Revision – 01, Date: - 03/10/2017, Supersedes 28/05/2014

Sl No 297

REVISED

ON-SITE EMERGENCY PLAN

DIRECTORATE OF FACTORIES & BOILERS
ACCEPTED
Date 4.4.18
ORISSA, BHUBANESWAR

Director of Factories & Boilers
Odisha, Bhubaneswar

TRADE Jindal MARK

JINDAL INDIA THERMAL POWER LIMITED

Vill/PO: Derang, Dist: Angul - 759117

2 x 600 MW Power Plant

CONTENTS

1.0 GENERAL INFORMATION OF THE FACTORY

1.1 INTRODUCTION:

M/s. Jindal India Thermal Power Limited (hereinafter referred as JITPL), wholly owned subsidiary of M/s. B.C. Jindal group, is involved in thermal power production. The Factory situated in Village - Derang in the district of Angul, Odisha, is having 02 units of 600 MW each.

Name & Address Of The Factory	M/s. Jindal India Thermal Power Limited. At/Po- Derang, Ps-Kaniha, Via- Kaniha, Dist.-Angul, Odisha-759117 E Mail:jindal_orissa@jitplgroup.com Fax No: 0674 - 2592985
Regd. Office Address	M/s. Jindal India Thermal Power Limited Plot No: 12, Local shopping complex, Sector-B1 VasantKunj, New Delhi – 110070 Tel : (011) 26139256-65 Fax: (011) 26121734
Site Office	M/s. Jindal India Thermal Power Limited. At/Po- Derang, Ps-Kaniha Via- Kaniha, Dist-Angul, Odisha-759117
Name & Designation Of Occupier	Shri. Anand Mohan Misra Chief Operating Officer & Whole Time Director
Name & Designation Of Manager Under Factories Act	Shri. Brajesh Kumar Pandey Sr. Vice Pesident – O&M (Plant Head)
Product	2 x 600 MW THERMAL POWER PLANT
Tel/Fax No Web Site	Tel : 9583040700/701/702 Fax: 0674 – 2592985 E Mail: Jitpl_orissa@jindalgroup.com www.jindalgroup.com

1.2 LOCATION AND ACCESSIBILITY:

The power plant is located at Village-Derang, District -Angul, Odisha and has the following coordinates:-

Latitude : $21^0 07' 16''$ to $21^0 08' 20''$ N

Longitude : $84^0 58' 50''$ to $85^0 00' 25''$ E

Site Elevation : 100 to 107mabove MSL

Total area of 950 acres has been acquired for the plant. The topography of the site is plain with small mounds with an average elevation of 100 to 107m above MSL. The site is optimally suited for considering the topography and availability of fuel and water at the proximity.

NH 200 is passing by at a distance of 7 km from the Factory site.

RAIL:

The nearest railway station is Talcher Road of East Coast Railway, at a distance of about 45Kms from the Factory.

AIRPORT:

The nearest airport is Bhubaneswar at a distance of 215Kms.

PORT:

Nearest port is Paradeep, which is located at a distance of 227Kms.

Other important features of the Factory:

Samal Barrage on Brahmaniriver which is about 14 -km from the Power Plant, is water source of the Factory.

The source of Fuel (coal) is coming from Mahanadi Coal Fields, Kaniha Open Cast mine (8.0-km from the Thermal Power Plant) and Captive Mandakini coal block (4.5 Km from the plant).

1.3 METEOROLOGICAL DATA:

Meteorological Data:

	Summer		Rainy		Winter	
	Day	Night	Day	Night	Day	Night
a. Average wind speed m/sec	2.6	1.8	2.8	2.1	1.8	1.4
b.Average wind direction(from)	W		W		WNW	
c.Humidity	77	56	81	73	64	41
d. Ambient air temp ^{0}C	43	21	34	22	32	12

NB :- The data is as per the Meteorological Department, Govt. of India (Attached as Annexure –V)

1.4. PLANT DETAILS:

M/s. Jindal India Thermal Power Ltd is a coal based 2X600 Mw thermal power plant at Derang, Angul, Odisha, out of which at present 2x600 Mw Thermal Power Plant has been commissioned.

1.4.1. PLANT FACILITY ALREADY IN PROCESS:-

1. STEAM TURBINE - 2 x600 MW
2. PC FIRED BOILERS - 2 x2000 TPH
3. MULTI FLUE CHIMNEY - 1 x 275 METERS.
4. ESP - 2 NOS.
5. COAL HANDLING PLANT-12360 TPD at 80% PLF,15452 TPD at 100% PLF(2X1200 MT/HR)

TRACK HOPPER– PROPOSED STAGE, WAGON TIPPLER – PROPOSED STAGE, STACKER RE-CLAIMER –1(1200 MT/HR)

6. ASH HANDLING WITH HCSD SYSTEM and ASH POND.
7. ASSOCIATED UTILITY SYSTEMS
8. RAW WATERRESERVOIR &RAILWAY LINE.

Directorate of Factories & Boilers BBSR Odisha

1.4 MANUFACTURING PROCESS DETAILS:-

The process for power generation system comprises of Boiler (steam generator), Turbine with accessories, Generator unit, Transformer and equipment's all arranged to operate as complementary parts of a complete monolithic set. The super saturated steam from the boiler of designated pressure and temperature drives the turbine thereby converting thermal energy into mechanical energy, which in turn drives the generator where mechanical energy is converted into electrical energy.

Process flow sheet of the proposed power generation process is presented in Figure.

INPUTS:-

- **COAL:** Coal is brought to site through truck, hyva and stocked in the coal yard. The coal is transferred from the yard to boiler Silo through stacker reclaimed and conveyors. The coal consumption is around 12360 TPD at 80% PLF and 15452 TPD at 100% PLF. Fuel oil—LDO and HFO are used in a meager manner for start-up. Approximate consumption of LDO –5500Kl per annum and HFO 10000Kl per annum.

- **WATER:** Water intake is from upstream of Samal Barrage on Brahmani River through river water intake pump house. This raw water is clarified and processed through ion exchange process to make DM water. The raw water after clarification is used for cooling tower makeup, service water and potable water.

The process for power generation system comprises of Boiler (steam generator), Turbine with accessories, Generator unit, Transformer and equipment's all arranged to operate as complementary parts of a complete monolithic set. The super saturated steam from the boilers of designated pressure and

temperature drives the turbine thereby converting thermal energy into mechanical energy, which in turn drives the generator where mechanical energy is converted into electrical energy.
Coal from the coal mines is transported by truck, hyva via talcher road and kaniha to our coal yard.

Coal from the track hoppers is conveyed directly to the crusher building. Coal is crushed in the crushers from 200 mm to 25mm or less as required for process. This crushed coal is conveyed up to the coal bunkers and stored there. Required amount of crushed coal is fed to the pulveriser mills through coal feeders. Pulveriser mills crush the coal to the required size for firing inside the boiler.
Natural circulation, drum type, two pass, radiant, single reheat, balanced draft, semi outdoor type coal fired steam generating units are used for steam generation. Initial lighting is achieved through the oil firing (First LDO followed by HFO) and subsequently the load gets transferred to coal firing on stabilization. Plant is designed to use F grade coal (3650 Kcal/Kg) for better heat transfer. Boiler feed water for steam generation is recycled through condenser hot well, make up water requirement being met by DM plant. Condenser cooling water requirement is made by the induced draft cooling water system in the plant.
The maximum rating for the boiler is 2000 TPH with final SH outlet steam temperature being 540*C @178 Kg/Cm^2. In the steam coming out from the SH enters into the HP turbine where it gets expanded and returns back to RH at 332^0C @ 42.9 Kg/Cm^2 and comes out of RH outlet header at 568^0C @ 40.3 Kg/Cm^2. The steam from the header is admitted to IP turbine where it further expands and then moves for further expansion towards LP turbine. After final expansion in LP turbine it moves to condenser where it changes its phase giving out its latent heat (here steam converts in to water) and thus the cycle continues. In the second pass economizer utilize the heat from the flue gas and add this sensible heat to feed water thereby increasing its temperature. The second pass also contains the low temperature SH which utilize the sensible heat of flue gas and increases the steam temperature to derive more work.

The turbine-generator converts the heat enthalpy to electrical energy through 400 kV switchyard of power station. Power distribution is achieved for end user areas via 33 kV, 11 kV & 440 V sub-stations.

Suitable electro static precipitator receives the flue gas from steam generators. Dust collection efficiency has been so designed to keep the SPM level less than equal to 50 mg/Nm^3. The collected dust from ESP hopper pneumatically conveyed with the support of the service air to ash storage silos. Bottom ash from boiler hoppers also conveyed and stored in dewatering beans in ash handling system. Ash handling system has provisions for dry ash unloading after suitably conditioning it and wet ash conveying to ash storage reservoir with help of high concentration slurry discharge system.

The whole plant is designed for Zero liquid discharge system. All excess liquid effluents will be treated for reuse in the process.

STEAM GENERATOR & AUXILIARIES:

The Steam generator (SG) would be designed for firing 100% coal and would be natural circulation drum type. The SG would be of two pass design, radiant, single reheat, balance draft, semi-outdoor type, rated to deliver 2000 TPH of superheated steam at 178ATA, 540 + 10°C when supplied with feed water at a temperature of 278°C at the economizer inlet. The reheat steam temperature would also be 540°C.

The steam generator would be provided with coal mills with individual raw coal gravimetric feeders and coalbunkers. Sampling arrangement at mill outlet would be provided for the purpose of establishing the average gross calorific value of coal as well as coal fineness. The coal mills would be provided with steam blanketing system for the purpose of fire protection. The SG should be designed in a way that no fuel oil support is required for flame stabilization beyond 40% MCR.

For unit light up and warm up operation, LDO shall be used. The oil system would be provided with necessary fuel oil pressurizing units and fuel oil heating equipment. High-energy electric arc igniters would be provided to ignite the fuel oil guns.
The steam generator would consist of water cooled furnace, radiant and convection super-heaters, re-heaters, economiser, regenerative air heaters, steam coil air pre-heaters, etc. Soot blowers would be provided at strategic locations and would be designed for sequential fully automatic operation from the unit control room.

Suitable balance draft system would be provided for the steam generator with two (2) axial blade pitch controlled plant would comprise primary air fans, forced draft fans and two (2) centrifugal type induced draft fans each of these fans would be capable of meeting the air requirement at 50% boiler MCR load. Electrostatic precipitator (ESP) and fly ash hoppers would be provided for the collection of fly ash. Multi field ESP (99.943% efficiency) shall be designed to achieve an outlet dust concentration of 50 mg / Nm^3 as per State / Central Pollution Control Board norms.
The steam generators would be provided with low NOx burners, hence the emission of oxides of nitrogen from the steam generator would be minimum.

STEAM TURBINE GENERATOR:

Steam turbine generator (STG) would be rated for 600 MW maximum continuous output at the generator terminals, with throttle steam conditions of 178ATA and 540°C / 568°C steam temperature and 0.1036 bar(a). The steam turbine would be a reheat extraction-condensing turbine.

The turbine-generator would be complete with all accessories such as protection system, lube and control oil systems, seal oil system, jacking oil system, seal steam system, turbine drain system, 60% TGMCR HP / LP bypass system, electro-hydraulic control system, automatic turbine run-up system, on-line automatic turbine test system and turbine supervisory instrumentation. The turbine-generator would also have all necessary indicating and control devices to permit the unit to be placed on turning gear, rolled, accelerated and synchronized automatically from the control room. Other accessories of the turbine-generator would include an oil purification unit with transfer pumps and clean and dirty oil storage tanks of adequate capacity.

GLAND STEAM CONDENSER:

A surface type gland steam condenser would be used to condense the gland steam exhausted from the turbine glands. The gland steam condenser would be of single-pass type with the main condensate flowing through the tubes to condense the steam. Exhausters would be provided to evacuate the air from the shell side and maintain the shell at the required negative pressure.

DE-AERATOR :

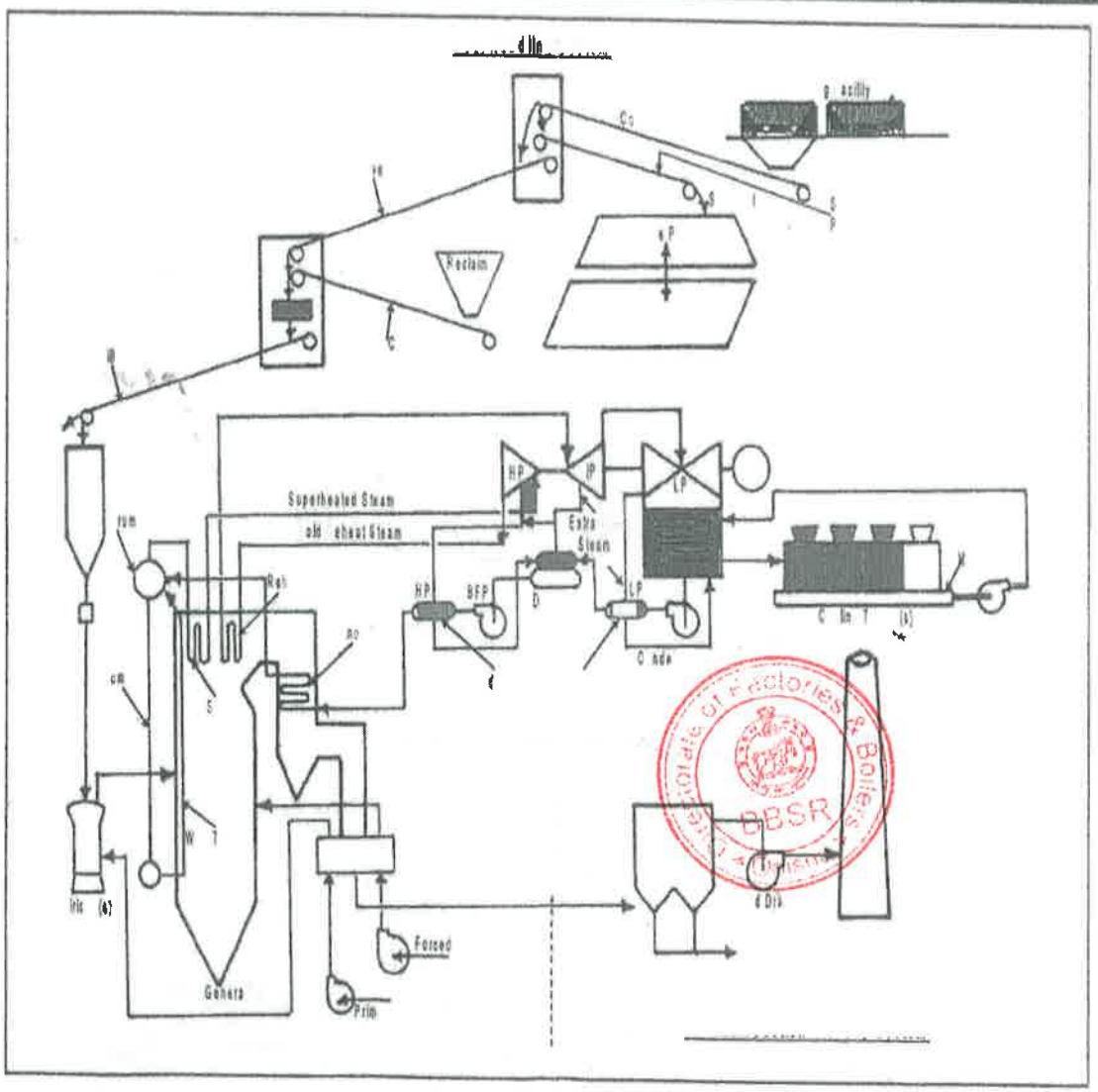
The de-aerating feed water heater would be a direct contact, variable pressure type heater with spray-tray type or spray type of de-aeration arrangement. The feed water storage tank would have a storage capacity adequate to feed the steam-generator for 6 minutes when operating at MCR conditions.

COMPRESSED AIR SYSTEM:

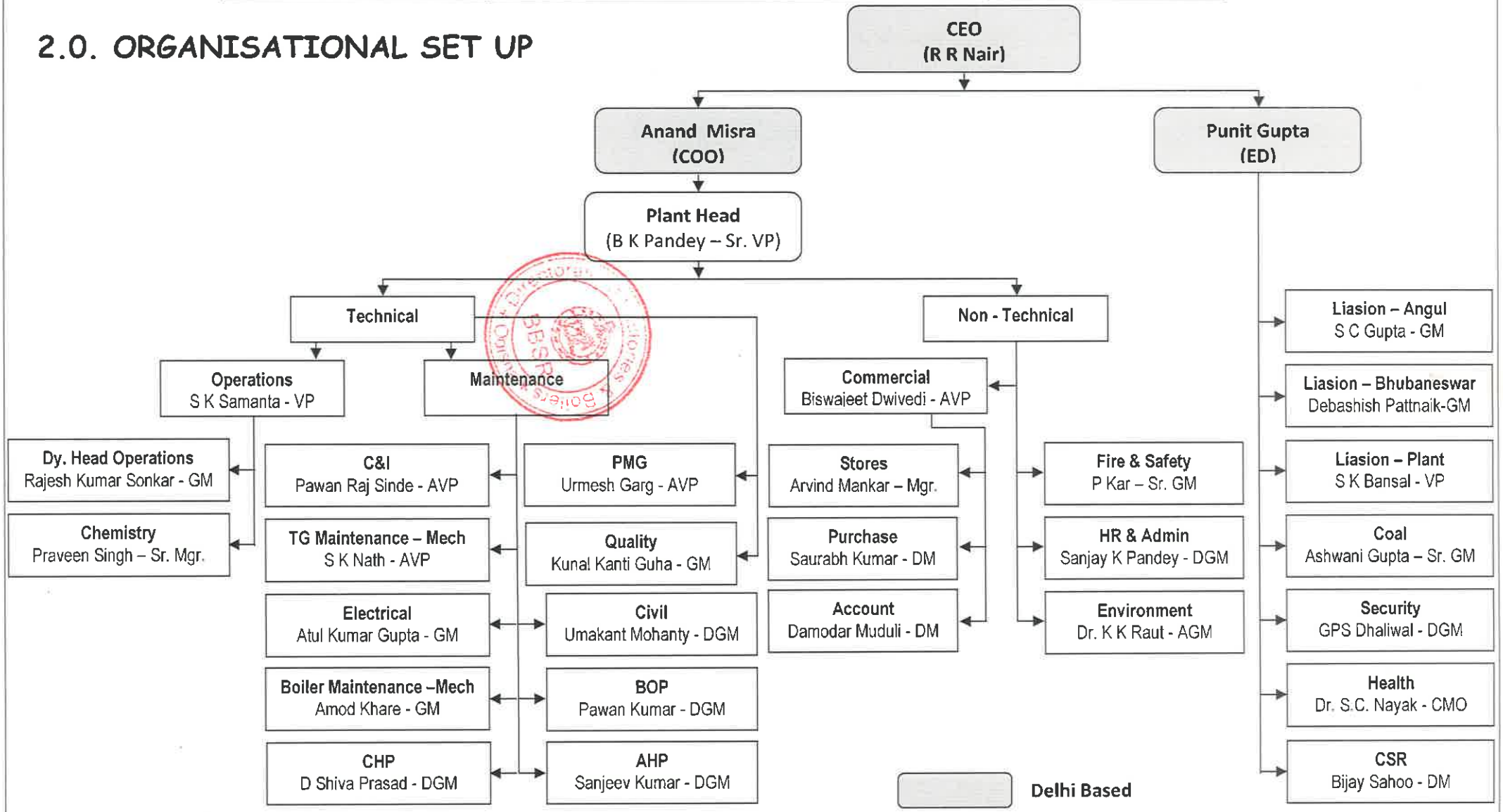
The Compressor is having a capacity of about 50 Nm^3/ min at discharge pressure of 8.0 kg / cm^2 shall be provided to cater the requirement of 2 x 600 MW units of Phase-I. The requirement of the compressed air for the fly ash conveying would be met through separate dedicated compressors.
The compressed air system would include accessories such as moisture separators and air receivers. Adequate number of air driers and air receivers of suitable capacity would be provided to cater the requirement of Instrument air and Service air.

1.5. PROCESS FLOW DIAGRAM (FIGURE 1) –

REIA for Proposed 2x600 Based Thermal Power Project Derang Village, Angul District, Orissa



2.0. ORGANISATIONAL SET UP



3.0 MAN POWER :-

Man Power (Maximum to be employed) in the Factory will be 1500. The details are mentioned below:

MANPOWER - (MAXIMUM) :

SHIFT	TIME	No. of Persons deployed per shift	No. of persons to be ordinarily present
A	0600-1400 hrs.	350	270
B	1400-2200 hrs.	350	270
C	2200-0600 hrs.	350	270
GENERAL	0800 - 1700 hrs. 0900 - 1800 hrs.	450	370
	Total	1500	1180

Maximum number of persons to be employed 1500. Those will be deployed in four shifts as above. Daily attendance/presence after availing weekly off/leave is as shown above. Maximum presence at any time on any day will be i.e. A+G or B+G (9 am to 6 pm) 640.

4.0. INVENTORY OF RAW MATERIALS

SL. NO.	NAME OF RAW MATERIAL	QUANTITY OF ONE TIME STORAGE MAXIMUM
1	COAL	2,50,000 MT
2	HFO	4000 KL
3	LDO	500 KL
4	HSD	140 KL

5.0. (A) PRODUCT :

Sl. No.	NAME OF THE PRODUCT	PRODUCTION CAPACITY	TYPE OF STORAGE
1	Electricity	2 X 600 MW	NA

5.0. (B) WASTE - PRODUCT :

Sl. No.	NAME OF THE PRODUCT	QUANTITY OF ONE TIME STORAGE IN MT - Capacity	TYPE OF STORAGE
1	Ash	4x1500 MT	4Cylindrical Concrete Ash Silo-1500 MT (2013 Cum) capacity Size - D-12 M., H-20.5M each

6.0. INVENTORY OF HAZARDOUS SUBSTANCES :

SL. NO.	NAME OF HAZARDOUS SUBSTANCES	CAPACITY	ONE TIME STORAGE QUANTITY	TYPE OF STORAGE	SIZE OF THE STORAGE TANK
1	HFO	2 x 2260 KL	2x2000 KL	2 Cylindrical Type above the ground MS Storage vessels	Each tank size(d-15.5m h-12.0 m)
2	LDO	1 x 560 KL	1x 500 KL	Cylindrical type above the ground MS Storage vessels	tank size (d - 9.0m h-9.0m)
3	Hydrogen	300 Nos. Cylinders (47 L). 7 nM3 of gas is filled at 150 kg/cm^2 = 490 gm	180 Nos.	Cylinders in Hydrogen plant & TG area.	Size of the storage area L- 18m B- 10 m H-3.8 m
4	HSD	1 x 115 KL 2 x 22 KL	1 x 100 KL 2 x 20 KL	Cylindrical - one above ground and others under ground	(1st = d - 5.0 m h-6.0m) (2nd & 3rd = d - 2 m, h -7 m)
5	Chlorine	32 Nos. cylinders (Each 900 kg).	20 cylinders	Chlorine storage building	The size is L- 48 m B - 8.4 ms H-7.2 ms

6	Sulphuric Acid (98 %)	2x24.5 M^3	2X20 M^3	Horizontal MS Tank (above the ground)	Each tank size (D- 2.5m, L- 5.0mts)
7	Hydrochloric Acid (33 %)	2x90 M^3	2X80 M^3	Horizontal Steel tank (above the ground)	Each tank size (D-3.8 m, H-8.0m)
8	Caustic Lye (48 %)	2x37.5 M^3	2X33 M^3	Horizontal Steel tank (above the ground)	Each tank size (D-2.6 m, H-7 m)
9	Transformer Oil	No of Transformers - 12 Capacity of each- (4x16MVA, 2x16MVA, 2x50MVA,2x50MVA, 2 x250MVA)	Quantity of transformer oil in each - 3x10KL, 6x5KL, 3x6KL) =78 KL	Inside the Transformers	NA

THRESHOLD QUANTITY OF HAZARDOUS CHEMICALS –

CHLORINE – 10 TON

FO – 15000 TON

LDO – 10000 TON

HSD – 10000 TON

HYDROGEN – 50 TON

SHORT TERM EXPOSURE LIMIT OF CHLORINE – 3 ppm and 9mg/m^3

TIME WEIGHTED AVERAGE CONCENTRATION OF CHLORINE – 1 ppm and 3 mg/m^3

DYKE SIZE (LENGTH, BREADTH, HEIGHT) OF DIFFERENT CHMICALS TANKS & VESSELS –

LDO – 18 m X 20 m X 1.4 m

FO & HSD – 109 m X 49 m X 1.4 m

SULPHURIC ACID – 16.2 m X 5 m X 0.9 m

CAUSTIC – 9.7 m X 13 m X 0.9 m

HYDROCHLORIC ACID – 15 m X 13 m X 0.9 m

NEUTRALISATION PIT FOR ACIDS/ALKALI – 2 Pits X 22 m X 11 m X 4.5 m

7.0. INVENTORY OF HAZARDOUS GASES PRODUCED/GENERATED DURING THE PROCESS :

SL. NO.	NAME OF HAZARDOUS GAS	QUANTITY OF ONE TIME STORAGE IN MT	TYPE OF STORAGE
1.	NA	NA	NA

8.0IDENTIFICATION OF HAZARD:

SL. NO.	HAZARD	PREDICTABLE HAZARD SCENARIO	IMPACT
1	LDO	Pool fire / Fire ball may occur due to rupture in the Tank and Subsequent release and instantaneous ignition.	Fire may propagate to the nearby area
2	HFO	Fire ball may occur due to rupture in the Tank and Subsequent release and instantaneous ignition	Fire may propagate to the nearby area
3	H_2 GAS	Fire / Explosion may occur due to leakage from valve / rupture of Hydrogen Storage Cylinder	Fire may propagate to the nearby area
4.	Chlorine Gas	Chlorine Gas leak may occur due to failure of Valve of the chlorine cylinder	Chlorine gas may spread to nearby area
5	Transformer oil	Fire ball may occur due to rupture in the Tank and Subsequent release and instantaneous ignition	Fire may propagate to the nearby area
6	Diesel	Fire ball may occur due to rupture in the Tank and Subsequent release and instantaneous ignition	Fire may propagate to the nearby area
7	COAL	Fire Hazard	Fire may propagate within the coal storage yard

9.0. IDENTIFICATION OF MOST CREDIBLE HAZARD SCENARIO

Case-1

Fire on LDO Storage Tank (Dispersion Modelling in Annexure - VI)

Fire Hazard in LDO Storage Tank is considered as Credible Scenario because of the following reasons;

LDO is a flammable liquid as per schedule-1, Part-II (b) (v) having flash point of > 52^{0}C and auto ignition temperature of 257^{0}C and explosive limit of lower value 0.6% & upper value 4.7% by volume in air. Fire classification as per OSHA, it comes under category Flammability-2 (Moderate). So, it is susceptible to fire hazard. Whenever LDO catches fire it shall manifest in the form of pool fire. Taking into consideration of the metrological data of the area, one time storage quantity of LDO and its physical and chemical property, it is considered credible Hazard scenario.

The effect of significant heat radiation level of 4.5 Kw /m^2,12.5 Kw/m^2 and 37.5 Kw/m^2 for different season in case of fire on LDO storage tank as assessed is given in table below.

Storage details	Significant heat level Kw/m^2	Experience at distance in Mtrs.						Indication
		Summer		Rainy		Winter		
		(D)	(N)	(D)	(N)	(D)	(N)	
LDO 500KL	4.5	19.03	18.9	18.13	19.2	19.1	21.97	Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely to cause with no lethality.
	12.5	11.98	13.0	12.62	12.7	11.2	14.23	Minimum energy requires for melting of plastic
	37.5	8.012	7.6	6.567	7.85	7.23	8.03	Sufficient to cause damage to the equipment.

*D- Day, *N-Night

Source need to be highlighted for all credible hazard scenarios and significant heat and distance to be changed accordingly.

Case-2

Fire on HFO Storage Tank (Dispersion Modelling in Annexure - VII)

Fire Hazard in HFO Storage Tank is considered as Credible Scenario because of the following reasons;

HFO is a flammable liquid as per schedule-1, Part-II (b) (v) having flash point of >60^{0}C and auto ignition temperature of 250^{0}C and explosive limit of lower value 0.5%& upper value 5.0% by volume in air. Fire classification as per OSHA, it comes under category Flammability-2 (Moderate). So, it is susceptible to fire hazard. Whenever HFO catches fire it shall manifest in the form of pool fire. Taking into consideration of the metrological data of the area, one time storage quantity of HFO and its physical and chemical property, it is considered credible Hazard scenario.

The effect of significant heat radiation level of 4.5 Kw /m^2,12.5 Kw/m^2 and 37.5 Kw/m^2 for different season in case of fire on HFO storage tank as assessed is given in table below.

Storage details	Significant heat level Kw/m^2	Experience at distance in Mtrs.						Indication
		Summer		Rainy		Winter		
		(D)	(N)	(D)	(N)	(D)	(N)	
HFO 2X2000KL	4.5	19.0	18.9	18.14	19.2	19.1	21.9	Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely to cause with no lethality.
	12.5	11.9	13.0	12.64	12.7	11.2	14.2	Minimum energy requires for melting of plastic
	37.5	8.01	7.6	6.564	7.85	7.23	8.03	Sufficient to cause damage to the equipment.

Case-3

Fire on Hydrogen(H_2) Storage Tank (Dispersion Modelling in Annexure - VIII)

Fire Hazard in Hydrogen(H_2) Cylinder is considered as most Credible Scenario because of the following reasons;

Hydrogen(H_2) is a flammable gas having auto ignition temperature of 571^{0}C and explosive limit of lower value 4.0%& upper value 75.0% by volume in air. So, it is susceptible to fire hazard. Whenever Hydrogen(H_2)catches fire it itself burns with explosion . Taking into consideration of the metrological data of the area, one time storage quantity of Hydrogen(H_2) and its physical and chemical property, it is considered credible Hazard scenario.

The effect of significant heat radiation level of 4.5 Kw /m^2,12.5 Kw/m^2 and 37.5 Kw/m^2 for different season in case of fire on Hydrogen(H_2)Cylinder as assessed is given in table below.

Storage details	Significant heat level Kw/m^2	Experience at distance in Mtrs.						Indication
		Summer		Rainy		Winter		
		(D)	(N)	(D)	(N)	(D)	(N)	
H_2 20X7 KL	4.5	9.35	8.64	10.5	11.4	8.52	7.54	Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely to cause with no lethality.
	12.5	6.43	5.27	9.32	9.2	6.54	5.74	Minimum energy requires for melting of plastic
	37.5	4.25	3.95	6.58	7.21	4.96	3.58	Sufficient to cause damage to the equipment.

Case-4

CHLORINE GAS LEAKAGE CHLORINE TONNER(Dispersion Modelling in Annexure – IX)

Gas Leakage from chlorine tonners considered as most Credible Scenario because of the following reasons;

Maximum one time storage: 32 (Tonners) X 990L (each) =31680 L.

Chlorine gas is very toxic obnoxious gas with greenish yellow colour and highly oxidizing agent. It reacts violently with water and Iron at elevated temperature. It is extremely irritating to the mucous membranes of the eyes and respiratory tract and is very toxic. Taking into consideration of the metrological data of the area, one time storage quantity of chlorine gas and its physical and chemical property, it is considered credible Hazard scenario.

The effect of significant concentration level of 1 PPM, 3PPM and 20 PPM for different season in case of chlorine gas leakage from chlorine or cylinder valve connecting pipe as assessed is given in table below.

Season	Wind speed (m/sec)	Wind direction	Humidity (%)	Ambient Temp. (^{0}C)	Distance in meter		
					1PPM	3 PPM	20 PPM
Summer (Day)	2.6	W	77	43	**1500**	**944**	**370**
Summer (Night)	1.8	W	56	21	**1700**	**1100**	**430**
Rainy (Day)	2.8	W	81	34	**326**	**183**	**69**
Rainy (Night)	2.1	W	73	22	**1600**	**1000**	**400**
Winter (Day)	1.8	WNW	64	32	**1700**	**1100**	**437**
Winter (Night)	1.4	WNW	41	12	**1700**	**1100**	**469**

From the above assessment, the maximum effect of chlorine gas dispersion distance (Iso-risk contour) due to leakage of chlorine for 1 PPM, 3 PPM & 20 PPM concentration is experienced up to **1700,1100 & 469**meters respectively in winter season night time from the source of leak.

Case-5

Fire in Coal Storage Yard

Fire Hazard in Coal Storage Yard is considered as a Credible Scenario because of the following reasons.

During storage of coal in the coal yard, weathering of coal takes place due to mild oxidation, which is an exothermic process. If the heat liberated is not completely dissipated, the temperature of Coal rises as Coal is a bad conductor of heat. The rate of oxidation is doubled with 10°C rising temperature. The bulk of Coal may reach critical temperature i.e. its ignition point 50-80°C and may burst into flame. This phenomenon is known as spontaneous ignition of Coal.

However, in the present situation, the following precautions are taken for prevention of spontaneous ignition of Coal.

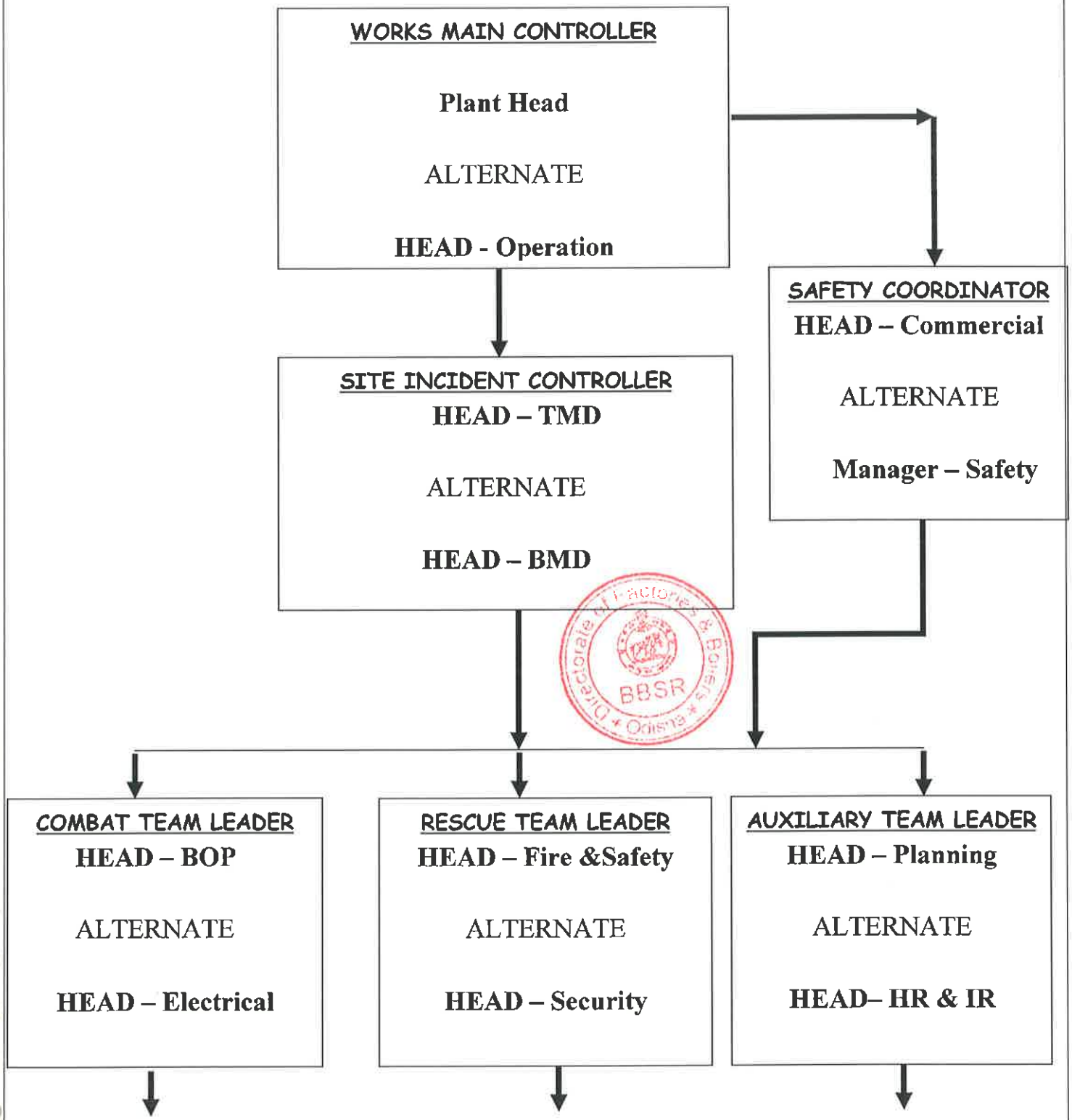
- The exposed surface area is reduced by avoiding segregation and by packing the coal tightly and uniformly.
- The ventilation at the coal heap is suppressed so that weathering is avoided due to cut-off of oxygen.
- Coals of different sizes stored in a pile so that air voids are reduced to a great extent.
- The coal is consumed before the critical temperature is reached.
- Water Sprinkling is done to reduce the temperature.
- Coal is stored away from the heat source i.e. Rotary Kiln.

PLOT PLAN (Annexure - X)

10.0

The plot-plan showing Hazard Zone, Iso-Risk Contour, Emergency Control Room, Assembly points, Main, Material & Emergency Exit (Gates) and Fire Hydrant line along with its no. of Hydrant Points in different color codes is given in Annexure-X.

11.0 EMERGENCY COMMAND STRUCTURE



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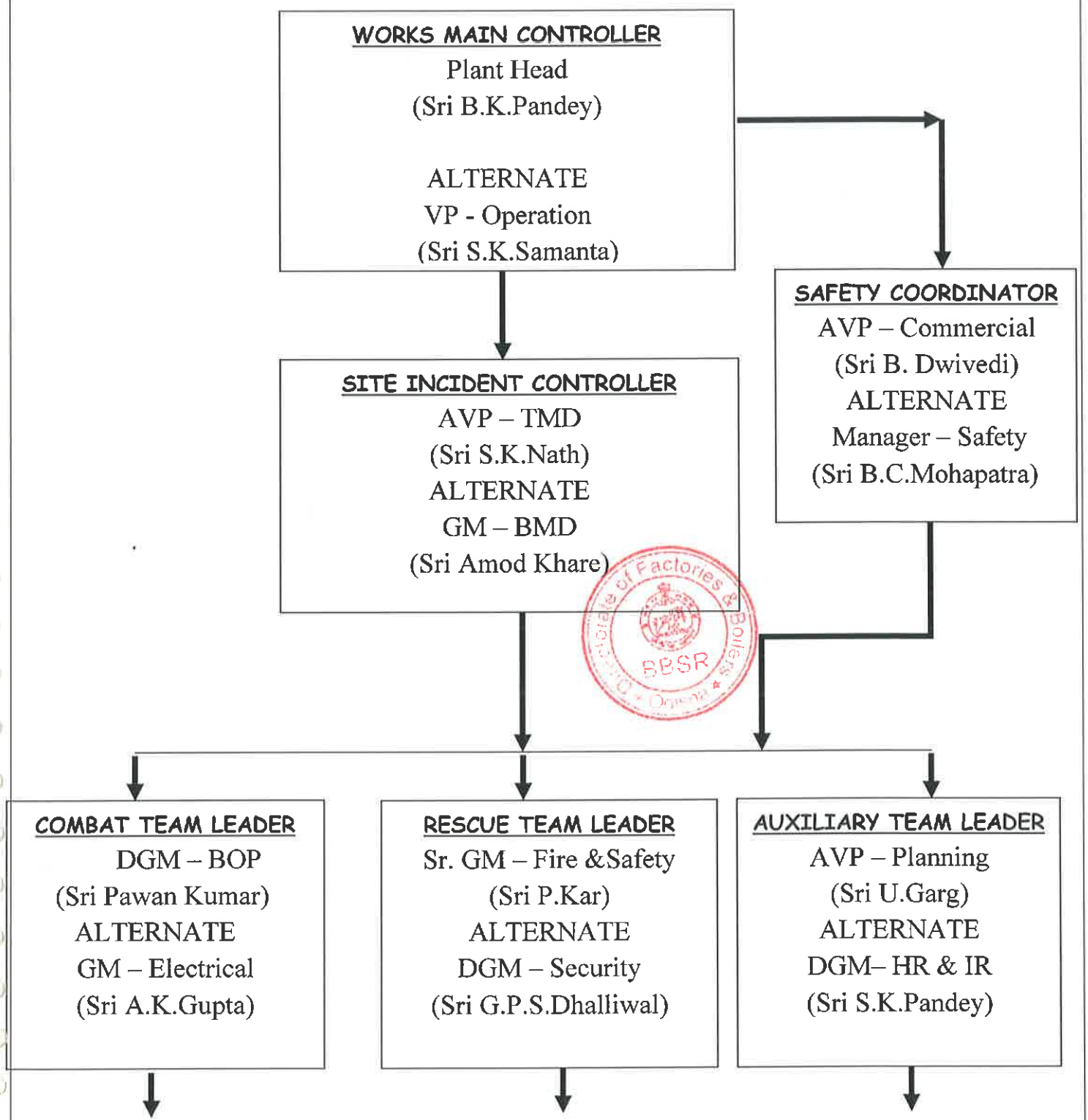


MEMBERS

1. Sri. R.Sonkar
   9583040015
2. Sri. U.K.Mohanty
   9583040472
3. Sri Sanjeev Kumar
   9583040911
4. Sri. A.Sapre
   9583040490
5. Sri. Shiv Prasad
   9583040171
6. Sri. V.N.Gupta
   9583040641
7. Sri. P.K.Singh–
   9583040675
8. Sri. Durgesh Sharma
   9583040398
9. Sri Mukti Kujur
   9583040397
10. Sri. S.B.Giri
    9583040495

MEMBERS

1. Sri Mithilesh Kumar
   9583040494
2. Sri K.Kishan
   9583040382
3. Sri. Abhit Panigrahi
   9583040620
4. Sri. Arun Behera
   9583040650
5. Sri Nepal Singh
   9583040916
6. Sri Bikram Dhal
   9583040478
7. Sri D.K.Singh
   9583040934
8. Sri Satbir Singh
   9583040950
9. Sri. Rahul Singh
   9583040625
10. Sri Shivendra Kumar
    9583040619

MEMBERS

1. Dr.S.C.Nayak
   9583040470
2. Sri. B.B.Sahoo
   9583040768
3. Sri D.K.Sahoo
   9583040170
4. Sri B.Ray
   9583040646
5. Sri. S.K.Samal
   9583040468
6. Sri. Gagan Pani
   9583040866
7. Sri S.K.Swain
   9583040194
8. Sri A.K.Mankar
   9583040652
9. Sri Nishikant Rath
   9583040647
10. Sri Sudhir Rathore
    9583040194

12.0 ROLE OF KEY PERSONS OF EMERGENCY COMMAND STRUCTURE

12.1 WORKS MAIN CONTROLLER (WMC):-

⇒ On being informed, rushes to the Emergency Control Room and takes overall charges of the situation

⇒ Makes quick assessment of the situation and decides declaration of emergency if any by blowing the siren in appropriate code **[intermittent three times for 30 seconds each with 5 seconds pause/interval in between]**

⇒ Makes continuous review and assesses the possible developments to determine the extent of damage to plant and human beings

⇒ Ensures that casualties are receiving adequate attention

⇒ Liaises with the fire services, police services and other statutory authorities

⇒ Declares closure of the emergency by blowing the siren [**only once long siren for 1 Minute**]

⇒ Issues the authorized statements to the media services

⇒ Reports all statutory authorities in the prescribed manner

⇒ Communicates to employees about the mishap, measures taken and gives confidence to employees for avoiding recurrence of the incident by investigation and ordering preventive measures to be implemented

12.2 SITE INCIDENT CONTROLLER:-

⇒ On hearing Emergency siren, rushes to the scene and reports to the Works Main Controller

⇒ Makes quick assess about the gravity of the situation and appraises Works Main Controller

⇒ Extend all sorts of help through different agencies to minimize the damage to human beings, plant, property and environment

⇒ Reports the development of the situation time to time to Works Main Controller

⇒ Provides the required information to the fire brigade team for fire fighting

⇒ Preserves the evidences for the subsequent inquiries

12.3 COMBAT TEAM LEADER:-

⇒ On hearing the emergency siren, rushes to the scene with his team with sufficient equipment in the minimum possible time and reports to Site Incident Controller

⇒ Ensures the team members that, they resume their position with appropriate equipment.

⇒ Monitors the combat operation to control the situation

⇒ Ensures that the situation is controlled by arresting, spillage, fighting fire, shutting of the valve and equipments by the team in consultation with Site Incident Controller

12.4 COMBAT TEAM MEMBERS:-

⇒ On hearing the emergency siren, rush to the scene with fire fighting equipments/gas masks in the minimum possible of time and report to their team leader

⇒ Operate the fire fighting equipments/close the valve of the gas cylinder for controlling the situation

12.5 RESCUE TEAM LEADER:-

⇒ On hearing the emergency siren, rushes to the scene and reports to the Site Incident Controller

⇒ Ensures the arrival of his team members

⇒ Keeps necessary equipment of first-aid for preliminary treatment

⇒ Keeps the ambulance ready to carry the injure persons to the nearest hospital

⇒ Ensures the use of proper personal protective equipments by his team members & leads the team for rescue operation

⇒ Informs the Works Main Controller for the developments time to time

⇒ Guides the Mutual Aid Partner for their course of action at the site

⇒ Guides the non-essential persons to reach assembly point

⇒ Searches the missing person on the roll call basis

12.6 RESCUE TEAM MEMBERS:-

⇒ On hearing the emergency siren, rush to the scene with appropriate personal protective equipments and report to their team leader

12.7 AUXILIARY TEAM LEADER:-

⇒ On hearing the emergency siren rushes to the scene and reports to the Site Incident Controller

⇒ Intimates statutory authorities over phone

⇒ Intimates nearest Fire Station over phone

⇒ Intimates Mutual-Aid Partner over phone

⇒ Keeps the first-aid and primary health center staff, equipment ready to take care of immediate medical needs

⇒ Takes care of victims' family

⇒ Makes all arrangement like transport, other needs, arrange finance

⇒ Ensures all casualties are shifted to hospital for medical treatment

⇒ Keeps records of casualties and provide information of the matter to Works Main Controller

12.8 AUXILIARY TEAM MEMBERS:-

⇒ On hearing emergency siren, rush to the scene and report to the team leader

⇒ Provide immediate first-aid treatment to the victims

⇒ Ensure ambulance vehicle ready

⇒ Coordinate with combat team, rescue team, statutory authorities and mutual-aid partners

12.9 SAFETY CO-ORDINATOR

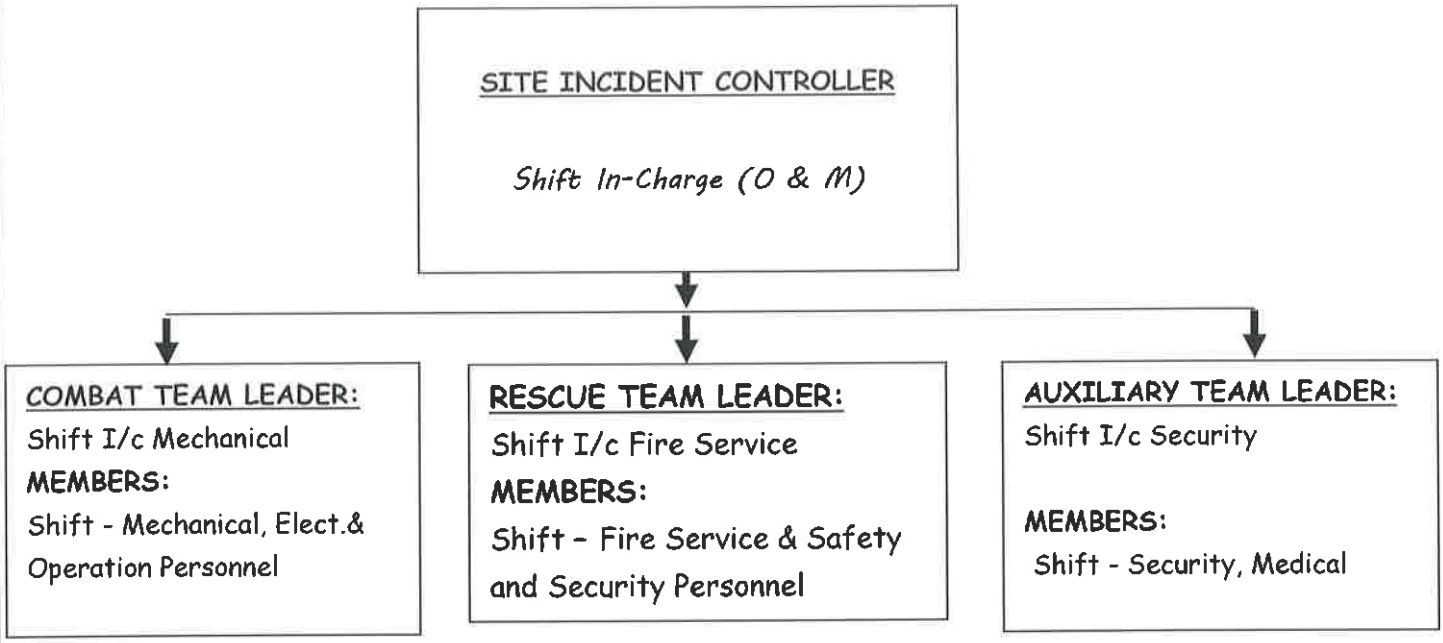
⇒ During the emergency safety coordinator co-ordinates the work between Works Main Controller, Site Incident Controller & Leaders of Combat, Rescue & Auxiliary Teams.

13.0 ACTION PLAN FOR ON-SITE EMERGENCY:

STEP NO.	INITIATOR	ACTION TO TAKE
1.	The person noticing the emergency	➢ Informs the Control Room who in turn will inform Fire, Safety, Ambulance, Incident controller and Works main controller regarding the fire and other emergency.
2	Works Main Controller (WMC)	➢ Rushes to Emergency Site and observes the ongoing activities. ➢ Takes stock of the situation in consultation with the SIC. ➢ Moves to Emergency Control Room. ➢ Takes decision on declaration of emergency and asks for emergency wailing siren. ➢ Decides on declaration of normalcy of emergency after combating the situation. ➢ Ensures that the emergency operations are recorded chronologically.
3	Site Incident Controller (SIC)	➢ Rushes to the emergency scene and takes overall charges of the situation ➢ Starts firefighting operation/ close the valve of the gas cylinder with combat team ➢ Shutdowns the plant ➢ Arranges to evacuate the unwanted persons and calls for additional help. ➢ Time to time to passes information to the Works Main Controller (WMC) about the situation at site.

4	Combat Team leader	➢ Organizes trained personnel, equipped with fire fighting appliances / gas mask and calls for fire tender at the place of fire. ➢ Starts combating, shutdown equipments and takes steps to extinguish fire with fire fighting facilities / stop gas leakage. ➢ Finds out the root cause of fire / gas leak and to takes necessary action for prevention of fire / gas leakage.
5.	Rescue Team leader	➢ Shift the injured persons to hospital by ambulance after providing necessary first aid. ➢ To inform the Auxiliary Team Leader for necessary help from Mutual Aid Partner.
6.	Auxiliary Team leader	➢ Informs about the emergency to Statutory Authorities depending upon the situation. ➢ Seeks help of Mutual Aid Partner and coordinates with Mutual Aid Partner to render their services, if required. ➢ Takes role call to find out the missing persons, if any. ➢ Arranges to inform the relatives of Casualties. ➢ Takes care of visit of the statutory authorities to the Emergency Site.
7.	Team Members	➢ Each of the team members should follow the instructions of concerned team leader to mitigate the emergency.
8.	Safety Co-coordinator	➢ Rushes to the site &coordinate the work between Works Main Controller, Site Incident Controller & Leaders of Combat, Rescue & Auxiliary Teams.

14.0 SILENT HOUR COMMAND STRUCTURE :-



14.1 ROLE OF KEY PERSONS IN SILENT HOUR

The above team leaders and members of the command structure during silent hour shall attend the emergency immediately during silent hour. The duties and responsibilities of the team shall be same as Emergency Command Structure.

The duties and responsibilities will be taken over by the actual Emergency Command Structure Team as they arrive. They shall arrive soon as they stay very near to the plant in the colony. They shall take control of the situation.

⇒ Silent Hour is the time when General Shift people are not available.

⇒ The command structure for the silent hour shall be same as during normal hour, however, during the silent hour the Shift In-charge (O&M) / Security in-charge shall act as Works Main Controller-cum-Site Incidence Controller , till the arrival of the Works Main Controller

⇒ Since during these hours Works Main Controller, Site Incident Controller, Combat Team Leader, Rescue Team Leader and the Auxiliary Team Leader may not be available inside the plant, they shall be informed by the Shift I/c O&M / Security I/c (Works Main Controller during Silent Hour) either by telephone or by sending special messenger to their residences

⇒ On receiving the information the Works Main Controller, Site Incident Controller, Combat Team Leader, Rescue Team Leader, Auxiliary Team

Leader& safety coordinator shall reach the site at the earliest and simultaneously Combat Team Leader, Rescue Team Leader and Auxiliary Team Leader shall ensure the presence of their respective team members.

⇒ Thereafter the action plan as well as the role of key persons shall be same as the normal hour execution of Command Structure.

14.2 WORKS MAIN CONTROLLER/ SITE INCIDENT CONTROLLER (SHIFT-IN-CHARGE – O&M):-

⇒ On being informed, rushes to the Emergency Control Room and takes overall charges of the situation

⇒ Makes quick assessment of the situation and decides declaration of emergency if any required before arrival of WMC/SIC by blowing the siren in appropriate code **[intermittent three times for 30 seconds each with 5 seconds pause/interval in between]**

⇒ Makes continuous review and assesses the possible developments to determine the extent of damage to plant and human beings

⇒ Ensures that casualties are receiving adequate attention

⇒ Liaises with the fire services, police services and other statutory authorities

⇒ Declares closure of the emergency by blowing the siren [**only once long siren for 1 Minute**] but by this time actual WMC/SIC may have arrived. So they will decide.

⇒ Communicates to employees about the mishap, measures taken and gives confidence to employees for avoiding recurrence of the incident by investigation and ordering preventive measures to be implemented

⇒ On hearing Emergency siren, rushes to the scene and reports to the Works Main Controller and SIC.

⇒ Makes quick assess about the gravity of the situation and appraises Works Main Controller

⇒ Extend all sorts of help through different agencies to minimize the damage to human beings, plant, property and environment

⇒ Reports the development of the situation time to time to Works Main Controller

⇒ Provides the required information to the fire brigade team for fire fighting

⇒ Preserves the evidences for the subsequent inquiries

14.3 COMBAT TEAM LEADER (SHIFT-IN-CHARGE – MECHANICAL):-

⇒ On hearing the emergency siren, rushes to the scene with his team with sufficient equipment in the minimum possible time and reports to Site Incident Controller

⇒ Ensures the team members that, they resume their position with appropriate equipment.

⇒ Monitors the combat operation to control the situation

⇒ Ensures that the situation is controlled by arresting, spillage, fighting fire, shutting of the valve and equipment by the team in consultation with Site Incident Controller

COMBAT TEAM MEMBERS:-

⇒ On hearing the emergency siren, rush to the scene with firefighting equipment/gas masks in the minimum possible of time and report to their team leader

⇒ Operate the firefighting equipment/close the valve of the gas cylinder for controlling the situation

14.4 RESCUE TEAM LEADER (SHIFT-IN-CHARGE – FIRE SERVICE) :-

⇒ On hearing the emergency siren, rushes to the scene and reports to the Site Incident Controller

⇒ Ensures the arrival of his team members

⇒ Keeps necessary equipment of first-aid for preliminary treatment

⇒ Keeps the ambulance ready to carry the injure persons to the nearest hospital

⇒ Ensures the use of proper personal protective equipment by his team members & leads the team for rescue operation

⇒ Informs the Works Main Controller for the developments time to time

⇒ Guides the Mutual Aid Partner for their course of action at the site

⇒ Guides the non-essential persons to reach assembly point

⇒ Searches the missing person on the roll call basis

RESCUE TEAM MEMBERS:-

⇒ On hearing the emergency siren, rush to the scene with appropriate personal protective equipment and report to their team leader

14.5 AUXILIARY TEAM LEADER (SHIFT-IN-CHARGE – SECURITY) :-

⇒ On hearing the emergency siren rushes to the scene and reports to the Site Incident Controller

⇒ Intimates statutory authorities over phone

⇒ Intimates nearest Fire Station over phone

⇒ Intimates Mutual-Aid Partner over phone

⇒ Keeps the first-aid and primary health center staff, equipment ready to take care of immediate medical needs

⇒ Takes care of victims' family

⇒ Makes all arrangement like transport, other needs, arrange finance

⇒ Ensures all casualties are shifted to hospital for medical treatment

⇒ Keeps records of casualties and provide information of the matter to Works Main Controller

AUXILIARY TEAM MEMBERS:-

⇒ On hearing emergency siren, rush to the scene and report to the team leader

⇒ Provide immediate first-aid treatment to the victims

⇒ Ensure ambulance vehicle ready

⇒ Coordinate with combat team, rescue team, statutory authorities and mutual-aid partners

14.6 SAFETY CO-ORDINATOR (Unit Controller/Shift – Safety Person):-

⇒ During the emergency safety coordinator co-ordinates the work between Works Main Controller, Site Incident Controller & Leaders of Combat, Rescue & Auxiliary Teams.

15.0 ACTIVATION AND CLOSING PROCEDURE FOR ON-SITE EMERGENCY

⇒ Anybody notices **FIRE**, shout **"FIRE", FIRE", "FIRE"** and informs to Shift-in-charge OR anybody notices "**GAS LEAK**", shout **"GAS LEAK", "GAS LEAK", "GAS LEAK"** and inform to shift in-charge.

⇒ Being informed about fire, the Shift-in-charge informs Works Main Controller and Site Incident Controller.

⇒ On hearing about the fire, Works Main Controller, Site Incident Controller& Safety coordinators rush to the scene and make quick assessment of the situation.

⇒ On quick assessment of the situation, the Works Main Controller rush to the emergency control room and declare emergency by blowing appropriate siren code **[intermittent three times for 30 seconds each with 5 seconds pause/interval in between]**

⇒ On hearing of Emergency siren the key personnel of Emergency Combat structure perform their duties and responsibilities as per the worksheet.

⇒ During the emergency operation, the Works Main Controller keeps records of activities carried on, supervises overall, maintain liaison with mutual aiders, statutory authorities.

⇒ After being controlled (the situation), the Works Main Controller declares normalcy (all clear) by blowing appropriate siren **[only once long siren for 1 Minute]**

PHOTOGRAPHS OF HAZARDOUS CHEMICALS AND INSTALLATIONS

TRAINING AND MOCK DRILL

ANNEXURE - I

Annexure-1

FACILITIES AVAILABLE TO COMBAT

- **FIRE STATION AND CREW:**
- **FIRE TENDERS:** Firefighting and rescue equipment.
- **FIRE EXTINGUISHERS AND BUCKETS:**
- **FIRE HYDRANT NETWORK:** Hydrants, monitors, water spray, sprinklers.
- **FIRE DETECTION AND ALARM SYSTEM:**
- **COMMUNICATION:** Mobile phones, wireless, walkie talkie, PA system.
- **ALARM AND SIREN:**
- **AMBULANCE AND AMBULANCE ROOM:**
- **FIRST AID BOXES AND FIRST AIDERS:**
- **SAFETY:**
- **SECURITY:**
- **TRANSPORT:** Light vehicles, heavy vehicles, cranes, hydra, earth moving equipment, loader, dozer, etc.
- **EMERGENCY CONTROL ROOM:** Fire Station & Service Building
- **PERSONAL PROTECTIVE AND LIFE SAVING EQUIPMENT:**
- **UTILITIES:** Water, air, compressor, oil, fuel, electricity.
- **OTHERS:** Operation, mechanical, electrical, civil, stores, purchase, accounts and liaison departments.

FIRE SERVICE

Reservoir, capacity, pump house, hydrants, monitors, water spray system, pumping system, booster system, foam system, FDA system, portable fire extinguishers, mobile fire tender, etc. are designed by Tata Consulting Engineers Limited, Mumbai as per TAC standards and installed by New Fire Engineers Pvt. Limited, New Delhi.

FIRE WATER RESERVOIR/STORAGE –

Water storage for hydrant system (2 hours operation) = 3 pumps x273 m3/hr x 2 hrs. = 1638 m3
Water storage required for spray system (1 hour operation) = 1 pump x 273 m3/hr x 1 hr. = 273 m3
Total water storage required = 1638+273 = 1911 m3
Water storage provided = 2500 m3

PUMP HOUSE – Fire water reservoir exclusive for fire service.

Type of the Pump	Number of Pumps	Capacity	Head
Jockey Pumps	2	35 m3/hr	88 m
Main Pumps (Electrical)	2	273 m3/hr	88 m
Stand by Pump (Diesel)	2	273 m3/hr	88 m
Main Booster Pump (Electrical)	2	137 m3/hr	50 m
Stand by booster pump (Diesel)	2	137m3/hr	50 m

HYDRANT NETWORK –

Following buildings/areas in the plant are protected by hydrant system.
TG Building & Boilers, ESP/ESP Control Room, Transformer yard & 400 KV switch yard/control room, DM Plant & CW Treatment Plant, Canteen, Fire Station, FOPH/storage & Hydrogen Plant, RWPH, CT MCC Room, Plant Air Compressor Building, Air washer room, Coal storage yard/Stock pile, Construction power switch gear building, Stores, CW & FW PH, Chemical Storage, ETP, CHP, Crusher House & JNTs

Number of hydrants

Outdoor hydrants = 158
Internal hydrants = 58
Double headed hydrants = 20 (10x2=20)
Water monitors = 38 (equivalent 114 hydrants)
Total number of equivalent hydrants = 350

HIGH VELOCITY WATER SPRAY SYSTEM –

Provided for the protection of following equipment (DV system).
Spray system tapped from hydrant system.
250 MVA Generator transformers = 7 nos.
50 MVA Station transformers = 2 nos.
50 MVA Station auxiliary transformers = 2 nos.
50 MVA Unit transformers = 4 nos.
16 MVA Unit aux. transformers = 4 nos.
Clean & dirty oil tank/cooler & pumping unit = 1 no.
Boiler burner fronts = 2 nos.
Generator seal oil skid = 2 nos.
CHP Transformer = 2 nos.
Total = 26 nos.

MEDIUM VELOCITY WATER SPRAY SYSTEM –
Provided for the protection of following area (DV system) –
Spray system tapped from hydrant system.
Cable galleries TG Building, Fuel oil storage tanks, Conveyors CHP to JNT 5 from hydrant pump system, Conveyors from JNT 5 to JNT 1 through Booster pump
Total = 67 nos.

FOAM SYSTEM – Fuel oil storage tanks.
FDA – FDA is provided in the following areas.
TG Building, Cable galleries of TG building and ESP building, ESP MCC/Control Room, Work shop & lab building, DM plant sub-station, Service building, FOPH, CW pump house, MCC/control room, FWPH control/MCC Room, Switch yard control/MCC room, CHP, MCC/control Room, Hydrogen storage MCC/Control room, Conveyors

MEN POWER –
Operation 13 in each shift Total = 48.
Maintenance = 15

FIRE TENDER – 2 Fire Tenders (1 foam tender 4500 L/500 L & 1 water tender 3000 L).
FIRE STAND WITH BUCKETS = 32

LIST OF FIRE FIGHTING AND RESCUE EQUIPMENT

1. Delivery hose and hose reel
2. Branches and nozzles – long, short, universal, diffuser, HCB, fog nozzle, revolving, LPA,
3. Couplings, adaptors and blank caps – male and female.
4. Breechings – collecting, dividing and control dividing.
5. Suction hose and fittings
6. Ropes and lines – long, short, rescue, etc.
7. Small gears – fireman axe, ceiling hook, torch, spades, pick axe, large axe, shovel, crow bar,
8. Fire extinguishers – DCP, foam, CO2,
9. Fire buckets
10. Foam and foam equipment
11. Extension ladder
12. B.A. sets and spare cylinders
13. Gas masks
14. Fire proximity suit
15. Chlorine emergency kit.
16. Gas detectors
17. Other required rescue equipment

SCHEDULE OF EQUIPMENT WITH THE FIRE TENDER

Sl. No.	DELIVERY/Others	Sl. No	SUCTION
1	Control Dividing Breeching –2 nos.	1	Suction hose – 10 m.
2	Long Branch – 4 nos.	2	Suction wrench – 2 pairs.
3	Hand Control Branch (London) - 2 nos.	3	Strainer (foot valve)– 2 no.
4	Diffuser - 2 nos.	4	Collecting Head(2 way)- 1 no.
5	Universal – 2 nos.	5	Adaptor Male – 1 no.
6	Fast action nozzle – 2 nos.	6	Adaptor Female – 1 no.
7	Aquajet multi purpose nozzle – 2 nos.	7	Basket Strainer – 1 no.
8	Superfire nozzle – 2 nos.		Rescue/accessories items
9	Challenger nozzle – 2 nos.	1	Fireman helmet – 6 nos.
9	No Shock Nozzle – 2 nos.	2	Boots – 6 pairs.
10	Elcot Nozzle – 2 nos.	3	Fireman axe – 6
11	Elcot Nozzle – 2 nos.	4	Belt and pouch - 6
12	Adaptor Male – 2 nos.	5	Nomex hand gloves – 6 pairs
13	Adaptor Female – 2 nos.	6	Nomex hood - 6
14	FB 5X with pick up tube – 2 Nos.	7	PVC Suits with gloves & gum boot – 04 Sets (in box or trunk) for acid/chemical handling.
15	Emergency light (rechargeable) – 2 nos. (High quality).	8	Long Line 50 mm, 30 m – IS-1084 - 3 nos.
16	Torch (05 Cells) – 3 nos. (High quality).	9	Short Line 50 mm, 15 m – IS-1084 - 3 nos.
17	Branch pipe, nozzle with pressure gauge to measure pressure in hydrant line – 2 nos.		

FIRE EXTINGUISHERS INSTALLED IN THE PLANT

Sl.No.	TYPE	CAPACITY	QUANTITY
1	MECH. FOAM TYPE	9 L	47
		50 L	14
		2 KG	11
2	DCP/ABC TYPE	6 KG	143
		9 KG	178
		75 KG	14
		2 KG	5
3	CARBON DIOXIDE TYPE	4.5 KG	114
		6.8 KG	41
		22.5 KG	3
TOTAL			570

FIRE EXTINGUISHERS DISTRIBUTION/INSTALLATION IN BOILER – 1 AS PER TAC ONE EXAMPLE

Sl. No.	Unit/section /Location	CO2 4.5kg	CO2 6.8 kg	CO2 22.5 kg	DCP 2/2.5 kg	DCP 5/6 kg	DCP 10 kg	Foam 9L	Remark
1.	Boiler-1 0 m	2					6		
2.	Boiler-1 9.35 m	2					6		
3.	Boiler-1 22 m	2					6		
4.	Boiler-1 34.3 m	2					6		
5.	Boiler-1 46.3 m	2					6		
6.	Boiler-1 59.55 m	2					6		
7.	Boiler-1 72.95 m	2					6		
8.	Boiler-1 76.25 m	2					6		
9.	Boiler-1 79.13 m	2					6		

❖ FACILITIES AVAILABLE IN EMERGENCY CONTROL ROOM

⇒ Department-wise mobile phone and P&T telephone numbers are provided

⇒ Switch for actuating the siren is located in the Control Room.

⇒ Details of telephone numbers of key personnel of emergency command structure, statutory authorities and mutual aiders

⇒ Worksheet of key personnel of emergency command structure

⇒ List of emergency telephone numbers (external and internal)

⇒ Local P & T telephone directories

⇒ List of people working in the installation, location wise

⇒ List of residential addresses of employees / contract workers and casual workers

⇒ Plot Plan

⇒ MSDS of chlorine, HFO, LDO, Diesel, Hydrogen, Transformer Oil& Diesel.

⇒ Factory Lay-out Plan & Emergency Lay-out Plan.

❖ COMMUNICATING THE EMERGENCY AND MEDICAL AID:

For communicating the declaration of emergency and evacuation decision to the plant personnel, it is envisaged that the siren would be utilized.

Declaration of emergency : Intermittent three times 45 secs to 1 minute each Interval

Normal factory siren : Continuous for 30 secs.

All-clear signal : Continuous for 1 min.

❖ AMBULANCE ROOM :

⇒ Ambulance room: Yes

⇒ No. of Ambulance provided: 02No

⇒ Doctor: 2 (On call round the clock)

⇒ No. of Pharmacist: 04

⇒ No of Staff Nurse: 02

NTPC HOSPITAL is situated around 10 Kms. From the plant.

Facility available is given in the **Annexure –XI**

❖ **FIRST AID BOXES:**

Company has provided 2 nos. of First Aid boxes with required first aid medicines and dressing materials as per statute at different locations inside the plant. Each first-aid box is kept in charge of a trained first aider in shift wise. First aid boxes are being checked once in a month and medicines are replaced. The locations are mentioned below:

Sl. No	Location	No of First aid Boxes
1	DM Plant	01
2	CCR # 1	01
3	CCR # 2	02
4	Switch Yard Control Room	01
5	Admin Building	01
6	ESP – 1 Control Room	01
7	ESP – 2 Control Room	01
8	Canteen cum rest room no. 1	01
9	Stores	01
10	Boiler Control Room	01
11	CHP Control Room	01
12	AHP Control Room	01
13	Gate- 1 (Main gate)	01
14	Gate – 2 (Material Gate)	01
15	Gate – 3 (Ash Pond Gate)	01
16	FOPH	01
17	RWPH	01
18	Weigh Bridge	01
19	Fire Station	01
20	Service Building	01
	Total	**20**

❖ **PPEs(Personal Protective Equipment's): (Inventory)**

1. No. of Safety Helmets :100no's
2. No. of Safety shoes :50 no's
3. No. of nose mask :500no's
4. No. of Safety Goggles : 50no's
5. No. of Hand Gloves : 50 Pairs.
6. Gumboots :20 pairs

Other PPE and lifesaving equipment and installation available:

Wind socks, safety showers, SCBA , Fire resistant suit, Acid handling suit, Boiler suit, Arc flash suit, heat/flame resistant suit, Fire proximity suit, chemical handling suit, gas mask (chlorine), gas detectors (hydrogen/LEL, chlorine, oxygen).

Provisions for fighting chlorine – Gas masks, emergency kit, BA sets, extract/absorption and scrubber system, universal hood, neutralization pit (Photographs attached).

Provisions for fighting hydrogen – Fire detection and alarm system, total flooding system (fixed firefighting installation).

Communication system

- No of Mobile Telephone Numbers: -310
- No of P & T Telephones: - 6
- No. of Mobile wireless: - 25 (walkie-talkies)
- No. of Red & Green Flags: -10
- Public Address System:- 02 nos.
- Fire Siren System: - 02 no.
- Online chlorine gas detector: 2
- Online hydrogen gas detector - 2
- Online fire sensor & Alarm system: FDA

Assembly points –

1. In front of Gate No. 1 near medical, 2. In front of Gate – 2 near BHEL office.

3. CHP yard opposite to stacker & reclaimer, 4. Yard near HSD outlet/Coal yard.

Exits/Gates:

1. Gate No. 1 – New Gate,
2. Gate No. 2 – Old Gate
3. Gate No. 3 – Ash Pond Gate

ANNEXURE - II

MUTUAL AID – UNDER PROCESS

Sl. No.	NAME & ADDRESS OF MUTUAL AIDDER	DISTANCE IN KM	FACILITIES TO BE PROVIDED DURING EMERGENCY	CONTACT PERSON & TEL.NO
1	NTPC, At/Po -Kaniha Dist-Angul	10	Fire Tender, Ambulance, Fire Extinguishers, Medical Aid, SCBA, Gas Mask & Fire Proximity Suit.	NAME 06760-243252

CONTACT NOS. OF NEAREST FIRE STATION

SL.NO	FIRE STATION NAME & LOCATION/ADDRESS	CONTACT NO	DISTANCE FROM THE SITE IN KM.
01	Fire Station, Kaniha	9438562445	10 Km
02	District Fire Station, Angul	06764-230322	62 Km

CONTACT NOS. OF AMBULANCE SERVICES

SL.NO	AMBULANCE AGENCY NAME	CONTACT NOS.
01	JITPL	9583040666, 9583040777

JINDAL INDIA THERMAL POWER LIMITED
VILL/P.O : DERANG, TEH. : KANIHA, DIST. : ANGUL, ODISHA, PIN-759117
Phone : +91 9583040700/701/702/703

Letter No. – F&S/1/2017
Dated – 05.07.17

To
The Executive Director, TSTPS, NTPC, Kaniha, Angul.

Sub. : Mutual Aid agreement.

Ref: Schedule – IX, Rule – 12 of the Orissa (Control of Major Accident Hazard) Rules, 2001.

Sir,

Ours and yours both are Power Generation Plant involving different kinds of hazards. We both have facilities and measures to tackle any eventuality arising out of any kind of emergency situations like fire, explosion, toxic release, structure collapse, etc.

In some grave situation we may require each other's help in mitigating the situation. So to help each other in any emergency we may have a plan in the form of an agreement i.e. mutual aid. It is also required as per Rule mentioned above.

So we request you to have a Mutual-Aid agreement for the said purpose. If you have consent we may go ahead with a meeting and planning involving Asst. Director of Factories & Boilers, Angul.

Anticipating a positive reply we remain.

Thanking you.
Yours faithfully,
For Jindal India Thermal Power Limited.

(B.K.Pandey)
Plant Head
&
Manager

NEAREST EMERGENCY SERVICES (FIRE SERVICE & HOSPITAL)

SL. NO	NAME & ADDRESS	TELEPHONE/CONTACT NO	DISTANCE
1	NTPC - TSTPS, Kaniha.	Fire Service – 06760 - 247777 Safety – M-9437299776	13 km
2	Odisha Fire Service, Kaniha.	06760 - 244200	10 km
3	NTPC - TTPS, Talcher.	06760 - 246293	40 km
4	Odisha Fire Service, Talcher.	06760 - 240222	40 km
5	JSPL, Nisha, Angul.	M – 9777443380 (Fire) M – 9777443463 (Safety)	32 km
6	Odisha Fire Service, Angul.	06764 - 230222	52 Km
7	Bhushan Steel Limited, Meramandali.	M – 7077760107 (F&S) M – 7077759011 (HR)	55 km
8	Kaniha, Hospital.	067651 - 243282	10 km
9	NTPC, Hospital.	06760 - 243252	12 km
10	District Hospital, Angul.	06764 – 232507/236507	55 km

ANNEXURE - III

TELEPHONE NUMBERS OF KEY PERSONNEL

INTERNAL

Sl. No.	NAME & DESIGNATION	DESIGNATION AS PER EMERGENCY COMMAND STRUCTURE	TELEPHONE/ CELL NUMBER
1	B.K.Pandey Plant Head	Works Main Controller	9583040002
2	S.K.Samanta VP - Operation	Works Main Controller (Alt)	9583040150
3	Amod Khare GM - BMD	Site Incident Controller	9583040175
4	S.K.Nath AVP - TMDI	Site Incident Controller(Alt)	9583040388
5	Pawan Kumar DGM - BOP	Combat Team Leader	9583040091
6	A.K.Gupta GM - Electrical	Combat Team Leader(Alt)	9583040496
7	P.Kar Sr. GM – Fire & Safety	Rescue Team Leader	9583040670
8	G.P.S.Dhaliwal DGM - Security	Rescue Team Leader (Alt)	9583040540
9	Urmesh Garg AVP - Planning	Auxiliary Team Leader	9583040174
10	S.K.Pandey DGM – HR & IR	Auxiliary Team Leader(Alt)	9583040179
11	B.Dwivedi AVP - Commercial	Safety Coordinator	9583040007
12	B.C.Mohapatra Manager - Safety	Safety Coordinator (Alt.)	9583040931

ANNEXURE - IV

TELEPHONE NUMBERS OF STATUTORY AUTHORITY

SL.NO	DESIGNATION/POSITION	LOCATION/ADDRESS	CONTACT NO
1	Collector & District Magistrate	Office of the District Collector Angul	06764-230567, 230234
2	Addl. District Magistrate	Office of the Addl. District Magistrate Angul	06764-230491, 236052
3	Sub Collector	Office of the Sub Collector Angul	06764-230302
4	Superintendent of Police	Office of the Superintendent of Police, Angul	06764-230316, 220616
5	Chief District Medical Officer	District Hospital, Angul	06764-232507
6	District Fire Officer	District Fire Office, Angul	06764-230322
7	In charge Police Out post	JITPL, DERANG	9583040614
8	In charge Police Station, Kaniha	Kaniha, Angul	067651-243237
9	Director of Factories & Boilers, Odisha	Office of the Director of Factories & Boilers, Kharvel Nagar, Unit – III, BBSR	0674-2396070 0674-2392228
10	Dy. Director of Factories & Boiler (Safety)	Office of the Director of Factories & Boilers, Kharvel Nagar, Unit – III, BBSR	0674-2393786
11	Dy. Director of Factories & Boilers, Angul Division	Office of the Dy. Director of Factories & Boilers, Nalco Nagar, Angul	06764-220164
12	Asst. Director of Factories & Boilers, Angul, Zone-II	Office of the Asst. Director of Factories & Boilers, Angul	9437686256
13	District Labour Officer	District Labour Officer, Angul	06764-231125, 236337
14	Regional Officer, OPCB, Angul	Regional Office, State Pollution Control Board, Angul	06764 - 236389
15	District Emergency Officer	Collectorate, Angul	06764 – 230980/ 234218/9439856531
16	Dy. Chief Controller of Explosives	PESO, BJB Nagar, Bhubaneswar	

ANNEXURE - V

3.0 BASELINE ENVIRONMENTAL STATUS

3.1 Introduction

A regional background to the baseline data is being presented at the very outset, which will help in better appreciation of micro-level field data generated on several environmental and ecological attributes of the study. The physical environment consisting of geology, hydrogeology and water resources form the first section of this baseline chapter. The second part contains micro-meteorology, ambient air quality, water quality, soil quality and noise levels and field investigations of aquatic and terrestrial ecology in the study area generated from 1st December 2007 to 29th February 2008 representing winter season. The third section is on land use pattern and socio-economic profile of the project site.

3.2 General Geology

3.2.1 General Geologic Setting:

The general geological setting is presented in **Table-3.2.1.**

TABLE-3.2.1
GENERAL GEOLOGICAL SETTING

The Gangpur Series	
Iron-Ore Series	Phyllites, slates and lavas Raghunathpali conglomerates
----------Shear Zone----------	
Gangpur Series--------	Phyllites and mica –Schists Upper carbonaceous Phyllites Calcitic marbles Dolomite marbles Mica-schists and Phyllites Lower carbonaceous quarzites and Phyllites Gondites with associated Phyllites (base not seen)

Gondwana	Talchir Talchir – Tillite

There is a general increase in the grade of metamorphism when the rocks are followed from the Singhbum border on the east to the centre of the anticlinorium on the west. It should, however, be noted that some of the rocks, which have phyllitic appearance and characters, are really products of retrogressive metamorphism, containing relics of garnet, staurolite, biotite, etc. the satpura strike (ENE – WSW) is found to be superimposed on an earlier, presumably eastern ghats, strike which is prominent.

The oldest rocks are gondites, found in the central or axial region of the anticlinorium. They contain, besides quartz – spessartite rocks, also those with rhodonite, blanfordite, winchite, etc., associated with workable bodies of manganese – ore. They are succeeded by carbonaceous quartzites and phyllites,

dolomitic and calcitic marbles and carbonaceous phyllites, these being intercalated with phyllites and mica – schists. The carbonaceous phyllites are flaggy or slaty in certain places while the marbles contain very large reserves of good limestone and dolomite which are now being used as fluxes in the iron smelting furnaces of Bengal and Bihar. Large quantities of the limestone are also burnt into quick – lime, well known in the Calcutta market as Bisra lime, named after Bisra which is a railway station near the Singhbum – Gangpur border. At the top of the succession is a shear zone in which the Raghunathapali conglomerate is involved. It is a sedimentary conglomerate which has suffered intense shearing as a result of which an autoclastic character has been imposed on it. The overlaying beds are phyllites and mica – schists belonging to some part of the Iron –ore series. The Gangpur series is intruded by basic sills (Dalma Traps) and by bosses of the chota Nagpur granite. The basic rocks have been converted into schistose amphibolites and epidiorites containing amphibole, clinozoisite, ilminite and magnetite.

3.2.2 Geology of Study Area

3.2.2.1Talchir Series

Tillite: - The lowest series of this group is named after the coal field and the former state of Talcher (Talchir) in Orissa, where it was first studied. Its lowest member is a Tillite or boulder – bed, which is succeeded by shales and sand stones. This boulder bed forms a conspicuous and characteristic datum line in the geology of the peninsula, and is in general 15 to 60 m thick.

Shales and Sandstones:- The talchir boulder – bed is overlain by shales and these in turn by sandstones, the total thickness of these being 150 to 200 m. the shales are greenish in colour and usually breakup into thin pencil – like or prismatic fragments, for which reason they are often called 'needle – shales'.

Distribution: - The Talchir beds are found in most of the Lower Gondwana areas of the peninsula in the faulted troughs, and also some times as outliers on the gneisses of the neighboring regions. It is thought that the deposition of a series of moraines in the early talchir age was responsible for the formation of a number of more or less connected lakes and swamps which are received the sediments of the succeeding (Damuda) age.

3.3 Meteorology

The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information regarding proposed plant area and surrounding area for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-Monsoon season : March to May
- Monsoon season : June to September
- Post-Monsoon season : October to November

3.3.1 Methodology

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (IS : 8829) and India Meteorological Department (IMD). On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected every hour continuously from 1st December 2007 to 29th February 2008 representing winter season.

3.3.1.1 Methodology of Data Generation

The Central Monitoring Station (CMS) equipped with continuous monitoring equipment was installed on top of a Residential building near by project site, Dereng village at a height of 7.0 m above ground level to record wind speed, direction, relative humidity and temperature. The meteorological monitoring station was located in such a way that it is free from any obstructions and as per the guidelines specified under IS: 8829. Cloud cover was recorded by visual observation. Rainfall was monitored by rain gauge.

The continuous recording meteorological instrument of Dynalab, Pune (Model No.WDL1002) has been used for recording the met data. The sensitivity of the equipment is given in **Table-3.3.1.**

TABLE-3.3.1
SENSITIVITY OF METEOROLOGY MONITORING EQUIPMENT

Sr. No.	Sensor	Sensitivity
1	Wind Speed Sensor	± 0.01 m/s
2	Wind Direction Sensor	± 3 degrees
3	Temperature Sensor	± 0.1°C

3.3.1.2 Sources of Information

Secondary information on meteorological conditions has been collected from the nearest IMD station at Angul. The available meteorological data of IMD, Angul station has been collected for the period 1984 – 2000 and analyzed.

IMD data from Angul has been collected for pressure, temperature, relative humidity, rainfall, evaporation, wind speed and direction. The data at IMD is usually measured twice a day viz., at 0830 and 1730 hr.

3.3.2 Presentation of Data

3.3.2.1Meteorological Data Recorded at IMD, Angul

The data collected from IMD includes wind speed, wind direction (recorded in sixteen directions), temperature, relative humidity, atmospheric pressure; rainfall and cloud cover over a period of 10 years from the year 1984 to 2000. The monthly maximum, minimum and average values are collected for all the parameters except wind speed and direction. All these parameters are recorded twice a day viz at 0830 and 1730 hours. The collected data is tabulated in **Table-3.3.2.**

3.3.2.2 Meteorological Data Generated at Site

The meteorological parameters have been recorded on hourly basis during the study period from 1st December 2007 to 29th February 2008 and the parameters recorded at site includes wind speed, wind direction (from 0 to 360 degrees), temperature, relative humidity, atmospheric pressure, rainfall and cloud cover.

3.3.3 Synthesis of Data on Climatic Conditions

3.3.3.1Analysis of the Data Recorded at IMD - Angul

1] Temperature

The winter season starts from December and continues till the end of February. December is the coolest month with the mean daily maximum temperature at 29.0^{0}C and the mean daily minimum temperature at 14.7^{0}C. Both the night and day temperatures increase rapidly during the onset of the pre-monsoon season from March to May. During pre-monsoon season, the mean maximum temperature (May) was observed to be 40.9^{0}C with the mean minimum temperature at 20.2^{0}C. The mean maximum temperature in the monsoon season was observed to be 35.6^{0}C in the month of June whereas the mean minimum temperature was observed to be 24.2^{0}C in the month of August and September. By the end of August, the day temperatures increase slightly, with the mean maximum temperature at 33.3^{0}C in the month of October and the night temperature decreases with the mean minimum temperature at 19.2^{0}C in the month of November. The monthly variations of temperature are presented in **Table-3.3.2.**

2] Relative Humidity

The air is generally humid in this region during the monsoon season when the relative humidity at 0830 hr was observed with a maximum of 83% and a minimum of 74%. Similarly, at 1730 hr, the relative humidity was observed with a maximum 79% and minimum of 65%. Generally, the weather during other seasons was observed to be dry. The monthly variations in the relative humidity are presented in **Table-3.3.2.**

TABLE-3.3.2
CLIMATOLOGICAL DATA
STATION: IMD, ANGUL

Month	Atmospheric Pressure (mb)		Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Mean Max	Mean Min	0830	1730	
January	1001.1	997.6	29.5	16.9	79	57	7.2
February	999.1	995.8	31.1	14.7	74	53	156.0
March	996.7	993.2	37.1	20.2	68	38	32.1
April	993.4	989.0	38.9	24.9	70	48	59.0
May	989.4	985.9	40.9	26.2	66	47	73.9
June	986.0	982.7	35.6	25.3	74	65	205.5
July	986.3	982.7	32.1	24.3	82	76	255.9
August	987.1	984.4	32.0	24.2	83	79	335.8
September	991.4	987.9	32.7	24.2	82	77	203.8

Month	Atmospheric Pressure (mb)		Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Mean Max	Mean Min	0830	1730	
October	995.9	991.9	33.3	22.7	79	70	89.8
November	996.1	993.8	31.5	19.2	80	65	24.5
December	1001.9	997.3	29.0	14.7	75	58	7.3

3] Atmospheric Pressure

The maximum pressure observed were 1001.9 mb at 0830 hr and 997.6 mb at 1730 hr, with the maximum pressure occurring during the winter season, in the month of December. The minimum pressure observed were 986.0 mb at 0830 and 982.7 mb at 1730, with the minimum pressure occurring during the month of June and July in the monsoon season. It can be seen from the data that not much variations are observed in the average atmospheric pressure levels. The pressure levels are found to be fairly consistent over the region. The monthly variations in the pressure levels are presented in **Table-3.3.2.**

4] Rainfall

The average annual rainfall based on the 10 year IMD data, was observed to be 1450.8 mm. The monsoon sets in the month of June and continues till September and sometime extends up to mid October. The maximum amount of rainfall (335.8 mm) occurs in the month of August. The maximum number of rainy days was observed in the month of July and August. Monthly variations in the rainfall are given in **Table-3.3.2.**

5] Cloud Cover

During the winter and the pre-monsoon seasons, it was observed that the skies were generally very clear. In the post-monsoon season, generally light clouds were observed in the evenings, with clear mornings. During the monsoon season, both in the mornings and evenings, the skies were found to be generally clouded.

6] Wind Speed/Direction

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours, while during the afternoon hours the winds were stronger. The seasonal wind roses are presented in **Figure-3.3.1 to Figure-3.3.5.**

TABLE- 3.3.3
SUMMARY OF WIND PATTERN – IMD ANGUL

Season	First Predominant Winds		Second Predominant Winds		Calm Condition in %	
	0830	1730	0830	1730	0830	1730
Winter	W (17.5%)	E (12.7%)	NW (15.2%)	W (11.4%)	(39.7%)	(45.7%)
Pre-Monsoon	E (14.3%)	W (22.3%)	W (10.5%)	S (15.0%)	(54.8%)	(25.7%)
Monsoon	W (22.1%)	W (24.3%)	NW (9.9%)	E (11.2%)	(48.0%)	(31.5%)
Post Monsoon	W (18.5%)	E (10.7%)	NW (12.0%)	W (10.3%)	(51.5%)	(60.0%)
Annual	W (17.4%)	W (18.1%)	NW (10.1%)	E (12.5%)	(48.2%)	(38.3%)

3.3.3.2 Observations on Primary Data

The site specific data is presented in **Table-3.3.4** and discussed below:

TABLE-3.3.4
SUMMARY OF THE METEOROLOGICAL DATA MONITORED AT SITE

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Cloud Cover (Oktas)	
	Max	Min	Max	Min		Min	Max
December 2007	28.8	14.5	77	68	7.2	2/8	6/8
January 2008	29.4	16.8	78	56	7.1	0/8	3/8
February 2008	30.8	14.8	73	52	148.0	3/8	5/8

1] Temperature

Maximum temperature of 30.8°C and minimum temperature of 14.5°C was recorded during the study period. Maximum temperature was observed during February and the minimum temperature was observed during December of the study period.

2] Relative Humidity

During the period of observation, the Relative Humidity recorded ranged from 52% to 78%. Maximum humidity was observed during the month of January.

3] Rainfall

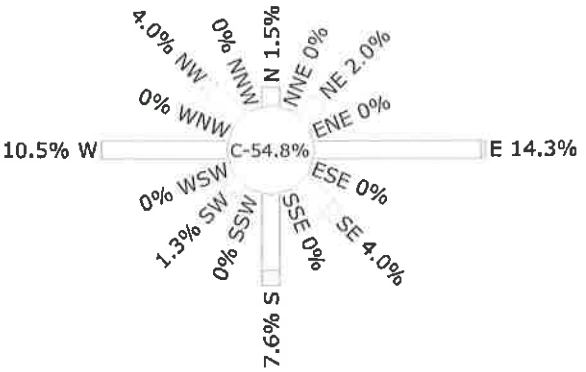
A total of 142.3 mm of rainfall was observed during the study period.

4] Cloud Cover

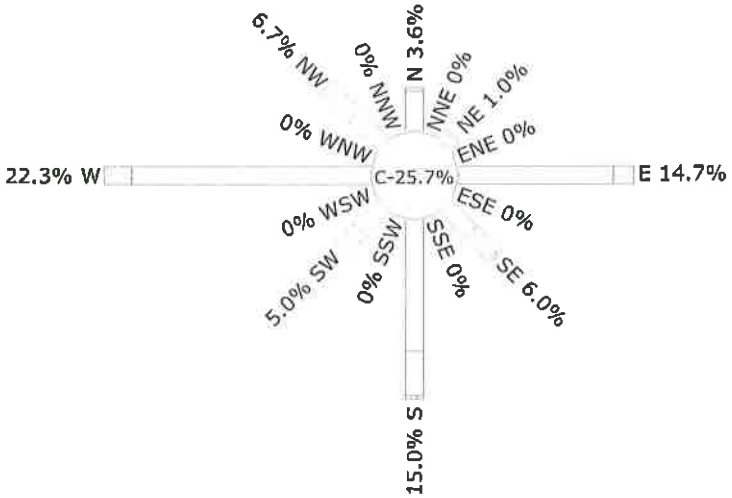
The clear skies were observed mostly during the study period except during rainy days.

5] Wind Speed/Direction

The wind roses for the study period representing winter season is shown in **Figure-3.3.6.** A review of the wind rose diagram shows that predominant winds are mostly from WNW (9.7%) followed by W (9.1%) and NW (8.6%) direction. Calm condition prevailed for 31.8 % of the total time.



08-30hrs
PRE MONSOON



17-30hrs
PRE MONSOON

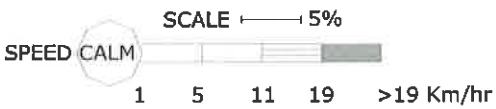


FIGURE-3.3.1
WIND ROSE-PRE-MONSOON (IMD- ANGUL)

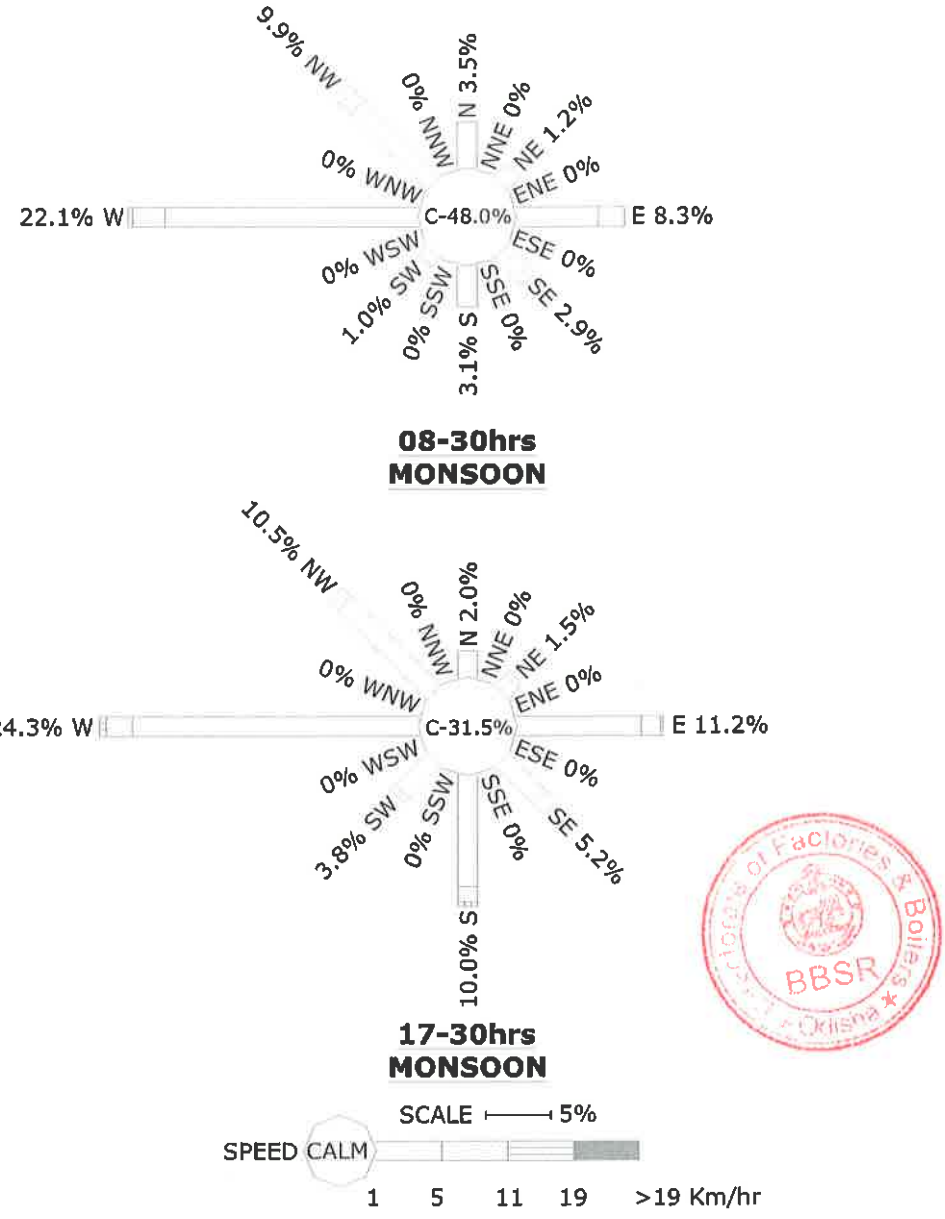
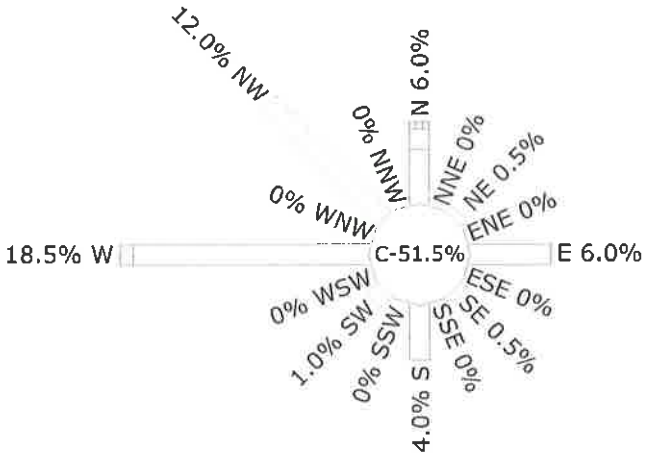
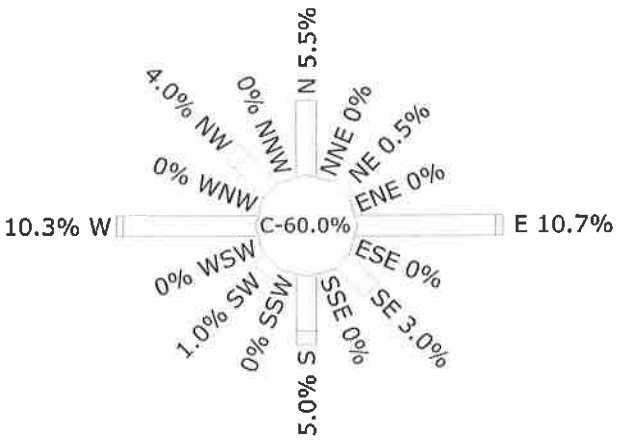


FIGURE-3.3.2
WIND ROSE-MONSOON (IMD- ANGUL)



08-30hrs
POST MONSOON



17-30hrs
POST MONSOON

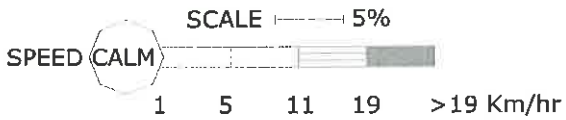
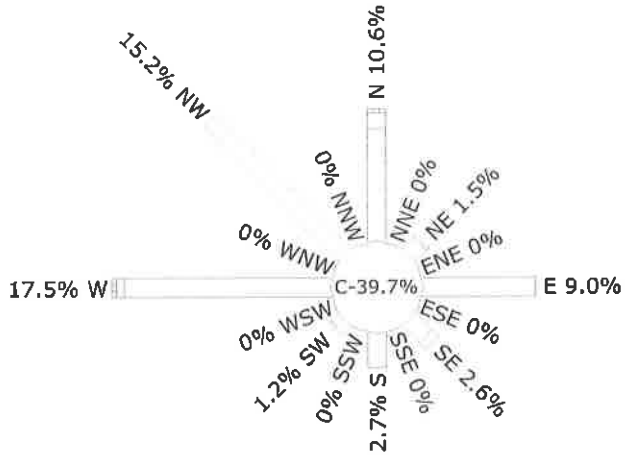
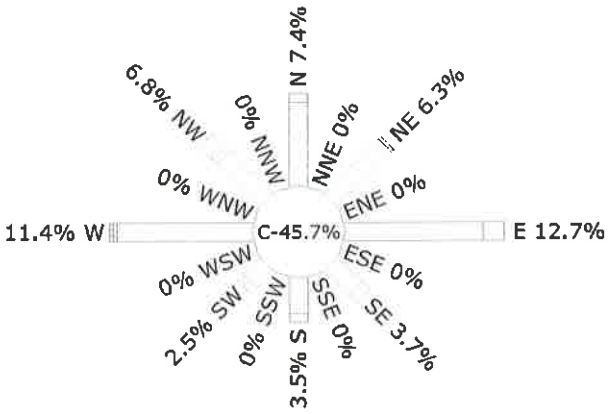


FIGURE-3.3.3
WIND ROSE-POST-MONSOON (IMD- ANGUL)



08-30hrs
WINTER



17-30hrs
WINTER

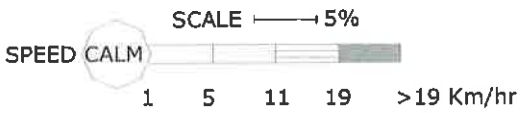
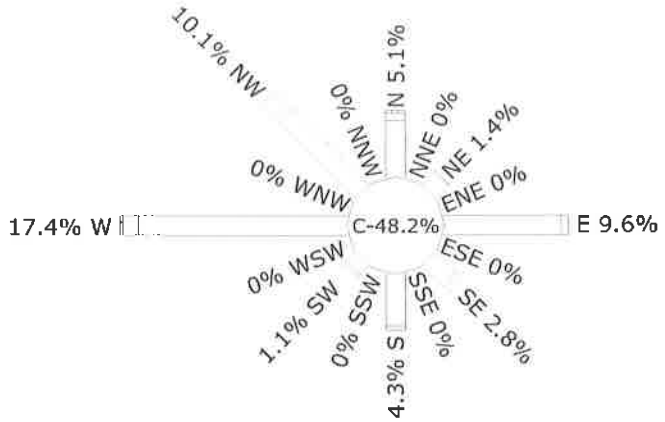
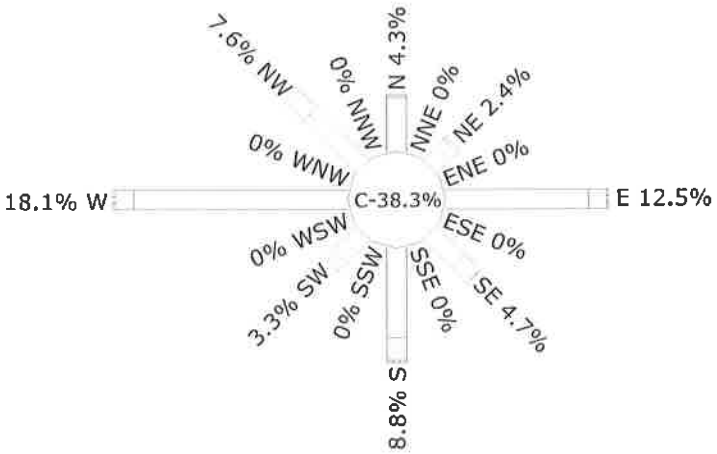


FIGURE-3.3.4
WIND ROSE-WINTER (IMD- ANGUL)



08-30hrs
ANNUAL



17-30hrs
ANNUAL

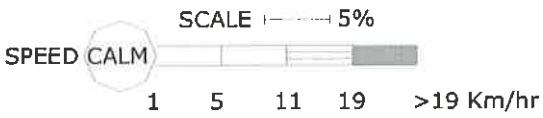


FIGURE-3.3.5
WIND ROSE-ANNUAL (IMD- ANGUL)

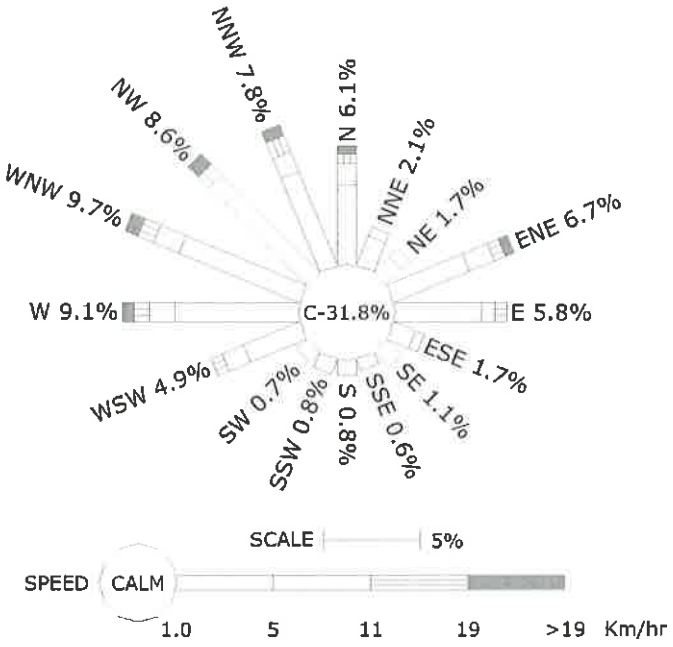


FIGURE-3.3.6
SITE SPECIFIC WINDROSE (WINTER SEASON, 2007-08)

3.3.3.3 Comments

The India Meteorological Department (IMD) records the data at two times a day viz. 0830 hr and 1730 hr while the site specific data has been recorded at an hourly interval. On comparison of site specific data generated for study period vis-à-vis the IMD data, slight variations were found. The following observations are brought out:

- The temperature recorded on site when compared vis-à-vis the IMD data, slight variations was found. The maximum and minimum temperatures recorded at site during study period were 30.8 °C and 14.5 °C, whereas the maximum and minimum temperature recorded at IMD, Angul for the same season are 40.2°C and 20.2°C respectively;

- The relative humidity was observed to range from 52% to 78% during the study period whereas according to IMD Angul data the relative humidity was observed to range from 38% to 83%. The variation could be because of the fact that the RH values considered for the site are actual values while the range of IMD, Angul data represents the average values for 10 year period.

The data generated at continuous monitoring station at project site when compared with the data recorded at IMD, it can be observed that the data generated at the site is broadly compatible with regional meteorology, except minor variations as descried above.

3.4 Air Quality

The ambient air quality with respect to the study zone of 10-km radius around the proposed plant site forms the baseline information. The various sources of air pollution in the region are industrial, traffic, urban and rural activities. This will also be useful for assessing the conformity to standards of the ambient air quality during the plant operation. The study area represents mostly rural environment.

This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. The monitoring has been carried out during 1st December 2007 to 29th February 2008 representing winter season.

3.4.1 Methodology Adopted for Air Quality Survey

3.4.1.1 Selection of Sampling Locations

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance programme has been based on the following considerations:

- Meteorological conditions on synoptic basis;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

ANNEXURE - VI

INPUT DATA: FOR SUMMER SEASON IN DAY TIME: LDO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 1 No
2. Capacity	: 500 Kl
3. Diameter	: 9.0 m
4. Length/Height	: 9.0 m

METEROLOGICAL DATA

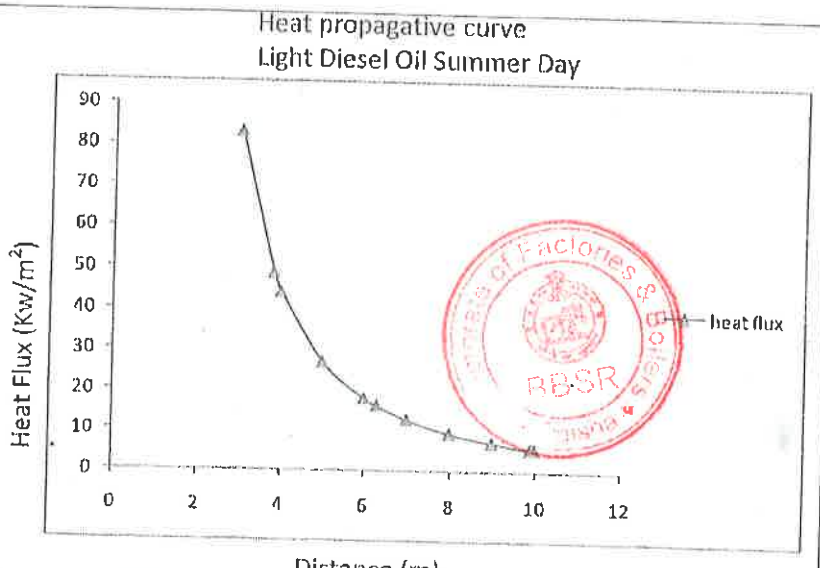
	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR SUMMER IN DAY TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DISEL OIL - Summer- Day	
DISTANCE(M)	HEAT FLUX (KW/M²)
3	82.81
4	48.75
5	44.135
5.21	37.5
6	18.031
7	16.25
7.32	12.5
8	9.49
9	7.293
10	5.85
10.54	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	10.54 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.32 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	5.21 m	Sufficient to cause damage to the equipment

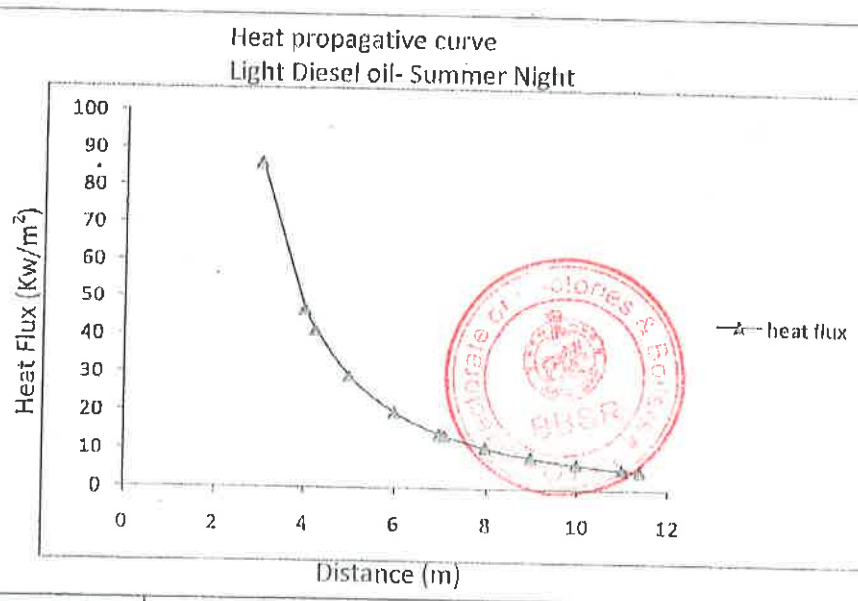
INPUT DATA: FOR SUMMER SEASON IN NIGHT TIME: LDO STORAGE TANK

STORAGE DETAILS								
1. No. of Tanks	: 1 No							
2. Capacity	: 500 Kl							
3. Diameter	: 9.0 m							
4. Lenth/Height	: 9.0 m							
METEROLOGICAL DATA								
	SUMMER		RAINY		WINTER			
	Day	Night	Day	Night	Day	Night		
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4		
b. Average Wind Direction (from)	W		W		WNW			
c. Humidity	77	56	81	73	64	41		
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12		
FIRE CHARACTERISTIC DATA								
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)						
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})						
K_m	=	Extinction co-efficient for fuel (m^{-1})						
m"	=	Mass Burning rate of fuel (kg/m^2)						
U_{10}	=	Wind speed at a height of 10 mtr(m/s)						
U_R	=	Unobscured ratio of upper flame zone						

OUTPUT DATA FOR SUMMER IN NIGHT TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DIESEL OIL - Summer- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	86.031
4	46.695
5	41.25
5.64	37.5
6	19.646
7	14.124
7.82	12.5
8	10.593
9	8.217
10	6.545
11	5.324
11.88	4.95



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	11.88 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.82 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	5.64 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN DAY TIME: LDO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 1 No
2. Capacity	: 500 Kl
3. Diameter	: 9.0 m
4. Lenth/Height	: 9.0 m

METEROLOGICAL DATA

	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

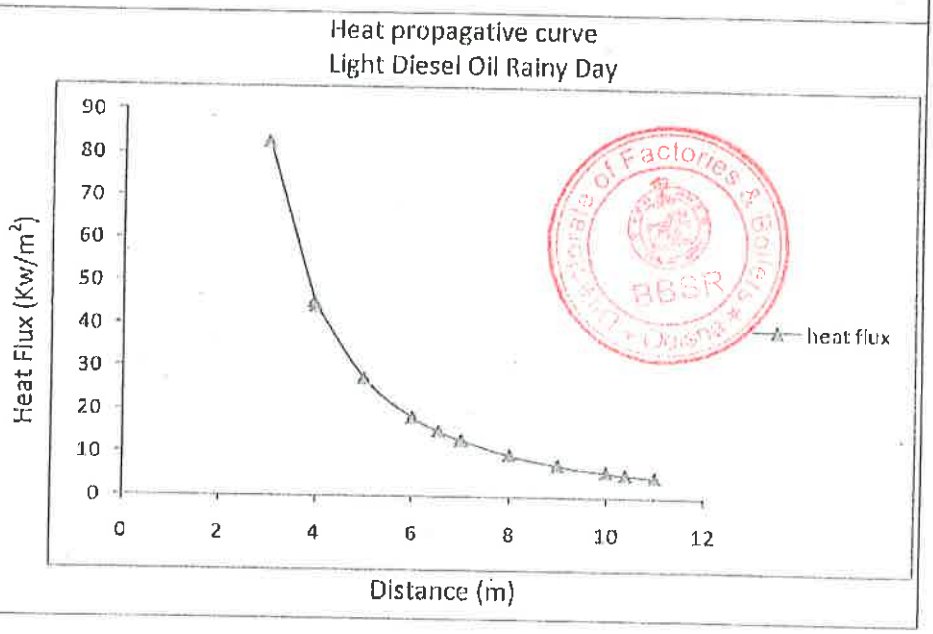
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR RAINY IN DAY TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DIESEL OIL - Rainy- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.38
4	45
4.6	37.5
5	27.096
6	18.156
7	15.34
7.46	12.5
8	9.624
9	7.404
10	5.856
11	5.4
11.95	4.5



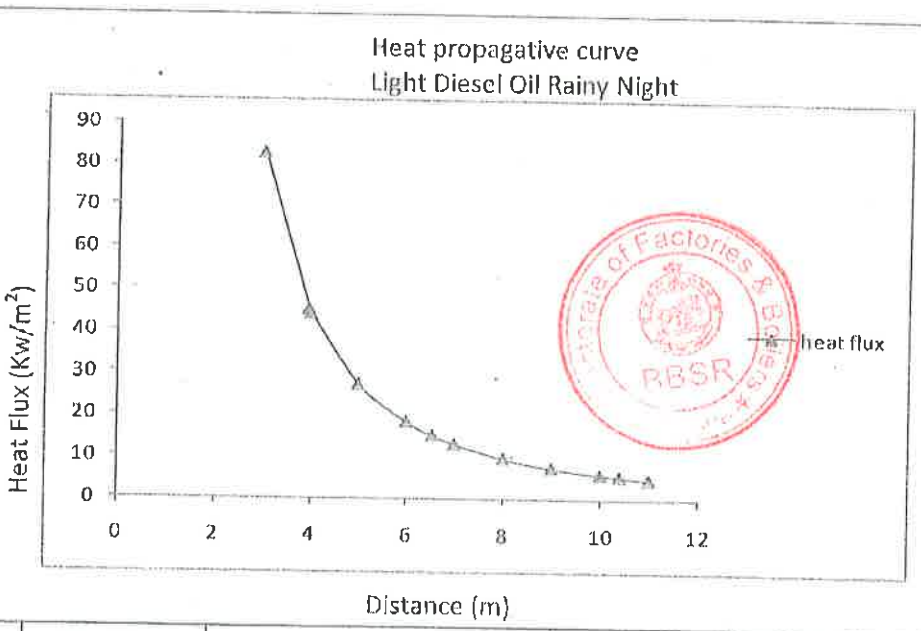
Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	11.95 M	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.46 M	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.6 M	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN NIGHT TIME: LDO STORAGE TANK

STORAGE DETAILS							
1. No. of Tanks						: 1 No	
2. Capacity						: 500 Kl	
3. Diameter						: 9.0 m	
4. Lenth/Height						: 9.0 m	
METEROLOGICAL DATA							
	SUMMER		RAINY		WINTER		
	Day	Night	Day	Night	Day	Night	
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4	
b. Average Wind Direction (from)	W		W		WNW		
c. Humidity	77	56	81	73	64	41	
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12	
FIRE CHARACTERISTIC DATA							
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)					
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})					
K_m	=	Extinction co-efficient for fuel (m^{-1})					
m"	=	Mass Burning rate of fuel (kg/m^2)					
U_{10}	=	Wind speed at a height of 10 mtr(m/s)					
U_R	=	Unobscured ratio of upper flame zone					

OUTPUT DATA FOR RAINY IN NIGHT TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DIESEL OIL- Rainy- Night	
DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.38
4	45
4.46	37.5
5	27.096
6	18.156
7	15
7.62	12.5
8	9.624
9	7.404
10	5.856
11	5.4
12.05	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	12.05 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.62 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.46 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN DAY TIME: LDO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 1 No
2. Capacity	: 500 Kl
3. Diameter	: 9.0 m
4. Lenth/Height	: 9.0 m

METEROLOGICAL DATA

	SUMMER		WINTER		RAINY	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA

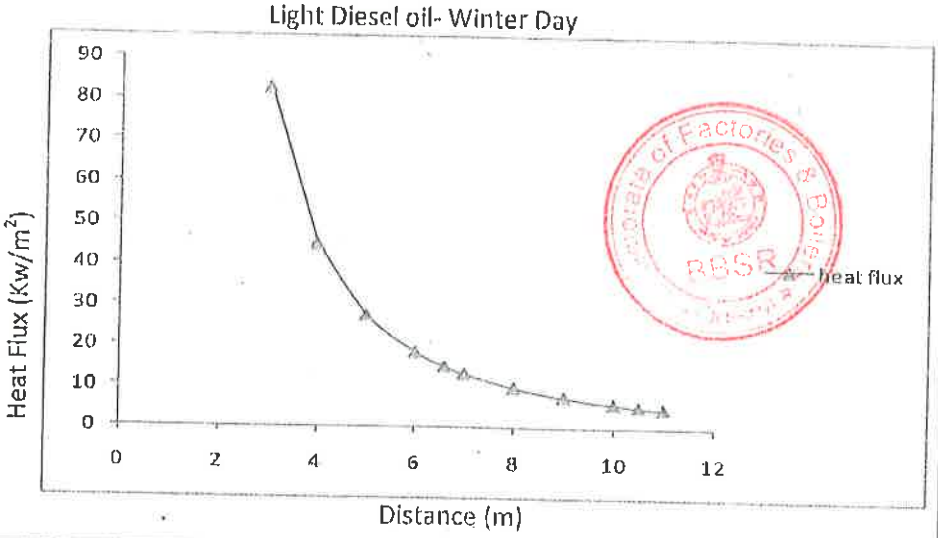
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN DAY TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DIESEL OIL - Winter- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.716
4	45
4.67	37.5
5	27.516
6	18.528
7	15
7.43	12.5
8	9.9
9	7.644
10	6.072
11	5.4
11.85	4.5

Heat propagative curve
Light Diesel oil- Winter Day



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	11.85 M	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.43 M	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.67 M	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN NIGHT TIME: LDO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 1 No
2. Capacity	: 500 Kl
3. Diameter	: 9.0 m
4. Lenth/Height	: 9.0 m

METEROLOGICAL DATA

	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

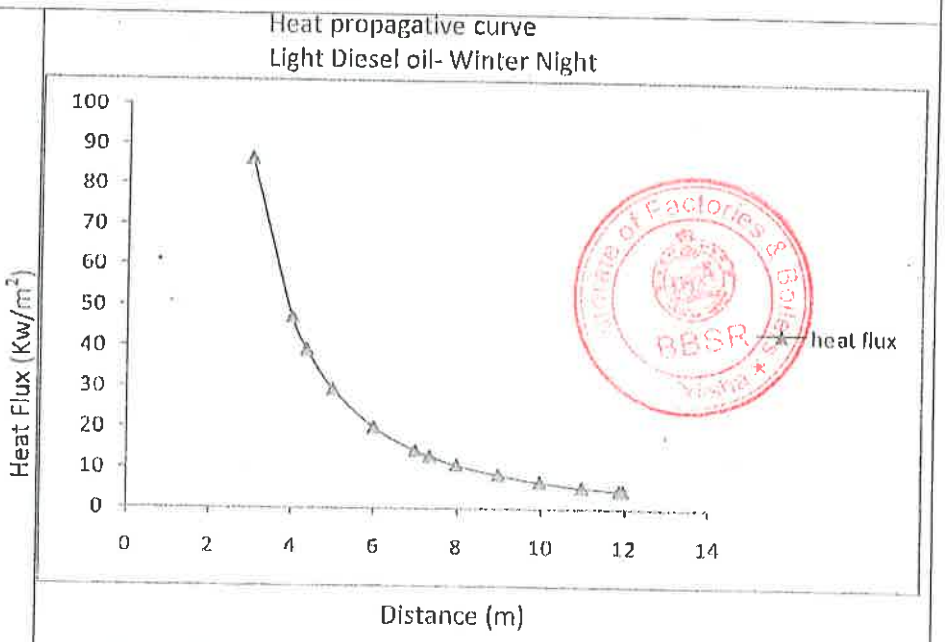
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m''	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN NIGHT TIME: Heat Flux Data: LDO

POOLFIRE MODEL – LIGHT DIESEL OIL - Winter- Night

DISTANCE (M)	HEAT FLUX (KW/M^2)
3	86.688
4	47.4075
4.76	37.5
5	29.6415
6	20.181
7	14.574
7.62	12.5
8	10.983
9	8.5575
10	6.846
11	5.586
12	4.725
12.38	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	12.38 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	7.62 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.76 m	Sufficient to cause damage to the equipment

ANNEXURE - VII

INPUT DATA: FOR SUMMER SEASON IN DAY TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Length/Height	: 12.0 m

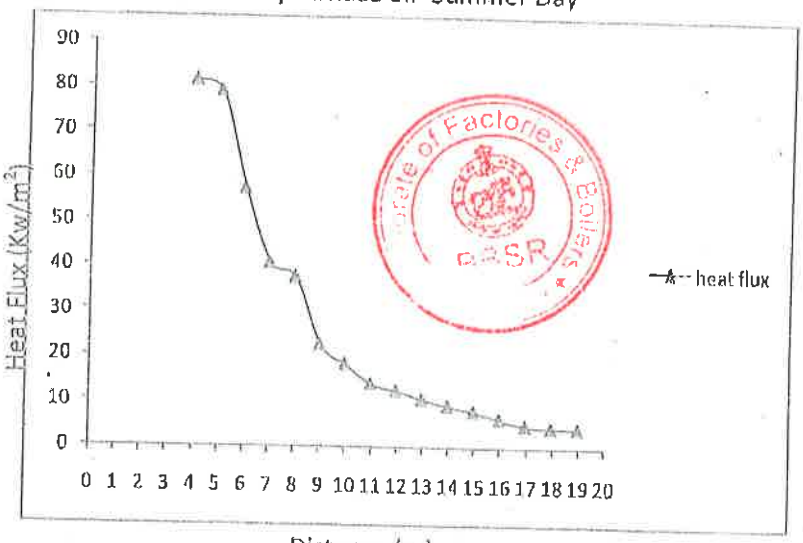
METEROLOGICAL DATA	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR SUMMER IN DAY TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL -Summer- Day	
DISTANCE(M)	HEAT FLUX (KW/M^2)
4	81.25
5	78.69
6	57.16
7	40.68
8.012	37.5
9	22.57
10	18.31
11	13.95
11.98	12.5
13	10.65
14	9.24
15	8.02
16	6.43
17	5.01
18	4.64
19.03	4.5

Heat propagative curve
Heavy furnace oil- Summer Day



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	19.03 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	11.98 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	8.012 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR SUMMER SEASON IN NIGHT TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Lenth/Height	: 12.0 m

METEROLOGICAL DATA

	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA

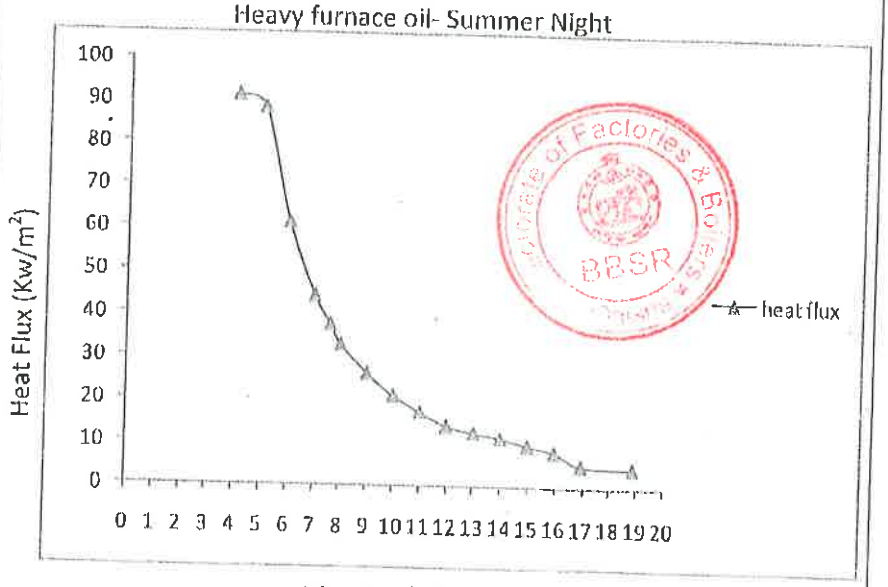
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR SUMMER IN NIGHT TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL - Summer- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
4	91.25
5	88.34
6	61.37
7	44.13
7.6	37.50
8	32.82
9	26.13
10	21.02
11	17.23
12	14.03
13.01	12.5
14	11.33
15	9.60
16	8.12
17	5.03
18.93	4.5

Heat propagative curve
Heavy furnace oil- Summer Night



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	18.93 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	13.01 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	7.60 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN DAY TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Lenth/Height	: 12.0 m

METEROLOGICAL DATA

	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

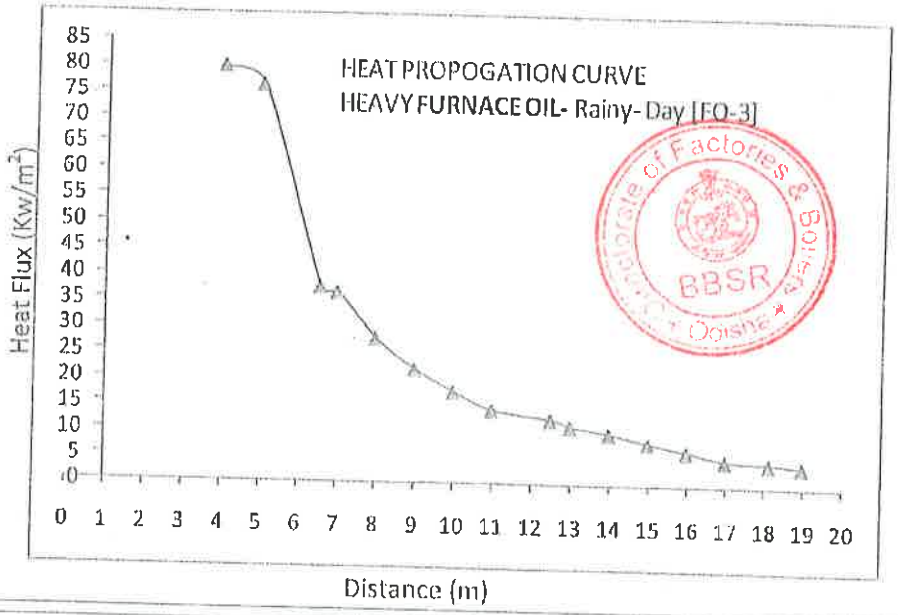
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR RAINY IN DAY TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL - Rainy- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
4	79.89
5	76.28
6.564	37.5
7	36.54
8	27.64
9	21.85
10	17.56
11	14.12
12.64	12.5
13	11.23
14	9.92
15	8.16
16	6.58
17	4.92
18.14	4.5
19	3.98



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	18.14 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	12.64 M	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	6.564 M	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN NIGHT TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Lenth/Height	: 12.0 m

METEROLOGICAL DATA	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

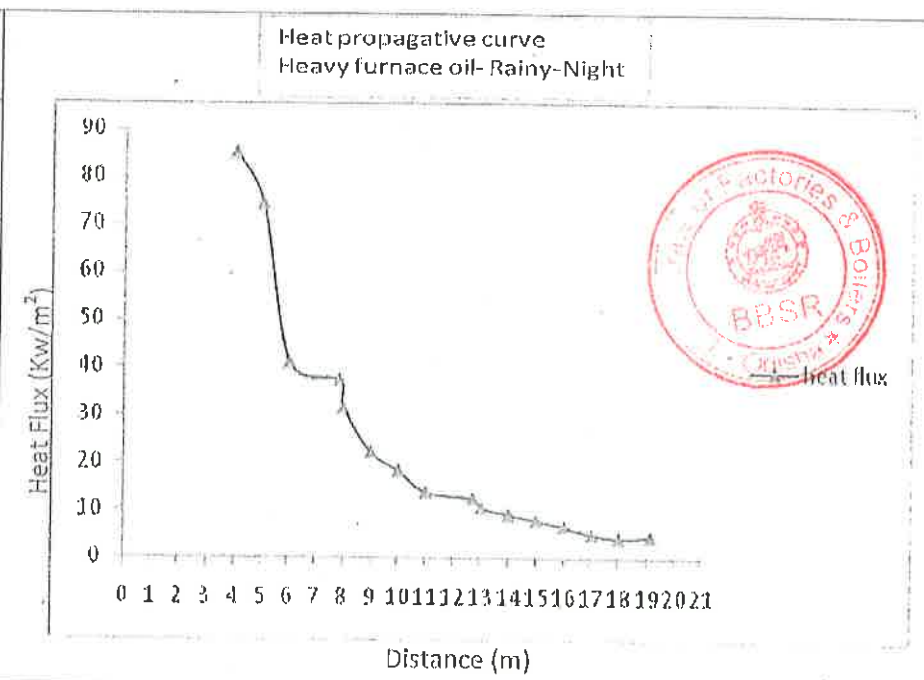
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR RAINY IN NIGHT TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL- Rainy- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
4	85.46
5	74.39
6	41.25
7.85	**37.5**
8	31.57
9	22.24
10	18.35
11	13.85
12.7	**12.5**
13	10.62
14	9.24
15	7.93
16	6.62
17	5.02
18	4.16
19.15	**4.5**



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	19.15 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	12.7 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	7.85 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN DAY TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Lenth/Height	: 12.0 m

METEROLOGICAL DATA	SUMMER		WINTER		RAINY	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (^{0}C)	43	21	34	22	32	12

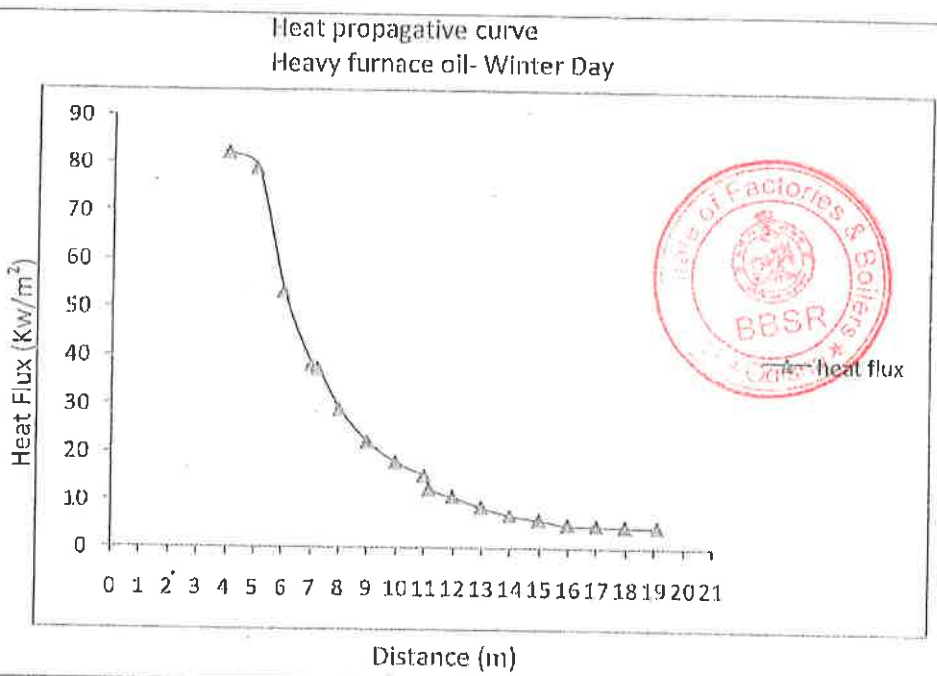
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN DAY TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL -Winter- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
4	82.35
5	79.03
6	53.39
7	38.23
7.23	37.5
8	29.14
9	22.37
10	18.12
11	15.32
11.17	12.50
12	10.9
13	8.72
14	7.03
15	6.12
16	5.03
17	4.83
18	4.62
19.12	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	19.12 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	11.17 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	7.23 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN NIGHT TIME: HFO STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 2 No
2. Capacity	: 2000 Kl
3. Diameter	: 15.5 m
4. Lenth/Height	: 12.0 m

METEROLOGICAL DATA

	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

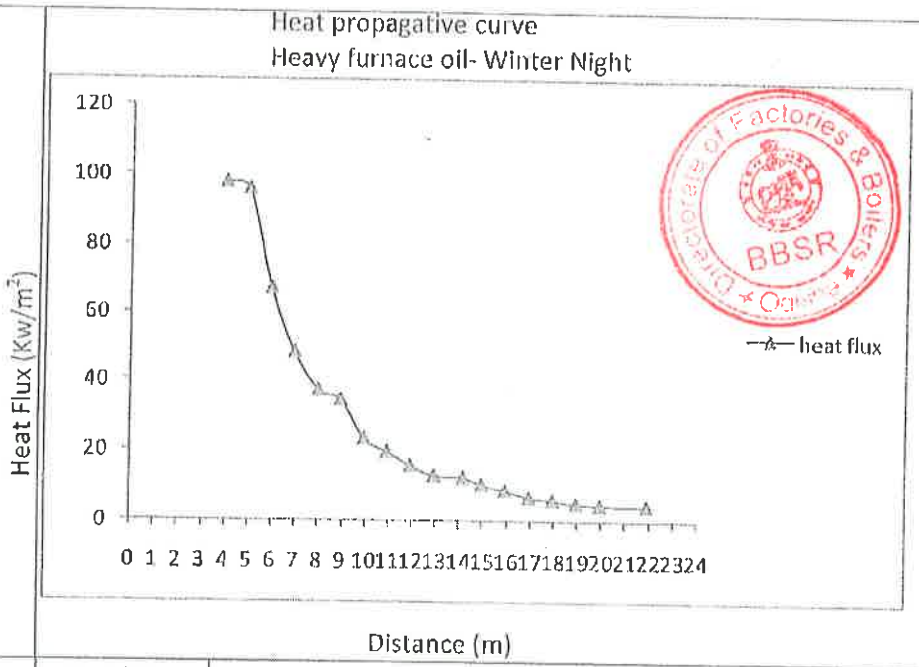
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN NIGHT TIME: Heat Flux Data: HFO

POOLFIRE MODEL – HEAVY FURNACE OIL -Winter- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
4	98.12
5	96.23
6	67.34
7	48.37
8.03	37.5
9	34.69
10	23.51
11	19.74
12	15.87
13	13.13
14.23	12.50
15	10.58
16	8.97
17	7.03
18	6.16
19	5.22
20	4.72
21.97	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	21.97 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	14.23 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	8.03 m	Sufficient to cause damage to the equipment

ANNEXURE - VIII

INPUT DATA: FOR SUMMER SEASON IN DAY TIME: H_2 STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 20 No
2. Capacity	: 7 Kl (each tank)
3. Diameter	: 23 cm
4. Length/Height	: 146 cm

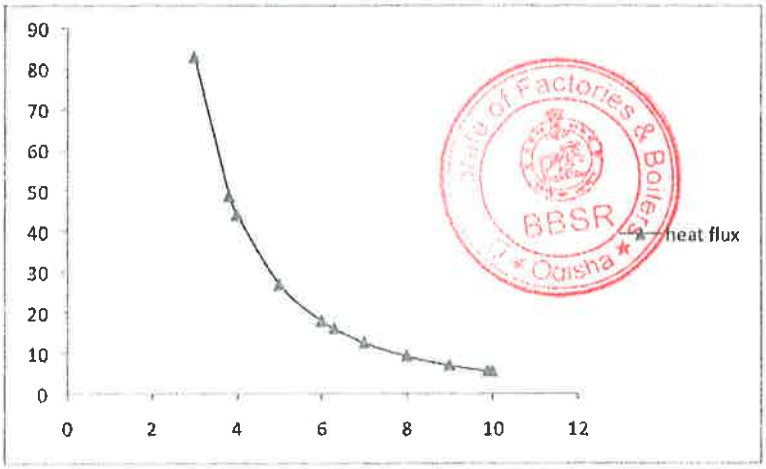
METEROLOGICAL DATA	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m''	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR SUMMER IN DAY TIME: Heat Flux Data: H_2

POOLFIRE MODEL – Hydrogen Gas - Summer- Day	
DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.81
3.5	48.75
4	44.135
4.25	37.5
4.5	18.031
5	16.25
6.43	12.5
7	9.49
8	7.293
9	5.85
9.35	4.5

Heat propagative curve
Hydrogen Gas Summer Day



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	9.35 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	6.43 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.25 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR SUMMER SEASON IN NIGHT TIME: H_2 STORAGE TANK

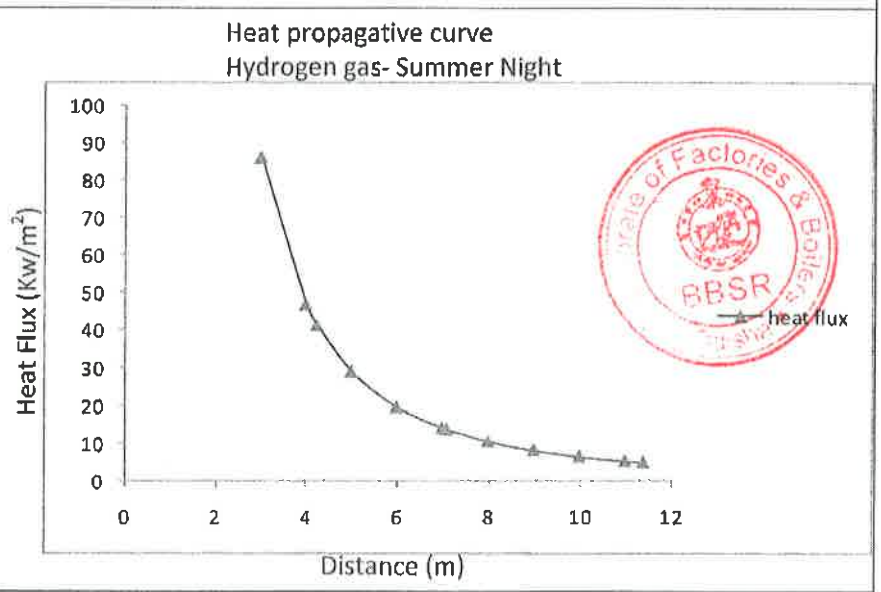
STORAGE DETAILS						
1. No. of Tanks	: 20 No					
2. Capacity	: 7 Kl (each tank)					
3. Diameter	: 23 cm					
4. Lenth/Height	: 146 cm					
METEROLOGICAL DATA						
	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR SUMMER IN NIGHT TIME: Heat Flux Data: H_2

POOLFIRE MODEL – HYDROGEN GAS - Summer- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	88.056
3.25	46.695
3.5	41.25
3.95	37.5
4.25	19.646
4.5	14.124
5.27	12.5
6	10.593
6.5	8.217
7	6.545
8	5.324
8.64	4.95



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	8.64 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	5.27 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	3.95 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN DAY TIME: H_2 STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 20 No
2. Capacity	: 7 Kl (each tank)
3. Diameter	: 23 cm
4. Length/Height	: 146 cm

METEROLOGICAL DATA	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed In m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (^{0}C)	43	21	34	22	32	12

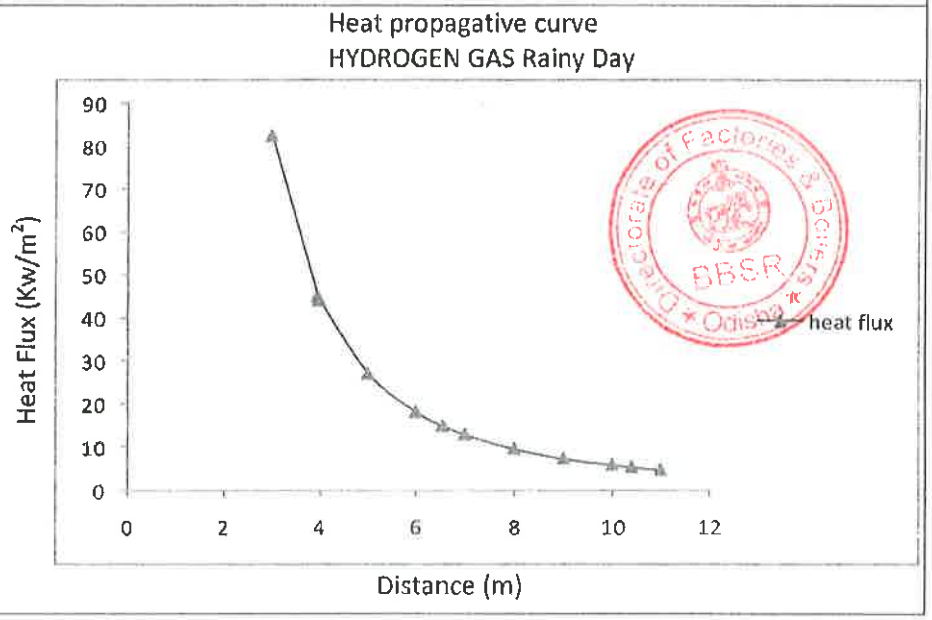
FIRE CHARACTERISTIC DATA

E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m''	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR RAINY IN DAY TIME: Heat Flux Data: H_2

POOLFIRE MODEL – HYDROGEN GAS – Rainy- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	84.96
4	45
6.58	37.5
7	27.096
8	18.156
9	15.34
9.32	12.5
9.5	9.624
9.75	7.404
10	5.856
10.25	5.4
10.5	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	10.5 M	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	9.32 M	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	6.58 M	Sufficient to cause damage to the equipment

INPUT DATA: FOR RAINY SEASON IN NIGHT TIME: H_2 STORAGE TANK

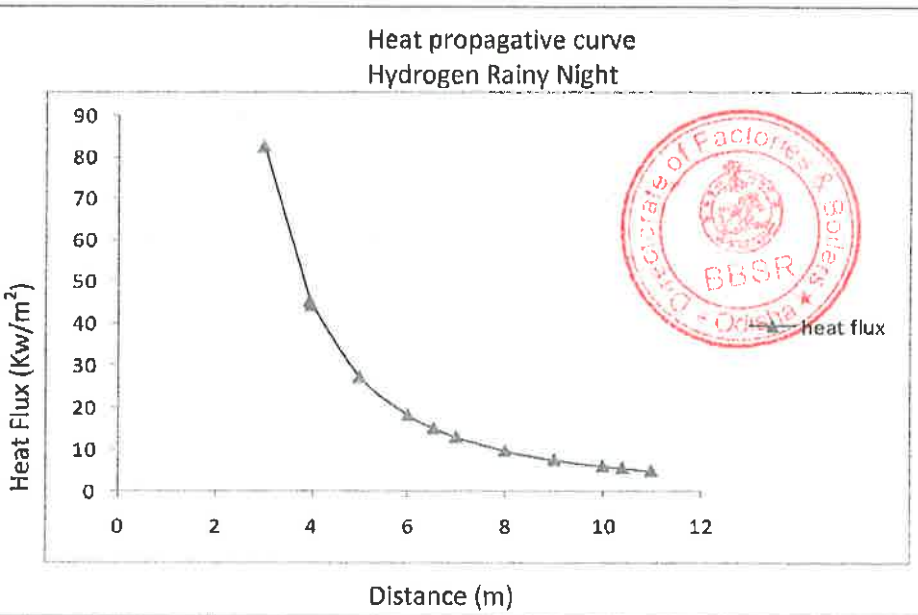
STORAGE DETAILS							
1. No. of Tanks						: 20 No	
2. Capacity						: 7 Kl (each tank)	
3. Diameter						: 23 cm	
4. Lenth/Height						: 146 cm	
METEROLOGICAL DATA							
	SUMMER		RAINY		WINTER		
	Day	Night	Day	Night	Day	Night	
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4	
b. Average Wind Direction (from)	W		W		WNW		
c. Humidity	77	56	81	73	64	41	
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12	

FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m''	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR RAINY IN NIGHT TIME: Heat Flux Data: H_2

POOLFIRE MODEL – HYDROGEN – Rainy- Night

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.38
4	45
7.21	37.5
8	27.096
8.25	18.156
8.5	15
9.2	12.5
9.5	9.624
10	7.404
10.5	5.856
11	5.4
11.4	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	11.4 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	9.2 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	7.21 m	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN DAY TIME: H_2 STORAGE TANK

STORAGE DETAILS							
1. No. of Tanks						: 20 No	
2. Capacity						: 7 Kl (each tank)	
3. Diameter						: 23 cm	
4. Lenth/Height						: 146 cm	
METEROLOGICAL DATA							
	SUMMER		WINTER		RAINY		
	Day	Night	Day	Night	Day	Night	
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4	
b. Average Wind Direction (from)	W		W		WNW		
c. Humidity	77	56	81	73	64	41	
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12	

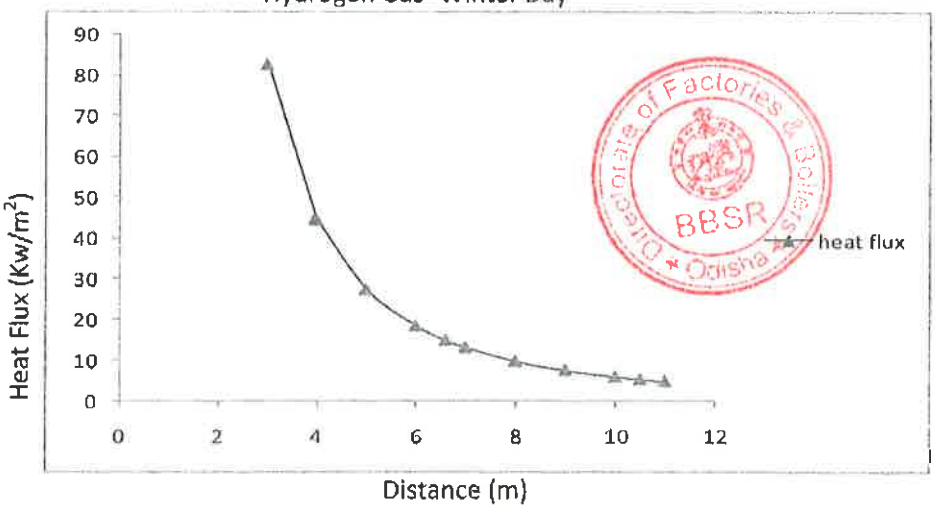
FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m''	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN DAY TIME: Heat Flux Data: H_2

POOLFIRE MODEL – HYDROGEN GAS - Winter- Day

DISTANCE(M)	HEAT FLUX (KW/M^2)
3	82.716
4	45
4.96	37.5
5.25	27.516
5.5	18.528
6	15
6.54	12.5
7	9.9
7.25	7.644
7.5	6.072
8	5.4
8.52	4.5

Heat propagative curve
Hydrogen Gas- Winter Day



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	8.52 M	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	6.54 M	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	4.96 M	Sufficient to cause damage to the equipment

INPUT DATA: FOR WINTER SEASON IN NIGHT TIME: H_2 STORAGE TANK

STORAGE DETAILS	
1. No. of Tanks	: 20 No
2. Capacity	: 7 Kl (each tank)
3. Diameter	: 23 cm
4. Lenth/Height	: 146 cm

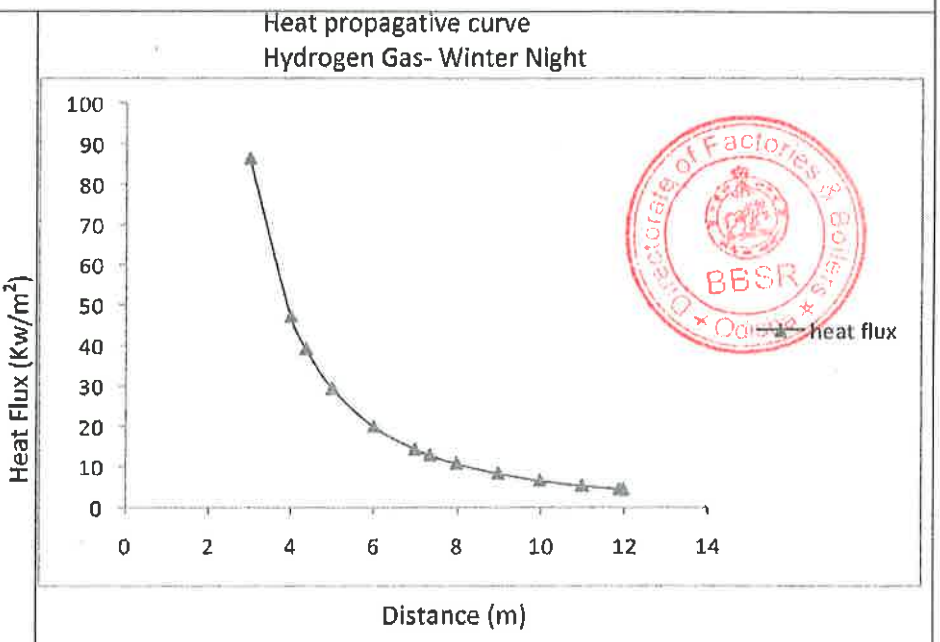
METEROLOGICAL DATA	SUMMER		RAINY		WINTER	
	Day	Night	Day	Night	Day	Night
a. Average Wind Speed in m/s	2.6	1.8	2.8	2.1	1.8	1.4
b. Average Wind Direction (from)	W		W		WNW	
c. Humidity	77	56	81	73	64	41
d. Average Ambient Air Temp. (°C)	43	21	34	22	32	12

FIRE CHARACTERISTIC DATA		
E_{max}	=	Maximum surface emissive power for the fuel (kw/m^2)
KB	=	Mean Began length corrector extinction co-efficient product (m^{-1})
K_m	=	Extinction co-efficient for fuel (m^{-1})
m"	=	Mass Burning rate of fuel (kg/m^2)
U_{10}	=	Wind speed at a height of 10 mtr(m/s)
U_R	=	Unobscured ratio of upper flame zone

OUTPUT DATA FOR WINTER IN NIGHT TIME: Heat Flux Data: H_2

POOLFIRE MODEL – HYDROGEN GAS - Winter- Night

DISTANCE (M)	HEAT FLUX (KW/M^2)
3	87.43
3.25	47.4075
3.58	37.5
4	29.6415
4.5	20.181
5	14.574
5.74	12.5
6	10.983
6.25	8.5575
6.5	6.846
7	5.586
7.25	4.725
7.54	4.5



Significant Heat Level	Value	Experience Distance	Indication
SHL-1	4.5 kw/m^2	7.54 m	Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality.
SHL-2	12.5 kw/m^2	5.74 m	Minimum energy required for melting of plastic
SHL-3	37.5 kw/m^2	3.53 m	Sufficient to cause damage to the equipment

ANNEXURE - IX

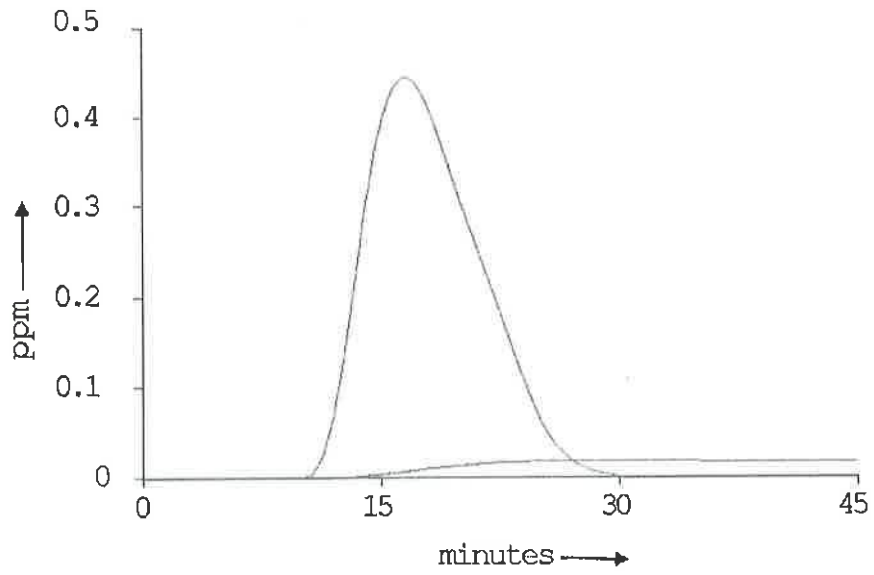
Concentration at Point

Time: February 05, 2014 2310 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges Per Hour: 0.23 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1,575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.445 ppm
Indoor: 0.0183 ppm



Outdoor Concentration
Indoor Concentration

At Point: Downwind: 1,575 m Off Centerline: 28 m

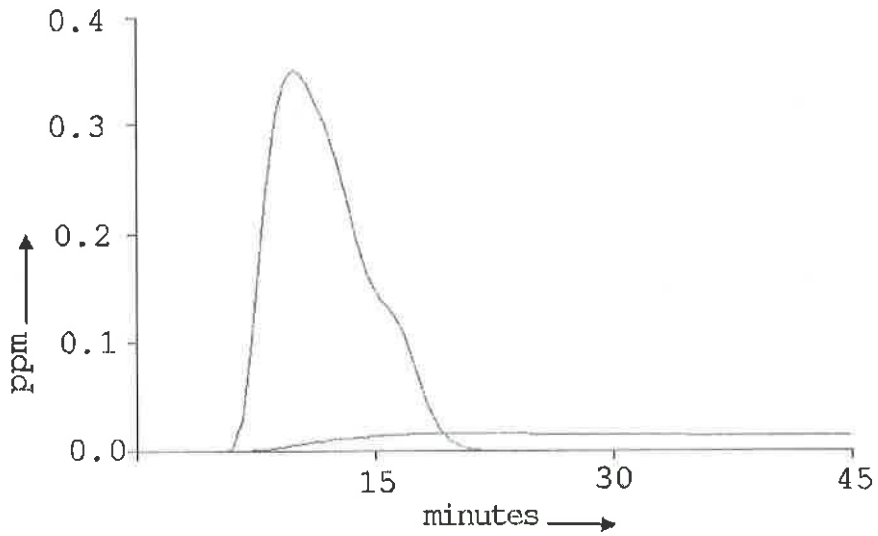
Concentration at Point

Time: February 02, 2014 2211 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges Per Hour: 0.30 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.35 ppm
Indoor: 0.0158 ppm



Outdoor Concentration

Indoor Concentration

At Point: Downwind: 1575 m Off Centerline: 28 m

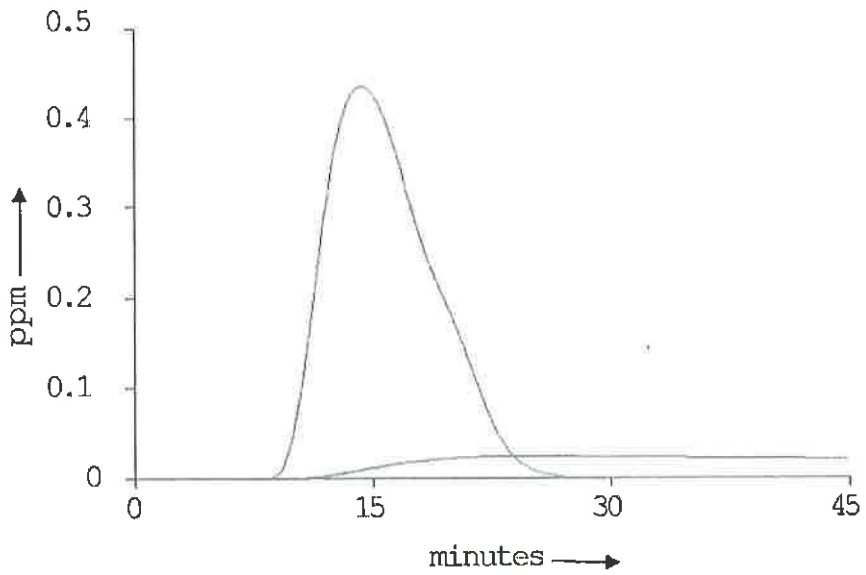
Concentration at Point

Time: February 04, 2014 2214 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges Per Hour: 0.34 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1,575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.435 ppm
Indoor: 0.0245 ppm



Outdoor Concentration

Indoor Concentration

At Point: Downwind: 1,575 m Off Centerline: 28 m

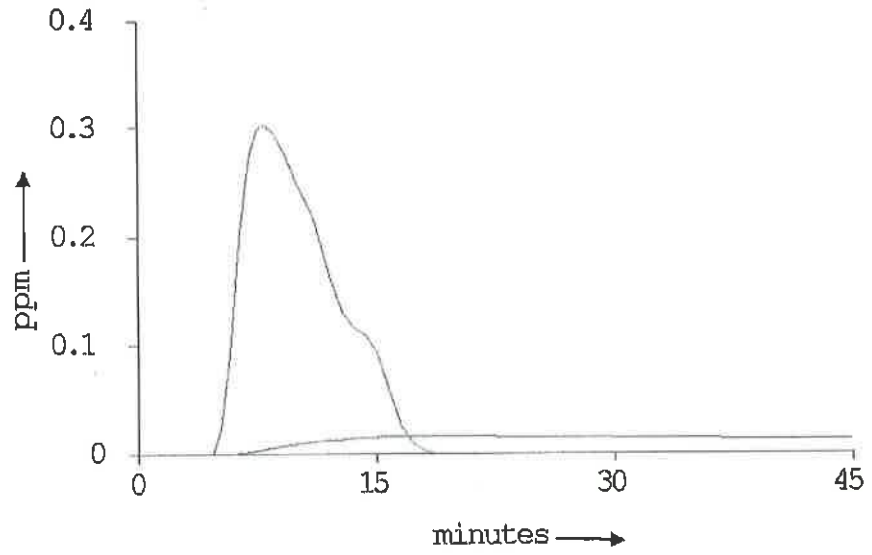
Concentration at Point

Time: February 04, 2014 2107 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges Per Hour: 0.38 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1,575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.302 ppm
Indoor: 0.0163 ppm



Outdoor Concentration

Indoor Concentration

At Point: Downwind: 1,575 m Off Centerline: 28 m

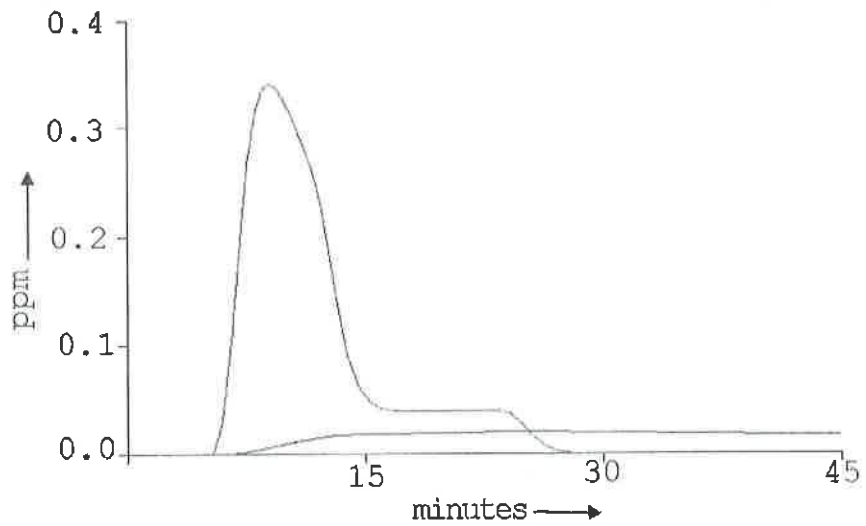
Concentration at Point

Time: February 02, 2014 2208 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges per Hour: 0.43 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.34 ppm
Indoor: 0.02 ppm



Outdoor Concentration
Indoor Concentration
At Point: Downwind: 1575 m Off Centerline: 28 m

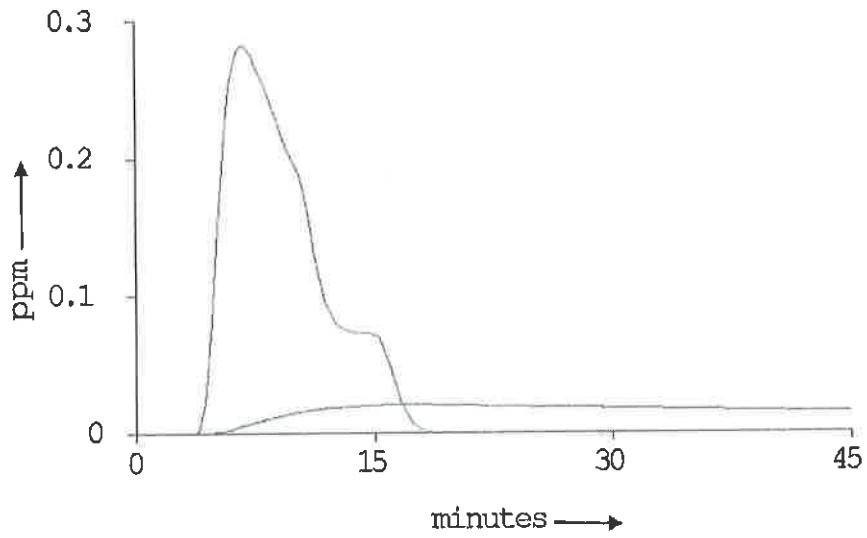
Concentration at Point

Time: February 04, 2014 2052 hours ST (using computer's clock)

Chemical Name: CHLORINE

Building Air Exchanges Per Hour: 0.56 (sheltered single storied)

THREAT AT POINT:
Model Run: Heavy Gas
Concentration Estimates at the point:
Downwind: 1,575 m Off Centerline: 28 m
Max Concentration:
Outdoor: 0.283 ppm
Indoor: 0.021 ppm

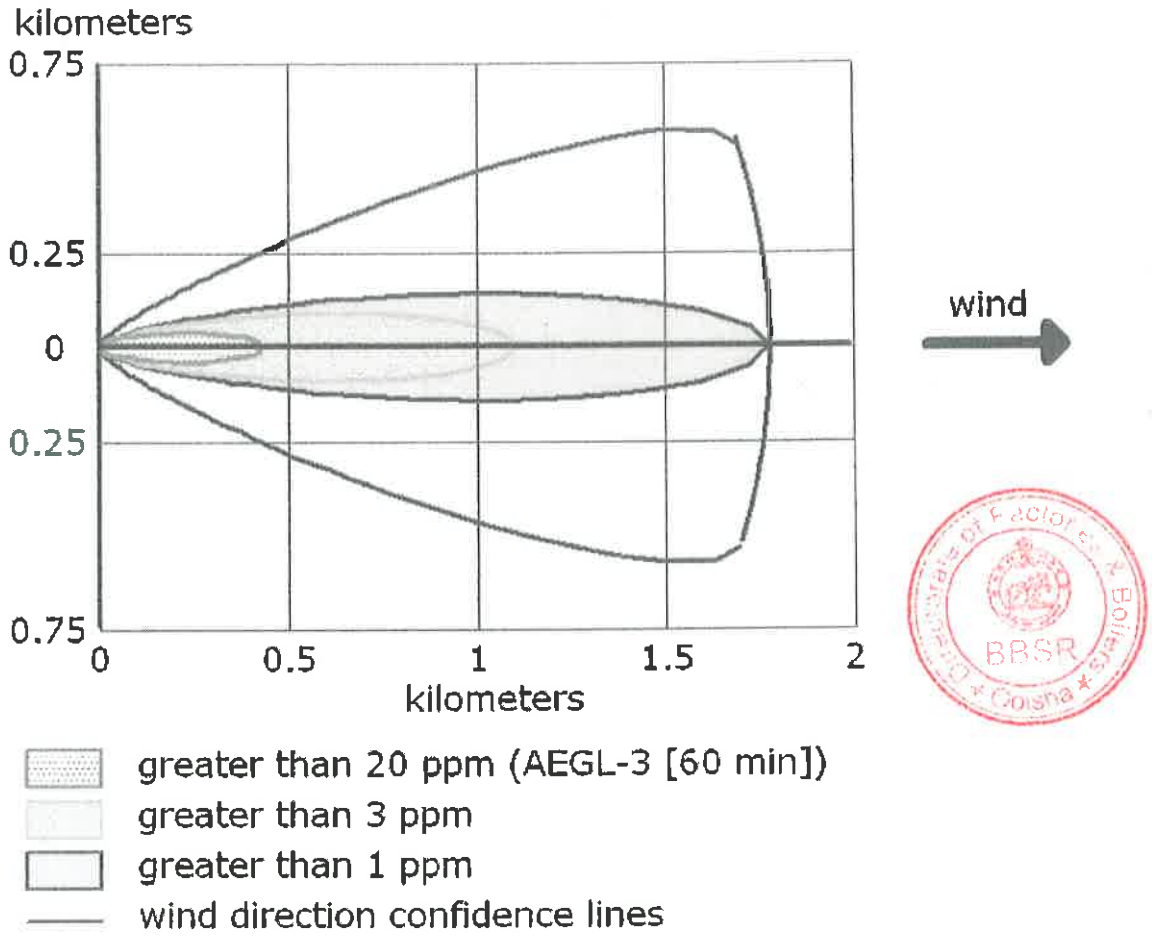


Outdoor Concentration

Indoor Concentration

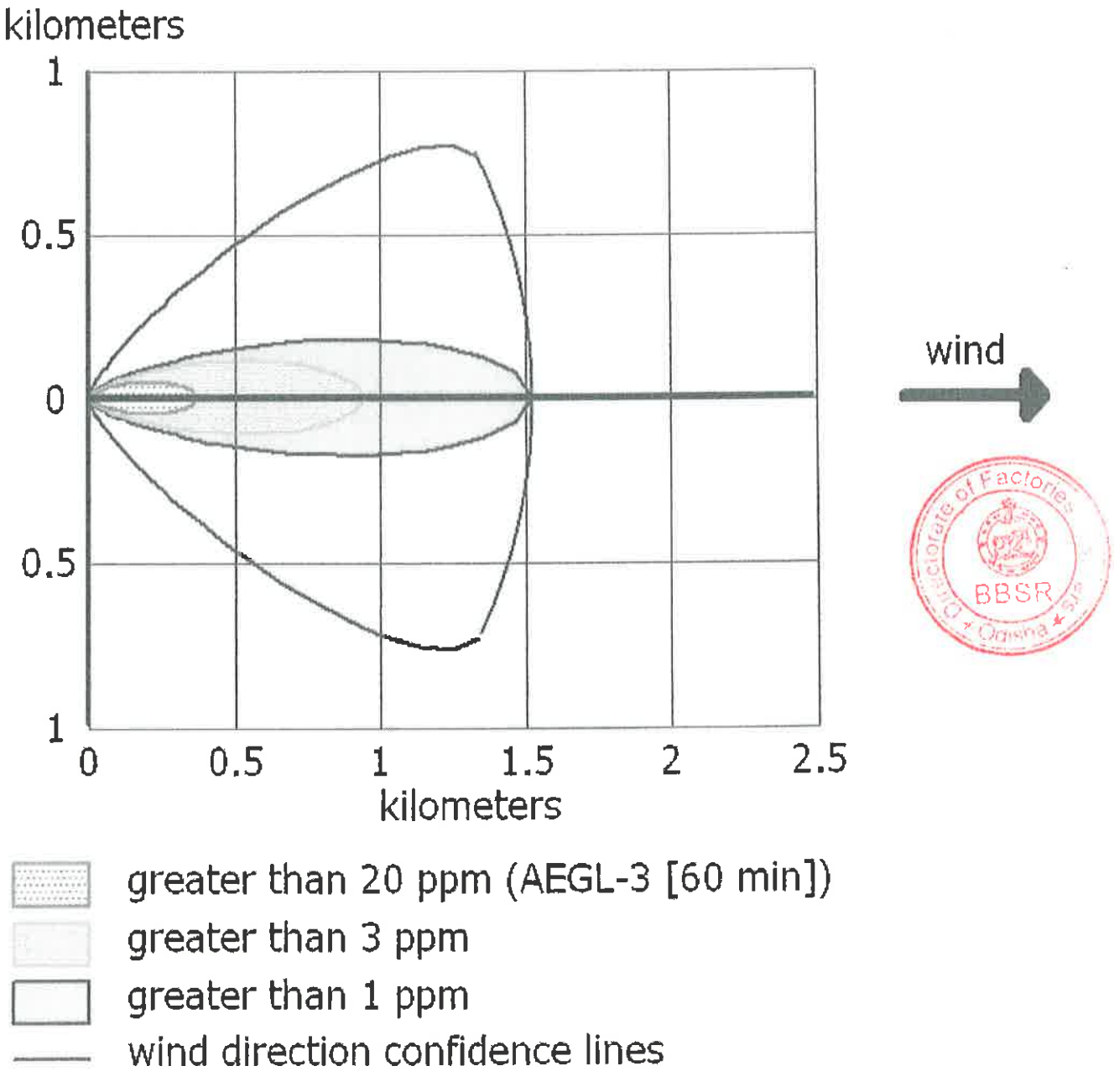
At Point: Downwind: 1,575 m Off Centerline: 28 m

Chemical Name: CHLORINE
Wind: 2.8 meters/second from w at 2 meters (Rainy-day)
THREAT ZONE:
Model Run: Heavy Gas
Red : 69 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 183 meters --- (3 ppm)
Yellow: 326 meters --- (1 ppm)

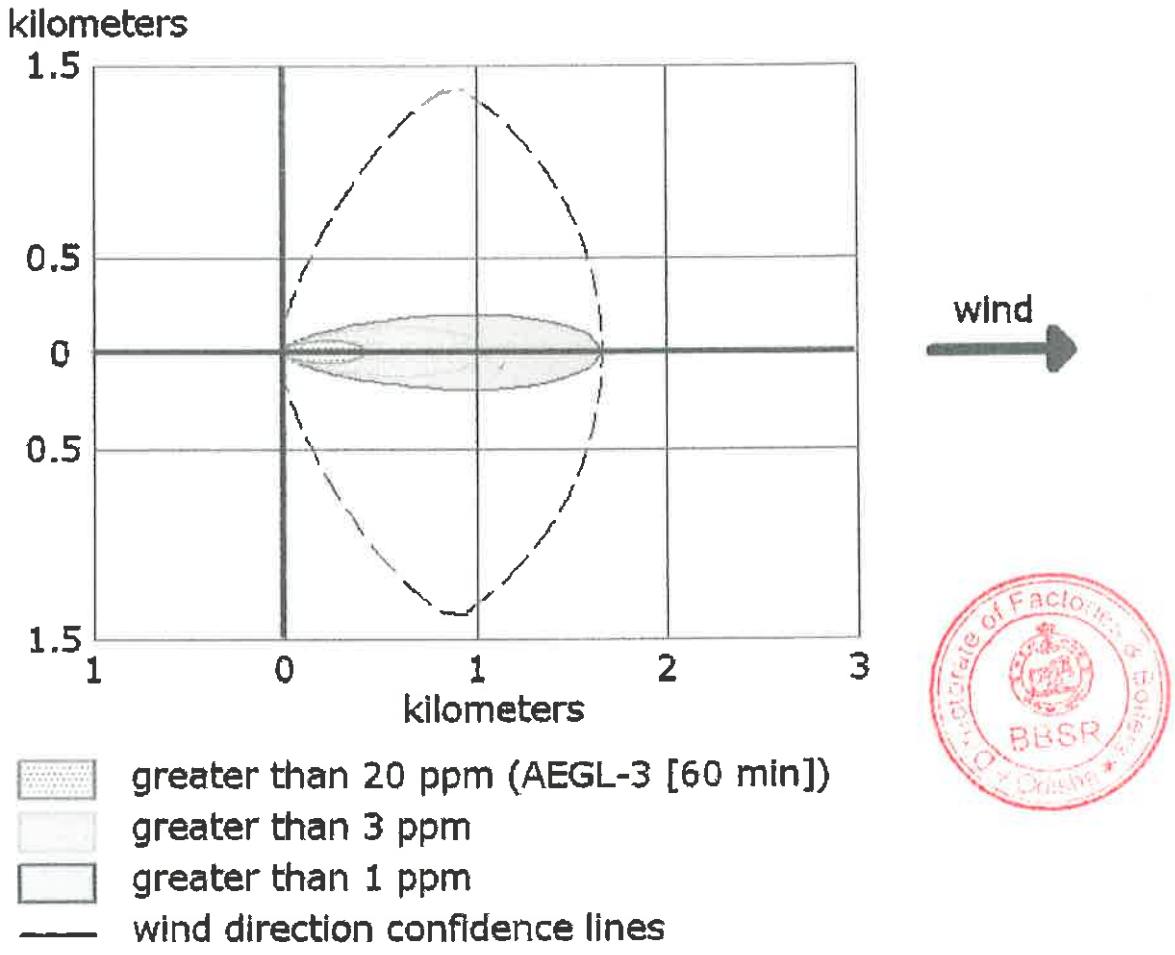


Chemical Name: CHLORINE
Wind: 2.6 meters/second from w at 2 meters (summer-day)

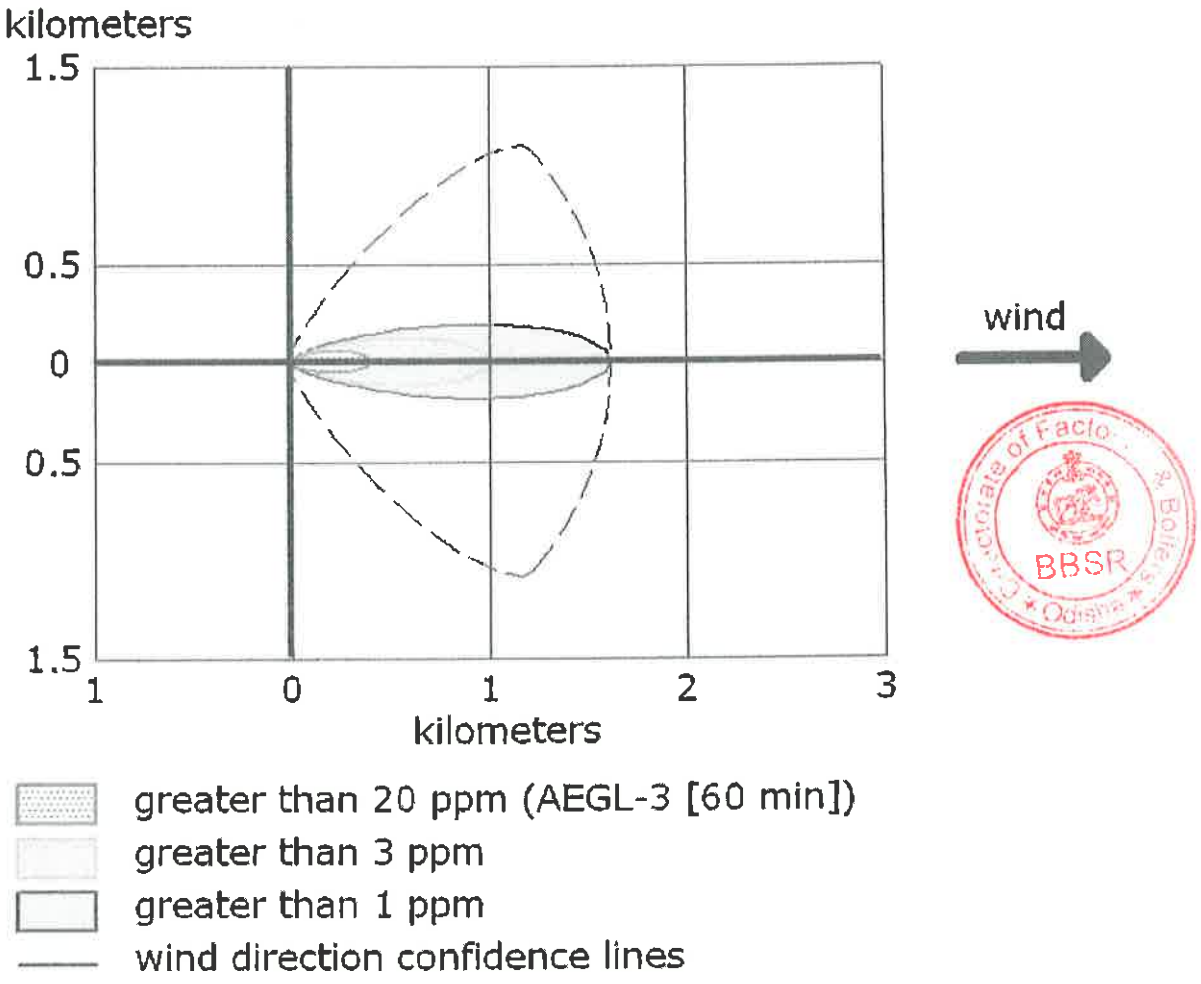
THREAT ZONE:
Model Run: Heavy Gas
Red : 370 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 944 meters --- (3 ppm)
Yellow: 1.5 kilometers --- (1 ppm)



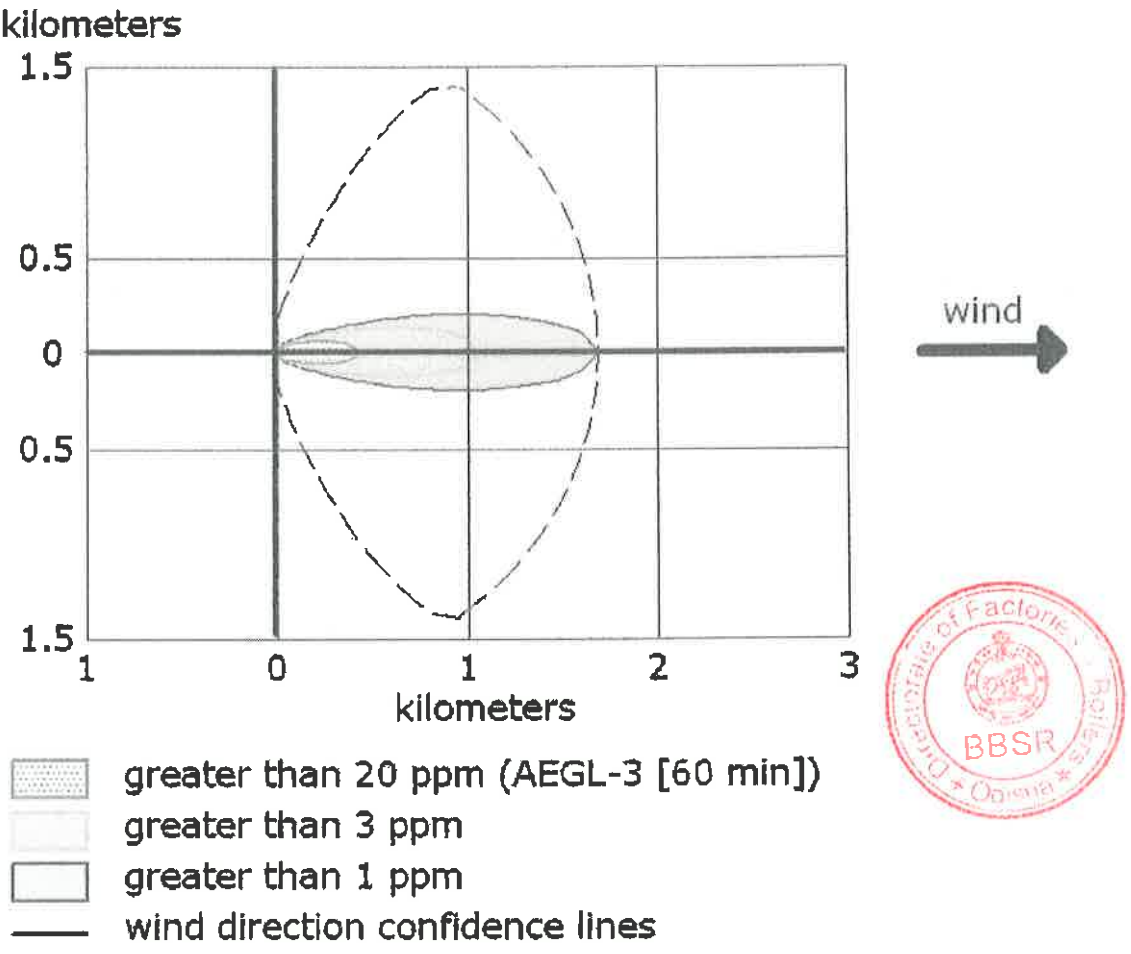
Chemical Name: CHLORINE
Wind: 1.8 meters/second from w at 2 meters (summer-Night)
THREAT ZONE:
Model Run: Heavy Gas
Red : 430 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 1.1 kilometers --- (3 ppm)
Yellow: 1.7 kilometers --- (1 ppm)



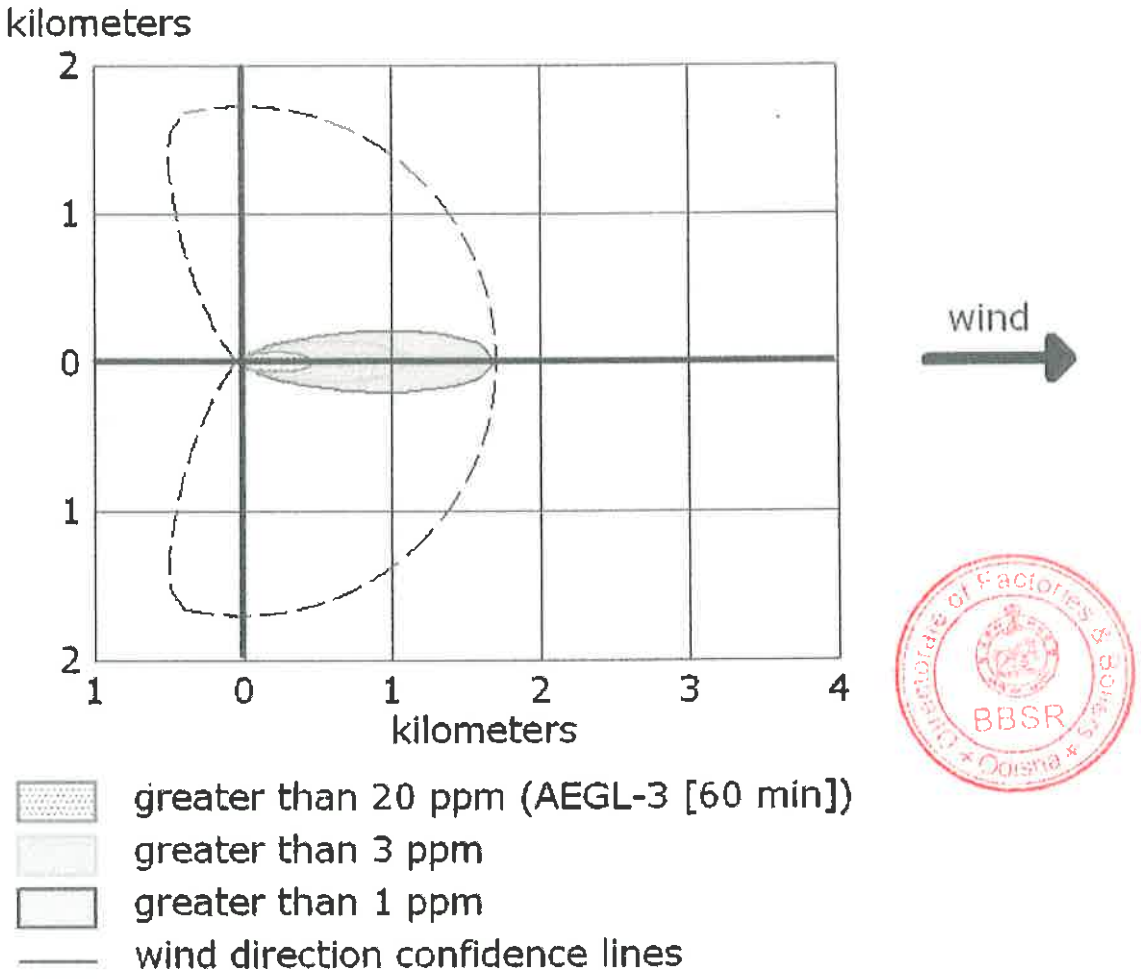
Chemical Name: CHLORINE
Wind: 2.1 meters/second from w at 2 meters (Rainy-Night)
THREAT ZONE:
Model Run: Heavy Gas
Red : 400 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 1.0 kilometers --- (3 ppm)
Yellow: 1.6 kilometers --- (1 ppm)



Chemical Name: CHLORINE
Wind: 1.8 meters/second from WNW at 2 meters (Winter-day)
THREAT ZONE:
Model Run: Heavy Gas
Red : 437 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 1.1 kilometers --- (3 ppm)
Yellow: 1.7 kilometers --- (1 ppm)



Chemical Name: CHLORINE
Wind: 1.4 meters/second from WNW at 2 meters (Winter-Night)
THREAT ZONE:
Model Run: Heavy Gas
Red : 469 meters --- (20 ppm = AEGL-3 [60 min])
Orange: 1.1 kilometers --- (3 ppm)
Yellow: 1.7 kilometers --- (1 ppm)



ANNEXURE - X

ANNEXURE - XI

NEAREST EMERGENCY SERVICES

NEAREST INDUSTRY
(FOR SAFETY, MEDICAL, AND FIRE SERVICE)

Sl. No.	NAME & ADDRESS OF NEARBY INDUSTRY	DISTANCE IN KM	FACILITIES TO BE PROVIDED DURING EMERGENCY	CONTACT PERSON & TEL.NO
1	NTPC, At/Po -Kaniha Dist-Angul	10	Fire Service, SCBA, Gas Mask & Fire Proximity Suit. Ambulance, Medical Aid, etc.	067651-243252

NEAREST FIRE STATION

SL.NO	FIRE STATION NAME & LOCATION/ADDRESS	CONTACT NO	DISTANCE FROM THE SITE IN KM.
01	Fire Station, Kaniha	9438562445	10 Km
02	District Fire Station, Angul	06764-230322	62 Km

AMBULANCE & MEDICAL SERVICES

SL.NO	AMBULANCE AGENCY NAME	CONTACT NOS.
01	JITPL	9583040666, 9583040777
02	Kaniha, PHC	067651-243282
03	District Hospital, Angul	06764 - 232507

FACILITY AVAILABLE IN NTPC HOSPITAL

(20 Bedded)

- One well-equipped operation theatres.
- Recovery room with all facilities (02 Beds).
- Well-equipped Casualty (01 bed).
- Separate general ward for male& female each with nine(9) beds. – 18 beds.
- Three Consultation Rooms.
- 24*7 Pharmacy Store.
- A Well Equipped Pathology Laboratory with hematology, Bio-Chemistry & Urine Analyzers.
- Diagnostics – Radiography Imaging (X-Ray with Computed Radiography System (Digital X-Ray)), Pulmonary Function Test, Mobile X - Ray.
- Centralized Air Conditioning.
- Fire Alarm System.
- Close Circuit Cameras.
- Central sterile supply department.

ANNEXURE - XII

PETRO-CANADA

Material Safety Data Sheet

WHMIS (Pictograms)	WHMIS (Classification)	Protective Clothing	TDG (pictograms)
	B-3, D-2B		

Section 1. Chemical Product and Company Identification

Product Name	**DIESEL FUEL**	**Code**	W104 SAP: 120, 121, 122, 287
		Validated on	3/2/2001.
Synonym	Diesel 50, Diesel 50 LS, #1 Diesel , #1 Diesel LS, Diesel LC, Seasonal Diesel, Seasonal Diesel LS, Diesel AA, Domestic Marine Diesel, International marine Diesel, Seasonal Diesel Locomotive, Domestic Marine diesel LS, diesel -20°C (LS), LSD, Low Sulphur Diesel, dyed diesel, marked diesel, coloured diesel, Naval Distillate.		
Manufacturer	PETRO-CANADA P.O. Box 2844 Calgary, Alberta T2P 3E3	**In case of Emergency**	Petro-Canada: 403-296-3000 Canutec Transportation: 613-996-6666 Poison Control Centre: Consult local telephone directory for emergency number(s).
Material Uses	Diesel fuels are distillate fuels suitable for use in high and medium speed internal combustion engines of the compression ignition type.		

Section 2. Composition and Information on Ingredients

			Exposure Limits (ACGIH)		
Name	**CAS #**	**% (V/V)**	**TLV-TWA(8 h)**	**STEL**	**CEILING**
1) Diesel oil. 2) Proprietary additives. 3) Aromatic content is 50% maximum (benzene: nil). 4) * Notice of Intended Change (2000): 100 mg/m³, skin, A3.	68334-30-5 Not available	>99.9 <0.1	Not established* Not established	Not established Not established	Not established Not established

Manufacturer Recommendation	Not applicable
Other Exposure Limits	Consult local, state, provincial or territory authorities for acceptable exposure limits.

Section 3. Hazards Identification.

Potential Health Effects	Eye contact may cause mild eye irritation. Skin contact can cause moderate to severe irritation and produce drying, cracking, or defatting dermatitis. Inhalation of vapours can cause CNS depression with symptoms of nausea, headaches, vomiting, dizziness, fatigue, light-headedness, reduced coordination, unconciousness and possibly death. Inhalation can also cause irritation of nose and throat. Aspiration of liquid drops into the lungs may produce potentially fatal chemical pneumonitis (fluid in the lungs), severe lung damage, or respiratory failure. For more information, refer to Section 11.

Section 4. First Aid Measures

Eye Contact	IMMEDIATELY flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact	Remove contaminated clothing - launder before reuse. Wash gently and thoroughly the contaminated skin with running water and non-abrasive soap. Seek medical attention.
Inhalation	Evacuate the victim to a safe area as soon as possible. If the victim is not breathing, perform artificial respiration. Allow the victim to rest in a well ventilated area. Seek medical attention.
Ingestion	DO NOT induce vomiting because of danger of aspirating liquid into lungs. Seek medical attention.
Note to Physician	Not available

Section 5. Fire-fighting Measures

Flammability	Class II - combustible liquid (NFPA).	**Flammable Limits**	LOWER: 0.7%, UPPER: 6%
Flash Points	Diesel Fuel: Closed Cup: >40°C (>104°F) Marine Diesel Fuel: Closed Cup: >60°C (>140°F)	**Auto-Ignition Temperature**	225°C (437°F)
Fire Hazards in Presence of Various Substances	Flammable in presence of open flames, sparks, or heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. This product can accumulate static charge and ignite. May accumulate in confined spaces.	**Explosion Hazards in Presence of Various Substances**	Containers may explode in heat of fire. Do not cut, weld, heat, drill or pressurize empty container. Vapour explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard.
Products of Combustion	Carbon oxides (CO, CO2), nitrogen oxides (NOx), sulphur oxides (SOx), sulphur compounds (H2S), water vapour (H2O), smoke and irritating vapours as products of incomplete combustion.		

Continued on Next Page

Available in French

Fire Fighting Media and Instructions	NAERG96, GUIDE 128, Flammable liquids (Non-polar/Water-immiscible). CAUTION: This product has a moderate flash point above 40°C: Use of water spray when fighting fire may be inefficient. If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also consider initial evacuation for 800 meters (1/2 mile) in all directions. SMALL FIRES: Dry chemical, CO_2, water spray or regular foam. LARGE FIRES: Water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. Fires Involving Tanks or Car/Trailer Loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting devices or any discolouration of tank. ALWAYS stay away from the ends of tanks. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection.

Section 6. Accidental Release Measures

Material Release or Spill	NAERG96, GUIDE 128, Flammable Liquids (Non-polar/ Water-immiscible). ELIMINATE ALL IGNITION SOURCES. Avoid contact. Stop leak if without risk. Contain spill. Absorb with inert absorbents, dry clay, or diatomaceous earth. Avoid inhaling dust of diatomaceous earth for it may contain silica in very fine particle size, making this a potential respiratory hazard. Place used absorbent in closed metal containers for later disposal or burn absorbent in a suitable combustion chamber. DO NOT FLUSH TO SEWERS, STREAMS OR OTHER BODIES OF WATER. Check with applicable jurisdiction for specific disposal requirements of spilled material and empty containers. Notify the appropriate authorities immediately.

Section 7. Handling and Storage

Handling	Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk. DO NOT reuse empty containers without commercial cleaning or reconditioning. Ground/bond line and equipment during pumping or transfer to avoid accumulation of static charge. DO NOT ingest. Do not breathe gas/vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately. Avoid contact with skin and eyes. Practice good personal hygiene. Wash hands after handling and before eating. Launder work clothes frequently. Discard saturated leather goods.
Storage	Store in tightly closed containers in cool, dry, isolated, well-ventilated area, and away from incompatibles. Ground all equipment containing material.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	For normal application, special ventilation is not necessary. If user's operations generate vapours or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit. Make-up air should always be supplied to balance air removed by exhaust ventilation. Ensure that eyewash station and safety shower are close to work-station.
Personal Protection -	***The selection of personal protective equipment varies, depending upon conditions of use.***
Eyes	Eye protection (i.e., safety glasses, safety goggles and/or face shield) should be determined based on conditions of use. If product is used in an application where splashing may occur, the use of safety goggles and/or a face shield should be considered.
Body	Wear appropriate clothing to prevent skin contact. As a minimum long sleeves and trousers should be worn.
Respiratory	Where concentrations in air may exceed the occupational exposure limits given in Section 2 (and those applicable to your area) and where engineering, work practices or other means of exposure reduction are not adequate, NIOSH approved respirators may be necessary to prevent overexposure by inhalation.
Hands	Wear appropriate chemically protective gloves. When handling hot product ensure gloves are heat resistant and insulated.
Feet	Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section 9. Physical and Chemical Properties

Physical State and Appearance	Bright oily liquid.	**Viscosity**	1.3-4.1 cSt @ 40°C (104°F)
Colour	Clear to yellow / brown. Low sulphur diesel fuels (<0.05 wt % sulphur) are colourless to light yellow (and may be dyed red for taxation purposes). Regular sulphur diesel fuels (0.05-0.50 % sulphur) may be colourless to yellow / brown and are usually dyed red for taxation purposes.	**Pour Point**	Variable, 0°C to -50°C (32°F to -58°F)
Odour	Petroleum oil like.	**Softening Point**	Not applicable.
Odour Threshold	Not available	**Dropping Point**	Not applicable.
Boiling Point	150-371°C (302-700°F)	**Penetration**	Not applicable.
Density	0.85 kg/L @ 15°C (Water = 1).	**Oil / Water Dist. Coefficient**	Not available
Vapour Density	4.5 (Air = 1)	**Ionicity (in water)**	Not applicable.

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Vapour Pressure	1.0 kPa @ 20°C (7.5 mmHg @ 68°F).	**Dispersion Properties**	Not available
Volatility	<0.1 (Butyl acetate = 1), less than gasoline.	**Solubility**	Insoluble in cold water, soluble in non-polar hydrocarbon solvents.

Section 10. Stability and Reactivity

Corrosivity	Not available		
Stability	The product is stable under normal handling and storage conditions.	**Hazardous Polymerization**	Will not occur under normal working conditions.
Incompatible Substances / Conditions to Avoid	Reactive with oxidizing agents and acids.	**Decomposition Products**	May release COx, NOx, SOx, H2S, H2O, smoke and irritating vapours when heated to decomposition.

Section 11. Toxicological Information

Routes of Entry	Skin contact, eye contact, inhalation, and ingestion.
Acute Lethality	Acute oral toxicity (LD50): 7500 mg/kg (rat).
Chronic or Other Toxic Effects	
Dermal Route:	Skin contact may cause moderate to severe irritation. Repeated exposure would produce drying and cracking or defatting dermatitis.
Inhalation Route:	Inhalation of vapours can cause CNS depression with symptoms of nausea, headaches, vomiting, dizziness, fatigue, light-headedness, reduced coordination, unconciousness and possibly death. Inhalation can also cause irritation of nose and throat.
Oral Route:	Aspiration of liquid drops into the lungs may produce potentially fatal chemical pneumonitis (fluid in the lungs), severe lung damage, or respiratory failure.
Eye Irritation/Inflammation:	Eye contact may cause mild irritation, but no permanent damage.
Immunotoxicity:	Not available
Skin Sensitization:	This product is not expected to be a skin sensitizer, based on the available data and the known hazards of the components.
Respiratory Tract Sensitization:	This product is not expected to be a respiratory tract sensitizer, based on the available data and the known hazards of the components.
Mutagenic:	This product is not expected to be a mutagen, based on the available data and the known hazards of the components.
Reproductive Toxicity:	This product is not expected to be a reproductive hazard, based on the available data and the known hazards of the components.
Teratogenicity/Embryotoxicity:	This product is not expected to be a teratogen or an embryotoxin, based on the available data and the known hazards of the components.
Carcinogenicity (ACGIH):	ACGIH Notice of Intended Changed (2000): proposed A3: animal carcinogen. [Diesel oil]
Carcinogenicity (IARC):	This product is not known to contain any chemicals at reportable quantities that are listed as group 1, 2A or 2B carcinogens by IARC.
Carcinogenicity (NTP):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by NTP.
Carcinogenicity (IRIS):	Not available
Carcinogenicity (OSHA):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by OSHA.
Other Considerations	No additional remark.

Section 12. Ecological Information

Environmental Fate	Not available	**Persistance/ Bioaccumulation Potential**	Not available
BOD5 and COD	Not available	**Products of Biodegradation**	Not available
Additional Remarks	No additional remark.		

Continued on Next Page

Section 13. Disposal Considerations

Waste Disposal Preferred waste management priorities are: (1) recycle or reprocess; (2) incineration with energy recovery; (3) disposal at licensed waste disposal facility. Ensure that disposal or reprocessing is in compliance with government requirements and local disposal regulations. Consult your local or regional authorities.

Section 14. Transport Information

TDG Classification	Diesel Fuel UN1202 3 III	**Special Provisions for Transport**	Not applicable.

Section 15. Regulatory Information

Other Regulations This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List).

All components of this formulation are listed on the US EPA-TSCA Inventory.

All components of this product are on the European Inventory of Existing Commercial Chemical Substances (EINECS).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

Please contact Product Safety for more information.

DSD/DPD (Europe)	Not evaluated.	**HCS (U.S.A.)**	CLASS: Irritating substance. CLASS: Target organ effects. CLASS: Combustible liquid having a flash point between 37.8°C (100°F) and 93.3°C (200°F).
ADR (Europe) (Pictograms)	NOT EVALUATED FOR EUROPEAN TRANSPORT NON ÉVALUÉ POUR LE TRANSPORT EUROPÉEN.	**DOT (U.S.A) (Pictograms)**	

HMIS (U.S.A.)

Health Hazard	2*
Fire Hazard	2
Reactivity	0
Personal Protection	H

NFPA (U.S.A.)

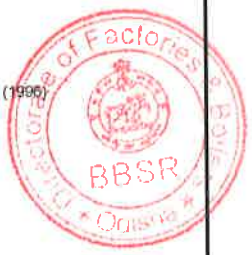
Rating
0 Insignificant
1 Slight
2 Moderate
3 High
4 Extreme

Section 16. Other Information

References Available upon request.
* Marque de commerce de Petro-Canada - Trademark

Glossary

ACGIH - American Conference of Governmental Industrial Hygienists
ADR - Agreement on Dangerous goods by Road (Europe)
ASTM - American Society for Testing and Materials (
BOD5 - Biological Oxygen Demand in 5 days
CAN/CGA B149.2 Propane Installation Code
CAS - Chemical Abstract Services
CEPA - Canadian Environmental Protection Act
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFR - Code of Federal Regulations
CHIP - Chemicals Hazard Information and Packaging Approved Supply List
COD5 - Chemical Oxygen Demand in 5 days
CPR - Controlled Products Regulations
DOT - Department of Transport
DSCL - Dangerous Substances Classification and Labeling (Europe)
DSD/DPD - Dangerous Substances or Dangerous Preparations Directives (Europe)
DSL - Domestic Substance List
EEC/EU - European Economic Community/European Union
EINECS - European Inventory of Existing Commercial Chemical Substances
EPCRA - Emergency Planning and Community Right to Know Act
FDA - Food and Drug Administration
FIFRA - Federal Insecticide, Fungicide and Rodenticide Act
HCS - Hazardous Communication System
HMIS - Hazardous Material Information System
IARC - International Agency for Research on Cancer
IRIS - Integrated Risk Information System
LD50/LC50 - Lethal Dose/Concentration kill 50%
LDLo/LCLo - Lowest Published Lethal Dose/Concentration
NAERG'96 - North American Emergency Response Guide Book (1996)
NFPA - National Fire Prevention Association
NIOSH - National Institute for Occupational Safety & Health
NPRI - National Pollutant Release Inventory
NSNR - New Substances Notification Regulations (Canada)
NTP - National Toxicology Program
OSHA - Occupational Safety & Health Administration
PEL - Permissible Exposure Limit
RCRA - Resource Conservation and Recovery Act
SARA - Superfund Amendments and Reorganization Act
SD - Single Dose
STEL - Short Term Exposure Limit (15 minutes)
TDG - Transportation Dangerous Goods (Canada)
TDLo/TCLo - Lowest Published Toxic Dose/Concentration
TLm - Median Tolerance Limit
TLV-TWA - Threshold Limit Value-Time Weighted Average
TSCA - Toxic Substances Control Act
USEPA - United States Environmental Protection Agency
USP - United States Pharmacopoeia
WHMIS - Workplace Hazardous Material Information System



For Copy of MSDS
Fuels & Solvents:
Western Canada, telephone: 403-296-4158; fax: 403-296-6551
Ontario & Central Canada, telephone: 1-800-668-0220; fax: 1-800-837-1228
Quebec & Eastern Canada, telephone: 514-640-8308; fax: 514-640-8385

For Product Safety Information: (905) 804-4752

Prepared by Product Safety - TAR on 3/2/2001.

Data entry by Product Safety - JDW.

Continued on Next Page

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

DIESEL FUEL No. 2

Product Use: Fuel
Product Number(s): CPS220122 [See Section 16 for Additional Product Numbers]
Synonyms: 15 S Diesel Fuel 2, Alternative Low Aromatic Diesel (ALAD), Calco LS Diesel 2, Calco ULS DF2, Calco ULS Diesel 2, Chevron LS Diesel 2, Chevron ULS Diesel 2, Diesel Fuel Oil, Diesel Grade No. 2, Diesel No. 2-D S15, Diesel No. 2-D S500, Diesel No. 2-D S5000, Distillates, straight run, Gas Oil, HS Diesel 2, HS Heating Fuel 2, Light Diesel Oil Grade No. 2-D, LS Diesel 2, LS Heating Fuel 2, Marine Diesel, RR Diesel Fuel, Texaco Diesel, Texaco Diesel No. 2, Ultra Low Sulfur Diesel 2
Company Identification
Chevron Products Company
Marketing, MSDS Coordinator
6001 Bollinger Canyon Road
San Ramon, CA 94583
United States of America

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
ChevronTexaco Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
MSDS Requests: (800) 689-3998 Technical Information: (510) 242-5357

SPECIAL NOTES: This MSDS covers all Chevron and Calco non-CARB Diesel No. 2 Fuels. The sulfur content is less than 0.5% (mass). Red dye is added to non-taxable fuel. (MSDS 6894)

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Diesel Fuel No. 2	68476-34-6	100 %wt/wt
Distillates, hydrodesulfurized, middle	64742-80-9	0 - 100 %wt/wt
Distillates, straight run middle (gas oil, light)	64741-44-2	0 - 100 %wt/wt
Kerosine	8008-20-6	0 - 25 %wt/wt
Kerosine, hydrodesulfurized	64742-81-0	0 - 25 %wt/wt
Distillates (petroleum), light catalytic cracked	64741-59-9	0 - 50 %wt/wt
Naphthalene	91-20-3	0.02 - 0.2 %wt/wt
Total sulfur	None	0 - 0.5 %wt/wt

SECTION 3 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW

- COMBUSTIBLE LIQUID AND VAPOR
- HARMFUL OR FATAL IF SWALLOWED - MAY CAUSE LUNG DAMAGE IF SWALLOWED
- CAUSES SKIN IRRITATION
- MAY CAUSE CANCER BASED ON ANIMAL DATA
- TOXIC TO AQUATIC ORGANISMS

****

IMMEDIATE HEALTH EFFECTS

Eye: Not expected to cause prolonged or significant eye irritation.
Skin: Contact with the skin causes irritation. Skin contact may cause drying or defatting of the skin. Symptoms may include pain, itching, discoloration, swelling, and blistering. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Because of its low viscosity, this material can directly enter the lungs, if swallowed, or if subsequently vomited. Once in the lungs it is very difficult to remove and can cause severe injury or death. May be irritating to mouth, throat, and stomach. Symptoms may include pain, nausea, vomiting, and diarrhea.
Inhalation: Mists of this material may cause respiratory irritation. Symptoms of respiratory irritation may include coughing and difficulty breathing. Breathing this material at concentrations above the recommended exposure limits may cause central nervous system effects. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death.

DELAYED OR OTHER HEALTH EFFECTS:

Cancer: Prolonged or repeated exposure to this material may cause cancer. Whole diesel engine exhaust has been classified as a Group 2A carcinogen (probably carcinogenic to humans) by the International Agency for Research on Cancer (IARC). Diesel exhaust particulate has been classified as reasonably anticipated to be a human carcinogen in the National Toxicology Program's Ninth Report on Carcinogens. The National Institute of Occupational Safety and Health (NIOSH) has recommended that whole diesel exhaust be regarded as potentially causing cancer. Diesel engine exhaust is known to the State of California to cause cancer. Contains naphthalene, which has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).
See Section 11 for additional information. Risk depends on duration and level of exposure.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.
Skin: Wash skin with water immediately and remove contaminated clothing and shoes. Get medical attention if any symptoms develop. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: If swallowed, get immediate medical attention. Do not induce vomiting. Never give

anything by mouth to an unconscious person.
Inhalation: Move the exposed person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if breathing difficulties continue.
Note to Physicians: Ingestion of this product or subsequent vomiting may result in aspiration of light hydrocarbon liquid, which may cause pneumonitis.

SECTION 5 FIRE FIGHTING MEASURES

See Section 7 for proper handling and storage.

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Combustible liquid.

NFPA RATINGS: Health: 0 Flammability: 2 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Pensky-Martens Closed Cup) 52 °C (125 °F) (Min)
Autoignition: 257 °C (494 °F)
Flammability (Explosive) Limits (% by volume in air): Lower: 0.6 Upper: 4.7

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in the vicinity of the spill or released vapor. If this material is released into the work area, evacuate the area immediately. Monitor area with combustible gas indicator.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. All equipment used when handling the product must be grounded. A vapor suppressing foam may be used to reduce vapors. Use clean non-sparking tools to collect absorbed material. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: Liquid evaporates and forms vapor (fumes) which can catch fire and burn with explosive force. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches. Fire hazard is greater as liquid temperature rises above 29C (85F). Do not get in eyes, on skin, or on clothing. Do not

taste or swallow. Do not breathe vapor or fumes. Do not breathe mist. Wash thoroughly after handling. Keep out of the reach of children.
Unusual Handling Hazards: WARNING! Do not use as portable heater or appliance fuel. Toxic fumes may accumulate and cause death.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
General Storage Information: DO NOT USE OR STORE near heat, sparks, flames, or hot surfaces . USE AND STORE ONLY IN WELL VENTILATED AREA. Keep container closed when not in use.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended exposure limits.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: Wear protective clothing to prevent skin contact. Selection of protective clothing may include gloves, apron, boots, and complete facial protection depending on operations conducted. Suggested materials for protective gloves include: Chlorinated Polyethylene (or Chlorosulfonated Polyethylene), Nitrile Rubber, Polyurethane, Viton.
Respiratory Protection: Determine if airborne concentrations are below the recommended occupational exposure limits for jurisdiction of use. If airborne concentrations are above the acceptable limits, wear an approved respirator that provides adequate protection from this material, such as: Air-Purifying Respirator for Organic Vapors. When used as a fuel, this material can produce carbon monoxide in the exhaust. Determine if airborne concentrations are below the occupational exposure limit for carbon monoxide. If not, wear an approved positive-pressure air-

supplying respirator. Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Agency	TWA	STEL	Ceiling	Notation
Diesel Fuel No. 2	ACGIH	100 mg/m3	--	--	Skin A3 total hydrocarbon
Diesel Fuel No. 2	CVX	--	1000 mg/m3	--	--
Kerosine	ACGIH	200 mg/m3	--	--	Skin A3 Total hydrocabon vapor
Kerosine	CVX	--	1000 mg/m3	--	--
Kerosine, hydrodesulfurized	ACGIH	200 mg/m3	--	--	Skin A3 Total hydrocabon vapor
Kerosine, hydrodesulfurized	CVX	--	1000 mg/m3	--	--
Naphthalene	ACGIH	10 ppm (weight)	15 ppm (weight)	--	Skin
Naphthalene	OSHA Z-1	50 mg/m3	--	--	--

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Varies depending on specification
Physical State: Liquid
Odor: Petroleum odor
pH: Not Applicable
Vapor Pressure: 0.04 kPa (Approximate) @ 40 °C (104 °F)
Vapor Density (Air = 1): >1
Boiling Point: 175.6°C (348°F) - 370°C (698°F)
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: Not Applicable
Specific Gravity: 0.8 - 0.88 @ 15.6°C (60.1°F) (Typical)
Viscosity: 1.9 cSt - 4.1 cSt @ 40°C (104°F)

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: This material did not cause skin sensitization reactions in a Buehler guinea pig test.
Acute Dermal Toxicity: LD50: >5ml/kg (rabbit).
Acute Oral Toxicity: LD50: > 5 ml/kg (rat)
Acute Inhalation Toxicity: 4 hour(s) LC50: > 5mg/l (rat).

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains gas oils.
CONCAWE (product dossier 95/107) has summarized current health, safety and environmental data available for a number of gas oils, typically hydrodesulfurized middle distillates, CAS 64742-80-9, straight-run middle distillates, CAS 64741-44-2, and/or light cat-cracked distillate CAS 64741-59-9. CARCINOGENICITY: All materials tested have caused the development of skin tumors in mice, but all featured severe skin irritation and sometimes a long latency period before tumors developed. Straight-run and cracked gas oil samples were studied to determine the influence of dermal irritation on the carcinogenic activity of middle distillates. At non-irritant doses the straight-run gas oil was not carcinogenic, but at irritant doses, weak activity was demonstrated. Cracked gas oils, when diluted with mineral oil, demonstrated carcinogenic activity irrespective of the occurrence of skin irritation. Gas oils were tested on male mice to study tumor initiating/promoting activity. The results demonstrated that while a straight-run gas oil sample was neither an initiator or promotor, a blend of straight-run and FCC stock was both a tumor initiator and a promoter.
GENOTOXICITY: Hydrotreated & hydrodesulfurized gas oils range in activity from inactive to weakly positive in in-vitro bacterial mutagenicity assays. Mouse lymphoma assays on straight-run gas oils without subsequent hydrodesulphurization gave positive results in the presence of S9 metabolic activation. In-vivo bone marrow cytogenetics and sister chromatic exchange assay exhibited no activity for straight-run components with or without hydrodesulphurization. Thermally or catalytically cracked gas oils tested with in-vitro bacterial mutagenicity assays in the presence of S9 metabolic activation were shown to be mutagenic. In-vitro sister chromatic exchange assays on cracked gas oil gave equivocal results both with and without S9 metabolic activation. In-vivo bone marrow cytogenetics assay was inactive for two cracked gas oil samples. Three hydrocracked gas oils were tested with in-vitro bacterial mutagenicity assays with S9, and one of the three gave positive results. Twelve distillate fuel samples were tested with in-vitro bacterial mutagenicity assays & with S9 metabolic activation and showed negative to weakly positive results. In one series, activity was shown to be related to the PCA content of samples tested. Two in-vivo studies were also conducted. A mouse dominant lethal assay was negative for a sample of diesel fuel. In the other study, 9 samples of No 2 heating oil containing 50% cracked stocks caused a slight increase in the number of chromosomal aberrations in bone marrow cytogenetics assays. DEVELOPMENTAL TOXICITY: Diesel fuel vapor did not cause fetotoxic or teratogenic effects when pregnant rats were exposed on days 6-15 of pregnancy. Gas oils were applied to the skin of pregnant rats daily on days 0-19 of gestation. All but one (coker light gas oil) caused fetotoxicity (increased resorptions, reduced litter weight, reduced litter size) at dose levels that were also maternally toxic.

This product contains naphthalene. GENERAL TOXICITY: Exposure to naphthalene has been reported to cause methemoglobinemia and/or hemolytic anemia, especially in humans deficient in the enzyme glucose-6-phosphate dehydrogenase. Laboratory animals given repeated oral doses of naphthalene have developed cataracts. REPRODUCTIVE TOXICITY AND BIRTH DEFECTS:

Naphthalene did not cause birth defects when administered orally to rabbits, rats, and mice during pregnancy, but slightly reduced litter size in mice at dose levels that were lethal to the pregnant females. Naphthalene has been reported to cross the human placenta. GENETIC TOXICITY: Naphthalene caused chromosome aberrations and sister chromatid exchanges in Chinese hamster ovary cells, but was not a mutagen in several other in-vitro tests. CARCINOGENICITY: In a study conducted by the National Toxicology Program (NTP), mice exposed to 10 or 30 ppm of naphthalene by inhalation daily for two years had chronic inflammation of the nose and lungs and increased incidences of metaplasia in those tissues. The incidence of benign lung tumors (alveolar/bronchiolar adenomas) was significantly increased in the high-dose female group but not in the male groups. In another two-year inhalation study conducted by NTP, exposure of rats to 10, 30, and 60 ppm naphthalene caused increases in the incidences of a variety of nonneoplastic lesions in the nose. Increases in nasal tumors were seen in both sexes, including olfactory neuroblastomas in females at 60 ppm and adenomas of the respiratory epithelium in males at all exposure levels. The relevance of these effects to humans has not been established. No carcinogenic effect was reported in a 2-year feeding study in rats receiving naphthalene at 41 mg/kg/day.

This product may contain significant amounts of Polynuclear Aromatic Hydrocarbons (PAH's) which have been shown to cause skin cancer after prolonged and frequent contact with the skin of test animals. Brief or intermittent skin contact with this product is not expected to have serious effects if it is washed from the skin. While skin cancer is unlikely to occur in human beings following use of this product, skin contact and breathing, of mists, vapors or dusts should be reduced to a minimum.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
96 hour(s) LC50: 21-210 mg/l (Salmo gairdneri)
48 hour(s) EC50: 20-210 mg/l (Daphnia magna)
72 hour(s) EC50: 2.6-25 mg/l (Raphidocellus subcapitata)
This material is expected to be toxic to aquatic organisms.

ENVIRONMENTAL FATE
On release to the environment the lighter components of diesel fuel will generally evaporate but depending on local environmental conditions (temperature, wind, mixing or wave action, soil type, etc.) the remainder may become dispersed in the water column or absorbed to soil or sediment. Diesel fuel would not be expected to be readily biodegradable. In a modified Strum test (OECD method 301B) approximately 40% biodegradation was recorded over 28 days. However, it has been shown that most hydrocarbon components of diesel fuel are degraded in soil in the presence of oxygen. Under anaerobic conditions, such as in anoxic sediments, rates of biodegradation are negligible.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: GAS OIL, Combustible Liquid, UN1202,III
IMO/IMDG Shipping Description: GAS OIL,3,UN1202,III, FLASH POINT SEE SECTION 5
ICAO/IATA Shipping Description: GAS OIL,3,UN1202,III,

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES:

1. Immediate (Acute) Health Effects: YES 2. Delayed (Chronic) Health Effects: YES
3. Fire Hazard: YES 4. Sudden Release of Pressure Hazard: NO 5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK
	07=PA RTK

The following components of this material are found on the regulatory lists indicated.

Diesel Fuel No. 2	07
Distillates, straight run middle (gas oil, light)	06
Kerosine	05, 06, 07
Naphthalene	01-2B, 02, 03, 04, 05, 06, 07

CERCLA REPORTABLE QUANTITIES(RQ)/EPCRA 302 THRESHOLD PLANNING QUANTITIES(TPQ):

Component	Component RQ	Component TPQ	Product RQ
Naphthalene	100 lbs	None	55556 lbs

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AICS (Australia), DSL (Canada), EINECS (European Union), IECSC (China), KECI (Korea), PICCS (Philippines), TSCA (United States).

NEW JERSEY RTK CLASSIFICATION:
Refer to components listed in Section 2. Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: DIESEL FUEL

WHMIS CLASSIFICATION:
Class B, Division 3: Combustible Liquids
Class D, Division 2, Subdivision A: Very Toxic Material - Carcinogenicity
Class D, Division 2, Subdivision B: Toxic Material - Skin or Eye Irritation

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 2 Reactivity: 0

(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

Additional Product Number(s): CPS225114, CPS225115, CPS225150, CPS266176, CPS270005, CPS270094, CPS270095, CPS270096, CPS271006, CPS272093, CPS272102, CPS272126, CPS272152, CPS272185, CPS272190, CPS272195, CPS272593, CPS272601, CPS272693, CPS272793, CPS273003, CPS273030, CPS273053, CPS275000
REVISION STATEMENT: This revision updates the following sections of this Material Safety Data Sheet: 1,8
Revision Date: 02/14/2006

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - ChevronTexaco	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Texaco Energy Research & Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Topaz Energy Ltd

Safety Data Sheet

Issued ; 1st December 2005

SDS No. DMC04007

Low Sulphur Heavy Fuel Oil

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY

Product name: Heavy Fuel Oil

Product code: HFO

Product type: Fuel for use in industrial combustion equipment.

Supplier: Topaz Energy Ltd

Address: Beech Hill,
Clonskeagh, Dublin 4

Contact numbers:

Telephone: +353 1 202 8888
Telex: 93634
Fax: + 353 1 283 8320

Emergency telephone number:

Emergency Cover +353 1 808 8232

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substance formal name: Fuel oil, residual - The liquid product from various refinery streams, usually residues. The composition is complex and varies with the source of the crude oil.

Synonyms: HFO, RFO, Residual Fuel Oil, Black Oil, Fuel Oil.

CAS number: 68476-33-5

Dangerous components/constituents:

Component name	CAS number	Content range	EC hazard	R phrases
Fuel oil, residual	68476-33-5	100 %(m/m)	Carc Cat 2	R45

Note: EU Dangerous Substances Directive, 67/548/EEC, Annex I number for the above substance is 649-024-00-9.

Contains the following substances for which exposure limits apply: hydrogen sulphide.

Other information: Contains cracked components in which polycyclic aromatic compounds, mainly 3-ring but some 4- to 6-ring species, are present. Contains sulphur, oxygen and nitrogen compounds. Contains organo-metallic compounds. Hydrogen sulphide may be present both in the liquid and vapour.

3. HAZARDS IDENTIFICATION

Human health hazards: May cause cancer. Product classified as a Category 2 carcinogen. Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis. Under conditions of poor personal hygiene, excessive exposure may lead to irritation, oil acne and folliculitis and development of warty growths which may subsequently become malignant. Prolonged exposure to vapour concentrations may affect the central nervous system. Hydrogen sulphide may accumulate in the head space of containers. Hydrogen sulphide is very toxic by inhalation and is an asphyxiant.

Safety hazards: Not classified as flammable, but will burn. Therefore it should be treated as a potentially flammable liquid. Flammable vapours may be present even at temperatures below the flash point.

Environmental hazards: Harmful to aquatic organisms. May cause long-term adverse effects in the aquatic environment. Not readily biodegradable. Has the potential to bioaccumulate. Persists under anaerobic conditions.

4. FIRST AID MEASURES

Symptoms and effects: Exposure to hydrogen sulphide at concentrations above the recommended occupational exposure standard may cause headache, dizziness, irritation of the eyes, upper respiratory tract, mouth and digestive tract, convulsions, respiratory paralysis, unconsciousness and even death. Unconsciousness as a result of exposure to hydrogen sulphide may occur extremely rapidly and without other symptoms.
Contact with hot product may cause skin burns, including to the underlying skin. Owing to its high viscosity, this product does not normally constitute an ingestion hazard. Ingestion will only occur in grossly abnormal circumstances. If ingested can lead to irritation of the mouth, irritation of the throat, irritation of the digestive tract, vomiting. Aspiration into the lungs may occur directly or following ingestion. This can cause chemical pneumonitis which may be fatal. Prolonged exposure to vapour/mist concentrations above the recommended occupational exposure standard may cause headache, dizziness, nausea, asphyxiation, unconsciousness and even death.

Protection of first aiders: Wear self-contained breathing apparatus if presence of hydrogen sulphide is suspected.

First Aid - Inhalation: Remove to fresh air. If breathing but unconscious, place in the recovery position. If breathing has stopped, apply artificial respiration. If heartbeat absent give external cardiac compression. Monitor breathing and pulse. OBTAIN MEDICAL ATTENTION IMMEDIATELY.

First Aid - Skin: If high pressure injection injuries occur, obtain medical attention immediately. In the case of burns, wash skin thoroughly with water using soap if available. Do not use kerosine, gasoline or solvents. Contaminated clothing must be removed as soon as possible. It must be laundered before reuse. If persistent irritation occurs, obtain medical attention.

First Aid - Eye:	Flush eye with water. If persistent irritation occurs or if there is any suspicion of damage from hot product, obtain medical attention immediately.
First Aid - Ingestion:	DO NOT DELAY. Do not induce vomiting. Protect the airway if vomiting begins. Give nothing by mouth. If breathing but unconscious, place in the recovery position. If breathing has stopped, apply artificial respiration. OBTAIN MEDICAL ATTENTION IMMEDIATELY.
Advice to physicians:	Treat symptomatically. High-pressure injection injuries require early surgical intervention and possible steroid therapy to minimise tissue damage and loss of nerve function. X-ray examination is required to assess the extent of the injury. Local anaesthetics or hot soaks should not be used with such injuries since they can contribute to local swelling, vasospasm and ischaemia. Prompt surgical decompression, debridement and evacuation of foreign bodies should be carried out under general anaesthetic. Because injected material may be deposited at some distance from the point of injection, wide exploration is essential. Prolonged exposure to high concentrations of hydrogen sulphide may lead to a delayed chemical pneumonitis (pulmonary oedema). In cases of excessive inhalation, observe in hospital for 48 hours for signs of pulmonary oedema. Diagnosis of ingestion of this product is by the characteristic odour on the victim's breath and from the history of events. In cases of ingestion, consider gastric lavage. Gastric lavage must only be undertaken after cuffed endotracheal intubation in view of the risk of aspiration. In cases of chemical pneumonitis, antibiotic and corticosteroid therapy should be considered.

5. FIRE FIGHTING MEASURES

Specific hazards:	Hazardous combustion products may include: carbon monoxide, oxides of nitrogen, oxides of sulphur, unburnt hydrocarbons. Flammable vapours may be present even at temperatures below the flash point.
Extinguishing media:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable extinguishing media:	Water in a jet. Use of Halon extinguishers should be avoided for environmental reasons.
Other information:	Keep adjacent drums and tanks cool by spraying with water.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:	Remove all possible sources of ignition in the surrounding area and evacuate all personnel. Ventilate contaminated area thoroughly. Do not breathe: vapour, mists. Avoid contact with: skin, eyes and clothing.. Take off immediately all contaminated clothing.
Personal protection:	Wear: impervious overalls, PVC or nitrile rubber gloves, safety shoes or boots - chemical resistant, monogoggles.
Environmental precautions:	Prevent from entering into drains, ditches or rivers. Use appropriate containment to avoid environmental contamination.

Clean-up methods - small spillage:	Absorb or contain liquid with sand, earth or spill control material. Shovel up and place in a labelled sealable container for subsequent safe disposal. Do not disperse using water.
Clean-up methods - large spillage:	Transfer to a labelled, sealable container for product recovery or safe disposal. Otherwise treat as for small spillage.
Other information:	Local authorities should be advised if significant spillages cannot be contained. Observe all relevant local regulations. See Section 13 for information on disposal.

7. HANDLING AND STORAGE

Handling:	Although not classified as flammable, this product should be handled as a potentially flammable liquid. When using do not eat, drink or smoke. Only use in well-ventilated areas. Take precautionary measures against static discharges. Earth or bond all equipment.
Handling temperature:	50°C minimum.
Storage:	Locate tanks away from heat and other sources of ignition. Ensure heating coils are always covered with product (minimum 15 cm). Do not store in unsuitable, unlabelled or incorrectly labelled containers. Keep container tightly closed in a dry, well-ventilated place away from direct sunlight and other sources of heat or ignition. Prevent ingress of water. Drums should be correctly stacked to a maximum of 3 high. Keep in a bunded area.
Storage temperature:	40°C minimum.
Product transfer:	Electrostatic charges may be generated during pumping. Ensure electrical continuity by bonding all equipment. Wait 10 minutes after tank filling before opening hatches or manholes.
Tank cleaning:	Cleaning, inspection and maintenance of storage tanks is a specialist operation which requires the implementation of strict procedures and precautions. These include issuing of work permits, gas-freeing of tanks, using a manned harness and lifelines and wearing air-supplied breathing apparatus. Prior to entry and whilst cleaning is underway, the atmosphere within the tank must be monitored using an oxygen meter and/or explosimeter. In addition, appropriate electrochemical sensors or colorimetric tubes must be used to check for the presence of hydrogen sulphide.
Recommended materials:	For containers, use mild steel, stainless steel. For seals and gaskets, use: compressed asbestos fibre, PTFE, Viton A, Viton B
Unsuitable materials:	Examples of materials to avoid are: cadmium, copper, copper alloys (ferrous and non-ferrous), lead, zinc, zinc alloys. Synthetic materials such as plastics and fibreglass may also be unsuitable, depending on the material specification and intended use. Materials for packages, containers (including containers for the retention or despatch of samples) and container linings must not adversely affect the quality of the product. They must be impermeable and must not be weakened or otherwise affected by the product. Examples of materials to avoid are: natural rubber, thermoplastics.
Other information:	Ensure that all local regulations regarding handling and storage facilities are followed.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational exposure standards: ACGIH threshold limit values are given below. Lower exposure limits may apply locally.

Name	Limit type	Value	Unit	Other information
Hydrogen sulphide	TWA	14	mg/m^3	
Hydrogen sulphide	STEL	21	mg/m^3	

Note: ACGIH - 'Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices', American Conference of Governmental Hygienists, Cincinnati, Ohio, 1996 edition.

Respiratory protection: Not normally required. In a confined space self-contained breathing apparatus may be required.

Hand protection: PVC or nitrile rubber gloves.

Eye protection: Monogoggles or full face shield if splashes are likely to occur.

Body protection: Wear overalls to minimise contamination of personal clothing. Launder overalls and undergarments regularly. Safety shoes or boots - chemical resistant.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Semi-solid at ambient temperature
Colour: Dark brown Black
Odour: Characteristic
Initial boiling point: circa 160°C
Final boiling point: > 350°C
Vapour pressure: <0.1 kPa at 40 C
Density: <1010 kg/m^3 at 15 C
Kinematic viscosity: < 40 mm^2/s at 100 C
Vapour density (air=1): > 5 at 15°C
Flash point: 62°Cminimum (PMCC)
Flammability limit - lower: circa 0.5 %(V/V)
Flammability limit - upper: circa 5 %(V/V)
Auto-ignition temperature: 220-300°C
Explosive properties: In use, may form flammable/explosive vapour-air mixture
Oxidizing properties: Not applicable
Solubility in water: Data not available
n-octanol/water partition coefficient: log P_{ow} = 3-7
Evaporation rate: Data not available

10. STABILITY/REACTIVITY

Stability: Stable.

Conditions to avoid: Heat, flames and sparks.

Materials to avoid:	Strong oxidizing agents.
Hazardous decomposition products:	None known.

11. TOXICOLOGICAL INFORMATION

Basis for assessment:	Toxicological data have not been determined specifically for this product. Information given is based on a knowledge of the toxicology of similar products.
Acute toxicity - oral:	LD_{50} expected to be >5000 mg/kg.
Acute toxicity - dermal:	LD_{50} expected to be above 2000 mg/kg.
Acute toxicity - inhalation:	LC_{50} expected to be >5 mg/l.
Eye irritation:	Expected to be slightly irritant.
Skin irritation:	Expected to be slightly irritant.
Skin sensitization:	Not expected to be a skin sensitizer.
(Sub) chronic toxicity:	Repeated skin exposure may cause moderate to severe irritation. Repeated exposure causes kidney damage in rabbits.
Carcinogenicity:	Dermal application to mice expected to cause tumours.
Mutagenicity:	Not considered to be a mutagenic hazard.
Reproductive toxicity:	May cause slight foetotoxicity in rats at doses which are maternally toxic.
Human effects:	Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis. Under conditions of poor personal hygiene, excessive exposure may lead to irritation, oil acne and folliculitis and development of warty growths which may subsequently become malignant. Excessive and prolonged exposure to mists may cause chronic inflammation of the lungs and a form of pulmonary fibrosis. See Section 4 for information regarding acute effects to humans.

Comment [A J C1]: Page: 6 Library Phrase has "expected to"

12. ECOLOGICAL INFORMATION

Basis for assessment:	Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the ecotoxicology of similar products.
Mobility:	If it comes into contact with soil, it will strongly absorb to soil particles.
Persistence/degradability:	Not readily biodegradable. Persists under anaerobic conditions.
Bioaccumulation:	Has the potential to bioaccumulate.
Ecotoxicity:	Poorly soluble mixture. Harmful, 10 < LC/EC50 ≤ 100 mg/l, to aquatic organisms. (LC/EC_{50} expressed as the nominal amount of product required to prepare aqueous test extract). Low acute toxicity to mammals. May cause physical fouling of aquatic organisms.

Sewage treatment: Product is expected to be harmful, EC_{50} >10-100 mg/l, to organisms in sewage treatment plants. (EC_{50} expressed as the nominal amount of product required to prepare aqueous test extract).

13. DISPOSAL CONSIDERATIONS

Precautions: See Section 8.

Waste disposal: Waste arising from a spillage or tank cleaning should be recycled or disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand. Do not dispose into the environment, in drains or in water courses.

Product disposal:

Container disposal: 200 litre drums should be emptied and returned to the supplier or sent to a drum conditioner without removing or defacing markings or labels. Drums should not be reused without first obliterating all markings.

Local legislation: Dangerous Substances (Conveyance of Petroleum by Road) Regulations 1979 - SI No 314 of 1979.

The European Communities (Waste Oils) Regulations 1992 - SI 399 of 1992.

Local Government (Water Pollution) (Amendment) Act 1990.

14. TRANSPORT INFORMATION

Not dangerous for conveyance under UN, IMO, ADR/RID and IATA/ICAO codes.

15. REGULATORY INFORMATION

EC Label name: Fuel oil, residual

EC Classification: Carcinogenic, category 2

EC Symbols: T

EC Risk Phrases:

R45	May cause cancer
R52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

EC Safety Phrases:

S53	Avoid exposure - obtain special instructions before use.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)
S61	Avoid release to the environment. Refer to special instructions/Safety data sheets.

EINECS (EC): All components listed

National legislation:

Dangerous Substances (Retail and Private Petroleum Stores) Regulations 1979 - SI No 311 of 1979.

Dangerous Substances (Conveyance of Petroleum by Road) Regulations 1979 - SI No 314 of 1979.

Safety, Health and Welfare at Work Act, 1993.

Local Government (Water Pollution) (Amendment) Act 1990.

The European Communities (Waste Oils) Regulations 1992 - SI 399 of 1992.

EC Directive 94/63/EC on VOC.

European Communities (Classification, Packaging, Labelling and Notification of Dangerous Substances) Regulations 1994 - SI No 77 of 1994.

European Communities (Dangerous Substances & Preparations Marketing and Use) Regulations 1994 - SI No 79 of 1994.

Other information:

16. OTHER INFORMATION

Uses and restrictions: Fuel for use in industrial combustion equipment. This product must not be used in applications other than the above without first seeking the advice of the supplier.

Technical contact point: PQE

Technical contact number:

Telephone: +353 1 202 8827
Telex: 93634
Fax: + 353 1 283 8318

SDS history:

Edition number: 3
First issued: June 25, 1993
Previous revisions: April 15, 1996
Revised: February 22nd 2001

Revisions highlighted: Section 2 and 12: recommended CONCAWE environmental classification for residual fuel oils added.
Sections 3, 4, 5, 6, 7, 8 and 11: Editorial changes.
Section 8: OELs for oil mist deleted.
Changes indicated by vertical bar on left of text.

SDS distribution: This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.

Other information:

References: Useful references include the following:
The Institute of Petroleum, London, 'Marketing Safety Code', Heyden and Son Limited, February 1978
Applied Science, London, 'European Model Code of Safe Practice in the Storage and Handling of Petroleum Products (1973) Part 1: Operations'

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not be construed as guaranteeing any specific property of the product.


Directorate of Factories & Boilers
BBSR
Odisha

MATERIAL SAFETY DATA SHEET
(CHLORINE)

I. PRODUCT IDENTIFICATION

Chemical Name : Chlorine
Trade Name : Liquid Chlorine
Synonyms : Liquefied chlorine gas, chlorine gas, chlor, Molecular chlorine, diatomic chlorine, Cl

II. COMPOSITION / INGREDIENTS

Liquid Chlorine, % : 99.99 % by volume
Chemical Formula : Cl_2
Molecular Weight : 70.90 g/mole
CAS Registry No. : 7782-50-5

III. HAZARDS IDENTIFICATION

EXPOSURE TO THIS PRODUCT IS :

Highly toxic agent via inhalation and ingestion. Primarily an intense respiratory irritant and a major potential hazard upon contact to skin and eyes. Sufficient concentration of the gas irritates the mucous membranes. It can cause pulmonary edema. Liquid chlorine in contact with skin will cause frostbite, smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. Vapors will cause severe irritation of eyes and throat and can cause eye and lung injury. Vapors cannot be tolerated even at low concentrations. In extreme cases, difficulty of breathing may increase to the point where death can occur from suffocation. The characteristic, penetrating odor of chlorine gas gives warning of its presence in the air.

IV. FIRST AID MEASURES

GENERAL:

Prompt treatment of anyone overcome or seriously exposed to chlorine, is of utmost importance. The patient should be removed from contaminated area. Obtain medical assistance as soon as possible.

CONTACT WITH SKIN OR MUCOUS MEMBRANES: Immediately wash contaminated skin and clothing with copious amounts of water for a minimum of 15 minutes. Contaminated clothing should be removed under the shower and the chlorine should be washed off with very large quantities of water. Skin areas should be washed with large quantities of soap and water. Never attempt to neutralize chlorine with chemicals. Salves and ointment should not be applied unless directed by a physician. Call or see a physician. (If victim has also inhaled chlorine, first aid for inhalation should be given first).

CONTACT WITH EYES: Immediately flush eyes with large amount of running water for at least 15 minutes even if minute quantities of liquid chlorine enter the eyes. Never attempt to neutralize with chemicals. The eyelids should be held apart during this period to ensure contact of water with accessible tissues of the eyes and lids. Call a physician, preferably and eye specialist, at once. If physician is not immediately available, the eye irrigation should be continued for a second period of 15 minutes. No oils or oily ointments, or any medications should be instilled unless ordered by the physician.

INHALATION: Remove victim from source of exposure. If breathing has not ceased, the patient should be placed in a comfortable position and be kept warm and remain at rest until medical help arrives. If breathing stops, administer artificial respiration. If available, oxygen should be administered. Call a physician.

INGESTION: Not pertinent, ingestion unlikely (chlorine is a gas above $-34.5\ ^{0}C$).

V. FIRE FIGHTING MEASURES

Autoignition Point : Not Applicable
Flash Point : Not Flammable
Flammability/Explosive limits : Not Flammable
Fire/Explosion Hazards: Toxic products are generated when combustibles burn with chlorine, although gas is not flammable.
Fire Prevention/ Extinguishing Media : Not Applicable

VI. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR RELEASE ;

Move people from the area. Move upwind. Avoid contact with acid. Stop leaks if safe to do so. Reposition container if this will reduce or stop leakage. If leak continues, remove leaking container from vehicle or move other materials from vehicle away from container. Never use water on a chlorine leak. Water will make the leak worst. If efforts to control leak fails, and the leakage continues, suitable provision should be available with all Chlorine from the leaking containers. Chlorine maybe absorbed in solution of caustic soda, soda ash or hydrated lime.

MATERIAL SAFETY DATA SHEET
(CHLORINE)

VII. HANDLING AND STORAGE

Storage Requirements: Protect against physical damage. Store outdoors or indoors in a well-ventilated, detached, or segregated area of noncombustible construction.
Incompatible Materials: Store away from heat. Separate from combustible, organic, or easily oxidizable materials and especially isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, and finely divided metals.
Containers: 50Kg, 68Kg and 1 Ton cylinders
Use Instructions: Wear suitable protective clothing, gloves and eye/face protection. In case of insufficient ventilation, wear suitable respiratory equipment.

EMERGENCY PROCEDURE for all emergencies – Shut off vehicle engine and any electrical equipment. Move people from immediate area; keep upwind. Consider initial evacuation distance of 100 meters in all directions. Send messenger, notify fire brigade telling them location, material, quantity, UN number and emergency contact as well as condition of vehicles and damaged observed. Do not move vehicle if movement could cause spillage. Warn traffic.

VIII. EXPOSURE CONTROLS AND PROTECTION

Ventilation: Use only in well-ventilated areas.
Protective Equipment for the eyes and skin :
Splash proof and face shield goggles, disposable latex/ rubber apron, PVC rain suits, rubber boots with pant legs over boots.
Respiratory Protection Requirements: NIOSH/MSHA approved respirator should be used.
Precautionary Hygiene/health/control measures :
Chlorine is not a serious industrial hazard if workers are adequately instructed and supervised in proper means of handling it. Avoid contact with skin, eyes, and clothing. Do not breathe mist or vapor. Wash thoroughly after handling. Safety showers and eye wash fountains should be available in storage and handling area. Any protective clothing contaminated with hydrochloric acid should be removed immediately and thoroughly laundered before wearing again.

IX PHYSICAL AND CHEMICAL PROPERTIES

STATE	: Gas at normal condition, liquefied compressed gas (as shipped)
APPEARANCE	: Greenish yellow gas, amber liquid in pressured container
ODOR	: characteristic choking/ pungent
BOILING POINT	: -34 ^{0}C = -29 ^{0}F at 1 atmosphere
FREEZING POINT	: - 101^{0}C = -150^{0}F
SPECIFIC GRAVITY	: Liquid = 1.467 at 0^{0}C, 1.424 at 15^{0}C Vapor (Gas) = 2.4
CRITICAL PRESSURE	: 76.05 atm = 1118 psia
CRITICAL TEMPERATURE:	144^{0}C = 291^{0}F
SOLUBILITY IN WATER:	slightly soluble

X. STABILITY AND REACTIVITY

Stability: Stable.
Hazardous polymerization will not occur.
Hazardous decomposition product: will not decompose.
Reactivity with water: Forms a corrosive solution. Weak solutions of hydrochloric acid and hypochlorous acids are formed. Highly corrosive in the presence of moisture.
Reactivity with metals: Reacts vigorously with most metals at high temperature. Copper may burn spontaneously.
Reactions with other elements: Unites with most elements under specific conditions. These reactions may be extremely rapid.
Reactions with Inorganic Compounds: Forms soda and lime bleaches (hypochlorites). Reacts with hydrogen sulfide, ammonia or ammonium compounds.
Reactions with Organic Compounds: May form chlorinated derivatives and hydrogen chloride.

XI. TOXICOLOGICAL INFORMATION

ACUTE TOXICITY: When a sufficient concentration of chlorine gas is present, it will irritate the mucous membranes, the respiratory system and the skin. Large amounts cause irritation of eyes, coughing and labored breathing. If the duration of exposure or the concentration of chlorine is excessive, general excitement of the person affected, accompanied by restlessness, throat irritation, and sneezing and copious salivation results. The symptoms of exposure to high concentrations are retching and vomiting, followed by difficult breathing. Chlorine produces no systemic effect. All symptoms and signs result directly or indirectly from the local irritant action.

CHRONIC TOXICITY: Low concentrations of chlorine gas in the air may have a minor irritating effect or may produce slight symptoms after several hours exposure, but careful examination of persons repeatedly exposed to such conditions reportedly have shown no chronic effect.

Reproductive Effects/Cancer Information: No data available

XII. ECOLOGICAL INFORMATION

ECOTOXICITY DATA: Combination of chlorine with ammonia, organic matter, and cyanide maybe detrimental to fish life.
WATER-POLLUTION RISK CLASSIFICATION: Harmful to aquatic life in very low concentrations

XIII. DISPOSAL CONSIDERATIONS

Add to large volume of concentrated reducer (hypo, a bisulfite, or a ferrous salt and acidify with 3M H2SO4). When reduction is complete, add soda ash or dilute HCl to neutralize.

Dispose of in accordance with all Government and Local regulations regarding health and safety.

MATERIAL SAFETY DATA SHEET
(CHLORINE)

XIV. TRANSPORT INFORMATION

Transportation of Dangerous Goods
TDG Classification: Do not ship by air.
DOT Hazard Classification: Nonflammable gas;
Label : Nonflammable gas and poison
DOT Shipping Name : Liquefied Chlorine Gas ID: UN 1017

XV. REGULATORY INFORMATION

No data available

XVI. OTHER INFORMATION

References:

1. Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W. Washington, D.C. 20009 Chemical Safety Data Sheet No. SD 80 "Chlorine" (1970)
2. Dangerous Properties of Industrial Material Report, Vol. 9, No. 4, 1989 "Chlorine"
3. "Chlorine Manual" Mabuhay Vinyl Corporation, Iligan City

Directorate of Factories & Boilers BBSR ODISHA

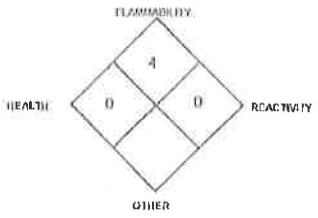
Airgas

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

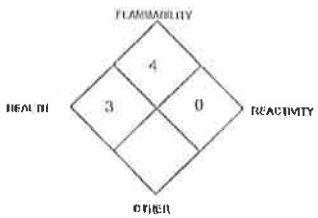
HYDROGEN GAS

NFPA RATING



LIQUID HYDROGEN

NFPA RATING



PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **HYDROGEN - H_2**
LIQUEFIED HYDROGEN- H_2 (Cryogenic)
Document Number: 001026

PRODUCT USE: For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.

ADDRESS: 259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253

EMERGENCY PHONE: 1-800-949-7937
International: 423-479-0293

DATE OF PREPARATION: May 20, 1996

DATE OF REVISION: October 22, 2002

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		NIOSH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Hydrogen	1333-74-0	99.99%	There are no specific exposure limits for Hydrogen. Hydrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					
Maximum Impurities		< 1% (100 ppm)	None of the trace impurities of this gas contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the Federal Occupational Safety and Health Administration Standard (29 CFR 1910.1200), U.S. State equivalent Standards and Canadian Workplace Hazardous Materials Identification System Standards (CPR 4).					

NE = Not Established. See Section 16 for Definitions of Terms Used.

NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Hydrogen is a colorless, odorless, flammable gas or a colorless, odorless, cryogenic liquid. The main health hazard associated with releases of this gas is asphyxiation, by displacement of oxygen. The liquefied gas can cause frostbite to any contaminated tissue. Hydrogen poses a serious fire hazard when it is accidentally released. Flame or high temperature impinging on a localized area of the cylinder of Hydrogen can cause the cylinder to rupture without activating the cylinder's relief devices. Provide adequate fire protection during emergency response situations.

HYDROGEN GAS

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	0
FLAMMABILITY HAZARD	(RED)	4
PHYSICAL HAZARD	(YELLOW)	0
PROTECTIVE EQUIPMENT		B

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For Routine Industrial Use and Handling Applications

LIQUID HYDROGEN

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	3
FLAMMABILITY HAZARD	(RED)	4
PHYSICAL HAZARD	(YELLOW)	0
PROTECTIVE EQUIPMENT		X

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For Routine Industrial Use and Handling Applications

See Section 16 for Definition of Ratings

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant route of overexposure for this gas is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

INHALATION: High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The following effects associated with various levels of oxygen are as follows:

CONCENTRATION	SYMPTOMS OF EXPOSURE
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

In addition, inhalation of very high levels of this gas may result in mild depression of the central nervous system. Symptoms can include headache, nausea, dizziness, drowsiness, incoordination, and confusion. Symptoms should be relieved upon removal to fresh air.

OTHER POTENTIAL HEALTH EFFECTS: Contact with cryogenic liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with liquid can quickly subside.

3. HAZARD IDENTIFICATION (Continued)

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Overexposure to Hydrogen may cause the following health effects:

ACUTE: The most significant hazard associated with this gas is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency includes respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, and, at high concentrations, unconsciousness or death may occur. The skin of a victim of over-exposure may have a blue color. High concentration inhalation exposure can also lead to mild central nervous system depression. Contact with cryogenic liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with liquid can quickly subside.

CHRONIC: Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may effect the heart and nervous system.

TARGET ORGANS: ACUTE: Respiratory system. CHRONIC: Heart, central nervous system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Remove victim(s) to a safe location. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area of the body in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None known.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: 571°C (1060°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 4.0%

Upper (UEL): 75.0%

FIRE EXTINGUISHING MATERIALS: Extinguish fires of this gas by shutting-off the source of the gas. Use water spray to cool fire-exposed structures and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited. **Hydrogen burns with an almost invisible blue flame.**

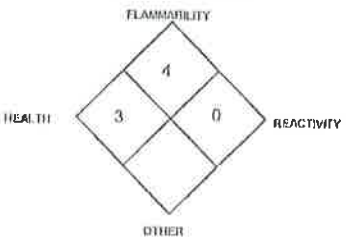
DANGER! Fires impinging (direct flame) on the outside surface of unprotected pressure storage vessels of Hydrogen can be very dangerous. Direct flame exposure on the cylinder wall can cause an explosion either by BLEVE (Boiling Liquid Expanding Vapor Explosion. This is a catastrophic failure of the vessel releasing the contents into a massive fireball and explosion. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the vessel. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

HYDROGEN GAS

NFPA RATING

LIQUID HYDROGEN

NFPA RATING



See Section 16 for Definition of Ratings

RESPONSE TO FIRE INVOLVING CRYOGEN: . Cryogenic liquids can be particularly dangerous during fires because of their potential to rapidly freeze water. Careless use of water may cause heavy icing. Furthermore, relatively warm water greatly increases the evaporation rate of Hydrogen. If large concentrations of Hydrogen gas are present , the water vapor in the surrounding air will condense, creating a dense fog that may make it difficult to find fire exits or equipment. Liquid Hydrogen, when exposed to the atmosphere, will produce a cloud of ice/fog in the air upon its release. A flammable mixture will exist within the vapor cloud, and it is advisable that personnel keep well outside the area of visible moisture.

Explosion Sensitivity to Mechanical Impact: Not Sensitive.

Explosion Sensitivity to Static Discharge: Static discharge may cause this gas to ignite explosively. Due to low electrical conductivity, this substance can generate electrostatic charges during handling operations.

5. FIRE-FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. The best fire-fighting technique may be simply to let the burning gas escape. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the still-leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. In this case, increase ventilation to prevent flammable or explosive mixture formation. Evacuation may be necessary. Refer to the North American Emergency Response Guidebook (Guide #115) for additional information.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area and protect people. Adequate fire protection must be provided. Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, mechanically-resistant gloves and Self-Contained Breathing Apparatus.** Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas, which is lighter than air, to dissipate. Monitor the surrounding area for combustible gas levels and oxygen. Combustible gas concentration must be below 10% of the LEL (LEL = 4.0%) prior to entry of response personnel. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.
RESPONSE TO CRYOGENIC RELEASE: Clear the affected area and allow the liquid to evaporate and the gas to dissipate. After the gas is formed, follow the instructions provided in the previous paragraph. If the area must be entered by emergency personnel, SCBA, Kevlar gloves, and appropriate foot and leg protection must be worn.
THIS IS AN EXTREMELY FLAMMABLE GAS. Protection of all personnel and the area must be maintained.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Hydrogen IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Hydrogen could occur without any significant warning symptoms.
STORAGE AND HANDLING PRACTICES: Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas. Note: Liquid Hydrogen must always be handled in air-tight systems specifically designed and installed for liquid Hydrogen, according to the appropriate standards, NFPA-50B, CGA G-5, G-5.3, G-5.4, and the supplier's internal specifications. Liquid Hydrogen must never be filled into or handled in open top or loosely capped Dewars. An atmospheric concentration of Hydrogen greater than the LEL will immediately be generated near the vicinity of the Dewar, creating an extreme fire and explosion hazard. This gas is lighter than air and must not be allowed to accumulate in elevated locations.
SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Isolate from oxidizers such as oxygen, chlorine, or fluorine. Use a check valve or trap in the discharge line to prevent hazardous backflow. Post "No Smoking or Open Flame" signs in storage and use areas. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to situations in which cylinders are being used:
Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap, if provided, in-place until cylinder is ready for use.
During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.
After Use: Close main cylinder valve. Replace valve protection cap, if provided. Mark empty cylinders "EMPTY".
NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with this product. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of manufacturer. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. For cryogenic liquids, refer to CGA P-12, *Safe Handling of Cryogenic Liquids* and CGA-5, *Hydrogen*, and NFPA 50B, *Standard for Liquefied Hydrogen Systems at Consumer Sites*. Additionally, refer to CGA Bulletin SB-2 "*Oxygen Deficient Atmospheres*".

7. HANDLING and STORAGE (Continued)

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to maintain oxygen levels above 19.5% in the workplace. Local exhaust ventilation is preferred, because it prevents Hydrogen dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially explosive air-gas mixtures. Monitoring devices should be installed near the ceiling.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations, or the Canadian CSA Standard Z94.4-93 and applicable standards of Canadian Provinces. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Splash goggles or safety glasses, for protection from rapidly expanding gases and splashes of liquid Hydrogen. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or Canadian Standards.

HAND PROTECTION: Wear mechanically-resistant gloves when handling cylinders of Hydrogen. Use low-temperature protective gloves (e.g., Kevlar) when working with containers of Liquid Hydrogen. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well as fire retardant items. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR.

9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY 21.1°C & 1 atm: 0.08342 kg/m^3 (0.00521 lb/ft^3)
SPECIFIC GRAVITY @ 0°C and 1 atm (air = 1): 0.069
SOLUBILITY IN WATER v/v @ 15.6°C: 0.019
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not applicable.
SPECIFIC VOLUME @ 21.1°C & 1 atm: 192 ft^3/lb (11.99 m^3/kg)
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
APPEARANCE AND COLOR: Hydrogen is a colorless, odorless gas.

pH: Not applicable.
TRIPLE POINT: -259°C (-434.6°F)
BOILING POINT(@ 1 atm.): -252.8 °C (-423.0°F)
EXPANSION RATIO: Approximately 850.
VAPOR PRESSURE (psia): Not applicable.
MOLECULAR WEIGHT: 2.016
MELTING POINT: -259°C (-434.6°F)

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no unusual warning properties associated with a release of Hydrogen. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation. NOTE: This gas is lighter than air and must not be allowed to accumulate in elevated locations.

10. STABILITY and REACTIVITY

STABILITY: Stable.
DECOMPOSITION PRODUCTS: Hydrogen. When ignited in the presence of oxygen, water will be produced.
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong oxidizers (e.g., chlorine, bromine, oxygen, oxygen difluoride, and nitrogen trifluoride). Oxygen/Hydrogen mixtures can explode on contact with a catalyst such as platinum.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: There are no specific toxicology data for Hydrogen. Hydrogen is a simple asphyxiant, which acts to displace oxygen in the environment.
SUSPECTED CANCER AGENT: Hydrogen is not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with rapidly expanding gases can be irritating to exposed skin and eyes.
SENSITIZATION OF PRODUCT: Hydrogen is not a sensitizer after prolonged or repeated exposure.

11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Hydrogen on the human reproductive system.

Mutagenicity: Hydrogen is not expected to cause mutagenic effects in humans.

Embryotoxcity: No embryotoxic effects have been described for Hydrogen.

Teratogenicity: Hydrogen is not expected to cause teratogenic effects in humans.

Reproductive Toxicity: Hydrogen is not expected to cause adverse reproductive effects in humans.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Hydrogen.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Hydrogen occurs naturally in the atmosphere. The gas will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments. No adverse effect is anticipated to occur to plant-life, except for frost produced in the presence of rapidly expanding gases.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of Hydrogen on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed of in accordance with appropriate U.S. Federal, State, and local regulations or with regulations of Canada and its Provinces. Return cylinders with residual product to Airgas, Inc. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS GAS IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

	Hydrogen Gas:	Hydrogen Liquid:
PROPER SHIPPING NAME:	Hydrogen, compressed	Hydrogen, refrigerated liquid
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1049	UN 1966
PACKING GROUP:	Not Applicable	Not Applicable
DOT LABEL(S) REQUIRED:	Class 2.1 (Flammable Gas)	Class 2.1 (Flammable Gas)

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 115 (Gas and Liquid)

MARINE POLLUTANT: Hydrogen is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

	Hydrogen Gas:	Hydrogen Liquid:
PROPER SHIPPING NAME:	Hydrogen, compressed	Hydrogen, refrigerated liquid
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1049	UN 1966
PACKING GROUP:	Not Applicable	Not Applicable
HAZARD LABEL(S) REQUIRED:	Class 2.1 (Flammable Gas)	Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS:	None	None
EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX:	0.12	0.12
ERAP INDEX:	3000	3000
PASSENGER CARRYING SHIP INDEX:	Forbidden	Forbidden
PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX:	Forbidden	Forbidden

MARINE POLLUTANT: Hydrogen is not Marine Pollutants

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: Hydrogen is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL U.S. REGULATIONS (continued):

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for Hydrogen. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. TSCA INVENTORY STATUS: Hydrogen is listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITIES (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS: Hydrogen is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 lb. Depending on specific operations involving the use of Hydrogen, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Hydrogen is not listed in Appendix A, however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lb (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

U.S. STATE REGULATORY INFORMATION: Hydrogen is covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Hydrogen.
California - Permissible Exposure Limits for Chemical Contaminants: Hydrogen.
Florida - Substance List: Hydrogen.
Illinois - Toxic Substance List: Hydrogen.
Kansas - Section 302/313 List: None.
Massachusetts - Substance List: Hydrogen.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: Hydrogen.
Missouri - Employer Information/Toxic Substance List: Hydrogen.
New Jersey - Right to Know Hazardous Substance List: Hydrogen.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: None.
Pennsylvania - Hazardous Substance List: Hydrogen.
Rhode Island - Hazardous Substance List: Hydrogen.
Texas - Hazardous Substance List: None.
West Virginia - Hazardous Substance List: None.
Wisconsin - Toxic and Hazardous Substances: None.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Hydrogen is not on the California Proposition 65 lists.

CGA LABELING:

DANGER:
FLAMMABLE HIGH PRESSURE GAS.
CAN FORM EXPLOSIVE MIXTURES WITH AIR.
MAY IGNITE IF VALVE IS OPENED TO AIR.
BURNS WITH AN INVISIBLE FLAME.
Keep away from heat, flames, and sparks.
Store and use width adequate ventilation.
Do not open valve until connected to utilization equipment.
Use equipment rated for cylinder pressure.
Approach suspected leak area with caution.
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

FIRST-AID:
IN CASE OF FROSTBITE, obtain immediate medial attention.
DO NOT REMOVE THIS PRODUCT LABEL.

CGA LABELING (for Liquid):

WARNING:
EXTREMELY COLD FLAMMABLE LIQUID AND GAS UNDER PRESSURE.
CAN FORM EXPLOSIVE MIXTURES WITH AIR.
CAN CAUSE SEVERE FROSTBITE.
BURNS WITH AN INVISIBLE FLAME.
LIQUID OR COLD GAS CAN FREEZE AIR IN VENT LINES.
ALWAYS KEEP CONTAINER IN UPRIGHT POSITION.
Keep away from heat, flames, and sparks.
Store and use with adequate ventilation.
Do not get liquid in eyes, on skin, or clothing.
For liquid withdrawal, wear face shield and gloves.
Approach suspected leak area with caution.
Do not drop. Use hand truck for container movement.
See container manufacturer's operating instructions to avoid freezing air in vent lines.
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

FIRST-AID:
IN CASE OF FROSTBITE, obtain immediate medial attention.
DO NOT REMOVE THIS PRODUCT LABEL.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: Hydrogen is listed on the DSL Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: Hydrogen is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS: Class A: Compressed Gases
Class B1: Flammable Gas

16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
619/670-0609

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

SKIN: Used when a there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

IDLH-Immediately Dangerous to Life and Health: This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard: No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation*: Essentially non-irritating. PII or Draize = "0". *Eye Irritation*: Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD_{50} Rat*: < 5000 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC_{50} Rat*: < 20 mg/L.); 1 (Slight Hazard: Minor reversible injury may occur; slightly or mildly irritating. *Skin Irritation*: Slightly or mildly irritating. *Eye Irritation*: Slightly or mildly irritating. *Oral Toxicity LD_{50} Rat*: > 500-5000 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 1000-2000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 2-20 mg/L); 2 (Moderate Hazard: Temporary or transitory injury may occur. *Skin Irritation*: Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation*: Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD_{50} Rat*: > 50-500 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 200-1000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.5-2 mg/L.); 3 (Serious Hazard: Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation*: Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation*: Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD_{50} Rat*: > 1-50 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 20-200 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.05-0.5 mg/L.); 4 (Severe Hazard: Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation*: Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation*: Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD_{50} Rat*: ≤ 1 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: ≤ 20 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: ≤ 0.05 mg/L.).

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.); 1 (Slight Hazard-Materials that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]; 2 (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.); 3 (Serious Hazard- Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]); 4 (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric]).

PHYSICAL HAZARD:

0 (*Water Reactivity*: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. Unstable *Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No "0" rating allowed. *Unstable Reactives*: Substances that will not polymerize, decompose, condense or self-react.); 1 (*Water Reactivity*: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives*: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III; Solids: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.);

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

2 (*Water Reactivity*: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group II Solids: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature); 3 (*Water Reactivity*: Materials that may form explosive reactions with water. *Organic Peroxides*: Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives*: Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases*: Pressure ≥ 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group I Solids: any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. Liquids: Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); 4 (*Water Reactivity*: Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides*: Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives*: Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases*: No Rating. *Pyrophorics*: Add to the definition of Flammability "4". *Oxidizers*: No "4" rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.). PPE Rating B: Hand and eye protection is required for routine chemical use. PPE Rating C: Hand, eye, and body protection may be required for routine chemical use.

HMIS PERSONAL PROTECTION EQUIPMENT CODES:

A = Safety Glasses; B= Safety Glasses, Gloves; C = Safety Glasses, Gloves, Apron; D = ace Shield (w/ safety glasses), Gloves, Apron; E = Safety Glasses, Gloves, Dust Respirator; F = Safety Glasses, Gloves, Apron, Dust Respirator Safety Glasses, Gloves, Apron, Dust Respirator; G = Safety Glasses, Gloves, Chemical Vapor Respirator; H = Safety Glasses, Gloves, Apron, Chemical Vapor Respirator; I = Safety Glasses, Gloves, Combination Dust and Chemical Vapor Respirator; J= Safety Glasses, Gloves, Apron, Combination Dust and Chemical Vapor Respirator; K = Airline Hood or Mask, Gloves, Full Protective Suit, Boots; X = Situations Requiring Specialized Attention to PPE

DEFINITIONS OF TERMS (Continued)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

HEALTH HAZARD: 0 (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); 1 (materials that on exposure under fire conditions could cause irritation or minor residual injury); 2 (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); 3 (materials that can on short exposure could cause serious temporary or residual injury); 4 (materials that under very short exposure could cause death or major residual injury).
FLAMMABILITY HAZARD AND REACTIVITY HAZARD: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR: Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: LD_{50} - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; LC_{50} - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo, LDLo,** and **LDo,** or **TC, TCo, LCLo,** and **LCo,** the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA.** IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information: BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

ECOLOGICAL INFORMATION:

EC is the effect concentration in water. BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. TL_m = median threshold limit; Coefficient of Oil/Water Distribution is represented by log K_{ow} or log K_{oc} and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

U.S. and CANADA:

This section explains the impact of various laws and regulations on the material. ACGIH: American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. EPA is the U.S. Environmental Protection Agency. NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (OSHA). WHMIS is the Canadian Workplace Hazardous Materials Information System. DOT and TC are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (SARA); the Canadian Domestic/Non-Domestic Substances List (DSL/NDSL); the U.S. Toxic Substance Control Act (TSCA); Marine Pollutant status according to the DOT; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. OSHA - U.S. Occupational Safety and Health Administration.

Material Safety Data Sheet
SULPHURIC ACID

Print Date: March 2004

SECTION 1 – Chemical Product and Company Identification

MSDS Name: SULPHURIC ACID MSDS Preparation Date: 02-2004, Supersedes 02-2001, 02-98

Synonyms or Generic ID: Oil of vitriol, hydrogen sulphate, vitriol brown oil, matting acid, battery acid.
SEASTAR™ Product Codes: IQ-03-0500, IQ-03-2500, IQ-03-25SK, BA-03-0250, BA-03-0500, BA-03-1000, BA-03-2000
Canadian TDG Classification: 8 PKG Gr II **Formula:** H_2SO_4
PIN (UN# / NA#): UN1830 **Molecular Wt:** 98.08
Canadian WHMIS Class: Class E; Class D Div 1 Sub A; Class C.

Supplier: Seastar Chemicals Inc, PO Box 2219, 2045 Mills Road West, Sidney, BC, Canada V8L 3S8
Tel: (250) 655-5880, **Fax:** (250) 655-5888

CANUTEC (CAN): (613)-996-6666

SECTION 2 – Composition/Information on Ingredients

CAS #	*Chemical Name*	*Percent*	*EINECS/ELINCS*	*TLV*	*Hazard*
7664-93-9	Sulphuric Acid	73-98%	231-639-5	1 mg/m³	Corrosive
7732-18-5	Water	Balance	None	None	None

Hazard Symbols: C Risk Phrases: 35

SECTION 3 – Hazards Identification

EMERGENCY OVERVIEW

Clear, colourless to dark brown, odourless, dense, oily liquid. Will not burn. Can decompose at high temperatures forming toxic gases, such as sulfur oxides. Contact with combustible materials may cause fire. Highly reactive. Contact with many organic and inorganic chemicals may cause fire or explosion. Contact with metals liberates flammable hydrogen gas. Reacts violently with water. VERY TOXIC. May be fatal if inhaled or swallowed. CORROSIVE to the eyes, skin and respiratory tract. May cause blindness and permanent scarring. Causes lung injury--effects may be delayed. Strong inorganic acid mists containing sulfuric acid are CARCINOGENIC. Target Organs: Lungs, teeth, eyes, skin, mucous membranes.

Potential Health Effects
Primary Route(s) of Entry: Inhalation and ingestion. Skin contact. Eye contact.
Effects of Acute Exposure: Corrosive, oxidizing and sulphonating properties on contact. May be fatal by ingestion, inhalation or skin absorption.
LD50/LC50: CAS# 7664-93-3: Inhalation, mouse: LC50 = 320 mg/m3/2H, Inhalation, rat: LC50 = 510 mg/m3/2H Oral, rat: LD50 – 2140 mg/kg.
Eyes: Causes severe eye burns. May cause irreversible eye injury.
Skin: Causes skin burns. Defatting dermatitis with prolonged use.
Ingestion: May cause severe and permanent damage to the digestive tract. Causes burns in mouth, pharynx and gastrointestinal tract. Nausea, Vomiting, Abdominal pain. Corrosive and toxic
Inhalation: Harmful if inhaled. May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract. May cause respiratory inflammation. Destructive to tissues of mucous membranes. Headache, May cause delayed lung injury. Vomiting. Nausea. Pulmonary edema. Corrosive and toxic.

Effects of Chronic Exposure: Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivities. May cause death. CORROSIVE to body tissues. To the best of our knowledge the chronic toxicity of this substance has not been fully investigated.

SECTION 4 – First Aid Measures

Eyes: Immediately flush eyes and skin with copious amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire surface. Do NOT allow victim to rub eyes or keep eyes closed. Get medical aid immediately.
Skin: Get medical aid immediately. Immediately flush skin with copious quantities of soap and water for at least 15 minutes while removing contaminated clothing and shoes. SPEEDY ACTION IS CRITICAL! Call a physician.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Consult a physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Get medical aid immediately Remove patient from exposure to fresh air immediately. Administer approved oxygen supply if breathing is difficult. Administer artificial respiration or CPR if breathing has ceased. Call a physician.
Notes to Physician: Treat symptomatically and supportively.

SECTION 5 – Fire Fighting Measures

General Information: Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Contact with water can cause violent liberation of heat and splattering of the material.
Extinguishing Media: Use extinguishing media most appropriate for the surrounding fire. Carbon dioxide. Dry chemical power. Do not use water.
Auto-ignition Temperature: Not available.
Flash Point: Not available.
NFPA Rating: Health – 3, Flammability – 0, Instability – 2, Water Reactive.
Explosion Limits: Lower: Not available. Upper: Not available.
Special Fire and Explosion Hazards: Oxidizing material – contributes to combustion of other materials. Reacts violently with water and organic materials with evolution of heat. Emits toxic and corrosive fumes under fire conditions.

SECTION 6 – Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Cover with sand, dry lime or soda ash, and place in a closed container for disposal.
Steps to be taken in case material is released or spilled: Evacuate. Wear self-contained breathing apparatus, rubber boots and heavy rubber gloves. Cover with soda ash or lime. Place in a suitable container and mark for disposal. Use non-sparking tools. Ventilate area and wash spill site after material pick-up is complete.
Waste disposal method: According to all applicable regulations.

SECTION 7 – Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before re-use. Use with adequate ventilation. Do not get in eyes, on skin or on clothing.
Storage: Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from combustible substances. Do not store near alkaline substances.
Store in a cool place away from heated areas, sparks and flame. Keep tightly closed. Do not add any other material to the container. Do not store in a damp atmosphere. Do not get in eyes, on skin or on clothing. Do not store near organic substances. Do not allow smoking and food consumption while handling. In accordance with good storage and handling practices. Do not store near flammable substances. Wash well after use.
Storage Code: White.

SECTION 8 – Exposure Control/Personal Protection

Engineering Controls: Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits:

Chemical Name	*ACGIH*	*NIOSH*	*OSHA*
Sulphuric acid	1 mg/m³ TWA; 3 mg/m³ STEL	1 mg/m³ TWA	1 mg/m³ TWA

OSHA Vacated PELs Sulphuric acid: 1 mg/m³ TWA.

Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.
Skin: Wear appropriate protective neoprene or polyethylene gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure. Apron or clothing to protect skin. Rubber boots. Sufficient to protect skin.
Respiratory Protection: Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.
Ventilation: Use only in a chemical fume hood.
Other Protective Equipment: Make eye bath and emergency shower available.

SECTION 9 – Physical and Chemical Properties

Physical State: Liquid
Appearance: colorless
Odor: odorless
pH: 0.3 (1N Solution)
Vapor Pressure: <0.00120 mm Hg
Vapor Density: 1.2 kg/m3
Evaporation Rate: Slower than ether.
Viscosity: Negligible.

Boiling Point: 554°F
Freezing/Melting Point: 50.6°F
Decomposition Temperature: 340°C
Solubility: Soluble in water and ethanol.
Specific Gravity/Density: 1.841
Molecular Formula: H_2SO_4
Molecular Weight: 98.0716

SECTION 10 – Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, contact with water, metals, excess heat, combustible materials, organic materials, oxidizers, amines, bases.
Incompatibilities with Other Materials: Acetic Anhydride, Acetone Cyanhydrin, Acetone + Nitric Acid, Acetone + Potassium Dichromate, Acetonitrile + Sulphur Trioxide, Acrolein, Acrylonitrile, Alcohols + Hydrogen Peroxide, Allyl Alcohol, Allyl and Aldehyde compounds, Allyl Chloride, 2-Aminoethanol, Ammonium Hydroxide Ammonium Iron (III) sulfate dodecahydrate, Ammonium Triperchromate, Aniline + Glycerol + Nitrobenzene, Benzyl Alcohol, Bromates + Metals, tert-Butyl-m-xylene + Nitric Acid, 1-Chloro-2,3-epoxypropane, Bromine Pentafluoride, n-Butyraldehyde, Cesium Acetylene Carbide, 4-Chloronitrobenzene + sulphur trioxide, Copper, Dichloromethane + Ethanol + Nitrate or Nitrite, 2-Cyano-4-nitrobenzenediazonium hydrogen sulphate, 2-Cyano-2-propanol, Chlorine Trifluoride, Chlorosulfonic Acid (Cyanides), Cycolpentadiene, Cyclopentanone oxime, 1,3-Diazidobenzene, Diethylamine, Cuprous Nitride, Diisobutylene, Ephchlorohydrin, Ethylene Cyanohydrin, Ethylene Diamine, Ethylene Glycol, Dimethoxydinitroanthraquinone, 4-Dimethylaminobenzaldehyde, 2,5-Dinitro-3-Methylbenzoic acid + Sodium Azide, 1,5-Dinitronaphthalene + Sulfur, Ethoxylated nonylphenol, Fulminates, Halides, Hexalithium disilicide, Ethylenimine, Other Acids, Iodine Heptafluoride, Metals, Isoprene, Hydrofluoric acid, Hydrogen peroxide, Metal acetylides or carbides, Metal Chlorates, Metal Perchlorates, 4-Methuylpyridine, Nitramide, Nitric Acid + Organic materials, Nitric Acid + Toluene, Nitrites, Nitroaryl bases and derivatives, Nitrobenzene, 3-Nitrobenzenesulfonic Acid, Nitromethane, N-Nitromethylamine, 4-Nitrotoluene, Permanganates, Phosphorus, Phosphorus (III) Oxide, Poly(silylene), Mercuric Nitride, Mesityl Oxide, P-Nitrotoluene, Pentasilver Trihydroxydiaminophosphate, Perchlorates, Permanganates + Benzene, Phosphorus Isocyanate, Picrates, Potassium t-Butoxide, Potassium, 3-Propynol, Potassium Chlorate, beta-Propiolactone, Propylene Oxide, Pyridine, Ruybidium Acetylene Carbide and Sodium, Silver Pemanganates, Silver Peroxochromate, Sodium, Sodium Carbonate, Sodium Tetrahydroborate, Sodium Thiocyanate, Sucrose, Tetramethylbenzenes, 1,2,4,5-Tetrazine, Thallium (I) azidodithiocarbonate, 1,3,5-Trinitrosohexahydro-1,3,5-triazine, Water, and Zinc Iodide. Carbonates, sulfides, sulphites, carbides, chlorates.
Hazardous Decomposition Products: Oxides of Sulphur.
Hazardous Polymerization: Has not been reported.
Reaction Product(s): Hydrogen is generated by the action of the acid on most metals.

SECTION 11 – Toxicological Information

RTECS: CAS# 7664-93-9: WS5600000.
LD50/LC50: CAS# 7664-93-9 Inhalation, mouse: LC50 = 320 mg/m³/2H. Inhalation, rat: LC50 = 51- mg/m³/2H. Oral, rat: LD50 = 2140 mg/kg.
Carcinogenicity: CAS# 7664-93-9: Not listed.
California: Not listed.
NIOSH: Not listed.
NTP: Not listed.
OSHA: Select carcinogen.

IARC: Group 1 carcinogen.
Epidemiology: Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal, nasal, sinus and lung cancer. These data suggests a possible relationsihop between carcinogenesis and inhalation of sulfuric acid mist.

Teratogenicity: No information available.
Reproductive: No information available.

Mutagenicity: No information available.
Neurotoxicity: No information available.

SECTION 12 – Ecological Information

Ecotoxicity: Sulphuric acid is harmful to aquatic life in very low concentrations. It may be dangerous if it enters water intakes. The aquatic toxicity for bluegill in fresh water was 24.5 ppm/24 hr, which was lethal.
Environmental: No information available.
Physical: No information available
Other: No information available.

SECTION 13 – Disposal Considerations

Dispose of in a manner consistent with federal, provincial/state/territorial, and local regulations.
RCRA D-Maximum Concentration of Contaminants: None of the components are on this list.
RCRA D Series – Chronic Toxicity Reference Levels: None of the components are on this list.
RCRA F Series Wastes: None of the components are on this list.
RCRA P Series Wastes: None of the components are on this list.
RCRA U Series Wastes: None of the components are on this list.
RCRA Substances Banned from Land Disposal: None of the components are on this list.

SECTION 14 – Transport Information

Proper Shipping Name: SULPHURIC ACID
Hazard Class: 8 **UN Number**: UN1830 **Packing Group**: II

SECTION 15 – Regulatory Information

US Federal

TSCA: CAS# 7664-93-9 is listed on the TSCA Inventory.
Health and Safety Reporting List: None of the components are on this list.
Chemical Test Rules: None of the components are on this list.
TSCA Section 12b: None of the components are on this list.
TSCA Significant New Use Rule (SNUR): None of the components are on this list.
CERCLA Reportable Quantities (RQ): CAS# 7664-93-9: final RQ = 1000 pounds (454 kg).
SARA Threshold Planning Quantities (TPQ): CAS# 7664-93-9: TPQ = 1000 pounds
SARA Hazard Categories: CAS# 7664-93-9: acute, chronic, reactive.
SARA Section 313: This material contains Sulphuric acid (CAS# 7664-93-9, 95-98%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act – Hazardous Air Pollutants (HAPs): None of the components are on this list.
Clean Air Act – Class 1 Ozone Depletors: None of the components are on this list.
Clean Air Act – Class 2 Ozone Depletors: None of the components are on this list.
Clean Water Act – Hazardous Substances: CAS# 7664-93-9 is listed as a Hazardous Substance under the CWA.
Clean Water Act – Priority Pollutants: None of the components are on this list.
Clean Water Act – Toxic Pollutants: None of the components are on this list.
OSHA – Highly Hazardous: None of the components are on this list.

US State

State Right to Know: Sulphuric acid can be found on the following state Right-to-Know lists: New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California Prop 65: No information available.
California No Significant Risk Level: No information available.

European/International Regulations

European Labelling in Accordance with EC Directives:
Hazard Symbols: XI
Risk Phrases: R 36/38 Irritating to eyes and skin.
Safety Phrases: S 2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S30 Never add water to this product.

WGK (Water Danger/Protection): No information available.

Canadian DSL/NDSL: CAS# 7664-93-9 is listed on Canada's DSL/NDSL List.
Canadian WHMIS Classification: This product has a WHMIS classification of C, D1A, E.
Canada Ingredient Disclosure List: CAS# 7664-93-9 is listed on Canada's Ingredient Disclosure List.

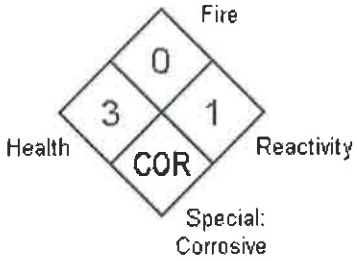
Exposure Limits:
CAS# 7664-93-9: OEL-ARAB Republic of Egypt: TWA 1 mg/m³
OEL-AUSTRALIA: TWA 1 mg/m³
OEL-BELGIUM: TWA 1 mg/m³; STEL 3 mg/m³
OEL-CZECHOSLOVAKIA: TWA 1 mg/m³; STEL 2 mg/m³
OEL-DENMARK: TWA 1 mg/m³
OEL-FINLAND: TWA 1 mg/m³; STEL 3 mg/m³; Skin
OEL-FRANCE: TWA 1 mg/m³; STEL 3 mg/m³
OEL-GERMANY: TWA 1 mg/m³
OEL-HUNGARY: STEL 1 mg/m³
OEL-JAPAN: TWA 1 mg/m³
OEL-NETHERLANDS: TWA 1 mg/m³
OEL-THE PHILIPPINES: TWA 1 mg/m³
OEL-POLAND: TWA 1 mg/m³
OEL-RUSSIA: TWA 1 mg/m³; Skin
OEL-SWEDEN: TWA 1 mg/m³; STEL 3 mg/m³
OEL-SWITZERLAND: TWA 1 mg/m³; STEL 2 mg/m³
OEL-THAILAND: TWA 1 mg/m³
OEL-TURKEY: TWA 1 mg/m³
OEL-UNITED KINGDOM: TWA 1 mg/m³
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check acgi tlv
OES-United Kingdom: TWA 1 mg/m³ TWA

SECTION 16 – Other Information

The statements contained herein are offered for informational purposes only and are based upon technical data. Seastar Chemicals Inc believes them to be accurate but does not purport to be all-inclusive. The above-stated product is intended for use only by persons having the necessary technical skills and facilities for handling the product at their discretion and risk. Since conditions and manner of use are outside our control, we (Seastar Chemicals Inc) make no warranty of merchantability or any such warranty, express or implied with respect to information and we assume no liability resulting from the above product or its use. Users should make their own investigations to determine suitability of information and product for their particular purposes.

Safety Data Sheet
Sodium hydroxide, solid

Section 1 - Identification
SDS Name: Sodium hydroxide, solid.
Synonyms: Lye, sodium hydrate, white caustic, caustic soda, soda lye, soda ash, ascarite.
Company Identification:
Certified Lye
PO Box 133
Spring Valley, CA 91976-0133
Website: http://www.certified-lye.com
Email: info@certified-lye.com
Telephone: 619-548-2378
Poison Control Center: 800-222-1222
Chemtrec: 800-424-9300



Section 2 - Hazards Identification
Emergency Overview
Appearance: White solid.
Danger! Causes eye and skin burns. Causes digestive and respiratory tract burns. Hygroscopic (absorbs moisture from the air).
Target Organs: Eyes, skin, mucous membranes.
Potential Health Effects
Eye: Causes eye burns. May cause blindness. May cause chemical conjunctivitis and corneal damage.
Skin: Causes skin burns. May cause deep, penetrating ulcers of the skin.
Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. Causes severe pain, nausea, vomiting, diarrhea, and shock.
Inhalation: Irritation may lead to chemical pneumonitis and pulmonary edema. Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. Causes chemical burns to the respiratory tract.
Chronic: Prolonged or repeated skin contact may cause dermatitis. Effects may be delayed.

Section 3 - Composition, Information on Ingredients
CAS#, Chemical Name, Percent, EINECS/ELINCS:
1310-73-2, Sodium hydroxide, 99-100, 215-185-5.
497-19-8, Sodium carbonate, <1.0, 207-838-8.
Food Chemical Codex (FCC):
These chemicals meet the FDA requirements for food use.

Section 4 - First Aid Measures
Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid immediately.
Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Immediately remove contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion: If swallowed, do NOT induce vomiting. Get medical aid immediately. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconscious person.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Use water spray to keep fire-exposed containers cool. Use water with caution and in flooding amounts. Contact with moisture or water may generate sufficient heat to ignite nearby combustible materials. Contact with metals may evolve flammable hydrogen gas.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Do not get water inside containers.
Flammability: Nonflammable.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Flammable Limits: Not available.
NFPA Rating: Health: 3; Flammability: 0; Instability: 1.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Avoid runoff into storm sewers and ditches that lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation. Do not get water on spilled substances or inside containers.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Do not allow water to get into the container because of violent reaction. Minimize dust generation and accumulation. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Avoid ingestion and inhalation. Discard contaminated shoes. Use only with adequate ventilation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from metals. Keep away from acids. Store protected from moisture. Containers must be tightly closed to prevent the conversion of NaOH to sodium carbonate by the CO_2 in air.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name, ACGIH (TLV), NIOSH (REL), OSHA (PEL):
Sodium hydroxide, 2 mg/m^3 Ceiling, 10 mg/m^3 Ceiling (15 minutes), 2 mg/m^3 TWA.
Sodium carbonate, none listed, none listed, none listed.
NIOSH IDLH Concentration: 10 mg/m^3.
OSHA Vacated PEL: None of these chemicals have an OSHA Vacated PEL.

Personal Protective Equipment

Eyes: Wear chemical splash goggles and face shield.
Skin: Wear gloves, apron, and/or clothing made of butyl rubber, nitrile rubber, and/or polyethylene.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirator: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Solid.
Appearance: White pellets.
Odor: Odorless.
pH: 14 (5% aq soln).
Vapor Pressure: 1 mm Hg @ 739 deg C.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 1390 deg C @ 760 mm Hg.
Freezing/Melting Point: 318 deg C.
Decomposition Temperature: Not available.
Solubility: Soluble.
Specific Gravity/Density: 2.13 g/cm^3.
Molecular Formula: NaOH.
Molecular Weight: 40.00.

Section 10 - Stability and Reactivity

Chemical Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: Moisture, contact with water, exposure to moist air or water, prolonged exposure to air.
Incompatibilities with Other Materials: Water, metals, acids, aluminum, zinc, tin, nitromethane, leather, flammable liquids, organic halogens, wool.
Hazardous Decomposition Products: Toxic fumes of sodium oxide.
Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

NIOSH RTECS#

CAS# 1310-73-2 (sodium hydroxide): WB4900000
CAS# 497-19-8 (sodium carbonate): VZ4050000

LD50/LC50

CAS# 1310-73-2:
Draize test, rabbit, eye: 400 ug Mild;
Draize test, rabbit, eye: 1% Severe;
Draize test, rabbit, eye: 50 ug/24H Severe;
Draize test, rabbit, eye: 1 mg/24H Severe;
Draize test, rabbit, skin: 500 mg/24H Severe.

CAS# 497-19-8:
Draize test, rabbit, eye: 100 mg/24H Moder;
Draize test, rabbit, eye: 50 mg Severe;
Draize test, rabbit, skin: 500 mg/24H Mild;
Inhalation, mouse: LC50 = 1200 mg/m^3/2H;
Inhalation, rat: LC50 = 2300 mg/m^3/2H;
Oral, mouse: LD50 = 6600 mg/kg;
Oral, mouse: LD50 = 6600 mg/kg;
Oral, rat: LD50 = 4090 mg/kg.

Carcinogenicity

CAS# 1310-73-2: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 497-19-8: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
Epidemiology: No information found.
Teratogenicity: No information found.
Reproductive Effects: No information found.
Mutagenicity: See actual entry in RTECS for complete information.
Neurotoxicity: No information found.
Other Studies: No information found.

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA F List: None of these chemicals are listed in 40 CFR 261.31.
RCRA K List: None of these chemicals are listed in 40 CFR 261.32.
RCRA P List: None of these chemicals are listed in 40 CFR 261.33(e).
RCRA U List: None of these chemicals are listed in 40 CFR 261.33(f).

Section 14 - Transport Information

US DOT, Canada TDG

Shipping Name: Sodium hydroxide, solid; Sodium hydroxide, solid.
Hazard Class: 8, 8.
UN Number: UN1823, UN1823.
Packing Group: II, II.

Section 15 - Regulatory Information

US Federal Regulations

TSCA Section 8(b):
CAS# 1310-73-2 is listed on the TSCA inventory.
CAS# 497-19-8 is listed on the TSCA inventory.
TSCA Section 12(b): None of these chemicals are listed under TSCA Section 12(b).
TSCA Significant New Use Rule: None of these chemicals have a TSCA SNUR.
Chemical Test Rules: None of these chemicals have a Chemical Test Rule.
Health & Safety Reporting List:
None of these chemicals are on the Health & Safety Reporting List.
SARA Title III/EPCRA:
None of these chemicals have a TPQ under EPCRA Section 302 (EHS).
None of these chemicals are reportable under EPCRA Section 304.
None of these chemicals are reportable under EPCRA Section 313.
SARA Codes:
CAS# 1310-73-2: Immediate, reactive.
CAS# 497-19-8: Immediate.
CERCLA Hazardous Substances and Corresponding RQ:
CAS# 1310-73-2: 1000 lb final RQ; 454 kg final RQ.
CAS# 497-19-8: This chemical is not listed and has no RQ.
Clean Air Act:
None of these chemicals are listed under CAA Section 112(r).
None of these chemicals are listed as hazardous air pollutants.
None of these chemicals are listed as Class 1 or Class 2 Ozone Depletors.
Clean Water Act:
CAS# 1310-73-2 is listed as a Hazardous Substance under the CWA Section 311.
None of these chemicals are listed as Priority Pollutants under the CWA Section 303.
None of these chemicals are listed as Toxic Pollutants under the CWA Section 307.
OSHA: None of these chemicals are considered highly hazardous by OSHA.
SARA Title III/EPCRA States' Right-To-Know Lists:
CAS# 1310-73-2 is listed by California, Massachusetts, Minnesota, New Jersey, and Pennsylvania.
CAS# 497-19-8 is not listed by CA, FL, MA, MN, NJ, or PA.
California Prop 65:
None of these chemicals are listed on the California Carcinogenic Chemicals list.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols: C.
Risk Phrases:
R 22 (harmful if swallowed),
R 35 (causes severe burns).
Safety Phrases:
S1 (keep locked up),
S2 (keep out of the reach of children),
S26 (in case of contact with eyes, rinse immediately with plenty of water and seek medical advice),
S36 (wear suitable protective clothing),
S37 (wear suitable gloves),
S39 (wear eye/face protection),
S45 (in case of accident or if you feel unwell seek medical advice immediately; show the label where possible).
WGK (Water Danger/Protection):
CAS# 1310-73-2: 1.
CAS# 497-19-8: 1.
Canada – DSL/NDSL:
CAS# 1310-73-2 is listed on Canada's Domestic Substances List.
CAS# 497-19-8 is listed on Canada's Domestic Substances List.
Canada – WHMIS:
This product has a WHMIS classification of E (corrosive material).
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and this SDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List:
CAS# 1310-73-2 is listed on the Canadian Ingredient Disclosure List.
CAS# 497-19-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

SDS Creation Date: MAY/04/2006.
Most Recent Revision Date: JAN/1/2015.
Most Recent Revision: Version 5.

Addendum

Safety Precautions for Sodium Hydroxide:
http://www.certified-lye.com/safety.html
Protective Equipment for Use with Sodium Hydroxide:
http://www.certified-lye.com/protect.html

The information above is believed to be accurate and represents the best information currently available to Certified Lye. However, Certified Lye makes no warranty of merchantability or any other warranty, express or implied, with respect to such information, and Certified Lye assumes no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Certified Lye be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Certified Lye has been advised of the possibility of such damages.

Material Safety Data Sheet

Hydrochloric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Hydrochloric Acid**

Synonyms/Generic Names: Aqueous Hydrogen chloride, Muriatic acid.

Product Use: Industrial, Manufacturing or Laboratory use

Manufacturer: Columbus Chemical Industries, Inc.
N4335 Temkin Rd. Columbus, WI. 53925

For More Information Call: 920-623-2140
(Monday – Friday 8:00-4:30)

IN CASE OF EMERGENCY CALL: CHEMTREC
(24 Hours/Day, 7 Days/Week) 800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Weight %	Component	CAS #	EINECS# / ELINCS#	Classification*
36 - 38%	Hydrochloric Acid	7647-01-0	231-595-7	C; R35, **

*Symbol and R phrase according to EC Annex1
** Subject to the reporting requirements of SARA Title III Section 313

3. HAZARDS IDENTIFICATION

Clear, colorless solution with caustic odor.

R35 – Causes severe burns.

S1/2, S26, S30, S45

Routes of Entry: Skin, eyes, inhalation and ingestion.

Ingredients found on carcinogen lists:

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST	ACGIH
Hydrochloric Acid	Not Listed	Not Listed	Not Listed	Not Listed

4. FIRST AID INFORMATION

Inhalation: Inhalation of mists can cause corrosive action on mucous membranes. Symptoms include burning, choking, coughing, wheezing, laryngitis, shortness of breath, headache or nausea. Move casualty to fresh air and keep at rest. Get medical attention if symptoms persist.

Eyes: Contact rapidly causes severe damage. Symptoms include eye burns, watering eyes. Permanent damage to cornea may result. In case of eye contact, rinse with plenty of water and seek medical attention immediately.

Skin: Severe and rapid corrosion from contact. Extent of damage depends on duration of contact. Symptoms include burning, itching, redness, inflammation and/or swelling of exposed tissues. harmful if absorbed through skin. Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and wash using soap. Get medical attention immediately.

Ingestion: **Do Not Induce Vomiting!** Severe and rapid corrosive burns of the mouth, gullet and gastrointestinal tract will result if swallowed. Symptoms include burning, choking, nausea, vomiting and severe pain. Wash out mouth with water and give a glass of water or milk. Get medical attention immediately.

5. FIRE-FIGHTING MEASURES

FLAMMABLE PROPERTIES:

Flash Point:	Not Flammable
Flash Point method:	Not Applicable
Autoignition Temperature:	Not Applicable
Upper Flame Limit (volume % in air):	Not Applicable
Lower Flame Limit (volume % in air):	Not Applicable

Extinguishing Media: Product is not flammable. Use appropriate media for adjacent fire. Cool containers with water, keep away from common metals.

Special fire-fighting procedures: Wear self-contained, approved breathing apparatus and full protective clothing, including eye protection and boots. Material can react violently with water (spattering and misting) and react with metals to produce flammable hydrogen gas.

Hazardous combustion products: Emits toxic fumes under fire conditions. (See also Stability and Reactivity section).

Unusual fire and explosion hazards: Material can react with metals to produce flammable hydrogen gas.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: See section 8 for recommendations on the use of personal protective equipment.

Environmental precautions: Cleanup personnel need personal protection from inhalation and skin/eye contact. Evacuate and ventilate the area. Prevent spillage from entering drains. Cautiously add water to spill, taking care to avoid splashing and spattering. Neutralize diluted spill with soda ash or lime. Absorb neutralized spill with vermiculite or other inert absorbent material, then place in a suitable container for disposal. Clean surfaces thoroughly with water to remove residual contamination. Any release to the environment may be subject to federal/national or local reporting requirements. Dispose of all waste or cleanup materials in accordance with local regulations. Containers, even when empty, will retain residue and vapors.

7. HANDLING AND STORAGE

Normal handling: See section 8 for recommendations on the use of personal protective equipment. Use with adequate ventilation. Wash thoroughly after using. Keep container closed when not in use.

Storage: Store in cool, dry well ventilated area. Keep away from incompatible materials (see section 10 for incompatibilities). Drains for storage or use areas for this material should have retention basins for pH adjustment and dilution of spills.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure controls: (consult local authorities for acceptable exposure limits)

Chemical name	Regulatory List	Value and type
Hydrochloric Acid	UK OES STEL	7 mg/m^3 (10 minutes)
	USA OSHA PEL	7 mg/m^3 Ceiling
	USA ACGIH	7 mg/m^3 TLV Ceiling
	USA NIOSH	7 mg/m^3 Ceiling
	Canada TLV	7 mg/m^3
	OSHA IDLH	50 ppm
	VLE France (STEL)	7.5 mg/m^3 (15 minutes)

TWA: Time Weighted Average over 8 hours of work.
TLV: Threshold Limit Value over 8 hours of work.
REL: Recommended Exposure Limit
STEL: Short Term Exposure Limit during x minutes.
IDLH: Immediately Dangerous to Life or Health

Ventilation: Provide local exhaust, preferably mechanical.

Respiratory protection: If necessary use an approved respirator with acid vapor cartridges.

Eye protection: Wear chemical safety glasses with a face shield for splash protection.

Skin and body protection: Wear neoprene or rubber gloves, apron and other protective clothing appropriate to the risk of exposure.

Other Recommendations: Provide eyewash stations, quick-drench showers and washing facilities accessible to areas of use and handling. Have supplies and equipment for neutralization and running water available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, colorless to slight yellow liquid
Physical state:	Liquid
Odor:	Acidic
Odor Threshold:	0.25 to 10 ppm
Specific Gravity:	1.1800
pH:	1
Melting Point/Freezing Point:	-46°C (-51°F)
Boiling Point/Range:	51°C (123°F)
Flammability:	Not Flammable (See section 5)
Flash point:	Not Flammable (See section 5)
Evaporation Rate (Butyl Acetate =1):	Not Available
Explosive Limits:	Not Explosive (See section 5)
Vapor Pressure (at 20°C):	15 mmHg
Vapor Density (air =1):	1.267
Solubility:	Completely soluble in water
Partition coefficient/n-octanol/water:	Not Available
% Volatile:	Not Available
Autoignition Temperature:	See section 5

10. STABILITY AND REACTIVITY

Stability: Stable

Conditions to avoid: Uncontrolled addition of water.

Incompatibility: Moisture, bases, organic material, metals, carbides, cyanides, chlorates, nitrates, picrates, permanganate, peroxides, zinc iodide, azides, perchlorates, phosphorus.

Hazardous decomposition products: Carbon oxides.

Hazardous polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Effects: See section 4 for symptoms of exposure and effects. Likely routes of exposure are skin, eyes and inhalation.
Target organs: Kidney, liver, mucous membranes, respiratory system, skin, eyes and cardiovascular system.

Acute Toxicity Data:

Hydrochloric acid	Lowest Published Lethal Doses (LDL/LCL) LDL [Man] Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M LD50 [oral, rat]; 700 mg/kg LC50 [rat]; 3124 (1 hour)

Chronic Effects: May affect liver, bleeding of nose and gums, nasal and oral mucosal ulceration, conjunctivitis, yellowing of teeth and erosion of tooth enamel, dermatitis.

Teratogenicity: Not Available
Mutagenicity: Not Available
Embryotoxicity: Not Available
Synergistic Products/Effects: Not Available

12. ECOLOGICAL INFORMATION

Ecotoxicity (aquatic and terrestrial): LD50 @ pH of 3 – 3.6
LC80 (72 hours): 56 mg/L (Daphnia Magna)

Persistence and Degradability: Not Available

Bioaccumulative Potential: Not Available

Mobility in Soil: Not Available

Other Adverse Effects: Not Available

13. DISPOSAL CONSIDERATIONS

RCRA:
Hazardous waste? Yes RCRA ID number: DOO2

Waste Residues: Carefully dilute with water, neutralize per spill procedures in section 6. Neutralized material may be flushed to sewer (REGULATIONS PERMITTING!) or disposed of through a licensed contractor. Users should review their operations in terms of the applicable federal/nation or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

Product containers: Containers, if thoroughly cleaned, preferably by rinsing three times and handling the rinse water as waste residues, may be disposed of or recycled as non-hazardous waste. Users should review their operations in terms of the applicable federal/national or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product may significantly change the characteristics of the material and alter the waste classification and proper disposal methods.

14. TRANSPORTATION INFORMATION

DOT: UN1789, Hydrochloric Acid, 8, pg II

TDG: UN1789, Hydrochloric Acid, 8, pg II

PIN: Not Available

IDMG: UN1789, Hydrochloric Acid, 8, pg II
Marine Pollutant: No

IATA/ICAO: UN1789, Hydrochloric Acid, 8, pg II

RID/ADR: Class 8, Item 5(b), corrosive, Kemler plate: 80/1789

15. REGULATORY INFORMATION

TSCA Inventory Status: All ingredients are listed on the TSCA inventory.

Federal and State Regulations:
Connecticut hazardous material survey: Hydrochloric acid
Illinois toxic substances disclosure to employee act: Hydrochloric acid
Illinois chemical safety act: Hydrochloric acid
New York release reporting list: Hydrochloric acid
Rhode Island RTK hazardous substances: Hydrochloric acid
Pennsylvania RTK: Hydrochloric acid
Minnesota: Hydrochloric acid
Massachusetts RTK: Hydrochloric acid
Massachusetts spill list: Hydrochloric acid
New Jersey: Hydrochloric acid
New Jersey spill list: Hydrochloric acid
Louisiana RTK reporting list: Hydrochloric acid
Louisiana spill reporting: Hydrochloric acid
California Director's List of Hazardous Substances: Hydrochloric acid

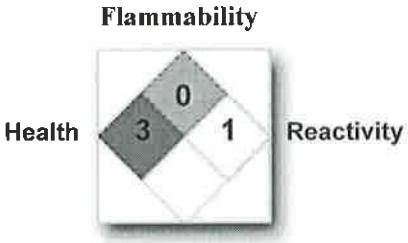
SARA 302/304/311/312 extremely hazardous substances: Hydrochloric Acid
SARA 313 toxic chemical notification and release reporting: Hydrochloric Acid
CERCLA: Hazardous Substances: Hydrochloric Acid, 5000lbs.

California Proposition 65: No
WHMIS Canada: Class E - corrosive liquid.
Class D-2A – Material causing other toxic effects (very toxic)
DSCL (EEC): R35 – Causes severe burns.

HMIS (U.S.A.)

Health Hazard	3
Fire Hazard	0
Reactivity	2

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



Protective Equipment:

ADR (Europe):

TDG (Canada):

DSCL (Europe):

1. OTHER INFORMATION

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Prepared by: Sherry Brock (920) 623-2140