

# **O & M Manual**

**Modern Slaughter House and carcass utilization  
-cum-rendering plant, Ghazipur**

**East Delhi Municipal Corporation**

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# 1. INTRODUCTION

## 1.1 Background

Meat and meat products are an important component of diet in many parts of India. Even though the consumption of animal protein per head of population is low compared to developed countries, the production and consumption of meat is increasing as levels of affluence are on the rise.

The slaughter of livestock to produce meat and meat products is a widespread activity and is developing into an important industry in India. Lack of appropriate slaughtering facilities, unsatisfactory slaughtering techniques and poor hygiene conditions demand introduction of modern slaughterhouses, which will overcome these deficiencies

East Delhi Municipal Corporation (EDMC) is responsible for providing various civic services within the limits of corporation of Delhi. This includes the operation and maintenance of slaughterhouse and carcass utilization-cum-rendering plant. For both environmental and economic reasons, the erstwhile MCD took a decision to urgently relocate the existing “Idgah Slaughter house” to Ghazipur on the outskirts of Delhi, where a modern, centralised facility has been constructed. The site was chosen because of its isolation from urban areas and proximity to road network for the delivery of animals and distribution of fresh meat.

The purpose of the new slaughterhouse to provide a stable and adequate supply of wholesome meat to the population of Delhi as well as ensuring highest international standards for hygiene and safety, operational efficiency and environmental management.

The Modern Slaughter House and Carcass Utilization-cum-Rendering Plant has been leased to a competent operator who is managing the entire operations covering maintenance of livestock market, operation and maintenance of slaughterhouse including lairage, utilities, compliance with various laws, rules and regulations of EDMC, Government of India and Government of NCT, Delhi rendering plant has also been leased out to the same private operator.

## 1.2 Basic Data

Type of facilities:	<p>Livestock market &amp; Slaughterhouse consisting the following areas:  Lairage block 3347 m<sup>2</sup>  Three separate section of lairage are divided as  Buffalo 945.50 m<sup>2</sup>  Halal 1396.60 m<sup>2</sup>  Jhatka 951.60 m<sup>2</sup></p> <p>Raceway 10 m approx.  Slaughter Hall building 3906 m<sup>2</sup> (approx.)</p> <p>For personnel hygiene of butchers, veterinary doctors and other workers there are facilities such as lab, offices, change room, showers, lockers and toilets.</p> <p>Utility block 880 m<sup>2</sup> (approx.)  Administrative block 336 m<sup>2</sup> for EDMC use.  Housing block 83.45 m<sup>2</sup>  check post 4 nos  Boundary 910 m (approx.)  Road &amp; parking 7305 m<sup>2</sup> (approx.)  Gates 5 nos  Overhead water tank 500KLD  Underground water tank 500 KLD  Additional UGR of capacity 500 KLD – 01 at Livestock Market  and 01 at Ghazipur Slaughter House  adjusted to EDMC office</p> <p>Other facilities 3 nos DG sets  25 street light poles all around boundary wall  3 nos Borewells with 10 HP motors each</p> <ul style="list-style-type: none"> <li>- 12 Ton capacity steam boiler with chimney, oil tank of 25 KLD storage capacity for supply of hot water through plate heat exchangers at different temperatures and pressures to all sections of slaughter hall and mezzanine floor.</li> <li>- Refrigeration system for air conditioning of slaughterhouse &amp; cold storage</li> <li>- Two compressor units of total 1020 CFM capacity with air receivers and refrigerated air dryer.</li> </ul>
Main contractor:	BANSS
Site features:	Site area 25907.20 m <sup>2</sup> Build up area 8608 m <sup>2</sup> Open area including road 17299 m <sup>2</sup>
Costs:	Rs. 100 Crores
Daily production:	The designed daily production throughout of the slaughterhouse is:
	Sheep / Goats (by Halal Method)/ Shift 3000 Nos
	Sheep / Goats (by Jhatka Method) / Shift 1500 Nos
	Buffaloes per Shift 500 Nos

No of shifts	Three shifts per day
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### 1.3 Features of the Modern Slaughterhouse

The basic amenities provided in the modern slaughterhouse are:

- Reception area for animals
- Lairage (resting place)
- Facilities for ante – mortem inspection
- Segregation ward for sick/diseased animals
- Facilities for carrying out humane slaughtering
- Dehiding, dressing and washing of carcasses
- Handling carcasses and edible offals
- Handling by-products and disposal (rendering plant)
- Inspection of meat and disposal of unfit meat
- Refrigeration store room for carcasses
- Laboratory
- Temporary/make shift Skin and hide godown (established by the existing lessee at his own cost)
- Blood processing unit (established by the existing lessee at his own cost)

#### 1.3.1 Hygiene and Sanitation Features

The new slaughterhouse is designed to meet the highest international standards for hygiene, i.e. European Community (EC) and United States Department of Agriculture (USDA) Standard. To achieve this, the following provisions are available:

- All work floors are constructed of hard impervious material such as dense acid resisting, non-dusting, non-slip and water proof concrete and graded, 33 mm per m to the drains.
- Floor and wall finish in slaughter hall is seamless construction to avoid the accumulation of dirt. All surfaces are non-absorptive and can be easily cleaned by using, water jet.
- Physical separation between “dirty” and “clean” operations.
- The “clean” area comprising of slaughter hall and carcass processing area.
- The layout of the slaughterhouse and building is designed so that the production process moves in one direction without any cross flow of products, which may adversely affect the hygiene of the product. Live animals are received at the “dirty” end of the slaughterhouse and meat is out loaded from the “clean” side of the slaughterhouse.



- Air flow system is so designed as to create positive air flow from clean to dirty areas
- Hot and cold potable water under adequate pressures and in sufficient quantities are available throughout the plant.
- Provision of hot water at various temperatures for sterilization and disinfection of equipment, washing and cleaning purposes. For disinfections, hot water is supplied at temperatures at more than 82<sup>o</sup> C wherever required.
- Height of conveying system is designed at 2.40 m (high) to meet the EC standard, so that splashing water will not contaminate the carcass
- Sanitation and health requirements set by various legislations and regulations would be met.
- Adequate lighting with overall intensity above 200 lux is provided in various area of slaughterhouse. For inspection purposes, lighting intensity of above 500 lux would be available.
- Maintenance requirements are taken into account during the design and construction of operational areas, equipment selection etc. sufficient space and access to all parts of building, fittings and equipment is provided so that maintenance activities can be easily carried out.
- The development of landscaping and green belt is provided comprising of grass and shrubs which create a pleasant environment and gives the impression that the slaughterhouse premises is well managed and cared for.
- From the point of view of industrial psychology, it has been found that the more attractively a site is maintained, the easier it is for the workers to accept and adapt to the high standards of hygiene expected of them. This is the guiding principle of this modern slaughterhouse.

### **1.3.1 Safety Features**

To address the safety requirements, the following principles have been adopted:

- Protection cover and facilities and installed to all equipment in the plant. Adequate rails and barriers are provided to protect the workers. Warning signs and signals are displayed at appropriate locations.
- Extensive period of training by manufacturer/ contractor was allowed for as part of the contract as it was recognized that with the introduction of new technology, process and procedures, substantial change of work culture for the butchers would be required.

### **1.3.3 Operational Efficiency**

To maximise operational efficiency, the slaughtering facilities has three automated lines exclusively for Buffalo, Sheep/ Goats (by Halal Method), Sheep/ Goats (by Jhatka Method). The facilities include:

- Automatic pneumatic stunning machine which eliminates the laborious and inefficient manual stunning operation.
- On-line dehiding machines, which allows skin to be loaded, dehided and unloaded automatically.
- Automatic splitting carcass saw for buffalo line, which reduces manpower and improves the quality of the splitting.
- Handling of offal is carried out automatically instead of manually.
- Energy efficient technologies are being adopted in the plant. Modern refrigeration system with a low kW/Ton has been installed. For compressed air, screw compressors are selected in view of low maintenance and high efficiency and for boiler, energy-efficient fire tube packaged boiler is provided. Fuel-efficient DG set is chosen to meet power needs in times of power failure.
- The plant is completely air conditioned to maintain high hygiene standards.

#### **1.3.4 Environmental Features**

- LDO is chosen as the fuel of boiler and DG set in view of its low sulphur content. Option to switch over the fuel from LDO to even cleaner natural gas in future is available for boiler.
- Sufficient stack heights are provided for DG sets and boilers for safe disbursement of pollutants into ambient air.
- DG sets are provided with acoustic insulation to dampen noise and vibration.
- The plant has been provided with separate drains for storm water so that storm water does not enter into wastewater drains.
- State of the art wastewater treatment system comprising of Dissolved Air Floatation (DAF), Up-flow Sludge Anaerobic Blanket Reactor (USABR) and sludge dewatering facility is installed for taking care of wastewater from various processes and operations.
- The plant is equipped with environmental laboratory to monitor the wastewater parameters on daily basis and displaying the same on plant website.
- The plant would comply with latest environmental regulations and standards.

#### **1.4 Locations and Layout**

The plant is located at Ghazipur about 19 km east of Delhi from New Delhi Railway Station near Ghaziabad Border. The plant is accessible from the rear for the movement of livestock from, livestock market to lairage and the front gate for utility and product dispatch.

Four main units in the slaughterhouse are:

- Lairage building block
- Slaughter hall
- Utility
- Rendering plant
- Blood Processing Unit
- Temporary/make shift Skin and hide godown

The size of the site allows for all buildings staff quarters, parking lots, access roads, green belt development and future expansion, Sufficient clearances are provided for staff passageways and products, work areas and process equipment. Separate welfare rooms for staff working in “dirty” and “clean” area are provided to prevent cross-contamination.

**“Dirty” area**

- Livestock entrance.
- Vehicle wash by for trucks that transport animals.
- Offloading platforms and facilities for marking animals.
- Lairage where animals are kept until they are slaughtered (shade for sheep).
- Ante mortem inspection.
- Isolation lairage for animals that are suspected or might be sick.
- Facilities where animals can be restricted and efficiently stunned
- Bleeding area.
- Area for electrical stimulation of carcasses
- Facilities where condemned products are handled.
- Including facilities for sorting grading and weighing
- Room for the cleaning and processing of offals.
- Disposal of solid waste such as paunch and intestinal contents.
- Dispatch area for rough offal
- Facilities for processing of condemned products as by-products such as blood/carcass meal etc.
- Cloakrooms, toilets, showers, washing facilities and dining room where only workers of the dirty area have access.
- Store rooms for dirty area
- Maintenance workshops.

**“Clean “area:**

- Slaughter halls for the dressing of animal under hygienic conditions.
- Area for inspection of the carcass and other edible portions in order to determine its fitness for human consumption.
- Facilities for the retention for secondary inspection of carcasses, which are suspected.
- Grading and weighing of carcasses as part of the marketing function.
- Chilling of carcasses to ensure that quality of the product is maintained and the optimal shelf life ensured.
- Sorting and loading of carcasses in cooled area to ensure that the cold chain is not broken.
- Dispatch facilities.
- Washing bay for meat trucks.
- Laboratories
- Cloakrooms, toilets showers, wash facilities and dining room where only workers in the clean area have access.
- Store rooms.

**1.5 Slaughterhouse Technology**

In the new slaughterhouse, animals will be subjected to both ante-mortem and post-mortem checks by veterinary doctors to ensure that the meat is of the highest quality. Animals failing the test will not be slaughtered.

The equipment for the slaughterhouse has been imported from Germany, France and the Netherlands. While German company BANSS is responsible for setting up the state-of-the-art slaughter house, Haarslev of Denmark has set up one of the rendering plants and MCM of France is also associated in the project.

## 1.6 Technology Description

The new slaughterhouse belongs to fully automatic category. List of major equipment used in the plant are given as follows:

### SELECT LIST OF EQUIPMENT IN BUFFALO SLAUGHTERING LINE

Landing grit	Tilting table
Stainless steel blood collecting channel	Sterilizing cabins/ basins for various applications
Hoist winch for the bleeding	Elevating platform for offal removal
Electric stimulating equipment	Central electric control panel
Horn and feet cutter tong sterilizer	Belt conveyors for various applications
Pneumatic lowering device	Carcass shower
Static working platforms	Loading and unloading elevator
Inspection tables	Bleeding roller shackles
Lifting platform pre-dehiding, removing red organs, carcass inspection etc.	Pneumatic bolt stunning system
Pneumatic dehiding knives	Blood collection tank
Roller dehider	Stunning bold for traditional slaughtering
Pneumatic lifting platform for final dehiding	Horn and feet cutting tongs
Head washing cabinet	Overhead rail systems
Breast bone saw	Electric manual splitting saw
Moving top inspection conveyor	Carcass quartering saw with sterilizer

### SELECT LIST OF EQUIPMENT IN GOAT/ SHEEP SLAUGHTERING LINE

HALAL LINE	JHATKA
Wash cabins for various application	Blood collecting channel
Overhead tubular rails	Lowerator (to lower bleeding carcass on to the conveyor)
Elevator for shackling	Dehiding knives
Conveyors for pre-dehiding, inspection, dressing, bleeding, hide, in storing, out storing	Sterilizing basins
Table elevator	Central electric control panel
Goat dehiding machine	Wash cabins
Sterilizing basins for various applications	Overhead tubular rails
Goat horn cutter	Electric stunning tongs
Central electric control panel	Elevator for shackles
Sterilizing basins	Bleeding shackles
Knives	Ritual killing box
Electric stunning tongs	Rails
	Table elevator
	Conveyors for various applications

Note: the lists are not all inclusive

## 2.0 PROCESS DESCRIPTION

### 2.1 Process overview

The entire process comprises of livestock market, lairage, slaughterhouse, and dry rendering plant. The generic processes that take place at slaughterhouse are shown in Fig.1.

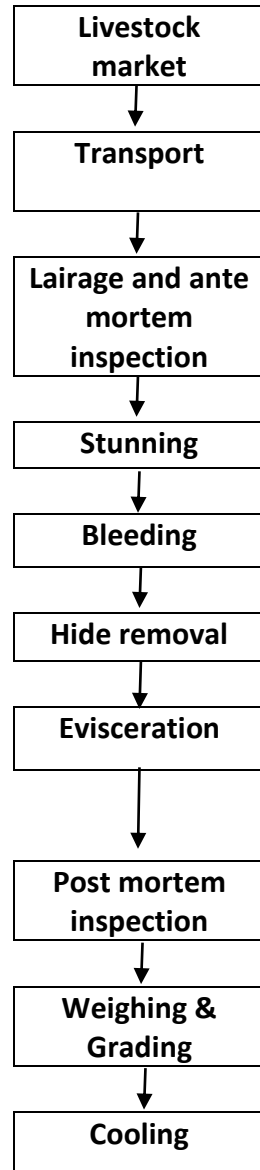


Fig 1 Generic Process in slaughterhouse

## 2.2 Livestock Market

The animals from various places in and around Delhi would be brought for sale in livestock market. The meat bulk purchase agencies/ shop owners would select and purchase the animals for slaughtering. The selected animals would be taken to slaughterhouse by directed drive-up in lorries or driven in on their feet.

## 2.3 Lairage

Lairage is an integral part of the slaughterhouse. Here, animals are rested for some time, Resting period can vary from 4-12 hours. In general, resting period lasts 4 hours in cold season and 6 hours in warm weather. Rest is important as when animals are overworked or fatigued, carcasses of lower quality result from slaughter. Animal are provided with adequate water in lairage.

The capacity of the lairage corresponds to the number of livestock to be slaughtered daily. Space provided in lairage is about 2.8 m<sup>2</sup> per large animal and 1.6m<sup>2</sup> per small animal. Each type of animal species would be separately kept.

During the resting period, veterinary doctor first inspects animals and certifies them for slaughtering. The certified animals are provided with identification number and codes. The operator shall establish an appropriate marking so that meat as well as parts of each animal are identified and traced after processing. Meat merchants receive the meat and parts of only the animals they have selected and purchased.

After the resting period, animals are driven up through a race way to the slaughter lines.

The slaughterhouse comprises of three separate lines according to animal type as well as slaughter method. They are:

- a) Buffalo slaughter line
- b) Goat /Sheep slaughter line (Halal)
- c) Goat /Sheep slaughter line (Jhatka)

### 2.4 Buffalo slaughter line

Buffalo slaughter line consists of lairage, killing box carcass transfer lines, blood collection, front and hind legs removal, dehiding, by-products removal and carcass trimming. The details are given in Fig2 and Fig 2A.

The buffalos are first received in lairage. Buffaloes are driven from lairage to the killing box. In feed gate is opened and buffaloes are driven in to the killing box.

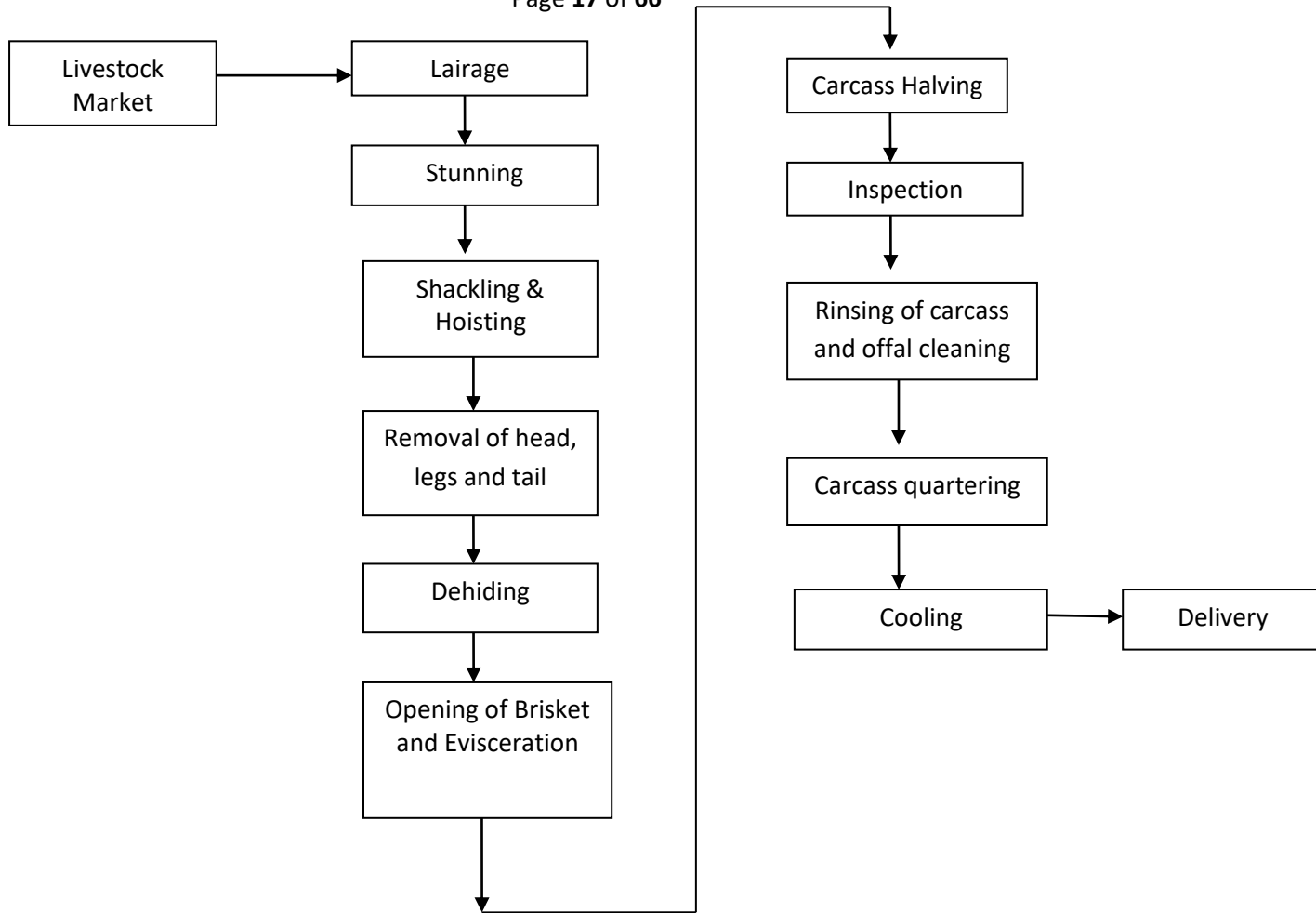
The gate is then closed and pneumatic guide positions the head of buffalo for stunning. Stunning is carried out by pneumatic stunning pistol. After stunning animal is ejected onto receiving gate. The person doing the stunning must stand above and behind the animal. The point of stunning is roughly at the intersection of imaginary lines drawn from the eyes to the horns. If effectively stunned, the animal will collapse onto the bottom of the stunning box. The eye reflex test may be done to ensure effective stunning before the gate is opened. After stunning, animal is ejected onto receiving gate.

Animals sent to slaughter house rest in lairage	Dehiding
Animal sent to waiting lairage before slaughter	Opening of brisket and evisceration
Ante-mortem inspection by veterinary doctor	Splitting
Stunning by captive bolt pistol	Post-mortem inspection
Sticking and bleeding	Cleansing of carcass and offal cleaning
Removal of head, leg and tail	Quartering
Shackling and hoisting	Transport

Fig. 2 Schematic view of Buffalo Slaughterhouse Process

The animal is shackled by wrapping the chain of the shackle around one of the hind legs and hoisted on the bleeding rail. As soon as animal is positioned over the bleeding trough, the bleeding knife is removed from the sterilizer and bleeding or sticking is done.





**Fig. 2A Buffalo Slaughter Process**

Bleeding should take place within 60 Seconds of stunning to facilitate maximum bleeding. The dripping blood is collected in blood trough for further processing in rendering plant. The whole process from stunning to bleeding, including hoisting, should be carried out quickly and without any delay.

After bleeding, animals may also be electrically stimulated to improve the quality of meat. Clamps are attached to ear, cheek or throat of the carcass and an appropriate current passed through for (+ or -) 50 seconds from a stimulation unit. After completion of the cycle, the cables are removed and prepared for the next animal. At the end of bleeding line, a cutting tong removes front leg and horns and carcass identity is marked on them. Legs are taken to leg procession room using a trolley. Free hanging leg is pre-skinned and under feet is removed. Dressing roller hook is inserted and carcass is lifted pneumatically and placed in a dressing conveyor. Bleeding shackle is then released and automatically returned to killing box for reuse.

Second front leg is removed in the same way as the first leg and dressing roller hook is inserted into the carcass. Carcass is lifted pneumatically and taken to the dressing conveyor and both the hind legs are spread. Udders and testicles are removed are

dropped on a workstation of the dressing conveyor. They are taken for inspection or taken for disposal in condemned material truck.

The rectum end is then closed and backside is manually pre dehided on a fixed working platform. Pre dehiding of flanks and belly is carried out manually using pneumatic dehiding knives at workstations with pneumatic lifting platforms. Final dehiding is carried out by a hide puller or roller dehiding machine. Hide is automatically released from the hide chains and transported in a belt conveyor.

After hide removal, breastbone is opened with a special brisket saw. Head and carcass are labelled and head is removed and transferred to head and red organs inspection conveyor after washing.

Evisceration of the white and red offal is then carried out. Punch is removed from carcass and transferred for inspection and cleaning. Red organs are suspended on a hook in inspection conveyor. Punches and red organs are marked after inspection and taken to separate storage room for dispatch.

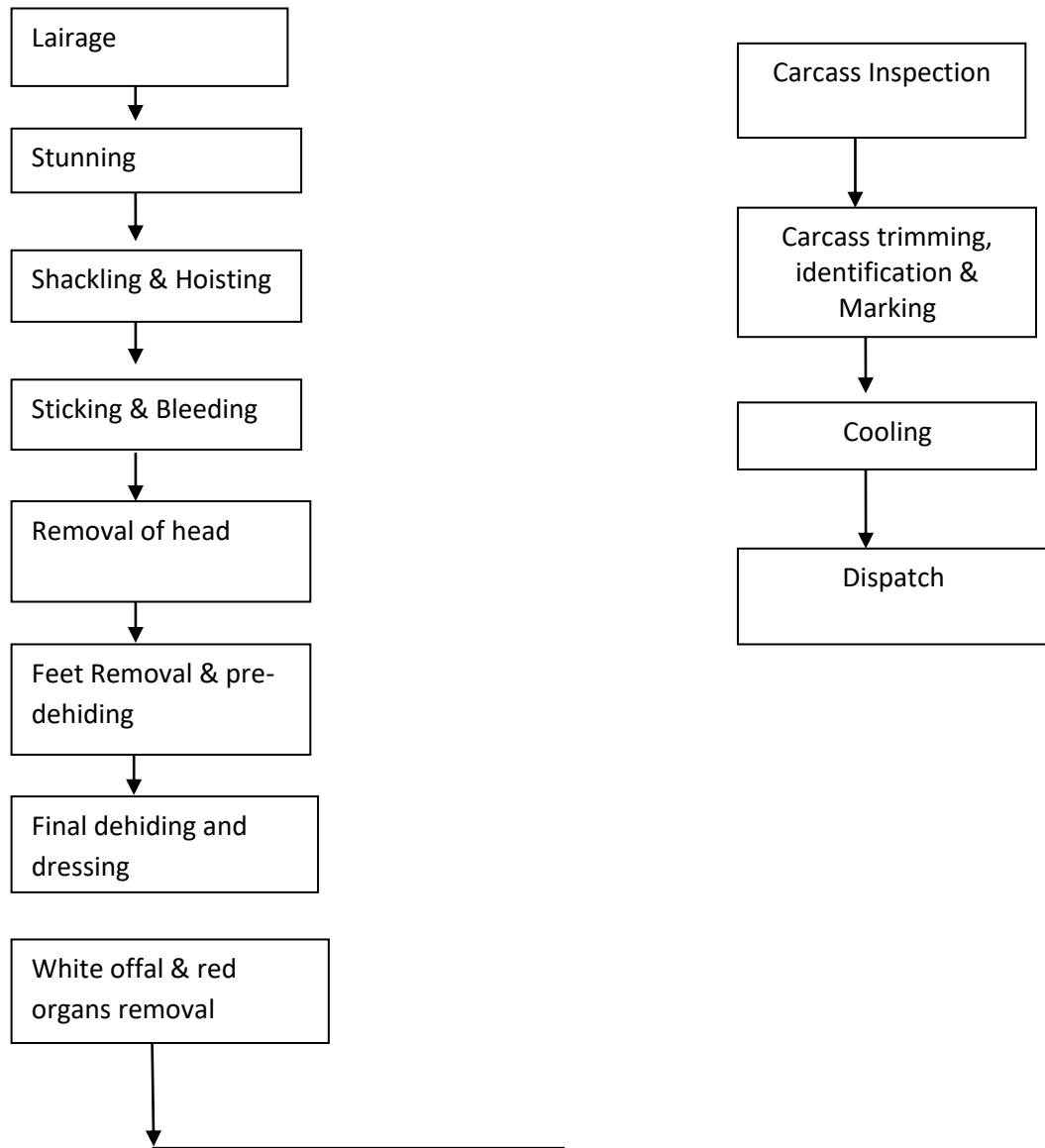
After removal of offal, the carcass is split into two equal halves with an electric bond saw and inspected. Two halves must be of equal size and weight for trading purposes, economical cuts and easy handling of the carcass. Carcass is identified and marked and passes through an automatic washing system.

Hot water at 82°C must be available for sterilising to saw, especially after contamination. Detained or condemned animals will be sorted out for additional inspection and condemned carcass are taken to condemned cooler.

Carcass halves are quartered after washing (Optional ) in automatic washing station. The carcasses are transferred from slaughter hooks to Euro hooks. The slaughter hooks are returned back to the beginning of slaughter line. Carcass is conveyed to cooling area maintained at a temperature of 2° C. the cooling area has capacity for storing 920 buffalo quarters. From the cooling area, carcasses quarters will be loaded in an elevator and taken to trucks for dispatch.

## 2.5 Goats/ Sheep Slaughter line

Goats are slaughtered using Halal method or Jhatka (Sikh) Method.



Sheep/goats are driven from lairage directly to stunning box for stunning. After stunning, and sticking the animals are lifted through elevator onto vertical the bleeding line and transferred to the bleeding conveyor. After sticking and bleeding, blood is collected in the bleeding channel under the bleeding rail.

After completion of bleeding, heads will be removed and carcasses are lowered onto the horizontal pre-dehiding conveyor. The shackle will be removed and returned back by separate conveyor and tubular area to the shackling area.

On the horizontal pre-dehiding conveyor, feet will be removed and skin opened from the back with necessary cuts. Carcass will first be pre-dehided so that subsequent de-hiding can be carried out without any problems. Empty slaughter hooks will be cleaned and returned back to the lifting station after horizontal pre-dehiding. At the end of pre dehiding conveyor, the carcasses are lifted again for final dehiding and dressing.

The final dehiding machine removes the complete hide of the animal. Compressed air is used between the carcass and the hide to help the removal process. The hide is placed into trolley and transported to by-product area.

After hide removal, the carcasses pass through a separation wall, which divides the unclean slaughter area from the clean slaughter area. the white offal is removed and placed into a tray and red offal are suspended on a hook for inspection. After inspection, approved offal and organs will be taken to the by- product area. The offal inspection conveyor and the dressing conveyor run synchronously.

After veterinary inspection, carcasses will be separated for final inspection. Carcasses, which are suspect, are taken to a separate cooler. Carcasses, which have passed the inspection test, are taken for trimming (quartering), identification and marking. Carcasses are then taken to the cooling rooms by automatic conveyors.

Cooling rooms have a capacity to store 880 goats and are maintained at a temperature of about 2° C approximately. Carcass quarters are dispatched by using an elevator into the trucks.

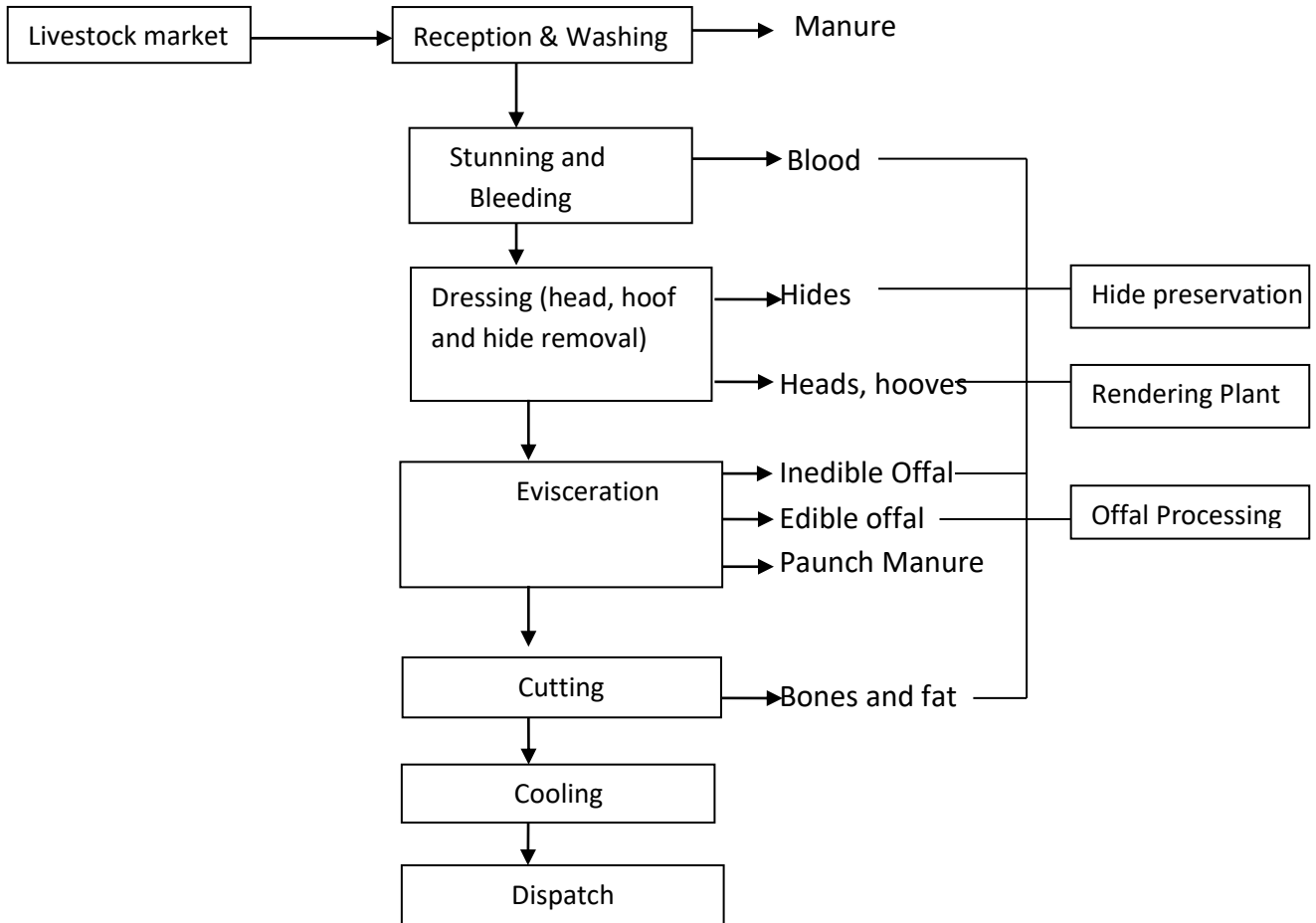
For each operator, hand wash, knife sterilization basins, apron wash cabins and sterilization equipment for all cutting tools are provided.

## **2.6 By-products processing**

Meat is the most significant product from the slaughterhouse, by weight and also by monetary terms. However, by-products can contribute significantly to the profitability of the

slaughterhouse operation since they generally have a commercial value. Various by-products and their use are shown in Fig. 4 and Table 1.

If animal by-products are not used effectively, not only valuable source of revenue is lost, but also the operator incurs additional cost of disposal of these products. From an environmental perspective, utilization of by-products makes sense as it reduces the overall environmental load of the process.



**Fig. 4 By-products from slaughter House**

Table – 1 By-products and uses

Type	Examples	Uses
Soft organs	Stomachs, intestines, lungs, carcass trimmings, reproductive structures etc. (Where not utilized for food); floor sweepings, drainage trappings	Rendered into meat/ bone meal
Hard organs	Horn and hooves	Processed into horn/h hoof meal and used as fertilizer
Blood		Blood is processed in the blood processing unit to make blood meal to be used as animal feed and fertilizer.
Gut contents and manure from lairages		For compost or fertilizer production or biogas production
Bones/ feet/shanks		Bone meal as animal feed or fertilizer For manufacture of combs buttons, cutlery handles, etc; Other uses are glue, gelatine and tallow.
Hooves and horns		As hoof/ horn meal for use as fertilizer, gelation and glue For manufacture of combs, buttons and hairpins Art work (including souvenirs and articles of tourist attraction)
Hides & skins		Cured hides /skins for leather-footwear, gloves, belts, bags, upholstery and saddler
Hair & wool		Brushes, yarn, fabrics and fibres
Glands & Organs	Thymus, thyroid, pituitary, gonads, Pancreas and gall bladder	Pharmaceuticals
Intestine		Sausage casings, musical instruments/ strings and surgical ligatures
Stomachs, other offals		Meat/bone meal for animal feed or fertilizer Tallow for soap and glycerine and for lubricants, grease and waxes
Gut contents manure, solid waste		Compost Biogas – as fuel for heating and lighting

## 2.7 Energy consumption

Overall energy consumption will depend on the types of activities occurring at slaughterhouse. Since rendering is carried out on site, it adds substantially to overall energy consumption.

Approximately 80-85% of slaughterhouse's total energy consumption would be for thermal energy in the form of steam or hot water produced from the combustion of fuels in boiler. Remaining 15-20% of a slaughterhouse's energy consumption would be provided by electricity. Refrigeration would account for a significant proportion of electricity uses. Other electricity uses in order of importance would be boiler room, rendering plant, slaughter area, compressed air, ventilation, lighting etc.

## 2.8 Environmental Management

Necessary provisions are made during design and equipment selection stage to comply with various guidelines and regularities laid by Delhi Pollution Control committee (DPCC) for air quality, noise, water & wastewater and solid wastes.

### 2.8.1 Air Pollution

- Gas emission from chimney provided for emergency DG sets and boiler exhaust is designed to comply with the prevailing air emission standards.

### 2.8.2 Indoor air Quality

The air within the slaughter and meat dispatch facility is controlled to avoid unclean outside air from entering the premises. These include:

- High efficiency particulate filters are provided for the fresh air supply to clean areas of the slaughter hall.
- Ultraviolet (light) air sterilization systems are provided for the clean area of slaughter hall and meat dispatch area.
- Positive pressure is maintained by air-conditioning system in meat dispatch area to avoid ingress of outside air during loading of carcasses to the vehicles.

### 2.8.3 Odour control and Gas Emission

The main sources of odour from slaughterhouse are generated from the animal unloading areas, lairage and effluent treatment plant. To minimise this problem to acceptable levels, the following has been incorporated into the design:

Lorry washing bay is provided for washing the lorries in livestock market before transporting the livestock to slaughterhouse. Water hose points are provided for floor cleansing of the lairages, external unloading and holding areas to reduce odour.

- Collection skips and containers for transporting coagulated blood, condemned carcasses and sludge are of enclosed design to minimize odour emission.
- Chutes are provided for directed dumping of manure into the collection skips to reduce odour.

#### **2.8.4 Noise Emissions**

The operation hours of the slaughter house are mainly from midnight to early morning for public. The main generators of noise are plant noise, unloading area noise, animal squealing, traffic noise, slaughter operation noise and other human activities. To minimize the nuisance factors to the local residents, the following mitigation measures are adopted:

- Acoustic louvers for lairages, acoustic enclosures and silencers for DG sets, acoustic linings for plant rooms, and enclosed building fabric design with double glazed glass panels for slaughter hall.
- Perimeter noise barrier walls of 2 to 4 m high are erected to reduce noise impact due to lorry movement and unloading.
- Emergency DG sets are also provided with acoustic enclosures as per standards.

#### **2.8.5 Water Consumption**

Raw water is drawn from bore wells installed at the site. In slaughterhouse, water is used for the following purposes:

- Livestock watering and washing
- Truck washing
- Washing of casings, offal and carcasses
- Transport of certain by-products and wastes
- Cleaning and sterilizing of knives and equipment
- Cleaning of floors, work surfaces, equipment etc.
- Make-up of water for boilers
- Cooling of machinery (compressors, condensers etc)

Slaughter, evisceration, casings and offal processing account for a large proportion of total water use, where water is used mainly for cleaning. It must be ensured that the water is bacteriologically and chemically safe. Since water is drawn from borewells, water has to be tested in recognized laboratory to prove that prescribed quality standards for portable water are met after treatment.

The operator has to pay water cess (Charges) to DPCC based on water consumption. Hence online meter has to be fitted to monitor water consumption.



### 2.8.6 Effluent Treatment

Out of the total quantity of water used in the slaughterhouse, 80-85% is discharged as wastewater or effluent. The remainder is held up with by-products and wastes or lost through evaporation.

Effluents from slaughterhouse originate from all areas of the plant where water comes into contact with carcasses, manure, offal and blood etc. and exhibit the following properties:

High organic loads due to presence of blood, fat, manure and undigested stomach contents

High levels of fat

Fluctuations in Ph due to the presence of caustic and acid cleaning agents

High levels of nitrogen, phosphorous and salt

High temperature

The concentration of organic matter is a key indicator of effluent quality, and is commonly expressed as chemical oxygen demand (COD) or 3-day biochemical oxygen demand (BOD<sub>3</sub>). Both these indicators are widely used other characteristics in the effluent are nitrogen, phosphorous, salt and fats.

Animal fats contained in slaughterhouse effluent are fatty acids and glycerol, collectively referred as fats, oils and greases or just fats. Fats in the effluent stream originate from trimmings that are allowed to fall to the floor, some of which will find its way into the effluent stream. Fat can also originate from carcass washings.

Blood is a significant source of nitrogen in the slaughterhouse effluent. Main sources of blood are from slaughterhouse and evisceration area as well as rendering plant, where blood processing takes place.

Phosphorous originates from manure and undigested stomach contents. Blood processing with the rendering plant can also be a source of phosphorous.

Salt also originates from manure and undigested stomach contents and also from rendering also the pickling processes. Raw water used in the plant can also contribute to high salt levels in the effluent.

Therefore, effluent quality depends upon on the extent to which blood, fat, manure and undigested stomach contents are present in the effluent stream. If blood and fat are allowed into the effluent stream, it increases the cost of effluent treatment and represents the loss of valuable resources.

Since rendering plant is available in the site, rendering plant is generally the largest single source of effluent quality. Rendering typically contributes to about 60% of plant's total organic load but only 5-10% of total effluent quantity.

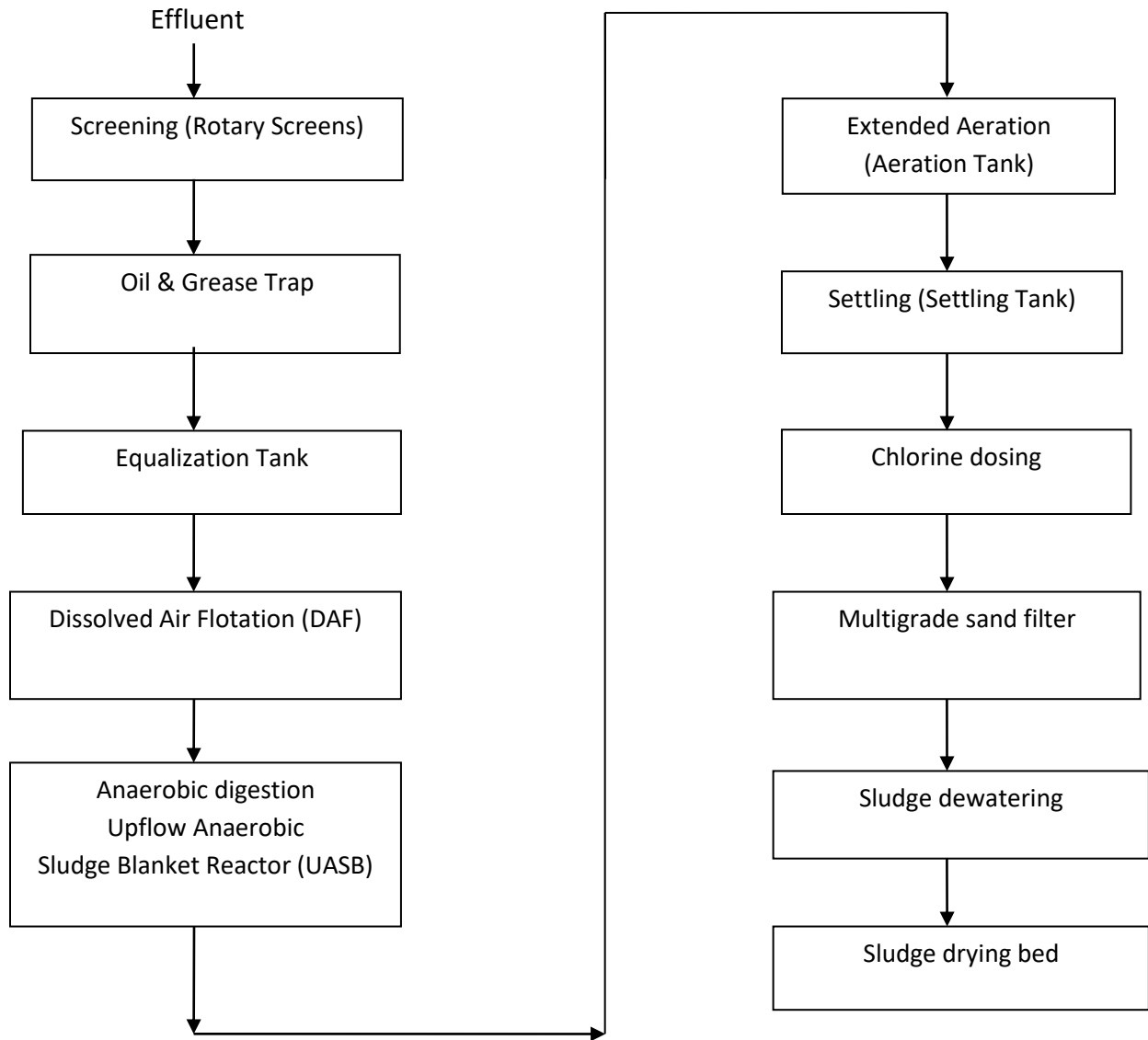
Wastewater of a slaughterhouse should be subjected to appropriate treatment system as given in Schedule-II to meet the prescribed standards before it is discharged. The standards notified under the Environment (Protection) Act, 1986 are presented in Schedule- III.

An effective and extensive waste water collection system is provided with separate drainage for storm water. Only wastewater from the plant would be directed into the wastewater treatment plant while rain water will overflow into the storm water drain to prevent overloading of the waste water treatment plant.

Different alternative treatment processes have been evaluated. Critical factors under consideration included space limitations and the treatment standards to be achieved. The "Up flow Anaerobic Sludge Blanket" reactor, being the most compact and efficient waste water treatment process, has been selected.

Effluent treatment plant is designed to handle 1750 KLD of slaughter house waste water. The ETP process flow is shown in Fig. 5. The ETP comprise of following components:

Screening	Tube settler
Oil and Grease tank	Aeration tank
Equalization tank	Secondary settling tank
Buffer tank	Chlorine contact tank
Anaerobic digester	Sludge drying beds



**Fig. 5 ETP Process Flow**

Characterise of effluent and treated water:

S. No	Parameters	Characteristics of inlet effluent	Characteristics of treated water after Anaerobic digestion	Characteristics of treated water after Aeration
1.	pH	7.1	5.5-9.0	6.5-8.5
2.	BOD	2500	About 50-0	<30
3.	COD	3300	<500	<250
4.	Total suspended solids	Up to 980	<150	<100
5.	Oil and Grease	Up to 50	<10	<5

Effluent treatment plant comprises of following process and equipment:

No	Process	Equipment	Purpose
1.	Screening	Rotary screen in Screening chamber (two nos)	Screening takes place rotary screen in screening chamber constructed of RCC below the ground. Two no of screening chambers are provided. One screen will be in operation and other one will be a standby.
2.	Oil & Grease Removal	Oil & Grease Trap constructed of RCC	Oil and Grease, which are lighter than water floats at the top and removed using a scraper. Water phase material is collected at bottom and removed via submerged pipe immersed in the tank.
3.	Equalization of effluent flow	Equalization tank	Variation of flow and concentration is equalized in equalization tank constructed of RCC below the ground.
4.	Dissolved Air Floatation (DAF) to separate suspended solids, oil and grease and to separate and concentrate sludge	DAF system comprises of air compressor, recirculation pump, mixing vassal and DAF tank.	
5.	Transferring the effluent from buffer tank to Upflow Anaerobic Sludge Blanket Reactor (UASB)	Buffer tank Centrifugal pump (two nos)	From DAF process, effluent will overflow to Buffer tank. From Buffer tank, two nos of horizontal centrifugal pump are used to transfer effluent to USAB. Buffer tank also receives part of sludge from USAB.
6.	Anaerobic digestion	Upflow Anaerobic Sludge Blanket Reactor (USAB)	

7.	Extended aeration (mixing effluent with oxygen)	Aeration tank	
8.	Setting	Secondary setting tank.	
9.	Chlorine dosing	Chlorine dosing tank with 2 nos of metering type diaphragm pumps	Chlorine dosing is controlled using metering type diaphragm pump
10.	Removal of suspended solids	Multigrade sand filter	
11.	Sludge dewatering and sludge drying	Sludge drying bed	Sludge drying bed is constructed of brickwork.

An on line monitoring and logging system will be provided to monitor the discharge continuously to ensure its compliance with the standards.

The unit will monitor the effluent parameters for conformance with the standards on a daily basis. Laboratory facilities for offline monitoring for required parameters will be setup to be manned by an environmental chemist and an assistant. The monitoring results will be updated on the plant website.

### 2.8.7: Solid waste Management

Solid wastes generated during process would be disposed to in-house rendering plant. Other sources of solid wastes are ETP sludge from desludging operations from final effluent and domestic sold wastes.

Animal manure and urine from lairages have high nutrient contents. To the extent practical, lairages has to dry cleaned before hosing with water for wet cleaning. Vacuum may be used to assist in this effort. This recovered material should then be land applied as manure or land filled as appropriate.

Common environmental issued in slaughterhouse is summarized in the following table:

**Table 2 Environmental Issues**

Process	Environmental Issue
Reception of livestock Truck washing Animal washing	Effluent containing manure wastes High Water consumption Noise
Stunning and bleeding	Effluent with high organic load if blood is discharged
Splitting and Evisceration	Energy consumption for equipment sterilization Generation of putrescible by products Effluent with high organic load Fugitive emissions (CFCs)

Cutting and boning	Electricity consumption Generation of putrescible byproducts Energy consumption For equipment sterilization
Offal processing	Effluent with high organic load High water consumption
Cleaning	High water consumption Consumption of chemicals Large volume of effluent with high organic load.
Rendering plant	Effluent with high organic load Potential for odour generation High energy consumption

## 2.9 Benchmarks

A benchmark is a number that acts as a guide to the level of best practice that is achievable in a specific area, for example environmental performance. Environmental indicators recommended for slaughterhouse to benchmark performance are water consumption, energy consumption and the organic load to effluent (COD or BOD5) expressed in figures per unit of production. It is recommended that slaughterhouse should first establish benchmark internally so that it may be possible to compare performance with other similar slaughterhouse in the country or abroad. An example of benchmark is given below:

**Table 3 Benchmark for buffalo abattoir (250 Kg)**

	Unit	Traditional technology	Average technology	Best available technology
Water	L/animal	5000	2500	1000
Heat and electricity	KWh/animal	300	125	70
BOD5	G/animal	5500	2500	1200

1above unit= 3 sheet/goat

A slaughterhouse is considered to avail Best Available Technology (BAT) if it has a good capacity utilization, and good housekeeping.

### 3. UTILITIES

#### 3.1 Boiler

To meet the hot water requirement of the slaughterhouse a 12 tonne per hour HSD/Natural gas IBR boiler has been installed. Steam will be used for making hot water at three temperature levels 90°C, 65°C and 45°C in different hotwell tanks. The heat will be delivered through plate heat exchangers. A 25 KLD tank is provided for storage of HSD. The specification of boiler is given in the table below:

Boiler Make	IBL
Model	Petropak 120
Maximum continuous rating	12000 KG/hr (F&A 100°C)
Safety valve set pressure	10.54 Kg/cm <sup>2</sup>
Thermal efficiency (NCV)	92%±2% (with HRU)
Fuel Consumption	
HSD@10200 Kcal/Kg	690 Kg/hr
Natural gas @ 8200 Kcal/Nm <sup>3</sup>	860 Nm <sup>3</sup> /hr
Chimney height	30 m

#### 3.2 Water Supply

Three piston type hydropneumatic pumps have been installed with interconnected piping for supply of cold water to all parts of slaughterhouse. The first pump delivers the output for goat, sheep (halal) and goat, Sheep (Jhatka). The second pump delivers output to Buffalo slaughter hall. The third pump is connected to 1<sup>st</sup> and 2<sup>nd</sup> pumps and functions as standby. The specifications of hydropneumatic pumps is given in the table below:

Hydropneumatic pump type	Piston
Capacity	5000l/hr to 50 bar
Pulsation damper	Provided
Pressure regulator	Provided
Auto cut off	At set pressure
Maintained pressure	4 bar

#### 3.3 Compressed Air System

Compressed air is distributed to all parts of the plant for activating pneumatic devices, valve etc. The specification of Air compressors are given in the table below:

Compressor Make	ELG1
Model	EH 54 120 two stage EH 06 150 one stage
Capacity	999 CFM
Rated Pressure	10 bar
Air dryer type	Refrigerated type
Receiver capacity	3 m3
Receiver pressure	10-12 Kg/cm2

### **3.4 Diesel Generator System**

To meet the emergency needs of electric power, the plant has installed 3 nos x 500 kVA DG sets with synchronization panel.

### **3.5 Refrigeration System**

### **3.6 H.V.A.C Air Conditioning System**

### **3.7 Lighting System**

### **3.8 Electrical Distribution System**

### **3.9 Water Supply System**

### **3.10 Water Treatment System**

### **3.11 Effluent Treatment Plant**

### **3.12 Electricity tariffs**



## **4.0 BEST OPERATIONAL AND MAINTENANCE PRACTICES**

**4.1** The operator has to employ best practices during operation and maintenance of slaughterhouse and rendering plant. It is the operator responsibility to handover the plant after expiry of the contract period in a good condition. Some guidelines for O & M practices are given as follows:

- Process related best practices
- Cleaning the plant and Equipments
- Water Management
- Cleaning Chemical Management
- Sanitation and hygiene
- Lighting
- Preventive maintenance

### **4.2 Process Related Best Practices**

#### **4.2.1 Livestock Market**

On arrival at livestock market, all animals would be provided with identification tags. Faecal contamination may be spread through successive batches by contact with soiled environmental surfaces of the common pathways. Defecations may occur which can be spread to incoming animals.

Livestock market should be equipped as follows:

- Good sanitary arrangement including sweeping, removal of manure and garbage and its proper disposal.
- Shelter for all animals without congestion and intermixing of different animals types.
- Arrangements for drinking water facilities.
- Veterinary health facilities for livestock care.

#### **4.2.2 Lairage**

After sale, animals bought by a particular buyer are moved to lairage where they may be mixed with animals from many different sources prior to transport. This may lead to agitated or aggressive behaviours patterns which results in spread of contamination through increased contact between animals. Bulls are normally penned individually before and after sale to avoid such physical contacts.

The livestock shall be washed if their bodies adhere with filth or excretion. The space of the lairage shall have a capacity to accommodate all livestock to be slaughtered per day is calculated on the basis of 1.00 square meters per sheep and 2.8 square meter per. Water spray and drinking water equipment for

livestock must be installed. Adequate water supply and faucets for washing shall be provided. Adequate space and facilities shall be made available for ante mortem inspection.

Lairage is provided with adequate lighting, taking care those bright lights and shadows, which frighten the animals or affect their movement, are avoided. Animals move more readily from darker area into a well lit area and accordingly lighting is regulated.

The following points need to be ensured:

- Animals move more readily from dark area to well-lighted areas and accordingly lighting should be regulated to help movement.
- Animals exit lorry and enter the lairage freely, without any encouragement.
- No fugitive dust emissions are visible.
- No unpleasant odour detectable by humans.
- Animals moved easily- none or minimal levels of vocal and physical guidance.
- Avoiding noisy hydraulic or pneumatic equipment, and muffling noisy metal equipment by the use of the suitable padding, or by minimizing the transmission of such noise.
- Handling and design facilities quiet and free movement of animals throughout the lairages. Generous space allowance.
- Plenty of room for all animals to rest.
- Clean floor or plenty of clean dry bedding.
- Easy access to water for drinking and washing.

#### **4.2.3 Stunning**

The area in which stunning takes place has been designed in such a way as to completely restrict the animal's freedom of movement so that stunning is done with a great deal of accuracy. The main stunning method used is bolt type, which penetrates the skull.

For, the correct stunning point is to aim at the point of intersection of two imaginary lines running from the highest point of each eye to the lowest point at the base of opposite horn. For hornless sheep, stunning point is the highest point of the head above the base of the ears and aim towards the throat. For horned sheep and goats, stunning point is the centre of the ridge between the horns with the barrel pointing towards the mouth.

#### **4.2.4 Hoisting**

All animals must be bled in a hanging position away from the floor. Hence, the bleeding area must be high enough and hoist is being used. A Bleeding chain is attached just above the hoof of one hind leg and the animal is hoisted by means of an electric hoist. As soon as the animal is over the adjacent bleeding trough, its neck arteries are severed.

These processes must be carried out rapidly, as the arteries must be severed within one minute of stunning. The bleeding rails is designed high enough for the animals to hand above floor level.

#### **Buffalo**

- On a crawl beam- 4.88 to 5 m
- On a bleeding rail- 4.5 to 4.8 m
- Bleeding hook or pulley- The lowest point of the hook at 4.2 metres.

#### **Sheep/Goat**

- 2.4 m

#### **4.2.5 Cutting the Throat**

The animal neck arteries and veins are to be cut immediately within one minute after stunning. In this period the blood pressure rises greatly. If the blood vessels are not severed immediately, blood splash will be caused by tiny hemorrhages in the muscles and organs. The incision is made after the animal has been hoisted up and is handing over the bleeding trough. Care must be taken that all the blood vessels in the neck are severed but the spinal cord remain intact.

The bleeding knife must be sterilized before each new animal is cut. Where large numbers of animals are slaughtered, several knives should be in use. Any animal with a dirty skin contains large number of bacteria. The knife becomes contaminated when it cuts through the skin. This could cause bacteria to enter the blood stream and spread through the body. The knife must therefore be sterilized regularly in order to prevent a build-up of bacteria and the transfer of these to other carcasses.

A hand basin/sterilizer has being provided within the convenient distance from the bleeding point. Heat causes blood to coagulate, so the knife should be rinsed with cold water before it is placed in the sterilizer.

#### **4.2.6 Bleeding**

At least 6-8 minutes must be allowed for bleeding and 3-4 minutes for sheep. If shorter period are allowed, blood will drip on the dressing floor,

Causing contamination in the work area or a loss of blood meal if by –products are to be manufactured .

The bleedings trough slopes steeply in the direction of a floor drainage opening situated directly below the bleeding point. It is advisable to drain the blood separately , so there should be a second opening for washing water . The opening, which is not in use , must be closed with a plug .

are still problems attached to the disposal of blood other than by processing in rendering plant. If blood is disposed off in the drainage system, it overloads the purification works as well as cause unpleasant odours .

The minimum time allowed for bleeding and the amount of blood per species are:

**Buffalo** : 6 minutes, 13-15 litres blood

**Sheep** : 5 minutes ,1,3-2 litres blood

The provision of a boot – washing trough at the exit prevents bloody boots from contaminating the passageways outside the bleeding area .

#### 4.2.7 **Blood collection / Blood Handling**

The aim is to maximize the capture of valuable blood and minimize the loss of blood to the wastewater. thereby reducing nitrogen , phosphorus and BOD in the wastewater . This is particularly important since blood is not removed in physical pre-treatment equipment like screens, clarifiers and floatation systems .

- Ensure stunning devices are properly functioning to maximize rapid bleed – out of the animal.
- Ensure the animals are properly stuck so they are thoroughly bled out before leaving the blood collection area .
- Check that adequate hang time is available so that the carcass is only dripping an occasional drop of blood when it leaves the blood collection area . if necessary , provide drip pans past the blood trough to prevent blood accumulation on kill room floor .
- Dry clean blood troughs and drip pans with a squeezer, or other appropriate tool , during sanitation and , if necessary , between shifts .
- Collect and transfer to rendering plant, the “ first rinse” water from blood trough sanitation, if possible .
- Electrical stimulation of carcasses maximizes blood recovery from the carcasses where it can be collected.

## **Routine Maintenance**

- Where possible, dry clean up blood spills.
- Repair or replace pump and valve seals as required to minimize or eliminate leaks of blood.
- strive to continuously eliminate pipe and equipment blood leaks and spills.

### **4.2.8 Beheading**

The head is removed after the bleeding process. The cut must be made in line with the animal's ears to ensure that the hide or skin will keep the right shape. The head must not be removed from the carcass until bleeding is over. Once the head has been removed, it is demasked based on market requirements. At the same time the tongue is removed, the nasal cavities are rinsed and the head dehorned where applicable. An important requirement is that the head, which has been removed, must be identifiable as part of the relevant carcass for inspection and grading purposes.

### **4.2.9 Dressing Process including Removal of the Hide / Skin**

The factors, which determine the suitability of a tanned hide or skin , do not start with the Curing process , but with the removal of the hide or skin from the carcass . When once it has been removed from the carcass, the handling it receives immediately determines the quality level.

The final shape of the hide or skin is more important. The value of the processed hide or skin depends on the way in which the cutting lines are made on the carcass.

Factors to be kept in mind during the removal of hides or skins are:

1. Hygienic and clean conditions will help to maintain the quality of the hides and skins.
2. Contact between the meat and the hide or skin must be prevented at all costs.
3. Use a flaying knife, and handle it with care because hides and skin can be badly damaged by cuts and flaying marks and this lowers their value.
4. The hide or skin must be removed from the carcass immediately after slaughter while it is still warm, as this makes its removal easier.
5. As little blood as possible should come into contact with the hide or skin.
6. Do not sacrifice the value of the hide or skin for the sake of the carcass. If correct flaying methods are used, neither needs to be damaged.
7. Do not use a flaying knife if it is possible to pull the hide or skin off the carcass, especially in the carcass of sheep where the skin can be eased off by hand.

8. All cuts to the hide or skin must be made from the inside to the outside to prevent contamination.
9. Contamination of the carcass because of dirty hands, hooks rollers and protective clothing must be prevented.
10. To prevent contamination, lactating udders must be cut off as soon as possible and placed in a container.

#### **Factors to be remembered during the Dressing process**

Dressing must be done in such a way that:

1. Hide/ skin damage is kept to the minimum and where possible eliminated completely.
2. No excess blood appears on the hide/skin
3. No damage is done to fat or meat on the carcass
4. Contamination is not transmitted to the carcass from the hide/skin on hands, instruments or equipment
5. No hairs or pieces of skin are left on the dressed carcass
6. All sexual organs or parts of them are completely removed
7. Cow udders are removed on the slaughter line and placed in containers
8. No unnecessary and injudicious cuts, excisions and marks are made on carcasses during the meat inspection
9. The forequarter is sawn or cut through in such a way that no damage occurs to the carcass or the offal
10. During evisceration contamination by stomach or intestine contents, uterus contents, urine or gall is prevented
11. No part or parts of the offal are left in the carcass
12. Damage to any offal is prevented during dressing or evisceration
13. Carcasses are halved without deviating from the centre line of the spinal column to prevent damage to any meat cuts.
14. All spinal marrow is removed from halved carcass
15. All loose blood vessels, fat, bone, glands, membranes and removable blood from the neck and carcass are removed during the final dressing process.
16. All remaining blood is removed from the neck and shoulder sections by pumping the front leg.

#### **4.2.10 Evisceration**

Evisceration means the removal of the viscera or gut from the carcass. It follows immediately after the removal of the hide/ skin in the case of sheep, etc.

For either a mechanical evisceration table or individual paunch/ gut holders can be used for the reception and inspection of these products. Facilities must be provided for the eviscerator to do his job hygienically. In the case of a mechanical conveyor belt, boot washing, apron washing and

other washing/ sterilising facilities must be made available. There must be facilities for the sterilisation of the evisceration plant form or offal containers.

#### **Important points during evisceration**

- Evisceration must take place as soon as possible after slaughter.
- Before evisceration the anus must be dressed and removed
- Damage to any organs such as the bladder, uterus, gall bladder, paunch or gut must be avoided at all costs. These organs contain bacteria which can contaminate both the inside and the outside of the carcass.
- It is not possible to clean the contaminated surfaces by washing. These surfaces will have to be cut away in order to get rid of all visible contamination.
- The eviscerator must not cut into any organ, nor may he remove the gall bladder from the liver.
- The gall bladder must also not be emptied on to the floor, but must be placed in a suitable container and taken to the retention/ condemnation room where it will be emptied and gallstones recovered.
- It is of the utmost importance the **hands should be washed regularly** during this process. All knives/ saws used for dressing must also be sterilised regularly and must never be put down on the floor.
- Organs in the carcass must not be separated during evisceration. Only the spleen may be removed.
- All staff involved in the flaying, evisceration and inspection of such carcasses must wear protective goggles, gloves and masks as well as their normal protective clothing.

#### **4.2.11 Marking Carcass**

The application of identification, classification and approval marks must be done in such a way as to do no harm to the appearance of the carcass. These marks must never be placed on the part of the carcass where the cuts are expensive, but preferably on the cheaper parts. Only edible oil should be used for marking purposes.

#### **4.2.12 Halving the carcasses**

Carcasses must be sawn through to simplify handling during loading and to make possible an effective carcass inspection.

While using electric carcass saws, special attention must be given to the following while carcasses are being sawn:

- Carcass must be sawn straight down the middle so as not to damage expensive cuts.
- If the carcass is cut off in the centre, this may affect its classification.

#### **4.2.13 Final Trimming of Carcasses**

After inspection and before the final washing, all approved carcasses can be finally trimmed and the following removed or cut off:

- Spinal cord
- left-over bits of skin and intestines
- portions of male and female genitals
- bloody membranes on the inside of the neck, and aorta

#### **4.2.14 Washing the Carcass**

After a carcass has left the final inspection point, it is sprayed with water to remove all blood, slight blood marks, bone dust and marrow before going to the cold room for cooling.

Carcass must not be washed until all contaminated portions have been cut away to prevent contamination. Further contaminated meat or fat surfaces cannot possibly be rendered microbe-free by spraying them with water. On the contrary, when surfaces that are already contaminated get washed this can actually spread the bacteria if water droplets splash on to adjacent areas and other carcasses. Contaminated surfaces must of necessity be cut away and the intestinal membranes removed in order to get rid of visible contamination. Chlorinated water can also be successfully applied after the visible contamination has been cut off.

It is not advisable to wash carcasses before evisceration, as this encourages slaughter hands to wash their mistakes away.

It is generally recommended therefore that only approved, uncontaminated carcasses should be washed with running water in order to remove from the carcasses any bone splinters and blood which might be present. Adequate time and rail length should be available so that the carcasses can drip dry, eliminating excess moisture in the cold room.

#### **4.2.15 Cooling**

##### **Temperature Control and Storage of Meat**

The main reason for chilling meat is to control the spread of bacteria and certain other microbes such as yeast and moulds. In this way, meat shelf life is lengthened by slowing down the multiplication of organisms, which cause meat to spoil, and of microbes, which causes food poisoning.

Other reasons for chilling meat are to reduce the rate of harmful chemical changes such as rancidity of fats, and to improve handling qualities. The number of microbes found on the surface of the meat immediately following slaughter will depend on how hygienically the work in the slaughterhouse has been done. Unpleasant odours and sliminess, indicating that the meat is going bad, are present when bacteria have increased to  $10^7$  bacteria/cm<sup>2</sup>.



## **Chilling**

Chilling is used for short-term storage. During chilling meat must be kept as close to 2° C as possible without actually freezing it. Low air temperatures together with high air speed result in a lower net weight loss.

The ideal chilling room will:

- (a) Inhibit the growth of surface bacteria;
- (b) Prepare a firm, dry carcass surface, where the risk of contamination during handling and transport will be much less; and
- (c) With a minimum mass loss of carcasses.

Both air temperature and humidity must be carefully controlled. Humidity must be maintained at about 90%-95%. If the humidity is too high, the carcasses will not dry, and if it is too low, excessive dehydration and darkening of the meat will take place.

## **Chilling speed**

The speed at which a carcass is chilled depends on:

- (a) certain properties of the carcass such as species, size and fat coverage; and
- (b) chilling conditions such as the difference in temperature between the product and the air and the rate of movement of the surrounding air.

In order to increase the speed of chilling, the following steps can be taken:

- (a) Increase the difference in temperature.
- (b) Increase the air speed.
- (c) Reduce the thickness of the meat.

## **Important Factors to be considered in connection with the chilling facilities.**

A refrigeration unit, which has been well designed and well maintained, may still not function effectively because air does not circulate efficiently around the heat source.

Cold air must be distributed evenly through the room following a circular flow pattern. The fan of the denser must not direct the cold air directly on to the carcasses, as a deflection of the air movement will affect the effective cooling of other parts of the room. The more the air is forced to move around the product, instead of through open spaces, the better is the cooling. It is preferable to have the air blown at right angles to the rails instead of along their lengths.

Carcasses must be spaced evenly in the chiller. The capacity of the chiller, which is determined by the rail lengths, must not be exceeded. This will overload the refrigeration unit and lead to inefficient cooling, with the possibility of faster spoilage.

The recommended rail spaces for the different species are:

660-750 cm per beef carcass, or 6 sheep carcasses with a minimum spacing of 5 cm between carcasses. As a result of the risk of condensation, warm carcasses must not be put into a cold room with chilled meat. It is not advisable to hang different kinds of carcasses or carcasses which differ considerably in size in the same room because the rate at which they cool down will differ.

Ice on the evaporation unit insulates the refrigeration mechanism. It is normal for ice to form on the evaporation coil. The ice must therefore be thawed and removed from the spiral at regular intervals. Water which freezes on the spiral comes from:

- losses from the carcasses by evaporation;
- warm, moist air coming in through open doors;
- the insulation, especially if this is damaged; and
- cleaning activities which leave water behind in the room.

Excessive ice formation causes more frequent defrosting. It can be avoided by:

- not overloading the chiller;
- closing the door;
- repairing damaged insulation; and
- mopping up all water during the cleaning process.

### **Heat loss exceeds the chilling capacity**

When the refrigeration unit is overloaded, the temperature rises and remains higher than it should be until the unwanted cause is removed.

In cold storage rooms the heat load includes:

- Motors of fans
- Lights
- Machinery/equipment
- Poor insulation of walls/floors
- Staff
- The product load being greater than was provided for in the design
- Warm air coming in through the doors.

In the last case, air curtains can be useful to prevent warm air from entering the chiller. If this is not possible, the fans must be switched off whenever the doors are open. Another possibility is to use plastic curtains to reduce the loss of cold air while the doors of the cold storage room or freezer are open.

Loading periods must be as brief as possible. The doors of the cold-storage room must be closed as soon as the loading is completed. Condensation of partly chilled carcasses must be avoided.

#### 4.2.16 Transport

Vehicles used to transport meat must be designed and constructed

- To protect food from contamination during transport; and
- Be able to be effectively cleaned and if needed, sanitized.
- Area used to transport food should be preferably separated from the driver's compartment and any passenger areas.

#### Material of construction

- The food transport area of the vehicle shall be constructed of material which is impervious, non-toxic, easily cleaned and resistant to corrosion, chipping or flaking.
- When considering the type of material used, durability and resistance to impact should also be considered.
- All joints in the food area shall be sealed and the sealing material shall be impervious to moisture.
- Doors may be hinged or sliding and fitted with flexible seals and closure mechanisms capable of exerting pressure on the seals. When doors are closed the meat storage compartment shall be impervious to moisture and dust.
- Floors shall be insulated, smooth and impervious and may be lined with suitable materials to protect from damage.

Examples of suitable materials are polystyrene cool room panels or insulated fiber glass preferable not less than 35mm thickness. Examples of floors linings include aluminum checker plate sheet or fiberglass.

#### Maintenance of the food transport vehicle

The food transport compartment is to be maintained in good repair. For example:

- Flaking paint, rust or damage to the surface of the area shall be repaired
- If the damage will increase the risk of contamination or affect the ability to
- Maintain the correct temperature (e.g. hole in paneling), repairs should occur immediately.
- The area used to transport food shall be cleaned after each use (e.g. daily).
- Any spills should be cleaned as soon as possible.

#### Temperature control during transportation and delivery

During the transport and deliver, all perishable food must be kept at less than 5° C.

To assist in controlling the temperature during transport, the area of the vehicle used to transport food shall be insulated; and to keep the food at less than 5° C, either:

- Ice shall be used; or
- A vehicle supplied with a refrigeration unit.

As a general rule refrigeration units will be required when the transport times are greater than 2 hours.

Irrespective of transport times, if perishable food is being transported and delivered at temperatures greater than 5° C.

Use of ice during transportation

- Ice shall be made from a potable water source and be free from any visible contamination.
- An adequate quantity of ice shall be supplied with the product to keep the product at less than 5 degree C.
- Ice shall be present at all times during the transport period and at delivery to the customer

#### **Vehicles with refrigeration units**

- It is recommended that all refrigeration units be serviced at least annually.
- This service would include a calibration of any temperature gauges.
- To assist in keeping the food at less than 5° C it is recommended that the
- Refrigeration unit be running prior to loading any food.

#### **Food handling and storage practices**

Food should be protected from contamination before and after transport

During transport:

- Chemicals must not be placed in the area used to transport food;
- Food transport vehicles must not be used to transport food unless the food carrying compartment is in a hygienic condition.
- All persons involved in handling food during transportation (including pick-up and delivery) must follow good personal hygiene practices.

#### **4.3 Cleaning the Plant and Equipment**

No refuse or waste materials, whether solid or liquid, must be allowed to accumulate except so far as may be unavoidable for the proper operation of the process. Waste materials should be removed from working area at frequent intervals throughout the working day.

Dry cleaning before wet cleaning has potential to bring down the effluent load as well as improve recovery of inedible for rendering.

Provide appropriate tools for dry cleanup, such as squeegees, shovels, dump carts, vacuums, etc. Adapt squeegees to fit within blood troughs.

Assign workers during the production shift(s), at breaks and lunch to dry cleanup materials from the floors for rendering plant.

Clean-up routines at the end of work-periods must be carried out promptly to prevent the drying out of product debris that may be difficult to remove later as well as result in microbial build up.

Consider establishing and enforcing written standard operating procedures for dry cleanup, either at the end of the production shift or at the start of the sanitation shift.

Dry cleaning is followed by wet cleaning using pressure cleaning using hoses fitted with hand-operated triggers and where the use of hot water is necessary, thermostatically controlled steam and water valves should be used. Knife sterilizers should be insulated and covered.

Potable water must be used for all wet cleaning routines.

Detergents must be properly used to ensure physically clean equipment clean equipment must be protected from possible recontamination.

Before beginning each work period, a documented pre-production check must be carried out of all work areas, equipment, tools and utensils, etc. to ensure they are hygienically acceptable and suitable for production. These checks must be carried out and signed off by a nominated individual.

All product contact surfaces of equipments, tools and utensils, must be cleaned as frequently as necessary throughout work period to prevent build up of micro-organisms and contamination of the products.

Non-product contact surfaces must be cleaned as frequently as necessary to prevent accumulation of product debris, dirt, refuse and other extraneous matter.

Critical areas must be designated for specific attention as a part of a permanent sanitation schedule. The frequency of the cleaning required for each area including floors, equipment, utensils, walls and vehicles and the requirements for adequate cleaning must be clearly defined. Detergents, disinfectants, the means of application and the strength of the sanitizer must be specified.

Product trays must not come into contact with the floor or walls and must not be subject to splash or spray from cleaning operations.

Each plan must designate a single individual who is held responsible for the cleanliness of the plant.

#### **4.4 Water Management**

Lower water use per animal will lead to lower waste loads on a total mass basis. Less water would be used if a scrap of meat is picked up during dry cleaning than if it is hosed to a floor drain during wet cleaning.

If water is sourced from private supplies, microbiological tests is recommended o test the quality of water. Since quality of water may change at different times, testing water samples at least once a month will indicate whether microbiological contamination is occurring ion site or whether he water is potable.

##### **Water distribution systems**

Water distribution system should be kept in good condition so that water does not become contaminated. Water tank should be cleaned regularly to prevent any build up of organic or mineral material that could act as a source of microbial growth and contamination. Even well maintained water distribution systems suffer from a buildup of organic matter over time. To prevent this from affecting water quality, it is good practice to drain and clean the entire system at least annually as well as when any contamination incident occurs.

Consider establishing a maintenance inspection program to inspect all hose nozzles and equipment spray nozzles and measure flow rates, where possible, at lease annually. Replace nozzles discharging excessive flow.

Carry out regular inspections of the water distribution systems for signs of damage, corrosion, leaks etc. The frequency of inspection will depend on the likelihood of a problem being found (once a month may be sufficient for well designed premises that are kept in good order). Keep an accurate, dated account (e.g. in a maintenance notebook) of the date and result of each inspection and of any corrective action taken.

Use the appropriate pressure and volume of water for sanitation according to each application. This will reduce water consumption.

Consider installation of “electronic eyes”, foot valves or other devices on spray cabinets, carcass washers, eviscerating machines, chill tanks and other large water users to shut off the water when no animals are present.

Evaluate installing water meters and monitoring potable water usage for: 1) each department within the plant, 2) each shift, and 3) individual machine that use large quantities of water, such as carcass washers.

Monitoring water use on a daily, monthly, and yearly basis can detect daily variations, as well as long-term trends. Gradually increasing water use for an individual piece of equipment may indicate whether spray nozzle openings are slowly wearing out. Significant water flow during idle shifts and weekends may indicate water leaks.

Consider establishing baseline quantities and holding each departmental in-charge manager responsible for water usage for his department.

Use push-to-open nozzles on hoses. This will reduce water consumption for sanitation significantly.

Clearly identify potable and non-potable water systems and particularly water outlets to avoid misuse of non-potable water. Make sure there are no opportunities for non-potable water to enter the potable distribution system, for example, through siphoning back from a drain.

#### **4.5 Cleaning Chemical Management**

Detergents, disinfectants, sanitizers and other chemicals employed in the cleaning and sanitizing routines must be approved for use in food processing establishments, safe to use and effective for their intended purpose. They must be used in such a way that the products are not adversely affected. Strong smelling substances, which may contaminate or taint the products must not be used.

All detergents, disinfectants, sanitizers and other chemicals used for cleaning must be properly labeled and stored safely to avoid the risk of product contamination.

Cleaning agents and disinfectants are stored away from food handling areas so that chemicals do not contaminate food.

Low phosphorus or non-phosphorus cleaning compounds should be preferred as cleaning agents. Chemicals such as organic surfactants (butyl oxy ethanol) and caustic cleaners (NaOH or KOH) are such examples. Overall benefit is reduced phosphorous in the effluent. However, this may entail higher costs, food safety concerns, lower effectiveness and potential harm to aluminum and copper equipment.

## 4.6 Sanitation and Hygiene

### Hot water for disinfections

Where hot water is used for disinfecting tools, minimum temperature of 82°C is recommended. To maintain the effectiveness of sterilizers a continuous flow of water with overflow ducted to a drain is required.

Knife blades/junctions and other tools should be fully immersed. Ideally, fit temperature indicators. Avoid temperatures above 90° C.

### Hygiene Practices

Hand washing facilities for staff handling exposed meat are fitted with taps designed to prevent cross contamination. Staff handling exposed meat should not use taps controlled by conventional hand operated taps as this may lead to re-contamination. Elbow operated taps should not be used as staff may use hands to operate them. Install taps that can be activated using knees or feet or automatically be sensors.

Careful and frequent hand washing will do much to reduce contamination. Therefore hand-washing facilities must be sufficient and the water supply is adequate.

Basically there should be two sites where the staff can wash their hands – the rest room and the working area where sufficient hand washing facilities must be placed closed to the working places. If the hand-washing facilities are situated in particular areas away from working places, there is a great risk that they will not be used.

It must be impressed on the staff that hand-washing must be done:

- Before work starts
- After using the toilets
- After touching dirty objects and materials
- After smoking and eating

It must be impressed on the staff that hands will be contaminated if used for scratching the skin or the hair, correcting clothes and picking the nose. Bacteria may be transmitted to the hands by these acts and thereafter transmitted to meat (food) which is handled by hand.

Special guidelines concerning hand-washing must be followed. The management of slaughterhouse/slaughter facilities or the authorities may require the use of a special bacteriostatic soap or dipping of the hands after washing in a germicidal rinse etc. Use of a nail brush is recommended because bacteria often hide along and under the nails.



### **Employees Hygiene Guidelines**

Employees working in slaughter house are required to maintain high standards of personal cleanliness while at work and take all necessary precautions to prevent contamination of the meat and materials used in the processing operation. In this regard they must:

- a) Keep as clean as is reasonably practicable, parts of their bodies which are liable to come in contact with the meat. Fingernails must be kept short, clean and must not be varnished.
- b) Wash and disinfect their hands on entering a work area, at frequent intervals during work periods and each time work is resumed.
- c) Keep any cut or abrasion on any exposed part of their person covered with a suitable waterproof dressing.
- d) Not wear personal adornments or jewellery of any kind, including watches, except for plain wedding rings.
- e) Strictly refrain from smoking, spitting or eating in working or storage areas.

All persons working in or passing through working areas must wear sufficient clean, light colored washable protective clothing and a head covering of a suitable type. A fine mesh hair net must also be worn. The protective clothing must be changed at least daily or more frequently if required and arrangements must be made for the collection and laundering of soiled protective clothing. Outdoor clothing must not be worn over in place of protective clothing.

Employees who work in the slaughter house must not be allowed to pass through other work areas where meat cutting operations are carried out without taking effective precautions to prevent cross contamination. Employees who are required to work in the slaughter house and in meat cutting areas must change their protective clothing and wash and disinfect their hands between the changeover.

Persons likely to contaminate meat must be prohibited from handling lit. Only persons duly authorized will be allowed to handle meat.

A valid medical certificate must be held for any person assigned to work on and handle meat.

Employees and factory visitors who are suffering from stomach disorders or any conditions that may cause infection must not be allowed to work on or handle the products. Immediately a member of staff becomes aware that they are suffering from, or they are a carrier of, any infection likely to cause food poisoning they must inform the Senior site Manger who must then immediately inform the relevant health authority. Staff must obtain clearance from their medical doctor before returning to work after any gastro-intestinal infection.

### **Working clothes**

The clothing of slaughterhouse workers must be clean. The purpose is not to protect the worker against contamination but to protect the meat/food against contamination. Working clothes must be used exclusively in the working area and nowhere else. If possible, it is advisable to avoid admittance from the unclean area to the clean area without changing clothes. Working routines should be planned in a way that the staff works either in the clean area or in the unclean area. The staff may eventually be allowed to go from clean to unclean work but never in the opposite direction, except when they have changed working clothes and washed hands.

Working clothes should be comfortable and easy to wash. Their design should encourage good hygiene habits. Light coloured working clothes show the need for cleaning earlier than dark coloured working clothes.

Aprons made of washable or even waterproof materials, such as rubber, are recommended.

Working clothes should be free of loose adornments (buttons, sequins etc.). During work jewellery, wrist-watches etc. are prohibited as these objects may be sources for contamination and make hand-washing difficult.

Working clothes should ideally be supplied by the slaughterhouse and a laundry service is recommended to assure a certain level of hygiene.

Arrangements for storage of aprons and tools should be available outside toilets and rest rooms.

### **Hair covering**

Human hair and beards are normally heavily contaminated with bacteria and to prevent contamination of food a hair or beard covering in the process area is a necessary part of the working clothes.

Many different types of hair coverings are seen in the food industry. It is important that the hair is completely covered and that the covering is clean. Disposable or washable hair and beard coverings are recommended.

### **Gloves**

If the use of gloves is indicated they must be kept in the same good hygienic conditions as hands, otherwise it is better to avoid their use. Gloves may be of rubber or plastic and they are used to protect the meat against contamination. They may also be used to protect the hands against knife cuts and will then be made of steel. Great care should be taken to keep ascertain hygienic standard of these gloves.

#### **4.7 Lighting**

Adequate lighting is fitted throughout the premises so that hygiene procedures can be carried out effectively. Suitable conditions are provided for ante and post-mortem.

In practice adequate lighting means at least:

540 lux at inspection points

220 lux in workrooms

110 lux in other areas

Enclose fluorescent tubes or light bulbs in waterproof and shatterproof covers for ease of cleaning and to minimize the risk of contamination of food by glass fragments if there are breakages.

#### **4.8 Preventive Maintenance**

Slaughterhouse floor and equipment that are not kept in good repair and condition are a significant potential source of contamination (especially physical contamination) of food. Poor maintenance may also allow the entry of other sources of physical, microbiological and chemical contamination. Procedures are needed to minimize the risk of such hazards causing illness to consumers.

- If the fabric of the building (walls, floors, roofing etc.) is not maintained in good repair, foreign material such as fragments of
  - masonry and mortar, pieces of wall or roof tile, paint flakes, rust, insulation etc. may contaminate the product.
  - Deteriorating surfaces are more difficult to keep clean.
  - If the roof or windows leak, rainwater may enter the premises. This is a potential source of microbiological contamination.
  - Inadequate building maintenance may allow pests to enter the premises. Pests are a significant source of microbiological and physical contamination.
  - Plumbing fixtures and drains that are not regularly maintained could allow non-potable, or waste water containing microbiological contamination to enter food-handling areas and contaminate the product.
  - Ventilation systems that are not maintained in good condition may be a source of air-borne microbiological and physical contamination (e.g. dust and dirt particles).
  - Poorly maintained equipment may be a source of physical contamination such as nuts and bolts, washers, small metal or plastic components, swarf, non food-grade lubricants etc. It may also lead to breakdowns, production delays and product deterioration; if for example, chillers are out of action.

### **Training on maintenance**

Staff need training on the need to avoid contamination of food during maintenance work, to use correct maintenance materials and storage of materials, equipment and spares safely and to report problems promptly.

### **Maintenance inspection**

Establish a timetable for inspecting all parts of the premises and particularly those areas where food is handled, as well as vehicles and containers used for transporting food. Inspections can give early warning of potential maintenance problems so that action can be taken to prevent contamination, an accident or more serious deterioration.

### **Frequency of inspection**

Frequency will depend upon intensity of wear or damage being found. Food handling areas will be given more attention. Specialist equipment, particularly those with temperature control (e.g. chillers, heat treatment equipment) are likely to need regular attention.

### **Building maintenance**

Inspections should include external and internal parts of the premises, such as fencing, yards, stores, loading/unloading areas, lairages /animal holding areas, roofs, roof spaces, guttering, damp courses, drain pipes, drains, ventilation systems, plumbing, light fittings etc.

### **Surfaces**

Inspections should include floors, walls, ceilings, doors, windows and screens as well as food contact surfaces. Exterior damage may allow damp to penetrate the building and lead to mould growth on interior surfaces.

### **Fittings and Equipment**

Inspections should include conveyors, cutting surfaces, control systems, processing equipment, cooking, chilling and freezing equipment, metal detectors, shackles, filters, components, bearings and lubrication points. Manufacturer's maintenance manuals are helpful in identifying components that need regular inspection or adjustment.

### **Preventive maintenance programme**

A preventative maintenance programme would help avoid the need for emergency repairs and may provide an opportunity for improvements that could reduce future maintenance costs. Repair or replace damaged or worn surfaces or items as soon as is practicably possible to keep all areas in good condition, but particularly food handling areas. Make sure that temperature control equipment (e.g. chillers) is repaired without delay as storage or processing of foods at incorrect temperatures can allow the growth or survival of food poisoning bacteria. If a temporary repair has been made to prevent contamination, make sure that the need for a permanent repair is added to the maintenance programme. Repairs in food handling areas should normally be carried out during breaks in production.

If it is necessary to repair items while production is in progress, the food must be properly protected from contamination while the work is being carried out. Spare parts and maintenance materials – make sure that all parts and materials used in repair work are compatible with food safety. Store parts and materials so they do not act as sources of contamination.

## 5. LEGISLATIONS, REGULATIONS AND STANDARDS

### 5.1 Consent to Establish and Operate

This act implies that no industrial plant (any plant used for any industrial or trade purposes) can emit any air pollutant (any solid, liquid or gaseous substance including noise) into the atmosphere without prior consent of the Delhi Pollution Control committee.

Giving effect to this notification, Delhi Pollution control Committee issues “Consent to Establish” to any industrial plant before its establishment and “Consent to Operate” before the plant starts its operation.

Consent to Establish is the first step for any industry/trade (this includes any activity involving manufacturing process or and or emitting pollution, by way of water pollution, Air and Noise pollution viz.). EDMC would obtain Consent to Establish for the operator. The consent to establish will be granted by DPCC within a period of four months after the receipt of the application for consent. DPCC would grant the consent applied for subject to such conditions and for such period as may be specified in the order, or refuse consent.

Consent to Operate/Renewal shall be applied before commissioning of the unit in the prescribed application format available in Delhi Pollution control committee. Consent to Operate/Renewal is to be granted only after the Delhi Pollution Control Committee is satisfied that the slaughterhouse has completed all other formalities such as EDMC license, power, water connection, and have installed the requisite Pollution Control Devices. DPCC may revoke consent to any industry before expiry of the same in case of any violation.

Consent fees are established based on total capital investment and average water consumption.

### 5.2 The Air (Prevention and Control of Pollution) Act, 1981

The objective of Air (Prevention & Control of Pollution) Act is to prevent, control & abate air pollution. The consent under this act requires the compliance with the following condition:-

- i) Control equipment of such specification as DPCC may approve.
- ii) Control equipment referred above shall be kept at all times in good running condition.
- iii) Chimney, wherever necessary, of such specifications as DPCC may approve.

No person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollution in excess of the standards laid down by the DPCC.

Under this act, slaughterhouse maintains stack height for boiler and DG sets as prescribed in the standards. The slaughterhouse has to conduct periodic ambient air monitoring at places identified by DPCC, noise monitoring at site boundary limits at site and stack monitoring for boiler.

Stationary DG sets (5 KVA and above) must maintain acoustic enclosure/acoustic treatment of room. The same has been complied with in the slaughterhouse design.

### 5.3 The water (Prevention and Control of Pollution) Act, 1974

The act applies to all establishments discharging effluents in water or on land. The Act prohibits use of stream or well for disposal of industrial effluent. Water standards for disposal of effluent to land, surface water and river body is laid down under the act.

#### Cess Act

This act is to provide for the levy and collection of a cess on water consumed by persons carrying on certain industries and by local authorities. For the purpose of measuring and recording the quantity of water consumed, every person carrying on any specified industry and every local authority shall affix meters. The details are as follows:

### [SCHEDULE II]

(see section3)

Purpose for which water is consumed	Maximum rate under sub – section (2) of section 3	Maximum rate under Sub-section (2A) of Section 3
1. Industrial cooling, spraying in mine pits or boiler feeds	Five paise per kilolitre	Ten paise per kilolitre
2. Domestic purpose		
3. Processing whereby water gets polluted and the pollutants are -		
a) Easily biodegradable; or	Two paise per kilolitre	Three paise per kilolitre.
b) Non – toxic; or		
c) Both non toxic and easily biodegradable.	Ten paise per kilolitre	Twenty paise per kilolitre.
4. Processing whereby water gets polluted and the pollutants are –		
a) Not easily biodegradable; or	Fifteen paise kilolitre	Thirty paise per kiloliter.
b) Toxic; or		
c) Both toxic and not easily biodegradable.		

#### 5.4 The Environmental (Protection) Act, 1986

Under the Environmental (Protection) Act, guidelines are specified for classification of slaughterhouses, wastewater treatment systems and Standards are laid for effluent (wastewater) parameters and solid wastes.

The classification of slaughterhouses is given in Schedule-I (Guideline – 12|). Description of wastewater treatment system is given I Schedule – II {Guideline – 12 (i)}.

The effluent Standards for various categories of slaughterhouse are given in Schedule – II (Guideline -12. The Standards for method of disposal is given in Schedule-II {Guideline-12 (i)}.

Schedule – I  
(Guideline 12)  
**Classification of Slaughter Houses**

S.No.	Category of Slaughter House	Criterion
1.	Large	Annual Slaughtering Capacity: Large Animals >40,000 and Goats/Sheep > 6.00,000 Or Daily Live Weight Killed > 15 – 70 Tonne
2.	Medium	Annual Slaughtering Capacity: Large Animals 10,001 – 40,000 and Goats/Sheep 10,00,01 - 6.00,000 Or Daily Live Weight Killed 15 – 70 Tonne
3.	Small	Annual Slaughtering Capacity: Large Animals >10,000 and Goats/Sheeps Upto 1,00,000 Or Daily Live Weight Killed 5 Tonne

Schedule – II  
(Guideline 12 (i))  
**Wastewater Treatment Systems**

S.No.	Category of Slaughter House	Essential Treatment
1.	Large	Self cleaning type screening, anaerobic treatment, aerobic treatment and filter press for dewatering of sludge.
2.	Medium	Two stage screening (bar type), anaerobic pond and polishing pond
3.	Small	Two stage screening (bar type), anaerobic pond and polishing pond



Schedule – III  
(Guideline 12)  
**Standards**

S.No.	Category of Slaughter House/Unit	Parameters	Limit not to exceed, mg/l
1.	Large Slaughter Houses (Capacity above 70 TLWK/day)	Bio-chemical Oxygen Demand (BOD <sub>5</sub> ) at 20°C	100
		Suspended Solids	100
		Oil and Grease	10
2.	Medium and small Slaughter House (Capacity above 70 TLWK/day)	Bio-chemical Oxygen Demand (BOD <sub>5</sub> ) at 20°C	500
3.	Meat Processing  (a) Frozen Meat	Bio-chemical Oxygen Demand (BOD <sub>5</sub> ) at 20°C	30
		Suspended Solids	50
		Oil and Grease	10
	(b) Raw Meat From Own Slaughter House	Bio-chemical Oxygen Demand (BOD <sub>5</sub> ) at 20°C	30
		Suspended Solids	50
		Oil and Grease	10
	(C) Raw Meat From other Slaughter House	-	Disposal via Screen and Septic Tank
4.	Sea-Food Industry	Bio-chemical Oxygen Demand (BOD <sub>5</sub> ) at 20°C	30
		Suspended Solids	50
		Oil and Grease	10

Note: (i) TLWK – Tonne of live weight killed

(ii) In case of disposal into municipal sewer where sewage is treated, the industries shall install screen and oil and grease separation units.

(iii) The industrial having slaughter house along with meat processing units will be considered in meat processing category as far standard re concerned.

Schedule – III  
(Guideline 12 (i))  
**Standards**

<b>S.No.</b>	<b>Type of Waste</b>	<b>Capacity of Slaughter House</b>	<b>Method of Disposal</b>
1.	Water consisting of inedible offals, animal tissue, organs, body parts, carcasses etc.	Large  Medium  Small	Rendering  Rendering or Controlled Incineration  Burial
2.	Stomach/intestinal contents, dungs etc.	All categories	Composting
3.	Sludge from wastewater treatment system	All categories	Composting

**5.5 Prevention of Cruelty to Animals (Slaughter House) Rules, 2001**

**NOTIFICATION**

New Delhi, the 26<sup>th</sup> March, 2001

S.O.270(E) – Whereas the draft Prevention of Cruelty to Animals (Slaughter House) Rules, 2000 were published, as required by sub-section (1) of section 38 of the Prevention of Cruelty to Animals Act, 1960 (59 of 1960), under the notification of the Government of India in the Ministry of Social Justice and empowerment number S.O. 1165 (E) dated the 26<sup>th</sup> December, 2000 in the Gazette of India, Extraordinary, Part II, Section 3, sub Section (ii) dated the 27<sup>th</sup> December, 2000 inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which copies of the Gazette containing the said notification are made available to the public.

And, whereas copies of the said Gazette were made sufficient for livestock subject to veterinary inspection available to the public on the 1<sup>st</sup> January 2001.

And, whereas no objection or suggestion has been received from the public in respect of the said draft rules by the Central Government.

Now, therefore, in exercise of the powers conferred by sub-section (1) and (2) of section 38 of the Prevention of Cruelty to Animals act, 1960 (59 of 1960), the Central Government hereby makes the following rules, namely :

**1. Short title and commencement :** (1) These rules may be called the **Prevention of cruelty to Animals (Slaughter House) Rules, 2001.**

(2) They shall come into force on the date of their publication in the Official Gazette.

**2. Definitions** – In these rules unless the context otherwise requires –

a) “Act” means the Prevention of Cruelty to Animals Act, 1960 (59 of 1960);

b) “Slaughter” means the killing or destruction of any animal for the purpose of food and includes all the processes and operations performed on all such animals in order to prepare it for being slaughtered.

c) “Slaughter house” means a slaughter house wherein 10 or more than 10 animals are

d) “Veterinary doctor” means a person registered with the Veterinary Council of India established under the India Veterinary Council act, 1984 (52 of 1984).

**3. Animals not to be slaughtered except in recognized or licensed houses** – (1) No person shall slaughter any animals within a municipal are except in a slaughter house recognized or licensed by the concerned authority empowered under the law for the time being in force to do so.

(2) No animal which –

(i) is pregnant, or

(ii) has an offspring less than three months old, or

(iii) is under the age of three months or

(iv) has not been certified by a veterinary doctor that it is in a fit condition to be slaughtered.

(3) The municipal or other local authority specified by the Central Government for this purpose shall, having regard to the capacity of the slaughter house and the requirement of the local population of the area in which a slaughter house is situated, determine the maximum number of animals that may be slaughtered in a day.

**4. Reception area or resting grounds** – (1) The slaughter house shall have a reception area of of adequate size sufficient for livestock subject to veterinary inspection.

(2) The veterinary doctor shall examine thoroughly not more than 12 animals in an hour and not more than 96 animals in a day.

(3) The veterinary doctor after examining the animal shall issue a fitness certificate in the form specified by the Central Government for this purpose.

(4) The reception area of slaughter house shall have proper ramps for direct unloading of animas from vehicles or railway wagons and the said reception area shall have adequate facility sufficient for feeding and watering of animals.

(5) Separate isolation pens shall be provided in slaughter house with watering and feeding

arrangements for animals suspected to be suffering from contagious and infectious diseases, and fractious animals, in order to segregate them from the remaining animals.

(6) Adequate holding area shall be provided in slaughter house according to the class of animals to be slaughtered and the said holding area shall have water and feeding facilities.

(7) The resting grounds in slaughter house shall have overhead protective shelters.

(8) Ante-mortem and pen area in slaughter house shall be paved with impervious material such as concrete non-slippery herring-bone type suitable to stand wear and tear by hooves, or brick, and pitched to suitable drainage facilities and the curbs of said impervious material 150 to 3000 mm high shall be provided around the borders of livestock pen area, except at the entrances and such pen shall preferably be covered.

5. Lairages – (1) Every animal after it has been subjected to veterinary inspection shall be passed on to a lairage for resting for 24 hours before slaughter.

(2) The lairage of the slaughter house shall be adequate in size sufficient for the number of animals to be aired;

(3) The space provided in the pens of such lairage shall be not less than 2.8 sq. mt. per large animal and 1.6 sq mt. per small animal.

(4) The animals shall be kept in such lairage separately depending upon their type and class and such lairage shall be so constructed as to protect the animals from heat, cold and rain.

(5) The lairage shall have adequate facilities for watering and post-mortem inspection.

6. **Slaughter** – (1) No animal shall be slaughtered in a slaughter house in sight of other animals.

(2) No animal shall be administered any chemical, drug or hormone before slaughter except drug for its treatment for any specific disease or ailment.

3) The slaughter halls in a slaughter house shall provide separate sections of adequate dimensions sufficient for slaughter of individual animals to ensure that the animal to be slaughtered is not ensure that the animal to be slaughtered is not within the sight or other animals.

(4) Every slaughter house as soon as possible shall provide a separate space for stunning of animals prior to slaughter, bleeding and dressing of the carcasses.

(5) Knocking section in slaughter house may be so planned as to suit the animals and particularly the ritual slaughter, if any and such knocking section and dry landing area associated with it shall be so built that escape from this section can be easily carried out by an operator without allowing the animal to pass the escape barrier.

(6) A curbed-in bleeding area of adequate size as specified by the Central Government shall be provided in a slaughter house and it shall be so located that the blood could not be splashed on other animals being slaughtered or on the carcass being skinned.

(7) The blood drain and collection in a slaughter house shall be immediate and proper.

(8) A floor wash point shall be provided in a slaughter house for intermittent cleaning and a hand-wash basin and knife sterilizer shall also be provided for the sticker to sterilize knife and wash his hands periodically.

(9) Dressing of carcasses in a slaughter house shall not be done on floor and adequate means and tools for dehiding or belting of the animals shall be provided in a slaughter house with means for immediate disposal of hides or skins;

(10) Hides or skins shall be immediately transported from a slaughter house either in a closed wheelbarrow or by a chute provided with self-closing door and in no case such.

(11) Floor wash point and adequate number of hand wash basins with sterilizer shall be provided in a dressing area of a slaughter house with means for immediate disposal of legs, horns, hooves and other parts of animals through spring load floor chutes or sidewall doors or closed wheelbarrow or trucks are used in a slaughter house, care shall be taken that no point wheelbarrow or truck has to ply under the dressing rails and a clear passage is provided for movement of the trucks.

(12) Adequate space and suitable and properly located facilities shall be provided sufficient for inspection of the viscera of the various types of animals slaughtered in a slaughter house and it shall have adequate facilities for hand washing, tool sterilization and floor washing

tool sterilization and floor washing and contrivances for immediate separation and disposal of condemned material.

(13) Adequate arrangements shall be made in a slaughter house by its owner for identification, inspection and correlation of carcass, viscera and head.

(14) In a slaughter house, a curbed and separately drained area or an area of sufficient size, sloped 13mm per metre to a floor drain, where the carcasses may be washed with a jet of water, shall be provided by the owner of such slaughter house.

**7. Slaughter house building** – The different construction of a slaughter house shall be built and maintained by its owner in the manner as specified below namely :

a) Plant Building – (i) Materials used shall be impervious, easily cleansable, and resistant to wear and corrosion. (ii) Materials such as wood, plaster board, and porous acoustic-type boards, which are absorbent and difficult to keep clean shall not be used.

b) – The floors shall be non-absorbent and non slippery with rough finish and shall have suitable gradient for drainage.

c) Coves – Coves with radii sufficient to promote sanitation shall be installed at the juncture of floors and wall, in all rooms and which shall not be less than 100 mm.

d) Interior Walls - (i) interior walls shall be smooth and fat and constructed of impervious materials such as glazed brick, glazed tile, smooth surface Portland cement plaster, or other non-toxic, non-absorber material applied to a suitable base. (ii) Walls shall provided with suitable sanitary type bumpers to prevent damage by hand trucks, carcass shunks, and the like. (iii) The interior walls shall have washable surface up to the height of 2 meters from the floor so that the splashes may be washed and disinfected.

e) Ceilings – (i) Ceilings shall be of the height of 5 mts or more in workrooms and so far as structure conditions permit, ceilings shall be smooth and flat (ii) Ceilings shall be constructed of Portland cement plaster, large size cement asbestos boards with joint sealed with a flexible sealing compound, or other acceptable impervious material and finished so as minimize condensation, mould development, flaking and accumulation of dirt. (iii) The walls above glazed type

portion and ceiling shall be painted with water resistant paint to maintain them clean.

f) Window Ledges – Window ledges shall be sloped 45 degrees to promote sanitation and to avoid damage to glass in windows from impact of hand trucks and similar equipments, the windowsills shall be 1200mm above the floor level with proper ventilation through mechanical venting or through working vents shall be provided in the roof structure.

g) Doorways and Doors – (i) Doorways through which product is transferred on rails or in hand trucks shall be at least 1500 mm wide. (II) Doors shall either be of rust resistant metal construction throughout, or if made with rust resistant metal having tight softwood, they shall be clad on both sides with soldered or welded seams. (III) Doorjamb shall be clad with rust resistant metal securely affixed so as to provide no crevices for dirt or vermin and the juncture at which the door joins the walls shall be effectively sealed with a flexible sealing compound.

h) Screens and Insect control – All windows, doorways and other openings that may admit flies shall be equipped with effective insect and rodent screens and 'Fly chaser' fans and ducts or air curtains shall be provided over doorways in outside wall of food handling areas that are used for dispatch or receiving.

i) Rodent-Proofing-Except in the case of solid masonry, walls constructed of glazed tile, glazed brick, and the like, expanded metal or wire mesh not exceeding 12.5 mm mesh, shall be embedded in walls and floor at their junction and such mesh shall extend vertically and horizontally to a sufficient distance to exclude the entrance of rats and other rodents.

j) Vehicular areas for Trucks – (i) Concrete paved areas, properly drained and extending at least 6 metres from building, loading docks or livestock platforms shall be provided at places where vehicles are loaded or unloaded. (ii) Pressure washing jets and disinfection facilities for trucks carrying animals shall also be provided at such places.

k) Drainage – (i) All parts of floors where wet operations are conducted shall be well drained and as far as possible, one drainage inlet shall be provided for each 37 metre square of floor space (ii) A slope of about 20 mm per metre to drainage inlets shall be ensured that the floor slopes uniformly to drain with no low spots, which collect liquid. (iii) Floor drains shall not be provided in freezer rooms or dry storage areas when floor drains are installed in rooms where the

water seal in traps in likely to evaporate without replenishment, they shall be provided with suitable removable metal screw plugs.

l) Traps and vents on drainage lines – (i) Each floor drain, including blood drains, shall be equipped with a deep seal trap (P-, U-, or S-Shape) (ii) Drainage lines shall be properly vented to the outside air and be equipped with effective rodent screens.

m) Sanitary drainage lines – Drainage line from toilet pans and urinals shall not be connected with other drainage lines within the plant and not discharge into a grease catch basis and such lines shall be installed so that if leakage develops, it shall not affect the product or the equipment.

n) Lighting and ventilation – (i) Unrefrigerated work rooms shall be provided with adequate direct natural light and ventilation or ample artificial light and ventilation by mechanical means. (ii) Uncoloured glass having a high transmissibility of light shall be used in skylights and windows (iii) The glass area shall be approximately one-fourth of the floor area of a workroom and such ratio shall be increased where there are obstructions, such as adjacent buildings, overhead catwalks, and hoists, which interfere with the admittance of direct natural light. (iv) Distributed artificial lighting of much quality and at such distances as may be specified by the Central Government shall be provided at all places where adequate natural light is not available or is insufficient.

o) Every abattoir shall be provided with distributed artificial light of an overall intensity of not less than 200 lux at the distances as may be specified by the Central Government throughout the slaughter hall and workrooms and at places where meat inspection is carried out, the overall intensity of artificial light shall be not less than 500 lux.

p) every abattoir shall be provided with suitable and sufficient means of ventilation to the outside air and the construction of the slaughter hall shall be so arranged that the dressed carcasses are not exposed to direct sunlight;

q) a sufficient, safe, potable and constant supply of fresh water shall be available at adequate pressure through the premises.

r) the pressure for the general purpose of floor washing may preferably be 200 to 330 kPa for through floor cleaning.

s) for thorough and efficient washing of carcasses, a higher pressure between 1000 kPa to 1 700 kPa shall be maintained.

t) floor washing point shall be provided preferably for minimum 37 meter square on slaughter floor and working departments

a. a constant supply of clean hot water shall be available in the slaughter hall and work rooms during working hours and the hot water required for frequent sterilizing of equipment shall not be less than 82 degree Celsius.

b. where necessary for sanitary maintenance, equipment shall be constructed and installed so as to be completely self-draining.

c. the following materials shall not be used in an abattoir, namely –

(i) copper and its alloys in equipment used for edible products.

(ii) cadmium in any form in equipment handling edible products

(iii) equipment with painted surface in product zone.

(iv) enamel containers or equipment is not desirable and

(v) lead

(x) all permanently mounted equipment shall either be installed sufficiently away from walls (minimum 300 mm) to provide access for cleaning and inspection.

(y) all permanently mounted equipment shall either be installed sufficiently above the floor (minimum 300mm) to provide access for cleaning and inspection or to completely sealed (watertight) to the floor area.

8. Engagement in slaughter house – (1) No owner or occupier of a slaughter house shall engage a person for slaughtering animals unless he possesses a valid license or authorization issued by the municipal or other local authority.

(2) No person who has not attained the age of 18 years shall be employed in any manner in a slaughter house.

(3) No person who is suffering from any communicable or infectious disease shall be permitted to slaughter an animal.

**9. Inspection of Slaughter house – (1)** The Animal Welfare Board of India or any person or Animal Welfare Organization authorised by it may inspect any slaughter house without notice to its owner or the person incharge of it at any time during the working hours to ensure that the provisions of these rules are being complied with.

(2) The person or the Animal Welfare Organization authorized under sub rule(1) shall after inspection send its report to Animal Welfare Board of India as well as to the municipal or local authority for appropriate action including initiation of legal proceedings if any, in the event of violation of any provision of these rules.

## 6. Others

### 6.1 Establishment of Quality Management System/ ISO 9001

Establishing a good quality system is a pre-requisite for establishing HACCP system. Quality management system conforming to ISO 9001 will include establishment of quality policy and objectives as well as many prerequisite programmes. Standard Operating Procedures (SOP's) include but not limited to

- Sanitation and hygiene
- Pest control
- Maintenance of equipment and facility
  - \* Slaughtering and dressing
  - \* Chilling
  - \* Dispatch
  - \* Offal Processing
- Water supply controls
  - 9\* Plant Water supply
  - 9\* Chlorination
- Boiler
- Refrigeration
- DG sets
- Rendering Plant
- Etc

### 6.2 Food safety & HACCP

Normally, the microbiological safety of food products is being assessed by the analysis of a small sample of each batch of the finished product. This approach to testing has a number of disadvantages:-

- Inadequate control of safety as inspection is only at final stage
- Destructive
- Batch variation or uneven distribution of micro- organisms in food not taken into account
- Time-consuming and expensive
- Process control only involves a limited number of staff

In a Hazard Analysis Critical Control Point (HACCP) system, all potential hazards to food safety at each stage of the production chain are identified. A Critical Control Point (CCP) is a point, step or procedure where control must be applied to prevent, eliminate or reduce a food hazard to an acceptable level. To assure food safety, each CCP is monitored to check that it is within critical limits.

If limits are in danger of being broken, corrective action must be taken. This systematic approach, if properly implemented should ensure the safe production of food.

The seven principles of a HACCP system are:-

1. Conduct a hazard analysis and develop production flow chart



2. Identify the CCP's
3. Establish critical limits i.e. set target levels which must be met to ensure the CCP in under control
4. Establish a system to monitor control of the CCP
5. Establish corrective action to be taken when monitoring indicates that a CCP is not under control
6. Establish procedures for verification to confirm that the HACCP system is working;g correctly
7. Establish documentation/ records for all procedures

Microbiological testing of carcasses can be used to help confirm that the procedures are working. HACCP procedures have the following advantages:-

- Proactive in identifying hazards before they occur
- Maximise product safety
- Non- destructive
- Provides evidence of due care in all stages
- Cost effective
- Food safety assurance involves all production staff

### 6.3 manpower requirements

### 6.4 Safety measures

A safe healthy work environment is the responsibility of everyone working in the slaughterhouse and health and safety shall not be sacrificed for expediency. Unacceptable performance of health and safety duties will not be tolerated.

The hazards that may be involved when operating the abattoir include:-

- Slipping hazards on wet floor
- Overhead and falling objects
- Sharp knives and saws.
- Exposure to sanitizing agents
- Handling animal carcasses

Practices should be implemented to reduce and eliminate slaughter house hazards. These include:-

- Wearing of a hard hat
- Handholds for exit and entry
- Positioning the entry ramp at as shallow an angle as possible
- Keeping all cutting tools sharp and in good repair.
- Keeping cutting tools encased or enclosed when not in use.
- Wearing cut resistant gloves.
- Making available material safety Data Sheets for all sanitizers used.
- Proper placement of captive bolt.

- Securely shackling animals when transporting to or placing in the abattoir
- Having first aid kit, emergency numbers and accident procedures list available at a known, accessible location.
- Advising all slaughterhouse worker safety aspects

Safety audit by third party such as National Safety Council should be conducted at least once in year. Recommendations provided in the report shall be implemented in a staged manner.