Daurala Sugar Works

(A UNIT OF DCM SHRIRAM INDUSTRIES LTD.)

Daurala, Distt. Meerut, Uttar Pradesh- 250221

HAZOP STUDY

(NOV-2020)

Prepared By

BBC Tech Associates

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NAME AND ADDRESS OF THE FACTORY WHERE HAZOP STUDY CARRIED OUT:

Mr. N. K. Jain (OCCUPIER) SITE: DAURALA SUGAR WORKS A UNIT OF DCM SHRIRAM INDUSTRIES LTD. DAURALA DISTT: MEERUT (UP)-250221	SIGN & SEAL

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1.0 ACKNOWLEDGEMENT

This Hazard and Operability (HAZOP) Report for M/s. Daurala Sugar Works - A Unit of DCM Shriram Industries Ltd. Distt: Meerut (UP) is based on the studies carried out in the month of NOV — 2020 and the information provided by the Management.

The Officials of the plant gave whole hearted co-operation during the studies and completion of the report. All the observations could be made freely.

We express our sincere thanks to management of M/s. Daurala Sugar Works - A Unit of DCM Shriram Industries Ltd. Distt: Meerut (UP) for providing unstinted support during the HAZOP Study without which the HAZOP study could not have been possible. The courtesy extended to our team is highly appreciated.

For BBC Tech Associates

Ashok Upadhyay
(Director)

2.0 PREFACE

M/s. Daurala Sugar Works - A Unit of DCM Shriram Industries Ltd. Distt: Meerut (UP) has engaged the service of BBC Tech Associates for carrying out a HAZOP Study of their plant. The Scope of work for HAZOP Study is to cover the Distillery division.

The Auditors of BBC Tech Associates as well as team of representatives from the company conducted the study with the help of various applicable guidewords to identify the abnormalities likely due to deviation in the process parameters and operating conditions certain recommendations are proposed. It was observed that P & I presented for the study were not in some section so the consultants with the help of plant personnel conduct the study on physical layout & available P & I Diagram.

All members with the help of universally accepted methodology of using guidewords had prolonged in depth discussion & brainstorming over P & I diagram and other literature made available to them. As a conclusion of this exercise certain recommendation has been proposed.

3.0 CERTIFICATE

We are pleased to certify that this HAZOP Study Report of Company has been conducted by us.
HAZOP STUDY is a legal requirement as per the rules 10 to 13 under Manufacture, storage and import of Hazardous chemicals rules, 2000 and environment (protection) Act, 1986.

It is obligatory of the occupier to carry out a "HAZOP Study", as required under item no. (II) (2) of the format for application of the Site Appraisal Committee and as per the Schedule 1 of the Factories Act under Section 2(CB) - Item No. 12 of the Schedule.

The Executive Summary is given in the beginning to highlight the important summary of our report and methodology of the HAZOP Study carried out.

4.0 INTRODUCTION:

Management of M/s. Daurala Sugar Works - A Unit of DCM Shriram Industries Ltd. Distt: Meerut (UP) has engaged M/s. BBC Tech Associates to conduct HAZOP study of their distillery division at Daurala Sugar Works, Daurala, Distt. — Meerut, (UP). It was noticed that updated P & I diagram were not made available in some area, so the Auditors have conducting the study based on the actual location. The problems of the plant were discussed in detail and recommendations were prepared.

LEGAL REQUIREMENT

The general duty of the Occupier specified in the section 7-A of the Factories Act, 1948, casts different obligations of the Occupier. These will be fulfilled to a great extent, if the recommendations / comments made in the present report of HAZOP are implemented. The various statutory provisions under section 41-A to section 41-H of the Factory Act require the status of the safety to be periodically examined from an external agency.

DESIRE FOR IMPROVEMENT

During the course of the assignment, discussions were held with the various officials of the plant. From this discussion it was quite apparent that apart from the legal obligations the management of M/s. Daurala Sugar Works - A Unit of DCM Shriram Industries Ltd. Distt: Meerut (UP) was really keen on improving the safety culture of the plant. It was therefore, very prudently thought that if an independent assessment of the safety is carried out, i.e. HAZOP. This would help the management to determine the "Risk" in and around the usage areas and to identify the hazard if any, in the industrial activity.

WHY "HAZOP" STUDY

One of the powerful techniques of assessing the risk in any operation is to carry out the systematic HAZOP study for the Hazardous operations.

HAZOP TEAM

The study was carried out by a team consisting Consultants of M/s. BBC Tech Associates as well as a team of M/s. Daurala Sugar works -Distillery division, Meerut, representative. The details of the team are as follows:

Mr. Sanjay Srivastav Mr. Sunil Kumar Dwivedi	BBC Tech Associates
Mr. Munish Sharma Mr. Sumit Mathur Mr. Rajbeer Arya Mr. Uma Shankar Mr. Mohit Khurana	Daurala Sugar Works, Daurala Unit: Distillery

5.0 OBJECTIVE AND METHODOLGY

5.1 OBJECTIVE

The specific objectives of the study are-

• Identification and assessment of major hazards potential in the storage and handling of petroleum products inside the depot.

• Study of built- in- safety measures and operational safety precautions in practice.

• Identification and assessment of major hazards potential in the process equipment.

• Suggesting measures to reduce risk by reducing hazard and reducing probability.

5.2 SCOPE OF THE WORK

The objective of this study is to evaluate the potential hazards to the plant.

• To evaluate the process safety system of plant from the safety point of view considering the structural / electrical / instrumentation aspects.

• To evaluate the system provided to protect fire & explosion in product pipe line and system full proof.

• Evaluate the maintenance & operation system of the Terminal.

• Evaluate provided control parameters and instrumentation.

• Suggest better system for safe operation & maintaining plant in a safe manner.

5.3 METHODOLOGY

Design data, built in safety systems are studied. Discussions are held with Officials. Safety related individual system is discussed with HAZOP team member.

HAZOP exercise is conducted taking into consideration of each and every equipments, storage tanks, Tank truck filling gantry, pump house, pipe lines, operating procedures, built in safety system, operating parameters and existing safety measures. Thus, this study is mainly oriented towards actual risks rather than chromic risks.

Possible causes of the possible events will be derived and consequences effect of such events will be discussed and required recommendation and follow-up sheet will be generated for implementation purpose

6.0 INTRODUCTION OF HAZOP

6.1 HAZOP STUDY

Safety and reliability of a modern processing plant can be improved by use of procedures that recognize and eliminate potential problems in the design stage. Hazard Operability study is now used to great satisfaction throughout the chemical Industries.

It is based upon the supposition that most problems are missed because of a lack of knowledge on the part of the design team. It can be used to examine preliminary process design flow sheet at the start of a project or detailed piping and instrument diagrams at the final design phase and during modifications of the existing plants.

In essence, it is an abbreviated form of "critical examination" based on the principle that a problem can only arise when there is a deviation from what is normally expected. The procedure, therefore, is to search the proposed scheme systematically for every conceivable deviation, and then look backwards for possible causes and forwards for the possible consequences.

6.2 DATA COLLECTION

- Process description broken into steps & sub steps.
- Process flow diagram.
- Factory layout.
- Block-diagram of the plant equipment.
- P & I diagram of concerned equipment's.
- Material safety data sheets summary.
- Equipment specification & history.

6.3 HAZOP COMMITTEE

The HAZOP committee is formed as per following guidelines

CHAIRMAN	**OCCUPIER / FACTORY MANAGER.**
CO –ORDINATOR	Safety officer.
MODERATOR	He is an expert in the HAZOP technique, not the plant; His job is to ensure that the team follows the procedure. He needs to be skilled in leading a team of people who are not responsible to him and should be the sort of person who pays meticulous attention to detail and can contribute wherever needed.
PROJECT or DESIGN ENGINEER For a new design MAINTENANCE MANAGER For operating plant	Usually a mechanical engineer and, at this stage of the project, the person responsible for keeping the costs within the sum sanctioned. He wants to minimize changes but at the same time wants to find out rather than later if there are any unknown hazards or operating problems.
PROCESS ENGINEER	Usually the chemical engineer who drew up the flow sheet.
PLANT MANAGER	Usually a chemical engineer, he will have to start up and operate the plant and is therefore inclined to press for any changes that will make life easier.
INSTRUMENT /DESIGN ENGINEER	As modern plants contains sophisticated control and trip systems and as HAZOP often result in the addition of yet more instrumentation to the plant.
RESEARCH CHEMIST	If new chemistry is involved.

6.4 STUDY PROCEDURE

The procedure involves examining the model systematically, section by section or line by line (depending on the level of detail required), looking for inadequacies in design. A checklist of guidewords is applied to each stage of the process in turn, thereby generating deviations opposites all conceivable eventualities. Typical aspects considered are normal plant operation, foreseeable changes in normal operation plant start-up and start- down, suitability of plant materials, equipment and instrumentation provisions for failure of plant services, provision for maintenance safety etc.

The possible causes and consequences of each deviation so generated are then considered and potential problems thereby identified and noted if they merit action. The need for action is decided semi quantitatively by taking into account both the seriousness of the consequence and the probability of the events occurring. For any major risk area a quantitative hazard analysis is also carried out.

The stage in the procedure is next considered for the case where a detailed line by line examination is required. If any member of the study team is not familiar with the technique an introductory talk and illustration is desirable before commencement of the study. Before examining each section of the project, a team member summarizes the function of the section, including normal process conditions and specifications if available to ensure that all team members have the necessary background knowledge of the process.

All guidewords are then applied in turn on a line-by-line basis there by including process deviations, e.g. no flow. They thus serve as an agenda to ensure that all aspects of plant operation are considered and also force consideration of the lines joining items of equipment or connecting the equipment to off sites and not directly to the equipment itself. This is because any problem that could arise in a piece of equipment should show up as a cause or consequence of a deviation in a line joined to that piece of equipment. However, the guideword

“OTHER” which has special significance for aspects other than normal operation must be applied to items of equipment as well as the lines.

6.5 THE IMPORTANT TERMS PERTAINING TO HAZOP STUDY ARE.

Intention	The intention defines how the part is expected to operate. This can take a number of forms and can be either descriptive or diagrammatic. In many cases, it will be a flow sheet (P & ID)
Deviation	These are departures from the intention which are discovered by Systematically applying the guide words.
Causes	These are reasons why deviation might occur. Once a deviation has been shown to have a conceivable or realistic cause, it can be treated as meaningful
Hazards	These are the results of the deviations
Consequences	These are the consequences, which can cause damage, injury or loss.

6.6 A LIST OF GUIDE WORDS TABLE — LIST OF GUIDE WORDS

Guide Words	Meanings	Comments
None	Complete negation of the intention	No part of the intention is achieved e.g. no flow or reverse flow.
More of	Quantitative increase	More of any relevant physical properties than there should be e.g. higher flow (rate or total quantity) Higher temperature, higher pressure viscosity, more heat, more reaction etc.
Less of	Quantitative decrease	Less of any relevant physical property than there should be, e.g. Lower flow (rate or total quantity), lower temperature, lower pressure, less heat, less reaction etc.
Part of	Quantitative decrease	Composition of system different from what it should be e.g. Change in ration of components, component missing etc.
More than	Qualitative increase	More components present in the system that there should be e.g. extra phase present (Vapour, solid), impurities (air, Water, acids, corrosion products etc.)

Other than	Substitution	What else can happen apart from normal Operation e.g. Start up, shutdown, high/low rate running, alternative operation mode, failure of plant services, maintenance, Catalyst change etc.

Guide words are applied to the design intention tells us what the equipment is expected to do. Each guideword was applied to the relevant parameter under examination of a sub step to form a deviation. GUIDE WORDS helps in identifying the relevance of parameter for risk assessment.

Thus for each section, the team determined the applicable parameter / guide word combinations or deviations. Then for each deviation that could realistically occur, the team member's brainstormed causes of the deviation. For each cause, consequences and safeguards were described. Consequences included fire, explosion, and release of flammable or toxic material & operating problems; while safeguards were those that help to prevent the cause of hazard or that mitigates the consequences of the hazard. In specific cases, safeguards also included precautionary steps in written procedures. Apart from these recommendations, whenever team members felt the need for further improvement, further study was recommended considering the probability and seriousness of the hazard Recommendations were for installation of procedures or administrative controls, of additional study to determine an optional solution or whether a problem exists which warrants any action.

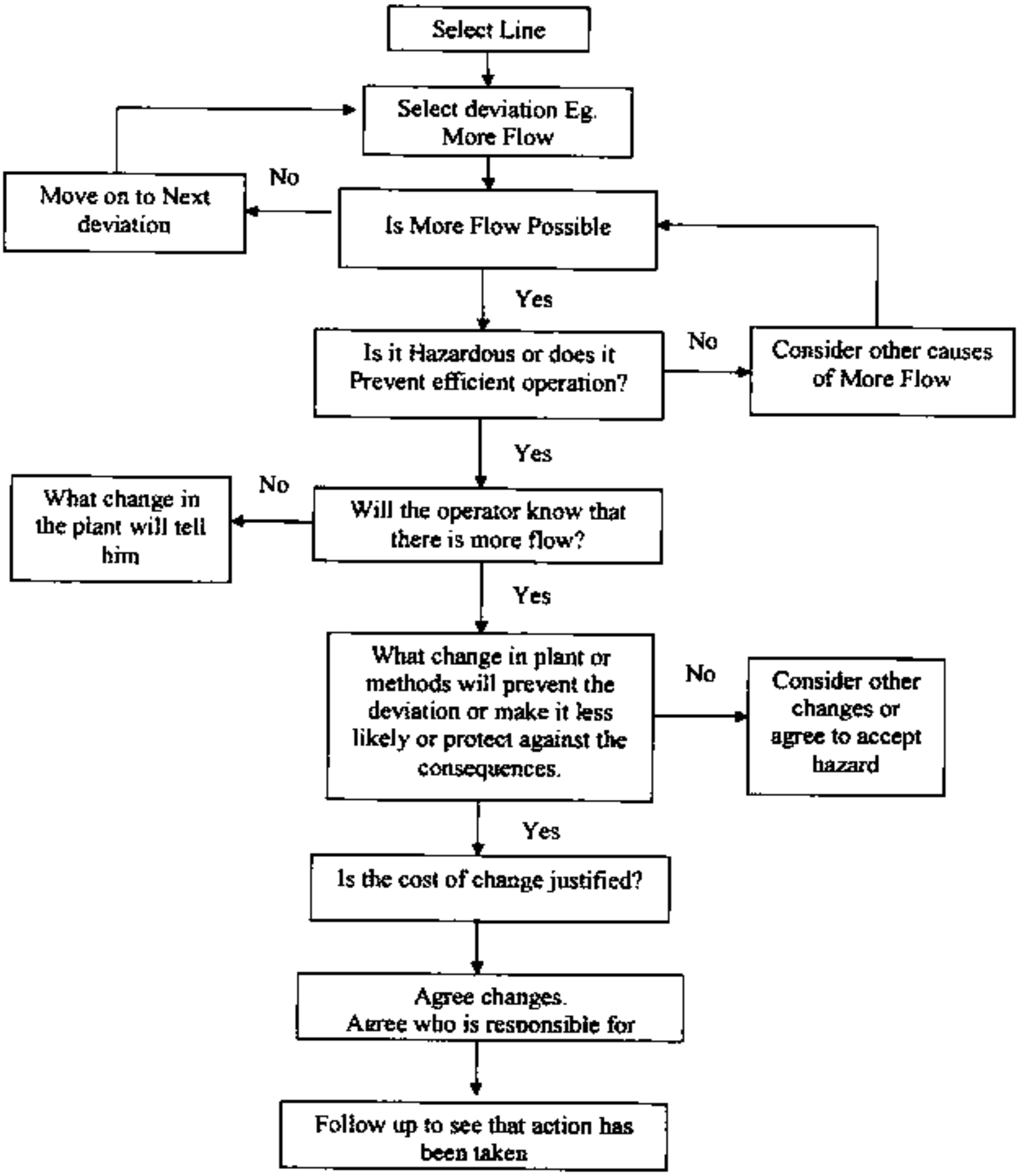
The creative state in the procedure is the recognition of possible causes and consequences of each deviation generated by the guidewords. This relies entirely on the knowledge, experience and expertise of the team and on an attitude of mind which looks for what could go wrong in every conceivable eventuality. It must be thorough and exhaustive. For example where provision has been made for a contingency, it must be questioned whether the provision is adequate (e.g. is a single non-return valve sufficient, do we need a high level alarm as well as a level indicator, is the trip system reliable and of the right type, is the vent large enough etc.)

Potential problems, as represented by the consequences of the deviations, should be evaluated as they arise, and a decision reached on whether they merit further consideration or action. Except for major risk areas where a fully quantitative assessment is required, this decision is made semi-quantitatively on the basis of both the seriousness of the consequence (usually scaled as trivial, important or every serious) and the frequency of the event (unlikely, occasionally or every probable).

In some cases, the need for further action is clear-cut and the best remedy fairly obvious, e.g. install a non-return valve to prevent back-flow. An action can then be quickly agreed and recorded, before the study moves on to the next point.

In other instances, where the need for action is again very clear but a satisfactory solution not immediately apparent, the team should avoid. It is sufficient to note the point as requiring further consideration outside the study meeting before moving on the to the next item. Also, if it is not possible to agree on whether or not any further action is required, either because the problem is of borderline significance or because further information is required, the point should again be recorded for attention outside the meeting.

6.7 A flow chart giving HAZOP procedure is given below:-



6.8 DOCUMENTATION

The worksheet, the basic documentation of the team deliberations, consists of the following details:

HAZOP STUDY	:	This consists of description in short of the process used or the manufacture of final product.
LOCATION/ PLANT	:	This is obviously the place where the product is manufactured.
P & I REFERENCE	:	This refers to the concerned P & I drawing number used for particular operating step.
OPERATING STEP	:	Description of the step in the manufacturing procedure.
DESIGN INTENTION	:	This actually is the sub step which describes the intention of the sub step.
UNIT/ EQUIPMENT	:	The name /number of the unit used for the sub steps.
GUIDE WORD	:	These are the words which are to be applied to intentions for asking questions for deviations. These are already well explained in above portion of this chapter. There can be many deviations.
CAUSE (S)	:	Each of the deviation as mentioned above can have many causes. These are mentioned in front of that deviation.
CONSEQUENCE	:	This is the cumulative effect of all or few deviations and is described as number of consequences.
S/ P/ R	:	For each cause there is specified probability and seriousness associated with each deviation. The probability an seriousness individually needs to be judged quantitatively on the predetermined scale. Considering the level of consequences from 1 to 5 and probability levels as 1 to 5 determined by safety philosophy and past experience of the HAZOP committee arrive at risk value index of level 1 to 10 for each identified hazard. The highest is indicated in the scale used.
ACTION	:	This is very important aspect and needs detail consideration. The actions are to be suggested for all those consequences except which fall as low class as far as probability and seriousness are concerned. While considering actions many points are to be debated to find a solution which is cost effective and removes root cause, so that the deviation does not occur or at least it reduces the probability and/or seriousness.
BY	:	This specifies who is expected to take action (preferably one of the team members) and by what time the action will be completed. Actually this needs management's concurrence as the time & money is

	the main constrains in the action plan
OPEN QUESTIONS	: In this column as mentioned in the earlier portion of the chapter, if further study is to be done it has to be mentioned as to what is expected from the experiments/data to be collected. Few can be done immediately as in our case or few may need longer period of experimenting. Thus the total work sheet is filled as described above and documented in. Further for each step, there is a need to have a summary sheet of the actions to be taken. These needs to be summarized in a single sheet as 'Recommendations from "HAZOP". Here detail description of the weakness observed during the study and the recommendations made are described. This helps management to get a view of the study in a nutshell without going through the volume of Hazard worksheets. Many actions on worksheet are repeated & hence one can cover many deviations on sheet.

Regular HAZOP meetings were carried out at factory. The HAZOP methodology adopted was explained to the members of the committee in the opening session followed by updating of P & ID for the plant. This enabled the team members to observe the equipment's layout, note environmental conditions and obtain a mental picture of the facility. Although the team members were familiar with the facility, they took the survey from different perspective. Along with the drawings, documents were verified and corrected on the spot. These corrected copies were used for the "HAZOP" study.

The "HAZOP" was then conducted for each section using the guidewords, which were fully explained to the team. As the study preceded a review of the past incidents were taken at appropriate intervals. Recording each session's work in a "HAZOP" worksheet carried out the table work of conducting the study. The documentation indicates: -

- Which segment of process or procedure was reviewed
- Which guide words & parameters were considered?
- The cause and consequences of each deviation studied.
- Whether a potential problem exists?
- What are the existing safeguards?

If there was a potential problem, the team recommended action to address the problem In case of uncovered potential problems, the team recommended follows up & resolution of the problem outside the "HAZOP" study to avoid spending of significant time. If the solution of the problem was obvious the team documented their recommended solution. The total work is documented as "HAZOP WORKSHEET".

6.9 STUDY RESULTS/ FINDINGS

The success of the study is completely dependent upon there being an effective system for the progressing of the points raised in the study and for implementing as appropriate. Ideally, the implementing authority, e.g. the project manager should be represented on the study team to gain commitment and to avoid having to explain points raised at the study meetings. This is particularly important if more than one department's are involved in implementation. Alternatively, progressing of the actions can be carried out at separate meetings attended by the project manager and or engineer and the individual study team member responsible.

Qualitative Assessment of hazards is carried out based on probability and seriousness while working out action plan based on experience of the HAZOP TEAM and past performance of the plant. Number of weaknesses leading to hazards are identified and summarized and recorded.

7.0 INTRODUCTION OF THE UNIT

7.1 Facilities / System for process safety, transportation, fire fighting system and emergency capabilities to be adopted following facilities and system will be installed/ implemented.

1. Total enclosed process system.
2. DCS operation plant.
3. Instrument & Plant Air System for control all parameters.
4. High level, low level, High pressure, low pressure, high temp, high flow, low flow indication and cut off interlocking provided on storage as well as process reactors.
5. Safety valve, rupture disk provided on reactor and pressure storage tanks.
6. Static earthing and electric earthing (Double) provided.
7. Jumpers for static earthing on pipeline flanges of flammable chemical provided.
8. Flame proof light fitting installed where ever it is required.
9. Emergency handling equipments like SCBA sets, Fire extinguishers, Gas mask, PPEs, Chlorine emergency Kit, chlorine hood, caustic pit, Air line respirator, provided.
10. Full fledge ETP plant made and it will take care of liquid effluent of the plant and final discharge parameter will be maintained as per CPCB norms.
11. Scrubbers provided on all process vents and air monitoring carried out and parameters will be maintained as per CPCB norms. Fire Water reservoir for fire hydrant and sprinkler system.
12. Storage tank area is away from the process plant and Separation Distance has been maintained. Dyke wall provided to all above ground storage tanks, collection pit with valve provided.
13. Dyke wall provide to all above ground storage tanks, collection pit with valve provide.
14. Flame arrestor with breather valve is installed on flammable material storage tank vent.
15. Lightening arrestor on all chimneys and building provided
16. Fencing and caution notes and hazard identification boards displayed.
17. Only authorized person are permitted in storage tank farm area.
18. Safety permit for hazardous material loading unloading is prepared and implemented.
19. Static earthing provision is made at all loading unloading points of flammable chemical storage tank farm area.
20. TREM CARD provided to all transporters and trained for transportation Emergency of Hazardous chemicals.
21. Fire hydrant system and water sprinkler system installed at tank farm area.
22. Caution note, safety posters, stickers and emergency preparedness plan displayed.
23. Emergency facilities and medical emergency facilities are available at site. Occupational Health centre facility generated at factory premises and paramedical staff is available round the clock.
24. Wind direction indicators are provided.

25. Safety Shower and eye wash are installed at acid/ alkali handling area.
26. Tele Communication system will be used in case of emergency situations for communication, (Mobile Phone is restricted in Distillery unit.)
27. Emergency siren installed at main gate as well as in all plant.
28. Training programme is being conducted regularly and induction training are being provided to all employees on chemical safety and process safety.

8.0 MANUFACTURING PROCESS

8.1 PROCESS DESCRIPTION OF DAURALA SUGAR WORKS, DISTILLERY DIVISION, MEERUT

Molasses is being used for producing Ethanol. Molasses obtained from the sugar factories as the raw material, Record of molasses is maintained in MF-6 format of Excise Department.

The detail of process description is as under:

For production of Ethanol, molasses based distillery consisting Fed batch high brix fermentation and MPR distillation process.

The main processes for the production of Ethanol are:

1) Fermentation
2) Distillation
3) Integrated Multi Effect Evaporator
4) Bio-Composting under Covered Premises
5) Wastewater Treatment cum recycling unit

The various sections involved in the process for manufacture of Alcohol are:

(a) Molasses Storage and handling section
(b) Fermentation section
(c) Distillation for production of Rectified spirit / Ethanol
(d) Integrated Multi-Effect Evaporator
(e) Bio-Composting under Covered Premises
(f) Wastewater Treatment cum recycling unit

Molasses Storage & Handling and Distribution:

In Daurala Sugar Works (Distillery division) there are 5 nos. of Molasses storage tank having total storage capacity approx. 218554 Quintals. This is sufficient for 25 days of its consumption. Molasses is pumped to molasses receiving tank in the fermentation section.

Molasses Fermentation

(a) Yeast vessel section

(b) Pre Fermenter

(c) Fermenter

a. Yeast Propagation

Yeast propagation section comprises of four culture vessels, pasteurization and cooling facility. During fermentation start up, yeast is grown in culture vessels.

b. Pre Fermentation (Two Nos.)

The grown yeast is transferred to pre-fermentation stage for further propagation (yeast activation tank). The pre-Fermenter is having capacity 45000 Litres each.

c. Fermentation —

Fermentation is a biochemical reaction in which the conversion of one compound to another takes place by the action of microorganism, such as Yeast."

Yeast is a microorganism which is used in fermentation to produce alcohol from sugar content present in molasses

In Aerobic fermentation, oxygen is basic requirement, supplied for growth of yeast. Maximum yeast biomass is formed during this process.

In Anaerobic stage the conversion of sugar in to ethyl alcohol and carbon dioxide takes place. —

INVERTASE

$$C_{12}H_{22}O_{11} + H_2\dot{O} \text{ ------------- } C_6H_{12}O_6 + C_6H_{12}O_6$$

(Glucose) (Fructose)

ZYMASE

$$C_6H_{12}O_6 \text{ ------------- } 2C_2H_5OH + 2CO_2 + Heat$$

(Mono saccharine) (Ethanol)

Molasses from the storage tank is pumped to the molasses weighing system where exact weighing of molasses going in the fermentation system is achieved. Weighed molasses is then pumped to a static molasses dilutors attached to each Fermenter where it is mixed with water / fermentation wash so as to achieve proper concentration of fermentation of fermentable sugars in the dilute molasses. This is a Thirteen Fermenter system. Four Fermenter are open and nine fermenters are closed vessel.

Process water is used to scrub the total outgoing carbon dioxide so as to recover the alcohol vapour in CO_2. This water is then recycled in the Fermenter. Temperature of the individual Fermenter is maintained in the desired range of 33 to 35°C by recalculating the fermented wash through the individual plate heat exchangers (PHE). The temperature of fermentation is being maintained by recirculation of cooling water (through fermentation cooling tower).

The fermented wash with 10 -10.8 % v/v alcohol is then fed into the degasifying column top for distillation. Average fermentation time is about 22-24 hrs. The advantage of using this system by distillery is that, inferior quality of molasses can also be used to achieve higher efficiencies, good quality of spirit with lower steam consumption.

Distillation

"Distillation is a physical process in which the various components of a mixture are separated by virtue of their difference in boiling points. "

The industry is using multi-pressure distillation (M.Pr.) system for production of rectified spirit. This process consist of three columns namely analyzer/ degasifying, Aldehyde and rectifier cum exhaust column. The distillation is integrated with MEE.

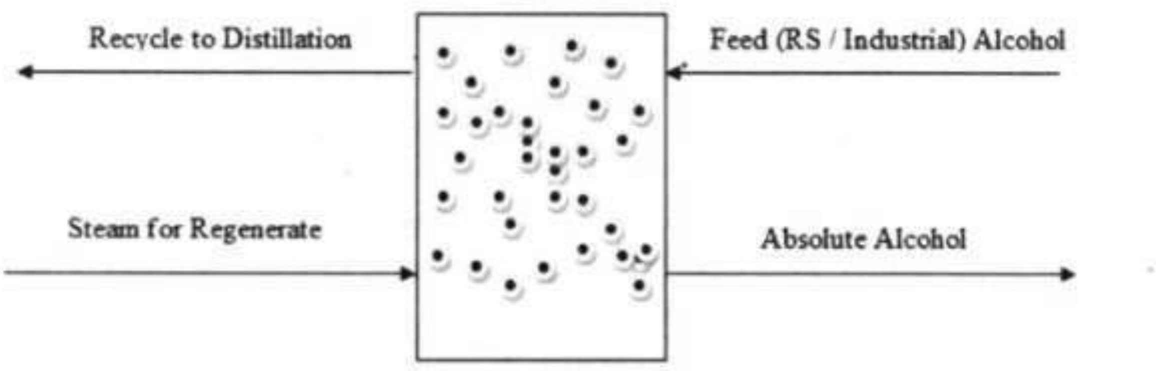
The analyzer vapor and the rectified vapors are operated the integrated MEE, Accordingly steam is saving. The fermented wash, which is fed to top of degasifying column, is operated under vacuum. The wash is then fed to analyzer column and the vapors from the top of the analyzer column are used to operate the falling film no. 2. The vapor of the falling film no.2 is used to operate the falling film no. 1.

Rectifier cum exhaust column is operated under pressure. The steam is given to rectifier cum exhaust column through re-boiler (live steam). The rectifier vapor is used to operate to heat the force recirculation no. 3 & 2 and the vapor generated from recirculation no. 3 & 2 is used to heat the force recirculation no 1 and the vapor generated from the force recirculation no. 1 is used to heat the analyzer bottom.

Alcohol is enriched towards the top and is drawn out as rectified spirit at about 95% v/v concentration from rectifier cum exhaust column. Fusel oil build up is separated in the rectifier cum exhaust column by withdrawing outside steams (fusel oils). These are sent to the fusel oil decanter where these streams are diluted with water and fusel oil rich layer is separated. The fusel oil wash water is recycled back to the column.

Molecular Sieve Dehydration

Molecular sieve technology works on the principle of pressure swing adsorption. Molecular Sieve is nothing but synthetic Zeolites typically 3 Angstrom Zeolites. The molecular sieve adsorbents developed for vapour phase, Ethanol dehydration are metal alumino-silicate with effective pores size opening of 3 Angstrom.



During dehydration of ethanol, the water of hydrolysis fills the cavities or pores in the molecular sieve. The potassium form of molecular sieve has pore size of
3Angstrom, the critical diameter of water molecules is 3.2A and Ethanol is 4.4 A, In vapour phase, the gaseous water molecules are strong dipoles. They are drawn in to the pores and condense at the wall of pores, while ethanol being bigger in size passes through the bed without getting in to pores of molecular sieve. The life of molecular sieve is 5 to 7 years.

There are two beds in parallel. Once a particular bed is saturated with water, it is taken up for regeneration so that adsorbed water is desorbed from the bed. Till that time, other bed is used for dehydration.

Multi Effect Evaporator (MEE)

There are two set of MEE plant of sufficient capacity each having five operational and one standby.
The plant is designed to operate 24x7 days and capable to achieve up to 60% solid in spent wash so that it can be utilized in slop fired boiler.

Condensate Polishing Unit:

The condensate polishing unit is also envisaged to take care of spent lees, cooling tower blow down, washing and process condensate from evaporation plant. After treatment all the stream at CPU, treated condensate can be recycled to process for dilution and as cooling tower make up and will achieve zero liquid discharge (ZLD) Due to recycle of process condensate back to process, fresh water demand can be reduced at large extent.

NFA Rating for Hazardous Chemical

Sr. No.	Chemical	Boiling Point °C	Flash Point °C	NFPA Hazard Classification		
				Flammability	Health	Reactivity
1	Ethyl Alcohol	78	16.6	6	2	0

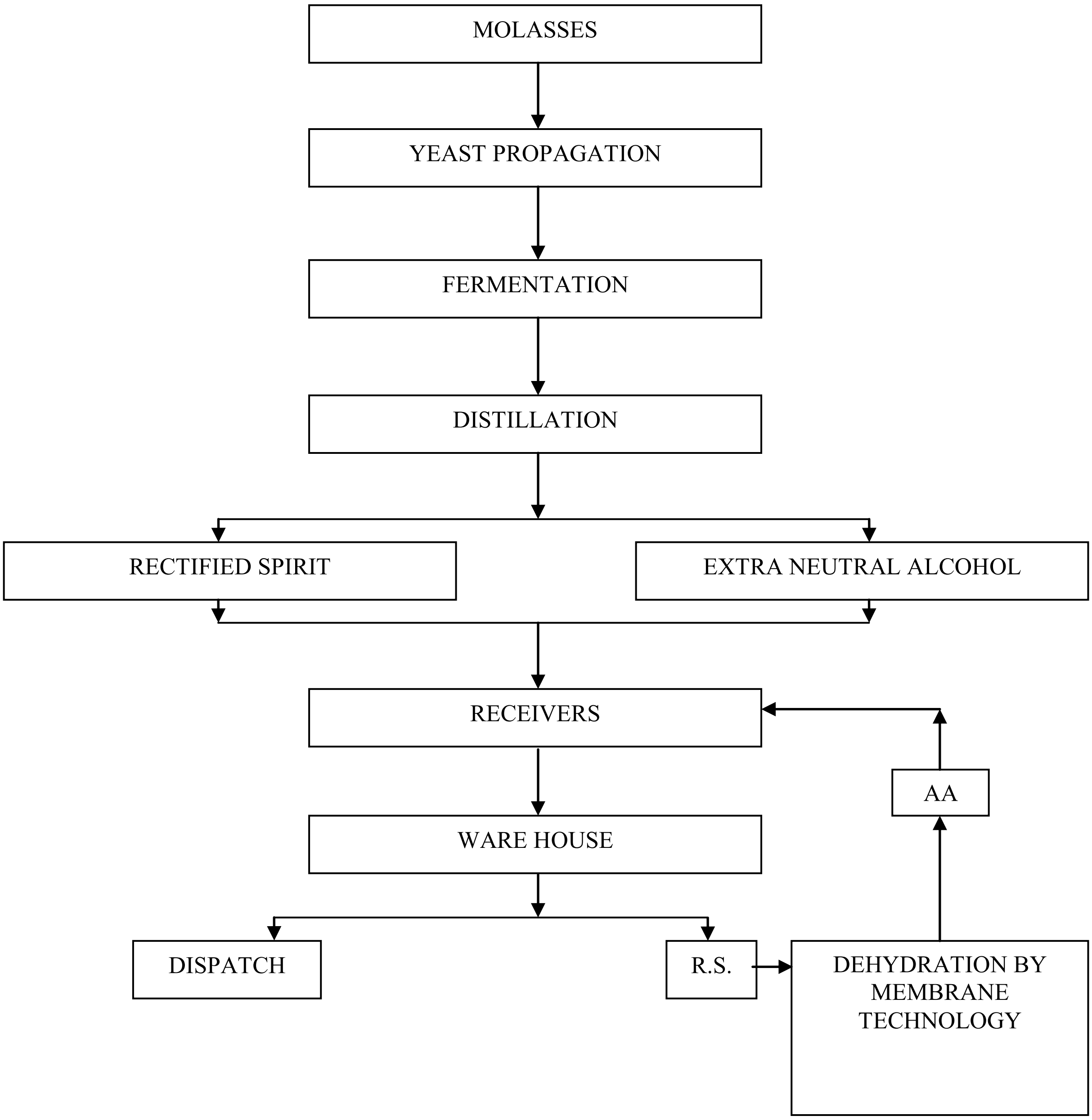
An Ethyl Alcohol - water solution that contains 40% V/V (Alcohol by Volume) will catch fire if heated to about 26 °C (79°F) and if an ignition source is applied to it. This is called its Flash Point. The Flash Point of pure Ethyl Alcohol is 16.60 °C (61.88 °C) less than average room temperature.

The flash points of pure Ethyl Alcohol concentrations from 10% V/V to 96% V/V are shown below:

- 10% - 49°C (12°C)
- 12.50% - about 52°C (126°C)
- 20% - 36°C (97°C)
- 30%- 29°C (84°C)
- 40%- 26°C (79°C)
- 50% - 24°C (75°C)
- 60% - 22°C (72°C)
- 70% - 21°C (70°C
- 80% - 20°C (68°C)
- 90% - 17°C (63°C)
- 96% - 17°C (63°C)

Alcoholic beverages that have a low concentration of Ethyl Alcohol will burn if sufficiently heated and an ignition source (such as an electric spark or a match) is applied to them. For example, the flash point of ordinary wine containing 12.5% Ethyl Alcohol is about 52°C (126°F)

8.2 PROCESS FLOW CHART



9.0 NFPA Rating for Hazardous Chemical

A. Health of NFPA Classification	
4	Materials, which on very short exposure could cause death or major residual injury even though prompt medical treatment were given
3	Materials, which on short exposure could cause serious temporary or residual injury even though prompt medical treatment were given
2	Materials, which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment, is given
1	Materials, which on exposure would cause irritation but only minor residual injury, even if no treatment is given
0	Materials, which on exposure under fire conditions, would offer no hazard beyond that of ordinary combustible material
B. Flammability Classification	
4	Materials, which will rapidly or completely vaporise at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily.
3	Liquids and Solids that can be ignited under almost all ambient temperature conditions.
2	Materials that must be moderately heated or exposed to relatively high ambient temperature before ignition can occur.
1	Material that must be preheated before ignition can occur.
0	Material that will not burn.
C. Reactivity Classification	
4	Materials, which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperature and pressure
3	Materials, which in themselves are capable of detonation or explosive reaction but require a strong initiating source or which must be heated under confinement before initiation or which react explosively with water.
2	Materials, which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Also materials, which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials, which in them are normally stable, but which can become unstable at elevated temperature and pressure or which may react with water with some, release of energy but not violently.
0	Materials, which in them are normally stable, even under fire exposure conditions, and which are not reactive with water.

RECOMMENDATIONS

AND

HAZOP SHEET

TABLE-1

RESULTS OF HAZARD AND OPERABILITY STUDY

UNIT: TRANSFER OF MOLASSES FROM TANKERS TO STORAGE TANK

SR. NO.	GUIDE WORD	DEVIATION	POSSIBLE CAUSES	CONSEQUENCES	ACTION REQUIRED	STATUS
1.	None	No Flow	A) Any of the valves from Tank to Molasses pump suction or Tank to Storage Tank closed	A) Operation delay	A) Regular and preventive maintenance of valves desired	A) Preventive maintenance of valves will be done as being followed at other plant
			B) Pipeline blockage	B) Molasses pumps heats up due to wearing and increased vibration level on account of cavitations developed in the pump	B) The pipe line should be cleaned after each two years	B) Line strainer is provided on suction side of pump which is cleaned at regular intervals
			C) No Molasses in Tanker	C) Molasses pumps heats up	C) Some interlocking system be provided so that if there is no flow of molasses from Tanker to pipe line it should trip	C) Low Pressure tripping device to be provided
2.	Less	Less Flow	A) Blockage in the pipeline or the valves are not fully open	A) Molasses pump will lose its NPSH (Net Positive Suction Head	A) Clear blockage open valve fully	A) A tripping system to be provided and this will trip pump as

				- NPSH		it loses NPSH
		Less Temperature	A) Molasses at low temperature	A) None	A) None	A) Self explanatory
			B) Ambient temperature very low	B) None	B) None	B) Self explanatory
3.	Reverse	Reverse flow of Molasses	A) Not possible as storage tank is filled from the top of the tank	A) None	A) None	A) Inspection will be done
4.	As well as	Flow of foreign material along with molasses	A) Flow of other product along with molasses	A) No Hazardous consequences. Quality of Molasses reduced	A) To be check the material before unloading started	A) Checking to be done as per established procedure
5.	More	More Temperature	A) Gas may be liberate at storage tank	A) Pressure build-up in storage tank	Vent provided Provision for cooling of tank provided	A) Checking of vent and cooling system is being carried out

TABLE - 2

RESULTS OF HAZARD AND OPERABILITY STUDY

UNIT: TRANSFER OF MOLASSES FROM STORAGE TANK TO PROCESS TANK

SR. NO.	GUIDE WORD	DEVIATION	POSSIBLE CAUSES	CONSEQUENCES	ACTION REQUIRED	STATUS
1.	None	No Flow	A) Any of the valves from Molasses pump Suction or Storage Tank to Process Tank closed	A) Operation delay	A) Regular and preventive maintenance of valves desired	A) Preventive valves will be maintenance of done as being followed at other plant
			B) Pipeline blockage	B) Molasses pumps heats up due to wearing and increased vibration level on account of cavitations developed in the pump	B) The pipe line should be cleaned after each two years	B) Line strainer is provided on suction side of pump which is cleaned at regular intervals
			C) No Molasses in Storage Tank	C) Molasses pumps heats up	C) Some interlocking system be provided so that if there is no flow of molasses from Tank to pipe line it should trip	C) Low Pressure tripping device to be provided
2.	Less	Less Flow	A) Blockage in the pipeline or the valves are not fully open	A) Molasses pump will lose its NPSH (Net Positive Suction Head -	A) Clear blockage open valve fully	A) A tripping system to be provided and this will trip pump as it loses

				NPSH		NPSH
		Less Temperature	A) Molasses at low temperature	A) None	A) None	A) Self explanatory
			B) Ambient temperature very low	B) None	B) None	B) Self explanatory
3.	Reverse	Reverse flow of Molasses	A) Not possible as storage tank is filled from the top of the tank	A) None	A) None	A) Inspection will be done
4.	As well as	Flow of foreign material along with molasses	A) Flow of other product along with molasses	A) No Hazardous consequences. Quality of Molasses reduced	A) To be check the material before unloading started	A) Checking to be done as per established procedure
5.	More	More Temperature	A) Gas maybe liberate at storage tank	A) Pressure build-up in storage tank	Vent provided Provision for cooling of tank provided	A) Checking of vent and cooling system is being carried out

TABLE - 3

RESULTS OF HAZARD AND OPERABILITY STUDY

UNIT: TRANSFER OF MOLASSES FROM PROCESS TANK TO FERMENTATION TANK

SR. NO.	GUIDE WORD	DEVIATION	POSSIBLE CAUSES	CONSEQUENCES	ACTION REQUIRED	STATUS
1.	None	No Flow	A) Any of the valves from Molasses / Water pump or Process Tank to Fermentation Tank closed	A) Operation delay	A) Regular and preventive maintenance of valves desired	A) Preventive maintenance valves will be done as being followed at other plant
			B) Pipeline blockage	B) Molasses pumps heats up due to wearing and increased vibration level on account of cavitations developed in the pump	B) The pipe line should be cleaned after each two years	B) Line strainer is provided on suction side of pump which is cleaned at regular intervals
			C) No Molasses in Process Tank	C) Molasses pumps heats up	C) Some interlocking system be provided so that if there is no flow of molasses from Tank to pipe line it Should trip	C) Low Pressure tripping device to be provided
2.	Less	Less Flow	A) Blockage in the pipeline or the valves are not fully open	A) Molasses pump will lose its NPSH (Net Positive Suction Head - NPSH	A) Clear blockage open valve fully	A) A tripping system to be provided and this will trip pump as it loses NPSH

		Less Yeast	A) Less Yeast mixed in vessel	A) Fermentation not occur properly	A) Operation delay	A) Check the percentage of Yeast
		Less Temperature	A) Molasses at low temperature	A) Fermentation not occur properly	A)Temperature gauge provided	A) To be calibrate temperature gauge
			B) Ambient temperature very low	B) Fermentation not occur properly	B) Temperature gauge provided	B) To be calibrate temperature gauge
3	Reverse	Reverse flow of Molasses	A) Not possible as storage tank is filled from the top of the tank	A) None	A) None	A) Inspection will be done
4	As well as	Flow of foreign material along with molasses	A) Flow of other product along with molasses	A) No Hazardous consequences. Quality of Molasses reduced	A) To be check the material before unloading started	A) Checking to be done as per established procedure
5	More	More Temperature	A) Gas maybe liberate at storage tank	A) Pressure build-up in storage tank	Vent provided Provision for cooling of tank provided	A) Checking of vent and cooling system will be done
			A) Molasses at High temperature	A) Fermentation not occur properly	A) Temperature gauge provided	A) To be calibrate temperature gauge
			A) Molasses at low temperature	A) Fermentation not occur properly	A) Temperature gauge provided	A) To be calibrate temperature gauge
		More Yeast	More Yeast mixed in vessel	Wastage of Yeast	Mixed the appropriate quantity of yeast	Check the yeast percentage

TABLE - 4

RESULTS OF HAZARD AND OPERABILITY STUDY

UNIT: DISTILLATION OF FERMENTED WASH

SR. NO.	GUIDE WORD	DEVIATION	POSSIBLE CAUSES	CONSEQUENCES	ACTION REQUIRED	STATUS
1.	None	No Flow	Steam discharge valve closed	**I.** No transfer of steam & required temperature of column will not be achieved **II.** Pressure build-up in boiler	I. Temperature & Pressure gauge installed. II SRV installed in boiler	I. Ensure opening of discharge valve. II Test and calibrate SRV at regular interval
			Steam discharge valve seat jammed	I. No transfer of steam & required temperature of column will not be achieved II.. Pressure build-up in boiler	I. Temperature & Pressure gauge installed. II SRV installed in boiler	Preventive maintenance to be ensure regularly
2.	Less	Less Flow	Discharge valve of steam line partially closed	Improper transfer of steam & required Temperature of column will not be achieved	Temperature & pressure gauge installed	Preventive maintenance to be ensure regularly
3.	More	More Flow	Line pressurized	Failure of Line	Steam release valve installed at pipeline	Check and calibrate the steam valve at regular interval

4.	No / Less	No / Less Pressure	i. As the discharge pressure of the steam not achieved. ii. Leakage in steam pipeline. iii. Boiler not generating required quantity of steam	i. Required temperature in the boiler will not be achieved ii. Leakage in Steam Pipeline	i. Check the condition of boiler and pipeline regularly ii. Failure of pipeline	Proper maintenance of system to be ensured
5.	More	More Pressure. More Temperature	i. Due to closing of the steam valve of the boiler jacket. ii. Due to overheating of steam	i. Bursting of steam jacket & causing fire hazard ii. Fire Hazard	i. Ensure proper opening of jacket outlet valve. ii. Ensure for proper functioning of interlocking system, Temperature sensor and Temperature gauge etc.	Regular monitoring of critical equipments

TABLE - 5

RESULTS OF HAZARD AND OPERABILITY STUDY

UNIT: FILLING OF TANK LORRY (ETHANOL)

SR. NO.	GUIDE WORD	DEVIATION	POSSIBLE CAUSES	CONSEQUENCES	ACTION REQUIRED	STATUS
1.	None	No Flow	B) Ethyl Alcohol line Leakage	B) Fire and explosion hazards	B) Stop filling and repair leakage patrolling desired	B) Necessary hydrostatic tests for pipeline are planned
			C) Filling point hose rupture	B) Fire and explosion hazards	C) Proper maintenance of hoses desired	C) Hoses will be subjected to hydrostatic, Pneumatic and electrical continuity testes once in four (04) months
			D) Filling gun detached from tank lorry	D) Ethyl Alcohol release	D) Proper Functioning and maintenance of filling gun required	D) Self explanatory
2.	More	More Flow	A) Not Possible	A) None	A) None	A) Self explanatory
		More Pressure	A) Not Possible	A) None	A) None	A) Self explanatory
		More Temperature	A) Some fire in the vicinity causing higher pressure on Ethanol line connected to lorry	A) Pipeline may rupture causing fire and explosion.	A) Ensure proper functioning of fire fighting systems	A) Fire fighting arrangements provided as per statutory requirements.

3.	Less	Less Flow	A) Some Leakage in pipeline	A) If leakage persists for longer time fire / explosion hazards may occur	A) Regular patrolling of pipeline desired	A) Regular patrolling of pipeline will be done
		Less Temperature	A) Very low ambient temperature	A) None	A) None	A) Self explanatory
		Less Pressure	B) Some leakage in Ethanol line	B) Fire and explosion hazard	B) Proper operation of fire fighting systems desired	B) Fire fighting arrangements have been provided as per statutory requirements
4.	As well as	Flow of foreign material along with Ethyl Alcohol	A) Not Possible	A) None	A) None	
5.	Other Than	Static Charge	A) Static Charge may be developed due to transfer of Ethyl Alcohol	A) Fire Hazards	**A)** Proper bonding / Jumper takes place on each flange joints **B)** Earthing of tanker	**A)** Proper bonding / jumper provided on each flange joints. **B)** Earthing of tankers provided
6.	Reverse	Reverse	A) Not Possible due to differential pressure between Storage Tank & Lorry	A) None	A) None	(A) Self explanatory