7.2 R & R ACTION PLAN

There is no R & R action plan because proposed expansion shall be taken up in existing premises of SCSSSKL complex located at Tal.: Kagal, Dist.: Kolhapur, Maharashtra.

7.3 RISK ASSESSMENT

The proposed project of the distillery would be undertaken and implemented by the management of SCSSSK in the premises of sugar factory. The risk assessment and hazard management study was done by **Mr. Vinod Sahasrabudde;** FAE for Risk and Hazard (RH) in respect of EEIPL. The proposed project would be formulated in such a fashion and manner, so that utmost care of safety norms and Environment Protection Act shall be taken care of.

7.4 POTENTIAL AND MAJOR HAZARDS IN SUGAR MANUFACTURING PLANT

The process for manufacturing and refining sugar is a standard process. Hazard Prone areas in Integrated complex of SCSSSKL, Kagal are presented as follows –

Table 7.1 Possible Hazardous Locations Onsite

Sr. No.	Hazardous Area	Hazard identified	Mitigation measures	Mitigation measures in place
1	Boiler Area	Explosion	IBR rules for design, maintenance and operation of boilers by certified boiler attendants in mandatory	These measures are in place as the boiler is in operation for the existing capacity.
2	All over the plant	Lightening	To design and install adequate number of best available lightening arrestors.	6 Lightening arrestors at critical locations installed at bagasse yard, biogas plant, distillery section. The drawing is available.
3	Electrocution	Lose fitting	Regular maintenance, internal safety audit, and external safety audit at regular intervals.	These are in place for the operation of the existing capacity
4	Electrical rooms	Fire and electrocution		
5	Transformer area			
6	Cable tunnel			
7	Bagasse Storage area	Fire	Fire hydrant around bagasse storage area.	Fire hydrant around the bagasse storage is in place
8	Alcohol production area	Fire and Alcohol vapour release	HAZOP study is strongly recommended for the production as well as Alcohol Storage area. And adequate safety instrumentation with alarms and interlocks to be	Same will be followed for expansion.

Sr. No.	Hazardous Area	Hazard identified	Mitigation measures	Mitigation measures in place
			incorporated to make the design and plant operation intrinsically safe.	
9	Distillery (ethanol storage tank)	Fire	QRA results and based on failure frequency risk has been calculated. Fire hydrant will be laid around with foam fighting arrangements.	---
10	Biogas production area	Fire	Adequate instrumentation and alarms to be incorporated in design. All flameproof fittings to be used. For all areas of the plant, with fire hazard: No hot work in the area without proper and adequate precautions. Work permit system to be followed.	Adequate measures as required are in place. Same Will be followed for expansion.

7.4.1. Bagasse Storage

- Bagasse generation per day will increase from **44,550 MT/M to 63,000 MT/M.** An area of 1.75 Acre has been allocated for storage of bagasse in the premises.
- Large quantity of bagasse stored poses the serious hazard of fire as it is easily ignitable and fire spreads rapidly. Serious fire accidents may take place.

Mitigation Measures -

Following precautions will be taken to minimize risk of fire.

- It will be ensured that no any high tension voltage lines would pass above the bagasse storage area.
- The combustible raw & useful material has already been stored away from fire prone area and the same will be followed for the storage of bagasse. Installation of fire hydrant (self auto-mode fire fighting) system around the area of bagasse yard has already been employed and the same will be followed. Copy of fire hydrant layout covering bagasse storage area is enclosed in **Appendix - I**
- Proper supervision and petrolling of yard will be done with necessary communication facility.
- Hot work like welding, gas cutting will not be carried out near bagasse storage.
- Daily record of bagasse storage data, proper review of conditions will be taken by higher authority.
- Training of all the involved staff in normal & emergency operating system will be done.

- Proper planning & installation of fire hydrant system around the bagasse storage yard and not depending exclusively on fire tender for firefighting will be implemented. Extra provision of Modern fire tender has been employed in the presence of any emergency.
- Awareness will be created among workers about sudden bagasse fire and emergency action plan will definitely avoid risks of heavy fire.
- Separate fire hydrant point covering maximum area has been already employed on plot.
- In case of fire, assembly points will be clearly shown with the help of sign boards.

7.4.2. Sulphur storage

The details of sulphur storage are given as follows.

Table 7.2 Storage of Sulphur

Sr. No.	Description	Details	
		Existing	Expansion
1.	Storage area	50 Sq. M	75 Sq. M
2.	Covered/ uncovered	Covered	Covered

Sulphur is a flammable substance in both the solid and liquid states. The dust is characterized by a very low ignition point of 190°C compared to other combustible dusts, and dust clouds are readily ignited by weak frictional sparks. Dusts containing 25 % or more elemental. Sulphur may be almost as explosive as pure sulphur.

Sulphur will be stored in a closed shed at the capacity of 250 MT and is transferred manually with the help of hand pulley to the sulphur burner. Hazards in storage and handling of sulphur are as follow.

1. Dust Explosion
2. Fire

Dust Explosion

As sulphur is stored and handled in granular form, there is always some dust formation, which can lead to dust explosion. A dust explosion occurs when a fine dust suspension in air is ignited, resulting in a very rapid burning, and the release of large quantities of gaseous products. This in turn creates a subsequent pressure rise of explosive force capable of damaging plant and buildings and injuring people. It is generally considered that a dust explosion can only be initiated by dust particles less than 500 microns diameter.

Fire in Sulphur storage

Solid and liquid sulphur will burn to produce sulphur dioxide gas, which is extremely irritating and toxic.

Mitigation Measures

- Sulphur will be wetted down.

- For prevention of fire, extinguishers will be placed on site.
- Sulphur dioxide gas is heavier than air and will accumulate. Sulphur fires produce hazardous sulphur dioxide gas; use of Self Contained Breathing Apparatus (SCBA) will be practiced.
- Presence of moisture will helps preventing dust explosion.

7.4.3. Sulphur Dioxide (SO_2) Production

The plant has standard SO_2 production unit. The existing production capacity is adequate to cater to the additional requirement of SO_2 for increased production. The unit produces required amount of SO_2 at the required rate by changing sulphur feed to the unit, it is melted and charged to the burner chamber and where in the air at controlled rate is fed to burner to produce SO_2. Gas at high temp of 400 to 600 deg C is cooled to 60 deg C and sent to the user unit through 100/150 mm piping at 1.5 to 1.7 atm pressure. This is unit designed for inhouse production and use of SO_2.

7.4.3.1. Hazard quantification

Following are the toxic properties of SO_2
NFPA rating N (H) =3, N(F)= 0 and N(R) = 0, TLV= 2 ppm

Toxicity Index:

Toxicity Number: The toxicity number (Th) is derived from the NFPA health factor NH. NH is an integer number ranging from 0 to 4.

Table 7.3 Values of NH and TH

Sr. No	NH	TH
1	0	0
2	1	50
3	2	125
4	3	250
5	4	350

- **Penalty Factor**

The Penalty Factor (Ts) is the second toxicity parameter used to determine the TI. The Ts value is derived from the 'Threshold Limit Values (TLV)'.
The TLV-values are drawn up by the American Conference of Governmental Industrial Hygienists (ACGIH). TLV represents a time weighted average (TWA) air concentration to which workers can be exposed during a normal working week of 6 days at 8 hrs per day, without ill effects. The penalty factor is determined from the table below:

Table 7.4 Values of TLV

TLV	Penalty factor (Ts)
<5	125
5-50	75
>50	5

Toxicity Index TI= Th+Ts/100 X (1+1.75+2.4) TI= 250+125/100 (5,15) = 3.75X 5.15, which is equal to 19.3

The resulting TI values are ranked into three categories:

1-5 Light
6-9 Moderate
10-up High

- Hence Toxicity index is in HIGH range.

Mitigation Measures

- Before the plant start up and every six months, pressure test and thickness test of all the equipments and piping carrying Sulphur dioxide will be carried out to avoid leakage.
- Alarm system in case, SO_2 leakage to warn all workers of the leakage has already been installed in existing plant the same will be followed for expansion.
- SO_2 leak detectors have been installed.
- Emergency shutdown procedure and action plan has already been installed in existing plant. The same is displayed in the local language. This exercise will be continued during expansion.
- Regular mock drills and training for workers working in this section are being carried out and shall be followed during expansion.
- In case of leakage is noticed from a flange joint, emergency shutdown will be ordered.
- Only trained persons will deal with the situations using safety appliances and breathing apparatus, and area around SO_2 production unit and part of the main plant will be vacated immediately.
- In case of major leakage, onsite emergency plan for the entire plant will be put in action and if necessary Govt. authorities will be alerted and off site emergency plan will be activated. In such situations, population around 1 to 1.5 km will be warned.
- LED paneled temperature sensors have been installed in the SO_2 production unit.

Table 7.5 Specifications of SO_2 compressors

Sr. No	Compressor No.	Discharge	Pressure	Vapour pressure	Temperature after cooling	System	Maximum duty of sulphur to burner
1	Compressor No. 1	800 m^3/hr	1 kg/m^3	6 pound	60^0 C	Automatic shutoff system	200 kg
2	Compressor No. 2	850 m^3/hr	1 kg/m^3	6 pound	60^0 C	Automatic shutoff system	200 kg

7.5 POTENTIAL AND MAJOR HAZARDS IN CO-GENERATION PLANT

The proponents have planned to go for expansion of existing 12.5 MW cogen plant to 28 MW.After expansion the 28 MW plant, will be fully automated with interlocks, alarms and will have following standard safety features.

1. Turbine will be interlocked with high and low steam inlet pressure and relative range of high and low outlet pressure.
2. Turbine will be interlocked for high vibration of any bearing of turbine, gear box, and alternator.
3. Turbine will be interlocked for any bearing high temperature.
4. High axial displacement of the rotor will be installed.
5. Turbine will be interlocked with high lube oil temperature.
6. Separate turbine over speed protection and interlock will be provided for turbine to trip on high speed.
7. For reduction of noise, all steam outlets will be provided with silencers.
8. Pressure safety reliefs valves will be provided on steam drum and steam lines.
9. In addition to mechanical SRV's electrometric safety relief valve is provided.
10. Smoke leak detector alarm will be provided.

Table 7.6 Details of Co-gen equipments for expansion

Sr. No.	Equipment
1	Steam Generator &Auxiliaries
2	28 MW Turbo Generator
3	Cooling Tower cap. Condensate System
4	Vessels & Heat Instruments Exchangers
5	Fuel handling
6	Ash handling

Following are the safety and interlocks system for boiler-

- Low drum level interlock
- Furnace high pressure interlock
- Boiler feed pump interlock
- De-aerator level interlock

7.6 POTENTIAL AND MAJOR HAZARDS IN DISTILLERY UNIT

Normally alcohol plants sections are fully automated with PC control for maintaining recommended operating conditions and ensuring the product specifications, plant safety and achieving the plant capacity. Sufficient instrumentation, alarms and interlocks would be provided to minimize any risk of accident.

Table 7.7 Areas of Operation and Hazard in Distillery

Sr. No	Area of operation	Hazard
1	Molasses Storage	Leakage
2	Alcohol Manufacturing	Leakage and fire
3	Alcohol storage	Leakage and Fire

7.6.1 Storage of Molasses

1. Molasses will be stored in good quality and leak proof steel tanks. Bund walls will be constructed around the tank.
2. Continuous mixing of molasses will be done.
3. If there is increase in temperature beyond 30^0C external cooling of tanks will be provided.
4. A temperature recorder will be provided to the tanks.

If there is leakage following measures will be followed –

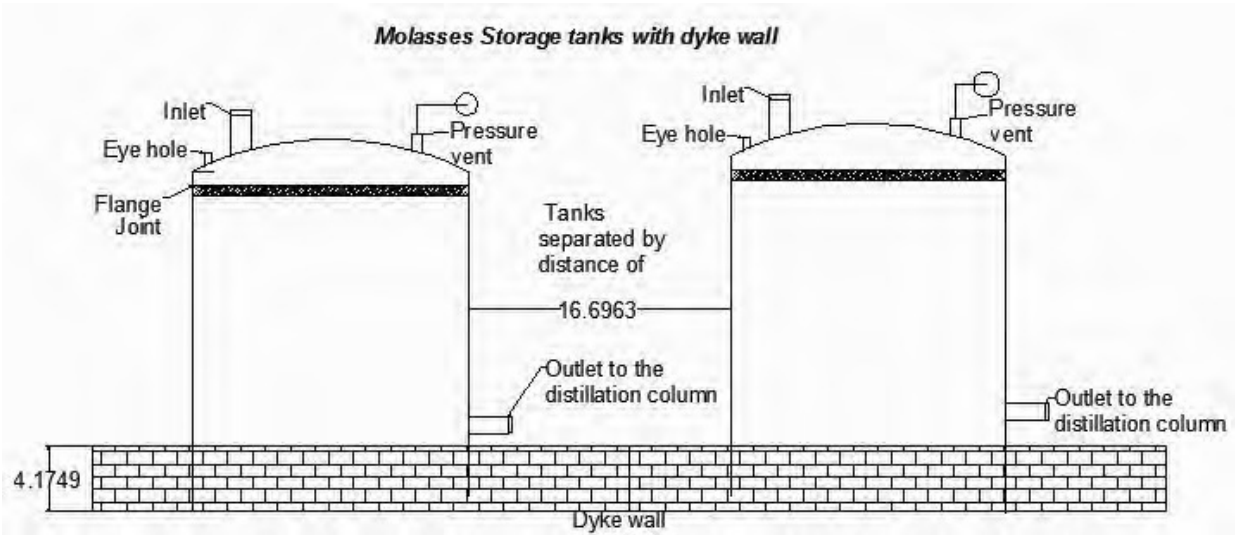
- Leakage will be washed out, diluted and recycled to the maximum extent.
- Replacement of leaky gaskets, joints will be done strictly by following work permit system.
- Leakage of pipelines, welding repairs will be carried out outside the plant. The necessary hot work permit system shall be followed for onsite hot work
- Leakage through pump gland will be reduced to the minimum by installing mechanical seals.
- To mitigate major leakage in tanks, following procedure will be followed.
  1. Transfer the material to other tank.
  2. Prepare the tank for welding repairs by making sure that it is positively isolated with blinds from other vessels. Ensure that the tank is free of the chemicals and gases by air analysis before any hot work is undertaken. This shall be strictly done by skilled workers. For this purpose safety permit will be given.

Table 7.8 Details of Molasses Storage

Sr. No.	Description	Details	
		Existing	Expansion
1	Capacity of Tank	4,500 MT Each	4,500 MT
2	Storage Area	945 M^3	315 M^3
3	No. of tanks	3 No.	1 No.
4	Covered / Uncovered	Covered	Covered
5	Dimensions of Tank	Diameter : 20 M Height : 9.75 M Thickness : 12 mm	Diameter : 20 M Height : 9.75 M Thickness : 12 mm

The representation of Storage tanks of molasses with dyke wall is given as follows.

Figure 7.1 Front views of Molasses storage tanks

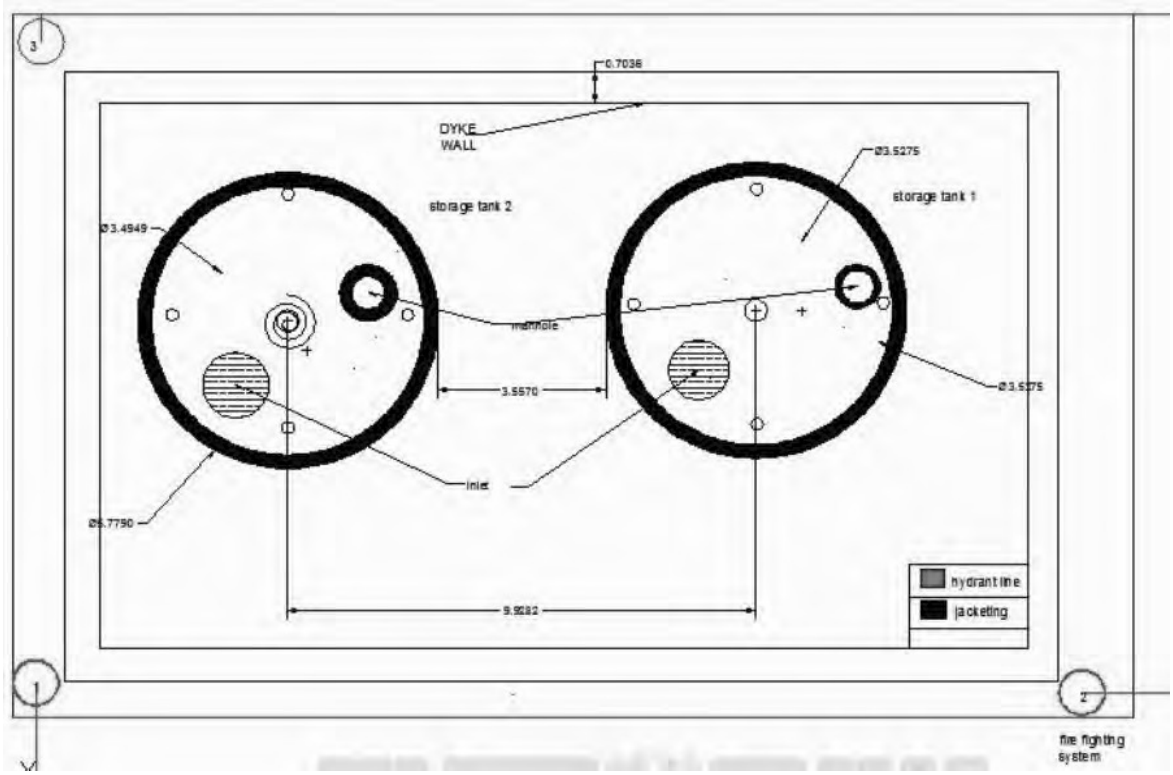


7.6.2 Alcohol manufacturing unit

The main hazard is the alcohol storage tanks where the hazard is leakage and fire so to prevent the risk considerable mitigations will be followed.

For improvisation of safety near storage tanks, the storage tanks will be separated with the distance half of the diameter of the nearby tanks. Refer **Table 2.22** for details of alcohol storage.

Figure 7.2 Top view of Alcohol storage tank



For worst case scenario mapping refer **Appendix – J**

7.6.2.1 Fire fighting system design around alcohol storage

- Fire hydrant system, with necessary alarm systems, piping, with required number of hydrant points, hose boxes, pump, auxiliary pump to operate, auxiliary power generator/backup will be designed as per relevant IS standards.
- The static fire fighting pumps will conform to the requirements given in IS 12469: 1988. The capacity of pumps would be worked out based on requirements of output and pressure for the system. 171 m3 / Hr, @ 7.kg / Cm^2.
- Fire fighting hydrant system in the entire plant will be laid as per IS 909: 1975 Standard with hose reels

7.7 FIRE TRIANGLE

The triangle illustrates the three elements a fire needs to ignite: Fuel, Heat, and an oxidizing agent (usually oxygen) A fire naturally occurs when the elements are present and combined in the right mixture, Meaning that fire is actually an event rather than a thing.

Figure 7.3 Fire Triangle

A fire can be prevented or extinguished by removing any one of the elements in the fire triangle. For example, covering a fire with fire blanket removes the oxygen part of the triangle and can extinguish a fire. This type of representation will be displayed in the fire prone areas.

7.8 COLOUR CODING FOR SAFETY DURING IN-HOUSE MATERIAL TRANSFER and PPE (personal protective equipment)

Following color coding will be implemented on site for pipes carrying materials in Industrial premises.

Figure 7.4 Colour Coding for Pipes

Substance	colour
Water	
steam	
Acid &alkali	
Air	
Other liquid	
Gaseous	

A) Mitigation Measures for Leakages And Fire

- Approval from Chief Controller of Explosives CCOE' will be procured in addition to regular factory inspector's approval and other statutory approvals.
- With respect to the Petroleum Act, Petroleum rules, 2002 following important measures with respect to tank layout and factory layout will be followed though these are recommended for storage above 5000 $M^{3.}$
- Minimum Clear distance between two tanks will be 0.5 D or d or 15 meters D= tank diameter in meters, d= diameter of small tank in meters. Or (D+d)/4
- Tanker vehicle loading/unloading center of the bay area will be minimum 15 meters away from the tanks storage periphery.
- Boundary fencing will be minimum 20 meters away from periphery
- All the tanks will be placed within the area surrounded by dyke wall, constructed as per standard design and construction norms.
- Volume of the within the dyke wall will be more than the largest storage tank inside the dyke wall.
- Provision will be made for spare tank of for pumping large alcohol spillage or leakage by proving sump and pump connection.
- In case, spare tank is not provided pump piping will be provided such that large leakage can be pumped to a suitable process tank.
- All pump motors and other electrical fittings will be flame proof of suitable class.
- Chilled water condenser will be provided over the tanks to avoid alcohol loss.
- Suitable and proper safety measures shall be installed on the tanks.
- Tanks will be provided with level indicating instruments with high and low alarms.

Table 7.9 Details of fire fighting line operating pumps

Pump no.	Make	Power KW/HP	R.P.M	Type	Source to operate	Discharge(M^3/hr)	Head(M)	Location
1	Kirloskar	110/150	1450	DSM 125/40	Electricity	273	88	At reservoir
2	Kirloskar	15/20	2900	CPHM 32/26	Electricity	11	88	At reservoir
3	Kirloskar	93/133	1800	CPHM 125/45	Diesel	273	88	At reservoir
4	Kirloskar	15/20	2900	KDS 1555	Electricity	15	44	At reservoir
5	Kirloskar	11/15	2900	KPI 1388H	Electricity	75.5	62	Distillery
6	Kirloskar	11/15	2900	KPI 1388H	Electricity	75.5	62	Bagasse storage yard

B) Details On Fire Fighting System to be Provided Around The Alcohol Storage Area

- Guidelines in OISD 117 will be followed, while designing firefighting system around the alcohol storage area.
- The main components of the fire system are Fire Water Storage, Fire Water Pumps and Distribution Piping Network.
- The fire water system installation will be designed to meet the fire water flow requirement to fight single largest risk at a time.
- Fire water flow rate for a tank farm will be aggregate as following :-
    1. Water flow calculated for cooling a tank on fire at a rate of 3 lpm/m² of tank shell area.
    2. Water flow calculated for exposure protection for all other tanks falling within a radius of (R +30) meters from centre of the tank on fire (R-Radius of tank on fire) and situated in the same dyke at a rate of 3 lpm/m² of tank shell area.
    3. Water flow calculated for exposure protection for all other tanks falling outside a radius of (R+30) m from centre of the tank on fire and situated in the same dyke at a rate of 1 lpm/m2 of tank shell area.
    4. Foam water requirement required will be calculated based on 5 lpm/m^2 of tank area
    5. For water flow calculations, all tanks farms having class A or B petroleum storage shall be considered irrespective of diameter of tanks and whether fixed water spray system is provided or not.
    6. Water flow required for applying foam on a single largest tank by way of fixed foam system, where provided, or by use of water/foam monitors.
    7. Various combinations will be considered in the tank farm for arriving at different fire water flow rate and the largest rate to be considered for design.
    8. Fire water flow rate for supplementary streams will be based on using 4 single hydrant outlets and 1 monitor simultaneously.
    9. Capacity of each hydrant outlet as 36 m^3/hr and each monitor as 144 m^3/hr minimum will be considered at a pressure of 7 kg/cm^2g.

C) Header Pressure

Fire water system will be designed for a minimum residual pressure of 7 kg/cm^2 (g) at hydraulically remotest point in the installation considering single largest risk scenario.

D) Storage

- Sufficient quantity of water required for fire fighting is being stored on site, The same shall also be utilized during expansion.

E) Other mitigation measures to avoid leakage and fire

- Regular mock drills and trainings are being carried out in the existing premises of SCSSSKL. This practice shall also be followed after expansion.
- Safety policy, Environment, Health and Safety policy has already been formulated, displayed and implemented in SCSSSKL.

- Frequent checking of pipe lines and storage units is being followed and shall be continued after expansion.
- Disaster/ emergency response plan is prepared as per the guidelines and rules laid down in Factory's act.

F) Mechanical operations and unit processes in sugar production

- During handling of the equipment such as - electrical motor-pumps, mechanical mixers, automatic weighing arrangement, automatic dosing arrangement, pressure release and safety accessories on steam generation , handling as well as conveyance systems, heat exchangers, condensers and cooling as well as chilling machinery, temperature and pressure gauges are used.
- The concerned workers are provided with adequate operation and safety tools / equipment.
- Sufficiently trained and qualified workers are employed in all sections of the industry.

G) Preventive Measures for Electricity Hazard

- All electrical equipments are provided with proper earthing. Earthed electrode are periodically tested and maintained.
- Emergency lighting is available at all critical locations including the operator's room to carry out safe shut down of the plant.
- Easy accessibility of fire fighting facilities such as fire water pumps and fire alarm stations is considered.
- All electrical equipments to be free from carbon dust, oil deposits, and grease.
- Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse tongs, discharge rod, safety belt, hand lamp, wooden or insulated ladder are used in regularly by concerned workers.
- Flame and shock detectors and central fire announcement system for fire safety are provided.

7.9 OCCUPATIONAL HEALTH ASPECTS AND MEDICAL PROVISION IN THE FACTORY

- Effects of Alcohol on health**:** It reacts vigorously with oxidizing materials. TLV for 8 hr. is 1000 ppm (ACGIH). Minimum identifiable concentration has been reported as 350 ppm.
- Exposure to concentrations of 5000 - 10000 ppm results in irritation of eyes and mucous membranes of the upper respiratory tract.
- Effects of exposure to higher concentration of alcohol in the atmosphere are given in the following table

Table 7.10 Effect of Ethyl Alcohol

Sr. No	Concentration in mg/l	Concentration in ppm	Effects
1	10-20	5300 – 10,640	Some transient coughing and smarting of eyes and nose, not tolerable.
2	30	15,960	Continuous lacrimation and marked coughing; could be tolerated with discomfort.
3	40	21,280	Just tolerable for short period
4	> 40	> 21,280	Intolerable

To prevent injury to workers, standard PPEs are provided. In addition, sufficient numbers of Self-contained breathing apparatus are provided to be used in case of major alcohol leakage to avoid exposure to higher levels of Alcohol. All precautionary methods are adopted by the company to reduce the risk of exposure of employees to occupational safety and health hazards. The same will be followed after expansion.

7.9.1 Medical check-up

Pre & post medical check-up of the employees are carried out on regular basis.
The following tests for each worker are conducted regularly.

- Lung Function Test
- Radiology – X-ray
- Pulmonary Function Test
- Audiometric Test
- General clinical examination with emphasis on respiratory system
- Pre employment examinations
- Periodical medical examinations at the time of employment and after completion of employment.

7.9.2 Occupational Health Center (OHC)

Standard medical facilities as required by Factories Act, 1948 have been provided in the OHC for the existing plant, important ones are illustrated below:

1. Well equipped First Aid Boxes are provided in each Section of the factory.
2. In case of need, factory will have dispensary to give effective medical facility to workers. In dispensary, sufficient stock of medicines will be available to provide to workers in case of any major emergent situation.
3. A vehicle is always available to shift the sick/injured person to District Hospital.
4. Ambulance is available 24x7 in the factory to deal with injured workers and to take them to the district hospital.

- SCSSSKL will continue the facility for expansion activities.

7.9.3 EHS policy

The factory has EHS policy for the existing unit and same will be followed for expansion

7.10 ONSITE & OFFSITE EMERGENCY PLAN

Onsite emergency plan and risk assessment report has been prepared w.r.t. existing unit. The same will be followed for expansion unit.

7.11 TRAFFIC STUDY

7.11.1 Traffic Load Due To Proposed Integrated Project

Following table shows the transportation details of product and raw material required for proposed integrated project.

Table 7.11 Sugarcane Transportation Details

Sr. No.	Type of Vehicle	Avg. wt (MT) / Vehicle	Daily No. of Vehicles	Quantity of Cane
1	Bullock Carts	3	500	1,500
2	Tractor Trolleys	15	350	5,250
3	Trucks	12	60	720
	Total	**30**	**910**	**7,470**

Table 7.12 Sugar and Press mud Transportation Details

Sr. No.	Product	Type of Vehicles	Daily No. of Vehicles	Average Capacity of Vehicle, M.T.	Daily Quantity of Material, M.T.
1.	Sugar	Trucks	30	10	300
2.	Press mud [During season only]	Tractor-Trolley	40	3.5	140

Table 7.13 Details of Alcohol Transport

Sr. No.	Product	Type of Vehicles	Daily No. of Vehicles	Avg. Capacity of Vehicles	Daily Quantity of Material
1.	Alcohol	Tankers	10	20,000 Lit	2,00,000 Lit