SAFETY AUDIT REPORT

THE ANDHRA SUGARS LIMITED

KOVVUR

2019-20

REPORT NO: RPT/782/THE ANDHARA SUGARS - KOVVUR/APRMS/2019-20/RO

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1.0 Introduction

The Andhra Sugars Limited, Kovvur commenced production in the year 1962. The plant is located at Kovvur village, 7 Kms from Rajahmundry on the banks of river Godavari. Plant manufacture Sodium Hypo Chlorite (15%), Hydrogen Gas, Sulphuric Acid, Potassium Hydroxide (Lye and Flakes), and Liquid Chlorine.

In order to comply with the provisions of the **Factories Act and AP FactoriesRules,** the organization engaged the services of M/ s Asia Pacific Risk Management Services Private Limited, Chennai to conduct a comprehensive Occupational Health and Safety Audit as per IS 14489:1998.

The safety audit was conducted on 13 and 14.09.2019 by the following team:

1 Mr.H.Ramakrishnan

2.Mr A.Lakshmnan

Due considerations were given for the existing safe guards in the plant.

The consultants wish to place on record their sincere thanks to the management and staff of The Andhra Sugars Limited for their excellent cooperation and participation in the study.

Date:04.10.2019 H.Ramakrishnan

2.0 SafetyAudit Goals

Audits are normally designed to achieve one or more of the following goals

- To provide the auditee with an opportunity to assess its own OS & H system against standards and identify areas for improvement.
- To determine the conformity of the implemented OS & H systems with specified requirements and identify areas for improvement.
- To meet regulatory requirements.

Audit Objectives

Occupational Safety and Health (OS & H) audits are conducted

- To carry out a systematic critical appraisal of all potential hazards involving personnel, plant, services and operational methods.
- To ensure that OS & H system fully satisfy the legal requirements and those of company's written safety policies, objectives and progress.

Audit Methodology

- Appraisal of Audit procedures to the concerned executives.
- Familiarization visit to various sections of the unit.
- Visit to various sections for in- depth study of hazard potential.
- Study of the maintenance system of process vessels, machines, pipes, equipments, buildings etc.,
- Interaction with various levels of employees.
- Perusal of documents relating to OS & H.
- Appraisal of major observations to the functional heads who are decision makers to improve SHE system.

Documents Perused

The following records are pursued during the audit.

01. OS & H Policy.
02. Safety Department's organization chart
03. Safety Budget
04. Safety promotional & motivational measures
05. Training records on safety, fire and first-aid
06. Record of plant safety inspections
07. Accident investigation reports
08. Accidents and dangerous occurrences – statistics and analysis.
09. Record of tests and examinations of equipment and structures as per statutes
10. Safe operating procedures for various operations
11. Record of work permits
12. Record of monitoring of toxic and flammable and other substances at work place
13. Maintenance and testing records of the detection and firefighting equipment
14.
15. Occupational Health Centre/First Aid Details
16. Medical records of employees
17. Records of industrial hygiene surveys (noise, ventilation and illumination levels, airborne substances and explosive gases)
18. Material safety data sheets
19. On-site emergency plan and record of Mock Drills
20. Communication Systems adopted in the unit

21. Records of waste disposal
23. Minutes of safety committee meetings
24. Approval of layouts; and other approval from statutory authorities
25. Records of any modifications carried out in plant or process
26. Maintenance procedure records
27. Calibration and testing records
28. Shut down and maintenance procedures
29. In service inspection manuals
30. Records including that of material handling
31. Inspection books and other statutory records
32. Records of previous audits
33. HAZOP Study Reports
34. Safety in transportation of hazardous substances
35. Personal Protective Equipment
36. Pressure Vessels, Pipes and Fittings
37. Lifting Machines and Tackles
38. Mobile Equipment and Vehicular Traffic
39. Tank Storage Area Vessel-Details
40. Onsite Gas Cylinder Storage Area-Details

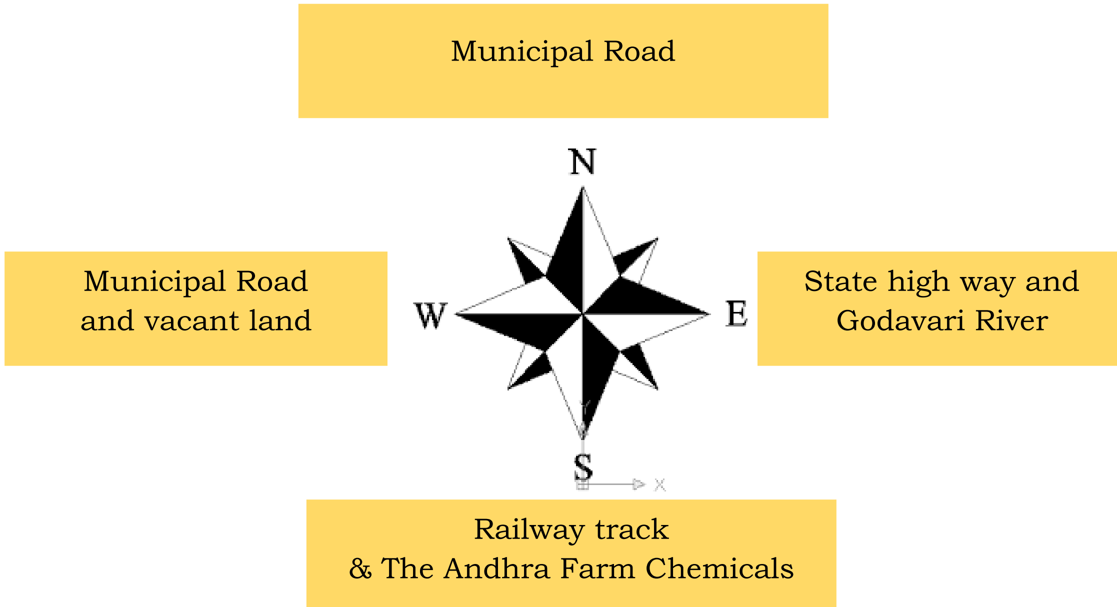
Areas covered under audit

01. Safety policy
02. Organization Setup
03. Safety Education and Training
04. Employees participation in OS & H
05. Safety Manual & Rules

06. Compliance with Statutory Requirements
07. New equipment review / inspection
08. Risk assessment including hazard identification
09. Plant safety inspections
10. Health and safety improvements plans / targets
11. First aid facilities – Occupational Health Centre
12. Personal protective equipment
13. House keeping
14. Machine and general area guarding
15. Material handling equipment
16. Electrical and personal safe guarding
17. Ventilation, illumination and noise
16. Work environment monitoring system
17. Occupational Health
18. Safe operating procedures
19. Work permit system
20. Fire prevention, protection and fighting system
21. Emergency preparedness plan
22. Process / plant modification procedures
23. Transportation
24. Hazardous waste storage and disposal
25. Safety in storage and warehousing
26. Contractor safety system
27. Boilers, Pressure Vessels and Utilities

3.0 Brief details of the plant

3.1 Surrounding properties of the plant



- ➢ Kovvur city has a population of around 30000 people.
- ➢ Plant is in 42 Acres of land with 25.6 Acres green belt area. Plant has 16 acres with plant and machineries.

3.2 Public utilities and their locations

- ❖ Railway Station, Kovvur at 1Km from the plant
- ❖ Police Station at Kovvur at 1 KM from the plant
- ❖ Fire Station, Kovvur at 1Km from the plant
- ❖ Government Hospital and Primary Health Center are at 0.5 Km from the plant

Plant is well connected by road and rail network. Plant has a railway siding to load the products directly into the tankers and railway wagons. Adjacent to plant is State High way connecting Hyderabad and Vishakhapatnam.

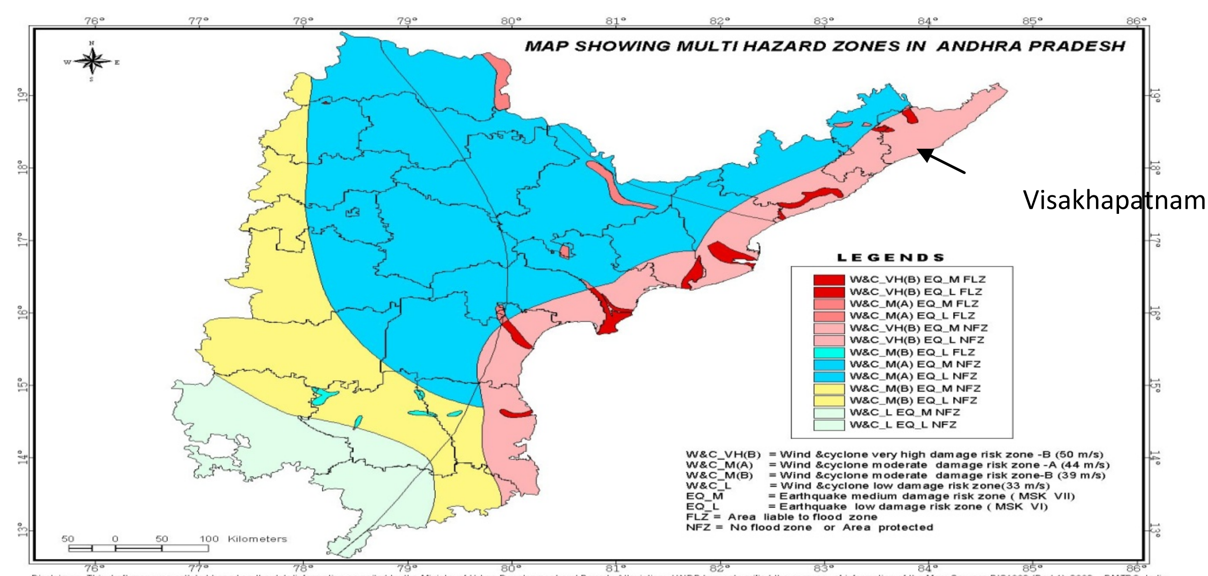
4.0 Risk relating to natural perils Flood, Cyclone and Earth quake

4. 1 **Lightning –** As per IS 2309, Vizag nearest city experiences 20 number of lightning days

4. 2 **Flood** – As per the details available the plant has not experienced any major floods in the past. Special pumps are available in the plant with DG supply to bail water to Godavari River in case of floods**.**

4. 3 **Earthquake** - From the data available the plant falls under moderate earthquake zone. It is learnt that the design taken into consideration this earthquake severity.

4. 4 **Cyclone** – Severe risk from cyclonic storm exists in this area as shown in the map attached to this report. Wind speed as high is as 50m /sec. viz. 180km/hr can reach in this area. Plant building are designed to withstand a wind speed of 200 KM /hour.



Disclaimer: This draft map was collated based on the data/information compiled by the Ministry of Urban Development and Poverty Alleviation. UNDP has not verified the accuracy of information of the Map. Sources:BIS1893 (Part 1): 2002., BMTPC, India.

5.0 Utilities in the plant:

- ✓ Plant has four boilers: 1.0 TPH oil fired boiler, 3 TPH oil fired boilers and WH recovery boilers 2 numbers 10T/hr.
- ✓ Plant has 132 KV incoming supply. It is stepped down to 33 KV with 10/16 MVA 132/33 KV power transformer.

- ✓ Electrolysis plant is working with 33 KV/100 DC GEC Recti formers and MV equipment are working with 11 KV/440V system
- ✓ Four indoor transformers are in 11 KV /440 V system
- ✓ Plant has five DG sets for backup power supply. 2x380 KVA, 1x156 KVA, 2x200 KV
- ✓ 110 KVA ups system is installed in Polarization rectifiers and feeding to hypo plant.
- ✓ DM plant with capacity 50 m3 and storage capacity 200 m3 is available

Brief details of the process

Receiving raw material KCL, Sulphur and Rock Phosphate in bulk through Trucks and wagons.

6.0 Process description

<u>PROCESS DESCRIPTION OF CAUSTIC POTASH (KOH):</u>

The following is the Process Description for the manufacture of Caustic Potash with the Membrane cell electrolysis process.

BRINE SYSTEM

Murate of Potash (Potassium Chloride) is the raw material for the manufacture of Caustic Potash. Satisfactory operation of the membrane electrolysis cells depends upon extreme purity of KCl brine attained in the brine treatment. Therefore, impurities like Calcium, Magnesium and Sulphates etc. must be removed. The KCl salt saturation and brine treatment consists of the following process steps.

Salt handling including covered KCl storage

- Brine saturation
- Chemical preparation and brine precipitation
- Brine clarification
- Brine filtration
- Secondary brine purification

After treatment in the secondary purification step, the brine meets the specific requirements for the electrolysis in the membrane cells.

Brine Saturation and Precipitation: Saturation pit is filled with salt from the salt storage. Dechlorinated lean brine from the lean brine pumps containing 150 – 170 gpl KCl is fed to the saturation pit through distribution pipes submerged under the salt bed. Lean brine passes from bottom to top of the salt bed. In this process the lean brine gets saturated.

Precipitation:

$$CaCl_2 + K_2CO_3 \longrightarrow CaCO_3 \downarrow + 2KCl$$

$$MgCl_2 + 2KOH \longrightarrow Mg(OH)_2 \downarrow + 2KCl$$

$$K_2SO_4 + BaCO_3 \longrightarrow BaSO_4 \downarrow + K_2CO_3$$

Brine Clarification: Raw brine is fed by gravity from the last precipitation tank to the clarifier. Before entering the clarifier flocculant solution is added by existing flocculant pump. Flocculant promotes setting of precipitated solids and gels in the clarifier.

Clarified brine flows into the existing clarified brine tank and is then pumped by clarified brine pumps to the brine filtration unit.

Brine Filtration : Any residual solid impurities in the clarified brine are removed in two different filtration stages consisting of :

First stage : Filtration with anthracite filters.

Second stage : Filtration with Polishing filters.

Both the stages are equipped with one stand-by filter, standby filter is made operational when the operating filter needs cleaning.

Filtered brine from the anthracite filters is collected in the filtered brine tank. Filtered brine is then pumped through polishing filters. Polished brine from polishing filters is collected in the polished brine tank.

Secondary Brine Purification:

For trouble-free operation of the membrane cells and a long service life of the membranes, cells must be supplied with extremely pure brine, Calcium and Magnesium content in the brine is not allowed to exceed 20 ppb. Deposition on these ions in the membrane effects its function and leads to increased power consumption.

The ion exchanger columns are filled with a cation exchange resin Regeneration of the resin is carried out at regular intervals. Resin is regenerated with dilute hydrochloric acid and conditioned with KOH.

Pure brine leaving the ion exchanger flows to the pure brine head tank. Before the brine enters the head tank, it is heat conditioned. Required temperature of pure brine depends on the operation load of the electrolysers.

Heat conditioned brine from the pure brine head tank flows to the electrolysis cells by gravity.

ELECTROLYSIS:

$$2KCl + 2H_2O \longrightarrow 2KOH + Cl_2 + H_2$$

Brine from the head tank flows into the anode chamber of the electrolyser cells. Cathode chambers of the electrolytic cells similarly receive weak caustic from the catholyte head tank. Anode and cathode chambers of the cell are isolated from each other by the membrane, which selectively allows K+ ions to migrate from anode to cathode. Water to the extent of about 2 – 3 moles/mole of K+ also diffuses through the membrane from the anode chamber to cathode chamber. Cl_2 is liberated at the anode surface and the brine in the anode compartment isdepleted to 150 – 170 gpl KCl. The two-phase mixture of depleted brine and chlorine overflows from the anode chambers via the insert pipe into the anolyte header. As a result of the electro chemical reactions taking place in the cathode chamber, H_2 is generated at the cathode surface and OH- ions combine with the K+ ions diffusing through the membrane. A two-phase mixture of 28.5% KOH and hydrogen overflows from the cathode chambers into the catholyte header. The water required for cathodic reaction is partly supplied by the water transport through the membrane and the rest is made up by addition of demineralized water in the recirculation catholyte loop. A differential pressure of about 400 mm WC is maintained across the membrane. The chlorine header pressure is controlled at about 2000 mm WC. The hydrogen header pressure is controlled at about 2000 mm WC. The hydrogen header pressure is maintained 400 mm WC higher than the chlorine header pressure by means of a differential pressure controller. Excessive Cl_2 side pressure is prevented by relieving the gas to the waste air system. Similarly, excessive H_2 side pressure is prevented by gas relief to the stack. The cells are further protected against overpressure by means of safety valves located on the anolyte and catholyte headers of each electrolyser.

ANOLYTE DECHLORINATION :

After the two-phase mixture of depleted brine and chlorine has separated in the anolyte header, depleted brine containing dissolved chlorine (called anolyte) flows into the anolyte tank. Anolyte tank is maintained under the chlorine header pressure.

Anolyte coming out of the cells is at a temperature of 88° C and has a concentration of 150 – 170 gpl KCl and also contains about 350 mgpl dissolved chlorine.

Before anolyte enters the anolyte tank, it is acidified to a pH of 2 to 2.5 by adding HCl to anolyte header. PH reduction reduces solubility of Cl_2 in brine. Anolyte is dechlorinated in two stages; Vacuum dechlorination and chemical dechlorination.

Vacuum Dechlorination

From anolyte tank, anolyte is sucked into the vacuum de-chlorination tank, where it boils under reduced pressure, liberating bulk of the dissolved chlorine. Vacuum is produced by vacuum pump/ejector, which draws the chlorine-water vapour mixture from the vacuum tank through the vapour condenser.

Steam is used as motive fluid for the ejector. Most of the water is condensed in the vapour condenser and the condensate returns to the anolyte tank. Ejector discharges chlorine gas into the main chlorine header through the anolyte tank. Pressure in the vacuum tank is approximately 0.4 Kg/cm^2 A.

Chemical Dechlorination

Lean brine leaving the vacuum de-chlorination tank at a temperature of about 85°C still contains 5 – 10 mgpl dissolved chlorine, which has to be eliminated by chemical means in Chlorate destruction tank. Lean brine from vacuum tank at a pH of 2 to 2.2 is first neutralized to a pH of 8 – 9. For this KOH from KOH head tank is added to the suction of lean brine pump through pH controller.

Solution of potassium bi-sulphite from potassium sulphite head tank is then added to the suction of the lean brine pump for chemical destruction of dissolved chlorine. Addition rate of potassium sulphite solution is controlled by means of redox controller. Dechlorinated lean brine is pumped to the saturator.

CATHOLYTE SYSTEM :

A catholyte recirculation system is established from the catholyte tank by means of the catholyte pump, which pumps 28.5% KOH to the catholyte head tank. Portion of the recirculating catholyte stream is tapped off as 28.5% KOH product stream, which is sent to the caustic evaporation unit. Caustic potash lye is concentrated from 28.5% to 50% at evaporation plant and further it is concentrated to 89 – 90 % in caustic flaking plant.

HYDROGEN SYSTEM:

Hydrogen gas leaving the cells is at a pressure of about 2400 mm WC and temperature is about 88-90°C. The gas is saturated with water vapor at these conditions and is cooled in a cooler to 40°C using cooling water. Gas is then passed through hydrogen filter in order to remove entrained KOH aerosols. The hydrogen gas downstream of the filter is sent through the Hydrogen buffer vessel to the Hydrogen Header. Hydrogen gas is sent the HCl synthesis unit as per requirement or sent to the Caustic Potash flaking unit.

II LIQUID CHLORINE

Chlorine leaving the cells at a pressure of 2000 mm WC (max) and temperature of 88°C. It is saturated with water vapor. Chlorine gas is cooled to 40-30°C in the existing Chlorine cooler -I using cooling water and further cooled t0 15-20°C in existing chlorine cooler II using chilled water.

Cooled chlorine gas is dried in a single drying tower using Sulphuric Acid as the drying media. The drying tower consists of a packed section in the lower part, tunnel trays in the upper part of the tower, and a droplet separator on the vapor out let.

98 % H2S04 is pumped from existing 98 % H2S04 storage tank by metering pump to the top of the drying tower. Acid used in the packed section is continuously circulated through the tower packing. Heat of dilution released during the drying process is removed by cooler. 78 % H2S04 formed in the process is collected in the 78 % H2S04 storage tank.
The dry chlorine gas after passing through mist eliminator is compressed up to 2.5 Kgs/Cm 2 with acid ring rotary compressor and fed into liquefactors. Chlorine gas is cooled in liquefactor up to -20°C under deep refrigeration system by Freon compressors. The gas gets condensed and forms as liquid chlorine is collected in storage tanks. The un liquefied gas containing 65-70 % chlorine sniffed off under pressure control system. The sniff Chlorine gas is consumed in the manufacture of Hydrochloric Acid or Sodium Hypochlorite.

From the storage tank the liquid Chlorine is withdrawn for cylinder filling by means of dry compressed air padding to 10 Kgs/Cm 2. The waste Chlorine generated from storage tank and cylinder filling section is sent to neutralizing system, Sodium Hypochlorite plant.

III **Hydrochloric Acid manufacturing**.

The HCl synthesis unit consists of three principal parts, viz. the burner, furnace, heat exchanger assembly and the gas liquid separator.

The burner consists of two or graphite tubes mounted inside a graphilor housing for their easy replacement. The burner has two inlets, one for Chlorine and the other for Hydrogen.

The furnace consists of a combustion chamber provided with two sight tubes, which permit the automatic control of the flame and to light the furnace. The synthesis unit is absorption type includes a distribution element with an inlet for the absorber. The heat exchanger (at the lower part) consists of columns of absorbing blocks. The heat exchanger includes a column of absorbing blocks. The heat exchanger includes a column of cooler blocks.

The receptor is a graphilor element for the separation of the acid product from the vent gases. At the bottom of this element there is a graphilor safety disc and below this an explosion guard.

The Hydrogen coming from the electrolysis room, after cooling, fed to the furnace burner. Similarly, Chlorine coming from the process plant is fed to the furnace burner. A pressure control valve automatically controls the Chlorine pressure.

$$H_2+Cl_2 \text{-}\rightarrow 2Hcl$$

The Hydrogen and Chlorine lines are fitted with auto shut-off valves interlocked with the furnace photoelectric cell. In case of flame failure, the two valves are automatically closed, while a third valve will allow nitrogen gas to enter the furnace to purge the system.

The Hcl gas produced in the synthesis furnace is first cooled and absorbed in water in cooler –absorber. Feed water before entering the cooler-absorber is fed to the tail gas tower. Suction is provided through the system by exhaust fan. The Hydrochloric acid solution (30-33% strength) is collected in gas liquid separator and sent to storage tanks.

IV. SODIUM HYPOCHLORITE:

Sodium Hypo Chlorite is manufactured by absorption of Chlorine in 18 % Caustic Soda solution at controlled temperature.
The main reaction is

$2NaOH + Cl_2 \text{---------}\rightarrow NaOCL + NaCl + H_2O$

The heat of reaction is approximately 350 Kcal/Kg of Chlorine absorption.

The waste Chlorine gases from various sections of the membrane cell based Caustic Potash Plant, Chlorine filling section and Chlorine cylinders testing section etc. are absorbed in dilute Caustic Soda to produce Sodium Hypochlorite in the Sodium Hypochlorite plant.

The production process consists of 3 absorbers with packed bed and connected two towers in parallel and 3rd tower is connected in series for the both towers to ensure the complete absorption of Chlorine. For each tower NaOH (18%) is fed to the top of the column and travels counter current to the waste Cl_2gas stream. Cl_2reacts with Caustic Soda to form Sodium Hypochlorite which is sold as Bleach Lye. The heat od absorption is removed by circulation of scrubbing liquid through coolers.

Normally in the first absorption tower itself all the Chlorine gets absorbed.

As a safety to ensure complete utilization / absorption of Chlorine, 2 towers are provided in series. Finally waste gases after absorption are let out to the atmosphere through a chimney of 60 m height.

V. <u>PROCESS DESCRIPTION OF SINGLE SUPERPHOSPHATE</u>

Rock Phosphate and Sulphuric Acid are the two raw materials for the S.S.P manufacture. Major components of Rock Phosphate are Tri calcium Phosphate [$Ca_3 (PO_4)_2$], Calcium Fluoride (CaF_2), Calcium Carbonate and traces of Phosphates of Iron and Aluminum.

Rockphosphate is an imported raw material which will be obtained from Jordan, Malesia, Egypt and other countries. The imported Rock Phosphate material will be obtained from Kakinada port to Kovvur unit by lorries and stored in the closed go-downs. The Rock phosphate is conveyed from the Go-down to the plant by belt conveyor and then ground to a fineness of 98% through 100 mesh sieve in a Ring Roll Mill Circuit and stored in a hopper.The other raw material is 98.4% Sulphuric Acid, which is manufactured in-house at Kovvur unit. The Sulphuric Acid is pumped from the storage tank to the 98.4% Sulphuric Acid overhead tank, from where it is taken into the mixing chamber through a **<u>rotameter</u>** and diluted to 75% using the scrubber water directly in the mixing chamber.

The S.S.P. is produced by 75% of Sulphuric Acid with the ground Rock Phosphate powder in the mixing chamber. The ground Rock Phosphate from the hopper is taken to the mixer through a roller feeder and vertical bucket elevator and a screw conveyor and fed through a table feeder. The excess ground Rock Phosphate is returned back to the hopper through a return screw conveyor.

The excess scrubber liquor from the 1stscrubber of the 3stage ventury scrubbing system is pumped into the overhead tank, from where it is taken into the mixing chamber through a rotameter.

The metered quantities of ground Rock Phosphate, Sulphuric Acid and Scrubber liquor are fed to the horizontal paddle mixer, where the following reactions takes place.

$2Ca_3(PO_4)_2 + 6H_2SO_4 \text{---}\rightarrow 4H_3PO_4 + 6CaSO_4$

$4H_3O_4 + Ca_3(PO_4)_2 + 3H_2O \uparrow \text{--}\rightarrow 3Ca(H_2PO_4)_2H_2O$

$Ca_3(PO_4)_2 + 2H_2SO_4 \rightarrow Ca\ (H_2PO_4)_2 + 2CaSO_4$

$Ca(H_2PO_4)_2$ is called Single Super Phosphate, which is water soluble.

The mixer outlet material, which is a semi solid and of cow dung consistency falls into a moving den and it's retention time of about 45 minutes in the moving den the S.S.SP gets dried up. The dried SSP is cut into finer material with a rotary cutter and conveyed to the go-down for curing of product.

The reaction gases from the den will contain HF and $CO_2$and these reaction gases are being removed by means of blower and by passing through the 3 stage venture scrubbing system. The HF and CO_2 are scrubbed with water to remove fluorine and Co_2 components in a 3 stage ventury scrubbing system. The material of construction for the scrubbers and scrubber water storage is MS with Rubber lining and Poly propylene.

The scrubber water which is acidic in nature will be used as the dilution water for the dilution of concentrated Sulphuric Acid during the production of S.S.P and there by achieving zero discharge from the plant operations.

PROCESS DESCRIPTION OF SULPHURIC ACID

Sulphuric Acid is manufactured with the Double Contact Double Absorption process to achieve higher efficiencies of the catalyst and higher yields of the product.

Sulphur is the only raw material for the manufacture of Sulphuric Acid and the Sulphur is melted in melter pits where steam heated coils are fitted. Molten Sulphur is traveled through a series of compartments and stored in clean Sulphur storage pit. The molten Sulphur is then pumped into Sulphur furnace for combustion with pre-dried process air. The process-air is supplied by blowers, which is dried in Drying Tower using Sulphuric Acid as drying media. Sulphur is converted into Sulphur dioxide in the Sulphur furnace.

$$S + O_2 \longrightarrow SO_2 + \Delta H$$

Sulphur combustion is an exothermic reaction and the heat so generated is utilized to produce steam in waste heat boiler – 1. The outlet gases from the boiler enters into theI pass of IV pass converters where $V2O_5$ catalyst is used. The conversion of SO_2 to SO_3 will takes place in the 4-stage converter and it is also an exothermic process.

$$2SO_2 + O_2 \longrightarrow 2SO_3 + \Delta H$$

The exothermic heat generated in I pass of converter is exchanged with water in No.2 boiler for generating steam and the cooled gases are sent to II pass of converter for further conversion. The gases from II pass of converter are cooled in Hot Heat Exchanger by transferring the heat to process gases and enters into the III pass of converter.

The III pass outlet gases are cooled in an economizer by heating the boiler feed water. The Economiser- I outlet gases are absorbed in Inter-pass Absorber Tower (IPAT) where 98.4% acid is in circulation. IPAT outlet acid concentration is adjusted to 98.4% by the addition of water.

$$SO_3 + H_2O \longrightarrow H_2SO_4 + \Delta H$$

Since, the SO_3 absorption and water dilution to acid are exothermic processes, the process acid is continuously cooled in acid coolers, and the excess acid generated as product from IPAT acid pump tank and by passing through an acid product cooler.

Mist generated in IPAT is separated from process gases in a candle filter and the gases are heated in Cold Heat Exchangers and Hot Heat Exchanger and finally sent to IV pass of converter, where in the balance conversion will be completed.

The IV pass outlet gasses are cooled in cold heat exchanger and absorbed in Final Absorption Tower (FAT), whose function is similar to IPAT. As conversion and absorption is carried out in two stages, this technology is called Double Contact Double Absorption (DC/ DA) process, which enhances the conversion efficiency to 99.7 % compared to conventional process of 97-98%. Thus, the DC/DA process has in built double absorption system, which reduces the process emission from plant stack.

The vent gases from FAT are let out through a stack after passing through an alkali scrubber, where dilute Caustic soda solution is in circulation for the neutralization of any residual SO3 emissions in the stack gases. The scrubber liquor, Sodium Sulphite, is being utilized in Caustic Potash plant for lean brine treatment for dissolved Chlorine removal. Online S02 analyzer is arranged in stack and connected to PCB website.

7.0 Safety Policy

- ✓ Plant has an integrated management system policy covering quality, environment, health and safety and signed by CMD
- ✓ IMS policy is signed by CMD and adopted from 1.7.2011
- ✓ It fulfills the requirements of AP Factory Rules

All employees are made aware of policy statement during induction training

7. 1 More display of safety policy in various departments and locations will create more awareness

7. 2 **Safety Organization**

Plant safety department is headed by Safety-In-charge having 35 years' experience in the plant. Safety head reports to Factory Manager. Fire services and OHS are under him.

8.0 Safety Communication, Motivation and training

8. 1 Plant has a suggestion scheme towards safety improvements suggested by employees. Safety day celebrations are conducted every year on March. Safety contests are organized and the winners are felicitated during the safety day function. DISH AP officials also invited for the safety day celebrations.

8. 2 Periodical training for contractors and employees are conducted in the plant. Specific to Chlorine leak arresting techniques are conducted for users.

8. 3 SCBA wearing competition is held during safety day celebration functions.

8. 4 Driver training, Chlorine Safety book let, Chlorine use booklet for users are issued to the users for creating more awareness and safety promotion.

8. 5 TREM cards are issued to the truck crew for safety awareness and emergency actions to be taken during transportation.

9.0 Safety Budget

There is no limit for the safety related works. Suggested to have a separate safety budget head to monitor the safety related expenses.

10.0 Safety Committee

Plant safety committee consists of management, staff and workmen. The safety committee meetings are held monthly. Safety related issues being are discussed and the minutes are recorded.

11.0 Occupational Health Center and First aid facilities

Occupational Health Centre in the plant is fully equipped to meet the emergencies of the plant.

11.1 Plant Occupational health center is equipped with beds and Oxygen cylinders.

11.2 OHC is manned with para medical staff all the 24 hours.

11.3 Medical officer is available during day shift.

11.4 Periodic medical checkup is carried out once in 6 months for Hazardous areas and once in a year for nonhazardous areas. Documents are available and verified.

12.0 Safety Manuals and rules

Safety of the plant is addressed in the preventive and periodic maintenance checks. But there is no separate safety manual for the plant.

12.1 It is suggested to have a separate safety manual including the safety in routine and non-routine activities, permits, emergency handling etc.

13.0 New equipment review& Process risk evaluation

Plant design consultants are M/s UHDE NORA Technology.

Plant to consider evolving a check list for management of change

The checklist is to include the following

01. Engineering data sheet entry to be made for any specification change
02. Insurance related aspects need to be covered –introducing the changes to be incorporated in the policy for additional assets involved.
03. Any change in on site emergency plan subsequent to change
04. Design code compatibility on the equipments on which modification
05. Statutory compliance or reporting of the modification.

A typical checklist for plant modification is given below.

13. 1 Risk analysis studies

Risk analysis studies have been carried out. It is opined that the risk analysis may have to be carried out for all the critical equipment as they may pose onsite emergencies in case of material release, fires, and explosions resulting from failures that may occur in these equipment.

14.0 Accident reporting, analysis and investigation

14.1 Accident reporting and investigation system is used for recording analyzing and to take corrective and preventive actions.

14.2 Ten year accident data is maintained and this made no reportable accidents in the plant.
It was told that system of reporting of 'Near miss' incident is there. In order to encourage reporting of Near misses, it is suggested to give at least small incentives like pen

15.0 Plant Safety Inspection

Plant safety inspections are carried out by Safety Committee members and the observations are discussed in safety committee meeting apart from the regular agenda.

16.0 Personnel Protective Equipments

Following special PPES are available in the plant apart from the regular PPES like gloves, Goggles and shoes.

Resuscitators	02
SCBA	21
Spare SCBA	06
Airline respirator	01
Canister masks	20
Gas filters	50

16.1 Mandatory warning signs may be provided in Acid and Alkali handling areas

16.2 SCBA: SCBA unit wearing by the operator in Chlorine storage area is verified. The operator is able to wear in lesser time than standard and followed the procedure.

16.3 SCBA cylinders are refilled when the pressure drops to 200bar. Normally the best practice is to fill the cylinder whenever there is 10 % drop in the full cylinder pressure. This is to ensure maximum time is available for use apart from the 5 minutes for escape.

17.0 Housekeeping& Civil

Plant has a good housekeeping system. All areas are well maintained.

17.1 KCl saturation tank needs hand rails to prevent fall into the tank. Hand rails are to be extended to the full area.

17.2 Secondary brine purification plant: The civil structure is in poor condition. Reinforcement bars are exposed and corroded. Stability needs to be checked and suitable repairs to be under taken.

17.3 NaOH Tank dyke volume is less. This is observed in other areas also. The distance from the tank surface to the dyke should be 0.6 H (where H is the liquid column height in the tank) to avoid spigot flow outside the dyke area. This needs to be considered in future tank farms.

17.4 Emergency escape from the chlorine storage area to be provided with exit signage.

17.5 In Solar plant panel area there is fully grown vegetation. On drying this poses fire hazard. Vegetation to be removed to reduce fire risk.

18.0 Tank farm area observations

18.1 NaOH tanker loading platform with safety belt arrangement is required. Since people has to reach the tank top for sample collection and level monitoring to prevent fall from height accidents platform with safety arrangements is required. Several accidents have occurred in petroleum distribution centers and chemical plants.'

18.2 H_2SO_4 Tank farm area: Manhole covers of the tanks are not properly closed. This will result in acid vapor escaping to atmosphere. The manhole covers needs to be closed properly.

18.3 Acid proof lining in the tank farm area is in progress. This needs to be completed on priority to prevent spills leaching in to soil.

19.0 Work permit system

Following work permits are available in the plant for non-routine activities:

- Confined space work permit
- Line breaking permit
- HT line permit
- Excavation work permit
- Hot work permit
- Working at Height Permit
- Salt unloading permit
- Wagon filling permit

19.1 Treat the conveyor basement as confined space and permits may be issued accordingly. As a thumb rule if the depth exceeds the width confined space permit has to be used.

20.0 **Fire safety**

20. 1 DCS is provided with smoke detectors on the false ceiling. Beneath the DCS false flooring power cables are laid. False flooring also requires smoke detector system for early detection and taking corrective actions.

20. 2 UPS system fire accident are reported in other units and resulted in serious consequences, fire and huge property damages. Following are suggested to ensure safety of the UPS system.

20. 3 -To monitor the UPS battery system provide display of installed date and due date.

-All batteries terminals require cap to prevent shorting during terminal tightening and replacement or spanner /tools.
-Individual cell voltage to be measured and monitored.
-Out put voltage under load to be checked.
-Battery stand needs to be earthed.

20. 4 Sulphuris stored in open yard.

20. 5 FRP liner and gasket manufacturing area: In this area FRP resin drums (flammable liquid) and LPG cylinders are stored together. LPG cylinder after use should be moved to safer place and not to be stored in FRP area.

20. 6 FRP resins are stored in an AC room with 2 ac units running alternately. An ordinary light is provided in this room. This may be disconnected or flame proof fittings to be provided.

20. 7 In Auto service station large volume of used tyres are kept. It is very difficult to fight fire in tyres. Used tyres should be disposed or separately from the plant area.

20. 8 Spares for mechanical, electrical and other departments are stored in Stores. This area requires smoke detector.

20. 9 Large quantity of old grease is kept in stores. Though grease is nonflammable but elevated temperatures the mineral oil in grease can flash, burn or evaporate at temperatures greater than 177°C (350°F). This may be reviewed and suitable actions may be taken to reduce fire risk.

21.0 On site emergency plan

21. 1 Emergency response plan is available and all requirements are met in the control room.

21. 2 Copy of the Emergency preparedness plan may be kept in the control room for easy reference by the site emergency controller.

22.0 Electrical

22.1 Temporary Lighting supply in the water treatment area. Provide permanent wiring with earthed metallic conduit.

22.2 Portable lamp is used for level checking in the tanks in water treatment area Provided RCCB 30 ma protected supply or 24 V DC lamp for safety.

22.3 All tank farms irrespective of the contents needs to be provided with 2 separate earth connection to prevent lightning attack.

22.4 Recti transformer 1 and 2: DC bus bars are accessible and the mechanical fencing is not covering on all sides. Mechanical fencing is required to avoid contact with DC bus. Also provide DC warning sign in this area.

22.5 Remove all electrical fan, heat exchanger tubes stored in the recti transformer area.

22.6 Dissolved gas analysis is carried out in 2016. Suggested to carry out every year as being followed in other plants.

22.7 Diesel underground tank area near spares stores. The tank farm area needs to be fenced to avoid storage of machinery spares.

22.8 Static earth pit and static earthing to be followed fordiesel unloading from the road tanker.

23.0 <u>Chemical safety</u>

23.1 Cell house membrane is changed once in 4 years and coating is carried out once in 8 years. A good practice for safety in cell house.

23.2 Chlorine leak detectors 2 numbers and Hydrogen detectorprovided in Cell House. A good practice.

23.3 In the tonner filling area Chlorine filled cylinders are left without identification. Suggested to mark place for full and empty cylinders and improve house keeping

24.0 <u>Review of Fire Protection System</u>

24 1 Presently water from the two overhead tanks at 10 meter height with capacity 85 m^3 each is available. In the raw water pump room 600 m^3 sump is available.

24 2 New fire tender is procured and under trails in the plant. SCBA sets may be provided in the fire tender for meeting any gas leak emergency.

25.0 Documents verified

25.1 Safety valve as per SMPV Rules for Chlorine storage –Vessel SRV tested on 8/10/2018.

25.2 Form-8 Pressure Vessel records dated 22/8/2019 verified.

25.3 Form- 38 Lifting Tackles and mobile cranes 5 nos verified

25.4 Documents on road safety week celebrations on 9th Feb 2019 is verified.

25.5 Safety day is celebrated with exhibition, pledge, essay& slogan competition, Housekeepingcompetition, SCBA wearing, Fire extinguisher demonstration and fire tender demonstration.

25.6 Directorate of Electricity approval for 2 nos of 6000 KVA transformer approval.

25.7 NSC program on Occupational Safety Management held on 25/2/2019 – Faculty support extended.

25.8 Boiler AP 2648 tested by Boiler inspector and approved for use till 01.08.2020.

25.9 Boiler AP 6475 tested by Boiler Inspector and approved for use till 1.1.2020

25.10 Equipment history card for all equipment, storage tank and safety equipment identified and followed

25.11 Preventive maintenance of lined vessels, HCL tank testy procedure are verified –good

25.12 HAZOP Study has been conducted by the UHDE designer. The records are available.

25.13 On 27/8/2019 Mock drill has been conducted for chlorine leak and entire drill was verified for positive and improvement observations.

25.14 CL2 condemned cylinder are recorded quarterly report is send toCCOE. On an average 8 cylinders are scrapped.

25.15 Condemnedcylinder report to CCOE 17.7/2019 verified.

25.16 Hydrogen cylinders are hydraulically tested once in 5 years. There are 5 condemned cylinders in the previous occasion. This can be reduced and made nil by educating the clients.

25.17 quarterly report to CCOE on HP testing for 40 no's dated 13/7/2019

25.18 Client customer awareness : training programs are conducted on request from Telangana Power Generation Corporation 17/8/2019

25.19 Outside seminar for awareness on Chlorine has been conducted in Kakinada for industries in East and West Godavari Districts on 18/3/2019

25.20 Preventive schedule with 14 heads. Covering all plant and machinery is followed :

Subject	Frequency
Scale removal	Yearly
External examination	Monthly
Internal examination	Yearly
Painting	yearly
Overhaul	Yearly/Two years
Repair /replace	4 years
HT test	2 Years/4 Years
Thickness /corrosion test	2 years
Vibration test	6 months
Bearing inspection	Monthly
SV test	Yearly

25.21 CL_2 storage HT test record. Procedure for testing is available. Last tested conducted on 22/11/2018

25.22 APSPCB is connected with CCTV cameras including effluent out let

25.23 Communication system is ensured by Land line BSNL RF link with other plants and cellular connection

25.24 Documents on road safety week celebrations on 9th Feb 2019 is verified.

25.25 IMPORTANT: Stability certificate is issued on 20.1.2017 by competent person. Suggested to review periodically as there are few buildings with concrete sealing are damaged.

25.26 Critical instrumentation are checked once in 3 months / Transmitters once in 6 months and DCS equipments are tested once in 2 months.

25.27 Chlorine sensors are tested once in 3 months.

25.28 Chlorine storage tanks are tested once in 2years.

25.29 Interlock status are verified during shut down.

25.30 PCB: Air and water consent valid up to 30.06.2021.

25.31 Earth pits 56 numbers +85 numbers are tested yearly.

25.32 Lightning arresters are tested on22/7/2019.

25.33 Transformer maintenance is carried out during shutdown. 33 KV relay and 132 KV relay testing, 7.5 MVA transformer testing records are available.

25.34 Earth pits 56+85 numbers tested yearly. Last test date 22.07.2019.

25.35 Four lightning arresters earth pits are tested

ANNEXURE - 1

The Tank Farm Fire History:

1. **Pulua Merlimau - Singapore**

Following two days of heavy rain, the pontoon-floating roof on a 134-foot-diameter by 48-foot-high naphtha tank was found partially submerged. The following day, while operators were pumping out the tank, the roof became jammed and some distortion of the shell was noticed. A foam blanket was being applied over the exposed naphtha surface when ignition occurred. About two hours later the seal area of a second naphtha tank of similar size and construction located a third to a half a diameter from the first tank ignited. A third naphtha tank ignited eight hours after the second became involved. Thirty hours later a 75-foot-diameter tank became involved.

2. **Millford Haven - United Kingdom:**

The most likely source of ignition of this 600,000-barrel floating roof tank fire was incandescent carbon particles discharged from the top of a 250-foot-high refinery flare stack situated 350 feet from the tank. The 256-foot-diameter by 66-foot-high tank, which contained 348,000 barrels of North Sea Crude at the time of ignition, was arranged within a standard individual dike. It had a single mechanical seal and was equipped with a 12-inch-high foam dam but no foam delivery lines or outlets. Reportedly, there were several cracks extending over 11 inches on the single plate-floating roof. Inspections of the roof a few days before the fire revealed oil seepage onto the roof deck. There had been no oil transfer in the 24 hours preceding the fire.

When first noticed, fire involved about half of the tank roof area. It progressively spread to the entire surface. Cooling water streams were positioned to protect two 138-foot-diameter, 142,000-barrel fixed roof vacuum gas oil and fuel oil tanks situated 200 feet away. Oils were being pumped out of the three tanks in preparation for a major foam attack when, 12 hours into the fire, a violent boil over occurred in the crude tank. The ensuing fire covered 4 acres and destroyed or damaged much of the firefighting equipment including two foam trucks. Two hours later a second less violent boil over occurred. The major foam attack, which commenced 21 hours after ignition, continued for 14-1/2 hours before extinguishment was complete. The crude tank was destroyed, two fixed roof tanks badly damaged, and 132,000 barrels of crude oil consumed.

This fire involved the use of 44 pumpers, 6 elevating platforms, and 14 foam trucks from four nearby refineries and the public fire service. In addition, 66 commercial tankers and vehicles transported 201,600 U.S. gallons of 3 percent and 6 percent foam.

3. **Shuaiba – Kuwait :**

The cause of this refinery tank farm fire, which destroyed eight tanks and damaged several others has not been disclosed. It appears to have originated at a pump manifold within the common dike serving six 160,000-barrel floating roof tanks containing petrochemical grade naphtha. Naphtha was being pumped into one of the tanks when the initial explosion and fire occurred.

About a half hour into the fire, the seal of the first tank caught fire. This was followed rapidly by two others. These spread progressively, eventually involving five of the six tanks in the group. The sixth tank was empty and sustained severe damage.

A strong firefighting attack was initially made by the refinery fire brigade, which was later assisted by nearby industrial fire brigades, military, and public fire departments. As many as 75 pieces of mobile firefighting equipment were used to supply up to 11,000 U.S. gpm of water and foam solution during the fire, which lasted five days and twenty hours.

In spite of heavy protective water streams, a strong wind and radiated heat caused the fire to spread into an adjoining row of four 72,000-barrel floating roof tanks containing intermediate products and to a fixed roof 32,000-barrel slop tank. This took place 64 to 103 hours after the fire-began.

Wind-driven flames caused the collapse of a heavily loaded unprotected steel pipe rack located between the two rows of three tanks. Water curtains set up between the tank groups and nearby process units at the 200,000 barrels-per-day refinery and petrochemical plant were effective. Damage was spilt 50-50 between liquid hydrocarbons and tanks and other equipment.

4. **<u>Romeoville – Illinois:</u>**

Lightning struck a 190-foot-diameter cone roof tank containing diesel fuel. Roof fragments thrown 240 feet stuck a 100-foot-diameter covered floating roof gasoline tank. A 180-foot floating roof gasoline tank at 80 feet distance was also stuck by debris. The entire surfaces of the cone and internal floating roof tanks ignited immediately. The rim fire on the floating roof resulted in the roof sinking after about four hours.

Extinguishment was by top-side and subsurface foam application after about 46 hours. The refinery's five stationary fire pumps supplied up to 10,000 gpm of the estimated 14,000gpm pumped during the fire. Thirty-five municipal and industrial fire departments, including a 12,000gpm-fire boat, assisted the refinery fire department. About 22,000 gallons of foam concentrate were used.

5. **Freeport – Texas:**

Failure of a 15KV transformer containing 235 gallons of mineral oil was the probable cause of this explosion and fire in the electric power plant of a large petrochemical complex. With the ignition of the mineral oil, nearby heavily loaded cable trays ignited and allowed the spread of fire. Heavy smoke evolved, forcing the operators to evacuate the power block control room and making fire fighting by the plant fire brigade very difficult. After six hours the concrete roof of the control room collapsed.

6. **Naples – Italy:**

Twenty-four of the 32 tanks at a large government owned marine petroleum products terminal were destroyed by fire which began with a tank overfill. Twenty-seven thousand tons (715,000 barrels) of gasoline and fuel oil was being off-loaded into tanks, which reportedly were equipped with high level gauges.

A large spill developed followed by a vapor cloud, which was ignited by an unknown source. Almost immediately 20 of the tanks were involved in massive fire covering 3.7 acres. The devastating explosion caused complete destruction of the terminal buildings and extensive damage to nearby industrial and residential structures. Tank piping failed, contributing more fuel to the fire. The main fire fighting control center as well as electric and engine driven fire pumps and foam lines were disabled. Efforts to extinguish the fire were handicapped by intense heat radiation and by debris from the explosion.

About 800 fire fighters with 166 pieces of mobile equipment responded from throughout south central Italy. This included airport crash trucks and even air tanker planes which dropped foam on the fire. Four-hundred sixty tons (132,000 gallons) of foam were used. The fire was extinguished three and one-half days after is started.

Annexure 2

Sulphur safety precautions

6.4 FIRE CONTROL

6.4.1 Automatic sprinkler systems which comply with NZS 4541 and provide a fine spray or mist are recommended as the most satisfactory extinguishing system for bulk stores. Fire hoses and extinguishers must be fitted with fine spray nozzles to ensure that Sulphur dust clouds are not raised, as these can explode on contact with the fire. PREVENTION OF SULPHUR FIRES AND EXPLOSIONS 19

6.4.2 Incipient fires in storage piles may be smothered by gently shoveling sulphur onto them. 6.4.3 At least two sets of self-contained breathing apparatus shall be available for use in case of Sulphur fires on premises where bulk Sulphur, fine or granular, is stored. The term "bulk Sulphur" shall not apply to Sulphur supplied in multi-wall bags, or similar packaging. All respiratory equipment shall comply with and shall be selected, used and maintained in accordance with AS 1715 and AS 1716. These standards have been adopted by Standards New Zealand.

6.4.3 Factory fire crews shall be available on premises where bulk sulphur is stored, and be provided with safety belts and lifelines, with one worker standing by in case of accidents.

6.4.4 In addition to the above provisions, employers should liaise with the local commander of the New Zealand Fire Service and follow his or her recommendations with regard to the size and training of factory fire crews and other related matters, including rescue and evacuation procedures.

8.2 ***EXPLOSION RISKS***

8.2.1 To avoid the possibility of an explosive concentration of sulphur vapor occurring, the temperature of the liquid sulphur shall not exceed 154°C. The temperature should, however, be maintained above 114°C to prevent the accumulation of solid sulphur on internal tank surfaces exposed to air. Any sulphur deposits are corrosive to steel in the presence of moisture.

8.2.2 Solid sulphur often contains impurities of mainly hydrogen sulphide but also traces of organic solvents. When melted the sulphur may liberate gases and solvent vapours in explosive or toxic quantities.

8.2.3 Tanks used to store liquid sulphur shall be fitted with vents to prevent the accumulation of explosive quantities of hydrogen sulphide. These pipes shall be so designed using steam tracing or other means, to ensure plugging with sublimed sulphur cannot occur.

8.2.4 The buildings housing liquid sulphur tanks shall be provided with good natural or mechanical ventilation to disperse flammable gases and vapour and maintain the atmosphere below the WES-TWA for hydrogen sulphide.

8.2.5 The concentration of flammable gases which may accumulate above molten sulphur shall not exceed 35% of the lower explosive limits under any circumstances. These concentrations shall be checked periodically with an explosimeter and after each new consignment of sulphur. If hazardous gas levels *are recorded, operations shall be discontinued until the gas concentration registers 15% of the LEL. Additional ventilation may be required.*

8.2.6 Because liquid sulphur is capable of building up a significant electrostatic charge, especially when pumped at high speeds, tanks shall be filled from the bottom or through discharge pipes that extend to the bottom. However, in situations where molten sulphur is flowing at rates not exceeding 2m/sec, as will normally be the case with gravity feed systems, bottom filling of tanks, while recommended, is not mandatory.

30 PREVENTION OF SULPHUR FIRES AND EXPLOSIONS

8.2.7 All pipe work, metal parts of tanks and buildings must be bonded and earthed in accordance with AS 1020. Where appropriate grounding connectors shall be provided for the bonding of liquid sulphur tanks and tank cars being loaded and unloaded.

6.2 MINIMISATION OF DUST

6.2.1 To prevent dust formation during the storage and handling of sulphur, enclosures should be constructed with a minimum number of horizontal surfaces where dust can accumulate. 18 PREVENTION OF SULPHUR FIRES AND EXPLOSIONS

6.2.2 Scattering of dust where solid sulphur is transferred from one point to another should be avoided. Where feasible, dust-tight housings or extraction hoods should be provided.

6.2.3 Where vacuum cleaners are used for dust control and removal, they shall be suitable for the hazardous area in which they are to be used. Refer to section

6.5.4 for electrical requirements. 6.2.4 Bulk accumulations of fine sulphur may also be removed using soft push brooms, having natural bristles and non-sparking scoops or shovels before vacuum cleaning equipment is used.

6.2.5 The use of compressed air to remove dust from any surface, vigorous sweeping or any other method of cleaning which may raise a dust cloud is prohibited

6.2.6 Long sulphur drops from overhead gantries into the store should be avoided by discharging near the top of the existing sulphur pile. Alternatively, dust formation can be reduced using a telescoping spout, preferably made from aluminium. Where this is not possible or practical, the sulphur shall be dampened (see section 6.2.7) to minimise dust cloud formation.

6.2.7 Where dust formation is a problem within a factory, a water sprinkler system shall be available to damp down the sulphur to approximately 3% moisture content prior to loading it into the bulk store.

Any enclosed plant in which dust can accumulate to the extent that it is liable to give rise to an explosive concentration must have explosion protection devices fitted.

22 <u>PREVENTION OF SULPHUR FIRES AND EXPLOSIONS practical of these</u>

Unmodified front-end loaders powered by diesel or other fossil fuels are a source of ignition. They must be equipped with spark arrestors and protected muffler and exhaust systems, when used in areas where the sulphur contains 10% or more fines. The temperature rating of the engine, and exhaust system shall be T5, which allows for a maximum surface temperature of 100°C.
The buckets of front-end loaders are generally manufactured from hardened alloy steels, which in contact with concrete can produce incendiary sparks and ignition of sulphur. There is no firm evidence, however, that the so called "non - sparking" metals such as bronzes are any safer in this respect, as these can also

generate sparks in contact with concrete which are hotter than those produced by steel. (The non-sparking metals generally do not spark in contact with steel but there are also exceptions, e.g. when the steel is rusty.)

With front -end loaders care must be exercised to avoid raising dust clouds as far as possible and to prevent the bucket from scraping along the concrete.

For complete document for reference visit e

https://worksafe.govt.nz/dmsdocument/329-acop-prevention-of-sulphur-fires-and-explosions

Annexure 3

Case study: Fire accident in sulphur Storage

Company Suspends Operations after Second Sulfur Dust Fire

May 9, 2017

https://hughesenv.com/company-suspends-operations-after-second-sulfur-dust-fire/

A company in Sarasota Florida is suspending operations after dealing with their second combustible Sulphur dust fire within ten days, in order for them to get their safety issues fixed. The dust that was causing these fires was a sulfate dust that was being stored in large mounds at the facility.

The first fire occurred when a truck driver drove outside of a marked area and onto dry sulfate dust, which was ignited merely by the friction from the tires. This fire destroyed a dump truck and forced nearby buildings to have to evacuate.

The latest Sulphur dust fire was caused when a sweeping machine made contact with something metal and created a spark, which ignited the flammable Sulphur dust. Five people were hospitalized due to smoke inhalation from trying to fight the fire.

Sulphur dust can cause extra safety issues to firefighters because when the Sulphur dust fire burns it creates hydrogen sulphur dioxide gas, which is toxic and flammable, and results in the dust having a lower flash point for explosion.

The firefighters used a drone to monitor hot spots in the piles of dust to prevent further flare-ups, and to track the plume of smoke to make sure it was not moving towards people. The facility has closed until a new water irrigation system and additional safety measures are installed, and are looking at extra corrective actions and working with local authorities to ensure future safety. The company will also switch to handling the dust by hand instead of with machinery that could cause sparks.