

Riverina Oils and BioEnergy

Integrated Oilseed Processing Plant

Appendix C
Preliminary Hazard Analysis



Riverina Oils & Bio Energy Pty Ltd Integrated Oilseed Processing Plant (IOPP) Wagga Wagga – NSW Preliminary Hazard Analysis

- NW00136 –RPT Final Rev 0
- 12th March, 2010



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EXECUTIVE SUMMARY

Introduction, Objectives & Scope

Riverina Oils & Bio Energy Pty Ltd, Australia (hereafter known as ROBE) proposes to construct and operate an integrated oilseed processing plant just outside of Wagga Wagga, NSW. As part of the plant operations, it will be necessary to store and handle Dangerous Goods in quantities that exceed the threshold levels listed in State Environmental Planning Policy (SEPP) No.33, "Hazardous and Offensive Industries" (Ref.1). Under such conditions, it is necessary to prepare and submit a preliminary hazard analysis (PHA) covering the proposal.

ROBE, has commissioned Sinclair Knight Merz (SKM) to prepare and document preliminary hazard analysis (PHA) covering the proposal.

This document details the results of the PHA study for the proposed Integrated Oilseed Processing Plant at Wagga Wagga, NSW.

Methodology

The methodology used for the study was that prescribed in Multi-Level Risk Assessment (Ref.3) and HIPAP No.6 (Ref.2).

Brief Description of the Integrated Oilseed Processing Plant

The facility will be located approximately 10 km north of the township of Wagga Wagga, NSW. The land is zoned No.1 Rural in the Local Environmental Plan (LEP) for the area. It is understood that the surrounding land uses are proposed for future industrial land uses and a current industrial site is located to the south and east of the plant, namely Riverina Wool Combing Facility.

The proposed Integrated Oilseed Processing Plant will crush canola, and safflower, seeds to produce oil that will produce unrefined vegetable oil, refined vegetable oil and solid meal product. Seeds will be delivered to site and stored in silos. The seed will then be crushed and the oil extracted, with the crushed seed product being subjected to a solvent extraction operation that will remove the remaining oil from the seed.

The finished vegetable oil product is then cooled, filtered, dosed with anti-oxidant and pumped to the storage tanks, awaiting distribution.

Hazard Analysis

The following incidents were carried forward from the hazard identification phase of the study for consequence analysis:

Event #	Event	Description
1	Dust Explosion	Canola / Safflower and meal grain storage silos
2	RTkr Pool Fire	Flammable liquid leak at the delivery bay, ignition and pool fire in the bunded area of the delivery bay;
3	Tks 301-303 Bund Fire	Full bund fire in the combustible liquids storage tank bunds 301-303.
4	Tank C2 Bund	Full bund fire in the combustible liquids storage tank bunds Tank C2.
5	Tank C1 Bund	Full bund fire in the combustible liquids storage tank bunds Tank C1.
6	Tks 101-212 Bund Fire	Full bund fire in the combustible liquids storage tank bunds 101-212.
7	Plant Fire – Crushing Unit	Plant fire in the Seed crushing plant resulting in full fire in the crushing building
8	Plant Fire – Extraction Unit	Plant fire in the extraction plant resulting in full fire in the oil extraction building
9	Plant Fire – Oil refining Unit	Plant fire in the oil refinery plant resulting in full fire in the oil refinery building

Consequences Analysis

Each incident listed above was subjected to a detailed consequence analysis (refer Section 5.2 – Hazard Analysis) to identify the heat radiation impact at the site boundary. Table 1 summarises the results of the analysis.

TABLE - 1 - SUMMARY OF CONSEQUENCE IMPACTS FROM POSTULATED INCIDENTS AT THE OILSEED PLANT

Event #	Plant	Area (m ²)	Pool Diameter	Distance (m) to Heat Flux kW/m ²				Distance to Boundary (m)	Heat Flux at Boundary (kW/m ²)	Risk Level at Boundary (x 10 ⁻⁶ per annum)
				35	25	12.6	4.7			
1	Dust Explosion	NA	NA					100	NA	-
2	Road Tkr Unloading	75	13.60	12	15	22	35	65	2	-
3	Tanks 301-303 Bund	150	19.23	17	20	31	52	80	2	-
4	Tank C2 Bund	40	9.93	9	11	16	27	95	-	-
5	Tank C1 Bund	40	9.93	9	11	16	27	100	-	-
6	Tanks 101-212 Bund	1600	62.80	55	67	100	170	90	12.6	4
7	Seed Crushing Unit 1	5	3.51	3	4	6	10	100	-	-
8	Solvent Extraction Unit 2	10	4.96	4	5.5	8	15	150	-	-
9	Oil Refinery Bld	11	5.21	4	5.5	8	15	140	-	-

Risk Analysis

The risk levels computed at the site boundary are approximately 4×10^{-6} p.a., as shown in the table 2 below. Such risk levels, when viewed against the NSW DoP Risk Criteria (50×10^{-6} p.a. for industrial land use) under the NSW Department of Planning guidelines (Reference 11) are considered acceptable.

TABLE 2 - OVERALL RISK EVALUATION

EVENT # / Item	Base Freq ($\times 10^{-6}$ per annum)	Pf(E)	Individual Risk $\times 10^{-6}$ At Boundary adjacent to Byrnes Rd	Effect Zone / Fatality Radius
2. Road Tkr Pool fire	21	0	0	35
3. Tanks 301-303 Bund fire	4	0	0	52
6. Tanks 101-212 Bund fire	4	1.0	4	80
TOTAL RISK LEVEL at BOUNDARY			4	

It is therefore concluded that the risk criteria levels at the boundary of the site do not exceed the risk criteria published by the NSW Department of Planning (Ref.4) at the boundary. And further, the ROBE plant, as proposed, is not considered potentially hazardous or offensive and is therefore permissible within the current land zoning.

Recommendations

Notwithstanding the above risk analysis results, a number of recommendations were made in order to enhance the safety systems at the site and ensure the risks are maintained as low as reasonably practicable (ALARP). The following recommendations are made:

- Dust Explosion** - Canola and safflower seeds can generate combustible dust. Hence, when filling silos, dust could be generated reaching combustible levels. SKM recommends that all silos and bins storing materials, that could generate combustible dusts (i.e. seeds and meals), be fitted with explosion relief systems designed in accordance with NFPA68 (Ref.15).
- Safety Management System (HIPAP No 9)** – A safety management system in accordance with the NSW DoP Advisory Paper no 9 should be developed for the site.
- Spill Kits** - It was identified that a number of corrosive materials are used in the Seed Oil production process. Spills of these materials, whilst contained within bunded areas will require rapid clean-up to minimise the potential for release

beyond the containment or for contact with personnel. It is therefore recommended that corrosive materials spill kits be installed throughout areas where corrosive materials are stored, handled and used at the site.

4. **Fire Safety Study (HIPAP No # 2)** - It was identified that in the event of an incident involving fire, there is a potential for heat radiation to impact areas adjacent to the fire. This could cause damage and/or fire growth. To combat this, fire water cooling is normally applied using hydrants and hoses. It is therefore recommended that a fire safety study be conducted to determine the areas where fire water cooling would be required to minimise the potential for incident growth.
5. **Foam Stocks** - The most appropriate fire fighting medium for flammable and combustible liquids is foam. It is therefore recommended that ROBE obtain a foam generation attachment for the fire hoses (one for each plant area where flammable & combustible liquids are stored and handled) and maintain a storage of at least 20 L of foam concentrate adjacent to the location where a foam generating attachment is held.
6. **Retention Basin** - It was identified that in the event of fire, it will be necessary to apply contaminated fire water to the incident. Fire water could be contaminated by products at the site that could have an adverse impact on the environment. Hence, it would be necessary to contain any fire water on site to limit the potential for environmental damage. It is recommended that a first flush retention pond be constructed at the ROBE site with a minimum freeboard capacity of 162m³, so that in the event of a fire, contaminated fire water may be retained on site.
7. **Sub-Bunds for Main Tank Farm** – The heat flux computations show that the main Oil tank farm bund must be divided into at least two equal sub-bunds to ensure heat flux levels of 4.7 kW / m² do not extend beyond the Byrnes Rd boundary.

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ABBREVIATIONS

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
API	American Petroleum Industry
AS	Australian Standard
DoP	Department of Planning
FAME	Fatty Acid Methyl Esters
HIPAP	Hazardous Industry Planning Advisory Paper
kL	Kilo Litres
kms	kilometres
kPa	kilo Pascals
kPag	kilo Pascals (gauge)
kV	kilo Volts
kW/m ²	kilo Watts per square metres
LEP	Local Environmental Plan
m	metres
m ²	square metres
m ³	cubic metres
m ³ /hr	cubic metres per hours
Nm ³ /hr	Normal cubic metres per hour
p.a.	per annum
PFD	Process Flow Diagram
PG	Packaging Group
PHA	Preliminary Hazard Analysis
pmpy	per million per year
PSA	Pressure Swing Absorption
ROBE	Riverina Oils & Bioenergy Pty Ltd Australia
SEP	Surface Emissive Power
SEPP	State Environmental Planning Policy
SKM	Sinclair Knight Merz
SS	stainless steel
t	tonnes
tpd	tonnes per day
tph	tonnes per hour

1. INTRODUCTION

1.1. Background

Riverina Oils and Bio Energy Pty Ltd (hereafter known as ROBE) propose to establish a new Integrated Oilseed Processing Plant off Trahairs Road, about 10 kilometres north of Wagga Wagga.

This plant would be located on a 39.5 hectare rural site located to the north of the Bomen industrial estate. In the past this site was used by the nearby Wool Combing Facility for wastewater storage and irrigation.

The area surrounding the site is dominated by rural and rural-residential development, and is sparsely populated. There are only 6 residences within a 2.5 kilometre radius of the site, with the closest residence being located about 1.1 kilometres from the site.

The plant would produce oil seed related products such as vegetable protein meal, edible vegetable oil and refined glycerine.

As part of the plant operations, it will be necessary to store and handle Dangerous Goods in quantities that exceed the threshold levels listed in State Environmental Planning Policy (SEPP) No.33, "Hazardous and Offensive Industries" (Ref.1). Under such conditions, it is necessary to prepare and submit a preliminary hazard analysis (PHA) covering the proposal.

ROBE, has commissioned Sinclair Knight Merz (SKM) to prepare and document preliminary hazard analysis (PHA) covering the proposal.

This document details the results of the PHA study for the proposed Integrated Oilseed Processing Plant at Wagga Wagga, NSW.

1.2. Objectives

The objectives of the study are to:

- Prepare a PHA study of the proposed ROBE Integrated Oilseed Processing Plant at Wagga Wagga, NSW in accordance with Hazardous Industry Planning Advisory Paper No.6, "Guidelines for Hazard Analysis"(Ref.2); and
- Report on the findings of the study for submission to the NSW DoP and other regulatory authorities.

1.3. Scope of Work

The scope of this Preliminary Hazard Analysis (PHA) study covers the:

- Proposed ROBE Integrated Oilseed Processing Plant at Wagga Wagga, NSW and identification of potential hazards associated with the manufacturing and storage of combustible oils and flammable additives,
- For those hazards identified, determination of their potential consequences and whether risks posed affect adjacent land users,
- A quantitative estimation of those risks that may have off site effects and their cumulative impact, and
- A review of emergency planning principles and fire safety management systems, particularly containment systems for the worst case fire scenario(s).

The format of the study and context is generally defined within the guidelines provided by the NSW DoP Hazardous Industry Planning series, including:

- Advisory Paper No:6 “ Guidelines for Hazard Analysis “
- SEPP33 & Multilevel Risk Assessment.

Note: For Completeness this study should be read in conjunction with the Project Development Application and supporting documentation.

1.4. Assumptions and Limitations

The process and description of all plant operations, and design drawings relied upon by SKM, has been supplied by ROBE.

The following limitations apply to the assessment:-

- Generally the assessment does not incorporate the detailed requirements of the relevant Australian Standards.
- Life safety objectives are limited to those identified in the PHA. The PHA scope specifically does not consider the issue of property damage or liability to neighbours or environmental damage or damage to the biophysical environment.
- The PHA does not consider the road transport of dangerous goods by road tanker (other than the on-site activities, e.g., tanker unloading operations)
- Future BioDiesel production facilities are also not covered by this PHA (these will be the subject of separate studies, if and when required).

2. Site Location

2.1. Land Zoning and Adjacent Land Uses

The proposed ROBE seed oil refining facility will be located about 10 km north of the Township of Wagga Wagga., NSW, as shown in **Figure 1 – Site Location map**. The proposed land is zoned No.1 Rural, and review of the Wagga Wagga Rural Local Environmental Plan 1991 (LEP 1991) indicates that the proposed facility is permitted in this zoning providing the facility is not classified as “Hazardous or Offensive”. The facility currently has only one industrial site within close proximity, the remaining adjacent areas are undeveloped and are currently open rural land. The surrounding facilities are listed below:

- **East** – Open rural land (Rural property, “Kalingur”, about 1000m directly to the east of the proposed plant);
- **North** – Open rural land, no rural/residential properties located to the north;
- **West** – Main southern railway immediately adjacent to the site boundary, west; Olympic Way about 1,500m to the west (no rural/residential properties located to the west between the site and the Olympic Way, and
- **South** – Wool Combing Facility (site water collection ponds located adjacent to the southern boundary of the site, wool factory buildings located about 750m from the southern site boundary).

The closest zoned rural/residential area is located about 2.5 km to the south in the township of Bomen.

2.2. Site Layout

The facility comprises a number of raw materials storages, process plant areas and product storages. In addition to the production and storages areas, the site will also contain ancillary services such as steam generation, compressed air facilities, electrical power supply, amenities, etc.

All these facilities are combined in an integrated plant as depicted in **Figure 2 – Site Layout Plan**. Two main varieties of oil seed – namely Canola and Safflower - will be delivered in trucks to the Plant, unloaded and stored in respective silos. The two types of seed will be processed in separate campaigns to avoid product contamination.

The plant will be located on a Greenfield site of 39.5 Hectares, with an occupied area of 7.59 Hectares (the remaining land is open buffer zone between the plant and site boundaries. The site will operate a continuous process (24 hours per day, 7 days per week), with planned shutdowns for maintenance only.

A proposed process flow diagram (PFD) is shown in **Figure 3**. This layout can be used to assist in understanding the description given below.

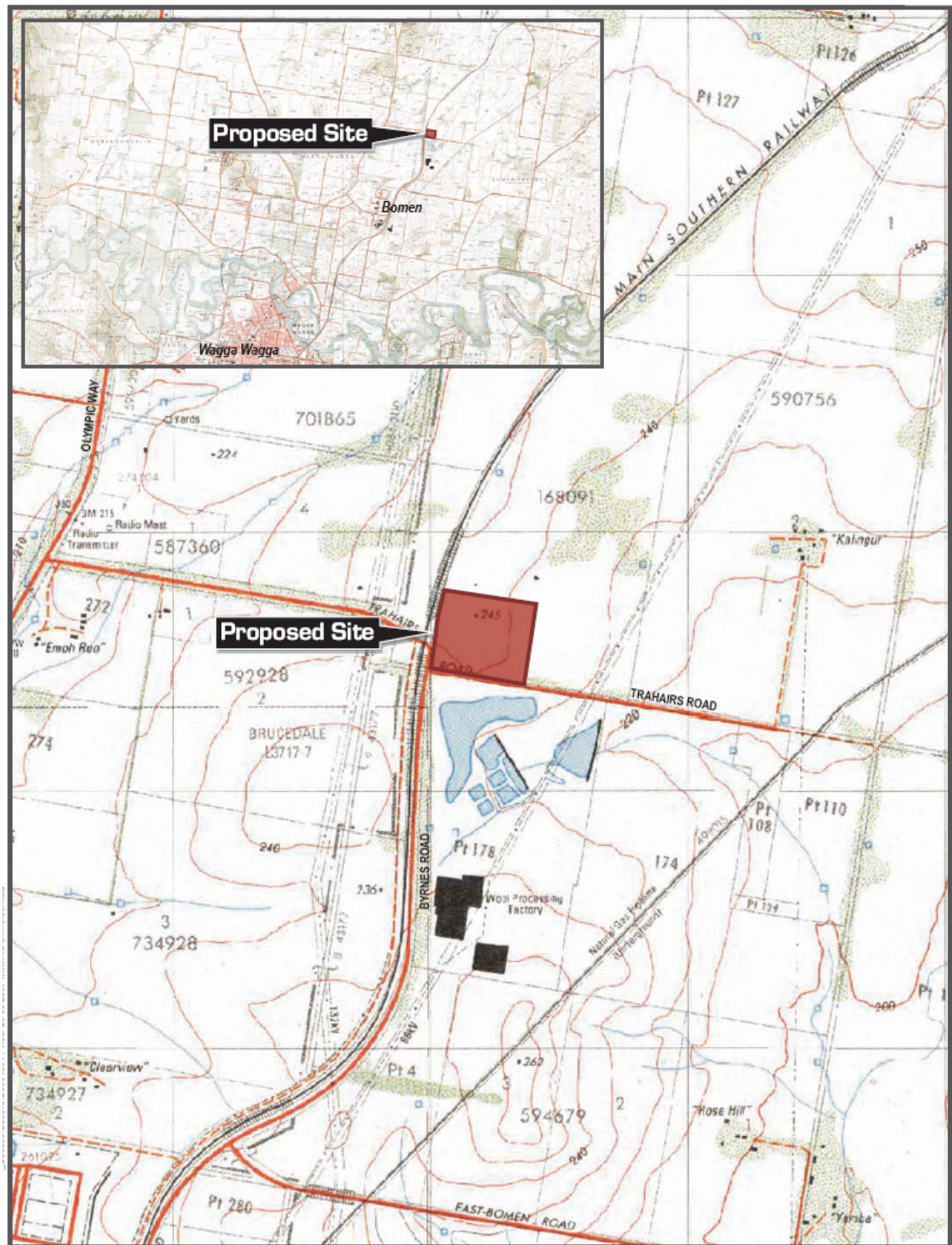


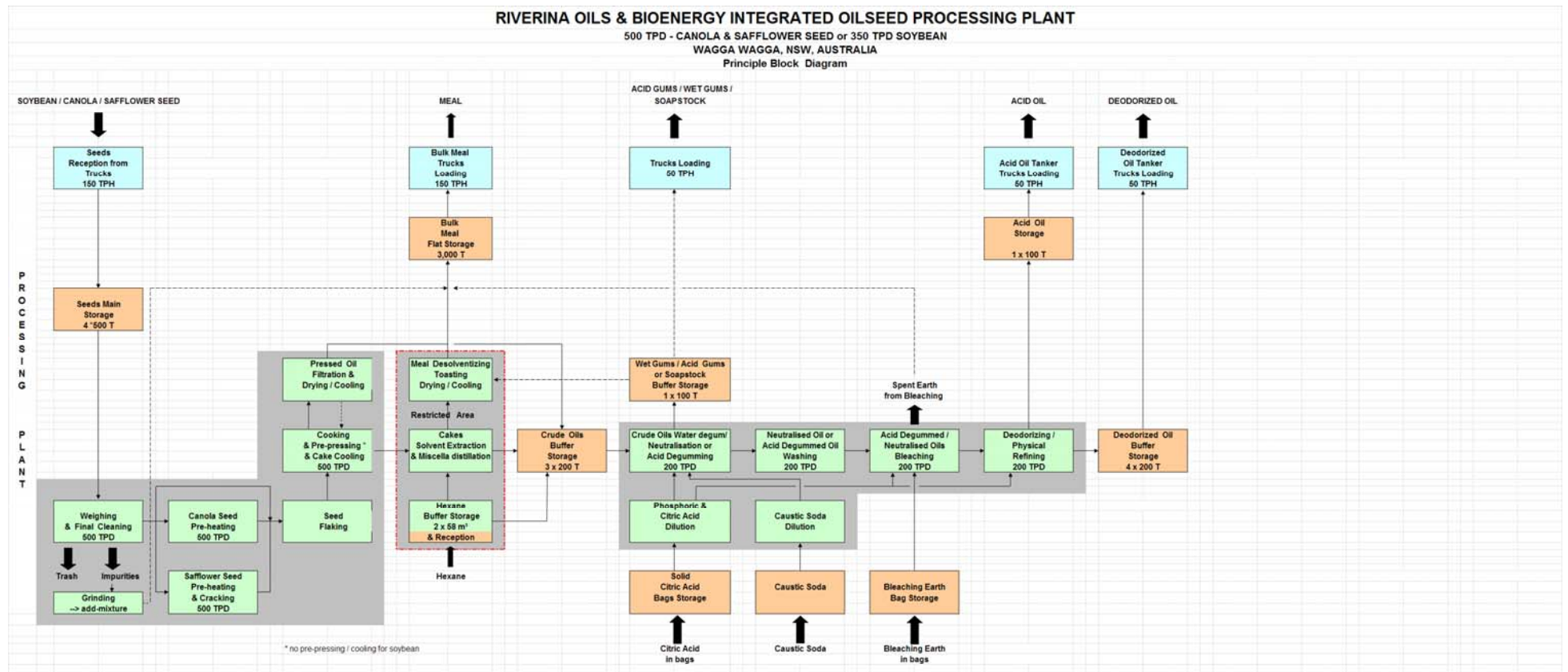
FIGURE 1 - SITE LOCATION MAP



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FIGURE 3 – Process Flow Diagram



3. General Process Description

3.1. General Site Operations

The ROBE oilseed crushing and refining operations will require some 165,000 tonnes of oilseed per annum,

The major plant components and their respective operations are summarised in this section;

- Oilseed crushing plant: the crushing plant can process 500 t per day (tpd) of oilseed to produce 150tpd of expelled oil and 350 tpd of oil cake.
- Solvent extraction plant: can process 350 tpd of oil cake, producing 60 tpd of solvent extracted oil and 290 tpd of de-oiled meal.
- Meal blending shed: is used to mix de-oiled meal from the solvent extraction building with produced gum, a by-product from the vegetable oil refinery, to produce 300 tpd of vegetable protein meal for sale in the local market.
- Vegetable oil refinery: will process 200 tpd of expelled oil or solvent extracted oil to produce 194 tpd of refined oil, and
- Storage Facilities: silos for oilseed, storage facility for de-oiled meal, tanks for vegetable oil, and other process chemicals including hexane and methanol.

These operations are described in more detail below;

3.2. Oil Seed Delivery and Storage

Oilseeds will be received in trailers and stored in four (4) steel silos, each with a capacity of -550 tonnes (t). The silo unloading/ filling system will have a capacity to handle 250 tonnes per hour (tph) of oil seed. The silos will be provided with an aeration system (but are held gas tight during fumigation). Each silo will have temperature and level monitoring instruments.

From the silos, seeds will be conveyed to - directly to the Seed Preparation section. The Silo Discharge system is controlled to deliver seed directly to the Crushing Plant within the Seed Preparation Building at a controlled rate of 20 to 40 tph. All seed handling and storage facilities will be design and constructed to meet the relevant Australian Standards.

3.3. Oil Seed Crushing

The oil seed crushing plant will have the capacity to process 500 tpd of oil seed, made up of 100 tpd of expelled oil and 400 tpd of oil cake. All equipment of the seed preparation plant would be housed in a 29 m high building with a concrete floor of approximate dimensions of 42.5 m long x 24 m wide. The building would be constructed from a steel frame with sheet steel cover. Eight floors will be installed; ground-level, and process access platforms at 4.525, 8.525, 13.525, 18.025 and 23.025 m above ground-level.

The seed will be delivered to the plant by conveyor and fed to the seed crushing machines where the seed oil will be extracted, filtered, and piped to the vegetable oil refinery. Seed Oil Cake will be conveyed to the Solvent Extraction Plant

3.4. Solvent Extraction Plant

This plant will use a solvent to process 350 tpd of oil cake to produce 60 tpd of extracted oil and 290 tpd of de-oiled cake (Meal). All the equipment would be housed in a 22m high “adequately ventilated” steel frame, metal clad building. The plant floor will be concrete and have approximate dimensions 28 m long x 20 m wide. Six floors will be installed; ground-level and process access platforms at 3.025, 7.025, 10.525, 13.275, and 15.775m above ground level.

Oil seed cake, from the seed crushing plant, will be fed to the solvent extraction plant. Hexane will be added to the cake in a continuous extraction unit. The hexane will dissolve any remaining oil in the seed cake and the seed meal will be discharged from the extractor to a desolventiser, before transfer to the meal blending and storage facility. The hexane/oil mix will then pass through a separation unit, where the vapours will be extracted from the oil in a steam heating process. Recovered solvent will then be fed back to the extractor unit and the recovered oil passed to the oil refining plant.

Since hexane will be used as solvent, the building together with its surrounding area will be considered as hazardous area as per the applicable code/standard.

3.5. Meal Blending Shed

The de-oiled meal from the solvent extraction building will be conditioned in the meal-blending shed and transferred to meal storage shed. The conditioning process will include mixing of the meal with produced gum and adjusting the moisture content of the meal. The building will be a single storey totally enclosed steel structure building and will be located adjacent to the Meal Storage Shed. The building will have dimensions of 10 m long x 6 m wide with a platform at about 4 m elevation.

3.6. Vegetable Oil Refinery

The vegetable oil “refinery” will be used to process the oil extracted from the seed or the oil produced from the solvent extraction process. The plant will have capacity to process 200 tpd.

All equipment of the Refinery plant would be housed in a 27 m high building with a concrete floor of approximate dimensions of 36.5 m long x 24 m wide. The building would be constructed from a steel frame with sheet steel cover. Eight floors will be installed; ground-level, and process access platforms at 3.525, 7.025, 10.525, 13.528, 16.525, 20.025 and 23.525 m above ground-level.

The Seed Oil process will require maximum permissible water content in the oil of 0.05 %. Hence, filtered oil from the seed crushing plant will first pass through a hydration process (mixed with sodium hydroxide and water) then passed through a separator and dryer to remove the water from the oil. The oil will then be refined in a vacuum distillation column to remove fatty acids before feed to the Seed Oil production unit.

3.7. Product and By-Product Storage

The plant will be constructed with bulk storages for raw materials, chemicals, products and by-products. Each area is described below.

3.7.1. De-Oiled Meal Storage

De-Oiled meal, conditioned in the meal blending section, will be transferred to the Meal Storage shed. During normal operations, the meal will be conveyed to the meal storage shed, at the rate of -15 tph. The meal storage shed will be a covered steel structure constructed to store a maximum of 3000 t of meal. The meal from the shed will be loaded to maximum vehicle size, B-Double articulated vehicles by a front-end loader.

Environmental control system will be installed in the meal storage shed in accordance with the relevant Australian standards.

3.7.2. Vegetable Oil Storage

Vegetable oils will be stored in a number of vertical cylindrical tanks with a sloping flat bottom and conical roof. Tanks will be constructed from mild steel or 304 stainless steel, designed and constructed relevant Australian standards Vegetable Oil tanks will be provided with steam heating coils to maintain the temperature at about 50°C to ensure viscosity is sufficiently low for ease of transfer. Refined oil tanks will be provided with nitrogen blanketing systems.

The vegetable oils group consists of a number of oils including palm oil, safflower oil, canola oils, etc. These will be stored in a number of tanks located, but predominately in the tank farm. . Tank farm storage tank details (including vegetable oil tanks) are presented in **Table 3: ROBE - TANK STORAGE DETAILS**.

Tank storage details are preliminary subject to the most efficient and cost effective storage options.

TABLE 3 – ROBE - TANK STORAGE DETAILS

Tank No	Product	Cap m3	Cap Mt	dia - mtr	ht-mtr	MOC	Heating Coils	Nitrogen Blanket
101	EXP CANOLA OIL	175	150	4.5	11	MS	NO	NO
102	EXP CANOLA OIL	175	150	4.5	11	MS	NO	NO
103	EXP CANOLA OIL	175	150	4.5	11	MS	NO	NO
104	EXP CANOLA OIL	175	150	4.5	11	MS	NO	NO
105	EXP CANOLA OIL	175	150	4.5	11	MS	NO	NO
106	EXP SAFFLOWER OIL	175	150	4.5	11	MS	NO	NO
107	EXP SAFFLOWER OIL	175	150	4.5	11	MS	NO	NO
108	EXP SAFFLOWER OIL	175	150	4.5	11	MS	NO	NO
109	SOL CANOLA OIL	175	150	4.5	11	MS	NO	NO
110	SOL CANOLA OIL	175	150	4.5	11	MS	NO	NO
111	SOL. SAFFLOWER OIL	175	150	4.5	11	MS	NO	NO
112	SOL. SAFFLOWER OIL	175	150	4.5	11	MS	NO	NO
113	FEED TANK	175	150	4.5	11	MS	NO	NO
114	FEED TANK	175	150	4.5	11	MS	NO	NO
201	RBD CANOLA OIL	175	150	4.5	11	MS	NO	YES
202	RBD CANOLA OIL	175	150	4.5	11	MS	NO	YES
203	RBD CANOLA OIL	175	150	4.5	11	MS	NO	YES
204	RBD CANOLA OIL	175	150	4.5	11	MS	NO	YES
205	RBD CANOLA OIL	175	150	4.5	11	MS	NO	YES
206	RBD CANOLA OIL	175	150	4.5	11	SS	NO	YES
207	RBD SAFFLOWER OIL	175	150	4.5	11	MS	NO	YES
208	RBD SAFFLOWER OIL	175	150	4.5	11	MS	NO	YES
209	RBD SAFFLOWER OIL	175	150	4.5	11	MS	NO	YES
210	RBD SAFFLOWER OIL	175	150	4.5	11	SS	NO	YES
211	RBD PALM OIL	175	150	4.5	11	SS	YES	YES
212	RBD PALM OIL	175	150	4.5	11	SS	YES	YES
301	SOAP STOCK	35	30	3	5	MS	YES	NO
302	SOAP STOCK	35	30	3	5	MS	YES	NO
303	GUMS	35	30	3	5	SS	YES	NO
304	DEO DISTILLATE	22	20	2.5	4.5	SS	YES	NO
C1	CAUSTIC SODA	35	50	3	5	MS	NO	NO
C2	PHOSPHORIC ACID	22	30	3	5	FRP	NO	NO

* Plant area shown in **Figure 2 – Site Layout Plan**.

3.7.3. Flammable Liquids Storage (Production Raw Materials)

The Seed Oil production process requires the use of flammable liquids, notably Hexane to extract the seed oil. Hexane will be stored in underground storage tanks. The tanks will be designed and constructed to API 650 or equivalent Australian standard (AS1692) and installed as per EPA 892 guidelines - -. The flammable liquids will be delivered by road tanker and unloaded to the respective storage tanks -using tanker mounted pumps or by gravity.

3.7.4. Chemical Storages (Production Raw Materials)

Additional chemicals, required as raw materials for the process, will be stored in tanks adjacent to the refined oil storage. The additional chemicals include the following.

- Caustic Soda or sodium hydroxide (30 %) - one (1) tank of 26 kL constructed from - Carbon Steel
- Phosphoric Acid– one (1) tank of 26 kL capacity constructed from -Stainless Steel 316

3.8. Product Transfer Facilities

Products will be transferred from storage tanks to road tankers at rates of 30 to 50 m³/hr capacity and at 200 kPa. Quantities of materials transferred will be measured by the respective level indicator in the storage tank. Additional assay measurements will be performed using a calibrated and certified weighbridge. Products delivered to site will be transported by road tanker and unloaded to the respective tanks by tanker mounted pumps. In cases where the road tankers are not fitted with tanker mounted pumps, the liquids will be transferred using site pumps with the same capacity as those used to transfer liquids to tankers (e.g. 30 to 50 m³/hr and at 200 kPa). Measurement for raw material deliveries will be performed by means of tank level indicators and counter checked over the weighbridge.

3.9. Buildings, Utilities and Services

The following ancillary buildings and services will be provided as part of the plant facilities:

- **Power Supplies** - power will be supplied to the site at 11 kV and will be transformed to various voltages for use by equipment in the plant.
- **Water** – industrial water will be supplied via an underground water main from the local water supply. A total of 650 m³/day will be used at the site.
- **Natural Gas** – natural gas will be supplied by underground pipe from the nearest high pressure gas pipeline. The gas will be supplied through a let-down and metering station at the site boundary. Gas reticulation pressure on site will be around 100 kPag.
- **Steam** – steam will be generated from natural gas package boilers and will be supplied to various users around the site by pipework. Condensate will be collected from the users and returned to the boilers for re-injection into the circuit.
- **Cooling Water** – a number of cooling towers will be installed at the site to provide cooling water to the various processes. The cooling water will be circulated throughout the plant using circulation pumps.

- **Nitrogen** – nitrogen will be used for the blanketing of storage tanks as well as a number of processes at the site. Nitrogen will be generated on site by a Pressure Swing Absorption (PSA) unit which will produce about -100 Nm³/hr of nitrogen. The nitrogen will be fed to the plant via a distribution header.
- **Plant & Instrument Air** – two compressors will be used to compress air into separate vessels; one for plant air and one for instrument air. Each compressor unit will have an installed stand-by that can be used in the event of main compressor failure. Air will be distributed throughout the plant in dedicated pipework headers (one system for the compressed air and one for the instrument air).
- **Tanker Loading/Unloading Bays** – all tanker loading/unloading bays will be constructed with spillage containment in the form of “speed-hump” style bunds. Water or spillage will be collected in the bunded area in a sump and passed to the waste water treatment plant for processing before licensed discharge to sewer.
- **Fire Potentially Contaminated Water Detention** - a ground level storm water detention tank will also be provided for receiving the storm water from the storage tank bunds and process plant areas. The collected water will be analysed and if necessary will be treated in the effluent treatment plant, before disposal.

4. METHODOLOGY

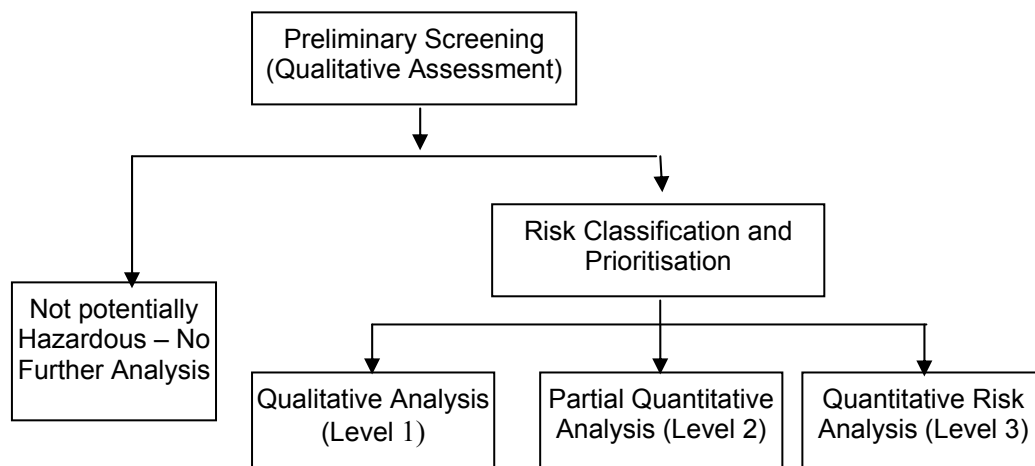
4.1. General Approach

The NSW Department of Planning (DoP) Multi Level Risk Assessment (Ref.3) approach was used for this study. The approach considered the development in context of its location and its technical and safety management control. The Multi Level Risk Assessment Guidelines are intended to assist industry, consultants and the consent authorities to carry out and evaluate risk assessments at an appropriate level for the facility being studied.

The Multi Level Risk Assessment approach is summarised in **Figure 4**. There are three levels of assessment, depending on the outcome of preliminary screening. These are:

- **Level 1 – Qualitative Analysis**, primarily based on the hazard identification techniques and qualitative risk assessment of consequences, frequency and risk;
- **Level 2 – Partially Quantitative Analysis**, using hazard identification and the focused quantification of key potential offsite risks; and
- **Level 3 – Quantitative Risk Analysis (QRA)** based on the full detailed quantification of risks, consistent with Hazardous Industry Planning Advisory paper No.6 – Guidelines for Hazard Analysis.

FIGURE 4 - THE MULTI LEVEL RISK ASSESSMENT APPROACH



The document “Applying SEPP 33” (Ref.1) guideline may also be used to assist in the selection of the appropriate level of assessment. This guideline states the following:

“It is considered that a qualitative PHA may be sufficient in the following circumstances:

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- *where materials are relatively non-hazardous (for example corrosive substances and some classes of flammables);*
- *where the quantity of materials used are relatively small;*
- *where the technical and management safeguards are self-evident and readily implemented; and*
- *where the surrounding land uses are relatively non-sensitive.*

In these cases, it may be appropriate for a PHA to be relatively simple. Such a PHA should:

- *identify the types and quantities of all dangerous goods to be stored and used;*
- *describe the storage/processing activities that will involve these materials;*
- *identify accident scenarios and hazardous incidents that could occur (in some cases, it would also be appropriate to include consequence distances for hazardous events);*
- *consider surrounding land uses (identify any nearby uses of particular sensitivity); and*
- *identify safeguards that can be adopted (including technical, operational and organisational), and assess their adequacy (having regards to the above matters).*

A sound qualitative PHA which addresses the above matters could, for some proposals, provide the consent authority with sufficient information to form a judgement about the level of risk involved in a particular proposal”.

Whilst the proposed ROBE facility is currently located in an area zoned rural, it is understood that the area is being considered for a rezoning under the amended LEP. It is understood that the area would be zoned industrial and whilst there are currently few industries within this area, it is anticipated that new industrial facilities will develop in the area over time, resulting in facilities that could be adjacent to the proposed Integrated Oilseed Processing Plant. Detailed technical and management safeguards are proposed for the Integrated Oilseed Processing Plant and the predominant Dangerous Goods at the site are all combustible liquids and relatively low risk. Hence, under these circumstances, a qualitative assessment may be considered for the project. However, it is noted that the anticipated growth of industries close to the proposed Seed Oil site could result in impacts to the adjacent sites in the event of an incident at the plant. Hence, there could be a potential for “domino” effects from incidents at the Integrated Oilseed Processing Plant to adjacent future sites.

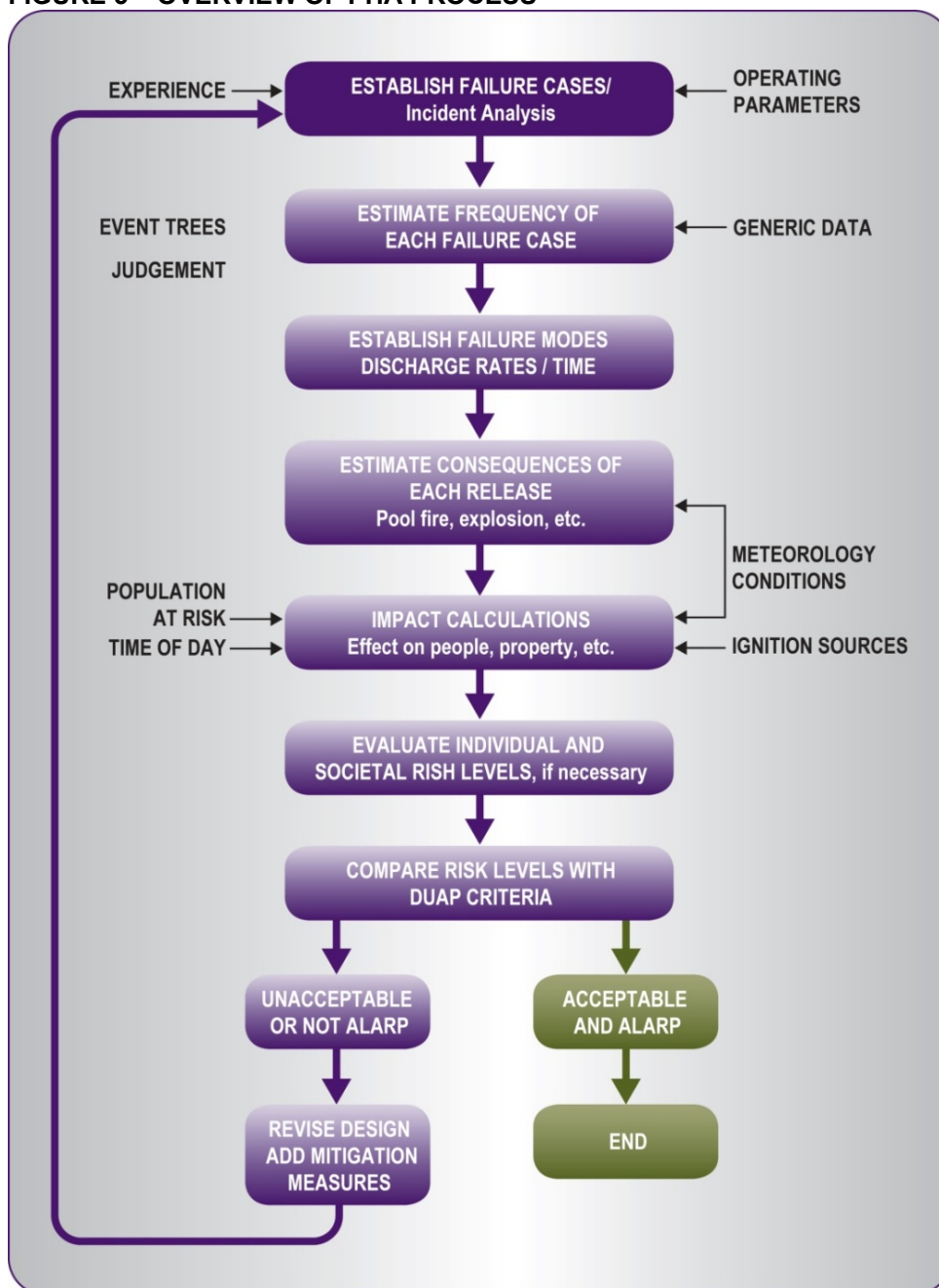
Based on the separation from sensitive receptors and the potential for domino incidents to adjacent industrial sites, a level 2 analysis has been selected as the most appropriate level of assessment for the site.

4.2. Detailed Approach

Essentially four major steps are involved in the analysis, namely incident identification, consequence analysis, probability and frequency estimations, leading to a quantitative risk assessment result. In practice however, as shown in Figure 5, there are many factors to be considered.

The detailed study approach follows that recommended in HIPAP No.6, "Hazard Analysis Guidelines" (Ref.2).

FIGURE 5 – OVERVIEW OF PHA PROCESS



The approach is summarised as follows;

4.2.1. Hazard Analysis

A detailed hazard identification was conducted for the site facilities and operations described in **Section 3**. Where an incident was identified to have potential off site impact, it was included in the recorded hazard identification word diagram (**Table 6**). The hazard identification word diagram lists incident type, causes, consequences and safeguards. This was performed using the word diagram format suggested in HIPAP No.6 (Ref.2). Each postulated hazardous incident was assessed qualitatively in light of proposed safeguards (technical and management controls). Where a potential offsite impact was identified, the incident was carried into the main report for further analysis. Where the qualitative review in the main report determined that the safeguards were adequate to control the hazard, or that the consequence would obviously have no offsite impact, no further analysis was performed.

The hazard analysis and safety systems review was conducted in discussion with the ROBE operations and management team.

4.2.2. Consequence Analysis

For those incidents qualitatively identified in the hazard analysis to have a potential offsite impact, a detailed consequence analysis and risk assessment was conducted to determine the risk levels at the boundary of the site. The analysis modelled the various postulated hazardous incidents and determined impact distances from the incident source. The results were compared to the consequence criteria listed in HIPAP No.4 (Ref.4). Where an incident was identified to result in offsite effect, it was carried forward for frequency analysis. Where an incident was identified to have an offsite effect, and a simple solution was evident (i.e. move the proposed equipment further away from the site boundary), the solution was recommended and no further analysis was performed.

4.2.3. Frequency Analysis

In the event a simple solution for managing consequence impacts was not evident, each incident identified to have potential offsite impact was subjected to a frequency analysis. The analysis considered the initiating event and probability of failure of the safeguards (both hardware and software). Generic failure frequencies for the Oil and Petrochemical industries were used to provide the risk estimates at the boundary. The references for the Generic failure frequencies are provided in the Summary (Table 10).

4.2.4. Risk Assessment

As the selected approach for this analysis was a Level 2 assessment (Ref.3), where incidents were identified to impact offsite and where a consequence and frequency analysis was conducted, the consequence and frequency analysis for each incident was combined to give a risk result, the risk results added to give a cumulative risk result at the boundary, which was then compared to the risk criteria published in HIPAP No.4 (Ref.4). Recommendations were then made regarding risk reduction measures, regardless of the risk levels achieved (following the ALARP principle).

5. HAZARD ANALYSIS

The four major steps are involved in the analysis, namely incident identification, consequence analysis, probability and frequency estimations, leading to a quantitative risk assessment result are presented in this section.

5.1. HAZARD IDENTIFICATION

The nature of the materials stored or processed on site is an important part of the PHA because it establishes whether fire, explosion or toxic releases are possible and to what degree. For example, the storage and transfer of flammable liquids presents potential fire and explosion hazards.

5.1.1. Nature and Quantity of Materials Stored and Used On Site

As part of the Seed Oil process, it is necessary to store and handle a number of Dangerous Goods. These are listed in **Table 4 – Dangerous Goods Stored**.

TABLE 4 - DANGEROUS GOODS STORED

Proper Chemical Name	Type of Storage	Class	PG	Hazchem Code	Quantity Stored (total)
Hexane	Underground tanks (2)*	3	II	3[Y]E	144 m ³
Vegetable Oil	Aboveground tanks (36)*	C1 /C2	N/A	N/A	3,232 m ³
Phosphoric Acid	Aboveground tank (1)*	8	II	2R	26 m ³
Caustic Soda (Sodium Hydroxide Solution – 30 %)	Aboveground tank (1)*	8	II	2R	26 m ³

* Indicated number of tanks

Potential hazards of dangerous goods stored and the safeguards employed by ROBE are described in Table 5 – Hazardous Nature of Materials. Material Safety data sheets are provided for Hexane, Phosphoric Acid and Sodium Hydroxide in Appendix A.

5.1.2. Hazard Identification and selection of Major Accident Events

A hazard identification word diagram has been developed and is presented in **Table 6 – General Hazard Identification Table and Selected MAE's**. Those hazards identified to have a potential impact offsite are assessed in detail in the following section of this document. **Table 4** lists the type and quantity of DGs stored and handled at the proposed Integrated Oilseed Processing Plant at Wagga Wagga, NSW. It is noted that all goods listed are either flammable/combustible liquids or corrosive liquids and will be stored and handled with reference to the Australian Standard AS1940-2004 (Ref.6) or AS3780 (Ref.14) respectively. It is noted that the quantity of flammable liquids stored at the proposed terminal will trigger the requirements for compliance with the NSW Occupational health and Safety (Dangerous Goods Amendment) Regulation 2005 (the Regulation). The facility, under this regulation, will be classified as a 'Manifest' site. It is understood that the Integrated Oilseed Processing Plant management will develop the appropriate safety management systems to comply with the requirements of the Regulation.

The seeds and meals stored at the plant are not listed as a Dangerous Goods; however, these materials could cause additional hazards in the form of combustible dust. The handling of seed and meal could generate dust in silos and equipment, which if mixed with air in the correct proportions could form a flammable dust cloud and if ignited may explode.

The detailed analysis below has been performed as a screening study to identify the major incidents that could occur at the site and determine whether any of these incidents has the potential to impact offsite (i.e. consequence analysis). This approach is commensurate with the methodology recommended in the Multi-Level Risk Assessment approach (Ref.3). The approach has been to review areas where initiating incidents could occur (e.g. minor fires) and then identify the worst case incident should the initiating incident fail to be controlled. The worst case incidents are then carried forward for consequence analysis where (for example) heat radiation impacts are assessed and compared to published criteria (Ref.4). Where no offsite impact is identified, the incident is not carried forward for further analysis. Where a worst case incident is identified to impact adjacent offsite areas, a more detailed review of specific incidents within the worst case incident envelope are assessed to ensure that should these incidents impact offsite areas the appropriate risk is addressed.

TABLE 5: HAZARDOUS NATURE OF MATERIALS

MATERIAL / QTY	HEALTH HAZARDS & PHYSICAL PROPERTIES	ENVIRONMENTAL HAZARDS	SAFEGUARDS
Combustible Liquid – Seed Oil Seed Oil (based on Mineral Oil) or	Class C1 Combustible Liquid. Density Range – 0.7 - 0.85 Flammable limits in air 1.2 – 6 % v/v. Combustion products: mainly CO – chemical asphyxiant, SOX, NOX. Seed-Oil (Chemical name – Fatty Acid Esters) is a combustible liquid with a flash point greater than 60.5oC but less than 150 deg C are classified as C1. Under these circumstances, the liquid does not flash (vaporise) readily at ambient temperature, hence, vapour clouds do not form and flash fires, at ambient temperature do not occur. Localised heating and minor vapour generation may result in ignition and pool fire which may escalate to larger incidents.	Dangerous to aquatic life in high concentrations. Aquatic Toxicity: 204 mg/l/24 hr juvenile American Shad/TLM/salt water. Fouling substance if spilled into waterways such as the sea, lakes and rivers. May contaminate groundwater if seeped into the soil	Oil Spills collected within the primary oil storage pit or bund of 110% oil capacity (A secondary oil collection system or retention pond will also be provided). Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.
Hexane (2 tanks – 144kL total)	Class 3 Pg Group II - Flammable liquid which has a flash point less than 23 deg C and hence may vaporise at ambient temperature resulting in localised vapour cloud, local flash fire potential and liquid pool fires. Vapours are irritating to the eyes and upper respiratory tract, may cause headaches, nausea and could have an anaesthetic effect. CNS depressant.TWA suggested is 50ppm. LEL - UEL 1.0 – 7.5 % Reacts violently with oxidising substances.	Negligible soluble in water, mainly a fire / explosion hazard.	Double walled tanks (Manufactured by Enviroguard) to be used for hexane storage. Underground tanks to be compliant with AS 1692 or equivalent. Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.
Combustible Liquid – Vegetable Oils (and	Class C2 - combustible liquids, with a flash point in excess of 150 deg C. Oils do not flash readily	Dangerous to aquatic life in high concentrations. Aquatic Toxicity: 204 mg/l/24 hr juvenile American Shad/TLM/salt water.	Oil Spills will be collected within the primary oil storage pit or bund (A secondary oil

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MATERIAL / QTY	HEALTH HAZARDS & PHYSICAL PROPERTIES	ENVIRONMENTAL HAZARDS	SAFEGUARDS
other oils)	unless heated above 150 deg C, hence, at ambient temperature flash fires and pool fires are unlikely. (Note: In process temperatures may be elevated above flash point and hence behave as a flammable liquid)	Fouling substance if spilled into waterways such as the sea, lakes and rivers. May contaminate groundwater if seeped into the soil	collection system or retention pond will also be provided). Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.
Corrosive liquids / Phosphoric Acid (26 kL)	Phosphoric Acids are classified as corrosive liquids. Corrosive liquids could impact the biophysical environment if released beyond the confinement systems at the plant. Contact with people could result in necrosis of the skin and other soft tissue. Vapours could impact the mucous membranes.	Acids and alkalis can cause burns, avoid contact with skin or eyes. PPE required. All products are miscible in water. Decomposition under fire conditions liberates toxic fumes.	Aboveground GRP tanks within separate bunded compounds. Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.
Corrosive liquids / Sodium hydroxide (26 kL)	Sodium hydroxide, in solution – 30 % is classified as a corrosive liquid (alkali). Like the acid corrosives, alkali corrosives can also impact the biophysical environment, if released beyond the confinement systems at the plant. Contact with people could also result in necrosis of the skin and other soft tissue. Vapours could impact mucous membranes.	Acids and alkalis can cause burns, avoid contact with skin or eyes. PPE required. All products are miscible in water. Decomposition under fire conditions liberates toxic fumes. Fumes may include chlorinated compounds or oxides of sulphur.	Aboveground GRP tanks within separate bunded compounds. Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.

Note: Further details of safety handling procedures and emergency response are provided in the Material Safety data Sheets (MSDS) – Appendix A.

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Table 6 – General Hazard Identification Table and Selected MAE's

Facility / Event	Cause /	Possible Results / Consequence	Safeguards Employed
Seed storage silos and meal storage bins / Dust explosion	- Dust generation in the seed storage silos and transfer equipment during silo filling - Dust generation in the meal storage bins and transfer systems	- Ignition of dust - Explosion and potential damage to plant - Missiles and projectiles – impact to personnel & injury/ fatality	- Ignition sources controlled in the silos (i.e. hazardous area classification of silos) - Seed dusts are low ST value (ST1 - low explosibility and impact) - Canola and Safflower seeds are high in oil content with low dust generation potential - Silos are sealed to minimise potential for ignition of dust from an external source - Explosion relief systems (e.g. explosion panels or bursting discs) are be fitted to those silo's where combustible/ explosive dusts with explosion panels. Explosion relief systems are to be designed in accordance with NFPA68 (Ref.15).
Road tanker loading bays / Transfer hose failure, ignition and pool fire	- Tanker impacts pipework adjacent to the bay - Tanker drive away whilst connected - Flexible hose failure (leak/rupture) - Operator error – incorrect connection of flexible hose (connection fails)	- Release of flammable/ combustible liquid into the loading bay - Potential spill and impact to the environment	- Loading bay area is bunded to contain spills ("speed-hump" style bund) - Road tanker unloading/loading operation is monitored by tanker drivers and plant operators during the full transfer operations - Delivery and despatch trucks are fitted with drive away protection to prevent drivers leaving the site whilst the truck is connected to the delivery/loading pipework (via the flexible hose) - Hoses are inspected and tested in accordance with the requirements of the ADG7 – Australian dangerous Goods Code #7 (Ref.12) - Pipework is installed behind protective bund walls to prevent truck impact on entering and leaving the bays

Facility / Event	Cause /	Possible Results / Consequence	Safeguards Employed
Liquid transfer via pipeline throughout the plant / Pipeline leak & pool fire	- Pipeline leak due to corrosion, overpressure, poor construction (welding), external interference	- Leak of liquid to environment - Ignition of leak and fire at leak point	- Pipeline will be fully welded steel along the full length (no flanges creating leak sources) - Pipeline will be non-destructively tested by hydrostatic pressure on completion of construction & prior to commissioning - Pipeline will be designed to withstand full pump “dead-head” with a conservative factor of safety (i.e. no rupture) - Pipelines will be installed above ground and will be fully visible for regular inspection
Tank Farm / Tank fire	- Overfill of tank during tank filling - Spill of flammable/ combustible liquid into the bund	- Potential offsite release, environmental impact	- All flammable & combustible liquid storages are bunded, no offsite release - Tanks are monitored during filling using level instrumentation (level in tanks repeated in the site control room) - All tanks are fitted with high level instruments and alarms (audible & visual in the site control room) - Visual inspection and checking of tank/bund area is performed during the transfer/filling operation

Facility / Event	Cause /	Possible Results / Consequence	Safeguards Employed
Tank Farm / Bund Fire	- Overfill of tank during tank filling - Spill of flammable/ combustible liquid into the bund - Ignition and bund fire	- Potential on and offsite heat radiation impact to surrounding areas - Potential for fire growth into adjacent areas	- Fire main (complying with AS2419-Ref.11), fire pumps (complying with NFPA20 – Ref.13) and fire water tank / retention pond. - Fire hydrants and hose reels close to the storage - Foam generation equipment will be available at the site for use by the Fire Brigades - Fire contained to bund – bund capacity exceeds largest tank in bund (in accordance with the requirements of AS1940 – Ref.6) - Majority of materials on site are combustible liquids stored at ambient temperature (low ignition potential) - Control of ignition sources in the process area. Areas will be classified as a hazardous area in accordance with Australian Standards where oils behave as class 2 combustibles – e.g. AS2430 (Ref.7) & AS60079 (Ref.8) - All tanks will be regularly inspected for potential leaks and corrosion impact; in the unlikely event of water build up in the tanks it will be drained regularly to prevent internal corrosion potential. - Tank level monitoring will be conducted at all times to identify potential rapid tank level loss indicating potential leaks
Tank Farm (those tanks containing flammable liquids) Vapour space ignition leading to explosion and tank fire	- Ignition of Flammable liquid in the tank	- Tank explosion and tank roof fire - Explosion overpressure and/or Heat radiation impact to surrounding area	- Flammable liquid tanks are all fitted with nitrogen blankets to eliminate the potential for vapour build up in the ullage space of the tank - All tanks will be fully vented with anti-flash gauze on vents to prevent ignition from entering the tank via the vent - All electrical equipment in the tank will be suitably specified for the specific hazardous area in which it will be installed

Facility / Event	Cause /	Possible Results / Consequence	Safeguards Employed
Tank farm Pump seal failure , leakage and fire	- Pipework, valve or flange leak - Pump seal leak	- Release of fuel to bunded area (i.e. pump bund) - Potential to impact environment if release escapes offsite	- Pipework between tanks and pumps is bunded and leaks will be contained within the tanks bunded area - Pump seals are double mechanical type to minimise the potential for leak - Pump area is bunded to contain spills - Pipework between pumps and flexible hose is located in a spill containment to prevent spills offsite - Pump operation is only conducted when site is staffed and pump/filling operations can be continually monitored
Road tanker unloading/ Acid spill	- Delivery tanker impacts pipework adjacent to the bay - Delivery tanker drive away whilst connected - Flexible hose failure (leak/rupture) - Operator error – incorrect connection of flexible hose (connection fails)	- Release of corrosive liquid into the loading bay - Potential spill and impact to the environment	- Loading bay area is bunded to contain spills (“speed-hump” style bund) - Road tanker unloading/loading operation is monitored by tanker drivers and plant operators during the full transfer operations - Delivery and despatch trucks are fitted with drive away protection to prevent drivers leaving the site whilst the truck is connected to the delivery/loading pipework (via the flexible hose) - Hoses are inspected and tested in accordance with the requirements of the ADG (Ref.12) - Pipework is installed behind protective bund walls to prevent truck impact on entering and leaving the bays
Tank Farm Acid spill	- Overfill of tank during tank filling - Spill of corrosive liquid into the bund	- Potential offsite release, environmental impact	- All corrosive liquid storages are bunded, no offsite release - Tanks are monitored during filling using level instrumentation (level in tanks repeated in the site control room) - All tank are fitted with high level instruments and alarms (audible & visual in the site control room) - Visual inspection and checking of tank/bund area is performed during the transfer/filling operation

5.2. CONSEQUENCE ANALYSIS

The following incidents were carried forward from the hazard identification phase of the study for consequence analysis:

Event #	Event	Description
1	Dust Explosion	Canola / Safflower and meal grain storage silos
2	RTkr Pool Fire	Flammable liquid leak at the delivery bay, ignition and pool fire in the bunded area of the delivery bay;
3	Tks 301-303 Bund Fire	Full bund fire in the combustible liquids storage tank bunds 301-303.
4	Tank C2 Bund	Full bund fire in the combustible liquids storage tank bunds Tank C2.
5	Tank C1 Bund	Full bund fire in the combustible liquids storage tank bunds Tank C1.
6	Tks 101-212 Bund Fire	Full bund fire in the combustible liquids storage tank bunds 101-212.
7	Plant Fire – Crushing Unit	Plant fire in the Seed crushing plant resulting in full fire in the crushing building
8	Plant Fire – Extraction Unit	Plant fire in the extraction plant resulting in full fire in the oil extraction building
9	Plant Fire – Oil refining Unit	Plant fire in the oil refinery plant resulting in full fire in the oil refinery building

Each incident has been assessed in detailed in this section.

5.2.1. Dust Explosion

Canola / Safflower and meal handling and deposition in silos may also generate dust that could reach a combustible mixture. Ignition of this dust could also cause significant explosion, plant damage and injury/fatality both on and offsite.

To prevent serious explosion in silos and storage bins ignition sources are carefully controlled, however, static electricity build up and discharge could provide sufficient energy to ignite a flammable mixture causing the explosion. Hence, careful control, of ignition sources cannot be considered a method of eliminating the explosion potential entirely. To minimise the potential for explosion impact in silos and storage bins, storing

materials that could generate combustible dusts, explosion relief systems (bursting discs or panels) can be installed that relieve the expanding gases. The panels can be designed to relieve the gas expansion before the maximum permissible pressure of the silo is exceeded.

It is therefore recommended that all silos and bins storing materials that could generate combustible dusts (i.e. seeds and meals) are provided with explosion venting systems (in accordance with NFPA 68)

Based on the assumption that this recommendation would be accepted, the impact from an ignition in a silo or bin (storing materials that could generate combustible dust) would be localised around the discharge point of the panel on the silo/bin. There would be no impact offsite or to adjacent plant and equipment as the impact of the explosion relief would be directed to open areas. This incident is therefore not been carried forward for further analysis as the effects at the boundary are considered negligible.

5.2.2. Road Tanker Loading/Unloading Fire

In the event of a release of flammable or combustible liquid during a transfer operation, the liquid would pool in the transfer area “bund” and if ignited would result in a pool fire in the containment bund / kerb. The distance to heat flux is provided in Table 7 below.

Table 7 summarises the results of the heat radiation impacts as a result of this incident. Appendix C – Heat Radiation Modelling, provides the method for heat flux computation at distance from the source, and Appendix B – Heat Radiation Effects provides the likely effects of various heat radiation levels over time.

TABLE 7 - Road Tanker Unloading Pool Fire

Plant	Area (m ²)	Pool Diameter	Distance (m) to Heat Flux kW/m ²			
			35	25	12.6	4.7
Road Tkr Unloading	75	13.60	12	15	22	35

The distance from the road tanker unloading area (oil) is around 65m, hence the heat flux at the boundary will be lower (estimated to be around 2 kW/m²) than the max desirable heat flux of 4.7 kW/m².

5.2.3. Bund Fires

Flammable and combustible liquids are stored in tanks within bunded areas. In the event of a tank leak and release of flammable or combustible liquid the material would collect in the bund forming a pool.

In the event of an ignition, a pool fire would form, resulting in a full bund fire in the worst case. A detailed bund fire analysis for each of the tank farms has been conducted in **Appendix C. Table 8** summarises the results of this analysis and **Figure 6** shows the heat radiation contours at 4.7 kW/m².

TABLE 8 - FULL BUND FIRES

Plant	Area (m ²)	Pool Diameter	Distance (m) to Heat Flux kW/m ²				Distance to Boundary (m)
			35	25	12.6	4.7	
Tanks 301-303 Bund	150	19.23	17	20	31	52	80
Tank C2 Bund	40	9.93	9	11	16	27	95
Tank C1 Bund	40	9.93	9	11	16	27	100
Tanks 101-212 Bund	1600	62.80	55	67	100	170	90
Tanks 101-212 Bund Note: (1)	800	30	26	32	50	80	90

Using the heat radiation criteria at the site boundary of 4.7 kW/m² (Ref.4), it can be seen from **Figure 6**, that a fire involving the entire tank bund (comprising tanks 101-212) whilst of low probability results in excessive heat flux levels at the boundary.

Note (1) - Hence, it is recommended that sub-bunds be employed to limit the potential size of the bund fire to approximately half to ensure resultant heat fluxes of 4.7 kW/m² do not extend beyond the Byrnes Rd Boundary.

5.2.4. Plant Fires

Flammable and combustible liquids are processed within plant areas at the site. In the event of a process equipment leak and release of flammable or combustible liquid the material would collect in the bund of the plant forming a pool.

In the event of an ignition, a pool fire would form, resulting in a full plant fire in the worst case. **Table 9** summarises the results of this analysis and **Figure 6** shows the heat radiation contours at 4.7 kW/m².

TABLE 9 - FULL PLANT FIRES

Plant	Area (m ²)	Pool Diameter	Distance (m) to Heat Flux kW/m ²				Distance to Boundary (m)
			35	25	12.6	4.7	
Seed Crushing Unit 1	5	3.51	3	4	6	10	100
Solvent Extraction Unit 2	10	4.96	4	5.5	8	15	150
Oil Refinery Bld	11	5.21	4	5.5	8	15	140

Using the heat radiation criteria at the site boundary of 4.7 kW/m² (Ref.4), it can be seen from **Figure 6**, that plant fire events are contained onsite when viewed against the NSW DoP requirement that heat flux levels not exceed 4.7 kW/m² at the boundary.

5.3. Summary of Consequence Impacts

The NSW Department of Planning (DoP) published heat radiation impact criteria in HIPAP No.4 (Ref.4). This document indicates that the maximum permissible level of heat radiation at the site boundary is 4.7 kW/m².

Further it can be seen from **Figure 6** that none of the postulated plant fire incidents exceed the 4.7 kW/m² criteria (provided the main bund for the oil tanks 101-212 is provided with 2 sub-bunds of equal size).

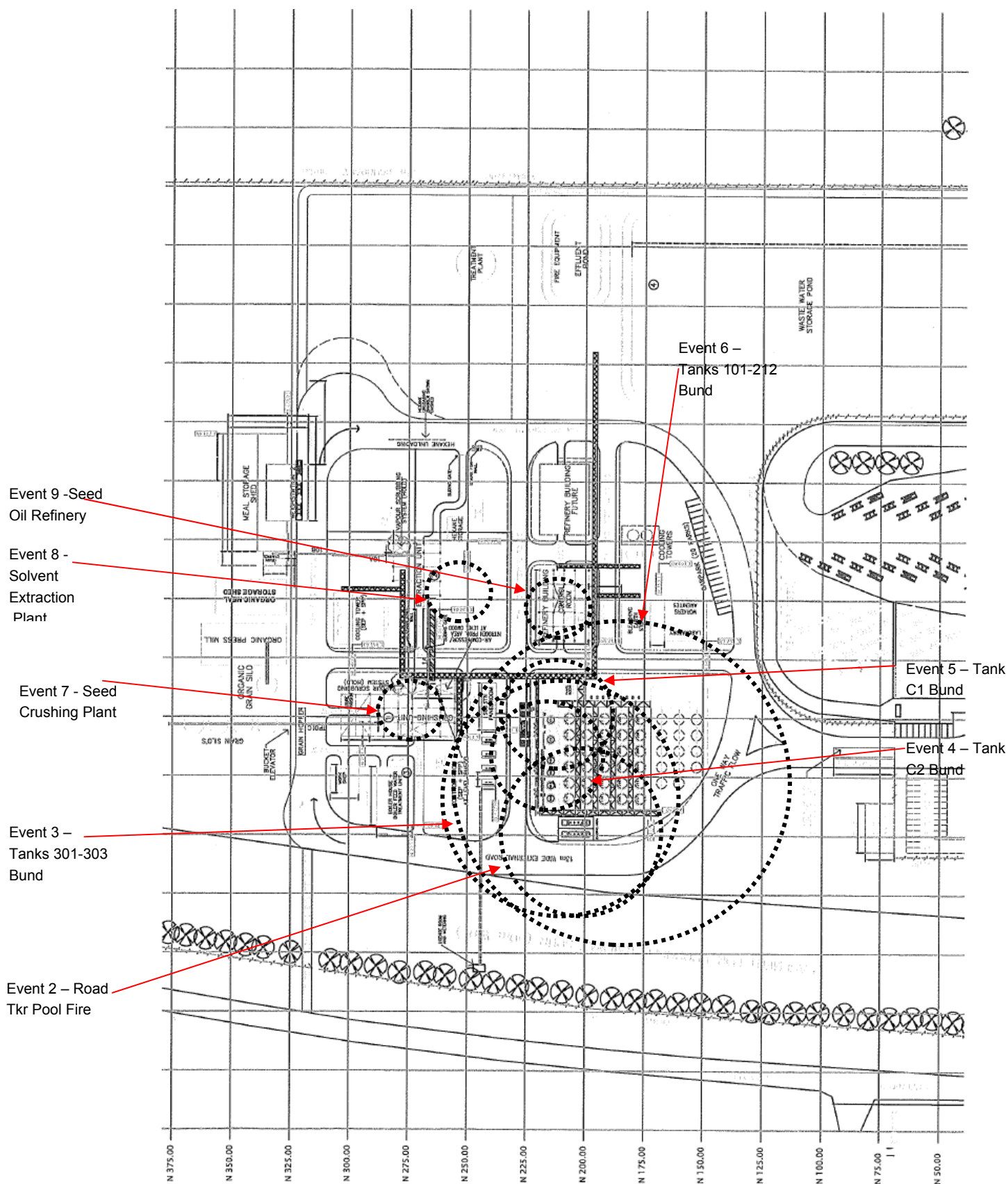


FIGURE 6 - HEAT RADIATION CONTOURS (4.7 kW/m^2) -----

5.4. Frequency Analysis

Generalised Probability/Frequency data is given in Table 10 for the potential events considered most relevant to this analysis. The data is generally expressed on a per annum basis; the exception to this is road tanker unloading, which is expressed as 4×10^{-8} per hour. Based on truck movements and filling rates of around 300 litres/minute ($20 \text{ m}^3 / \text{hr}$) it is estimated that transfer operations amount to 528 hrs/yr/hose; hence the failure rate/yr is estimated to be $2.1 \times 10^{-5}/\text{yr}$.

The reference sources for all data used are also given in the table.

TABLE 10 - GENERALISED PROBABILITY DATA

Event	Item	Failure Possibility	Reference
Bund Fires	Storage	$4.2 \times 10^{-6}/\text{yr}$	Covo Study
	Road Tanker Area (hose failure)	$4 \times 10^{-8}/\text{hr}$	Covo Study
Tank Fires	Bulk Liquid Tanks	$1.4 \times 10^{-6}/\text{yr}$	R. Montano
	Floating Roof	$1.4 \times 10^{-5}/\text{yr}$	
	Fixed Roof		
Warehouse Fire	Raw Material	$4.6 \times 10^{-4}/\text{yr}$	NSW ABS (1982-83)
Centrifugal Pumps	Casing failure	$3.8 \times 10^{-6}/\text{yr}$	USAEC
	Shaft failure	$1 \times 10^{-4}/\text{yr}$	
	Seal failure	$1 \times 10^{-2}/\text{yr}$	

5.5. Risk Analysis

The risk assessment now requires we combine the event frequencies and consequence distances (effects) and provide the risk levels at the boundary of the site.

The land use safety implications for the proposed development are summarised in Table 11 – Overall Risk Evaluation.

The table summarises the events, event probability, probability of fatality, and risk levels at the boundary. The parameters as provided in the table are defined as follows:

Event – the event is taken from the risk identification table, and is comprised of an office fire

Base Frequency x 10^{-6} – is the failure frequency of each event

PF (E) – is the probability of fatality to a person on the boundary from the event. Due to the fact that those external to the office would take shelter or emergency action the probability of fatality is estimated at less than 1.0. For the purpose of this study, the following probability of fatalities are estimated (for detailed computations refer to Appendix D - Probit Computations);

- Event 2 – PF(E) = 0
- Event 2 – PF(E) = 0
- Event 6 – PF(E) = 1.0

Risk x 10^{-6} – is the product of the frequency x probability of injury/fatality and is defined as the risk of exposure from the event.

Fatality Injury – is the hazard distance to fatality from the fire, in this case typically deemed to be the distance to 4.7 kW/m²,

CF-Risk – is the cumulative addition of the individual risk results.

TABLE 11 - OVERALL RISK EVALUATION

EVENT # / Item	Base Freq (x 10^{-6} per annum)	Pf(E)	Individual Risk x 10^{-6} At Boundary adjacent to Byrnes Rd	Effect Zone / Fatality Radius
2. Road Tkr Pool fire	21	0	0	35
3. Tanks 301-303 Bund fire	4	0	0	52
6. Tanks 101-212 Bund fire	4	1.0	4	80
TOTAL RISK LEVEL at BOUNDARY			4	

The risk levels expected at the boundary of the site are around 4 x 10^{-6} pa. Such risk levels are considered acceptable (Ref: NSW DEPT. OF PLANNING Risk Criteria at Boundary of site = 50 x 10^{-6} p.a. for industrial land use) under the NSW Department of Planning guidelines (Reference 11).

6. Fire Prevention and Protection Measures

6.1.1. Process Safeguards Provided

A number of safety features have been installed at the site to minimise the potential for impact as a result of incidents or to manage or mitigate incident impacts. These are summarised below.

- **Spillage Containment** – all storage tanks and process area will be constructed with spillage containment. Tank storages will comply with the spill containment requirements of AS1940 (Ref.6). Process areas will be designed, as a minimum, to contain spillage from the largest process vessel in the plant around which the bund is constructed.
- **Ignition Control** – all tanks, intermediate receivers and equipment containing flammable and combustible liquids will be blanketed with nitrogen (inert atmosphere) to prevent the potential for flammable vapour build up in the tanks. In addition, all tanks and process plant will be designed in accordance with the relevant Hazardous Area Classification as required in AS2430 (Ref.7) or AS60079 (Ref.8).

6.1.2. Fire Protection Systems

- **Fire Detection** – the site will be provided with a fire detection system within the process plant areas, flammable/combustible liquids storages and seed storages where dusts may be hazardous. The fire detection system will be connected to a general alarm system as well as a dedicated area alarm that will notify plant operators of the incident location.
- **First Attack Fire Protection** – fire extinguishers will be provided throughout the plant in accordance with the various Dangerous Goods storage standards and AS2444 (Ref.9). Fire hose reels will be provided in accordance with the requirements of the various Australian Standards (e.g. AS1940, Ref.6) and AS2441 (Ref.10).
- **Fire Main** – the site will be fitted with a fire main, installed in accordance with the requirements of AS2419 (Ref.11). The fire main will be fitted with hydrants, located throughout the site.
- **Fire Water Supply** – fire water will be supplied from a fire water tank capable of supplying a minimum of four hours fire water (in compliance with AS2419, Clause 4.2). The water will be supplied by one electrically driven pump and one diesel engine driven pump. The fire main will be maintained at a pressure of 1000 kPag by a jockey pump.

6.1.3. Containment of Fire Water and runoff

In the event that a fire does occur at the site, there will be a need to apply a fire extinguishing medium, such as dry powder from extinguishers or water from fire hose reels or hoses, and those systems previously described to extinguish the fire.

In the event of relatively small fires in the process or storage areas, a fire extinguisher or hose reel (with foam attachment) will be adequate to control the fire. **SKM recommended that ROBE obtain a foam generation attachment for the fire hoses (one for each plant area where flammable & combustible liquids are stored and handled) and maintain a storage of at least 20 L of foam concentrate adjacent to the location where a foam generating attachment is held.** However, in the event of a fully developed fire, in any of the plants and storages, it will be necessary for the Fire Brigade to apply foam or water, via hoses, to control the fire. In this event, there is a potential for the applied water to become contaminated with the leaked products. Should the contaminated water escape the site, there is a potential for an environmental incident outside the site boundary.

The quantity of fire water to be retained on site is estimated by calculating the number of fire hoses used to fight the fire (e.g. the water flow onto the fire) and the time required to extinguish the fire. Using Table 2.1 from AS2419-2005 (Ref.11), the recommended fire hydrant requirements for fighting fires in structures/buildings at the site is two (2) (which is based on the floor area of the largest plant at the site). For open yards, Table 3.3 of AS2419 (Ref.11) is used and the number of hydrants required is THREE (3), also based on the yard area. Table 2.2 of AS2419 lists the flow rate of fire hoses as 10 L per second or 600 L per minute. Using this flow rate and the recommended maximum number of hoses (3), the total flow rate applied to a fire in the Integrated Oilseed Processing Plant is $3 \times 600 = 1,800$ L/minute.

The NSW Government's Best Practice Guidelines for Contaminated Water Retention and Treatment Systems, requires 90 minutes of fire water to be retained on site. Hence, for a fire water application rate of 1,800 L per minute for 90 minutes, the total fire water required for retention on site is $1.8 \text{ m}^3 \times 90 = 162 \text{ m}^3$.

SKM recommended that a first flush retention pond (detention tank) be constructed at the ROBE site with a minimum freeboard capacity of 162 m^3 , so that in the event of a fire, contaminated fire water may be retained even though the pond could contain some water. The first flush retention pond should contain all storm water from plant areas, roadways and open yard areas.

7. Conclusions and Recommendations

7.1. Conclusions

A review of Hazardous Industry Planning Advisory paper No.4, Risk Criteria for Land Use Safety Planning (Ref.4), indicates that heat radiation from fires at potentially hazardous facilities should not exceed 4.7kW/m^2 . Comparing the distance to heat radiation impacts from postulated worst case incidents at each of the hazardous areas at the proposed Integrated Oilseed Processing Plant, shows that none of the incidents exceed the level of 4.7kW/m^2 beyond the site boundary.

Risk levels are computed at the nearest site boundary (along Byrnes Rd) to the tank farm and processing units.

The risk levels expected at the boundary of the site are around 4×10^{-6} pa. Such risk levels are considered acceptable (Ref: NSW DEPT. OF PLANNING Risk Criteria at Boundary of site = 50×10^{-6} p.a. for industrial land use) under the NSW Department of Planning guidelines (Reference 1).

It is therefore concluded that the risk criteria levels at the boundary of the site do not exceed the risk criteria published by the NSW Department of Planning (Ref.4). And further, the ROBE plant, as proposed, is not considered potentially hazardous or offensive and is therefore permissible within the current land zoning.

7.2. Recommendations

Notwithstanding the above analysis, a number of recommendations were made in order to enhance the safety systems at the site and ensure the risks are maintained as low as reasonably practicable (ALARP). The following recommendations are made:

1. **Dust Explosion** - Canola and safflower seeds can generate combustible dust. Hence, when filling silos, dust could be generated reaching combustible levels. SKM recommends that all silos and bins storing materials, that could generate combustible dusts (i.e. seeds and meals), be fitted with explosion relief systems designed in accordance with NFPA68 (Ref.15).
2. **Safety Management System (HIPAP No 9)** – A safety management system in accordance with the NSW DoP Advisory Paper no 9 should be developed for the site.
3. **Spill Kits** - It was identified that a number of corrosive materials are used in the Seed Oil production process. Spills of these materials, whilst contained within bunded areas will require rapid clean-up to minimise the potential for release beyond the containment or for contact with personnel. It is therefore recommended

that corrosive materials spill kits be installed throughout areas where corrosive materials are stored, handled and used at the site.

4. **Fire Safety Study (HIPAP No # 2)** - It was identified that in the event of an incident involving fire, there is a potential for heat radiation to impact areas adjacent to the fire. This could cause damage and/or fire growth. To combat this, fire water cooling is normally applied using hydrants and hoses. It is therefore recommended that a fire safety study be conducted to determine the areas where fire water cooling would be required to minimise the potential for incident growth.
5. **Foam Stocks** - The most appropriate fire fighting medium for flammable and combustible liquids is foam. It is therefore recommended that ROBE obtain a foam generation attachment for the fire hoses (one for each plant area where flammable & combustible liquids are stored and handled) and maintain a storage of at least 20 L of foam concentrate adjacent to the location where a foam generating attachment is held.
6. **Retention Basin** - It was identified that in the event of fire, it will be necessary to apply contaminated fire water to the incident. Fire water could be contaminated by products at the site that could have an adverse impact on the environment. Hence, it would be necessary to contain any fire water on site to limit the potential for environmental damage. It is recommended that a first flush retention pond be constructed at the ROBE site with a minimum freeboard capacity of 162m³, so that in the event of a fire, contaminated fire water may be retained even though the pond could contain some water. The first flush retention pond should contain all storm water from plant areas, roadways and open yard areas.
7. **Sub-Bunds for Main Tank Farm** – The heat flux computations show that the main Oil tank farm bund must be divided into two equal sub-bunds to ensure heat flux levels of 4.7 kW/m² do not extend beyond the Byrnes Rd boundary.

8. REFERENCES

1. "Applying SEPP33-Hazardous and Offensive Development Application Guidelines", NSW Department of Planning (1994).
2. Hazardous Industry Planning Advisory Paper No.6, Guidelines for Hazard Analysis", NSW Department of Planning (1992).
3. Multi-Level Risk Assessment, Department of Infrastructure, Planning and Natural Resources – 1997.
4. Hazardous Industry Planning Advisory Paper No.4, Risk Criteria for Land Use Safety Planning (1992).
5. AS1940-2004, "The storage and handling of flammable and combustible liquids", Standards Association of Australia, Sydney.
6. AS2430-2004, "Classification of Hazardous Areas (various Parts)", Standards Association of Australia, Sydney.
7. AS60079-Electrical apparatus for explosive gas atmospheres - Part 10: Classification of Hazardous Areas (IEC 60079-10:2002 MOD), Standards Association of Australia, Sydney.
8. AS2419-2005,"Fire Hydrant Installations – Part 1: System design, installation and commissioning", Standards Association of Australia, Sydney.
9. The Australian Code for the Transport of Dangerous Goods by Road and Rail (known as the Australian Dangerous Goods Code or ADG), 7th ed., National Transport Commission, Canberra, 2007.
10. AS3780-1994, "The storage and handling of corrosive substances", Standards Association of Australia, Sydney.
11. NFPA68-2002, "Guide for the Venting of Deflagrations", National Fire Protection Association, Quincy, Ma, USA.
12. Lees, F.P. (1996), "Loss Prevention in the Process Industries", Butterworth-Heinemann, London.
13. Tweeddale, H.M. (1993), "Hazard Analysis and Reduction", University of Sydney, School of Chemical Engineering.

APPENDIX A – Material Safety Data Sheets

1. Hexane
2. Phosphoric Acid
3. Sodium Hydroxide (Caustic Soda)

Hexane

Material Safety Data Sheet

Section 1. Product and Company Identification

Product Name	Hexane	Product Code	HX0296P
Manufacturer	EMD Chemicals Inc. P.O. Box 70 480 Democrat Road Gibbstown, NJ 08027 Prior to January 1, 2003 EMD Chemicals Inc. was EM Industries, Inc. or EM Science, Division of EM Industries, Inc.	Effective Date	3/20/2003
For More Information Call	856-423-6300 Technical Service Monday-Friday: 8:00 AM – 5:00 PM	In Case of Emergency Call	800-424-9300 CHEMTREC (USA) 613-996-6666 CANUTEC (Canada) 24 Hours/Day: 7 Days/Week
Synonym	HEXANE		
Material Uses	Analytical reagent.		
Chemical Family	Solvent.		

Section 2. Composition and Information on Ingredients

Component	CAS #	% by Weight
n-Hexane	110-54-3	100

+ Section 3. Hazards Identification

Physical State and Appearance	Liquid.
Emergency Overview	DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. ASPIRATION HAZARD. HARMFUL IF INHALED OR SWALLOWED. CAUSES RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CAUSES DAMAGE TO THE FOLLOWING ORGANS: PERIPHERAL NERVOUS SYSTEM, RESPIRATORY TRACT, SKIN, CENTRAL NERVOUS SYSTEM, EYE, LENS OR CORNEA.
Routes of Entry	Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Potential Acute Health Effects	Eyes Hazardous in case of eye contact (irritant). Inflammation of the eye is characterized by redness, watering, and itching. Skin Hazardous in case of skin contact (irritant). Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Inhalation Hazardous in case of inhalation (lung irritant). Ingestion Hazardous in case of ingestion. Aspiration hazard if swallowed– can enter lungs and cause damage.

Potential Chronic Health Effects

Carcinogenic Effects This material is not known to cause cancer in animals or humans.

Additional information See Toxicological Information (section 11)

Medical Conditions Aggravated by Overexposure: Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4. First Aid Measures

Eye Contact Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention immediately.

Skin Contact In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Inhalation If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Section 5. Fire Fighting Measures

Flammability of the Product Product will burn.

Auto-ignition Temperature 224.9°C (436.8°F)

Flash Points Closed cup: -23.1°C (-9.6°F).

Flammable Limits LOWER: 1.1% UPPER: 7.5%

Products of Combustion These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances Extremely flammable in presence of open flames, sparks and static discharge, of shocks, of heat, of oxidizing materials.

Explosion Hazards in Presence of Various Substances **Risks of explosion of the product in presence of static discharge:**
Extremely flammable in presence of open flames, sparks and static discharge.
Highly explosive in presence of open flames, sparks and static discharge.

Risks of explosion of the product in presence of mechanical impact:
Extremely flammable in presence of shocks.
Extremely explosive in presence of shocks.

Fire Fighting Media and Instructions SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Protective Clothing (Fire) Be sure to use an approved/certified respirator or equivalent.

Hexane

Special Remarks on Fire Hazards Vapor may travel considerable distance to source of ignition and flash back.
Special Remarks on Explosion Hazards Not available.

Section 6. Accidental Release Measures

Small Spill and Leak Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.
Large Spill and Leak Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
Spill Kit Information The following EMD Chemicals Inc. SpillSolv ® absorbent is recommended for this product: SX1330 Solvent Treatment Kit

+ Section 7. Handling and Storage

Handling Keep away from heat, sparks and flame. Do not ingest. Use only with adequate ventilation. Do not get in eyes, on skin, or on clothing.
Storage Keep container in a cool, well-ventilated area. Keep container tightly closed.

Section 8. Exposure Controls/Personal Protection

Engineering Controls Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective occupational exposure limits. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection

Eyes Splash goggles.
Body Lab coat.
Respiratory Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Hands Gloves.
Feet Not applicable.

Protective Clothing (Pictograms)

Personal Protection in Case of a Large Spill Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Product Name
n-Hexane

Exposure Limits

BAUA (Germany, 1997).
Spitzenbegrenzung: 720 mg/m³
Spitzenbegrenzung: 720 mg/m³
Spitzenbegrenzung: 200 ppm
TWA: 180 mg/m³
TWA: 180 mg/m³ 8 hour(s).
TWA: 50 ppm 8 hour(s).

Hexane

DK–Arbejdstilsynet (Denmark, 1996).

GV: 90 mg/m³

GV: 90 mg/m³ 8 hour(s).

GV: 25 ppm 8 hour(s).

Työterveyslaitos (Finland, 1998).

STEL: 540 mg/m³

TWA: 180 mg/m³

Työterveyslaitos (Finland, 1998).

STEL: 540 mg/m³ 15 minute(s).

STEL: 150 ppm 15 minute(s).

TWA: 180 mg/m³ 8 hour(s).

TWA: 50 ppm 8 hour(s).

INRS (France, 1996).

VME: 170 mg/m³

VME: 170 mg/m³ 8 hour(s).

VME: 50 ppm 8 hour(s).

National Authority for Occupational Safety/Health (Ireland, 1999).

OEL: 70 mg/m³ 8 hour(s).

OEL: 20 ppm 8 hour(s).

Arbeidsinspectie (Netherlands, 1999).

TGG 8 uur: 90 mg/m³

TGG 8 uur: 90 mg/m³ 8 hour(s).

TGG 8 uur: 25 ppm 8 hour(s).

N–Arbeidstilsynet (Norway, 1996).

AN: 90 mg/m³

AN: 90 mg/m³ 8 hour(s).

AN: 25 ppm 8 hour(s).

EH40–OES (United Kingdom (UK), 1997).

TWA: 72 mg/m³ 8 hour(s).

TWA: 20 ppm 8 hour(s).

ACGIH (United States, 1998). Skin

TWA: 50 ppm 8 hour(s).

NIOSH REL (United States, 1994).

TWA: 180 mg/m³ 10 hour(s).

TWA: 50 ppm 10 hour(s).

OSHA (United States, 1989).

TWA: 180 mg/m³

OSHA Final Rule (United States, 1989).

TWA: 180 mg/m³ 8 hour(s).

TWA: 50 ppm 8 hour(s).

Section 9. Physical and Chemical Properties

Odor Characteristic.

Color Colorless.

Physical State and Appearance Liquid.

Molecular Weight 86.2 g/mole

Molecular Formula C₆–H₁₄

pH Not available.

68.94°C (156.1°F)

Hexane

Boiling/Condensation

Point

Melting/Freezing -139.39°C (-218.9°F)

Point

Critical 234.3°C (453.7°F)

Temperature

Specific Gravity 0.659 (Water = 1)

Vapor Pressure Not available.

Vapor Density 3 (Air = 1)

Odor Threshold 130 ppm

Evaporation Rate 6.82 compared to (n-BUTYL ACETATE=1)

LogKow Not available.

Dispersion See solubility in water.

Properties

Solubility Partially soluble in water.

Section 10. Stability and Reactivity

Stability and The product is stable.

Reactivity

Conditions of Not available.

Instability

Incompatibility with Highly reactive with oxidizing agents.

Various Substances

Rem/Incompatibility Not available.

Hazardous carbon oxides (CO, CO2)

Decomposition

Products

Hazardous Will not occur.

Polymerization

Section 11. Toxicological Information

RTECS Number:

n-Hexanes MN9275000

Toxicity

Acute oral toxicity (LD50): 25000 mg/kg [Rat].
Acute toxicity of the vapor (LC50): 48000 ppm 4 hour(s) [Rat].

Chronic Effects on **TERATOGENIC EFFECTS:** Classified 3 by European Union.

Humans

Acute Effects on Hazardous in case of eye contact (irritant). Inflammation of the eye is
Humans characterized by redness, watering, and itching. Hazardous in case of skin
contact (irritant). Skin inflammation is characterized by itching, scaling,
reddening, or, occasionally, blistering. Hazardous in case of inhalation
(lung irritant). Hazardous in case of ingestion.

Synergetic Products Not available.

(Toxicologically)

Irritancy

Draize Test (Rabbit):
Eyes: 10mg/time not available. Reaction: Mild.

Sensitization

Not available.

Carcinogenic

This material is not known to cause cancer in animals or humans.

Effects

Toxicity to Tests on laboratory animals for reproductive effects are cited in Registry

Hexane

Reproductive System	of Toxic Effects on Chemical Substances (RTECS).
Teratogenic Effects	Classified 3 by European Union.
Mutagenic Effects	Tests on laboratory animals for mutagenic effects are cited in Registry of Toxic Effects of Chemical Substances (RTECS).

Section 12. Ecological Information

Ecotoxicity	Not available.
BOD5 and COD	Not available.
Toxicity of the Products of Biodegradation	The products of degradation are less toxic than the product itself.

Section 13. Disposal Considerations

EPA Waste Number	D001
Treatment	Incineration, fuels blending or recycle. Contact your local permitted waste disposal site (TSD) for permissible treatment sites. Always contact a permitted waste disposal (TSD) to assure compliance with all current local, state, and Federal Regulations.

Section 14. Transport Information

DOT Classification	Not available.
TDG Classification	Not available.
IMO/IMDG Classification	Not available.
ICAO/IATA Classification	Not available.

Section 15. Regulatory Information

U.S. Federal Regulations	TSCA 4(a) final test rules: n-Hexane TSCA 8(b) inventory: n-Hexane SARA 302/304/311/312 extremely hazardous substances: No products were found. SARA 302/304 emergency planning and notification: No products were found. SARA 302/304/311/312 hazardous chemicals: n-Hexane SARA 311/312 MSDS distribution – chemical inventory – hazard identification: n-Hexane: Fire Hazard, Immediate (Acute) Health Hazard, Delayed (Chronic) Health Hazard SARA 313 toxic chemical notification and release reporting: n-Hexane Clean Water Act (CWA) 307: No products were found. Clean Water Act (CWA) 311: No products were found. Clean air act (CAA) 112 accidental release prevention: No products were found. Clean air act (CAA) 112 regulated flammable substances: No products were found. Clean air act (CAA) 112 regulated toxic substances: No products were found.
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WHMIS (Canada)

Hexane

WHMIS Class B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).

WHMIS Class D-2B: Material causing other toxic effects (TOXIC).

CEPA DSL: n-Hexane

This product has been classified in accordance with the hazard criteria of the Controlled Product Regulations and the MSDS contains all required information.

International Regulations

EINECS n-Hexane 203-777-6

DSCL (EEC) R11- Highly flammable.

R37/38- Irritating to respiratory system and skin.

R41- Risk of serious damage to eyes.

International Lists Australia (NICNAS): n-Hexane

Japan (MITI): n-Hexane

Korea (TCCL): n-Hexane

Philippines (RA6969): n-Hexane

China: No products were found.

State Regulations Pennsylvania RTK: n-Hexane: (generic environmental hazard)

Massachusetts RTK: n-Hexane

New Jersey: n-Hexane

California prop. 65: No products were found.

Section 16. Other Information

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

3 Fire Hazard

Health

Reactivity

Specific Hazard

Changed Since Last Revision +

Notice to Reader

The statements contained herein are based upon technical data that EMD Chemicals Inc. believes to be reliable, are offered for information purposes only and as a guide to the appropriate precautionary and emergency handling of the material by a properly trained person having the necessary technical skills. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use, storage and disposal of these materials and the safety and health of employees and customers and the protection of the environment. EMD CHEMICALS INC. MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, WITH RESPECT TO THE INFORMATION HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

Hydrochloric Acid 30%, SUPRAPUR ®

Material Safety Data Sheet

Section 1. Product and Company Identification

Product Name	Hydrochloric Acid 30%, SUPRAPUR ®	Product Code	318
Manufacturer	EMD Chemicals Inc. P.O. Box 70 480 Democrat Road Gibbstown, NJ 08027 Prior to January 1, 2003 EMD Chemicals Inc. was EM Industries, Inc. or EM Science, Division of EM Industries, Inc.	Effective Date	3/3/2003
For More Information Call	856-423-6300 Technical Service Monday-Friday: 8:00 AM – 5:00 PM	In Case of Emergency Call	800-424-9300 CHEMTREC (USA) 613-996-6666 CANUTEC (Canada) 24 Hours/Day: 7 Days/Week
Synonym	None.		
Material Uses	Analytical reagent.		
Chemical Family	Solution.		

Section 2. Composition and Information on Ingredients

Component	CAS #	% by Weight
WATER	7732-18-5	70
HYDROCHLORIC ACID	7647-01-0	30

Section 3. Hazards Identification

Physical State and Appearance	Liquid.
Emergency Overview	WARNING! CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS. HARMFUL IF INHALED OR SWALLOWED. CONTAINS MATERIAL WHICH CAUSES DAMAGE TO THE FOLLOWING ORGANS: LUNGS, RESPIRATORY TRACT, SKIN, EYE, LENS OR CORNEA.
Routes of Entry	Absorbed through skin. Eye contact. Inhalation. Ingestion.
Potential Acute Health Effects	
Eyes	Extremely hazardous in case of eye contact (corrosive). Causes severe eye burns.
Skin	Extremely hazardous in case of skin contact (corrosive). Skin contact produces severe burns.
Inhalation	Extremely hazardous in case of inhalation (lung corrosive). Hazardous in case of inhalation.
Ingestion	Hazardous in case of ingestion.
Potential Chronic Health Effects	
Carcinogenic Effects	This material is not known to cause cancer in animals or humans.

Hydrochloric Acid 30%, SUPRAPUR ®

Additional information See Toxicological Information (section 11)

Medical Conditions Aggravated by Overexposure: Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4. First Aid Measures

Eye Contact Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Inhalation If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Section 5. Fire Fighting Measures

Flammability of the Product Non-flammable.

Auto-ignition Temperature Not applicable.

Flash Points Not applicable.

Flammable Limits Not applicable.

Products of Combustion Not available.

Fire Hazards in Presence of Various Substances Not applicable.

Explosion Hazards in Presence of Various Substances Risks of explosion of the product in presence of static discharge: No.

Risks of explosion of the product in presence of mechanical impact: No.

Fire Fighting Media and Instructions Not applicable.

Protective Clothing (Fire) Not applicable.

Special Remarks on Fire Hazards Not available.

Special Remarks on Explosion Hazards Not available.

Section 6. Accidental Release Measures

Small Spill and Dilute with water and mop up, or absorb with an inert dry material and

Hydrochloric Acid 30%, SUPRAPUR ®

Leak	place in an appropriate waste disposal container.
Large Spill and Leak	Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
Spill Kit Information	The following EMD Chemicals Inc. SpillSolv ® absorbent is recommended for this product: SX1310 Acid Treatment Kit

Section 7. Handling and Storage

Handling	Do not ingest. Do not breathe vapor or mist. Keep container closed. Do not get in eyes, on skin, or on clothing.
Storage	Keep container in a cool, well-ventilated area.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection	
Eyes	Face shield.
Body	Full suit.
Respiratory	Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Hands	Gloves.
Feet	Boots.
Protective Clothing (Pictograms)	
Personal Protection in Case of a Large Spill	Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Product Name	Exposure Limits
WATER	Not available.
HYDROCHLORIC ACID	BAUA (Germany, 1997). PEAK: 8 mg/m ³ MAK: 8 mg/m ³ DK-Arbejdstilsynet (Denmark, 1996). Loftvaerdi: 7 mg/m ³ Loftvaerdi: 5 ppm GV: 7 mg/m ³ GV: 5 ppm 80/1107/EEC (Europe, 1996). STEL: 10 mg/m ³ STEL: 15 ppm TWA: 5 mg/m ³ TWA: 8 ppm EH40-OES (United Kingdom (UK), 1997).

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STEL: 8 mg/m³
 STEL: 5 ppm
 MEL: 2 mg/m³
 MEL: 1 ppm
ACGIH (United States, 1994).
 CEIL: 7.5 mg/m³
 CEIL: 5 ppm
NIOSH REL (United States, 1994).
 CEIL: 7 mg/m³
 CEIL: 5 ppm
OSHA Final Rule (United States, 1989).
 CEIL: 7 mg/m³
 CEIL: 5 ppm

Section 9. Physical and Chemical Properties

Odor	Not available.
Color	Not available.
Physical State and Appearance	Liquid.
Molecular Weight	Not applicable.
Molecular Formula	Not applicable.
pH	Not available.
Boiling/Condensation Point	The lowest known value is 99.9°C (211.8°F) (WATER). Weighted average: 102.93°C (217.3°F)
Melting/Freezing Point	May start to solidify at -0.1°C (31.8°F) based on data for: WATER. Weighted average: -22.27°C (-8.1°F)
Critical Temperature	The lowest known value is 51.5°C (124.7°F) (HYDROCHLORIC ACID).
Specific Gravity	The only known value is 1.2 (Water = 1) (HYDROCHLORIC ACID).
Vapor Pressure	The highest known value is 21.3 kPa (160 mmHg) (@ 20°C) (HYDROCHLORIC ACID).
Vapor Density	The highest known value is >1 (Air = 1) (HYDROCHLORIC ACID).
Odor Threshold	Not available.
Evaporation Rate	0.36 (WATER) compared to (n-BUTYL ACETATE=1)
LogKow	Not available.
Solubility	Soluble in water.

Section 10. Stability and Reactivity

Stability and Reactivity	The product is stable.
Conditions of Instability	Not available.
Incompatibility with Various Substances	Slightly reactive to reactive with metals, alkalis.
Rem/Incompatibility	Not available.
Hazardous Decomposition Products	These products are halogenated compounds.
Hazardous Polymerization	Will not occur.

Section 11. Toxicological Information

RTECS Number:

Water ZC0110000

Hydrochloric Acid MW4025000

Toxicity

Acute oral toxicity (LD50): 3000 mg/kg (Rabbit) (Calculated value for the mixture).

Acute toxicity of the vapor (LC50): 1847 ppm 4 hours (Mouse) (Calculated value for the mixture).

Chronic Effects on Humans

Not available.

Acute Effects on Humans

Extremely hazardous in case of eye contact (corrosive). Causes severe eye burns. Extremely hazardous in case of skin contact (corrosive). Skin contact produces severe burns. Extremely hazardous in case of inhalation (lung corrosive). Hazardous in case of inhalation. Hazardous in case of ingestion.

Synergetic Products (Toxicologically)

Not available.

Irritancy

Draize Test: Not available.

Sensitization

Slightly hazardous in case of inhalation (lung sensitizer).

Carcinogenic Effects

This material is not known to cause cancer in animals or humans.

Toxicity to Reproductive System

Not available.

Teratogenic Effects

Not available.

Mutagenic Effects

Not available.

Section 12. Ecological Information

Ecotoxicity

Not available.

BOD5 and COD

Not available.

Toxicity of the Products of Biodegradation

The products of degradation are as toxic as the product itself.

Section 13. Disposal Considerations

EPA Waste Number

D002

Treatment

Specified Technology – Neutralize to pH 6–9. Contact your local permitted waste disposal site (TSD) for permissible treatment sites. Always contact a permitted waste disposal (TSD) to assure compliance with all current local, state, and Federal Regulations.

Section 14. Transport Information

DOT Classification

Proper Shipping Name:
HYDROCHLORIC ACID
Hazard Class: 8
UN number: UN1789
Packing Group: II
RQ: 5000 lbs. (2268 kg)

Hydrochloric Acid 30%, SUPRAPUR ®

TDG Classification	Not available.
IMO/IMDG Classification	Not available.
ICAO/IATA Classification	Not available.

Section 15. Regulatory Information

U.S. Federal Regulations	TSCA 8(b) inventory: WATER; HYDROCHLORIC ACID SARA 302/304/311/312 extremely hazardous substances: HYDROCHLORIC ACID SARA 302/304 emergency planning and notification: HYDROCHLORIC ACID SARA 302/304/311/312 hazardous chemicals: HYDROCHLORIC ACID SARA 311/312 MSDS distribution – chemical inventory – hazard identification: HYDROCHLORIC ACID: Sudden Release of Pressure, Immediate (Acute) Health Hazard, Delayed (Chronic) Health Hazard SARA 313 toxic chemical notification and release reporting: HYDROCHLORIC ACID 30% Clean Water Act (CWA) 307: No products were found. Clean Water Act (CWA) 311: HYDROCHLORIC ACID Clean air act (CAA) 112 accidental release prevention: HYDROCHLORIC ACID Clean air act (CAA) 112 regulated flammable substances: No products were found. Clean air act (CAA) 112 regulated toxic substances: HYDROCHLORIC ACID
WHMIS (Canada)	Class D–1A: Material causing immediate and serious toxic effects (VERY TOXIC). Class D–2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid. CEPA DSL: WATER; HYDROCHLORIC ACID This product has been classified in accordance with the hazard criteria of the Controlled Product Regulations and the MSDS contains all required information.
International Regulations	
EINECS	WATER 231–791–2 HYDROCHLORIC ACID 231–595–7
DSCL (EEC)	R23– Toxic by inhalation. R35– Causes severe burns. R37– Irritating to respiratory system.
International Lists	Australia (NICNAS): WATER; HYDROCHLORIC ACID Japan (MITI): WATER; HYDROCHLORIC ACID Korea (TCCL): WATER; HYDROCHLORIC ACID Philippines (RA6969): WATER; HYDROCHLORIC ACID China: No products were found.
State Regulations	

Hydrochloric Acid 30%, SUPRAPUR ®

Pennsylvania RTK: HYDROCHLORIC ACID: (environmental hazard, generic environmental hazard)

Massachusetts RTK: HYDROCHLORIC ACID

New Jersey: HYDROCHLORIC ACID

California prop. 65: No products were found.

Section 16. Other Information

National Fire Protection Association (U.S.A.)	0	Fire Hazard
	30	Health
		Reactivity
		Specific Hazard

Changed Since Last Revision +

Notice to Reader

The statements contained herein are based upon technical data that EMD Chemicals Inc. believes to be reliable, are offered for information purposes only and as a guide to the appropriate precautionary and emergency handling of the material by a properly trained person having the necessary technical skills. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use, storage and disposal of these materials and the safety and health of employees and customers and the protection of the environment. EMD CHEMICALS INC. MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, WITH RESPECT TO THE INFORMATION HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

Sodium Hydroxide 30%

Material Safety Data Sheet

Section 1. Product and Company Identification

Product Name	Sodium Hydroxide 30%	Product Code	VW3364
Manufacturer	EMD Chemicals Inc. P.O. Box 70 480 Democrat Road Gibbstown, NJ 08027 Prior to January 1, 2003 EMD Chemicals Inc. was EM Industries, Inc. or EM Science, Division of EM Industries, Inc.	Effective Date	3/4/2003
For More Information Call	856-423-6300 Technical Service Monday-Friday: 8:00 AM – 5:00 PM	In Case of Emergency Call	800-424-9300 CHEMTREC (USA) 613-996-6666 CANUTEC (Canada) 24 Hours/Day: 7 Days/Week
Synonym	None.		
Material Uses	Laboratory Reagent		
Chemical Family	Caustic Solution		

Section 2. Composition and Information on Ingredients

Component	CAS #	% by Weight
SODIUM HYDROXIDE	1310-73-2	30
Water	7732-18-5	70

Section 3. Hazards Identification

Physical State and Appearance	Liquid.
Emergency Overview	DANGER ! POISON ! HARMFUL IF INHALED OR SWALLOWED. CAUSES EYE AND SKIN BURNS. CAUSES RESPIRATORY TRACT IRRITATION. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CONTAINS MATERIAL WHICH CAUSES DAMAGE TO THE FOLLOWING ORGANS: LUNGS, RESPIRATORY TRACT, SKIN, EYE, LENS OR CORNEA.
Routes of Entry	Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Potential Acute Health Effects	Eyes Hazardous in case of eye contact (corrosive). Causes eye burns. Skin Hazardous in case of skin contact (corrosive). Skin contact produces burns. May be hazardous in case of skin contact (permeator). Inhalation Hazardous in case of inhalation (lung irritant). Ingestion Hazardous in case of ingestion.
Potential Chronic Health Effects	

Sodium Hydroxide 30%

Carcinogenic This material is not known to cause cancer in animals or humans.

Effects

Additional information See Toxicological Information (section 11)

Medical Conditions Aggravated by Overexposure: Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4. First Aid Measures

Eye Contact Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Inhalation If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Section 5. Fire Fighting Measures

Flammability of the Product Non-flammable.

Auto-ignition Temperature Not applicable.

Flash Points Not applicable.

Flammable Limits Not applicable.

Products of Combustion Not applicable.

Fire Hazards in Presence of Various Substances Not applicable.

Explosion Hazards in Presence of Various Substances Risks of explosion of the product in presence of static discharge: No.

Risks of explosion of the product in presence of mechanical impact: No.

Fire Fighting Media and Instructions Not applicable.

Protective Clothing (Fire) Not applicable.

Special Remarks on Fire Hazards Not available.

Special Remarks on Explosion Hazards Can react with certain metals to release explosive hydrogen gas.

Sodium Hydroxide 30%

Section 6. Accidental Release Measures

Small Spill and Leak	Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.
Large Spill and Leak	Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
Spill Kit Information	The following EM SCIENCE SpillSolv (TM) absorbent is recommended for this product: SX1320 Caustic Treatment Kit

Section 7. Handling and Storage

Handling	Avoid prolonged contact with eyes, skin, and clothing. Do not ingest. Do not breathe vapor or mist. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling.
Storage	Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection	
Eyes	Face shield.
Body	Full suit.
Respiratory	Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Hands	Gloves.
Feet	Boots.
Protective Clothing (Pictograms)	
Personal Protection in Case of a Large Spill	Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Product Name	Exposure Limits
SODIUM HYDROXIDE	ACGIH (United States). CEIL: 2 mg/m ³
	OSHA (United States). CEIL: 2 mg/m ³
	AUVA (Austria, 1995). Spitzenbegrenzung: 4 mg/m ³ 8 times per shift, Period: 5 minute(s). MAK: 2 mg/m ³
	Belgium Minister of Labour (Belgium, 1998). CEIL: 2 mg/m ³

Sodium Hydroxide 30%

VL: 2 mg/m³
BAUA (Germany, 1997).
 Spitzenbegrenzung: 2 mg/m³
 MAK: 2 mg/m³
DK-Arbejdstilsynet (Denmark, 1996).
 Loftvaerdi: 2 mg/m³
 GV: 2 mg/m³
Tyterveyslaitos (Finland, 1998).
 TWA: 2 mg/m³
INRS (France, 1996).
 VME: 2 mg/m³
National Authority for Occupational Safety/Health (Ireland, 1999).
 STEL: 2 mg/m³
Arbeidsinspectie (Netherlands, 1999).
 MAC-C: 2 mg/m³
 TGG 8 uur: 2 mg/m³
N-Arbeidstilsynet (Norway, 1996).
 AN: 2 mg/m³
AFS (Sweden, 1996).
 KTV: 2 mg/m³
EH40-OES (United Kingdom (UK), 1997).
 STEL: 2 mg/m³
NIOSH REL (United States, 1994).
 CEIL: 2 mg/m³
OSHA Final Rule (United States, 1989).
 CEIL: 2 mg/m³
 Water Not available.

Water

Section 9. Physical and Chemical Properties

Odor	Odorless.
Color	Clear.
Physical State and Appearance	Liquid.
Molecular Weight	Not applicable.
Molecular Formula	Not applicable.
pH	Not available.
Boiling/Condensation Point	The lowest known value is 99.9°C (211.8°F) (Water).
Melting/Freezing Point	May start to solidify at -0.1°C (31.8°F) based on data for: Water.
Specific Gravity	The only known value is 2.13 (Water = 1) (SODIUM HYDROXIDE).
Vapor Pressure	Not available.
Vapor Density	Not available.
Odor Threshold	Not available.
Evaporation Rate	0.36 (Water) compared to (n-BUTYL ACETATE=1)
LogKow	Not available.
Solubility	Soluble in water.

Section 10. Stability and Reactivity

Sodium Hydroxide 30%

Stability and Reactivity	The product is stable.
Conditions of Instability	Not available.
Incompatibility with Various Substances	Highly reactive with metals, acids. Slightly reactive to reactive with organic materials.
Rem/Incompatibility	Incompatible with organic halogens, nitro organic compounds, peroxides, flammable liquids, and chloroform–methanol mixtures. Reacts with most metals to produce flammable H ₂ gas.
Hazardous Decomposition Products	SO _x
Hazardous Polymerization	Will not occur.

Section 11. Toxicological Information

RTECS Number:	Sodium Hydroxide Water	WB4900000 ZC0110000
Toxicity	LD50: Not available. LC50: Not available.	
Chronic Effects on Humans	Not available.	
Acute Effects on Humans	Hazardous in case of eye contact (corrosive). Causes eye burns. Hazardous in case of skin contact (corrosive). Skin contact produces burns. May be hazardous in case of skin contact (permeator). Hazardous in case of inhalation (lung irritant). Hazardous in case of ingestion.	
Synergetic Products (Toxicologically)	Not available.	
Irritancy	Draize Test: Not available.	
Sensitization	Slightly hazardous in case of inhalation (lung sensitizer).	
Carcinogenic Effects	This material is not known to cause cancer in animals or humans.	
Toxicity to Reproductive System	Not available.	
Teratogenic Effects	Not available.	
Mutagenic Effects	Not available.	

Section 12. Ecological Information

Ecotoxicity	Not available.
BOD5 and COD	Not available.
Toxicity of the Products of Biodegradation	The products of degradation are less toxic than the product itself.

Section 13. Disposal Considerations

EPA Waste Number	D002
Treatment	Specified technology– Neutralize to pH 6–9. Contact your local permitted

Sodium Hydroxide 30%

waste disposal site (TSD) for permissible treatments sites.
ALWAYS CONTACT PERMITTED WASTE DISPOSER (TSD) TO
ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE
AND FEDERAL REGULATIONS.

Section 14. Transport Information

DOT Classification	Proper Shipping Name: SODIUM HYDROXIDE SOLUTION Hazard Class: 8 UN number: UN1824 Packing Group: II RQ: Not applicable.
TDG Classification	Not available.
IMO/IMDG Classification	Not available.
ICAO/IATA Classification	Not available.

Section 15. Regulatory Information

U.S. Federal Regulations	TSCA 8(b) inventory: SODIUM HYDROXIDE; Water SARA 302/304/311/312 extremely hazardous substances: No products were found. SARA 302/304 emergency planning and notification: No products were found. SARA 302/304/311/312 hazardous chemicals: SODIUM HYDROXIDE SARA 311/312 MSDS distribution – chemical inventory – hazard identification: SODIUM HYDROXIDE: Immediate (Acute) Health Hazard SARA 313 toxic chemical notification and release reporting: No products were found. Clean Water Act (CWA) 307: No products were found. Clean Water Act (CWA) 311: SODIUM HYDROXIDE Clean air act (CAA) 112 accidental release prevention: No products were found. Clean air act (CAA) 112 regulated flammable substances: No products were found. Clean air act (CAA) 112 regulated toxic substances: No products were found.
WHMIS (Canada)	Class D–1B: Material causing immediate and serious toxic effects (TOXIC). CLASS E: Corrosive liquid. CEPA DSL: SODIUM HYDROXIDE; Water This product has been classified in accordance with the hazard criteria of the Controlled Product Regulations and the MSDS contains all required information.
International Regulations	
EINECS	SODIUM HYDROXIDE 215–185–5 Water 231–791–2
DSCL (EEC)	R35– Causes severe burns.

Sodium Hydroxide 30%

**International
Lists**

Australia (NICNAS): SODIUM HYDROXIDE; Water

Japan (MITI): SODIUM HYDROXIDE; Water

Korea (TCCL): SODIUM HYDROXIDE; Water

Philippines (RA6969): SODIUM HYDROXIDE; Water

China: No products were found.

State Regulations

Pennsylvania RTK: SODIUM HYDROXIDE: (environmental hazard, generic environmental hazard)

Massachusetts RTK: SODIUM HYDROXIDE

New Jersey: Sodium Hydroxide 30%

California prop. 65: No products were found.

Section 16. Other Information

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

0 0

Health³

Fire Hazard

Reactivity

Specific Hazard

**Changed Since Last
Revision** +

Notice to Reader

The statements contained herein are based upon technical data that EMD Chemicals Inc. believes to be reliable, are offered for information purposes only and as a guide to the appropriate precautionary and emergency handling of the material by a properly trained person having the necessary technical skills. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use, storage and disposal of these materials and the safety and health of employees and customers and the protection of the environment. EMD CHEMICALS INC. MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, WITH RESPECT TO THE INFORMATION HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

APPENDIX B – Heat Radiation Effects

Heat Radiation Intensity (kW/m ²)	Effect
1.2	Equivalent to heat from sun at noon in summer.
1.6	Minimum level at which pain can be felt.
5 – 8	Will cause pain in 15-20 seconds and at least 2nd degree burns after 30 seconds.
12.5	Heats wood to temperature where pilot ignition (e.g. spark) will start fire.
25	- Spontaneous ignition of wood. - Thin uninsulated steel sections can reach a temperature at which thermal stresses cause failure.
75	100% fatality – 5 seconds.

The following guidelines have been suggested.

1.6 kW/m ²	Usual maximum for residential areas (Reference 9).
4.7 kW/m ²	Maximum for residential areas if probability very low (Reference 10).
5 kW/m ²	Maximum for brief exposure on an operator (e.g. while closing a critical valve) if protected by water sprays etc. (Reference 11).
12.5 kW/m ²	Maximum for areas with public access (e.g. roads) – if probability low.
38 kW/m ²	Storage tanks.

APPENDIX C – Heat Flux Computation Methods

POOL FIRE CALCULATIONS										
Program Functions										
1. For a given set of heat fluxes received, calculates the distance from the flame to the receiver.										
2. Calculates the heat flux received at a given distance from the flame.										
Calculation Methods										
1. Inverse Square and API methods										
- They can be used to calculate the direct distance from the flame centre to the receiver r2 (m)										
- They do not allow for attenuation effects										
2. View Factor ICI method										
- This can be used to calculate the horizontal distance from the flame centre to receiver R (m)										
- Includes correlations for effect of attenuation** (in the form of transmissivity T) of the base of the pool and the receiver										
- If R < 30m, then attenuation is negligible & T = 1 (This gives a conservative estimate of the heat radiated)										
- If 30m <= R <= 200m, then the Lihou & Maund correlation (depends only on R) is used										
- If R > 200m, go to inputs of % relative humidity & the ambient temperature to account for the effect of water vapour										
**NOTE: If attenuation is significant, the distance R can be recalculated in the spreadsheet by replacing the initial values of T (cells I42-I45) by those of T (cells G42-G45)										
Assumption										
Flame height = 2 times the pool diameter										
Calculations										
Calculation of the surface flux q1 from the pool fire (kW/m ²)										
Pool diameter (D)					30	m				
Burning rate of fuel (r)					4	mm/min				
Fuel density (p)					850	kg/m ³				
Proportion of heat radiated to surrounds (n)					0.3					
Heat of combustion of fuel (Hc)					40	MJ/kg				
Heat radiated per unit area of flame (q1)					85	kW/m²				
Calculation of water vapour partial pressure Pw										
% relative humidity					70					
Ambient temperature					30	deg C				
Water vapour partial pressure Pw					2959.22					
DISTANCE FROM THE FLAME TO HEAT FLUX q2 AT THE RECEIVER										
Flux q2 (kW/m ²)	Direct distance to q2		Horizontal distance to q2		Initial T values	View Factor f	R/x1	Slope a	Y-intercept b	Mean Dist
	API	Inverse Square	ICI View Factor	Calculated Attenuation						
40	30.92	21.87	19.75	1.00	1	0.4706	1.3165	-1.2297	-0.1805	24.17904143
35	33.06	23.38	22.01	1.00	1	0.4118	1.4675	-1.2297	-0.1805	26.14903489
30	35.71	25.25	24.95	1.00	1	0.3529	1.6635	-1.2297	-0.1805	28.63622715
25	39.12	27.66	28.94	1.00	1	0.2941	1.9294	-1.2297	-0.1805	31.9048616
20	43.73	30.92	34.70	0.98	1	0.2353	2.3133	-1.2297	-0.1805	36.45148985
12.6	55.10	38.96	50.52	0.97	1	0.1482	3.3682	-1.2297	-0.1805	48.19356182
9	65.19	46.10	64.88	0.96	1	0.1059	4.3255	-1.6005	0.0428	58.7240912
5	87.46	61.85	93.67	0.94	1	0.0588	6.2450	-1.6005	0.0428	80.99525377
2	138.29	97.79	148.44	0.90	1	0.0235	9.8960	-2.117	0.479	128.1737759

APPENDIX D –Probit Computations

Probit Equations

Probability Estimates¹ (probits) are used to calculate the percentage of an exposed population that will suffer a certain type of consequence from a given magnitude of an adverse effect. They can be used to estimate the consequences of toxic exposures, thermal radiation from fires and overpressure from explosions.

In mathematical terms probit is a straight line probability relationship developed to measure, for example, killing a certain proportion of the population, expressed as a standard deviation and related to a mean of 5. It has the advantage of being easily used without deep understanding of the underlying theory, provided suitable data is available.

Probit equations have the form

$$Y = k_1 + k_2 \ln V$$

Where Y is the probit, which is related to the percentage of the population suffering the set consequence. k_1 and k_2 are constants which are determined from historical data and V is the magnitude of the effect, for example the overpressure or thermal dose.

For fires and explosions the following vales of the constants are suggested²

Injury	Causative variable V	Probit equation constants	
		k_1	k_2
Burn deaths from pool fire	$tI^{4/3}/10^4$	-14.9	2.56
Explosions			
Death from lung haemorrhage	p^o	-77.1	6.91
Death from impact (see below)	p^o	-46.1	4.82
Eardrum rupture	p^o	-15.6	1.93

I is the intensity of radiation (W/m^2), t is the exposure time (s), p^o is the peak over pressure (N/m^2).

These are not definitive parameters, different values are used for the constants, depending on the original data used to determine them. Care should be taken to select appropriate probit equations from those available in the literature.

In this instance we are concerned with the heat radiation from seed oil, or combustible liquids pool fire.

Therefore we select the probit , $y = -14.9 + 2.56 \ln (t \times i^{4/3} / 10^4)$

The various PF(E) values are computed as follows;

Event 2 –

If we take heat flux received at the boundary from a potential bund fire (Road Tkr unloading) about 65 metres from the pool fire , the resultant heat flux (i) is around 2 kW/m² or 2,000 W / m² and we take the heat received as 5 minutes (as people would tend to move away from the intense heat) , i.e. t = 300 seconds.

$$\text{Then } Y = -14.9 + 2.56 \ln (300 \times (2000)^{4/3} / 10,000) = 6.6 - 14.9 = 0$$

From the Probit ,

Transformation of percentages into probits, %

%	0	1	2	3	4	5	6	7	8	9
0	-	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33

At Y = , Probit is approx. 0% , ie 0% chance of fatality for a person at the boundary.

Event 3 – is the same as the above computation.

Event 6 -

If we take heat flux received at the boundary from a potential bund fire (Tanks 101-212 Bund) about 90 metres from the pool fire , the resultant heat flux (i) is around 12.6 kW/m^2 or $12,600 \text{ W / m}^2$ and we take the heat received as 5 minutes (as people would tend to move away from the intense heat) , i.e. $t = 300$ seconds.

Then $Y = -14.9 + 2.56 \ln (300 \times (12600)^{4/3} / 10,000) = 23.2 - 14.9 = 8.3$.

From the Probit ,

Transformation of percentages into probits, %

%	0	1	2	3	4	5	6	7	8	9
0	-	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33

At $Y = 8.3$, Probit is approx. 100% , ie 100% chance of fatality for a person at the boundary.