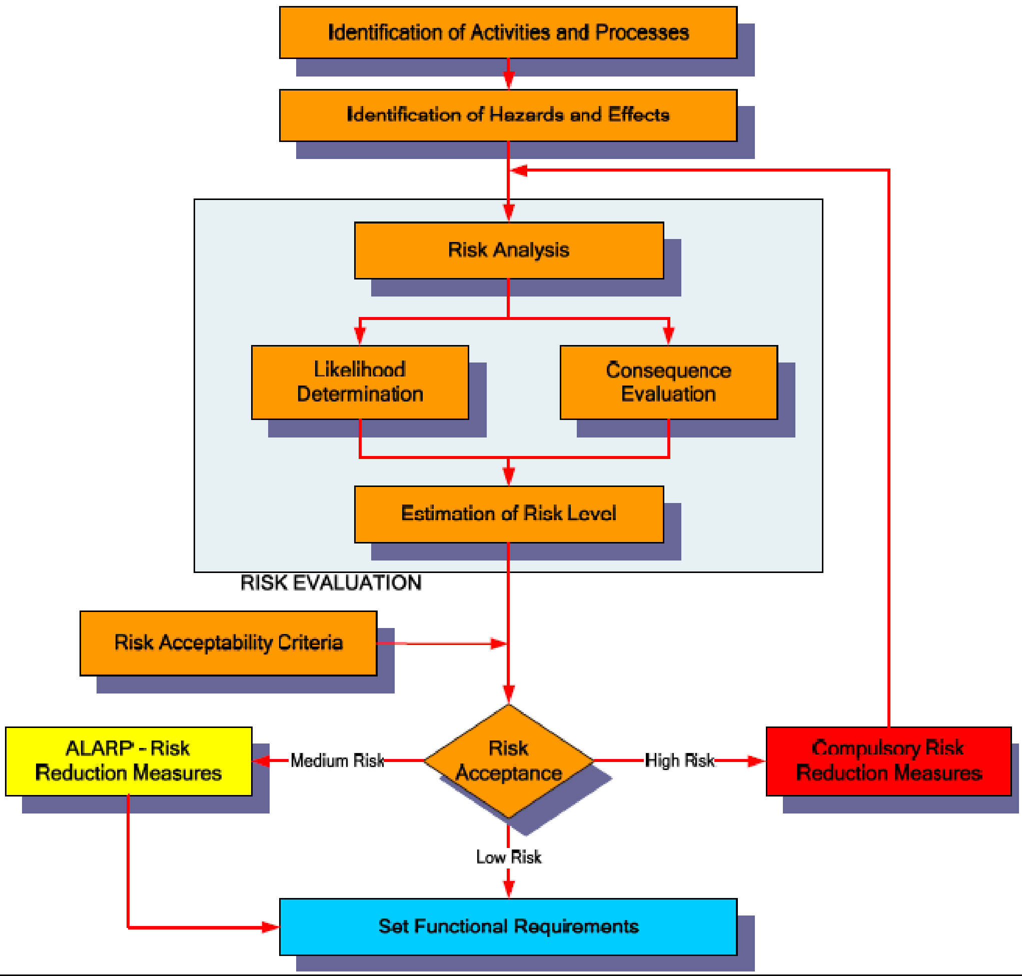
- Identify potential risk scenarios that may arise from isolated storage of corrosive chemicals particularly acrylic acid monomer;
- Review existing information and historical databases to arrive at possible likelihood of such risk scenarios;
- Predict the consequences of such potential risk scenarios and if consequences are observed to be high, establish the same through application of quantitative simulations; and
- Recommend feasible preventive and risk mitigation measures as well as provide inputs for strengthening of the project Emergency Response Plan (ERP).

1.3 RA Methodology

The risk assessment process is primarily based on likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed project, major risks viz. leaks and rupture of storage tanks been assessed and evaluated through a risk matrix generated to combine the risk severity and likelihood factor. Risk associated with the flammable storages have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (risk ranking = severity/consequence factor X likelihood/probability factor). Significance of such project related risks was then established through their classification as high, medium, low, very low depending upon risk ranking.

The risk matrix is widely accepted as standardized method of risk assessment and is preferred over purely quantitative methods, given that it's inherent limitations to define a risk event is certain. Application of this tool has resulted in the prioritization of the potential risks events for the existing operations and proposed expansion thus providing the basis for drawing up risk mitigation measures and leading to formulation of plans for risk and emergency management. The overall approach is summarized below in ***Figure 1.1****.*

Figure 1.1 Risk Assessment Methodology



1.4 Hazard Identification

The first stage in any risk assessment is to identify the potential incidents that could lead to the release of a hazardous material from its normal containment and result in a major accident. This is achieved by a systematic review of the facilities to determine where a release of a hazardous material could occur from various parts of the installation.

The major hazards are generally one of three types: flammable, reactive and/or toxic. In this study, only toxic exposure hazards are relevant involving loss of containment and leaks from isolated storage of corrosive liquids in this case acrylic acid (Refer ***Table 7.1***).

Based on the result of this exercise, potential hazards that may arise due to proposed project were identified and a qualitative understanding of their probability and significance were obtained. Taking into account the applicability of different risk aspects the following hazard have been identified with respect to the proposed project which has been dealt in detail in the subsequent sections.

- Release of corrosive liquids from failure from storage tank leaks may lead to formation of evaporating puddle and subsequent exposure to workers/nearby communities.

1.4.1 Hazards from Chemical Storages

For the toxic chemicals presently and likely to be stored and handled for the proposed project, the following hazards have been identified and presented in ***Table 1.1*** along with their existing control measures. For the hazard rating of the toxic chemicals to be used for the proposed project, the National Fire Protection Agency (NFPA) 704 rating system has been used. Chemical substances are rated for degree of HEALTH RISK, FLAMMABILITY and REACTIVITY, on a scale of 0 to 4 as described below

Health Risk

- Level 4 – Can affect health or cause serious injury, during periods of very short exposure, even though prompt medical treatment is given.
- Level 3 – Can affect health or cause serious injury, during periods of short exposure, even though prompt medical treatment is given.
- Level 2 – Can cause incapacitation or residual injury, during intense or continued exposure, unless prompt medical treatment is provided.
- Level 1 – Cause irritation upon exposure, but only minor injury is sustained even if no medical treatment is provided.
- Level 0 – Offer no unusual hazards upon exposure to fire conditions.

Flammability

- Level 4 – Completely vaporize at normal pressure and temperature and burn readily.
- Level 3 – Liquids and solids that can be ignited under the most ambient conditions.
- Level 2 – Must be moderately heated before ignition can occur.
- Level 1 – Must be strongly heated before ignition will occur.
- Level 0 – Will not burn.

Reactivity

- Level 4 – Capable of explosive decomposition at normal temperatures and pressure.
- Level 3 – Easily capable of explosive decomposition, but require an ignition source or will react explosively with water.
- Level 2 – Easily undergo a violent reaction, but do not explosively decompose.
- Level 1 – Normally stable, but become explosive at elevated temperatures and pressure.
- Level 0 – Stable even under exposure to fire.

Table 1.1 Hazard Summary of Acrylic Acid

S. No.	Chemical Name	NFPA Hazard Rating			Toxicity	Existing Control Measures
		Health	Flammability	Reactivity		
1	Acrylic Acid	3	2	2	It is a corrosive chemical and may burn skin or eyes upon short contact. Life threatening health effects likely to be experienced at a concentration of 180ppm and above (AEGL-3).	

Source: https://cameochemicals.noaa.gov/ and **https://www.epa.gov/aegl/access-acute-exposure-guideline-levels-aegls-values#chemicals**

1.5 Frequency Analysis

The frequency analysis of the hazards identified with respect to the proposed project was undertaken to estimate the likelihood of their occurrences during the project life cycle. Hazard frequencies in relation to the proposed project were estimated based on the analysis of historical accident frequency data and professional judgment. Based on the range of probabilities arrived at for different potential hazards that may be encountered with respect to the storage and handling of toxic chemical (acrylic acid) with respect to the expansion project, the following frequency categories and criteria have been defined (Refer ***Table 1.2***).

Table 1.2 Frequency Categories and Criteria

Likelihood Ranking	Criteria Ranking (cases/year)	Frequency Class
5	Likely to occur often in the life of the project, with a probability greater than 10^{-1}	Frequent
4	Will occur several times in the life of project, with a probability of occurrence less than 10^{-1}, but greater than 10^{-2}	Probable
3	Likely to occur sometime in the life of a project, with a probability of occurrence less than 10^{-2}, but greater than 10^{-3}	Occasional/Rare
2	Unlikely but possible to occur in the life of a project, with a probability of occurrence less than 10^{-3}, but greater than 10^{-6}	Remote
1	So unlikely it can be assumed that occurrence may not be experienced, with a probability of occurrence less than 10^{-6}	Improbable

Source: Guidelines for Developing Quantitative Safety Risk Criteria – Centre for Chemical Process and Safety

1.5.1 Frequency Analysis –Chemical Storage Tankages

The most credible scenario of toxic liquid tankages will be toxic vapor cloud. In order to determine the probability of a toxic vapor cloud occurring, the failure rate needs to be modified by the probability of the material finding an ignition source. The probability of any of the aforesaid incident occurring in the event of a release is therefore equal to the product of the failure rate and the probability of ignition. The frequency of the possible release scenarios has been presented in *Table 1.3* below.

Table 1.3 Tank Failure Frequency

Sl. No	Type of Release	Failure Rate (per vessel per year)	Frequency
A	**Ambient Temperature Vessels**		
1	Catastrophic tanks failure	5.0 x 10-6	Remote
2	Major failure	1.0 x 10-4	Remote
3	Minor failure	2.5 x 10-3	Occasional/Rare
4	Roof top release	2.0 x 10-3	Occasional/Rare

Source: Failure Rate and Event Data for use within Risk Assessments (28/06/2012) **-** UK HSE

Based on the chemical inventory made available, acrylic acid shall be stored under ambient conditions. In all such cases, the catastrophic failure frequency rate is found to be **~5.0 X 10^{-6} per vessel per year**.

1.6 Consequence Analysis

In parallel with the frequency analysis, hazard prediction / consequence analysis exercises were undertaken to assess the likely impact of project related risks on onsite personnel, infrastructure and environment. In relation to the proposed project as well as the existing activities have been considered, the estimation of the consequences for each possible event has been based either on accident frequency, consequence modelling or professional judgment, as appropriate. Overall, the consequence analysis takes into account the following aspects:

- Nature of impact on environment and community;
- Occupational health and safety;
- Asset and property damage;
- Corporate image; and
- Timeline for restoration of property damage.

The following criteria for consequence rankings (Refer Table 1.4) have been drawn up in context of the possible consequences of the risk events that may occur during the proposed project operations:

Table 1.4 Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	• Multiple fatalities/permanent total disability to more than 50 persons. • Net negative financial impact of >10 crores • International media coverage • Loss of corporate image and reputation
Major	4	• Single fatality/permanent total disability to one or more persons • Net negative financial impact of 5 -10 crores • National stakeholder concern and media coverage.

Consequence	Ranking	Criteria Definition
Moderate	3	• Short term hospitalization & rehabilitation leading to recovery • Net negative financial impact of 1-5 crores • State wide media coverage
Minor	2	• Medical treatment injuries • Net negative financial impact of 0.5 – 1 crore • Local stakeholder concern and public attention
Insignificant	1	• First Aid treatment • Net negative financial impact of <0.5 crores. • No media coverage

Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

The ***Table 1.5*** below illustrates all possible product results for the five likelihood and consequence categories while the

Table 1.6 assigns risk significance criteria in three regions that identify the limit of risk acceptability. Depending on the position of the intersection of a column with a row in the risk matrix, hazard prone activities have been classified as low, medium and high thereby qualifying for a set of risk reduction / mitigation strategies.

Table 1.5 Risk Matrix

			Likelihood →				
			Frequent	**Probable**	**Unlikely**	**Remote**	**Improbable**
			5	**4**	**3**	**2**	**1**
Consequence →	**Catastrophic**	**5**	25	20	15	10	5
	Major	**4**	20	16	12	8	4
	Moderate	**3**	15	12	9	6	3
	Minor	**2**	10	8	6	4	2
	Insignificant	**1**	5	4	3	2	1

Table 1.6 Risk Criteria and Action Requirements

S.N.	Risk Significance	Criteria Definition & Action Requirements
1	**High (16 - 25)**	**"Risk requires attention"** – Project HSE Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits
2	**Medium (10 – 15)**	**"Risk is tolerable"** – Project HSE Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
3	**Low (5 – 9)**	**"Risk is acceptable"** – Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered.
4	**Very Low (1 – 4)**	**"Risk is acceptable"** – All risks are managed by well-established controls and routine processes/procedures. Additional risk controls need not to be considered

1.6.1 Risk Scenarios Considered

The main hazards associated with the storage and handlings of acrylic acid monomer with respect to the proposed project are toxic vapour cloud resulting from the accidental release of material. The hazards may be realised following tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of flammable material on failure.

In addition to overfill, the scenarios considered for chemical storage tanks and containers were leaks and catastrophic failures. Factors that have been identified as having an effect on the integrity of tanks are related to design, inspection, maintenance, and corrosion[1]. The following representative scenarios for the tanks were considered (Refer ***Table 1.7***).

Table 1.7 Acrylic Acid Storage– Risk Modelling Scenarios

Sl. No	Chemical Name	Total Storage including expansion (MT)	Event	Scenario
1	Acrylic Acid	350	Toxic Vapour Cloud	5mm leak
			Toxic Vapour Cloud	10mm leak
			Toxic Vapour Cloud	MCLS

NOTE:

The chemical storage tank and container failure scenarios have been modeled using ALOHA and interpreted in terms of Thermal Radiation and Toxic Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) and ppm or mg/m^3 respectively to create the default threat zone.

Toxic Level of Concern

Toxic Level of Concern has been interpreted in the form of Acute Exposure Level Guidelines (AEGLs) and Emergency Response Planning Guidelines (ERPGs) calculated for– 60 minutes.

[1] AEA Technology, HSE Guidance Document

AEGL "levels" are dictated by the severity of the toxic effects caused by the exposure, with Level 1 being the least and Level 3 being the most severe. All levels are expressed as parts per million or milligrams per cubic meter (ppm or mg/m^3) of a substance above which it is predicted that the general population could experience, including susceptible individuals:

AEGL-1 (Yellow): *Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure;*

AEGL-2 (Orange): *Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape; and*

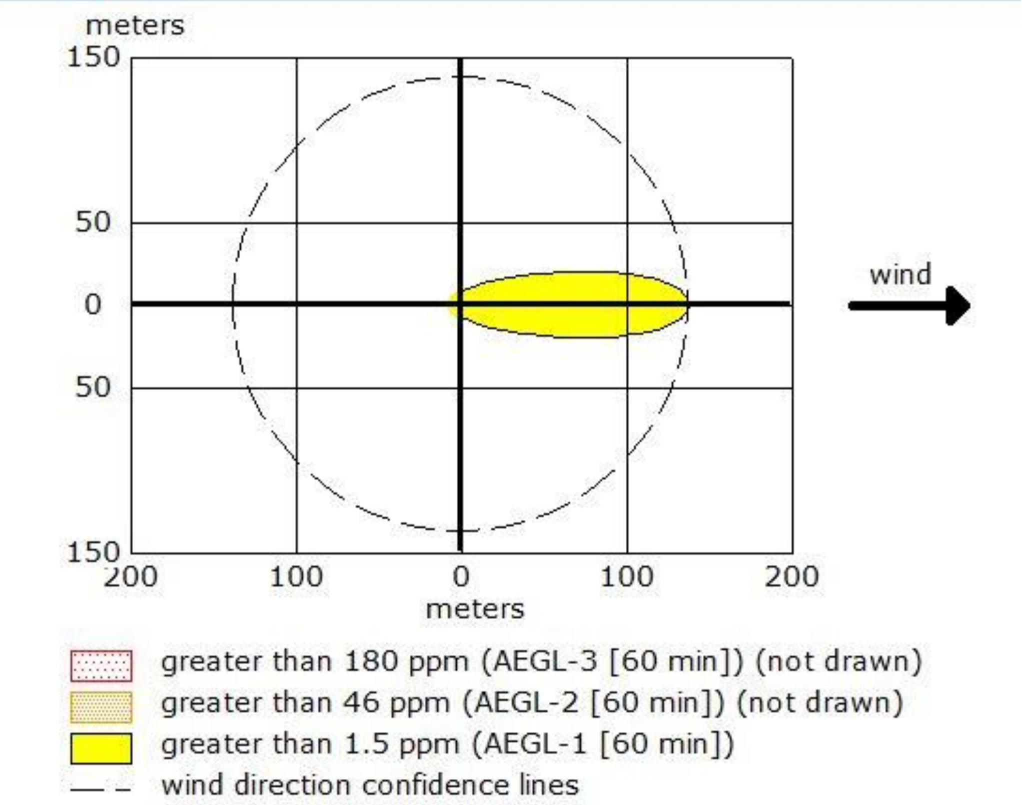
AEGL-3 (Red): *Life-threatening health effects or death.*

The risk contours for acrylic acid storage tank failure scenarios have been presented in ***Figure 1.2*** to ***Figure 1.4*** below.

Acrylic Acid Storage Tank – 10mm leak

The toxic threat zone plot for acrylic acid storage tank leak of 10mm is represented in ***Figure 1.2*** below.

Figure 1.2 Threat Zone Plot – Acrylic Acid Storage Tank -10mm leak



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Model Run: Gaussian

Red : less than 10 meters --- (180 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: 14 meters --- (46 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.

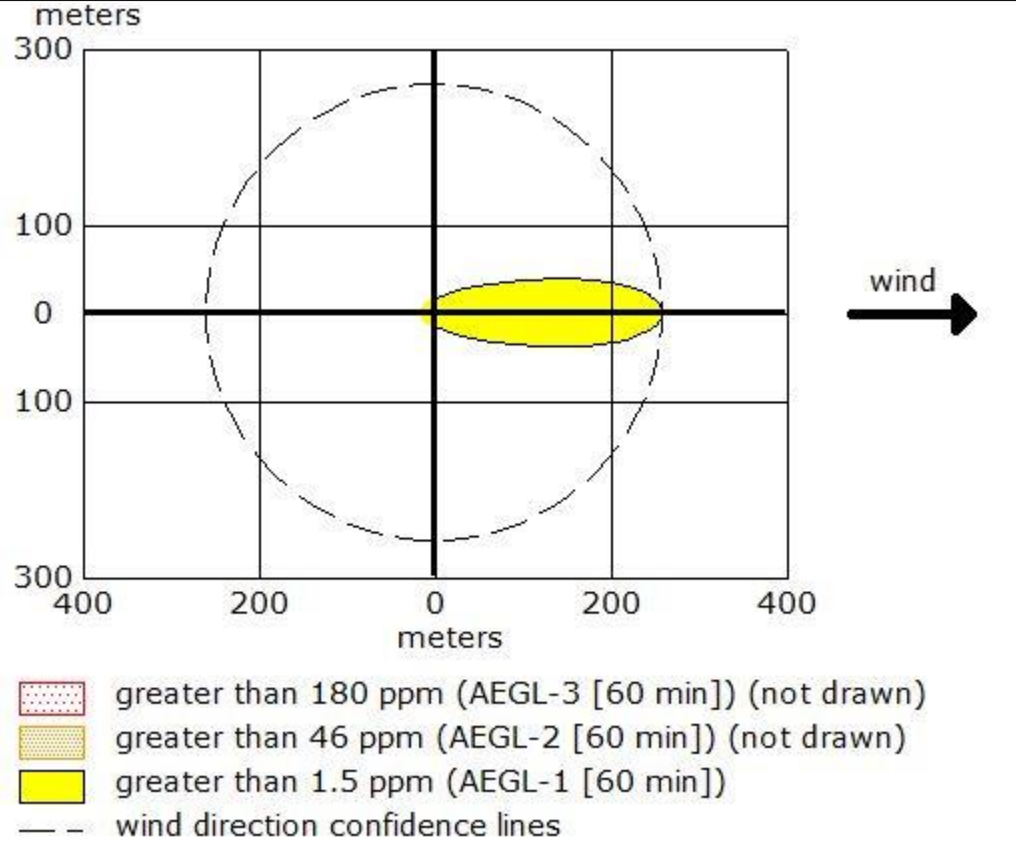
Yellow: 138 meters --- (1.5 ppm = AEGL-1 [60 min])

The maximum effect resulting from 10mm leak of acrylic acid storage tank will be experienced within a maximum radial distance of less than 10m source with potential lethal effects within 1 hour.

Acrylic Acid Storage Tank – 20mm leak

The toxic threat zone plot for acrylic acid storage tank leak of 20mm is represented in ***Figure 1.3*** below.

Figure 1.3 Threat Zone Plot – Acrylic Acid Storage Tank – 20mm leak



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Model Run: Gaussian

Red : 16 meters --- (180 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: 27 meters --- (46 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.

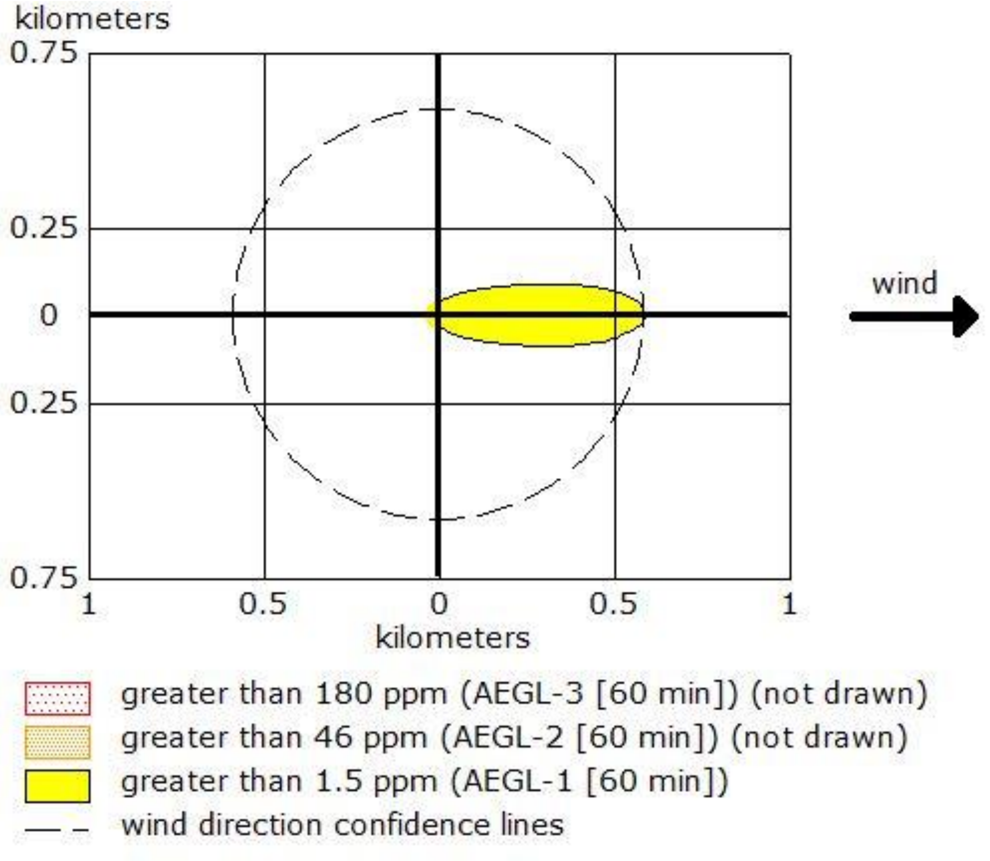
Yellow: 259 meters --- (1.5 ppm = AEGL-1 [60 min])

The maximum effect resulting from 20mm leak of acrylic acid storage tank will be experienced within a maximum radial distance of 16m source with potential lethal effects within 1 hour.

Acrylic Acid Storage Tank – MCLS

The toxic threat zone plot for Maximum Credible Loss Scenario (MCLS) for acrylic acid storage tank is represented in ***Figure 1.4*** below.

Figure 1.4 Threat Zone Plot – Acrylic Acid Storage Tank – MCLS



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Model Run: Gaussian

Red : 39 meters --- (180 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: 61 meters --- (46 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: 586 meters --- (1.5 ppm = AEGL-1 [60 min])

The maximum effect resulting from catastrophic failure of acrylic acid storage tank will be experienced within a maximum radial distance of 39m source with potential lethal effects within 1 hour.

Risk Ranking – Catastrophic Failure of Acrylic Acid Storage Tank (MCLS – Toxic Vapour Cloud)

Likelihood ranking	**2**	**Consequence ranking**	**2**
Risk Ranking & Significance = 4 i.e. "Very Low" i.e. All risks are managed by well-established controls and routine processes/procedures			

1.7 RA Outcome

The review of the RA results for acrylic storage tank indicates that in most of the scenarios involving leakages leading to toxic vapour cloud, the risk significance assessed to be **"*Low*"**. For scenarios with low risk significance, the effective distance for damage resulting from toxic vapour cloud is likely to be experienced in the range of 10-39m. Hence, damaging effect is evaluated to be limited to site personnel and workers operating in the immediate vicinity.

The site shall implement the following appropriate engineering and administrative controls to further prevent and reduce any exposure risk related to acrylic acid storage and handling.

- Engineering Controls such as redundant instrument interlocks and temperature control systems and probes for monitoring the temperature, rate of temperature change and for activating an alarm in the event of a high temperature excursion.
- Provision of emergency venting of bulk acrylic acid storage tanks
- Properly designed dikes and flooring constructed of concrete which can hold at least 110% of the entire contents of the largest tank
- Written safe work procedures
- A Workplace Hazardous Materials Information System (WHMIS) program
- Exposure control plan
- Respiratory protection program (personal protective equipment)
- Written emergency procedures
- Written preventive maintenance procedures
- Checking on a worker working alone
- Training, instruction, and supervision

In addition to the above , adequate fire protection system is required to be in place and supplemented by implementation of focussed training and awareness sessions and organizing periodic ONSEMP (Onsite Emergency Preparedness Plan) drills to check effectiveness of existing risk management system.

1.8 Disaster Management Plan

Disaster Management is a process or strategy that is implemented when any type of catastrophic event takes place. The Disaster Management Plan envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time in event of any emergency. Adequate manpower, training and infrastructure are required to achieve this.

The objectives of Disaster Management Plan are as follows:

- Rapid control and containment of the hazardous situation;
- Minimising the risk and impact of occurrence and its catastrophic effects;
- Effective rehabilitation of affected persons and prevention of damage to Property and environment;
- To render assistance to outside the factory.

The following important elements in the disaster management plan (DMP) are suggested to effectively achieve the objectives of emergency planning:

- Reliable and early detection of an emergency and careful response;
- The command, co-ordination, and response organization structure along with efficient trained personnel;
- The availability of resources for handling emergencies;
- Appropriate emergency response actions;
- Effective notification and communication facilities;
- Regular review and updating of the DMP;
- Proper training of the concerned personnel.

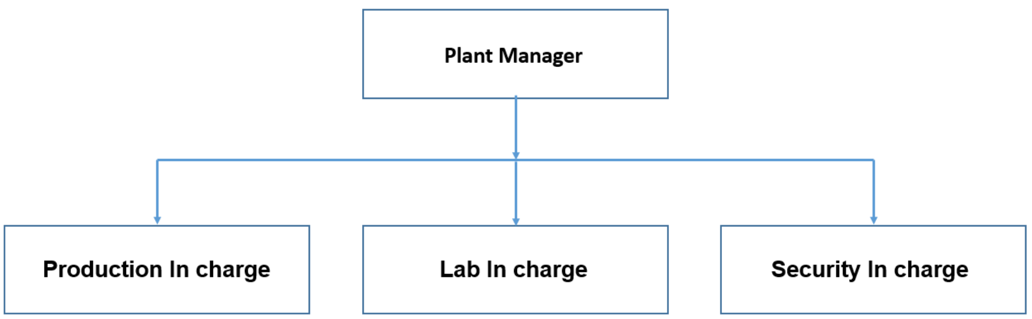
1.8.1 Onsite Disaster Management Team & their Responsibility

Responsibility for establishing and maintaining record of disaster management belongs to Works Main Controller. He is responsible for distribution & control of the plan, and for ensuring that the plans are implemented, reviewed and revised annually. Incidence Controller is responsible for the training of personnel to ensure that adequate emergency response capabilities are maintained in accordance with the plan.

Works Main Controller and Incidence Controller are responsible for ensuring the efficacy of the conduct of drills, as outlined in the DMP. All employees of various departments are responsible for carrying out their responsibilities, as defined in DMP.

In order to handle disaster/emergency situations, an organizational chart entrusting responsibility to various site personnel has been prepared along with their specific roles during an emergency. The disaster management team CHRYSO Patalganga plant is given in ***Figure 7.5***

Figure 1.5 CHRYSO Disaster Management Team



1.8.2 Emergency Resources Available

The DMP include emergency preparedness plan, emergency response team, emergency communication, emergency responsibilities, emergency facilities, and emergency actions.

1.8.2.1 Facilities and Resources during Emergencies

CHRYSO is maintaining the following facilities in a state of readiness with equipment to detect the emergency and respond effectively during any disaster.

1.8.2.2 Emergency Control Centre (ECC)

It is a location, where all key personnel like Combat Team Leader, Rescue Team Leader and Auxiliary Team Leader, etc. can assemble in the event of onset of emergency and carry on various duties assigned to them.

During an emergency, the Incident Controller including Combat Team Leader, Rescue Team Leader and Auxiliary Team Leader will gather in the ECC. Therefore, the ECC is equipped with adequate communication systems in the form of telephones and other equipment to allow unhampered communication with the teams involved in bringing the incident under control, and with the external response organisations and other nearby facility personnel.

The ECC is always ready for operation and provided with the equipment and supplies necessary aids during the emergency such as:

- Latest copy of the On-site Disaster Management Plan;
- Emergency telephone rosters;
- Factory Layout, Site Plan
    - Plans indicating locations of hazardous inventories, sources of safety equipment, hydrant layout, location of pump house, road plan, assembly points, vulnerable zones, escape routes;
- Emergency shut-down procedures;
- Nominal roll of employees;
- List and address of key personnel, Emergency coordinators, first aiders, firefighting employees.

1.8.2.3 Emergency Communication

The plant has Local Audio Alarm System, PA system, & Emergency siren with siren code to make the emergency known both inside and outside of the facility, and co-ordinating among the various groups involved in response operations.

Warning/Alarm/Communication of Emergency: The emergency would be communicated by operating electrical siren for continuously for three minutes with high and low pitch mode.

1.8.2.4 Personal Protective Equipment

This equipment is used mainly for three reasons:

- To protect personnel from a hazard while performing rescue/accident control operations,
- To do maintenance and repair work under hazardous conditions, and
- For escape purposes.

The list of Personal Protective Equipment provided at the facility and their locations are available in ECC.

1.8.2.5 Fire Fighting Facilities

- Internal hydrant system;
- Portable extinguishers.

1.8.2.6 Fire Protection System

These systems are available to protect the plant by means of different fire protection facilities and consist of

- Hydrant system for exterior as well as internal protection of various buildings/areas of the plant.
- Portable extinguishers and hand appliances for extinguishing small fires in different areas of the plant.
- Water monitor will be provided in hypo plant area.
- Fire water pumps.
- Two (2) independent motor driven pumps each of sufficient capacity and head are proposed for the hydrant system which is capable to extinguish Fire or cooling purpose.

1.8.2.7 Medical Facilities, Equipment and Supplies

- Doctor and preliminary treatment facilities in the plant;
- Ambulance; and
- Mutual aid with nearby industries.

1.8.2.8 Emergency Escapes

The objective of the emergency escape is to escape from the hazardous locations, to the nearest assembly point or the other safe zone, for rescue and evacuation. Emergency escape routes have been provided within the plant. Wind socks are also provided in various locations.

1.8.2.9 Emergency Transport

Emergency Ambulance is stationed at the main gate and round the clock-driver is available for emergency transportation of injured personnel, if any.

The other vehicles of the company also would be available for emergency services.

1.8.2.10 Security and Access Control Equipment

In case of an emergency the incoming response teams and resources will be directed to assembly place. Admission to contaminated area / effected area will be restricted. The response team and resources coming from outside will reach to event place after permission from Works Main Controller.

1.8.2.11 Assembly Point

Assembly point is location, where, persons not-connected with emergency operations would proceed at assembly point and await for rescue operation.

1.8.2.12 Emergency Power and Lighting

Plant has equipped with a Diesel generator sets, which are auto started on the loss of all On-site power to the primary bus. The DG set is sized to provide emergency lighting in required areas and to meet the requirement to run the essential service equipment and critical equipment to safety & environment including emergency siren.

1.8.2.13 Mutual Aid

While necessary facilities will be made available and updated from time to time, sometimes, it may be necessary to seek external assistance; it may be from the neighbouring factories or from the State Government.

1.8.2.14 Command, Co-ordination and Response Team

One of the most important objectives of emergency planning is to create a response organisation structure capable of being developed in the shortest time possible during an emergency.

Command and control of an emergency condition, encompasses the key management functions necessary to ensure the least impact on environment, health and safety of employees, as well as the public living in the vicinity. These primary functions are summarised as follows:

- Detection of the emergency conditions;
- Assessment of the conditions;
- Classification of emergency;
- Mitigation of the emergency conditions;
- Notification to management personnel;
- Notification to local, state, and government agencies;
- Activation and response of the necessary on-site and off-site support personnel;
- Continuous assessment and reclassifications, as necessary;
- Initiation of proactive actions;
- Aid to affected personnel;
- Recovery and re-entry.

The plant has well defined command co-ordination and response team (***Appendix L***) and their responsibilities are well defined.

1.8.2.15 Emergency Training, Exercises, and Planned Maintenance

Training Program

Training is one of the basic components of disaster management. In principle, anyone who occupies a position within the disaster management plant organisation undergoes some kind of training, followed by refresher courses at periodical intervals.

The main goal of training for emergencies is to enable the participants to understand their roles in the response organisation, the tasks associated with each position, and the procedures for maintaining effective communications with the other response functions and individuals.

An in-house team will be appointed for the development of such training programme. This team is composed of the same people in-charge of developing and reviewing the response plan.

Mock Drill

In spite of detailed training, it may be necessary to try out whether, the OSEP works out and will there be any difficulties in execution of such plan. In order to evaluate the plan and see whether the plan meets the objectives of the OSEP, periodical mock drills are contemplated. Before undertaking the drill, it would be very much necessary to give adequate training to all staff members and also information about possible mock drill. After few pre-informed mock drills, few un-informed mock drills would be taken. All this is to familiarize the employees with the concept and procedures and to see their response. These scheduled and unscheduled mock drills would be conducted during shift change, public holidays, in night shift etc. To improve preparedness once in 6 months mock drill will be conducted. Incident Controller (IC) coordinates this activity.

PPEs

In certain circumstances, personal protection of the individual maybe required as a supplement to other preventive action. It should not be regarded as a substitute for other control measures and must only be used in conjunction with substitution and elimination measures. PPEs must be appropriately selected individually fitted and workers trained in their correct use and maintenance. PPEs must be regularly checked and maintained to ensure that the worker is being protected.