CHAPTER 10
RECOMMENDATIONS

10.1 DESIGN/ENGINEERING IMPROVEMENT

Upgrading of design to avoid potential loss of containment from any reasons such as:

- Tank Overflow
- Tank Floor Corrosion and Leak
- Tank Roof Water Drain pipe leak (internally)
- Flange leak

The Committee recognizes that there are a number of installations where similar equipment and configuration have been adopted in the corporation, and any major change in the design could be time consuming (besides being expensive). Therefore, the Committee has made the technical recommendations under two categories, viz, for immediate implementation and secondly for planned implementation.

10.2 IMMEDIATE MEASURES

(Technical & Operational)

i) Push buttons on the MOV should be brought just outside the dyke

ii) Push button operation should be modified so that action required for opening is different than action required for closing (e.g. pull type and push type).

iii) The push button assembly should be mounted at a place where it is easily visible to the operator.

iv) Lighting adequacy should be checked so that visibility is adequately ensured at the push button of MOV & HOV location)

v) A technical group should study the feasibility of providing a limit switch on the hammer blind with interlocking for MOV operation

vi) Main emergency shut down switch which should be located in the control room should also activate the MOVs to close.

vii) A separate pad locking arrangement on each of the hammer blinds on the inlet and outlet lines should be provided so that they can be independently locked as required.

viii) The pad lock on the hammer blind on the outlet line should not be removed before the tank joint dipping is completed.

ix) If any MOV is observed to be passing, it should be immediately attended and records maintained

x) VHF handsets to be provided to each of the operating crew.

xi) Supervisor should be present to oversee the pipeline transfer line up and related operation.

xii) Site specific, Standard Operating Procedures (SOPs) should be prepared which not only give what the procedures are, but also why they are needed. These must be made with the involvement of procedure users and approved by the operations and safety team.

xiii) Emergency procedures should be written and available to all personnel in the installation outlining the actions to be taken by each during a major incident.

xiv) A Check list for operators for checking safety system and equipment should be prepared and check records kept in safe custody.

xv) Mock drill whenever conducted should include the full shut down system activation also.

xvi). Shift manning should always be maintained. Only in serious exigencies, permission can be granted by Terminal Manager subject to obtaining a reliever forthwith. The person leaving site should only be allowed on a valid gate pass issued by the immediate officer.

xvii) A dedicated, qualified and experienced officer should be designated as 'Safety Officer' of the Terminal after training. He should be given exposure to Hazop, risk assessment, safety audit and upkeep of fire fighting facilities and conducting safety meetings.

xviii) The security supervisor at the gate should be provided with external telephone. The supervisor shall be provided with telephone numbers of all officers. A board displaying the names, address and phone numbers of the emergency contact points of the company as well as the local authorities shall be provided therein.

xix) A system should exist for informing neighbouring industries about impending danger.

xix) The company should approach and coordinate with the district authority for conducting "Off Sites Mock Drills".

xx) The critical operating steps should be displayed on the board near the location where applicable.

xxi) Any bad practice of HOV being opened first before opening of hammer blind should be done away with and conveyed throughout the organization.

xxii) Control room should be manned on continuous basis.

xxiii) Immediately the feature of remote shut off of the MOV from the control room should be restored. The cable leading to the control room should be fire safe.

xxiv) The pipeline transfer should preferably be commenced during day light hours

xxv) Personal protective equipment such as safety glasses must be worn while carrying out all operations

xxvi) All other PPEs should be available at location and easily identified.

xxvii) All PPEs as well as safety equipment required for emergency use such as breathing apparatus, fire suit, fire extinguishers, monitors and sprinklers should be regularly tested in presence of safety officers and records maintained.

xxviii) All PPEs required during emergency shall be located in designated safe areas.

xxix) Hydrocarbon (HC) detectors shall be installed near all potential leak sources of class ‘A’ and ‘B’ petroleum products e.g. tank dykes, tank

manifolds, pump house manifolds, etc. Further, HC detectors of proper type should be selected and should be proof tested and maintained in good condition.

xxx) Medium expansion foam generators shall be provided to arrest vapour cloud formation from spilled volatile hydrocarbons.

xxxi) An emergency kit shall be provided consisting of safety items viz. fire suites, various leak plugging gadgets, oil dispersants and oil adsorbents, lifting jacks (for rescue of trapped workers), high intensity intrinsically safe search lights for hazardous area, etc. and shall be readily available at the terminals.

xxxii) Regular inspection of pipelines including thickness survey and pipeline support systems shall be carried out and records maintained.

xxxiii) All terminal operating personnel including regular contractors and security personnel should be given safety and fire fighting training with the help of reputed training institutes.

xxxiv) The security staff should be trained as first responders for fire fighting and rescue operations along with plant operating personnel.

xxxv) Near miss reporting system should be immediately implemented.

xxxvi) Management of change procedure should be immediately implemented.

xxxvii) Manning level in the shift should be reviewed to have adequate coverage in the emergencies.

xxxviii) Vehicles with spark ignition engine should not be allowed inside the Installation area except up to the Administrative Block and also to ensure continuous manning at the control room.

xxxix) Advancements in technology make it possible to automate tanks and terminals with sophisticated systems both in hardware and software. This enhances the safety and can greatly reduce possibility of human error by having interlock permissive and recording and measurement of events like valve opening or closing and measurement of flow rate/level etc. Existing Terminal managements should review the technology for retro-fitment which can reduce risk levels.

10.3 MEASURES FOR PLANNED IMPLEMENTATION

Note: All the recommendation under the Immediate Measures category above should also be considered for new installations

a) Avoid hammer blind as an equipment in the plant design. Only a closed system design should be adopted. It is understood that other OMCs/MNC's are already using such designs in their installations. Using a Plug valve or a Ball Valve in place of the Hammer Blind should be an acceptable option.

b) The first body valve on the tank should be Remote Operated Shut Off Valve (ROSOV) on the tank nozzle inside the dyke with Remote Operation only from outside the dyke as well as from the control room. ROSOV should be fail safe and fire safe. It should have only 'close' feature and not 'open' and 'stop' from control room. However, it should have 'close', 'open' & 'stop' operation from the panel located outside the dyke.

c) All operational valves must be outside dyke area.

d) SIL (Safety Integrity Level) of the tank level control must be improved and independent overfill protection meeting the requirement of Part 1 of EN 61511 shall be provided. For this purpose, radar gauges must be provided at least in class 'A' tanks in addition to presently existing positive displacement level indictor/control. The MOVs which are the primary items for cut off must be always kept in proper and best working order and the SIL level of the entire interlock loop to be raised to meet the requirement of EN 61511.

e) Dyke should be constructed and tested to be leak proof.

f) The floating roof tank design may be reviewed to avoid the possibility of a cascade or splash of product in the event of an overflow due overfilling.

g) Design, inspection and repair as per latest API Codes.

h) High level alarm from the radar gauge and high high level alarm from a separate tap off should be provided.

i) For floating roof tanks, roof drain to be of more robust design to prevent oil coming out when roof drain is open for water draining operation.

j) Piping design inside tank dyke area should ensure easy accessibility for any operations inside dyke in the tank farm.

k) Adequate lighting in operational areas should be ensured.

l) Thermal Safety Valve (TSV) should be provided at the operating manifold (outside dyke).

m) The dyke volume has been revised to 110% of largest tank in certain international standards. This should be reviewed by OISD for tank terminals and refinery tankage.

n) Wherever PLT transfers take place, to avoid pilferages, a Mass Flow Meter with Integrator shall be provided on delivery pipelines.

o) Tank Dyke Valves should be provided with position indicator (open or close) in control room and necessary hardware and instrumentation should be provided for this.

p) The TFMS system should be upgraded and integrated with SAP and provision for recording of all critical events in SAP as well as TFMS (such as critical valves position, start/stop of pumps, levels in tanks, alarms etc.).

q) A CCTV should be installed covering tank farm areas and other critical areas. The CCTV can nowadays provided with an alarm to provide warning in case of deviation from any normal situation. The CCTV monitoring station should be provided both in the control room as well as in the Security cabin/office.

r) Advancements in technology make it possible to automate tanks and terminals with sophisticated systems both in hardware and software. This enhances the safety and can greatly reduce possibility of human error by having interlock permissive and recording and measurement of events like valve opening or closing and measurement of flowrate/level etc.
Most of the operations are controlled from control room and giving the control room operator an overview of terminal operation. Right sequence of operation is ensured through interlocks and permissive which bar the operator from opening the wrong valves. Recording of all events in the control room computer can provide effective monitoring of operation.

Measurement of flow rates and quantities can give more accurate stock control.

It is recommended that new installations should evaluate the technology options in this area and safety enhancing configuration should be incorporated.

10.4 PROCESS SAFETY MANAGEMENT

a) Carry out HAZOP and Quantitative Risk Assessment (QRA) on large sized installations through well qualified agency and implement recommendations forthwith.
b) The Terminal Managers should be trained in Hazard Identification techniques and be familiarized with risk assessment and risk mitigation methods.
c) Annual Safety Audit by well qualified third party, which should ensure that systems and procedures and safety back-ups are in place, their requirements are understood by all concerned and they are propeorly operated by the concerned personnel.
d) Site specific “Standard Operating Procedure (SOP)” to be developed.

10.5 PLANT LAYOUT

a) The control room should be located far away from potential leak sources as far as practical. Otherwise, the control room should be made blast proof.

b) Fire water tank and fire water pump house should be located far away from potential leak sources/tankage area.

c) Locate buildings and structures in the upwind direction (for the majority of the year) as far as practicable.

d) Avoid congestion in the plant site because of buildings, structures, pipelines, trees etc. The location of these individual facilities should be decided based on Quantitative Risk Assessment.

e) All buildings which are not related to terminal operation shall be located outside the plant area. This includes the canteen also where any spark or open flame may exist.

f) Wherever the tank terminal site also have pipeline division operational area in the same site, the control rooms for both the tank terminal and pipeline shall be located in the same operational building.

g) The emergency exit gate shall be away from the main gate and always be available for use for personnel evacuation during emergency.

10.6 FIRE FIGHTING FACILITIES

a) The fire water requirement for terminals shall be based on two fire contingencies simultaneously as is the case in Refineries. The fire water storage, therefore, shall be reviewed accordingly. The sprinkler flow rate which is presently 3 LPM (OISD standard) may be reviewed. The NFPA (US) Standard recommends 10 LPM where as IP-55 (UK) Standard recommends much lower figure. The review should be based on actual heat load calculations to fight fire and protect the adjacent tanks. Water storage requirements should also keep in mind whether adequate supplies are available if not, the storage should be increased appropriately. It is also recommended that auto start of the fire water pumps be linked with the Hydro Carbon leak detection and alarm system in order to start the

sprinkler system automatically especially in tank farm area and pump house.

b) The Rim Seal fire detection and protection system shall be installed in all Class 'A' products in the terminal.

c) Remote operated long range foam monitors (1000 GPM and above) to fight tank fires shall be provided which should be of variable flow.

d) Wherever there is a cluster of terminals of different companies, an emergency response centre equipped with advanced fire fighting equipment viz. fire tenders and trained manpower shall be considered on cost sharing basis or on outsourcing basis.

e) All terminal operating personnel should be given safety and simulated fire fighting training based on simulated modules of live fires in tanks, pipeline manifold and pumps, process platforms etc., in reputed training institutes equipped with these facilities. These training performances should be linked to their KRAs and promotions. Personnel from security services should be trained fully for fire fighting and rescue operations using Personal Protective Equipment.

f) There is a present trend internationally wherein for fighting major tank fires (in most such cases the built in static fire and foam systems gets partially or largely de-capacitated), fire fighting equipment which are quickly installable at sites are made readily available with specialized agencies so that these equipment could be put in use from a safe distance to fight major tank fires. This new practice need to be studied and its applicability in case of tank terminals should be explored.

g) Sprinklers shall also be provided in lube oil drum areas.

h) During all operations even after the general shift a dedicated fire fighting team should be present.

i) There should be a minimum level of manning maintained apart from the security personnel for monitoring the facilities even during non operational hours.

10.7. ORGANIZATIONAL AND MANAGERIAL ISSUES

Our observations are based on the feedback provided in relation to the Terminals and Installations activities and for a corporate wide recommendation further study may be required.

10.8 TRAINING

a) Training for Safety is currently based on OISD 154 for all categories. Safety training for operators should be based on the needs of the operation, the procedures and why these are needed. Fire training will always be an important part of his training, which is best provided by realistic fire fighting exercises in an area designated for this purpose. Training should also be given to prevent operational malpractices such as shortcuts, on safety provision being bypassed and how they can create unmanageable risks to life and property. Training should be based on the needs of the job, and relevant to the trainee.

b) For Supervisors, intimate knowledge of the operator's job is essential and this should be ensured. In addition Leadership Training should be provided on Manpower management and motivation, and also on

Communication which should enable them to give proper task instructions to the operators.

c) For Terminal Managers, safety training should include areas like

- Basics of Safety Management System
- The causes and effects of accidents
- Hazard identification
- Risk Assessment and risk mitigation
- Controlling risks and Preventing Accidents
- Emergency preparedness
- Critical Task Analysis
- Crisis Management
- Importance of trip/alarm and Safety Procedures and systems

  Learnings from case histories

Training activities should include Safety Training for contract employees since a number of activities have been outsourced.

10.9 COMPETENT PERSONNEL

a) Selection of Operators: Apart from the technical capabilities, a process operator should have certain personal qualities which should be assessed during selection. A process operator should be:

i) Responsible – with training and experience his judgment in matters of discretion should be such that it does not require frequent checking by superiors.

ii) Conscientious – ready to take extra care and trouble without prodding.

iii) Reliable – never make mistakes, forget instructions or otherwise fail in his prescribed duties

iv) Trustworthy – honest and truthful in reporting to senior, not concealing facts when his own actions might have had an adverse impact

Persons with proven chronic illnesses or those who cannot cope with stress may not be suitable as process operators and should be taken off critical operational duties.

10.10 TRANSFERS

Knowledge and experience accumulation is a critical factor at the managerial level especially in critical operation areas. Frequent transfers (8 terminal changes in last 14 years) with some of the tenures less than one year only goes against this principle. Preferably three to five years minimum tenure should be ensured for the key Managers.

c) For supervisory and managerial staff, a competency assessment and exercise which identifies the aptitude of the person and the gap between competencies of the person and requirements of the job should be done.

d) The Corporation must ensure that a reasonable percentage of the high performers in the organisation at any time, are deployed in managing such high hazard installations.

e) Similarly, for manning the safety department at least a fair percentage of the people must be of high callibre who can comprehend and lead with conceptual understanding using quantitative techniques etc. They should be given the best possible exposure through collaborating with international safety experts and agencies.

f) The performance evaluation system for Terminal incharges has 17 key result areas identified and safety is one of them with a rating of 5% in the performance criteria which amounts to 3% only in overall. For high hazard locations like Terminals, LPG Plants, Refinery Plants etc., the safety parameter weightage should be increased to minimum of 20% of performance parameters to get the due attention.

10.11 SAFETY AWARDS

The certifications such as ISO, NSC awards, Greentech awards, Ministry of Labour awards etc., are all based on documentation submitted by the organizations and not on field verifications and safety practices. The awards/recognitions mesmerize the higher management besides giving wrong signals about safety management systems leading to complacencies. It is, therefore, recommended that time and efforts be directed towards annual safety audits by involving non-company experts so as to have unbiased reports. The companies should be cautioned to be circumspect about utilizing agencies and organizations who claim to be providing expert safety advice and assessment.

10.12 CORPORATE SAFETY SET UP

i) Corporate Safety Department should be strengthened by making it directly report to the CEO.

The Safety department should be professionally trained in the use of quantitative techniques of Risk Assessment/Hazop and Hazard identification and Safety Auditing. A Process Safety Group should be part of the set-up.

ii) The Corporate Safety department should take responsibility for:

a) being an advisor to the senior and top management and raise alarm at the highest level whenever need arises on any safety issues.

b) implementing and monitoring a Safety Management System in the organization.

c) Initiate and oversee safety related activities/programs. Improve the quality of audits to make them more sensitive to any deficiency in systems and procedures.

d) Carry out audits (Including Surprise Audits) and ensure suitable follow up actions

e) Providing Safety Training, based on assessment of training needs and effectiveness. Training should also be provided in quantitative and risk assessment areas.

f) Scan the environment to seek information on Case Histories of accidents globally, on changes in regulations in India and elsewhere, on developments in technology and practices especially related to Safety.

g) Communicate lessons learnt from Case Histories, and other updated information to in company personnel

h) The agenda of the safety meeting should be more focused on root cause analysis of accidents and near misses and lessons learnt for thereof for risk reduction strategies.

i) Install appropriate Safety Measurement Systems for different areas. Whereas personal safety can be monitored easily by accident statistics, safety from major hazards which happens infrequently, may be measured more appropriately by the degree of adherence to systems and procedures.

j) Periodically review changes in the land use around running Installations and assess any increased risk and identify additional risk reduction measures and ensure its speedy implementation.

The corporate safety department should clearly bring out the high hazard areas to the top management and outline the steps being taken for risk mitigation.

10.13 FUNCTIONAL HEAD OFFICE AND REGIONAL SAFETY DEPARTMENTS

In addition to the corporate safety set up, reporting to the CEO, the safety department of respective divisions viz, Pipeline, Marketing (except Refinery) shall report to the ED-HSE Corporate office in order to function as an independent autonomous entity like Internal Audit, Vigilance etc. Regular reviews as with Vigilance and Internal Audit at the CEO level will go a long way in enhancing safety consciousness and safety culture. Since the safety performance of the refineries is quite satisfactory the present set up on safety may be continued with policy direction from corporate safety group.

The safety departments in the regions should look after safety in all the functional areas in the region viz. Marketing, Pipeline & LPG and the safety officers attached to the various locations should be directly reporting to this Regional set up. This will provide independence and autonomy to the Safety Department and personnel in the entire Marketing and associated activities.

10.14 STRENGTHENING INTERNAL SAFETY AUDIT

The Internal Safety Audit functions can be strengthened by Ensuring the audit team to comprise of people from outside the functional areas eg. Marketing, audit can have people from Pipeline, LPG or Refinery etc.

a) Providing professional training in auditing and continuously updating from global best practices in the industry.
b) By the reorganization of the corporate safety group as proposed above.

10.15 MANAGEMENT COMMITMENT

Management commitment to Safety should be made visible by several actions such as:

a) In depth Board level reviews on a quarterly basis of Safety in different sections of the organization, and especially focus on Risk and steps being taken for its mitigation in the different operations.

b) Senior Management group from across functions and departments (ED's and GM's) should make Inspection visits of two major Installations per year, preferably in group of 2, with appropriate checklists, standard of performance with a recording system and assess the Safety preparedness of field locations and report back to the CEO. Depending on the numbers of ED's/GM's and number of locations to be visited, such visits may be undertaken once every six months. In addition to improving safety preparedness this should generate some inter-functional inter-actions and greater cohesiveness.

c) Management meeting agendas should start with a review of recent safety performance and progress.

d) CEO must review Safety especially on site visits to important locations. Audit, esp. external safety audit deficiencies should get the personal attention of the CEO.

e) The accumulated knowledge and experience of operating, technical, and management personnel in such installations should not be lost, and should be maintained always at a high level. A separate specialist group for Terminal and Installations either on an outsourced basis or as a JV with 50% company participation and 50% public (Petronet LNG model) can be considered. This will develop specialist skills and provide a bottom line focus and a sense of ownership and pride in the work, esp. in Terminal operating areas. CEOs of such companies will have undivided attention on safety and other connected issues for these activities.

f) The lessons learned from this investigation should be widely disseminated and shared with the Industry so that recurrence of these accidents can be prevented and there is better emergency preparedness for eventualities. The Government may consider appropriate website for displaying such information.

10.16 EMERGENCY PLAN

For Maximum Accident Hazard sites, MSHIC Rule requires the preparation Of both on-site and off-site emergency plans to minimise as far as possible the consequences of a major incident. The Company should revise the emergency plans to take into account scenarios such as vapour cloud explosions (before first Buncefield and now Jaipur, VCE had not been considered credible by the sector or Controlling Authority).and severe multi- tank fires.

10.17 OISD STATUS

OISD, is a technical Directorate under The Ministry of Petroleum & Natural Gas that formulates and coordinates implementation of a series of self regulatory measures aimed at enhancing the safety in the oil and gas industry in India. A small group of technical experts on deputation from the industry (Governement owned oil and gas companies), forms a core group in OISD. OISD, headed by an Executive Director, gets its direction and guidance from the Safety Council, the apex body consisting of senior officials of Ministry of Petroleum & Natural Gas, Chief Executives of Oil/Gas Companies and Heads of concerned statutory and advisory bodies. The apex body meetings are chaired by the Secretary, Ministry of Petroleum & Natural Gas.

While OISD has served an extremely useful purpose as they have formulated several standards and guidelines applicable to the oil and gas industry, in order to make their functions more independent, it is recommended that OISD can be developed as an autonomous body totally independent from the public sector oil and gas companies and free to develop its own cadre of safety professionals with no affiliations to any company.

OISD shall keep itself abreast of all major industrial accidents globally maintain a data base and conduct sessions for safety and operational managers of oil and gas companies on these incidents and lessons learnt thereof.

10.18 STANDARDIZATION OF MARKETING TERMINALS

It is observed that oil companies are following different standard and practices in design, operation and maintenance of POL Terminals.

Although the layout, fire fighting facilities etc., are as per relevant OISD Standards, considering the above aspect it is recommended that a comprehensive standard covering all aspects including design, operation and maintenance should be brought out by OISD on the lines of LPG Installation OISD STD.144.

10.19 SITING CRITERIA

One of the major issues raised by this event is the siting of petroleum storage sites with such major hazard potential. These sites are set up to maintain the supply of essential products and their strategic importance of the location must be balanced by highest standards of safety and control. Major Hazard sites are identified for regulatory purpose based on nature and quantities of materials they store, and are subject to MSHIC Rule under Environment Protection Act.

The starting point is therefore, the proper design, installation, operation and maintenance of the equipment/systems intended to maintain primary containment allied with a consistent approach to ensure its integrity.

The potential of any major accident can only be reduced, not entirely eliminated, as there will always be some degree of residual risk in any operation. This residual risk should be comparable with risk associated with daily life of an individual. To ensure that the residual risk of a maximum accident hazard installation is within acceptable limit, the means of early detection of loss of containment (from a tank or any other source), therefore, needs to be integrated with appropriate primary and secondary and tertiary containment measures to prevent the release from escalating into a serious accident.

Secondary containment is the enclosed area around storage tanks/containers called dykes or bunds constructed generally by concrete or earthen walls with leak proof measures. Their purpose is to hold any escaping liquid as well as any water or chemicals used in fire fighting. Tertiary containment includes measures such as drains, design to limit the passage of products/water or chemicals (used in fire fighting) into the effluent treatment plant wherein products/chemicals are separated ensuring that they do not find passage outside the plant.

The risk control measures and the emergency response arrangements at such sites would have to be primarily directed at the possibility of major incidents which includes formation of a “large flammable vapour cloud” as it happened in Jaipur. The location of hazardous sites and land use (nature of habitation/industry in the vicinity) should be decided on the basis of a sound “Quantitative Risk Analysis (QRA)”.
MoP&NG. may suitably review this at later date.

10.20 REGULATION FOR SITING HIGH HAZARD PETROLEUM/PETROCHEMICAL FACILITIES

i) New Statutes

Government may consider regulating by an Act, the planning and use pattern of land around major petroleum and petrochemical high hazard installations and plants which will make it mandatory to institute process of consultation between the major industries and the land planning authorities (both state and local). This will ensure that vulnerable sections of society are kept at a safe distance from the installation and the industries on their part adopt best available technology and systems to minimize risk. Also that roads and infrastructure and escape routes are adequately provided and maintained around the high hazard areas**.**

ii) Amendment of Existing Statutes:

The Petroleum Rules 2002 which regulates the Safety in Petroleum Installations do not specify any distances to be kept clear or unoccupied beyond the boundaries of the Installation. The Committee has studied the vapour cloud dispersion models in this incident and is of the opinion that a distance of 250 to 300 meters from the likely point of ignition is necessary to be kept clear. The Committee recommends that the Petroleum Rules 2002 may be suitably amended for a buffer safety zone around the Petroleum Installations.

10.21 SECURITY ISSUES

In high hazard locations such as the Jaipur installation it will be preferable to deploy the services of CISF for security responsibility.

It would be desirable to get a complete study done from the security angle from a competent agency like CISF or others and take appropriate steps for ensuring security.

During the interactions with the site security personnel the Committee learned of the exemplary courageous action taken by the Head of the security of the Terminal, Shri Sher Singh, who risked his life and made valiant efforts to save the lives of the two operators who perished in this accident. The Committee recommends that the efforts of Shri Sher Singh be recognized through appropriate bravery award.