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EMERGENCY SAFETY PROCEDURES
FOR
PESTICIDE FORMULATION UNITS

EMERGENCY SAFETY PROCEDURES FOR PESTICIDE FORMULATION UNITS

(DR. M.G. SRIVASTAVA)*

Disasters of the nature known in the chemical industry including basic manufacture of pesticides following hazardous/ runaway reactions, release of highly toxic gases etc. are fortunately rare in pesticide formulation units. Nevertheless emergencies can and do arise in this activity for a veriety of reasons. The major causes of emergency however, are -

* Equipment Failure
* Human Failure
* Natural Calamities

In addition to these, emergency could also arise in the process of transportation of toxic & inflamable raw materials into and of finished products out of the factory. Clearly therefore, the management and workers of such units should be prepared to cope with the emergencies. In this paper the cause and effects of the emergency episodes are discussed. The procedures required to prevent or minimise the effect of incident are identified for incorporation into good manufacturing practice (GMP). Unavoidably, the subject is treated on total industry basis as country specific requirements may vary according to the local laws and rules. However, the these procedures will easily integrate with the requirements of individual country.

EMERGENCIES : CAUSE & EFFECT

In order to develop safety procedures, it is essential to understand the nature (cause) of the emergency and its potential for hazard or damage. To illustrate, certain episodes are localised to a plant/activity unit, others may have the potential to cover the entire factory and yet others may extend beyound the factory affecting persons and preperties in the neighbourhood.

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A. EQUIPMENT FAILURE

As in all manufacturing activities, adequate attentic is paid to safety in designing and installation of plant machinery and equipment of pesticide formulation plants. Notwithstanding this and operating procedures, failure of machinery and equipment are known to occur, sometimes with serious consequences. The propensity of failure depends on the nature of plant and operation.

i) Solid Formulations

The main equipment liable to failure are parts c jaw crushers and pulverisers. Wornout beaters and hammer shoes not only damage the casing but also act as serious projectiles causing damage and injury.

An essential equipment in the solid formulation units is the dust exhausting and separation system. Failure of these equipments creates health hazard for workers but more importantly dust elouds which may also cause explosion.

A third recognised area of failure is the earthi of equipment. Grinding/milling operations as well as charging of vessels or during packing of solids, static charge is built up. Failure of earthing has somethin lead to explosion and fire.

ii) Liquid Formulations

Hazardous failures of equipment occur in pressur vessels & pressure pipelines as well as valves and vents. These failures may cause simple leaks or sud spill/spray of toxic chemicals causing worker exposu and environmental hazard. In case, the discharge is of inflameable solvents or other liquids, a major fir episode can occur. Leakage of gases from drums or cylinders eg. oxygen, Acetylene, Chlorine etc. may cause fire besides chemical toxicity to workers.

The failure of mixing vessels is not common. However, when the high speed agitator is in operating and port hole windows open due to failure or tampering a serious hazard situation can arise.

Similarly failure of heat exchangers can cause hazardous build of temperature & consequent emergencie

B. POWER SYSTEM FAILURE

Short circuits and failure of safety fuses may lead to fire which is exacerbated by the presence of inflameable solvents and finished products or other combustible raw material.

Power failure in some situations causes leakage of toxi gases (eg. chlorine) or combustible gases (eg. hydrogen) wh are used in the process.

Electrocution, bursting of tension cables and tension equipment are the other emergency situations.

C. HUMAN FAILURE

More often, emergencies are caused by human failure. These might involve physical and chemical injury, fire or environmental hazard. Some of the common human failures are -

i) <u>Failure to observe SOP</u>

At the start up of the shift and during the operations of plants, a laid down procedure is to be followed. Workers are not only provided the Standard Operating Procedure (SOP) but also trained in its observance. Nevertheless, cases of non-observ eg. of switching order, switching on an "OUT" vessel, opening of port windows while the unit is working, probing the hammers while the pulverising mill is operating, failure to switch on ventilation/exhaustio systems etc. are liable to lead to serious accidents or other emergencies.

ii) Failure to monitor the Control Panels

Most modern plants have built-in monitoring system programmed for the safe range of temperature, pressure etc. However, most of the formulating plants in the developing countries still depend on human monitoring of the control panels to ensure that the safety limits are not crossed, and timely corrective action taken. Failure to do so for any reason whatsoever (casualness, tiredness or any other) can cause equipment failure and lead to explosion, fire or other emergencies.

iii) Failure to observe Safety Rules

Besides the operational hazards outlined earlier, every well-managed formulation plant has procedures laid down for the personal safety of workers. These involve use of sepecific dress and safety equipment for different type of activities. For reasons of carelessness or lack of supervision, workers bypass the Safety Rules resulting in injury to themselves and co-workers or other hazards.

Similarly, the seriousness of an emergency is aggravated if the response to the detection of a hazard and/or activating emergency procedure is slow. Oftentimes failure to observe the safety rules is due to lack of training in the procedure/s and drills to ensure practical experience.

D. NATURAL CALAMITIES

Natural calamities are a potential source of emergency However, in formulation plants and specially in the develop countries, sufficient attention is not given to this aspect Some of these hazards are listed below -

i) Lightening

Lightening striking transformer, Sub-station, sol storage tanks or mixing plants lead to serious fires. For protection from lightening, all vulnerable str must not only be provided with lightening arrestors b

also regularly checked for proper earthing.

ii) Flash Floods

Flooding of plants and warehouses due to excessive precipitation or overflow of river/water channels causes grave pollution emergency. The flood waters not only damage equipment and packaging of the stocks, it also carries out with it toxic pesticides and other chemicals resulting in undesireable environmental contamination.

Where the chemicals in store are likely to react with water or where the ingress of moisture can set off autoreactions, an emergency of much greater magnitude can arise.

iii) Earth Quake

Severe earth quake can cause collapse of roofs or whole building, power transmission towers, dislodge plant & equipment and lead to collapse of stacks in warehousess. These in turn could cause fire, spill of large quantity of toxic chemicals etc. with attendant emergencies. The problem is specially great in the quake-prone areas.

PREVENTION OF EMERGENCY

Given the nature of pesticides, it hardly needs emphasis that proper planning and precautions can substantially reduce the risk of emergency. The principal prevention measures include.

a) Plant Design and Layout -

Hazards in the operation of different plants/units must be anticipated and taken into account in the designing of plant equipment as well as their location eg. safe distance between plants/structures, ventilation, dyke walls, storm drains, security and alarm systems, hydrants/water reservoirs etc must be provided.

Similarly, care should be taken to ensure that vents, valves and other safety equipment are provided in the vessel compressors, boilers and delivery pipelines.

Lists of pressure vessels, safety vents & relief valves and other high risk items should be prepared and readily accessible for surveys as well as testing and repair/replacement, as required. Proper record of testing & maintence should be kept for each plant site.

b) Production/Manufacturing Process

The process should be documented in detail highlighting the hazardous steps or reactions. The precautions are normally documented in standard operating procedure of the plant. However, the Process details and SOP must be checked by the Plant Safety Committee and any areas needing extra precautions must be brought to the notice of all concerned.

c) Property and Toxicity of Chemicals

The technical grade/concentrated pesticides and other raw materials used in the production of formulations have their own properties. Such data for each chemical should be readily available in a standard form for reference and use both inplant and outside (See Annexure I).

d) Safety Rules & Observance

Well managed pesticide formulation factories maintain documented safety rules or each activity/area/unit in relation to the nature of process, equipment & chemicals involved (eg. mixing and packing plants, warehouses, workshop etc.). Proper supervision to ensure observance of safety measures is of critical importance.

Safety equipments & installations eg. fire hydrants, fire applicances, fire pumps, foam, monitors, fire extinguishers etc. must be listed and tested maintained regularly according to a prepared plan. Testing and maintenance records of safety equipments must be properly maintained.

e) Inspection And Maintenance of Plant

Good manufacturing Practice (GMP) demands the following -

i) Daily Inspection - of safety equipments and vulnerable areas of the plant should be carried out. More detailed/special inspect. may be periodically organised in some cases.

ii) Routine Maintenance -Prompt repair/fault correction as noted during daily and special inspections.

iii) Special Maintenance- Undertaken in the case of a major failure of equipment

iv) Annual Maintenance - Such maintenance/overhaul is prepla nned and must be carried out meticu lously.

f) Hazard Assessment

All hazards and equipment limitations may not be anticipated at the time of instalation. Some snags come to notice on commissiong. Other sangs surface after the plant has been operated for sometime. Yet others might be located during hazard surveys. Many companies have therefore adopted the HAZOP & HAZEN studies for corrective messures. Many others use entirely 'Outside Experts' to survey the plants & safety systems for adequacy and/or modification. These reports shou consitute the basis for modification in the plant/s as well for installing additional safety equipment.

g) Safety in Transportation

Most of the pesticide (incl. Raw Materials and Furnished Products) is transported in developing countries through road transport. Emergencies of heavy spillage and resultant hazardous pollution, fire or human exposure occur due to failure of bulk packing, collision or overturning of the vehicles. For optimum safety in transportation, the following measures are necessary -

i) Product Information : The driver must be briefed about the nature and properties of the product and likely hazards in the event of spillage or leakage. The product leaflet giving the relevant details and "dos & dont's" in handling the consignment must be made available to the driver.

ii) Safety Equipment : The driver should be provided gloves, goggles, gum boots, fire extinginsher etc. for use during transit. It is desireable to also provide a catch-pot/tray for collection of small leakage, if any.

iii) Consignor/Consignee Information : The name, address and telephone number of the consignor and consignee should be made available to the driver to enable him (or police) to contact for additional product detail precautions etc. in case of an accident or emergen

iv) Emergency Procedure : An emergency procedure card (desc -ng with illustrations) the step by step procedure to be followed in the event of leakage or fire, should be available with the driver for his refere as well as for the guidance of fire brigade etc. if required.

EMERGENCY PROCEDURES

Onsite emergency plan and procedures are prepared so as to to create alertness in the factory staff and workers and to activ safety action as soon as the need arises. The emergency activit may be divided according to the order of action into 3 groups as follows -

I. PRE-EMERGENCY ACTIVITIES

These activities are aimed at preparedness to cope wit emergency situations that may arise. These cover -

1) Internal Hazard Survey : to identify the hazard areas in the plant and safety measures and (Annexure II) and
   - check safety installations
   - " " equipment
   - " Fire system
   - Suggest modifications/additional requirements

2) External/Third Party Survey - use outside experts to :
   - Identify hazards (compare also with internal Survey report)
   - Survey in-built safety system for suitability
   - Survey other existing safety equipment for suitability
   - Suggest modification.

3) Pressure vessel Testing - To organise suitable tests for vessels :
   - Prepare list of pressure vessles.
   - Prepare procedure for testing
   - Prepare testing & maintenance records for reference or comparison

4) Safety vents & relief value testing - Similar to the testing of vessels, it covers :
   - Listing of vents & valves in each plant.
   - Preparation of testing and maintenance schedul- for these items.
   - Draw action plan for repair/replacement.

5) Fire System Testing - To check and verify :
   - List of hydrants (points), applicance, motors, monitors etc.
   - Prepare testing programme and document findings
   - List and check standby equipment for workabili

6) Emergency Drills - These are conducted both for interna training and also to verify the working of emergency procedure, response time and performa

7) Alertness - Level Zoning - Based on the in-house and external (Expert) surveys of the areas and nat of hazard in each plant, warehouse, other installations and structures must be classifel for the alertness level required to handle lik emergencies. The commonly adopted hazard/aler level calssification is as follows -

   Level I - Minor Accident/Fire within the plant and mino leaks eg. from joints or localised dust clouds

Level II- Accident/Fire within the factory i.e. spreading beyound the site of origin or plant

Level III- Likeli-hood of cloud formation & its spread or Fire spreading beyound the factory.

This classification is important for setting communication procedure, action plan and determining the safety equipment & system to be provided at individual site.

8) Location of Safety Equipment - Unit/area wise listing of safety equipment has been referred earlier. However, locationwise for overall control/coordination a sonsolidated list of equipments must be readily available with the General Manager and Safety Officer. This information must also be shared with the Safety teams during the training programmes.

9) Training of Emergency Teams - This constitutes regular and on-going preparedness and includes -
   - Fire staff
   - Plant Personnel
   - Security Force (if considered necessary).

II. EMERGENCY ACTIVITIES

While pre-emergency measures develop awareness and preparedness, the real task is during the emergency. The task profile during the emergency comprise -

a) Assessment of incident and immediate action to control
b) Communication to Safety Officer, Unit Head, Dy. G.M. and General Manager. Also external Fire & Medical service and neighbouring factories if necessary.
c) Evacuation/safeguard of people and assembly at a predetermined safe point - First Aid, where required.
d) Coordination of the work of Fire Service, Medical Service and Maintenance group and requesting help of mutual aiders.
e) Preservation of all clues/evidence relating to the incident for subsequent enquiry. (Site to be cordoned of for visitors).

To achieve the above and to ensure individual role clarity, safety teams (action groups)are nominated as follows -

i) Plant/Unit Level Action Group (Annexure III)

This is the front line group intended to quickly tackle the emergency at its origin inorder to contain the episode to Hazard Level I, as for as possible.

ii) Factory Level Action Group (Annexure IV)

This group gets involved in the action when the incident has/is prone to spread beyound the unit level. Such emergencies commonly arise due to fire, explosion or large release of gas.

First Aiders

Training a few individuals from each activity unit (eg. plant, laboratory, workshop etc.) in the FIRST AID measures is a part of Good Manufacturing Practice. All such trained individuals consitute the "Team of First Aiders". These individuals should not be assigned other duties during an emergency.

In the event of an alarm of emergency, the members of the FIRST Aid Team should rush to the site of incident and

i) Start evacuation of personnel that are not engaged in emergency duty at site
ii) Provide first aid to the injured
iii) Arrange for the Action Group leader to call for ambulance or medical aid, as necessary.

To keep the First Aiders uptodate, refresher courses and mock-emergency drills must be carried out perodically.

Communication Procedure

Effectivenes of safety procedure depends on the speed and correctness of communication (of incident) internally and where necessary externally. To ensure this, the communication procedure must be laid down (documented) and made known to all action group Managers and supervisors. This is illustrated in Annexure V To ensure timely communication (in relation to the hazard level of the episode), the task may be distributed over more than one individual.

III. POST EMERGENCY ACTIVITY

After the emergency is over, steps have to be taken to identify reasons of incident and/or weakness in the safety system. The following steps are generally involved -

a) Appointment of Enquiry Committee (if a committee does not already exist in the factory)
b) Collection of all relevant records and documentation of evidence.
c) Procedings of Enquiry and preparation of report including preventive measures
d) Lodging insurance claim/s
e) Implementation of recommendations of the Enquiry Committ
f) Recommissioning of plant
g) Rehabilitation of the factory personnel injured or disabled during the incident (if any).

EMERGENCY ACTION DRILLS

As the two major emergencies in pesticide formulation factori arise from leakage of chemicals or fire, it is necessary to prepar step-wise action plan for the guidance and use of the Safety Actio Groups described earlier. The details of the actions to be taken are outlined in the following annexures -

a) Actions in case of Fire (Annexure VI)
b) " " " Chemical Leakage (Annexure VII)

These may however, be ammended depending on special requirem under the specific country laws, if any.

MUTUAL AID ARRANGEMENTS

The importance of an accident/episode is not always limited to the factory where it occurs. Incidents of fire and chemical leakage may extend to areas beyound the factory including other factories or establishments. Even within the factory, the size of emergency may be beyond the capacity of the in-factory resources. For this reason, factories or establishments come to mutual assistance agreement to meet emergency in any of them. The mutual aid may include fire fighting personnel and equipment, transport vehicles, ambulance, medical personnel etc. The emergency procedure therefore involves alerting the Mutual Aid members of the incident and thereafter they are kept informed

of the situation as it develops further. The communication channels (telephone or any other) with the members have therefore to be kept open.

EMERGENCY & NEIGHBOURING COMMUNITY

Although undesireable, labour lines, housing estates etc do often exist in the close vicinity of factories. In the event of fire explosion or gas leak, this community is exposed to hazard/s. It is the responsibility of the factory management to suitably inform the people about the nature of the operations in the factory and possible hazards should an accident occur. The community elders and opinion leaders provide a useful channel of communication with the people. The same channel should also be used to educate the community of the safety measures to be adopted in case of an emergency situation. This could be imparted in different ways eg. through illustrated safety leaflets, exhibition of safety films etc. In addition, factories should instal public address system or emergency hooter devices to alert the people, when in the judgement of management, such a warning is necessary.

CONCLUSION

The episodes recorded round the world in chemical industry including pesticide manufacture serve to emphasise the need for preparedness to meet emergency situations. Pesticide formulation, eventhough a relatively simple activity, it is not free from hazards of emergency nature. In GMP, therefore, the preparation to cope with emergency is a technically evaluated and properly documented procedure. The procedure is tailored according to the nature of plant and machinery as well as the properties of chemicals and raw materials used in the process.

Safety systems are generally built-in/provided for in designing and establishment of the formulation units. Besides, a number of precautions andpre-emergency measures should be taken to minimise the possibility of occurrence of emergency as well as prompt action to containthe impact of emergency. Not-withstanding these, should the emergency situation still arise,

the laid down emergency procedure must be followed step by step. The success of the procedure depends on the speed and accuracy of communication, the role clarity of the different action groups, and proper coordination of the resources in the factory and available from Mutual Aiders and state/municipal services in the vicinity. All these aspects are described in detail in this paper. The reponsibility of the factory towards the neighbouring community in such an eventuality is also emphasised.

ACKNOWLEDGEMENTS

In preparing this paper the author has drawn on some of the systems and procedures adopted in the pesticide factories of ICI India, Hindustan Insecticides Ltd. and Kanoria Chemicals & Industries Ltd. to cope with accidents and emergencies. This is duly acknowledged.

Annexure :

CHEMICAL DATA FORM

Section I : Material Identification & Use

Name/Identifier ----------

Manufacturer's Name & address ----------

Suppliers " " ----------

Chemical Name ----------

Molecular Formula ----------

Do Weight ----------

Trade Name/Synonyms ----------

Product Uses ---------- ----------

Section II. Hazardous Ingredients

Degree of hazard : Very degerons
Dangerous
Safe.

Chemical hazard : Fire/Explosion
Ignition with intense light
Ignition on contact with other chemicals eg. ---------- --

Toxicity Data :

Lethal Conc. Levels

For Humans ---------- ----------

" Dogs ----------

" Rabit ----------

" Guinea Pigs ----------

Section III : Physical Data

Physical state ---- ------ Solid/liquid/gas

Colour ----------

Odour ----------

Relative Density ----------

Vapour pressure & density ----------

Section IV : Fire & Explosion Hazard

Flameability ----------

Means of Extinction ----------

Flash Point
Explosion Limit Upper ----------Lower ----------

Autoignition Temperature --------- ----------

Hazardous Combustion Products ----------

Sensitivity to Chemical Impact ----------

" " Static discharge ----------

Section V : Reactivity Data

Chemical Stability ----------

Incompatability with other substances ----------

Reactivity Conditions ----------

Hazardous decompostion products ----------

Section VI : Toxicological Properties (Effects)

Route of entry - Skin Contact ----------
Eye Contact ----------
Inhalation (Acute) ----------
(Chronic) ----------

Exposure Limits

TLV ----------

STEL ----------

Irritancy level ----------
Sensitisation ----------

Carcinogencity & Related Effects : Carcinogen----------

Teratogen ----------

Mutagen ----------

Reproductive Effects ---------

Section VII : Preventive Measures

a) Personal Protective Equipment - Gloves
Footwear
Clothings
Respiratory
Eyes
Face
Others

b) Engineering Control

Process Control - ----------

Leak/Spill Procedure - ----------

Storage Requirements - ----------

Shipping/Transport Requirements - ----------

Section VII : First Aid & Medical Measures

First Aid Steps (In appropriate order)

Medical Treatment :

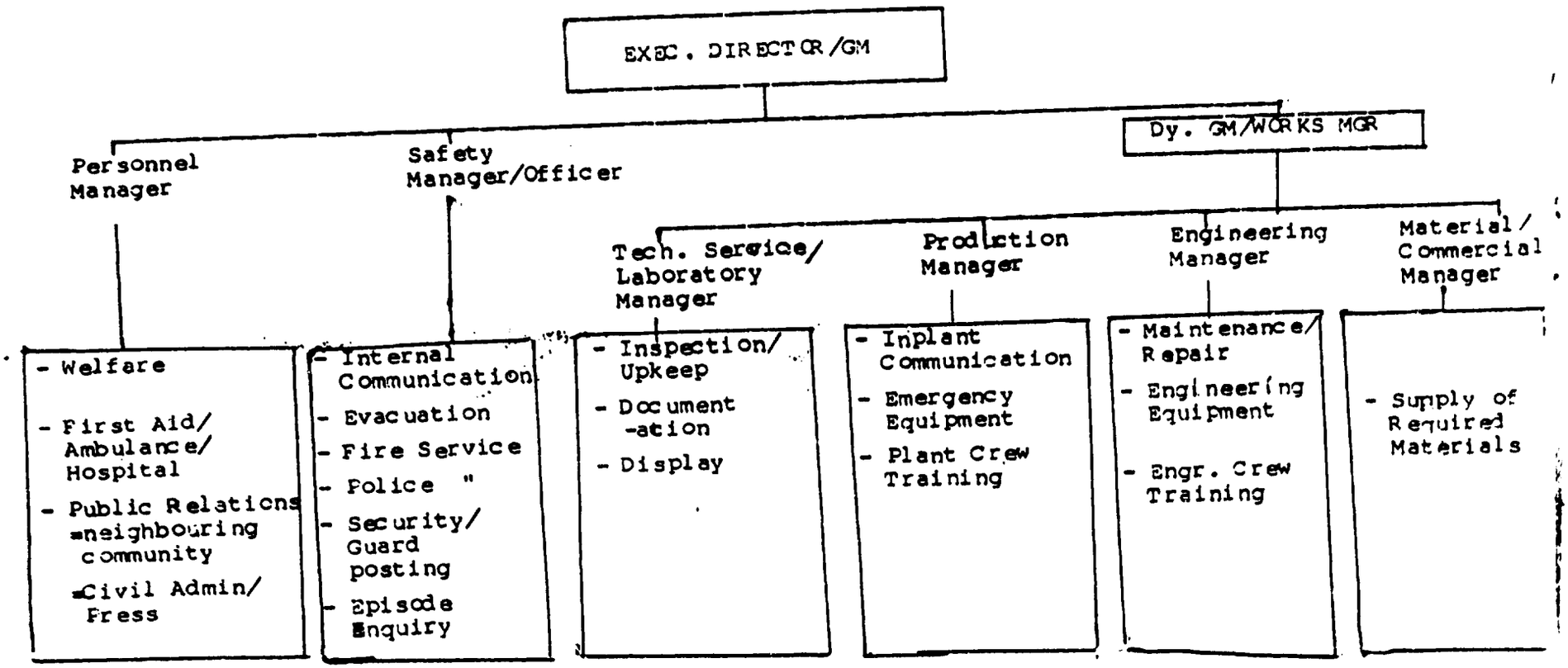
Antidote/s ----------

Other Treatments
(Indicated Course
for plysician) ----------

Annexure II

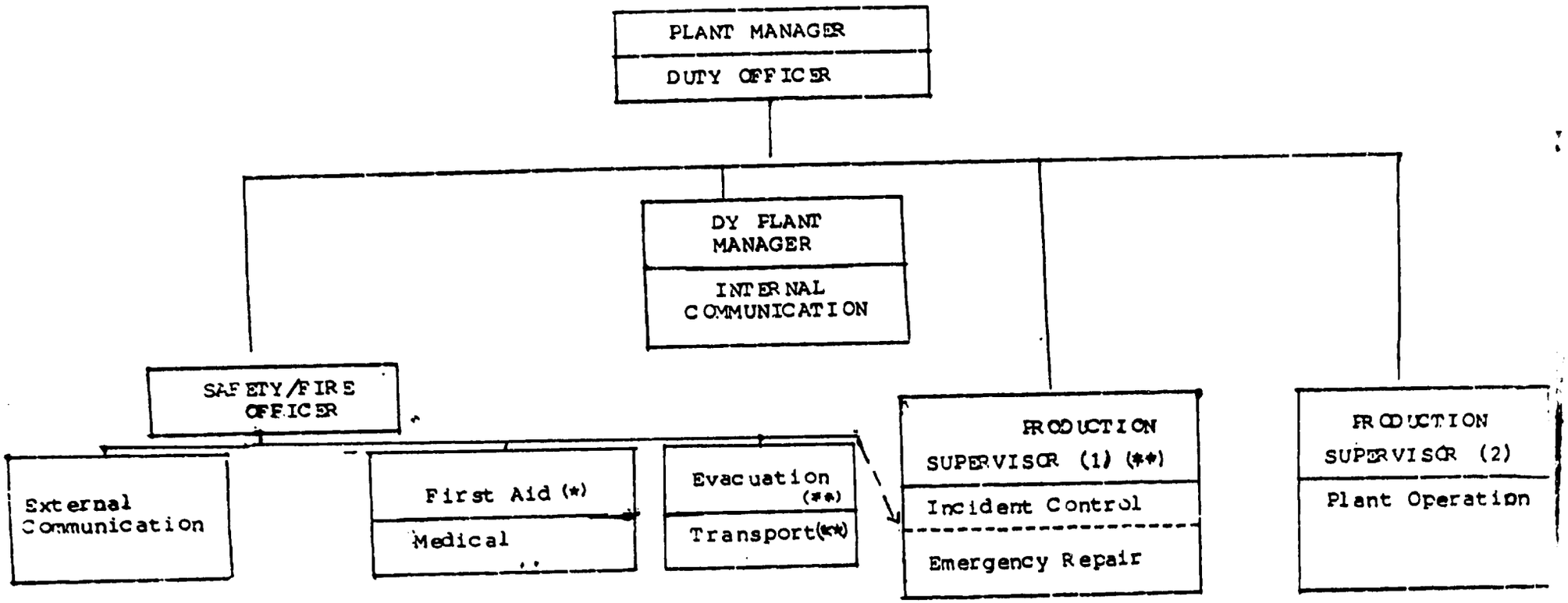
EMERGENCY ADVISORY GROUP

Composition & Duties



(Acknowledgement : Hindustan Insecticides Ltd, New Delhi).

PLANT/UNIT LEVEL ACTION GROUP
(And Duties)

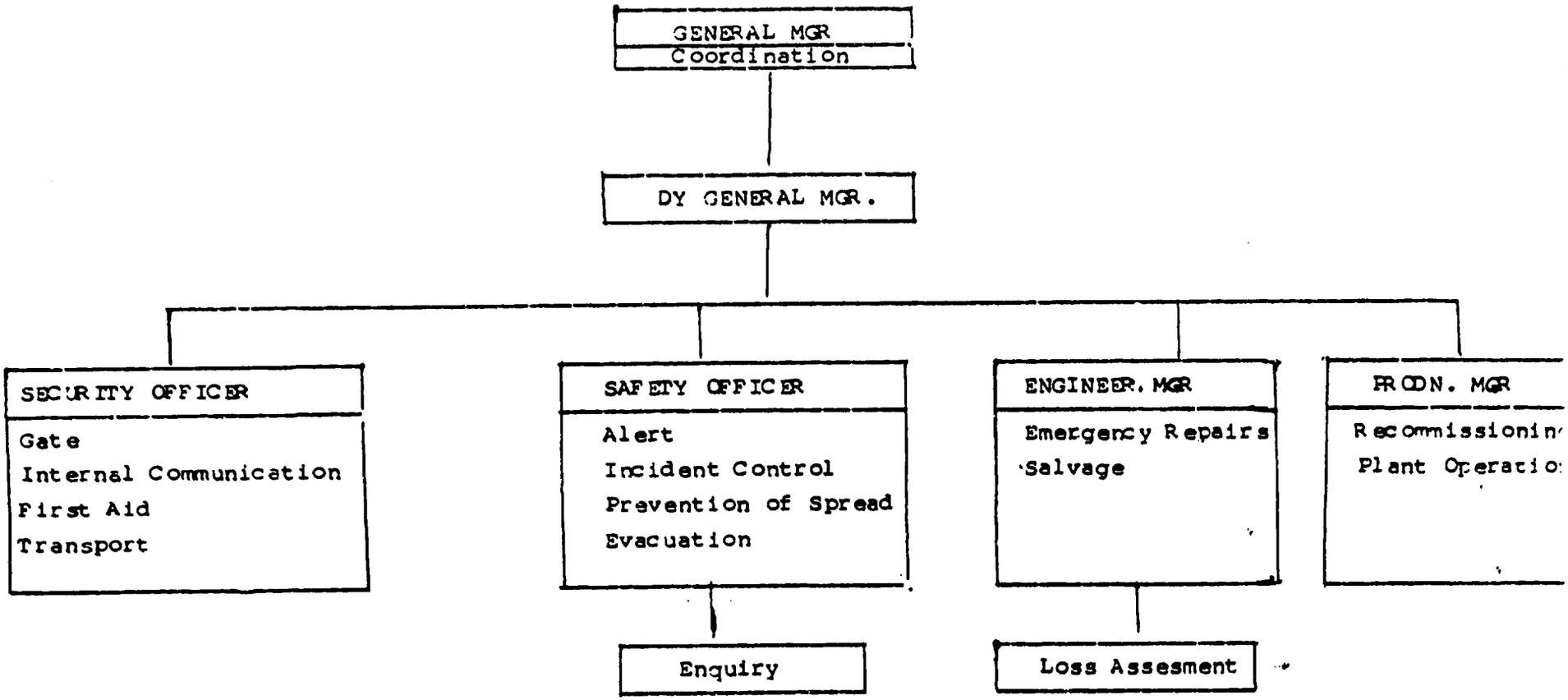


(*) First Aider Group & Dispensary

(**) Assisted by Action Group Members

(Annex-IV)

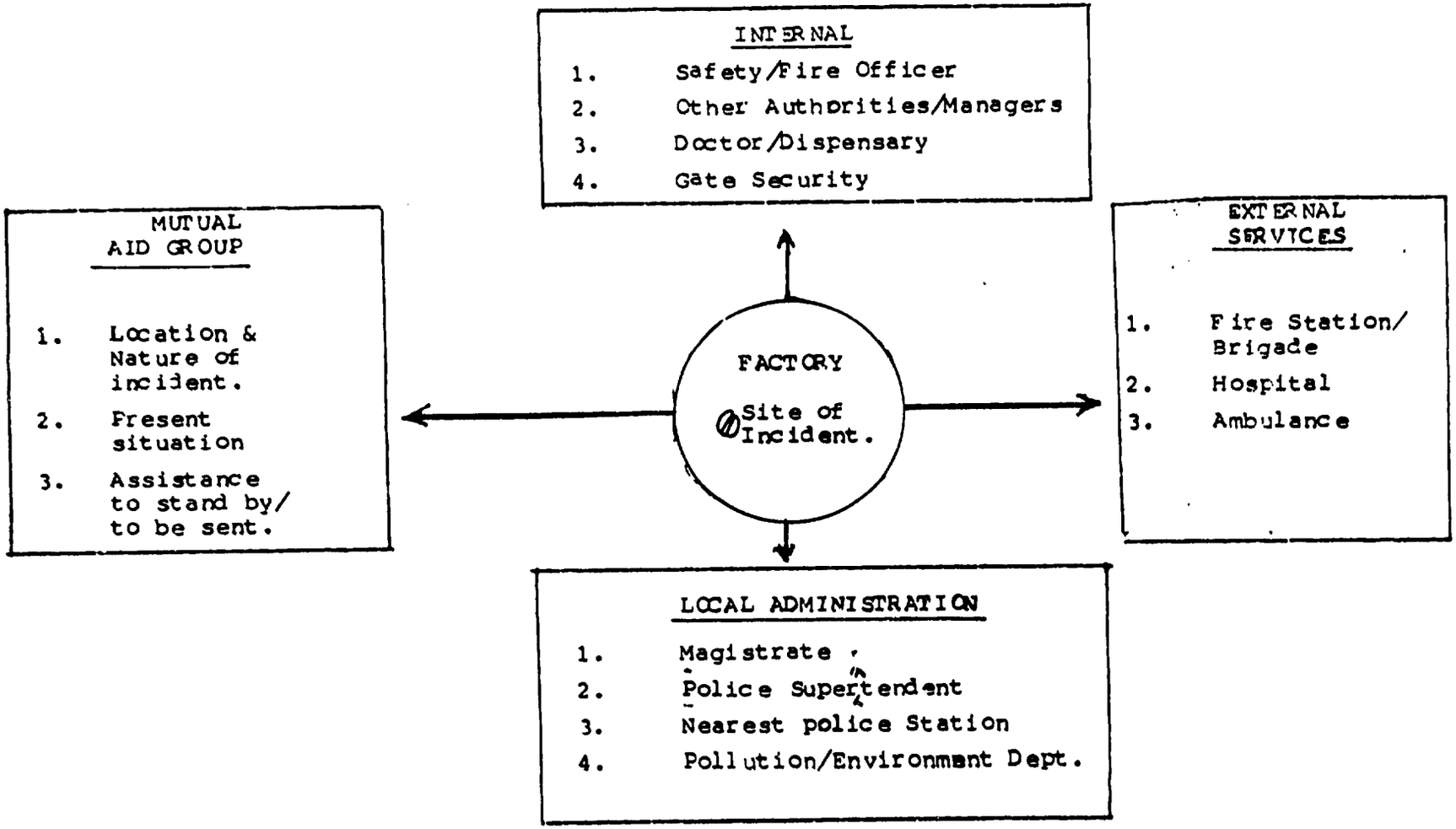
FACTORY LEVEL ACTION GROUP
(And Duties)



(Annex. IV)

Annexure .IX.....

EMERGENCY COMMUNICATION CHART



(Annex - IX)

Annexure VI

ACTION DRILL FOR FIRE INCIDENTS

1. By the Discoverer of Fire

   a) Attempt to put out the fire by the use of appliances available nearest to the site. (Fire extinguisher/sand/water, where permitted)

   b) Raise alarm (by shouting) to attract attention and help of others.

   c) Inform (or arrange to inform) the factory Fire Officer or state Fire Brigade by telephone.

2. By Persons Reaching the site next

   a) Raise alarm/shout that there is a fire incident

   b) Assist in rescue and fire fighting operations, using safety equipment.

   c) Inform the Fire Officer by telephone

   d) Guide the fire staff to the correct location

3. By the Plant Action Group

   a) All members of the group to rush to the fire site

   b) Start firefighting and rescue work using safety equipment

   c) Evacuate all other personnel and keep the doors and passages clear

   d) Start salvage measures by shifting moveable items and providing covers on fixed machinery items.

4. By Incharge of the Affected Section

   a) Rush to the site of fire

   b) Inform the Fire Officer and Plant Manager by telephone (if not already done).

   c) Post a guard to direct the fire staff to the actual location of fire and prevent entry to visitors.

   d) Instruct telephone operator/Attendant to inform all concerned as per the emergency communication list.

e) If fire is not controlled or worsens, commission outside assistance (State Fire Brigade & Mutual Aid Members)

f) Main gate to be informed of the external assistance and to direct them to the hazard location.

g) Order closure of a part or whole of the plant, depending on the extent of fire.

h) If required, get the electrical power circuit to the affected area cut off by the main switch

i) Keep Senior Officers/Managers informed of the situation AND hand over the operation to the next senior on his arrival.

5. By Coordinator of Fire Fighting Operations

The senior most officer present at the scene becomes the Coordinator of the fire fighting operations. He assumes charge and makes assessment of the situation. Initiates acti to extinguish the fire or bring it under control as soon as possible. He also decides on the need for further action and summons further assistance, as required. He will also arrange that the waste water (from fire fighting) is directed into a holding lagoon i.e. not allowed to drain out.

6. By Incharge of Sections not involved in Fire

a) Relieve all members of the Action Group and First Aiders to assist in the operations to control fire and provide aid.

b) All other personnel to containue their normal work

c) Maintain vigil to ensure that the fire is not spreading towards his section. If there is a danger, inform Fire Officer and other authorities.

7. By Telephone Operator on Duty

a) Keep alert to receive and transmit messages about the fire/fighting operations on priority basis.

b) Inform the following authorities regarding the location & nature of fire -

General Manager	Deputy General Manager
Security Officer	Factory Doctor/Dispansary
Transport Dept.	Electrical Dept.

c) On receipt of instructions from the Coordinator of the operations, call for emergency assistance from the
   Nearest Fire Tender Station
   Fire Brigade - main Office
   Nearest Hospital & Ambulance (to stand-by)
   Any other (as instructed)

d) Keep in contact with the telephone near the scene of fire AND keep outside telephone lines free for emergency communication.

8. By Duty Officer Transport Dept.

a) Mobilize maximum number of drivers and vehicles to be in readiness

b) Direct them for evacuation or transportation duty when requested by the coordinator.

9. By Electrical Dept.

a) Ensure that the power/supply to the fire hydrant pumps is not interrupted.

b) Switch off power circuit to the affected area on the receipt of information (or instruction).

c) Keep alert to take any other safety action, as demanded by the Coordinator.

10. By Factory Dispensary

a) Doctor/Dispensary Incharge to be ready to attend to servious burn or injury cases.

b) Dispensary staff to be ready to provide first aid to minor injury cases.

c) Depending on the nature of casualaties, arrange for transfer of serious cases to the nearest good hospital. Arrange ambulance, if required.

11. Actions After Fire is Extingnished

a) Fire operation coordinator to satisfy himself and ensure that there is no chance of re-ignition.

b) After the above, sounded 'ALL CLEAR' on the siren.

c) After 'All Clear' signal, all personnel other than the members of Plant Action Group, shall return to their place of duty and resume work.

d) Plant Action Group assisted by other plant staff (if required) to return all fire fighting applicances and first aid equipment to their normal location. They might also assist in the post-fire salvage operation.

e) Initiate enqiury to establish the cause of fire. Ensure that Safety enqiury report is submitted as per the rules of the factory.

Annexure VII

ACTION DRILL FOR INCIDENTS OF LEAKAGE OF CHEMICALS

1. By Discoverer of leakage

   a) Try to stop leakage through isolation valve on the time leading to the point of leak or as feasible

   b) Simultaneously, inform the Section Incharge of the location of leak

   OR

   If Section Incharge is not available, inform the supervisor nearest to the incident site.

2. By other Persons Reaching the site next

   a) Members of the Plant Action Group, First Aiders and Supervisors/Officers to quickly reach the location along the direction of wind (not against/into the wind).

   b) Assist in stopping leak using safety dress and equipment

   c) Guide/help safety officer/others to the correct location

3. By Safety Department Personnel

   Members to rush to the scene and -

   a) Start rescue and safety work

   b) Evacuate plant personnel and keep passages & doors clear.

   c) Start salvage operation by preventing further leakage and/or spreading.

4. By Section Incharge (Affected Section)

   a) Rush to scene

   b) Post a person to direct the safety teams etc. to the location though the safe route.

   c) Ensure communication to Safety Officer & higher officers.

   d) Supervise and guide the operation to control leak

   e) Order shutting down of whole or part of the plant depending on the extent of hazard.

   f) If the nature of leaked chemical demands, get the electric current switched off from the main switch of the plant.

g) Keep Senior Managers/Officers informed of situation and hand over the site to the next senior person as soon as he arrives.

5. By Incharge of Hazard Control Operation

The senior most officer present at the scene of chemical hazard, assumes charge of as Hazard Controller. He will review the action/s taken by different sections (as per plan), assess situation and commission additional help, if required.

6. By Incharge of Sections not involved

a) Relieve all personnel who are members of Safety Action Group and first aiders and instruct them to rush to the location of incident (No other personnel to leave the section).

b) Instal vigilance against leaked chemical spreading into their sections. Inform safety officer, if spread is thereatened.

7. By Telephone Operator/Attendant

a) Keep alert to receive and transmit information concerning the incident. Assign top priority to this.

b) Keep communication open with the Mutual Aid factories/ establishments.

c) Inform the following authorities about the nature & location of chemical leakage -

General Manager	Dy. General Manager
Factory Doctor/Dispensary	Fire Brigade/Fire Service
Ambulance	Electrical Department.

d) Inform any other external agency as instructed by the officer Incharge of the factory/coordination at the moment.

8. By Transport Department

a) Direct vehicles to or near the site of incident (as permitted) on receipt of demand for them

b) Mobilise maximum number of vehicles & drivers and keep them ready for transporting men or material.

9. By Electrical Dept.

a) Switch on booster pump/s for water supply

b) Switch off power supply circuits to the affected area.

c) Await further instructions.

10. By Dispensary Incharge

On receipt of information, the factory dispensary must arrange for

a) The Incharge to be ready to attend to serious cases

b) Other dispensary staff to provide first aid to slightly injured persons.

ACTION AFTER LEAKAGE IS CONTROLLED

i) All safety equipment to be returned to the designated location by the ~~Safety~~ Action Group (assisted by others if necessary)

ii) Safety Officer to check that all returned equipment is cleaned and in good working condition. Damaged ones to be repaired/ replaced quickly.

iii) Section I/C to Supervise that all moveable articles are kept in safe custody in the plant.

iv) Intiate proper enquiry into the causes of incident & ensure that safety report is submitted to the concerned authority as per the rules of the factory.