

Contents

Executive Summary

Introduction

Methodology

Findings

Recommendations

Introduction

The management of XXXXX Pvt. Ltd. (XXXXX) had approached Cholamandalam MS Risk Services (CMSRS) to conduct a safety audit of their unit at XXXXX, District xxxxx, @@@@. Accordingly engineers from CMSRS had visited the plant from October 31 to November 2,2002. The audit focussed on the following aspects of the safety system.

- Comments on the existing Safety Management system and recommendations for improving the same.
- Fire and Explosion prevention, protection and emergency management
- Work injury prevention
- Health hazards control
- Safe handling of chemicals

Methodology

The objective was to review existing safety systems and suggest improvements wherever necessary. The review was not intended to be comprehensive, but sufficient to draw reliable conclusions about the existing facilities and recommend improvements. This is limited to deviations from desired situations.

The review methodology is briefly described below:

Kick-off meetings

Kick-off meeting was held on-site involving management personnel. A presentation was made to senior management staff on the scope and methodology of the audit. The objective of the meeting was to confirm the scope of work and proposed methodology. The meeting was also used to gain a general understanding of the facilities and their design and operational philosophies. Following the on-site meeting a detailed tour of the facilities was conducted.

Close-out meetings

Closeout meeting was held on-site with the management staff present. The objective was to provide a preliminary indication of the conclusions of the review and to make sure that the review team had misunderstood no issues.

Reporting

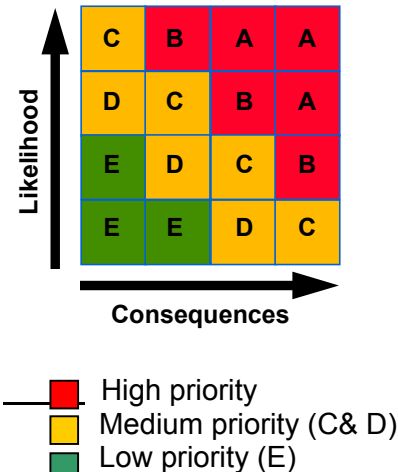
A draft written report was prepared and submitted to XXXXX for review.

Areas audited

The audit team visited all sections of the plant (process blocks, utilities, storages and support services). During the audit period, discussions were held all department heads and records were examined. Wherever necessary, information was also gathered from operating personnel in the field. The most important findings, observations and conclusions are summarised here.

Recommendations

This section summarizes the recommendations from the review and provides a commentary to help XXXXX with implementation. Recommendations have been rated as high, medium or low priority. The prioritization is based on a qualitative assessment of the potential consequences and likelihood of losses using the risk matrix described below.

 <p> ■ High priority ■ Medium priority (C& D) ■ Low priority (E) </p>	<p>A Immediate threat to your business A loss with a high likelihood that could threaten business viability Immediate action should be taken to reduce risk</p> <p>B A serious threat to your business Represents a long-term threat to business viability Early action is recommended</p> <p>C A moderate risk Could impact short-term performance Plan to take action at next opportunity</p> <p>D A low risk which will have a minor impact Include on "to-do" list at low priority</p> <p>E A very low risk which will have little impact Fix only if other benefits will accrue</p>
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Consequence criteria		Likelihood criteria	
1	Minor Direct financial impact or recovery costs less than Rs100,000 Time losing injury to one worker	1	Remote Less than 10^{-5} /year likelihood
2	Moderate Direct financial or recovery costs between Rs100,000 and Rs. 500,000 Time losing injury to more than one worker	2	Unlikely Likelihood between 10^{-4} and 10^{-5} /year
3	Significant Direct financial or recovery costs between Rs.500,000 and Rs1m Single fatality to worker	3	Possible Likelihood between 10^{-4} and 10^{-2} /year
4	Severe Immediate financial impact or recovery costs more than Rs. 1,000,000 Multiple fatalities	4	Likely Likelihood greater than 10^{-2} /year

General Safety Evaluation

<p>RD-1 Medium</p>	<p><u>Safety Policy</u></p> <p>XXXXX has adopted XXXXX India policy as its safety policy. Consider translating the policy into local language for facilitating understanding by all the employees. Copies to be circulated among all the employees. Also, XXXXX can consider the following</p> <ul style="list-style-type: none"> ▪ Policy can be signed by the Board of directors to affirm that company's board backs the policy ▪ Periodical review of policy ▪ Prominent display of the policy
<p>RG-1 Low</p>	<p><u>Safety Committee</u></p> <p>Safety Committee that has been constituted and is functional. Consider re-aligning roles and responsibilities of safety committee members in line with the new safety policy. Consider displaying minutes of the Safety Committee prominently in the notice board. The functions and duties of safety committee are given in Rule no: 88-C-5 of Factories rules. Some of the important functions of the safety committee are</p> <ol style="list-style-type: none"> i. Assisting and co-operating with management in achieving the aims and objectives outlined in the Health and Safety Policy of the occupier ii. Discussing reports on safety, environment and occupational health surveys, safety audits, risk assessment and disaster management plans and implementation of recommendations made in the report. iii. Carry out health and safety surveys and identifying causes of accidents and near misses.
<p>RD-2 Medium</p>	<p><u>Hazard identification and control</u></p> <ul style="list-style-type: none"> ◆ XXXXX can consider using the checklists developed by the parent company for identifying hazards in various operations ◆ There is no standard format for reporting the health hazards. The same should be developed by XXXXX ◆ The internal auditing has been started only this year. The internal safety audit process should be formalised and a schedule be drawn up.

<p>RG-2 Low</p>	<p><u>Performance measurement</u></p> <ul style="list-style-type: none"> ◆ There are many health and safety activities that are conducted by enterprise that could be used as additional measure of SHE performance. These additional measures would focus on how successfully an enterprise is performing in relation to SHE. These indicators are often described as Performance indicators that include number of safety audits conducted, percentage of workers receiving safety-training etc. As most unsafe acts don't result in immediate injuries, positive performance can be used to measure effectiveness of SHE system, processes etc. ◆ Apart from the current performance measures indicated by CPI we suggest that XXXXX can consider following positive performance indicators to measure its performance internally. <ul style="list-style-type: none"> i. Meantime between injuries (MTBI) ii. Number of incident reports/near misses raised (Providing an indication of safety awareness) iii. Number and quality of safety audits conducted iv. Risks as identified by formal safety process v. Quality of leadership and degree of management commitment to safety as measured by perception survey. vi. Number of safety improvement actions completed. vii. Number of employee safety meetings and number of initiatives acted upon. viii. Degree of conformance with Safety Management System
<p>RD-4 Medium</p>	<p><u>Instrument Tagging</u></p> <p>XXXXX can consider introducing instrument-tagging system for all its critical instruments.</p>

<p>RG-3 Medium</p>	<p><u>Visible management leadership</u></p> <p>Some of the existing practices include Safety policy, plant inspections, staff meetings, safety steward system, inclusion of safety performance in KPI of senior executives, signatory to responsible care</p> <p>We recommend the following</p> <ul style="list-style-type: none"> ◆ XXXXX can consider inclusion of health and safety objectives in vision/mission statements of company. We also recommend inclusion of EH&S performance in the annual report. ◆ The health and safety goals should be communicated down to all the management staff and workers on a periodic basis, to reinforce the desired behaviour. ◆ XXXXX can consider issuing annual ‘SHE Responsibility’ letter to its employees. ◆ XXXXX should emphasise on off-the –job safety by devising an off-the-job accident prevention policy, and educating the employees about dangers outside the work place. (e.g commuting between XXXXX and @@@@) ◆ XXXXX should draw a road map for achieving various milestones in EH&S area. Some of the immediate targets could be <ul style="list-style-type: none"> • ISO-14000 • OHSMS-18000/ Safety Management Systems • Membership of World Business Council for Sustainable Development • Global reporting initiative • SA-8800
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<p>RG-4 Medium</p>	<p><u>Safety Communication and Motivation</u></p> <p>As part of the Safety communication efforts, XXXXX has</p> <ul style="list-style-type: none"> ▪ Safety boards at various locations ▪ Safety posters ▪ Distribution of safety materials. ▪ Safety newsletter <p>XXXXX can consider further improving safety communications to contract and out sourced employees. XXXXX can consider evolving innovative techniques for communicating safety message. Corporate intranet can be the best medium to convey the safety message. XXXXX-XXXXX can consider having a separate home page for safety where all relevant safety information is available.</p> <p>XXXXX can consider having competitions like</p> <ul style="list-style-type: none"> ▪ spot the hazard context, ▪ quiz, ▪ Safety lottery etc. can be considered. ▪ Annual XXXXX Festival can be used for generating interest in Safety. Inter unit and intra divisional competitions among all XXXXX units can be considered. ▪ Management can consider devising a policy of rewarding employees and managers who have consistent safety record. <p>XXXXX can consider display of its accident statistics near the entrance to the factory. Also XXXXX can consider challenging safety awards instituted by reputed bodies like CII etc.</p> <p>XXXXX has a system of assessing safety performance of management personnel in the annual appraisal system.</p>
<p>RD-5 Low</p>	<p><u>Perception surveys</u></p> <ul style="list-style-type: none"> ◆ Even though lot of SHE activities are carried out the effectiveness of the communication channels was never measured. It is also not known how far the workers/supervisors are able to grasp the safety message. We suggest a perception survey may be carried out to know the effectiveness of safety campaigns. Perception surveys help companies to evaluate their safety programs and draw up new plans. ◆ We recommend that perception surveys may be carried out separately among workmen and management staff to determine the effectiveness of the safety program. XXXXX can model its survey in the same lines as NASA, which did pioneering work in this area. More information can be obtained from http://pep.jsc.nasa.gov ◆ Alternately XXXXX can study the method developed by Toyota Australia for measuring the effectiveness of the safety program. Many Australian companies successfully used this method for improving their safety performance.

<p>RG-5 Low</p>	<p><u>Accident Investigation</u></p> <p>We observed that accidents/incidents/First aid cases are being properly recorded and investigation is being carried out. XXXXX has a system of recording even near misses also.</p> <p>XXXXX can consider investigating near misses also. (Studies have indicated that the probability of sustaining an injury increases 10 to 25% for persons who experienced near miss.)</p> <p>Proper investigation of accidents/near misses helps in initiating suitable measures. All accident investigation reports should be discussed in Safety Committee meetings.</p>
<p>RG-6 Low</p>	<p><u>No Smoking</u></p> <p>“No smoking” is enforced with in the plant premises. Consider printing the No Smoking instructions on visitor gate pass</p>
<p>RG-7 Low</p>	<p><u>Analysis of Accident Statistics</u></p> <p>At present an analysis of accident statistics is being carried out. Currently Frequency Rate, Severity Rate are computed.</p> <p>Investigation of accidents and analysis of accident statistics is an important element in accident reduction program. Consider training some of the safety committee members in these techniques.</p> <p>Audit team is of the opinion that definition of incident and near miss need to be clearly defined. XXXXX can consider adopting the incident and near miss as per IS-15001</p> <p><u>Incident:</u> Unplanned event which has the potential to lead to accident</p> <p><u>Near miss:</u> an accident where no ill health, injury, damage or other loss is also referred as near miss.</p>
<p>RD-6 Medium</p>	<p><u>Safety Management System</u></p> <p>XXXXX is in the process of evaluating various SMS systems for adoption. XXXXX can consider adopting parent company’s SMS or OHSMS-18000/PSM of OSHA for process safety.</p>

<p>RG-8 High</p>	<p><u>Material Safety Data Sheets(MSDS)</u></p> <p>During site visit we could observe that MSDS are being collected for some of the chemicals used in the factory. XXXXX has a system of collecting MSDS from suppliers.</p> <p>We recommend the following.</p> <ul style="list-style-type: none"> ▪ All the users should be made aware of hazards associated in storing and handling of chemicals ▪ Training programme on MSDS to all personnel handling chemicals. ▪ Monitoring of work environment/health for some of the chemicals(styrene monomer) ▪ Availability of MSDS on intranet ▪ Distribution of MSDS to key personnel(all departments)/strategic locations/Emergency control center/Doctor/Occupational health center) ▪ Procurement of antidotes for widely used chemicals <p>XXXXX can consider adopting standard format for MSDS. Standards that can be considered are EU,OSHA,Factories act. Standardization helps in early retrieval of information and training.</p>
<p>RG-9 High</p>	<p><u>Contractor Employee Activities</u></p> <p>Audit team is of the opinion that contractor employee activities need to be closely monitored. XXXXX has incorporated safety clauses in the agreement with contractors and service providers.</p> <ul style="list-style-type: none"> ▪ Contractor workers to be trained in safety policies and procedures of the company. ▪ We recommend enforcing of penalty clauses for safety violations. ▪ Construction workers/Painting contractors should be encouraged to use safety belts/fall arresters while working at height. ▪ Fabrication workers should be encouraged to use appropriate safety gear while carrying out welding/cutting/lifting of weights etc. ▪ Usage of PPE by contract workmen requires management attention. During audit we could observe barefooted workmen in the bagging and palletizing area. ▪ Ensure that all the contract works in hazardous areas are carried out under the permit system only.

<p>RG-10 Medium</p>	<p><u>On-site Emergency Plan</u> XXXXXXXX has prepared an onsite emergency plan as per the requirement of Manufacture, Storage Import of hazardous chemicals rules. XXXXXXXX also carries out mock drills/rescue drills. XXXXXX also participated in the offsite emergency mock drill held by District authorities. XXXXXXXX can consider the following</p> <ul style="list-style-type: none"> ▪ Expedite the setting up of Emergency control center ▪ Identification of Escape routes(signage) in the plant-e.g. control room. ▪ Signing of Mutual aid agreement with neighbouring industries ▪ Model the plan as per NFPA-1600-standard on onsite emergency plan ▪ Include the RA report as an annex to the On site emergency plan ▪ Inclusion of guidelines on managing transport emergencies ▪ Availability of plan at an offsite location ▪ Maps: Wall maps of appropriate size and shape as required under Risk analysis report ▪ Emergency Communication audit to be done periodically. Consider Manning of ECC round the clock. During site visit audit team could not contact ECC. Alternately call transfer facility should be available for transferring the calls to 24 hour-manned section. ▪ Display of all emergency telephone nos near all area telephones. ▪ Training of personnel on managing emergencies ▪ Offsite mock drill ▪ Setting up 24 hour callcenter to respond to transport emergencies. ▪ Training on Trauma care management to select plant personnel. ▪ Copies of risk assessment that provide quantitative outputs for various accidental release scenarios in terms of <ul style="list-style-type: none"> i. Likely distances/areas affected ii. Likelihood of such incident(probability) iii. Likely number of people injured requiring rescue and medical assistance.
<p>RD-8 Low</p>	<p><u>Safety Manual</u> A safety manual to suit the specific operations carried out in XXXXXX was prepared. We recommend translation of important sections of this manual in to local language (@@@@i/Hindi) so that workers can easily follow the guidelines listed in the manual. XXXXXXXX can also consider having plant wise safety manual. Also, consider making available the manual on the intranet for easy reference. Audit team is of the opinion that, Safety Manual should be circulated more widely among plant personnel.</p>

<p>RD-9 Medium</p>	<p><u>Training</u></p> <p>XXXXX conducts training programmes to its employees in the area of Safety and Loss Prevention. We suggest following training programs, which will help in improving the awareness levels. As an alternative to classroom training XXXXX can also use INTRANET for on line safety training of its entire management staff.</p> <p>Some of the programs that can be considered are</p> <ol style="list-style-type: none"> i. Safety inspection and auditing techniques ii. Work Permit systems iii. Manual material handling techniques/Kinematics of manual handling of materials. (for baggage plant employees) iv. Use, care and maintenance of Personal Protective Equipment v. Functions of Safety committee members(NSC-Seminars) vi. Accident investigation techniques vii. Electrical safety and maintenance of flameproof electrical equipment to electrical staff.(ACC-Mumbai and CMRI-Dhanbad) viii. Identification and elimination of Electro static hazards ix. Hazard Spotting techniques to safety committee members x. Use, care and maintenance of fixed fire protection systems xi. Safe handling of LPG, Handling of LPG emergencies for canteen employees xii. Defensive driving techniques for Forklift truck operators/contract drivers xiii. Refresher training for contract fire fighting crew/security <p>Companies, which aim to be World-Class Manufacturing (WCM) facility normally, devote 5% of their man-hours for training. XXXXX can consider aiming for this target.</p> <p>We suggest development of annual training calendar indicating the likely dates for various training programmes planned for the year.</p> <p>Also, Safety training can be part of KPI for senior management staff.</p>
<p>RG-11 Low</p>	<p><u>Contractor Employee training</u></p> <p>XXXXX conducts programme for contractor employees regularly. Audit team is of the opinion that no. of programmes and type of programmes should be designed as per the work activity of contract workmen. Some of the programmes outlined in RD- can be considered for contract work men also.</p>
<p>RD-10 Low</p>	<p><u>Safe Operating Procedures</u></p> <p>As part of ISO requirements standard operating procedures for the operations were prepared. We suggest incorporation of safety guide lines into these SOPs.(E.g. unloading of styrene monomer)</p>
<p>RD-12 Medium</p>	<p><u>Work area monitoring</u></p> <p>Work area monitoring is required under rule nos. 14 and 41F of Factories act. XXXXX is carrying out work area monitoring through an external agency. Noise level measurement, and measurement of gaseous contaminants using Drager gas detector tubes is carried out internally.</p> <p>In door air quality to be monitored for some of the areas like Bagging plant, palletizing area.</p>

<p>RD-13 Low</p>	<p><u>Plant modifications</u></p> <p>We recommend constitution of a management committee to go into all modifications that are carried out in the factory. The committee should satisfy itself that plant safety standards are not jeopardized and design intentions are not upset with respect to layout, installation of new equipment, fire protection arrangements etc.,</p> <p>XXXXX can consider HAZOP for plant modifications also.</p>
<p>RD-14 High</p>	<p><u>Health issues</u></p> <p>XXXXX maintains a Occupational health center, manned by a nurse. It also maintains an ambulance. Medical facilities are available in neighbouring industries. Annual medical examination is carried out for all the employees.</p> <p>We recommend the following Fork lift drivers to be subjected to eye tests as per CRRRI note no-63</p> <p>Consider monitoring health of contractor employees in Bagging plant.</p> <p>XXXXX can consider laising with corporate office in Germany for carrying out tests for exposure to styrene monomer.</p>
<p>RG-12 Low</p>	<p><u>Management of Change</u></p> <p>XXXXX should develop a comprehensive document on management of change. Whenever a change is planned different departments should review it. What if scenarios should be constructed before implementation. The whole procedure should include several working steps, each of which must be traceable.</p> <p>Appendix to this report reproduces system followed in SHELL group of companies including procedure and authorization formats. XXXXX can consider adopting the same.</p> <p>Operator can change process parameters in DCS system. Audit team is of the opinion that supervisor should authenticate change of critical parameters. XXXXX can consider contacting the DCS OEM for further opinion.</p>
<p>RG-13 Medium</p>	<p><u>Natural hazards –Checklist</u></p> <p>XXXXX is located close to the coast. Consider developing a comprehensive checklist for checking important areas before the onset of cyclones.</p>
<p>RG-14 Medium</p>	<p><u>Testing of emergency shutdown devices- Safety interlock systems(SIS)</u></p> <p>Validation of complete SIS operations and their related alarm systems is a critical function prior to the start-up of the plant, during normal operating condition and after any modifications has been made.</p> <p>We recommend reviewing the test schedule and procedure for the safety critical shutdown devices.</p>

<p>RG-15 Low</p>	<p><u>Positive material identification</u></p> <p>XXXXX can consider introducing the system of positive material identification for any replacement. We recommend reviewing and implementing a system, which will cover any alloys and other critical materials. The procedure should consider the complete path of the material from entry into inventory to its end use in the field.</p>
<p>Work Injury Prevention</p>	
<p>RG-16</p>	<p><u>Analysis of accidents</u></p> <p>Analysis of accidents and dangerous occurrences is being carried out and reported. We suggest analysis of accidents as per IS-3786(Method for computation of frequency and severity rates for industrial injuries and classification of industrial accidents)</p>
<p>RD-16 Low</p>	<p>We suggest introduction of numbering system for the following for better monitoring.</p> <ol style="list-style-type: none"> i. SRV-Lifting tackles ii. Electrical switch boards
<p>RG-17 Medium</p>	<p><u>Safety Relief Valves</u></p> <p>Safety Relief Valves provided for various pressure vessels need to be identified. Also all these valves need to be tested annually as per the Factories Act.</p>
<p>RG-19 Medium</p>	<p><u>PPE for persons working at height</u></p> <p>We suggest procurement of roof crawlers for persons working on Fragile roof. This is also a requirement under the Factories act. Also, contractor employees should be encouraged to use PPE while working at height. We recommend annual testing of safety belts used by contract workmen also. This is a requirement under the Factories act.</p>
<p>RD-17 Medium</p>	<p><u>Work Permit System</u></p> <p>XXXXX has work permit systems for hotwork, confined space and general work permit covering electrical, mechanical and other works. Hot and confined space work permits are counter signed by Safety department only</p> <p>We recommend the following</p> <ul style="list-style-type: none"> ▪ Separate work permit for electrical works and working at height ▪ Training to all operating personnel on work permit system. ▪ Periodic monitoring of work permit system by safety department. ▪ Radiation safety permit-while working with radioactive instruments. <p>XXXXX is in the process of standardization of work permit system. During site visit we could observe that xerox copies of work permit system are being used.</p>

RD-18 High	<p><u>Colour Coding of Pipe lines</u></p> <p>Currently no uniform standard is followed for identifying pipelines. Proper identification of all pipelines is recommended. This can be done by relevant colour coding and labeling. Colour coding should be conforming to IS -2379.</p>
RD-19 High	<p><u>Hoists</u></p> <p>Hoists are used at no. of locations. SWL is clearly marked on the hoist. Consider marking directional indicators on the wall for mechanical work shop.</p>
RD-21 Medium	<p><u>Measurement of Noise levels</u></p> <p>XXXXX carried out measurement of Noise level through out the factory. We recommend noise levels should be prominently displayed.</p>
RD-22 Medium	<p><u>Hand Tools</u></p> <p>The condition of hand tools used in various departments is not satisfactory. XXXXX can consider phased replacement of hand tools with double insulated hand tools(e.g drilling machines used by contractors)</p>
Specific Recommendations(WIP)	
RD-23 Medium	<p><u>Insulation for cold lines</u></p> <ul style="list-style-type: none"> ▪ Consider insulating cold lines(Temp-4°C) of GB-5101B ▪ Insulation was found missing for valve of HFA-801-6 m level
RD-24 High	<p><u>Instrumentation</u></p> <p>Pressure gauge installed on the N2 receiver was found broken and non-functional. We recommend immediate rectification of the same.</p>
RD-25 Medium	<p><u>Cylinder connection</u></p> <p>Water, N2, Air out lets are of same configuration near Compressor house. We recommend different nozzle sizes to prevent inadvertent connections of cylinders.</p>
RD-26 Medium	<p><u>Railings/monkey cage ladders</u></p> <ul style="list-style-type: none"> ▪ Consider providing monkey cage to ladder of instrument air receiver. ▪ Consider providing railings to Zinc sterate injection platform.
RD-27 High	<p><u>Palletizing area</u></p> <p>Operators and workmen in this area are exposed to high noise levels. We recommend the following</p> <ul style="list-style-type: none"> ▪ Consider providing a cabin to reduce the exposure to noise in these areas ▪ Dust collection system for additive A ▪ Re design the Vacuum suction so that no styrene monomer vapours escape into work area.

<p>RD-28 Medium</p>	<p><u>Tool Grinders</u></p> <p>Tool grinders to be provided with suitable tool rest, guard and grinding wheels. As they have potential to cause severe injuries, we suggest immediate replacement of worn out grinding wheels. We suggest that employees be provided with goggles. RPM of the tool grinder needs to be displayed. This is also a requirement under the Factories Act.</p>
<p>RG-21 High</p>	<p><u>Beehive</u></p> <p>Beehive behind the transformer (NG-22) to be removed at the earliest.</p>
<p>RD-29 Low</p>	<p><u>Identification of slippery surfaces</u></p> <p>We recommend display of caution boards warning personnel about the likely hazard</p> <ul style="list-style-type: none"> ▪ Bagging area ▪ Palletizing area ▪ GBPS-PNC-1 Rotary valve
<p>RD-30 High</p>	<p><u>Fork Lifts</u></p> <p>Fork lifts merit management immediate attention</p> <ul style="list-style-type: none"> ▪ During site visit audit team could notice forklifts being operated with two pallet loads in the forward direction. We recommend periodic refresher courses to forklift truck drivers on defensive driving techniques. ▪ Reverse horn and hand brake is not working for most of the forklifts ▪ Tyre condition (tread depth) for the tyres need to be ascertained ▪ Seat belts are not provided ▪ Consider evaluating the performance of FL trucks every three years.
<p>RD-31 High</p>	<p><u>Storing of material –Ware house</u></p> <p>During site visit audit team could observe finished material stacked in three pallets/four pallets high. Many stacks appeared unstable/tilted. We recommend storage height reduced to two pallets level to prevent accidental fall and damage</p>
<p>RG-21 Low</p>	<p><u>Identification of hot surfaces</u></p> <p>It was observed that in boiler section, some un insulated hot sections were observed. We recommend identification of those areas.</p>
<p>RD-32 Medium</p>	<p><u>Product warehouse-pallet magazine</u></p> <p>Audible alarm has been disabled. We recommend immediate re-initiation of the same.</p>
<p>RD-33 Low</p>	<p><u>Identification of trip hazards</u></p> <p>XXXXX can consider identifying trip hazards in the plant premises through safety stewards</p> <p>E.g HIPS vibrating screen, steam condensate line in the palletizing area, Fabrication area near the temporary canteen.</p>

<p>RD-34 Low</p>	<p><u>PPE for handling Peroxides</u></p> <p>XXXXX can consider displaying a signboard near the peroxide storage on safe handling. Some of the points that can be included are</p> <ul style="list-style-type: none"> ▪ Rubber gloves and safety goggles ▪ Guard against ingestion or breathing of vapours/mist ▪ Avoid the skin contact while handling.
<p>RD—35 Low</p>	<p><u>Identification of low clearance areas</u></p> <p>XXXXX to identify areas which are having low clearance and consider providing signage to warn the users.</p>
<p>Fire Prevention</p>	
<p>RG-22 Medium</p>	<p><u>House Keeping</u></p> <p>House keeping standards to be improved in bagging and stores areas and waste yard on the west side of the warehouse. XXXXX can consider initiating suitable steps in segregating and disposing of waste at regular intervals. During site visit most of the dustbins throughout the plant were found full of waste Further following areas require attention</p> <ul style="list-style-type: none"> ▪ Mineral oil unloading ▪ Therm S-700 leak (HFA-801-6 mts level) ▪ Blower room-Palletizing area-converted into a mechanical store
<p>RG-23 Low</p>	<p><u>Cable Pass Sealants</u></p> <p>Cable pass openings to be sealed to prevent fire spread from one area to another at no. of locations. Some of the locations are</p> <ul style="list-style-type: none"> ▪ Cable gallery entry and exit-Below MCC <p>MMTCL(winston@ho.mmtcl.co.in) can be contacted for further details</p>
<p>RG-24 Low</p>	<p><u>Spark Arrestors</u></p> <p>Tankers/other vehicles carrying flammable materials are generally fitted with spark arrestor when they enter the factory premises. Security personnel at the plant gate should be instructed to check for spark arrestors for all vehicles entering through Gate -4</p>
<p>RG-25 Low</p>	<p><u>Flame proof equipment</u></p> <p>The integrity of all the flameproof equipment should be checked on a regular basis.</p>
<p>RG-26 Medium</p>	<p><u>Contractor and Canteen area</u></p> <p>Contractor activities in and around canteen area require management immediate attention. Audit team could observe that many contract personnel are carrying out work with out proper PPE.</p>

<p>RG-27 Medium</p>	<p><u>Use of non-sparking tools</u></p> <p>Audit team observed use of iron hammers in flammable atmospheres. XXXXX can consider instructing the contract workmen about safe work practices in hazardous areas.</p> <p>Permit conditions should include information on zoning.(Ex, zone II etc) Also, maintenance department should have information on zoning in the factory.</p>												
<p>RG-28 Low</p>	<p><u>Extinguisher operation</u></p> <p>All employees to be trained in operating fire extinguishers. Ensure that each shift at least 20% trained employees are available. Further comments on safety training are given in the General Safety Evaluation.</p>												
<p>RD-36 Medium</p>	<p><u>Static Electricity</u></p> <p>All hydrocarbon pump delivery line flange joints are to be bonded. This is to facilitate dissipation of electrostatic charges safely. XXXXX can consider examining the following locations for continuity</p> <ul style="list-style-type: none"> ▪ Diesel Discharge pump area ▪ Diesel day tanks ▪ Styrene monomer unloading area ▪ Ethyl benzene unloading area ▪ Pneumatic pipe line conveyor -warehouse 												
<p>RD-37 Medium</p>	<p><u>Flameproof Electric Switches</u></p> <p>Flameproof electrical switches at following locations merit attention</p> <table border="1"> <thead> <tr> <th>Location</th> <th>Type of defect</th> </tr> </thead> <tbody> <tr> <td>Top floor-Production block</td> <td>Openings in the junction box</td> </tr> <tr> <td>GA5111D</td> <td>Cable gland opening</td> </tr> <tr> <td>H-GA-818 Motor terminal box</td> <td>Missing bolt on the terminal</td> </tr> <tr> <td>H-GA-817B</td> <td>Missing bolt on the terminal</td> </tr> <tr> <td>GA-4002B Push button station</td> <td>Un used opening</td> </tr> </tbody> </table> <p>Audit team observed that in a few pump motors bigger cable glands are used. XXXXX can consider replacing oversized cable glands wherever necessary. This is to maintain the integrity of flameproof equipment and prevent ingress of extraneous material.</p> <p>Audit team is of the opinion that XXXXX should draw up a comprehensive plan for auditing/maintaining Flameproof electrical equipment</p>	Location	Type of defect	Top floor-Production block	Openings in the junction box	GA5111D	Cable gland opening	H-GA-818 Motor terminal box	Missing bolt on the terminal	H-GA-817B	Missing bolt on the terminal	GA-4002B Push button station	Un used opening
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RD-38 Medium	<p><u>Cylinder Storage</u></p> <p>XXXXX uses Oxygen, Nitrogen, Hydrogen and acetylene cylinders for process/laboratory operations. Consider creating a separate well-ventilated store for cylinder storage. Also, consider disposing off Chlorine cylinders stored in the drum storage area.</p>
RD-39 High	<p><u>Tank Farm</u></p> <p>In tank farm Thermic fluid tank has been identified as HSD. Identification of chemicals help in effective management of emergencies. Consider displaying capacity of styrene monomer, hazard associated with the chemical. XXXXX can consider adopting NFPA standard for display of chemicals.</p>
RD-40 High	<p><u>Chemical storage</u></p> <p>Currently acids and bases are stored together. (e.g. caustic soda with H₂SO₄) We recommend segregation of the same. Annexure to the report has more information on storing of chemicals.</p>
RG-29 Low	<p><u>Leaking flanges</u></p> <p>Audit team observed leaking flanges esp. at unloading area and GPPS plant. XXXXX to lay emphasis on preventive maintenance.</p>
RG-30 Low	<p><u>Tappings < 1.5" dia</u></p> <p>All tappings of less than 1.5" should be regularly inspected on vessels (N₂ storage) and large dia pipes</p>
RD-41 Low	<p><u>Power and Data Cables</u></p> <p>Wherever possible segregation of power and data cables should be taken up. As a rule for all future installations this should be followed. We suggest identification of all UPS power points for effective isolation and to prevent overloading of battery.</p>

Specific Recommendations (Fire Prevention)

RD-42 High	<p><u>xxxxx monomer storage</u></p> <p>XXXXX has a storage capacity of 5000 m³. It has a concreted bund to hold the leakages. However in the same bund Ethyl benzene (class A) storage is also located. Audit team is of the opinion that it would be prudent practice to segregate both the flammables in view of their classification. Also consider identifying the chemical unloading bays. Unloading procedure to be displayed prominently.</p>
RD-43 Medium	<p><u>Warehouse</u></p> <ul style="list-style-type: none"> ▪ Consider providing a main switch outside the warehouse ▪ Currently all the light fittings are above the stored material. Consider relocating the light fittings to the aisle area.

RG-31 Medium	<p><u>Handling of xxxxx manomer in process area</u></p> <p>Audit team observed that xxxxx monomer is sampled in metal buckets and transferred to reactors. We recommend use of metallic respectacles with a provision to discharge static charges.</p>
RD-44 Medium	<p><u>Transformer area</u></p> <p>Consider closing the ventilation openings above the transformer to prevent spread of smoke into MCC.</p>
RD-45 Low	<p><u>Diesel daytanks</u></p> <p>Consider earthing the diesel day tanks to dissipate the static charge To prevent overflow from daytank, consider providing pushbutton control switch to control pump operation in addition to existing arrangements.</p>
RD-46 High	<p><u>Drum storage</u></p> <p>Currently drums are stored in open. In view of the large no. of drums handled and stored we recommend creating a separate storage</p>

Fire Protection	
RD-47 Medium	<p><u>Smoke Detectors/Beam detectors</u></p> <ul style="list-style-type: none"> ▪ We suggest installation of smoke detectors in blower room-palletizing area. ▪ Consider providing suitable detection system in Peroxide storage area. A note on storage and handling of organic peroxides is enclosed for further information. ▪ Beam detectors have been provided in the Ware house (finished goods) out of the two beam detectors one beam detector is not working during site visit. We recommend early rectification. Also consider entering into an AMC for the beam detector and other fire protection systems. ▪ Detectors in Palletizing area were found disabled. We recommend activation of detectors at the earliest. ▪ Consider providing Linear heat sensing cable to cable gallery below MCC room.
RG-32 Low	<p><u>Extinguishers</u></p> <ol style="list-style-type: none"> i. At many places extinguishers are not identified. Indian Standard IS -2190 can be referred for selection, installation and maintenance of portable first aid fire extinguishers. ii. We also suggest replacement of chemical foam extinguishers with mechanical foam extinguishers, AFFF or stored pressure type. iii. Indian standards recommend a height of 1000 mm from ground for mounting extinguishers. At many places in XXXXX this is not maintained.

<p>RG-33 Medium</p>	<p><u>Peroxide storage</u></p> <p>As per the manufactures recommendations, only explosion proof fittings should be used in the warehouse. XXXXX has a blower (a/c) in the warehouse that is non-flame proof. XXXXX can consider laising with manufacturers</p>
<p>RD-48 Medium</p>	<p><u>Fire brigade entry</u></p> <p>Currently XXXXX has only one gate for entry into factory premises. Audit team is of the opinion that a second gate may be considered for use during emergencies.</p>
<p>RG-34 High</p>	<p><u>Data Backups</u></p> <p>Consider storing all data backups in fireproof cupboards (A minimum of 2 hours fire resistance) or at an offsite location. Also consider storing important software(DCS) in a fire proof cupboard.</p>
<p>RD-49 Low</p>	<p><u>Fire water runoff</u></p> <p>XXXXX has arrangements to contain Firewater run off with in the premises. Provision should be made to contain the fire water runoff for fires involving peroxides.</p>
<p>RD-50 Medium</p>	<p><u>Detection system and HVAC</u></p> <p>In XXXXX detection system has been installed at most of the places. It is prudent to link detection system with HVAC to prevent spread of smoke. Some of the areas that can be considered are</p> <ul style="list-style-type: none"> ▪ Control room ▪ Inverter room(UPS) ▪ Administrative office ▪ Palletizing blower room ▪ Peroxide storage(after installation of detection system)
<p>RG-35 Medium</p>	<p><u>Fire alarm panel</u></p> <p>The ECC fire alarm panel battery was last checked in Jan-2001. Considering the criticality of the system we recommend quarterly inspection.</p>
<p>RD-51 Medium</p>	<p><u>Hydrant System/Monitors</u></p> <p>As part of the audit, monitors near the styrene monomer storage and LSHS/FO tanks were activated and performance was found satisfactory. The hydrant line pressure in the fire pump room was found to be 8.5 kg/cm²</p> <p>At present all the areas of the factory are protected by Hydrant system</p> <p>We recommend the following</p> <ul style="list-style-type: none"> ▪ Consider providing a pressure gauge in the hydrant circuit preferably at the farthest point ▪ Also, fire hydrant system should not be used for any other purpose other than fire fighting.

Electrical Safety	
RD-52 Medium	<p><u>Substation</u></p> <ul style="list-style-type: none"> ▪ Closing of all feeder doors. ▪ Currently relays are being calibrated once in three years. Audit team is of the opinion that it is prudent to calibrate once in a year.
RD-53 Medium	<p><u>Basket Protection</u></p> <p>A 66 KV line runs in front of the factory gate. Consider providing caging.</p> <p>XXXXX can consider requesting GEB to re route the overhead line or alternately, routing of cables through underground can be considered.</p>
RG-36 Low	<p><u>Locking and Tagging</u></p> <p>At present XXXXX has locking and tagging system for all maintenance works. However there is no provision for locking and positive isolation. All future DBs, isolation equipment, feeders should have a provision for locking.</p>
RG-37 Low	<p><u>Earth Pit</u></p> <p>Earth pit testing was done for all the earth pits. However, continuity from equipment to earth pit was not checked. Audit team is of the opinion that for select equipment XXXXX can consider checking the continuity . Testing to be done once in 11 months and records maintained. This is also required as per the Electricity Act.</p>
RG-38 High	<p><u>Earthing</u></p> <p>Single earthing has been provided for a few medium voltage motors. We recommend double earthing. E.g.: GA-5111 C&D, K- additive building</p>
RG-39 Low	<p><u>Adoption of Standards</u></p> <p>XXXXX can consider adopting standards with respect to laying, selection of cables and other equipment for all its future requirements Some of the standards that can be considered are FRLS cables/XLPE cables for high voltage/ metal conduits or FRLS PVC. conduits, segregation of power and instrumentation cables</p>

<p>RD-54 Medium</p>	<p><u>ELCBs</u></p> <p>ELCBs were provided in XXXXX at no. of locations. However there is no program to periodically check the functioning of the ELCB. As this is an important safety measure, we recommend periodical checking once in a month.</p> <p>A sample survey has been carried out to check the functionality of ELCBs.</p> <table border="0"> <thead> <tr> <th>Location</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>MLDB-2F2</td> <td>Non functional</td> </tr> </tbody> </table> <p>Consider providing ELCB on the MCB-DB located in the workshop. XXXXX can consider providing ELCBs with 30 mA sensitivity for shock protection and 100 mA /300 mA for fire protection.</p> <p>Consider providing ELCBs even in stores/admin office/security area/fire water pump house lighting DB.</p> <p>XXXXX can consider installing special ELCBs to avoid nuisance tripping due to harmonics in UPS/DC loads.</p>	Location	Function	MLDB-2F2	Non functional
Location	Function				
MLDB-2F2	Non functional				
<p>RD-55 Medium</p>	<p><u>Lightning Protection</u></p> <p>XXXXX is having lightning protection on top of the chimney. However audit team is of the opinion that XXXXX can consider rechecking the lightning protection coverage as per IS-2309.</p> <p>Lighting protection should be provided to cover all areas in the factory and the same may be inspected and tested once in 11 months as per IS-2309.</p>				
<p>RD-56 Low</p>	<p><u>Dust tight fittings</u></p> <p>Consider providing dust tight fittings in palletizing area.</p>				
<p>RG-40 High</p>	<p><u>Gloves</u></p> <p>We recommend annual testing of gloves(33 Kv/11 Kv). This is also a requirement under the IE act.</p>				

<p>RG-41 Medium</p>	<p><u>Preventive Maintenance practices</u></p> <p>XXXXX has checklist based preventive maintenance for critical electrical equipment. Observations are recorded and history card maintained. Checklist can also have points relating to un used openings/open panel doors etc. During audit, we could observe lizard in one of the DBs of Firewater pump house.</p> <p>Currently, Bucholtz relay is tested electrically. Audit team is of the opinion that it should be tested mechanically also.</p> <p>Oil leak was observed in the 66 kv, 5 MVA main transformer from conservator tank. XXXXX should take immediate steps to arrest the leak</p> <p>5MVA- on load tap changer(OLTC) counter readings to be taken periodically and maintenance recommended by OEM should be adhered to .</p>												
<p>RG-42 Low</p>	<p><u>Electrical hot spot survey</u></p> <p>As part of the audit, CMSRS has carried out electrical hot spot survey for select equipment as per details below.</p> <table border="1"> <thead> <tr> <th>Equipment</th> <th>Temp.</th> <th>comment</th> </tr> </thead> <tbody> <tr> <td>MLDB-2F2</td> <td>36-RYBN</td> <td>OK</td> </tr> <tr> <td>EPDB2</td> <td>36 RYB</td> <td>OK</td> </tr> <tr> <td>Refrigeration LDB</td> <td>35 RYB</td> <td>OK</td> </tr> </tbody> </table> <p>GB-5101B(110 Kw) 54(surface temp) Current practice is to run the motor for 15 days. As the temperature is slightly high, XXXXX can consider reducing the duration of running to 7 days.</p> <p>Electrical department can consider using non contact type infrared temperature measuring equipment to identify electrical hot spots as part of preventive maintenance practice.</p>	Equipment	Temp.	comment	MLDB-2F2	36-RYBN	OK	EPDB2	36 RYB	OK	Refrigeration LDB	35 RYB	OK
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<p>RD-57 Medium</p>	<p><u>Storage of material close to DBs</u></p> <p>Material stored close to electrical panel in . We suggest identification of those areas and discontinuing of this practice. Evidence: Warehouse, Rubber godown electrical welding outlet. A minimum of 1 mt clearance need to be maintained. Consider isolating the with metal barricades to prevent storage of material close to DBs</p>												
<p>RD-58 Low</p>	<p><u>Cable trays in Palletization area</u></p> <p>Polystyrene dust is getting deposited on the cables in this area. Consider periodic cleaning of cables/provide cover to the cable trays/all future installations could be vertical to prevent dust accumulation.</p>												