final report

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Design concepts for abattoirs in Indonesia

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Abstract

This report provides a concept design for a small (20-50 head per night) beef abattoir facility suitable for urban and regional areas of Indonesia. The design provides for the humane slaughter of cattle and the hygienic production of meat products for the non-refrigerated (wet) market with particular emphasis on providing cost effective solutions that meet specific site operational requirements and international food safety and hygiene guidelines.
The report includes a conceptual process and building layout, capacity statement, description of operation, costed equipment list and a bill of quantities for major building elements.

Executive summary

The traditional methods of supplying food and sustenance to the Indonesian population is via the wet markets. The wet market is by far the most popular way of distributing food to the population which in the majority of cases is sold fresh. There is little to no refrigeration in the traditional wet market so perishable items such as meat protein is sold live or slaughtered nearby. It therefore follows that the beef processing sector has evolved around the wet markets so that the time from slaughter to consumption is minimal and that freshness and wholesomeness can be provided to the consumer.

The objective of this project was to assist the Indonesian government in its efforts to improve the food hygiene standards and operational efficiency of its many small abattoirs. This was to be achieved by providing a concept design based on Indonesian and international standards and regulations. The concept design provides practical hygiene and food safety guidelines to the Indonesian cattle processing industry.

The project has been split into two stages with this report focusing on the Stage One wet market application. The objective of Stage One was to detail the design concepts of an abattoir to be located in regional areas of Indonesia for the humane slaughter of cattle, and the hygienic production of meat products for the non-refrigerated (wet) market trade. The capacity of the facility is to be 20 head per eight hour night with potential to expand throughput to 50 head per night.

The concept design includes the following information:

- Concept process and building layout
- Building elevations, sections and details highlighting hygienic building features such as floor drains, floor slopes, and cove details
- Description of operation so as to provide the basis for training to improve animal welfare and food hygiene standards
- Costed equipment list
- Bill of quantities for major building elements to allow assessment of Indonesian building costs
- Capacity statement defining throughput, equipment and services

The design will consider the following needs:

- Halal slaughter requirements
- Animal welfare to international standards
- Food safety with reference to Indonesian and international regulations and standards
- Operational and personal hygiene and safety
- Appropriate level of technology for the expected volume and established practices
- Extendable to 100 head per night throughput and refrigerated product option
- Traditional slaughter practices and preferences (e.g. multiple butcher groups)
- Tropical environment
- Cost efficiency
- Durability and low maintenance
- Building construction methods suitable for regional areas and able to achieve hygienic outcomes

The most significant challenge with the development of this concept design was to provide outcomes that will raise operational standards and also meet the expectations of the administrative authorities and the market place. To understand the local issues and existing market conditions, a study tour was conducted of some existing meat processing facilities within the greater Jakarta area. A total of 10 abattoir operations were inspected ranging from government controlled plants to un-registered plants processing a few cattle per night.

The main findings of the study tour were:

- A repeatable process that underpins the philosophy of food safety and hygiene was not evident in some parts of the supply chain.
- There was a need to separate “process” from “infrastructure”, and focus on improving the paradigm within the market. This can be achieved by designing a process that focuses on:
    - Philosophy
        - Cleanliness and sterilisation
        - Functional integrity
    - Objectives
        - Discipline
        - Repeatability
        - Compliance
- The existing infrastructure can be upgraded and retro fitted with modular slaughter systems that meet commercial expectations and compliance requirements.
- Abattoir designs must be able to provide flexibility in terms of throughput, service, and be able to offer a wet market and cold chain options to suit specific cultural, regional and market conditions.

The abattoir functionality has been based on two alternative dressing systems: a bed dressing and a rail dressing system. Both of these dressing systems are able to fulfil regulatory requirements and meet the commercial and cultural expectations of users and consumers. The principal objective of the design was to produce a process that is disciplined, repeatable, and operationally compliant.

The dressing design eventually proposed is a combination of bed and rail dressing thus incorporating the best of both systems. After the animal is stunned and slaughtered, it is lifted off the dry landing area and never again touches the ground. The work place is adequately serviced with appropriate facilities that provide the operator with the means to produce a clean and hygienic outcome every time. It is important to note that bed dressing allows an operator to combine tasks much more readily than a rail system so that the skinning and evisceration of the carcass is performed on a bed or cradle arrangement off the ground and within a predetermined work space. The by-products and other animal parts will also be conveyed and processed off the ground and in accordance with international standards.

During the course of developing this abattoir design it become clear that significant flexibility was required in applying and introducing these new food safety and hygiene standards to the Indonesian market. By separating the operational process from the infra-structure that supports the process, we can create a range of practical solutions that will achieve the same standard of outcome, at least cost, with better social and economic benefits. Some solution options are:

- Refurbishment of existing buildings and installation of a purpose built slaughter processing module.
- In more isolated areas where the daily demand for beef protein is limited to 2 to 3 animals a night, a prefabricated skid mounted abattoir and slaughter modular system has real potential. This type of system could be installed and operational at a remote location within weeks and would be very cost effective. The design and structure would not be easily adapted to anything more than a wet market abattoir facility. The basic principles of process would be instilled in the design and therefore be practiced.

The process of introducing improved standards of hygiene and food safety to the Indonesian market place requires the introduction of a more controlled and objective assessment of process that takes into account the following:

- Existing infrastructure – means that the location, building, and services that support the process are adequate and can be adapted to meet new standards.
- Administrative process – means that the management team have the desire and control necessary to implement the new standards.
- Commercial imperatives – means that the market place has a capacity to value the new standards.
- Operator culture – means that there are the skill sets within the workforce that can be developed to support the change in product outcomes.

The concept of simply designing a specific abattoir to a certain standard and operational criteria has, during the course of this project, been challenged to some extent and has lead us to the view that the philosophy that under pins the operational process is the catalyst for genuine change. This process must be matched to the specific needs of each particular site and or region and ultimately becomes part of the new food culture.

In summary, we have provided numerous abattoir design options for the wet market application that provide a range of outcomes that can be matched to any situation. The development of a beef supply chain must be undertaken in consultation with all stakeholders. This will ensure that all expectations are met and appropriate infrastructure is provided that underpins an operational process that promotes food safety and hygiene.

Contents

1. Background

As with most progressive countries, infrastructure is lagging behind the growth in population so the traditional methods of supplying food and sustenance to the population is via the wet markets. There is little to no refrigeration in the traditional wet market so perishable items such as meat protein is sold live or slaughtered nearby. It therefore follows that the beef processing sector has evolved around the wet market so that the time from slaughter to consumption is minimal and that freshness and wholesomeness can be provided to the consumer.

Over the past 15 years the Indonesian economy has been growing at an average rate of 6 % per year. As a result, consumers are looking for new food and eating experiences. This demand has resulted in the importation of beef protein to supplement the domestic supply, and takes the form of boxed beef or live cattle sourced mainly from Australia. The live cattle are fed in feedlots that are located close to populations so that they can attract labour and stockfeed. With this growth in beef production and free market approach to abattoir infrastructure, we have seen the development of small local slaughter yards and abattoir facilities that do not meet acceptable food safety and hygiene standards.

The Director General Livestock and Animal Health Services (DGLAHS) is the national body with responsibility for meat processing and abattoir standards. The DGLAHS interacts with provincial governments and district officials regarding the abattoir sector. The Indonesian Ministry of Agriculture, through the DGLAHS, has expressed concern over the inappropriate location of many existing abattoirs, their hygiene standards, and inefficiency due to inadequate scale. DGLAHS wish to raise the standards of food safety and hygiene and in doing so modernise the beef protein supply chain

The objective of this project was to assist the Indonesian government in its efforts to improve the food hygiene standards and operational efficiency of its many small abattoirs. This is to be achieved by providing a concept design based on Indonesian and international standards and regulations. This design is suitable to be adapted to the specific needs of any proposed abattoir site and focus on operational process rather than superficial infrastructure improvements that do nothing to change the status quo.

2. Project objectives

The abattoir concept design was to consider the following needs;

- Animal welfare codes and guidelines including
  - Office International des Epizooties (OIE) Terrestrial Animal Health Code recommendations for slaughter of animals-chapter 7.5,
  - The Australian Export Supply Chain Assurance System (ESCAS), and
  - Temple Grandin guidelines.
- Food hygiene and safety with reference to:
  - OIE,
  - Codex Alimentarius. The codex document is an important part of the development process as its set standards in relation to the correlation and disposition of product and provides a process for measuring country to country equivalency and inspection procedures.
  - European Union (EU),
  - Australian Quarantine and Inspection Service (AQIS) and
  - the United Nations Food and Agriculture Organisation (FAO) guidelines.
- Operational and personal hygiene standards that reflect international food safety and hygiene standards.
- Halal slaughter requirements as defined in the guidelines of Halal assurance system criteria on slaughter houses HAS 23103 which is specific to Indonesian religious and cultural standards.
- The design will provide enough flexibility to cater for the commercial complexity of the market in terms of volume and service.
- The concept design will allow for different processing techniques and throughput capacities based on a philosophy of functional integrity that will direct effort to achieve defined outcomes.
- The tropical environment issues in terms of process, design, and effluent disposal.
- A variety of options in terms of process and infra-structure at least cost and low maintenance.

The specific objective of the project was to:

- Develop abattoir design concept drawings and associated technical material and instructions for improved slaughter of cattle in Indonesia. The concept design was to include:
  a. A description of the operation
  b. A costed equipment list
  c. A bill of quantities for major building elements
  d. A capacity statement

The abattoir concept design for Stage One was based on the following assumptions:

- Design to be generic and easily adaptable to unique local requirements (Note - modification of the designs to suit specific unique local requirements was outside the scope of this project).
- Sufficient reliable power and water supplies will be available at the abattoir sites selected.
- Live animal weight is assumed to be in the range of 350 to 550kg.
- A suitable restraining box for improved non-stun slaughter to be provided.
- Building is to be designed to Australian minimum standards, for hygiene and building codes.

- Blood will be discharged to the effluent treatment system.
- Treatment of liquid waste will be limited to a simple anaerobic/aerobic pond system.
- Suitable road access will be available at all selected sites to allow for construction and ongoing operations, including livestock delivery and finished goods transport.
- For the Stage One design concept, there will be no refrigeration in the entire slaughter to sale process.
- For the Stage Two design concept, ammonia based refrigeration systems can be supported locally and are commercially available.

Issues that were addressed in the concept design included:

- The use of bed dressing, overhead gantry systems, and suitably designed product trolleys to improve hygiene standards.
- Transfer of contamination from animal to animal was to be minimised by the introduction of appropriate work practices, sterilisation, operational hygiene practices, and food safety procedures.
- Slaughter, offal and boning operations are to be separated by provision of separate processing spaces or rooms.
- Maintain correlation and disposition of carcasses.
- Water treatment must be provided where necessary to ensure potable quality water supply.
- Provide washing facilities for shackles, handling and other equipment to permit cleaning between animals.
- Ergonomics for staff to be improved by elevating the carcass above the floor and providing suitable height work areas.
- Services requirements to be minimised but adequate.
- Maintenance requirements to be minimised but adequate.

The Stage One concept design project milestones were to:

1. Undertake extensive consultation with MLA Indonesia staff, DGLAHS, provincial governments, and Indonesian meat processors to fully understand current processing practices, markets, and required/preferred changes.

2. Prepare:

    - A process and building concept layout of the abattoir. Note that this would not include peripheral features such as administration, amenities, workshops, roads; which are all site specific details.

    - A list of slaughtering equipment and estimated Australian or global prices (where the equipment will most likely be sourced).

    - A bill of quantities for major building elements to allow assessment of Indonesian building costs. Note that this is not an all-encompassing list for tender. The purpose is to quantify major cost components such as concrete, structural steel, masonry, wall and roof cladding.

    - A capacity statement that defines throughput, method of processing (Halal, bed dressing, gravity rail, etc.), products and by-products, method of packing, services, utilities consumed, waste and manning levels.

- A description of operation for the slaughter and boning operations. This will include how cuts and parts are to be collected and transported.

3. Review the documentation prepared in milestone 2 above with MLA, and attend to change requests

4. MLA, LiveCorp and Felix Domus to visit Indonesia and present the design to DGLAHS. Visit candidate sites for a Stage One design concept and Stage Two design concept facility.

5. Based on the Indonesian meeting, update the documentation as may be required, and agree on any next steps that may be identified for a Stage One design concept facility, such as implementation assistance.

3. Methodology

3.1 Study tour

The most significant challenge with the development of this concept design was to provide outcomes that would raise operational standards and also meet the expectations of the administrative authorities and market place. To understand the local issues and existing market conditions, a study tour was conducted of some existing meat processing facilities within the greater Jakarta area. A total of 10 abattoir operations were inspected ranging from government controlled plants to un-registered plants processing a few cattle per night.

The main findings of the study were:

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    - Philosophy
        - Cleanliness and sterilisation
        - Functional integrity
    - Objectives
        - Discipline
        - Repeatability
        - Compliance
- The existing infrastructure can be upgraded and retro fitted with modular slaughter systems that meet commercial expectations and compliance requirements.
- The project design should be able to provide flexibility in terms of throughput and service, and be able to offer a wet market and cold chain options to suit specific cultural, regional and market conditions.

3.2 Operational principles

The Indonesian Ministry of Agriculture provides two key regulatory documents relating to the design and operation of abattoir facilities within Indonesia. The first relates to veterinary control certification for food of animal origin enterprises - Number: 381/ kpts / OT.140/10/2005. The second regulation provides guidelines for ruminant slaughter houses and meat cutting plants - Number: 13/permentan/OT.140/1/2010. Both of these documents were used extensively in developing the design and functionality of the abattoir, particularly in relation to cultural and religious matters. Another key reference used in the production of this concept design was AS 4696 – 2007: Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption. This document was used with particular reference to sections relating to the following:

- Operational hygiene.
- Cross contamination.
- Animal welfare.
- Ante mortem inspection and disposition.
- Slaughter and dressing.
- Post-mortem inspection and disposition.
- Premises, equipment and essential services.
- Schedule 1: Personal hygiene.
- Schedule 2: Procedures for post mortem inspection.
- Schedule 3: Ante-mortem and post-mortem dispositions.

The Stage One abattoir concept design specification was a non-refrigerated facility and as such there were several related operational and supply chain elements that will not be addressed in this report. Additionally, the management systems specifically designed to ensure the wholesomeness of meat products under an approved arrangement that can be externally audited and validated by approving authorities is not within the scope of this report. The design and operational aspects of the Stage One abattoir will have the capacity to incorporate these management programs and have the flexibility to meet any international standard and market if required. Obviously the need to move to a Stage Two abattoir design (refrigerated abattoir and cold chain) would be an essential part of this process.

The abattoir functionality has been based on two alternative dressing systems: a combination bed and rail dressing system and a rail dressing system. Both of these dressing systems are able to fulfil regulatory requirements and meet the commercial and cultural expectations of users and consumers. The principal objective of the design was to produce a process that is disciplined, repeatable, and operationally compliant.

3.2.1 Traditional bed dressing system

The bed dressing system process can be divided into two parts:
1. De-hiding the carcass; and
2. Removal of the alimentary tract and other organs.

The process of de-hiding is performed with the carcass on its back (horizontal plane) so that the belly is uppermost and the feet are elevated. This slaughtering position allows the operator to remove the fore and hind hocks, and open and clear the hide with minimal hide tension and without exposing the underlying fat and muscle tissue to external contamination. If the de-hiding technique is applied correctly, hygiene and dressing standards are equal to any other slaughter technique employed anywhere in

the world. As the hide is released from the carcass, gravity acts to pull the hide down and away from the underlying carcass, thus reducing the risk of cross contamination. A schematic diagram of commonly observed bed dressing process is shown in Figure 1. Note the viscera and head are dropped onto the floor. The slaughter operator flays the hide until the flanks of the carcass are exposed and the hide can no longer be freed given that the carcass is lying on its back. Using a spreading device, the hind legs are fixed and the carcass is hoisted into a vertical position ensuring at all times that the exposed carcass does not come in contact with the supporting cradle and or floor. It is in this vertical position that the hide is completely removed and the animal is then eviscerated. All alimentary, reproductive, and thoracic organs are removed and placed in an appropriate container for correlation and inspection by an approved meat inspector and or veterinarian.

The obvious advantage of the bed dressing system is that the cost of infra-structure is minimal and the combination of tasks allows for the flexible use of labour at lower production levels.

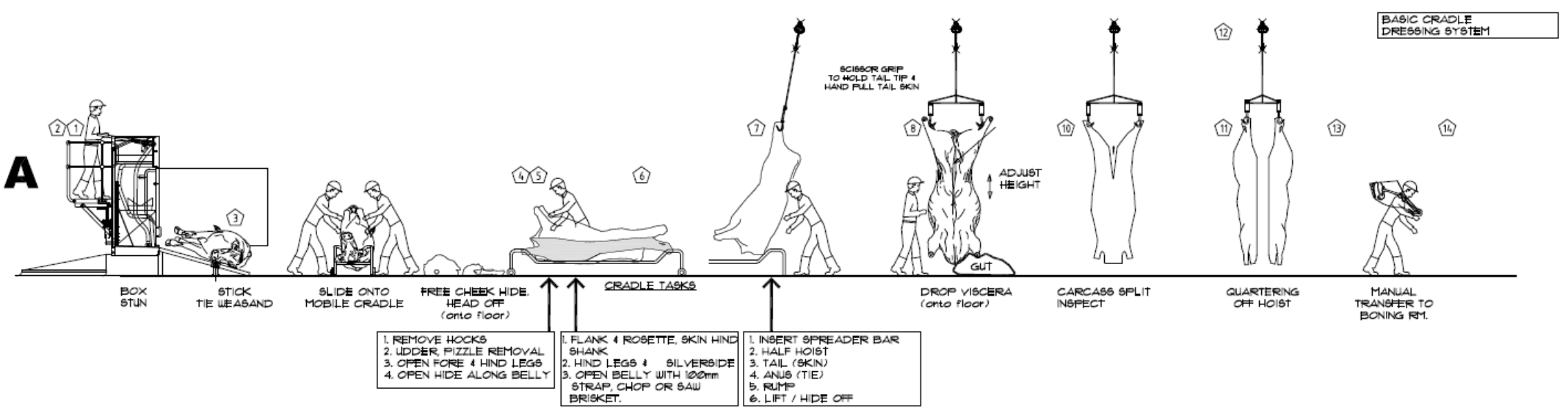

Figure No. 1: Traditional Indonesian bed dressing process (as observed during study tour)

3.2.2 Rail dressing system

The rail system elevates the animal immediately after the animal is slaughtered and the entire process of de-hiding and eviscerating the carcass is performed while the animal is in the vertical position. This elevation of the carcass above the ground ensures that it is not exposed to any contamination emanating from the ground, water splash and or contact with surrounding infrastructure during the slaughtering process. However, like the bed dressing system, there are issues in relation to cross contamination that have to be managed with appropriate dressing protocols which are described later in this report.

Following de-hiding and evisceration the carcass, in a vertical position, can be conveyed along the rail (gravity or powered) and at each elevated work station the slaughter operator can perform a particular task. Once completed, the carcass is moved to the next work station. This process requires a lot more infra-structure and labour given the restriction imposed by elevating the carcass. The advantage over the bed system is the economy of scale as production rates increase.

Figure 2 below shows a process schematic of an efficient and hygienic rail dressing system. A typical process plan for a rail dressing system is shown in Figure 5.

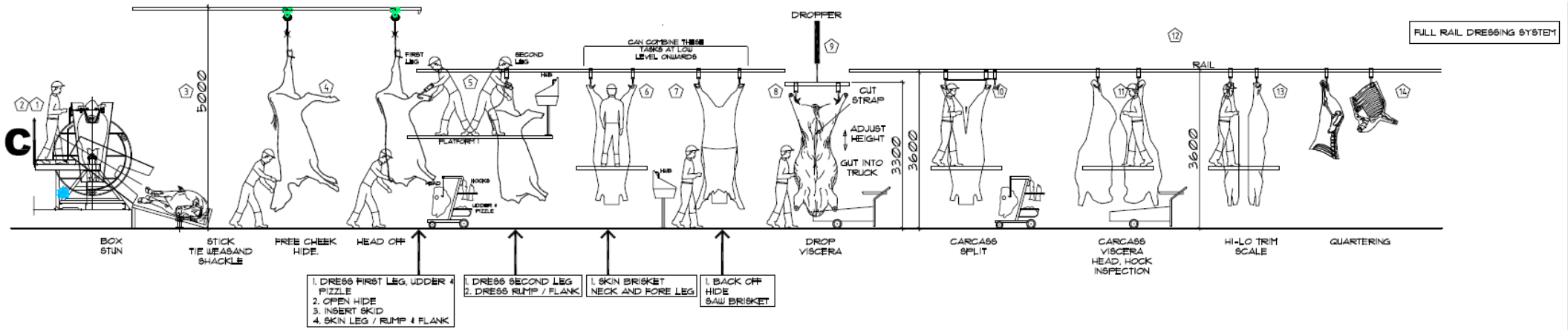

Figure No. 2: Rail dressing process

3.2.3 Proposed combined rail and bed dressing system

To ensure that the slaughter and dressing process is efficient, hygienic and repeatable, we recommend combining the bed and rail dressing elements into a system that is flexible as well as being efficient at low production rates. It can be adapted to fit any commercial requirement while maintaining the process integrity that underpins food safety and hygiene. Figure 3 below shows a process schematic of the proposed combination bed and rail dressing system. A typical process plan for this system is shown in Figure 4.

The progression from the traditional bed dressing process to the combination bed and rail involves getting people to work on successive tasks, not total group activity. This allows better task definition and a culture of process rather than physical enthusiasm to get the task completed.

4. Process definition sequence

The process schematic and process plan for the proposed combination bed and rail dressing process are shown in Figures 3 and 4 respectively. Similar information for the rail dressing process is shown in Figures 2 and 5 respectively. Each of these drawings includes position numbers showing where particular tasks are performed.

The process sequence for both the combined bed and rail dressing process with corresponding task position numbers is detailed in table 1. Operations which are common to both processes are indicated.

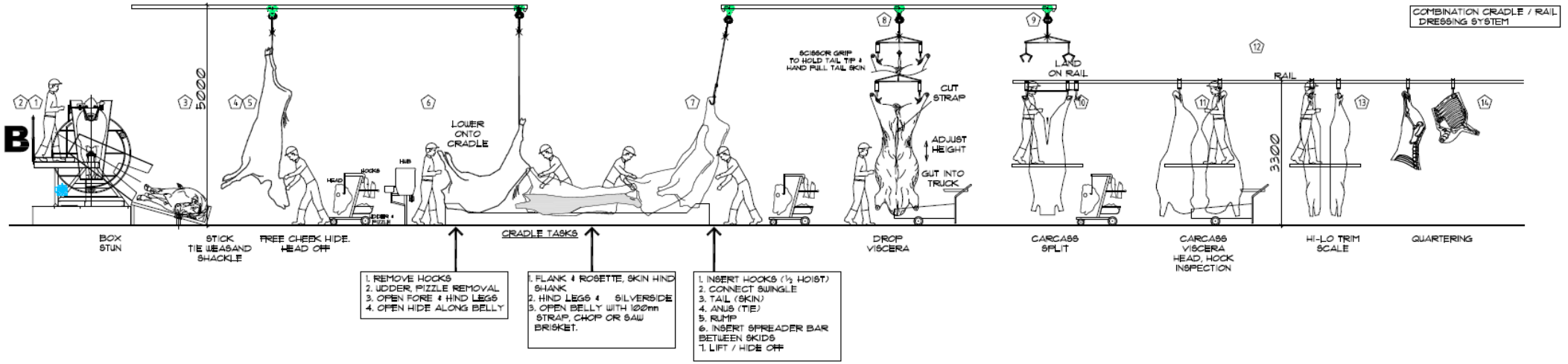

Figure No. 3: Combined bed and rail dressing process

Table 1 – Process Definition Sequence-Combination Bed/Rail Dressing Process and Rail Dressing Process

Position Number		**Description**	
Bed	**Rail**	**Combined Bed/Rail Dressing**	**Rail Dressing**
1	1	Stockman - using the natural behaviour of livestock and low stress animal handling techniques move stock to the restraining box.	Common
2	2	Stunning - the animal is restrained and stunned as quickly as possible in accordance to ESCAS and OIE standards.	Common
3	3	Sticking – confirm effective stun by ensuring animal is unconscious and slaughter immediately allowing the animal to bleed out prior to further processing.	Common
3	3	Clip oesophagus - to prevent the discharge of any material from the alimentary tract	Common
3	3	Wash anus of animal and surrounding area.	Common
3		Shackling – of both hind legs to ensure proper transfer to the bed dressing apparatus.	
	3		Shackling - of the right hind leg to ensure that the animal is on the correct side of the rail (non-hanger side).
4	4	Fore shanks - are removed and place onto the Head Trolley. .	Common
4	4	Rodding - the oesophagus is freed to improve evisceration.	Common
4	4	Horns - remove the horns if required and place into the Condemned Trolley.	Common
4	4	Cheeking – removing the hide on both cheek muscles (m. Masseter)	Common
5	4	Head – is removed from the carcass and prepared for inspection and correlation on the Head Trolley	Common
6		The animal is lowered onto a fixed dressing bed ensuring that no part of the exposed cranial dressed portions of the animal touches the ground or surrounding infrastructure.	
	5		The animal is presented to the first leg position.
	5		First leg – External reproductive organs such as the pizzle, testes, or udder are removed and placed onto the Viscera

Position Number		Description	
Bed	**Rail**	**Combined Bed/Rail Dressing**	**Rail Dressing**
			Trolley.
	5		First leg - clear the hide from around the leg and lower butt ensuring that there is no cross contamination.
	5		Hind hock is removed and placed onto Head Trolley.
	5		First leg change-over - a slide is inserted behind the shin and in front of the Achilles tendon of the hock, placed on the hoist and raised to the main dressing level.
	5		Shackle chain and trolley are released from the right leg and allowed to return to the sticking area.
	5		Second leg - clear the hide from around the leg and lower butt ensuring that there is no cross contamination.
6	5	Hind hocks are removed and placed onto Head Trolley.	Common
6		De-hiding of the animal commences at the ventral portion of the animal clearing the brisket, belly and lateral flanks, hind and fore legs.	
	5		A slide is inserted behind the shin and in front of the Achilles tendon of the hock, placed on the hoist and raised to the main dressing level.
	6		Flanking - the hide is cleared from the ventral and lateral portions of the carcass including the sternum, fore legs, and rosettes (shoulder and red bark). Care should be taken to pick up the rim (fat and connective tissue).
6		External reproductive organs such as the pizzle, testes, or udder are removed and placed onto the Viscera Trolley	
6		The sternum bone (brisket) is split using a cleaver and or saw ensuring that the paunch is not cut or ruptured.	
7		Bung Tie – the anus, rectum, and associated reproductive, and urinal organs are freed and released from the pelvic/anal cavity thus allowing a plastic bag to be pulled down over same ensuring that there is no contamination.	
7		Tail - is prepared by removing a portion and or the entire hide and placed onto Head Trolley (hide-on) or Viscera Trolley (hide-off).	
7		Slides are inserted in each hind leg behind the shin and in front	

Position Number		Description	
Bed	**Rail**	**Combined Bed/Rail Dressing**	**Rail Dressing**
		of the Achilles tendon of the hock.	
	6		Rumping - the hide is cleared from the caudal and dorsal portions of the carcass.
	6		The tail is prepared by removing a portion and or the entire hide and placed onto Head Trolley (hide-on) or Viscera Trolley (hide-off).
	6		Bung tie - the anus, rectum, and associated reproductive and urinal organs are freed and released from the pelvic/anal cavity thus allowing a plastic bag to be pulled down over same ensuring that there is no contamination.
7		A spreading rail is then attached to each slide and connected to an overhead hoist for elevation.	
7		De-hiding of the carcass is completed by fixing the hide flaps to the bed dressing frame and then slowly raising the carcass while the operator flays the hide from the underlying sub cutaneous fat and connective tissue.	
	7		De-hiding of the carcass is completed by flaying the hide on either side and over the dorsal and back portion until the hide is released.
7	7	Hide – is placed onto the Hide Trolley for further processing.	Common
	8		The sternum bone (brisket) is split using a cleaver and or saw ensuring that the paunch is not cut or ruptured.
8	9	The suspended carcass is then positioned over a suitably designed Viscera Trolley that fits below a work station platform thus providing suitable access for an operator to eviscerate the carcass.	Common
8	9	Evisceration - the alimentary, thoracic, urinal, and associated reproductive organs are removed separately ensuring that there is no contamination and or spillage. These organs are placed onto the Viscera Trolley and presented for inspection and correlation.	Common
9		The suspended carcass is then positioned over the fixed rail and using a hoist the carcass is lowered down thus affecting the	

Position Number		Description	
Bed	**Rail**	**Combined Bed/Rail Dressing**	**Rail Dressing**
		weight transfer to the fixed rail.	
10	10	The carcass hind legs are spread thus exerting suitable lateral tension to allow the pelvis and spinal column to be split in half using a hand held cleaver or powered reciprocating saw	Common
11	11	Inspection and correlation of carcass	Common
11	11	Product disposition and treatment determined	Common
12	12	Retain rail operation	Common
12	12	After inspection all offal products are conveyed to the respective offal treatment areas	Common
13	13	The sides are trimmed to customer specification.	Common
13	13	The carcass is weighed and records provided to the customers.	Common
14	14	Carcass sides are conveyed to the breaking rail for dissection into quarters	Common
14	14	Quarters are placed into the boning room for further processing and or prepared for shipment to market	Common
15	15	White Offal Room – Receive alimentary tract from slaughter floor, separate edible intestines from paunch and remove bung. Dispose of plastic bag and rubber band to waste bin then transfer intestines to adjacent work station.	Common
16/ 17/ 18	16/ 17/ 18	Open empty contents, wash and flush, drain, and pack all organs	Common
19	19	Red Offal room – receive all thoracic organs, liver, kidneys, diaphragms, spleen, head, tongue and all other edible products.	Common
20/ 21	20/ 21	Trim, wash, drain, and pack all organs	Common
22	22	Hide-On Offal Room – receive hide on product for further treatment	Common
23	23	Trim, wash, drain, and pack all hide-on products	Common
24	24	Dispose of all condemned material as required	Common

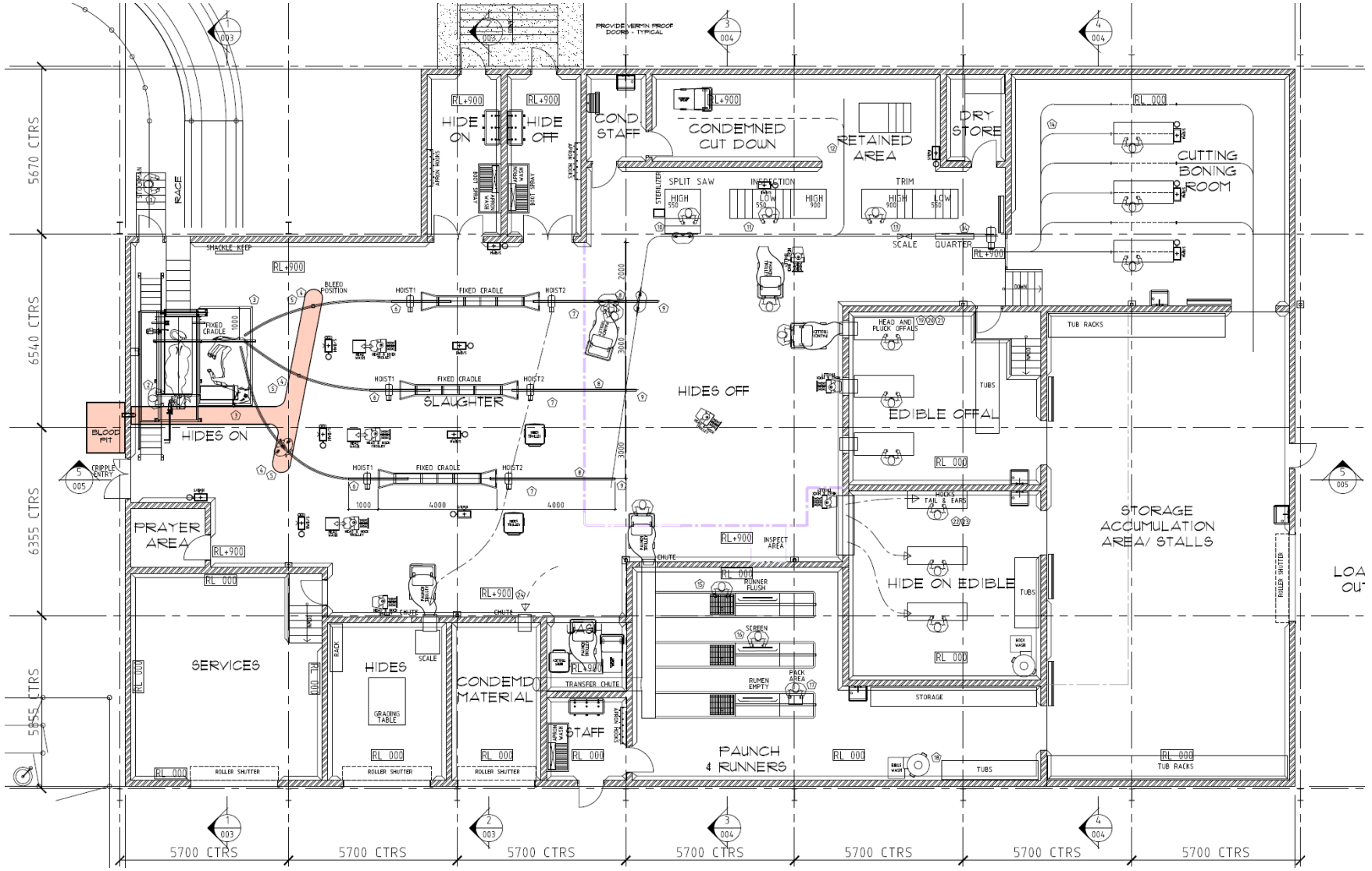

Figure No. 4: Process Layout for combined bed and rail dressing process

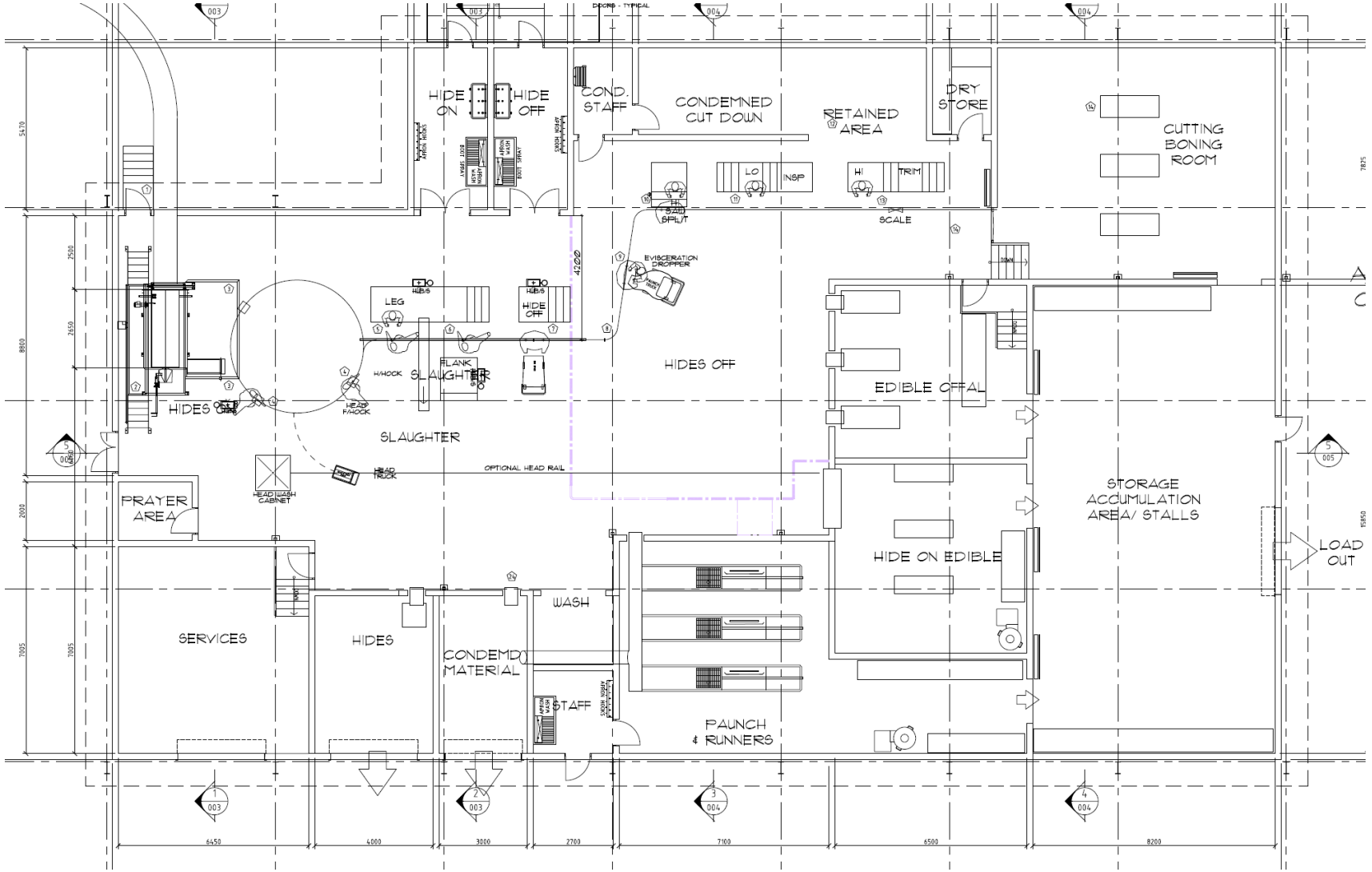

Figure No. 5: Process Layout-Rail dressing process

5. Standard operating procedures

These Standard Operating Procedures (SOPs) describe the processes required to slaughter, de-hide, eviscerate, and trim the carcass including the treatment of offal and by-products. The SOPs include a generic introduction relating to the slaughter and treatment of cattle relevant to both a rail and bed type dressing system.

5.1 Introduction

Producing a high quality carcass and meat products depends on the consistent application and operation of the systems within the abattoir complex.
The basic steps are listed above and the management of each of these procedures is made up of a number of individual steps or tasks.
All people involved in the handling and treatment of the animal and carcass have an obligation to ensure that all of the health and hygiene tasks are conducted in a manner that provides proper food safety outcomes.

Key points or requirements addressed by these SOP are:

- The animal needs to be stunned and slaughtered in accordance with the Islamic Sharia law, and OIE standards relating to animal welfare.
- The de-hiding and evisceration of the animal and carcass needs to be performed in a manner that does not allow for the cross contamination of carcass due to foreign objects, ingesta or faecal matter.
- The inspection, correlation, and disposition of animals and animal parts be performed in accordance with the Indonesian laws and regulations and can be measured against other international standards if required.
- All personal hygiene standards be strictly adhered to during the work process.
- All edible food products be conveyed in a sterilised container and be processed on a suitably designed table or stand.

Purpose and Scope

The SOPs cover pre-slaughter and slaughter of bovine animals (cattle) from the livestock holding yards to load out. The purpose is to outline the procedure for receiving, handling, stunning and slaughtering and processing livestock and to ensure that optimal efficiency and meat quality is obtained and welfare is not compromised.

The SOPs are designed to allow for safe and hygienic treatment of cattle so that the food safety and hygiene standards are instilled into the work practices. SOPs are different in scope and content to a Work Instruction (WI). An SOP is written with a general overview of what will be done and who will be responsible for making sure it gets done. A work instruction will provide specific details on how to perform a task. For example, a work instruction will give step-by step instructions on how to complete an individual task. SOPs ensure that all workers are informed of what is expected and help them perform their jobs to a described standard.

Personal hygiene requirements

A high standard of personal hygiene and health is required to prevent the transfer of micro-organisms and other contaminants (e.g. loose items) from people and their clothing/equipment to animal products. Contamination may adversely affect the

required quality of edible product. Contamination could also result in a risk to human health and reduce shelf life.

Hygiene requirements apply to all personnel handling edible product or working in edible product handling areas, personnel visiting processing areas and personnel from non-edible processing areas.

To ensure all personnel achieve a uniform standard of hygiene in production areas, all personal equipment (boots, gloves, knives etc.) and lockers must be kept in a clean and tidy condition.

Hygiene obligations or requirements of production personnel include:

- Persons engaged in the handling of exposed meat and meat products must wash their hands before commencing work and immediately after going to the toilet, smoking, coughing, sneezing, drinking or touching their hair, scalp or body opening.
- Washing hands before commencing or recommencing work and as required to comply with his or her work duties.
- The obligation to not spit, smoke, urinate, or defecate within the defined work area.
- Ensuring that open cuts, wounds, and sores are completely protected in a waterproof covering.
- Having clean and sanitised clothing and work implements.
- Storing personal items and effects in a clean place outside the defined work area.

To address hygiene issues related to hand tools it is recommended that the ‘two knife principle’ is applied. This is an operational procedure where the operator changes the knife after every initial cut through the hide, thus preventing cross contamination of foreign matter onto the underlying sterile carcass.

Hands and knives are to be washed and sterilised after each body or when they become contaminated.

5.2 Standard operating procedures-combined bed and rail dressing process

The list of operation forming the standard operating procedure for the combined bed and rail dressing process is:

1. Stockman and stockyard management.
2. Stunning.
3. Sticking.
4. Shackling.
5. Rodding.
6. Head treatment.
7. Lower to cradle.
8. Clear hide-legs and ventral portion
9. Split sternum
10. Clear hide-shoulders and flanks.
11. Bunge release
12. Remove from cradle and dehide.
13. Evisceration.
14. Split carcass.
15. Correlation and inspection.
16. Retain rail.
17. Forequarter hygiene carcass trim.
18. Hind quarter hygiene carcass trim.
19. Scales.
20. Red offal treatment.
21. White offal treatment.
22. Condemned material treatment.

SOP 1 - Stockman

Key Objectives:

- Inspecting and managing livestock.
- Anti-mortem inspections.
- Using the natural behaviour of livestock and low stress animal handling techniques to move animals to slaughter.

Task Description:

- Before unloading, stockman should check that the pens have an adequate water supply, that there are sufficient pens to hold all animal comfortably and that pens are free from sharp edges and protrusions. The responsible person should be notified immediately if the pens and facilities are not fit to receive animals.
- During unloading animals should be carefully observed. Any animals showing signs of stress or injury should be assisted from truck, or if this is not possible, be humanely destroyed. Observations for stress or injury should include:
    - Evidence of severe pain (e.g. limb fractures, extensive hide damage, localised swelling, bleeding).
    - Unable to remain resting on its sternum unassisted. Handlers may assist the animal to its sternum from lateral recumbency then watch to see if it can stay there.
    - Unable to keep its head off the ground, i.e. doesn't repeatedly let the head flop or slowly lower towards the ground.

  - Displaying signs of severe pain, such as groaning, teeth grinding, eyes closed or partly closed, little or no interest in the surroundings (noise, people etc.).
  - Overall appearance. Does the animal appear to be able, or care to control its body so as to be lying in a way that animals normally do?
  - Female animal showing signs of calving or with new born calves.
  - Any lactating female animal with calf will be isolated and held in a purpose built holding yard for further assessment.

- The Stockman supervises the cattle moving through the pens and race towards the knocking box.

- The Stockman controls the flow of cattle into the race and knocking box with the operation of manual and or automated gates.

- Throughout the shift, the Stockman must monitor the condition of the cattle, notifying a responsible person should any animal require emergency slaughter or if a deceased animal is found in the pens.

- The Stockman is responsible for separating the cattle before the door to the knocking box; ensuring one animal enters at a time. He utilises the walkway alongside the cattle race to monitor the flow of cattle through to the knocking box.

- The Stockman must check all penned cattle a minimum of once per day also ensuring that adequate feed and access to drinking water of suitable quality and quantity is available and that water troughs are clean. This task is performed by walking through the pens during operations.

SOP 2 - Stunning

Key Objectives:
- Once the animal is restrained, the stun application should be quickly applied.
- Once the animal is stunned it should be immediately released to the dry landing area for further processing.
- If not stunned correctly a second stun should be applied immediately.

Task Description
- Prior to stunning, the Operator must perform a maintenance check on the stunning device to ensure that it is functioning correctly. The operator should also have a standby device available at all times as a back-up in case of primary failure.

- All operators using stunners must be suitably trained and skilled in the correct stunning techniques to ensure all animals are stunned effectively and remain unconscious up to death following sticking. Operators will follow the stunner manufacturer's or approved supplier's recommendations that are appropriate for the type of animal stunned.

- Ensure that the stunner is operating effectively. If not, he will exchange it for another implement and not use it again until it has been adequately cleaned and/or repaired.

- Ensure that the stunner is applied to the correct position on the head of the animal.

- Ensure the replacement equipment is in position ready for use in case of ineffective stun.

- The Operator is responsible for operating the stunning device to stun each animal individually in the knocking box.

- The Operator must secure the animal's head in the head bale and chin lift so that the head is in the correct position.

- The Operator must be trained to position and apply the stunning device to the correct position on the animal's skull. The Operator must ensure the animal is effectively stunned (should it not be effective, a re-stun must occur).

- The stunned animal must remain unconscious and be presented in the correct position for the throat cut.

SOP 3 - Sticking

Key Objectives:
- Test the corneal reflex.
- To have a fully compliant Halal slaughter.
- To stick the animal immediately.
- Confirm death before moving and or dressing the animal.

Task Description:
- To confirm an effective stun, the Operator must observe lack of rhythmic breathing and absence of corneal reflex.
- The knife must be sterilised between each animal, or when contamination occurs.
- The length of the blade should be approximately twice the width of the animal's neck.
- Knives must be prepared and sharpened before the beginning of the slaughter.
- Halal slaughter person, using a pre sterilised knife, makes an incision across the front of neck close to the head, severing the carotid artery, the oesophagus and trachea, in line with Halal slaughter and OIE requirements.
- The Operator reaches down and slits through the hide on the throat, exposing the trachea and oesophagus. He then frees the oesophagus using one hand to pull the oesophagus away and the other hand to apply a clip (to ensure the stomach contents do not empty out).
- The bleeding process commences and the animal is ready to be hoisted onto the overhead rail.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through the hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 4 - Shackling

Key Objectives:
- Hoist the animal as soon as practical.
- Ensure that the animal is free of faecal contamination.

Task Description:
- Place bleeding shackle on hoist hook.
- Place the chain portion of the shackle around both hind legs, between the hoof and tarsus joint and hoist the carcass off the dry landing area.
- Wash anus, away from the body if required, using a limited amount of water to remove any faecal contamination.
- Allow animal to be lifted by a hoist to a suitable height for further processing.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or a cut is made through the hide.

Hygiene Procedures:
- Keep floor, walls and landing area in a clean condition during production.
- Ensure landing area is kept in a clean and hygienic condition.

SOP 5 - Rodding (separating oesophagus from trachea and clearing ingesta from oesophagus)

Key Objective:
- Ensure that the oesophagus is free and the clip is appropriately placed.

Task Description:
- Using pre-sterilised rod applicator, the freed portion of the oesophagus is placed in the rodder and ‘cleared’ from the trachea by pushing the rodder through to the base of the stomach.
- The rodder is withdrawn and then placed at the base of the closed oesophagus clip and the oesophagus clip is pushed to the base of the stomach. Sterilise the rodder if it becomes contaminated between these two operations.
- Using hydraulically operated hock cutters, or a conventional knife, the fore feet are removed and placed in the Head Trolley.
- Remove muzzle (if required) and lip and place in the Hide Trolley.
- Horns are removed if required.
- Using a pre-sterilised knife fleece the hide away from both cheeks and mark down either side of the tongue.
- Using a pre-sterilised knife, make an incision at the head joint on the occipital and atlas bones then severe the spinal cord and lower neck muscles to partly releasing the head. Then make an incision on one side of the tongue to allow application of the head hook.
- The head is fully released and place in the head work up cabinet for further processing.
-

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 6 - Head treatment

Key Objectives:

- Remove the hide, ears and face piece, ensuring that the head is free of any hide, hair or any other foreign matter.
- Prepare the head and tongue for inspection.

Task Description:

- The hide, ears, face piece and eyelashes, on the head are to be removed and placed in the Hide Trolley.
- Using a resterilised flushing tong (hand held water gun with two outlet nozzles), flush the nasal, buccal and oral cavities to remove any ingesta and/or vomitus.
- Using a resterilised knife the tongue is removed ensuring the glands are kept on the tongue for inspection.
- The tonsils are then removed and placed into the condemned container and conveyed to the condemned room.
- The head (inside/outside) and tongue are then washed.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 7 - Lower to cradle

Key Objective:

- Place the carcass onto the cradle without contaminating dressed portions of the animal

Task Description:

- After the animal has been allowed to bleed out, the carcass is lowered onto the fixed bed dressing platform which consists of two parallel pipe supports mounted approximately 400 to 500 mm above the ground.
- Care should be taken that no part of the exposed cranial dressed portions of the animal touches the ground or any portion of the bed dressing apparatus during the transfer.
- Using a pre sterilised knife, the hind hocks are removed and placed on the head and hock trolley.
- Using a pre sterilised knife, the external reproductive organs such as the pizzle, testes, or udder are removed and placed onto the Viscera Trolley.
- Using a pre sterilised knife, the hide surrounding the throat region of the carcass is cleared to allow for the release of the oesophagus and wind pipe (trachea).

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 8 – Clear hide-legs and ventral portion

Key Objective:
- Clear the hide from the legs and ventral portion of the animal ensuring minimal contamination.

Task Description:
- Using a pre sterilised knife the hide is cleared from around the fore and hind legs ensuring that the underlying carcass tissue is free from external contamination.
- Using a pre sterilised knife, the hide is cleared from the ventral portion, namely the sternum, and belly portion of the carcass with particular care in releasing the red bark (M cutaneus trunci)and rim (heavy connective tissue encapsulating the muscle groups).

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 9 - Split sternum

Key Objective:
- Ensure that the brisket bone is split without any damage or spillage to the paunch positioned directly above the cutting line.

Task Description:
- Using a pre sterilised knife, the sternum fat is marked exposing the underlying bone.
- With a pre sterilised hand saw or cleaver, the sternum bone is split through from the navel to point end with particular care being taken not to burst the paunch with the saw.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 10 - Clear hide-shoulder and flanks

Key Objectives:
- To remove the hide without contaminating the carcass.

Task Description:
- Using a pre sterilised knife, the hide is cleared from around the lateral portion of each side of the carcass namely the rosettes (shoulders) and flanks.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of 'Two Knife Principle'.

SOP 11 - Bung release

Key Objectives:
- To release the bung while preventing any faecal contamination.

Task Description:
- Using a pre sterilised knife, the hide over the rump and the bung is released, from the anal cavity. The rectum is pulled up free of the anal cavity (taking care not to touch the exposed rump area) and the knife is placed back in the steriliser. A plastic bag is then pulled down over the rectum.
- A rubber band is then applied to the bag to ensure that no contamination can occur. The bagged rectum is then pushed back into the anal cavity.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body, when they become contaminated or if a cut is made through the hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment and washing of hands.

SOP 12 – Remove from cradle and dehide

Key Objectives:
- To remove the hide without contaminating the carcass.
- To remove the carcass from the dressing cradle without contaminating the carcass
- Ensure that the carcass has been prepared for evisceration.

Task Description:
- To complete the de-hiding process the hide on either side of the carcass (at the caudal aspect of the hide) is clamped to the bed dressing apparatus.

- To facilitate the raising of the carcass, a spreading rail is attached to each of the slides that are inserted behind the shin and in front of the Achilles tendon of the hock.
- The carcass is raised off the bed dressing cradle using an overhead powered or manual winch. Care should be taken to ensure that no part of the exposed carcass tissue touches the surrounding frame.
- As the carcass is lifted from the bed dressing cradle, operators on either side of the carcass should flay the hide from the underlying sub cutaneous fat and connective tissue.
- The hide is dropped into the Hide Trolley which is a suitably placed bin under the carcass for transfer to the hide treatment area.

Sterilisation Procedures:

- Hands and forearms are to be washed with soap and knives are to be washed and sterilised after each body and or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 13 - Evisceration

Key Objectives:

- To remove the alimentary tract without any ingesta or faecal contamination.
- The lumbar and thoracic organs are removed separately.

Task Description:

- A Viscera Trolley is positioned below the hanging carcass.
- The carcass is moved away from the dressing cradle and raised approximately one metre above the floor thus allowing the Viscera Trolley to be positioned under the carcass.
- Using a pre sterilised knife, the carcass is opened by a cut commencing at the aitchbone (Os Coxae) to the lower position of the flank steak then reverse the knife so the blade is pointed out and continue down to the brisket. Care must be taken to ensure flank steak is split evenly and that the paunch is not cut. The rectum is pulled free of the anal cavity with care to avoid bursting the bladder.
- The paunch and intestines are pulled from the body and placed into the Viscera Trolley. They are placed in such a manner that the stomach and intestine do not obscure each other allowing visual examination of the intestines and mesenteric lymph nodes and the rumen and reticulum. The oesophagus and spleen will be also presented uppermost allowing for these products to be visually examined.
- When kidneys are not being saved they must be presented for inspection fully intact and enucleated on the inspection station side of the viscera table for visual and palpation examination.
- Care must be taken to ensure that livers are presented free of any pancreas gland but with portal lymph nodes attached.
- The thoracic viscera (heart, lungs and connecting tissue) is removed in its entirety, (subject to any pathological defects preventing full removal) and placed on the Viscera Trolley.

- The operator and person separating the pluck are to ensure that all portions of offal have their required lymph nodes left in situation, i.e. when diaphragm is removed from the pluck the mediastinal lymph nodes remain on the lungs.
- The contents of the carcass along with the other elements of the animal are now available for correlation and inspection by the veterinary staff
- The Viscera Trolley is then transferred to the offal area and another clean Viscera Trolley positioned for the next carcass.
- Following evisceration, the carcass is raised to just above fixed rail height and lowered gently onto the rail for further treatment. After the weight transfer to the slides the spreading rail is removed and place into position for reuse.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body, when they become contaminated.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment and washing hands and use of the 'Two Knife Principle'.

SOP 14 - Carcass splitting

Key Objective:
- Ensure that the carcass is split down the centre and that no soft siding (off centre splitting) occurs.

Task Description:
- To facilitate the splitting of the carcass the legs of the carcass are spread thus exerting lateral tension on the spinal column.
- On a platform, at the correct working height, the tail is jointed between sacral and coccygeal vertebra and placed onto the respective trolley for further treatment.
- A pre-sterilised saw or cleaver is placed above the aitchbone in the middle line of the backbone and the carcass is sawn or split evenly down to the neck ensuring that there is no soft siding of the carcass.

Sterilisation Procedures:
- Hands and knives and any process equipment are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.

SOP 15 - Inspection and disposition

Key Objectives:
- Unwholesome meat is excluded from the human food chain and disposed of separately.
- Condemned material to be secured and incinerated.

Task Description:
- Post-mortem inspection of each carcass and its carcass parts is carried out by an appropriately qualified meat inspector and or veterinary officer.
- The following parts of the animal should be presented for inspection:

  - Carcass.
  - Other carcass parts intended for human consumption (eg. head, heart, lungs).
  - Inedible carcass parts which must be inspected in order to establish whether edible carcass parts may be affected by disease or other abnormality (eg. feet, udder and reproductive organs).
- Correlation – carcass and carcass parts are not to leave the floor until a post mortem inspection and disposition is applied.
- The following dispositions are applied to carcass and carcass parts:
  - Passed fit for human consumption.
  - Retained for final disposition.
  - Unfit for human consumption but may be recovered for a non - edible use animal food and or pharmaceutical material.
  - Condemned.
  - Passed fit for human consumption but require further treatment.
- Carcass and carcass parts that are condemned as unfit for human consumption must be separated and collected in a suitably marked bin or trolley and conveyed to the condemned area for disposal and incineration.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body, when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.

SOP 16 - Retain rail operations

Key Objective:

- For the further treatment of any non-compliant carcass.

Task Description:

- If a carcass and or side is found to be non-compliant and requires further assessment and or treatment then the carcass is retained by the meat inspector and or veterinarian.
- Follow the scanning or inspection procedures as outlined in table 2 below.

Table 2 – Carcass Inspection Criteria

Scanned Region	Specific Features	Defects
Hock	Tendon, hook hole, and shank	Hair, hide, grease, and rail dust, stains.
Hindquarter External surface	Tail area, butt, and loin, flank and rump topside outside.	Grease, hair, rust, hide, pizzle butts, faeces, urine, innoculation abscesses, milk stains, bruises, stains and extraneous material.
Forequarter External surface	Rib plate, chuck, neck, outside of briskets.	
Hindquarter Inside	Butt, aitch bone, pelvic canal, pizzle, rectal mucosa cod fat, spinal column lumbar area, abdominal surfaces, peritoneum.	Grease, hair, rust, hide, faeces, urine, milk stains, blood clots, remnants of organs, and mature udders, bone fragments bruises and spinal cord.
Forequarter Inside	diaphragm, thorax, spine, neck, inner forearm, end Of shank, brisket and Pleura	Grease, hair, rust, hide, faeces, ingesta, urine, milk stains, bruises, innoculation, abscesses and extraneous material.

- Carcass and carcass parts that are condemned as unfit for human consumption must be separated and collected in a suitably marked bin or trolley and conveyed to the condemn area for disposal and incineration.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 17 - Forequarter hygiene trim

Key Objective:

- Check for hygiene defects and trim as required.

Task Description:

- After inspecting the areas on the forequarter remove any contamination. Specific attention to zero visual tolerance for faeces, ingesta, and milk spillage.
- Forequarter external surface: Check the rib plate, chuck, neck and outside of briskets for grease, hair, rust, hide, faeces, ingesta, milk stains, bruises, inoculation abscesses and extraneous material.
- Forequarter inside: Check the diaphragm, thorax, spine, neck, inner forearm, end of shank, brisket and pleura, spinal column for grease, hair, rust, hide, faeces, ingesta, milk stain, bruises, broken ribs, pieces of trachea and lung.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 18 - Hindquarter hygiene trim

Key Objective:

- Check for hygiene defects and trim as required.

Task Description:

- After inspecting the areas on the hindquarter remove any contamination. Specific attention to zero visual tolerance for faeces, ingesta and milk spillage.
- Hock external surface: Check the tendon, hook hole and the shank for hair, hide, grease, faeces, rail dust or stains.
- Hindquarter external surface: Check the tail area, butt, loin, flank, rump, topside and outside for grease, hair, rust, hide, faeces, inoculation abscesses, milk stains, bruises, stains and extraneous material.
- Hock inside: Check the tendon, hook hole and the shank for hair, hide, grease, rail dust or stains making sure you lift up tail tag bag.
- Hindquarter inside: Check the butt, aitch bone, pelvic canal, rectal mucosa, cod fat, spinal column, lumbar area, abdominal surfaces and peritoneum for grease, hair, rust, hide, faeces, milk stain, blood clots, remnants of organs, mature udders, bone fragments, bruises and spinal cord.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 19 - Scales

Key Objective:

- Weigh, grade and record each carcass.

Task Description:

- Check weigh scales using stamped weights before commencing production on a daily basis.
- Weigh and record the carcass weights as required.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.

SOP 20 - Red offal treatment

Key Objective:

- To trim, wash, drain, and pack product.

Task Description:

- All red offal items are removed from the Viscera Trolley via an offal chute onto the treatment table in the Red Offal Room.
- Check product for any hygiene defects. If defects are found then remove.
- Trim product to required specifications.
- Offal including thick and thin skirts, spleens, kidneys, tongues, lips, hearts, lungs, trachea, oesophagus, livers, tails (hide off) and all other edible body parts are to be washed and drained before carrying out the next procedure.
- The skin off head and jaw will be trimmed if required and washed. Drain prior to disposal.
- Pack chilled offal onto pre cleaned and sterilised white plastic trays and or bags for storage.
- Kidney, channel, and body fats are packed into plastic bags and or cartons for disposal.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.

SOP 21 - White offal treatment

Key Objective:

- To trim, wash, drain, and pack product.

Task Description:

- Separation of the Paunch
  - Receive paunch from slaughter floor, via an offal chute onto the treatment table in the white offal room.
  - Separate edible intestines from paunch and remove bung. Dispose of bag and rubber band to waste bin then transfer intestines to another part of the processing table.
  - Pull omasum (bible) away from the paunch by hand, then cut between abomasum and omasum and transfer to another part of the processing table.
  - Remove any excess fat and oesophagus from the paunch. Place the oesophagus clip to waste bin and position paunch over pit.
  - Open paunch by cutting along the blood line, empty contents in pit, then place over wash post and apply water.
  - After wash transfer to drainage portion of the table.
  - Table to be washed down after each paunch set.

  Omasum (bible)
  - Trim to remove excess fat.
  - Cut in half, transfer pieces to the bible washing machine and press the cycle start button.

- Check to ensure that omasum is clean. If dirty, place back into degreaser machine. If clean, trim to customer specification and place for drainage
- Bible pieces are packed into suitable container for disposal.

Separation of the Large and Small Intestine

- Operator receives crown set (Mesenteric/intestinal tract) and intestines and places onto the holding table.
- Operator separates the large and small intestine from the crown set by hand.
- Remainder of crown set is washed and drained.
- Operator places large and small edible intestine into a flushing trough.
- Large and small intestine is then attached to the flushing tube where water is applied and contents flushed.
- After flushing, operator splits open large intestine using a cutting blade or hand then transfers to a drainage table.
- Pack offal onto pre cleaned and sterilised white plastic trays and or bags for storage prior to disposal.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.

SOP 22 - Hide-on offal treatment

Key Objectives

- Process any hide on product.
- Trim, wash, drain, and pack product.

Task Description:

- Receive hide-on product from slaughter floor, via a counter onto the treatment table in the hide-on offal room.
- The hoofs are individually washed and drained.
- The hide-on tail is washed and drained.
- Pack product into pre cleaned and sterilised white plastic trays and or bags for storage.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.

5.3 Standard operating procedures- rail dressing process

The list of operation forming the standard operating procedure for the rail dressing process is:

1. Stockman and stockyard management.
2. Stunning.
3. Sticking.
4. Shackling.
5. Rodding.
6. Head treatment.
7. First leg
8. Change over and second leg
9. Flanking
10. Rump and bung tie
11. Hide removal
12. Brisket splitting
13. Evisceration.
14. Split carcass.
15. Correlation and inspection.
16. Retain rail.
17. Forequarter hygiene carcass trim
18. Hind quarter hygiene carcass trim.
19. Scales.
20. Red offal treatment.
21. White offal treatment.
22. Condemned material treatment.

SOP 1 - 3

As per combined bend and rail dressing process.

SOP 4 - Shackling

Key Objectives:

- Hoist the animal as soon as practical.
- Ensure that the animal is free of faecal contamination.

Task Description:

- Place bleeding roller on hoist hook.
- Place the chain portion of the shackle around right hind leg, between hoof and tarsus joint and hoist the carcass off the dry landing area.
- Wash anus, away from the body if required, using a limited amount of water to remove any faecal contamination.
- Allow animal to be lifted by a hoist to a suitable height for further processing.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated or a cut is made through the hide.

Hygiene Procedures:

- Keep floor, walls and landing area in a clean condition during production.

- Ensure landing area is kept in a clean and hygienic condition.

SOP 5 - Rodding (separating oesophagus from trachea and clearing ingesta from oesophagus)

As per combined bend and rail dressing process.

SOP 6 - Head treatment

As per combined bend and rail dressing process.

SOP 7 - First leg

Key Objective:
- Clear the hide from the hind leg ensuring minimal contamination.

Task Description:
- Commencing at the cod area, a cut is made through to the anus. Sterilise knife and make a second cut around the other side of the anus.
- After this cut the knife is placed in the steriliser and a pre-sterilised knife is used for a cut commencing behind the cods in a straight line to the navel.
- Using a pre-sterilised conventional knife, the external reproductive organs with the pizzle are cleared as close to the anus as possible and through to the navel and placed in the Viscera Trolley. With cows, the udder is skirted and the cut is continued in a straight line to the navel and placed in the Viscera Trolley. The knife is replaced with a pre-sterilised knife and the udder is then cut from the animal ensuring no milk is spilt. The lymph nodes in the area of the cod and udder are to remain intact and on the carcass for inspection. The knife is then replaced to the steriliser?
- Starting at the top of the Achilles tendon, a strip of hide is cut from the back of the foot to the dewclaws. This strip is placed between the toes to prevent contamination. The knife is rinsed of hair and placed in the steriliser.
- Starting in the middle of the leg a cut is made to the tip of the Achilles tendon, using the tip of the knife clear the inside of the hock.
- The next operation is carried out using a second pre-sterilised knife working downwards, from the initial cut; the hide is removed from the inside of the leg to the navel. Clear outside of the hock and remove tendon.
- Any milk spillage, faecal contamination or hair is to be removed by cutting of with a sterilised knife before the carcass moves to the next workstation.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the ‘Two Knife Principle’.

SOP 8 – Changeover and second leg

Key Objective:
- Clear the hide from the hind leg ensuring minimal contamination.

Task Description:

- A clean functional slide is inserted behind the shin and in front of the Achilles tendon.
- The slide is then placed on the rail.
- The second leg is then lowered; the shackle is removed from the hock.
- Using a pre-sterilised knife, starting at the top of the Achilles tendon, a strip of hide is cut from the back of the foot to the dewclaws.
- Using a pre-sterilised knife, the hide is opened from the centre of the leg drawing the knife back to the tip of the Achilles tendon and clearing the inside of the hock.
- The next operation is carried out using a second pre-sterilised knife working downwards from the initial cut. The hide is removed from the inside of the leg to the navel. Clear outside of the hock and remove tendon.
- Wash hands before commencing de-hiding the outside of the leg.
- Using a sterilised knife the outside of the leg is then skinned back to the stifle joint.
- Any faecal contamination or hair is to be removed by cutting of with a sterilised knife.
- Using hock cutters or a conventional knife the hock is removed and placed in an appropriate bin for transfer.
- A clean functional slide is inserted behind the shin and in front of the Achilles tendon. The slide is then placed on the rail.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the ‘Two Knife Principle’.

SOP 9 - Flanking

Key Objective:

- Clear the hide from the hind leg ensuring minimal contamination.

Task Description:

- Using a pre-sterilised knife the hide is opened, cutting inside out, down to the point of the brisket. The knife is washed and placed in the steriliser. All visual contamination to be removed before proceeding.
- Using a sterilised knife the hide is opened exposing the flank down to the point of the brisket ensuring that red-bark remains on the carcass.
- The hide is then opened on the opposite side exposing the flank down to the point of the brisket.
- The rosettes and shoulder portion on each side of the carcass is cleared ensuring that the red bark (M cutaneus truni) and connective tissue is freed.
- Any faecal contamination or hair is to be removed by cutting before the carcass moves to the next workstation.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 10 - Rump and bung tie

Key Objectives:
- Ensure that all fat selvage (sub cutaneous fat) is cleared from the hide.
- No faecal contamination.

Task Description:
- Using a pre-sterilised knife and starting at the tail side of the anus a strip of hide is partially removed from the underside of the tail leaving a section of hide at the end of the tail.
- Using a pre-sterilised knife, the tail switch is removed and placed in a container for disposal.
- The anus is held with a plastic bag covered hand and freed, by cutting with a pre-sterilised knife, from the anal cavity. The rectum is pulled up free of the anal cavity (taking care not to touch the exposed rump area) and the knife is placed back in the steriliser, then the plastic bag is pulled down over the rectum.
- A rubber band is then applied to the bag to ensure that no contamination can occur. The bagged rectum is then pushed back into the anal cavity.
- Using a pre-sterilised knife the hide is then cleared from both rump areas.
- Any faecal contamination or hair is to be removed, by cutting before the carcass moves to the next workstation.

Sterilisation Procedures:
- Hands and knives are to be washed and sterilised after each body or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:
- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of 'Two Knife Principle'.

SOP 11 - Hide removal

Key Objectives:
- Clear and remove the hide from the lateral and dorsal regions of the carcass with the minimal contamination to the underlying carcass.
- Ensure that the carcass has been prepared for evisceration.

Task Description:

The hide can be removed manually or mechanically dependent on production volumes.

Manual Hide removal
- Working in unison the two operators positioned on platforms each side of the carcass and using a pre-sterilised conventional or air knife clear the hide from the lateral portions of the loin and thoracic regions of the carcass.

- The hide is allowed to fall into a prepositioned hide trolley under the work station.
- The cutting implement is washed and placed in the steriliser. All visual contamination to be removed before proceeding.
- Any faecal contamination or hair is to be removed by cutting before the carcase moves to the next workstation.

Mechanical hide removal

- Using a simple rotating drum and chain pulling arrangement the hide is attached at the hind leg/hock region of the hide and pulled taut.
- Working in unison the two operators positioned on platforms each side of the carcass and using a pre-sterilised conventional or air knife clear the hide from the body as the drum rotates allowing the hide to fall into a pre-positioned hide trolley.
- The cutting implement is washed and placed in the steriliser. All visual contamination to be removed before proceeding.

- Any faecal contamination or hair is to be removed, by cutting, before the carcase moves to the next workstation.

Sterilisation Procedures:

- Hands and forearms are to be washed with soap and knives are to be washed and sterilised after each body and or when they become contaminated or if a cut is made through a hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment, washing of hands and use of the 'Two Knife Principle'.

SOP 12 - Brisket splitting

Key Objective:

- Ensure that the brisket bone is split without any damage or spillage to the paunch positioned directly above the cutting line.

Task Description:

- Using sterilised hydraulically operated reciprocating saw or a conventional hand saw the brisket bone is sawn through from the navel to point end with particular care being taken not to burst the paunch with the saw. The saw is then dipped in a cold water wash tub and then sterilised in a hot water steriliser.
- Any faecal contamination or hair is to be removed by cutting not scraping, before the carcass moves to the next workstation.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body, when they become contaminated or if a cut is made through the hide.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment and washing of hands.

SOP 13 - Evisceration

Key Objectives:

- To remove the alimentary tract without any ingesta or faecal contamination.
- The lumbar and thoracic organs are removed separately.

Task Description:

- A Viscera Trolley is positioned below the hanging carcass.
- The carcass is positioned on the fixed rail thus allowing the Viscera Trolley to be positioned under the carcass.
- Using a pre sterilised knife, the carcass is opened by a cut commencing at the aitchbone (Os Coxae) to the lower position of the flank steak then reverse the knife so the blade is pointed out and continue down to the brisket. Care must be taken to ensure flank steak is split evenly and that the paunch is not cut. The rectum is pulled free of the anal cavity with care to avoid bursting the bladder.
- The paunch and intestines are pulled from the body and placed into the Viscera Trolley. They are placed in such a manner that the stomach and intestine do not obscure each other allowing visual examination of the intestines and mesenteric lymph nodes and the rumen and reticulum. The oesophagus and spleen will be also presented uppermost allowing for these products to be visually examined.
- When kidneys are not being saved they must be presented for inspection fully intact and enucleated on the inspection station side of the viscera table for visual and palpation examination.
- Care must be taken to ensure that livers are presented free of any pancreas gland but with portal lymph nodes attached.
- The thoracic viscera (heart, lungs and connecting tissue) is removed in its entirety, (subject to any pathological defects preventing full removal) and placed on the Viscera Trolley.
- The operator and person separating the pluck are to ensure that all portions of offal have their required lymph nodes left in situation, i.e. when diaphragm is removed from the pluck the mediastinal lymph nodes remain on the lungs.
- The contents of the carcass along with the other elements of the animal are now available for correlation and inspection by the veterinary staff
- The Viscera Trolley is then transferred to the offal area and another clean Viscera Trolley positioned for the next carcass.

Sterilisation Procedures:

- Hands and knives are to be washed and sterilised after each body, when they become contaminated.

Hygiene Procedures:

- Maintain equipment and clothing in a hygienic state during production.
- Maintain hygiene procedures by regular sterilisation of equipment and washing hands and use of the ‘Two Knife Principle’.

SOP 14 - 21

As per combined bend and rail dressing process.

6. Capacity statement

6.1 Introduction

The objective of this capacity statement was to define the capacity and functional requirements of the Stage One concept abattoir design.

It is intended that the facility be primarily designed to serve a local wet market. The design was not intended to meet the design standards needed to achieve the export requirements for international (EU or USDA) markets given that it is a non-refrigerated plant. However the process design will allow for future development that could bring the plant to international standards if required.

This capacity statement defines the function and capacity of the primary abattoir elements of the facility only.

6.2 Pre slaughter

The abattoir is to process local cattle or imported cattle fattened in feedlots by local farmers. Live animal weight is assumed to be in the range of 350kg to 550kg with 600kg being a possibility.

Unloading Ramp

A ramp of a suitable height and constructed with a non-slip base and free of sharp protrusions that could injure animals would be required to allow cattle to be unloaded safely from a truck. Fencing will guide cattle from the receiving area to the holding yards.

Holding Pens or Lairages

Indonesian regulations (Number 13/permantan/OT.140/1/2010) require holding pens adjacent to the slaughter floor be sized to provide a minimum of 1.5 days production. This equates to a minimum of 30 cattle in the case of 20 head per night, expandable to a minimum of 75 in the case of 50 head per night. However, Indonesian abattoir holding yards are typically required to hold cattle for butchers for much longer periods than one or two days. The ability to feed and water these cattle for this extended period is required. The necessary holding yard capacity will therefore be dependent on typical norms for the region. In addition to providing adequate overall holding capacity, there is also a need to separate the cattle belonging to the various butcher groups.

The size of each holding pen should allow approximately 1.8m^2 area per animal and provide independent access to the raceway leading to the restraining box. The holding pens should be located at least ten metres from the slaughter floor. The yards should provide for watering and feeding stock. They should have a concrete base sloped away from watering and feeding access to a formal drainage system leading to effluent treatment. They should be arranged to allow for anti-mortem inspection of animals by the appropriate veterinarian. The floor of the holding pens should have a herringbone pattern to provide a non-slip surface for stock while allowing drainage. The yards are to be roofed so that animals are protected from exposure to adverse weather conditions. It is expected that the

yards will be manually cleared of manure with a shovel and scraper at regular intervals. The yards roof will have open sides and a vented ridge to allow natural ventilation and air circulation. Roof runoff will be separately drained from manure and effluent.

Suspect Pen / Isolation Yard

An isolation yard or suspect pen is required for animals identified as requiring further veterinary examination. This yard will be located separately from the holding pens to reduce the risk of spread of disease. The construction requirements for the isolation yard are the same as for the holding yards. The capacity of the isolation yard should be three to five animals. A crush will be provided as part of the isolation yard to allow the veterinarian to conduct a proper ante-mortem examination of animals identified as suspect. A hand wash basin and equipment locker will be provided for the veterinarian adjacent to the crush.

Reproductive Female Yard

Indonesian regulations require a special holding area for female cattle which have calved during their period in the holding yards. The construction requirements for this special area are the same as for the holding yards and should form part of the normal holding yards. In this way, the yard space allocated for this purpose can be expanded or contracted as required to match demand. The yard is to be clearly signposted when used for this purpose, and one yard should have a pen for reproductive status examination. The yard perimeter fence should have additional rails near ground level to prevent calves from escaping. An allowance should be made for ten animals with calf.

Livestock Races

The movement of livestock from the holding pens to the slaughter facility will be fenced with steel posts, mid rails and fitted with gates at convenient centres. The raceway will consist of curved sections on the level areas and straight sections where there is an incline. It will have a non-slip concrete base with appropriate steps on ramp areas, and stockman access along its whole length. It may be a requirement to have three small pre slaughter holding yards for two or three animals each just prior to the main slaughter building for better sequencing of cattle and to comply with cattle handling procedures as defined by the ESCAS standards.

6.3 Restraining device / dry landing area

It is recommended that a single ESCAS approved restraining box be used and oriented correctly for Halal. The restraining box will operate with the animal stunned prior to slaughter using a non-penetrating stunner that meets the requirements for Halal slaughter. The movement of cattle in races to the restraining box and subsequent stunning will comply with OIE and ESCAS guidelines.

In the case of multiple butcher groups, the race, restraining box, stunner and dry landing area will be communal or shared facilities. Use of the box will need to be sequenced with each butcher group having an agreed timeslot for slaughter.

6.4 Slaughter floor

Many Indonesian abattoirs, whether privately or state owned, operate by charging independent butcher groups a fee for use of the facility for the butchers to process their own cattle. Typically, multiple butcher groups would use the facility at the same time with minimal sharing of equipment or facilities. For example, in many abattoir operations there are two to four restraining devices that are serviced by separate cattle races and yards thus allowing these butcher groups to use the facility at the same time. Furthermore, during certain religious periods the daily production requirement may be ten times the normal throughput. While this duplication of infrastructure provides for this peak demand, it is a cultural issue rather than a structural or operational issue and can be overcome with proper design and some flexibility in production scheduling. In providing a design that is cost effective, we must also offer a practical alternative that can meet the expectations of the users.

6.4.1 Combination bed and rail dressing process

Current practice is for various butcher groups to use the abattoir facility at different times to spread its use over the evening, typically six to eight hours commencing at about 9.00 pm. Depending on the number of cattle to be processed by each butcher group, many more than three groups could use the facility over the evening.

Due to the significant capital cost of a restraining box and stunner, and the low average utilisation, it is proposed that only one restraining box and stunner be provided and shared between butcher groups. Depending on the time allowed for the animal to bleed out on the dry landing area following slaughter, the frequency at which animals could be processed through this shared part of the facility is approximately one animal every four to five minutes. This equates to a rate of twelve to fifteen animals per hour or 100 to 120 per eight hours of operation. Average utilisation would be between 42% and 52% based on 50 head per night.

The low utilisation should mean that the frequency of scheduling issues where two or more butcher groups want to use the same facility at the same time is low. Even in the event of a scheduling conflict, the wait time for the facility to become available for use by another butcher should be minimal.

It should be pointed out that a properly designed restraining box can process up to a 100 cattle per hour and be fully compliant with the Halal slaughter requirements. It therefore follows that such a capacity should be better utilised by serving three separate cradle slaughtering systems simultaneously. To allow for a quick transition from the dry landing area, a separate area for the hoisted carcass to bleed out will be provided for each of the cradles. This is an important feature of the process in a number of ways:

- Under the guidelines of Halal assurance criteria on slaughter houses HAS 23103 the animal must not be treated until the animal is dead as defined in clause 10.4 post slaughter procedures,
- That after the appropriate bleeding time the carcass can be butchered in a much more conventional manner and be fully compliant with international processing standards.

- As the carcass has been elevated into a vertical position it can be conveyed to the fixed cradle system in a way that minimises cross contamination and again is fully compliant to international standards.
- By moving the carcass from the dry landing area the restraining box can be used immediately to service the other cradle systems.

The fixing of the cradle to the floor will ensure that the process is controlled and repeatable with respect to the relative position of the cradle to the hoist beam, hand wash basin, steriliser and other work areas. The animal is at a convenient and ergonomic work height, and many butchers can work on the animal at the same time.

Time required to dress an animal on a cradle with four butchers is less than fifteen minutes. This equates to a rate of at least four per hour or 32 per eight hours of operation. Three cradles fully utilised would therefore be able to process 100 carcasses in eight hours of operation. For the expected 50 head per night, this gives a cradle utilisation of 52%. Even assuming two butchers use each cradle and can process an animal in say twenty minutes, this equates to three head per hour, 24 head in eight hours of operation or 72 head for all three cradles fully utilised.

Shared carcass handling facilities after the cradle dressing process are the common hot carcass rail, splitting area, inspection area, trim area, carcass scale and rail into the boning/carcass portioning area. It is expected that carcasses will occupy these shared facilities for only a very short time.

6.4.2 Rail dressing process (alternate system)

The abattoir facility will be arranged to handle all animals on a single rail with workstations and platforms provided to allow specific operations to be performed in specific locations. The rail process will occupy the same floor plan as the cradle process, but will utilise more equipment. There are two modes of operation for this type of rail dressing system.

Batch Operation
This mode of operation involves multi-skilled butchers from different butcher groups following their particular animal or animals through the dressing process. They would move from workstation to workstation as the carcass progresses along the rail. The efficiency of the rail system can be realised while still allowing small butcher groups to retain control and ownership of their animals and the products generated.

Continuous Operation
This mode of operation is more suitable for an abattoir owner or operator who employs butchers to operate the process. Each butcher would operate a particular workstation and perform the same tasks on each animal or carcass. The abattoir would perform service kills for its clients at a higher throughput and potentially with more equipment and labour efficiency.

Expected rate or throughput of a rail dressing system, whether batch or continuous, depends on the number of work stations employed. It is therefore quite conceivable that a rail system could process up to 200 head per shift if manned correctly and had the support services and other related infrastructure to maintain this production rate.

6.5 Carcass processing

Following the dry landing area, the cradle/bed and rail processes diverge. However, the combined bed and rail operation and the rail dressing operation, would both be able to be accommodated within the same basic slaughter floor footprint. This means the development of the abattoir from a combined bed and rail process to a rail process could be achieved within the same slaughter floor building, and only require the installation of new equipment and material handling systems.

In both the combined bed and rail dressing process (per Fig. No. 3) and rail dressing process (per Fig. No. 2), fixed platforms would be provided to enable ergonomic access to the carcass for all tasks. Additionally, hand wash basins (45°C), knife sterilisers (85°C) and apron wash facility (45°C) would be provided at designated locations (per Drg. #18) to permit personnel to sanitise between animals and between skin opening and internal cuts. Sterilisers will also be provided for the cleavers or saws used to split the brisket and carcass. Separate staff entries will be provided for access to 'Hide On' and 'Hide Off' areas that include boot bath, apron, equipment and hand wash facilities Per Fig. No. 4).

The layout of the abattoir has been arranged to provide a smooth flow of product from the slaughter floor to the associated co-product and processing areas such as the hide room, offal areas, trolley wash area, inspection and boning rooms with the minimum of crossed paths and with open access to all areas. The height of the roof structure will allow for support of the monorail beam from the dry landing area to the cradles at a level of 5000 mm to top of beam. The carcass rail will be lower at 3300 mm to top of rail.

Rooms and areas provided adjacent to the slaughter floor are:

- Services (water heater, air compressor, pumps, etc.).
- Hide room.
- Offal rooms (red, white and hide-on).
- Staff entries (separate hide on and hide off).
- Prayer room.
- Condemned product room.
- Retain area.
- Wash area (for hooks, trolleys and other equipment).
- Dry store.
- Boning room.
- Storage/accumulation area.
- Despatch area and office.

These rooms and areas are clearly identified in Figure No. 4.

Offal Collection

The process of using trolleys for offal and by-product collection and transport is the same for both the bed dressing process and rail dressing process. The hide, hocks, head, tail and viscera are to be collected on three specially designed manual trolleys. Three separate offal treatment and handling areas isolated from the slaughter floor will be provided. These are nominated as red offal, white offal and hide-on offal areas. The disposition of the offal and by-products into each of the trolleys and their onsite processing destination is detailed below:

Viscera Trolley:

- Gut in a lower basin of trolley — White offal area
- Pluck on an upper shelf — Red offal area
- Tail (hide-on) on an intermediate level — Hide-on offal area

Head Trolley:

- Head on a hook at the top — Red offal area
- Tongue on hook near the head — Red offal area
- Feet separated from head by barrier — Hide-on offal area

Hide Trolley:

- Hide on low tray — Hide room

Use of these trolleys will facilitate correlated veterinarian inspection of the carcass and offal products, as well as ergonomic movement of products around the slaughter floor. Note that the design of the Head and Viscera Trolleys will facilitate cleaning and ongoing hygienic operation. After discharging the by-products at their respective destinations and before use on another animal, the trolleys are to taken to the wash bay to be rinsed with cold water to remove any blood and then sterilised with 85°C water.

The trolleys will have various hooks, platforms and basins to contain the offal and ensure by-products are clear of each other to prevent cross contamination. The offal handling areas will be at a level approximately 900 mm lower than the slaughter floor (per Drg. #13 and #14) and the trolleys will be of a tipping type enabling the heaviest elements (especially gut and hide) to be ergonomically discharged through a hatch onto a working height processing bench.

As a principle, facilities and space will be provided at the abattoir to enable all offal which could be expected to be used for human consumption to be handled and treated as edible product to acceptable international food hygiene standards.

Offal and by-product processing on site is to be limited to:

- Separate and trim
- Wash and clean
- Drain
- Pack

Offal preparation tables are provided for each of the primary offal types:

- Abdominal viscera (stomach, intestines, fats, etc) to allow separation, emptying of green waste material and washing prior to trimming and bagging for dispatch. A paunch emptying and wash unit would be provided for each paunch wash facility. Intestines would be moved by a slide to a separate

treatment area where they would be flushed on an inversion tube. This would improve efficiency and effectiveness over the traditional tub dunking techniques. A shared bible washing machine could be located in the white offal room, again eliminating the need to use the water tub dunking process. These washers would facilitate the cleaning of offal to a standard that is considered adequate for human consumption.

- Thoracic viscera (pluck co-product, heart, etc) to allow separation, wash, trim and accumulation for dispatch.

- Head/Hock/Hide-on Products

These tables and designs are shown in drawing x and allow the process to be managed so as and to provide hygienic work areas that can be standardized for all abattoirs. The introduction of offal preparation tables also removes product from concrete or tiled benches and tubs that are difficult to maintain and keep hygienically clean. The design imposes a standard of offal handling on the basic process and becomes part of a food safety culture.

No further offal processing on site is intended. It is recommended that offal be packaged into plastic bags or tubs. All offals and by-products are to be shipped fresh daily with no provision for chilling or freezing. In the future, further processing and value adding of the offals and by-products on site could be expected. The design allows for the ability to expand the offal areas as required.

Separate facilities will be provided for each of the three butcher groups to process their offal products. In the case of a continuous rail operation with a single operator, a single offal handling bench (as for a single butcher group) would be provided and offer adequate capacity for the intended volume.

Carcass Splitting

At the low throughputs expected, it is proposed that the carcass be split at a single (shared) splitting point with a heavy cleaver. To facilitate use of the cleaver to split the suspended carcass, a spreader will be located above the rail. This will spread the rear legs wider apart as the carcass is split, allowing clear access to the neck vertebrae.

A multi-height step platform would provide access for the splitting of the carcass.

A reciprocating powered saw (with saw steriliser) could be an alternative to a heavy cleaver for carcass splitting. This provides the ability to more efficiently split carcass at higher rates.

Inspection/ Area

The design concept has a single (shared) carcass inspection position. The skinned head, tongue, feet and viscera will all be presented on trolleys in nominated locations for a correlated pathological inspection of the carcass and relevant by-products.

A small non-refrigerated retain area will enable up to two carcasses to be held if required while further assessment is conducted. Carcass assessed as condemned

will be cut down into a designated condemned material trolley and transported to the condemned product room. In this way, condemned materials are kept separate from edible product.

The condemned product room has a floor level approximately 900 mm lower than the slaughter floor (same level at hides area per Drg. #12). This facilitates gravity discharge of contaminated and condemned product through a chute from the slaughter floor. Condemned materials in the condemned area should be stored in lidded waste containers or bins. The condemned product area will have vehicle access to its external door to enable waste containers to be cleared on a daily basis. Condemned material will be disposed of onsite by incineration.

Carcass Trim

A single (shared) carcass trim area is located after inspection. A catch tray will be located adjacent to the trim area to collect all edible trim material.

Weighing

A carcass side weigh station will be provided on the hot carcass rail after the trim station. The scale will be electronic with a simple digital indication. Depending on recordkeeping procedures, the scale readout may need to be duplicated in an abattoir office.

Quartering

Following weighing, a manual quartering rail arrangement will enable the sides to be ergonomically quartered before delivery to the boning area or despatch. Additional skids with hooks are to be supplied from a bin.

Emergency Slaughter

Crippled or downer stock assessed as unable to walk to the restraining box are to be humanely slaughtered where they lay. A trolley will be used to transport the carcass through a doorway adjacent to the restraining box and onto the slaughter floor. The carcass can then be shackled and lifted using one of the existing hoists and processed in the normal way. Such animals would be processed at the end of a normal production shift.

Boning

The boning room has a number of functions relating to the preparation of the carcass prior to despatch to the wet market:

- Simply a transit room where the carcass is taken directly to the load out for placement into the vehicle,
- The carcass can be pre boned by separating the major muscle groups to allow the internal heat to dissipate thus avoiding bone taint,
- The carcass can be completely deboned prior to despatch with fat, bones and muscle meat packed into suitable hygienic containers for shipment to market. This usually does not occur in the service abattoir as the butcher will debone the carcass at the market thus avoiding any further contamination during transportation.

The boning room will contain a simple overhead rail system to enable the quarters to be moved to the boning stations and after processing to the load out area for despatch. The boning tables will be of stainless steel construction and of suitable size to enable table boning and trimming of the muscles groups to specific customer specifications. All bones, fat, and other miscellaneous material will be treated as edible product and stored in suitable containers off the floor.

GIn the future, further processing and value adding of the product could be performed, however there may be a need to expand the boning area and introduce adequate refrigeration services to provide suitable food safety and hygiene standards.

Work benches, storage hooks and shelves for packaged product to be accumulated prior to despatch are to be provided. Hand wash basins will be provided at the two entry points to the boning area for the use of the boning room personnel. In addition, a dropped meat inspection and trim point will be located adjacent to one of these hand wash basins.

Other than plastic bags inside reusable stainless steel or plastic tubs, no other type of packaging is proposed. Provision should be made for rail type scales to weigh sides and quarters, and for bench scales to weigh packaged meat.

Items excluded from the packaging area scope are:
- Provision to refrigerate product.
- Metal detection.
- Labelling.
- Rail type quarter scales.
- Bench type platform scales for sliced meat.

Load-out

Load-out involves product being manually loaded into light vehicles for delivery. Provision for three vehicles to reverse up to the load-out area has been recommended.

The load-out area is to be under cover and directly accessible but separated from all the offal rooms and the boning room. The area will be fully enclosed with a concrete floor and a doorway through which product can be carried to nearby vehicles. An extension of the quarter rail from the boning room will enable quarters to be ergonomically moved to load-out if this method of despatch is required. A despatch office and scale for weighing quarters may be needed.

The load out area will be arranged to allow for future extension of the boning room or offal rooms.

The load out and outside areas need to have effective separation through either an air lock or vehicle barrier while still allowing efficient movement of accumulated product into the waiting vehicles. The transport of product from boning room to load out needs proper control and management with limited staff movement and outside personnel access to manage hygiene, vermin access and product contamination.

Blood Handling

Blood would be collected from floor drains in the dry landing area and directed into a blood collection system separate from waste water.

Hides

Hides are to be sold directly from a room adjacent to the slaughter floor. No treatment or long term storage facilities are to be provided for hides. A scale for weighing hides would be required in the hide room. Space and facilities to store 50 hides (one night's throughput) will be provided.

Hook Handling

The hooks would be collected in a tub from the boning and despatch areas and returned to the equipment washing area located off the slaughter floor. The stainless steel hooks will be sanitised in hot chemical solution and then rinsed/cooled with cold water to ensure they are fully cleaned. The hooks are then loaded manually into a dry tub and returned to the cradle or legging area, their point of use on the slaughter floor. The movement of hooks around the abattoir will be in tubs on a hand trolley.

Refrigeration

No refrigeration is proposed. The design will allow for possible future expansions to include carcass chilling as well as refrigerated and frozen product.

7. Building and services

7.1 Services and infrastructure

General

The provision of adequate services is essential in achieving the desired level of hygiene and food safety. Service requirements for the plant are estimated below. It should be noted that typical values have been quoted and more detailed examination of the process, facilities and local considerations will be required to provide more accurate service requirements for individual locations and design requirements. The numbers provided will give guidance as to typical usage levels.

Potable Water Supply

The abattoir must have an adequate supply of potable water for use in washing and sterilising plant and equipment. If the quality of water supplied to the abattoir cannot be guaranteed as potable quality, then appropriate treatment facilities are required. Depending on the available water quality, these facilities might typically include filtration, odour and taste removal, and sterilisation functions.

Options include solids flitration, activated carbon filtration, reverse osmosis, chlorination (solid, liquid or gas) and UV light sterilisation. A common application in Indonesia is a water purifier module utilising a Yamaha reverse osmosis unit and UV light steriliser as well as various filters, pumps and tanks. A unit typically used in Indonesia for food safe production would be based on a Yamaha Type OH 300 SC reverse osmosis unit which produces 30 litres per minute of potable water. With appropriate storage, this unit would provide adequate potable water for a production shift.

Depending on throughput, the extent of on-site processing and the process methods employed, water consumption could vary between 200 litres per head to a maximum of 1000 litres per head. Based on this, maximum estimated abattoir water use for the 20 head per night scenario is 20 KL/day and for the 50 head per night, 50 KL/day. With a water treatment plant able to produce 30 litres per minute, an on-site potable water storage tank of approximately 10 KL capacity would be required. A larger tank or higher capacity treatment plant would be required for the 50 head per night scenario.

Hot Water (W82)

Hot water (82°C minimum at point of usage) is required for the effective sterilisation of knives, hand tools, work benches, trolleys, hooks and other contact surfaces. Typically this hot water is produced at approximately 87°C and should be stored in an insulated tank and reticulated around the plant with an electric pump pressure control unit. The volume of 87°C water required per operating day is estimated at a maximum of 10 KL/day for the 20 head per night scenario and 25 KL/day for the 50 head per night scenario.

Wash down-Hose Points

Wash down water (typically 50-60°C) would be made by mixing the hot water with cold in strategic locations around the plant to service specific process areas. A location of hose points is provided In Drg. #18.

Hand Wash (W45)

Hand wash basin water (typically supplied at 42-45°C) will be made by mixing hot water with cold water in a small stainless steel buffer tank and reticulating around the plant. Thermostatic mixing valves or tempering valves are commonly used in domestic and commercial applications to mix hot and cold water to produce an acceptable and safe temperature for hand washing.

Boiler House / Fuel Storage

A water heater is required to provide adequate quantities of hot sterilising temperature water (82°C minimum), hand wash water (45°C) and wash-down water (55-65°C). It is proposed that the water heater produce 87°C water and that the warm water be produced by mixing hot water with cold to achieve the desired temperature of 45°C and 50/60°C. The volume of 87°C water required per operating day is estimated at a maximum of 10 KL/day for the 20 head per night scenario and 25 KL/day for the 50 head per night scenario.

Hot water can either be generated over the day and stored in an insulated tank for use during the operating period, or produced as needed with an instantaneous water heater and smaller buffer tank. In the case of an instantaneous water heater and small tank, the water heater requirement is 90 KW for the 20 head per night scenario and 225 KW for the 50 head per night scenario. A typical solution would be to use multiple LPG fired storage heaters of about 100 KW each. Typical water heating units would be Rheem LPG industrial water heaters. The incremental approach allows additional heaters to be installed as required to meet changing demand. The use of multiple heaters also provides a level of standby capacity in the case of a breakdown to ensure sufficient hot water is available for processing and cleaning operations.

Options to provide fuel for the water heater include:

- Liquid fuel (kerosene, oil (diesel or similar).
- LPG.
- Biomass (wood or agricultural waste).
- Biogas from on-site digester (using paunch contents waste).
- Solar water heater (to warm water prior to feeding a secondary water heater).

The choice of fuel to be used will depend on the relative availability and price of each of these options in the selected abattoir location. Energy required for water heating would be of the order of 2.6 GJ and 6.5 GJ/day for the 20 and 50 head per night throughputs respectively. Alternative fuel sources for specific sites would need to be individually assessed.

Electrical Supply

With only basic automation, the abattoir is estimated to have a connected load of approximately 30 KW with a maximum demand of about 25 KW. This estimate only includes the abattoir and holding yards, and not administration, amenities, external security lighting and other site loads.

Compressed Air

Compressed air may only be required for miscellaneous valves, controls and actuators in the services room or elsewhere. It is expected that the stunner will have its own high pressure compressor. The restraining box and carcass split spreader will be manually operated. Leg changeover hoists will be electric and the dissolved air flotation (DAF) effluent treatments system would have its own aeration pump. Estimated compressed air use is therefore likely to be minimal.
A nominal 100-150 l/min compressor with small accumulator is recommended. This should provide low utilisation and extended service life.

Services Module

It is recommended that a services module be provided that has application to most abattoir sites. The module would be skid mounted with a steel base frame and fitted with the potable water holding tank, filtration equipment, hot water tank, pressure pumps, chlorination equipment, water heaters, water temperature controls and mixing equipment for an average sized abattoir.
This would be assembled at a specialized factory (supplier) complete with pipework, electrical wiring, controls and switch board. This means that services are properly designed and operational in the simplest possible format as an industry standard.

Knife Sharpening

A manual knife sharpening stone will be provided at each entry area. An electric sandstone wheel will be provided away from production areas outside the entry rooms for the use of all staff.

Production Store

A lockable production store fitted with appropriate racking will be provided for the safe and secure storage of cleaning chemicals, spare parts, and consumables such as plastic bags.

Cleaning

General abattoir cleaning will occur daily involve the following process:

- Dry cleaning (sweeping of solids for collection and dry disposal, use of rubber wiper to move blood into drains).
- Cold water wash down to remove blood (mains pressure or pump boosted)
- Hot water wash with detergent
- Cold water rinse
- Chemical sanitisation (if required)

This process will minimise the quantity of water used and effluent generated while achieving the required level of sanitisation. Hot and cold water mixing and hose points would be provided at appropriate points for wash down in each area.

Locations of service points are identified on the services drawing (#18) indicating:

- Hand wash basins
- Hand wash basins/sterilisers
- Equipment sterilisers
- Wash down hose points (CW/HW/mixer)
- Electrical power-single phase outlets and three phase outlets

Summary of Services Consumption

Services/Utility	Estimated Consumption	
	20 head/night	50 head/night
Water (KL/day)	20	50
Electricity (KW max dem)	25	25
Compressed Air (l/min FAD)	100-150	100-150
Gas (GJ/day)	2.6	6.5

7.2 Building details

7.2.1 Design principles

The key abattoir design and construction principles that have been applied to this concept design include:

Cleanability

Internal walls, floor, ceilings and coves have been constructed from impervious, smooth, corrosion resistant materials able to withstand repeated cleaning with detergents and sanitisers. Surfaces allow visible contamination to be easily seen. Hose points and sanitising chemical facilities have been provided.

Drainage

Floor and drain gradients have been designed to have sufficient slope to prevent standing water. Underfloor drains have been arranged to ensure that they are cleanable and that the highest point is vented outside the building. Cleanout access for underfloor drains has been provided outside the production area. All drainage points have been designed with a water trap. Equipment has been arranged todrain to a dedicated drain point, not across the floor.

Prevention of moisture and bacterial harbourage

Cracks and crevices which retain moisture and harbour bacteria have been avoided. Floor coves and wall corner coves have been provided. Conduit and pipe work within production areas have been designed to be installed with a standoff to allow cleaning access. Sills and roofs have been angled to prevent build-up and allow wash down. Cleaning access has been provided to all surfaces capable of causing contamination.

Entry and harbourage of pests

Drain traps, sealing doors, entry point lighting and appropriate mesh on all openings and ventilation points have been provided to exclude insects, birds and rodents. Procedures require that product build-up be cleared frequently. Condemned containers have been sealed to eliminate any food source for pests.

Arrangement and layout

The production area layout has been arranged to provide for separate hide-on and hide-off staff entries, separation of contaminated or inedible product areas from edible product areas, and separate offal handling areas. The site layout has been designed to separate clean activities and routes such as personnel access and meat load-out from contaminated activities and routes such as cattle entry, and hide, paunch and condemned product removal.

Prevention of contamination

The building arrangement has been designed to exclude external contaminants such as dust, smoke, manure and effluent. Materials of construction and internal finishes have been selected to prevent contamination from flaking surfaces and dust accumulation. Contact of carcasses with walls, equipment, personnel or other carcasses has been prevented. Procedures require that equipment used in inedible areas has been be sanitised before use in an edible area.

Equipment for personal hygiene

Hand wash basins with detergent dispensing have been provided conveniently accessible to relevant workstations. Apron washers, boot baths and boot washers as well as hand wash facilities have been provided at staff entries and at other points as required.

Equipment for sanitising contact surfaces

Facilities for washing and sanitising equipment and surfaces which contact the carcass and edible meat products have been provided. This includes: shackles, skids, rollers, knives, steels, cleavers, saws, and offal and boning tables.

Condensation

Ventilation and building design have been arranged to control humidity and prevent contamination from condensation.

Suitable water supply

An adequate supply of potable water has been made available for cleaning premises and equipment.

Control of carcass parts for inspection

The production area layout and equipment have been designed to enable correlated inspection of the carcass and viscera.

Condemned product disposal

A safe means of disposing of condemned product has been provided. This ensures that this product cannot reach consumers or be accessed by animals.

Isolation pen

An isolation pen has been provided for the assessment of suspect stock. This pen has been located away from main holding pens to reduce the risk of contamination.

7.2.2 Building construction

The building element of this project is the key to successful implementation of the concept abattoir operation.

The building must be an envelope or shell that will provide the environment for the operational and hygienic process to occur on a day by day basis. It must be cleanable, durable and able to be repaired to maintain that condition.

Metal corrosion inhibits repair and cleaning processes. Paint in whatever form is an unattractive option, and hot dip galvanised items have a limited life. All metal elements in the process area should be stainless steel including nuts and bolts, pipes, electrical services, drainage and building door frames, etc.

Concrete must be of a quality that allows continuous cycles of washing, drying and cleaning as well as an aggressive atmosphere of blood, fat, detergents and continual moisture.

The building must be designed to have natural ventilation with a roof pitched to a central ridge vent (lantern roof) and adequate air entry below eave level to create airflow (refer drg. #13). Walls to pedestrian door height need to have a smooth, impervious finish which inhibits mechanical damage and facilitates cleaning and possible repair.

The basic structure of the building will typically be a steel frame that will span the process areas and free standing interior walls. The plant should be built around the drainage system which must handle the partial walls.

The simplest form of construction is possibly concrete blockwork installed to a local construction code. This will usually require reinforced concrete infill columns and ring beams to meet construction code requirements. External walls need no treatment, however, internal walls need to be sealed to avoid moisture build-up and to allow cleaning. Paint finishes have proved inadequate.

Glass fibre reinforced GRP wall coatings have been very effective on block work and do tie the blocks together whilst providing a cleanable waterproof surface that is able to be repaired. Although components are readily available, skilled installation would be required. These trades are usually associated with truck body or boat building industries. In Australia and New Zealand, such coatings are sold under the name “FibreClean”.

The more traditional solution is hard, acid resistant, industrial tiles (Buchtal/Metz) attached to block work with a waterproof swimming pool grade adhesive and grouted with an epoxy grout to ensure a long life and impervious surface. All products must be non toxic and repairable. Any lost grout must be able to be overcoated.

Jointing at the interface of tiles to other finishes requires an agreed and achievable detail. Joints between tiles and fixed frames such as doorways need to be completed with a selected polysulphide sealant to avoid water ingress as excess moisture equates to growth of contamination materials. Details of appropriate tile attachments and joint interfaces have been provided in Drg. #16.

Condensation of any sort accumulating on structures must be avoided to prevent bacterial growth. This is typically due to insufficient air flow.

All wall to floor joints must be finished with a coved detail to assist cleaning and maintenance of a water impervious joint at that line. Typical examples have been provided and apply to all wall to floor joints in the building (refer drg. #16). Wall to wall joints also require a cove treatment to manage cracking or movement, and aid cleanability. Similarly (and where applicable), coved wall to ceiling joints are required. This is particularly important with flat ceilings of insulated panel construction.

Alternative wall finishes may be provided using concrete precast panels, where alignment, support and joint details are similar to a tiled finish. Panels are usually supported on the floor line and supported between steel building frame columns. A typical detail is provided (refer drg. #11). Panels manufactured with attention to detail would require no special surface treatment for application to a food processing facility.

A further alternative is a stainless steel clad plank similar to a precast panel but made in smaller widths and supported by a header steel girt. This allows ‘on-site’ construction by filling preformed stainless steel trays with fibre reinforced cement. The stainless steel tray provides a clean and durable working surface and can be made from stainless steel rolled material similar to roof sheeting.

7.2.3 Drainage

The removal of waste and contaminated water from an abattoir operation is a significant component of the hygiene and life or durability of the plant.

Drains that can be cleaned out from one side of the plant to the other, and with a service pit at each end to allow ease of access for rodding or high pressure water cleaning, are imperative. The pits are normally square concrete structures with sealed metal covers suitably vented. Cross drains would normally be 150mm diameter pipes with branch drains to pick up floor waste points being 85-100mm diameter, depending on the materials and drainage system used (refer drg. #17).

Materials for subfloor drains would be cast iron, stainless steel or high quality vitreous clay sewer pipe. Plastic piping systems have been used but only in sewer grade materials that are able to withstand high temperature water (90°C max) and mechanical cleanout.

Drainage systems are not designed for a calculated expected flow rate, but are sized for the type of materials, animal parts and waste that may find its way into the collection system in much the same way as a domestic sewer.

Drain slopes of approximately 1:100 are preferred on collector runs.

Manure drains are usually sized at 250 to 300 mm diameter with 1:50 to 1:70 slope to a screening pit. Blood drains are typically 100mm diameter to pump pits.

Pumped effluent lines will generally be 75mm diameter with long radius bends and matched flange or clamped joints at appropriate lengths to facilitate dismantling for cleanout in the event of blockage.

Floor waste outlets will be P or S traps or equivalent basket traps. These provide a water seal to effectively isolate the drainage system from operating areas.

Floor wastes are to be located as indicated on the drawings provided (refer drg. #15) and will be set at a level which allows drainage from sloped floor slabs without puddling and with seals that ensure water does not bypass the metal drain. No plastic material floor drainage piping or outlets should be used in an abattoir building as they are subject to damage and leakage, and are difficult to clear.

Any equipment requiring a drain is to have its own dedicated equipment drain. No equipment is to drain across floors to general floor waste outlets

All equipment with waste water discharge will be fitted with P or S traps, or bottle traps above floor level as they are normally 45-50mm diameter and susceptible to blockage. The exposed trap allows access for cleanout. These waste traps are preferably manufactured from stainless steel or similar material as they will be subject to dismantling on a regular basis.

The layout drawings show slot drains in the area of the dressing cradles that collect from flat plain floor areas that discharge uniformly into the slot drain (refer to slot drain detail in Drg. #16, detail E396.)

The slot will discharge into a number of basket trap drains along its length. These are positioned to collect hand wash water which flushes out the slot drain to remove manure from hides, blood and fat that accumulate along the length of the cradle. This avoids waste laying on floors and feeding to a single waste drain under each bed which would become blocked.

Blood drains will consist of an open trough drain with a square pattern non skid cover that can be raised for cleaning out the blood, usually with a plastic or rubber wiper. This would run under the Halal stick area with a collector to run onto the dressing floor to collect blood from the carcass hanging position noted for head removal as shown in Drg #15.

7.2.4 Lighting

As the plant will normally operate at night to provide direct supply to the wet markets, lighting is a significant issue.

It is recommended that lighting be standardised on 2 x 36W fluorescent fittings, waterproofed to international standard IP65. Fittings must be fully enclosed and be smooth shaped to avoid collection of dirt on the top and sides of the unit. A suggested typically acceptable unit is the fully enclosed and sealed Pierlite PWP236H. The lighting layout is shown in drawing #19.

If mounted on the ceiling of a high open roof structure, fittings will not provide appropriate lighting levels to the work area. It is proposed that groups of fittings (a stick of say 4 units) be mounted on a stainless steel rectangular tube section and wired to a single 'plug in' power supply connected to a dedicated lighting circuit with a non power circuit plug. These multi light units would be suspended off rail work steel to provide necessary lighting levels in process areas, generally as set out on the lighting layout drawing provided. Some natural lighting may be provided during daytime from open wall vents, however, the night operation of the plant makes it dependent on electrical lighting. General lighting levels proposed are 400 lux in process area work zones, and a general minimum lighting level of 200 lux. Separate additional fitting would be required to enhance lighting in inspection areas to 600 lux measured at the point of inspection.

No glass should be included in light fitting housings and units should be readily disassembled for maintenance. It is suggested that it is easier to disconnect a 'stick' of lights for replacement than access to a fixed fitting by ladder or similar in process areas. In low ceiling areas, fixed units, mounted off the ceiling would be appropriate.

For external lighting it is recommended that enclosed halide or sodium units with low insect attraction colour are used. External lighting should include a separately switched, small group of fittings, that allow illumination of the plant for general access in non production periods.

Light switching should be through a central switch area, possibly the services area for the slaughter floor and the loadout dock for the remainder of the plant. Regardless of the area a hygienic switchboard installation should be provided. All conduit connections to internal walls must be offset from the wall with spacer blocks. A general lighting pattern is set out on the lighting layout drawing #19.

7.2.5 Floors

Concrete floors are to be poured on ground level with minor adjustment for slope and level. Compacted sand fill and with a layer of moisture barrier building film to eliminate water movement should be used.

Elevated floors of more than 400mm above ground level are proposed as slab on compacted fill as shown in Drg #10 and #11. It would be normal procedure to cast the supporting sub wall on a footing and compact fill inside that wall. Floor waste drains and pipes are then cut into the fill and compacted in packing sand to allow some movement and avoid leakage into sub floor slab material.

This procedure depends on local techniques of placing slabs and building walls on top of slab compared with placing walls and pouring slabs inside the wall line. This remains a detail design consideration requiring regional civil engineering advice. Concrete floors need to accommodate drainage falls usually set at 1:100 minimum on the flat plain slope toward a drainage point (refer drg. #15).

It is normal practice to work all levels from a common floor crest point (level) at doorways and the bottom edge of walls for the entire building, and adjust levels of drain outlets in each area to provide the fall necessary from that crest to the finished drain height. Height is then adjusted in the drain pipework.

Floor material is normally 35 MPa concrete with a steel trowel finish then broomed to an appropriate non skid surface. In high wear areas such as adjacent to dressing cradles, tile or stainless steel wear plates may provide a replaceable area that copes with high traffic and dropped tools. All product handling trolleys on the floor must be fitted with rubber compound type tyres to avoid floor damage.

Fixed cradles will also assist in reducing the risk of floor damage. All hoists must be adjusted to avoid chain hook contact with the floor at lowest point.

Floor toppings are an option. Epoxy or similar sand/resin flooring materials provide satisfactory performance, however, they require maintenance and are expensive to install and replace. Heavy acid resistant textured floor tiles and epoxy grout are attractive but expensive. Cheap, low quality floor tiles are an inappropriate short term solution and should be avoided.

Concrete in cattle yards and races should be 40 MPa and patterned to avoid slippage but allow drainage and cleaning (refer separate notes on yards).

7.2.6 Roofing

This building is proposed to have a metal deck roof sheeting with a ‘colorbond’ light colour finish. It is also proposed to have a similar sheeting (low profile, light colour version) used as a ceiling material attached to the underside of roof purlins. The void between purlins should support a sarking and a mineral wool insulation material (to avoid condensation on underside of exposed roof sheeting).

7.2.7 Vermin proofing

The plant should be bird proof and insect access controlled by mesh screening over all wall openings, access doors and the lantern roof vent. All doors, drains and product chute entry points should be suitably closed to restrict entry of vermin.

7.3 Waste management

Waste streams are kept separate in three categories.

1. Red stream - blood and blood wash water
2. Green stream - containing paunch, intestinal contents and wash water. This stream does not contain any fat or blood.
3. Plant waste stream- solids and fatty material with washwater

Sewage from site amenities is to be kept completely separate from abattoir waste streams. Disposal of this stream is not considered in this project.

Red Stream

Blood represents a significant source of biological load to the effluent treatment system. It is proposed that the blood and blood wash water be collected in a separate blood pit, and pumped into a tanker or intermediate bulk container to be taken offsite. It may be necessary to add an anti-coagulant to avoid small volumes solidifying. Blood can typically be disposed of as animal feed or as a fertiliser. If no beneficial use can be found for the blood, it should be handled as liquid waste and disposed of appropriately at an off-site disposal facility. It is understood that blood cannot be sold under Islamic codes.

Plant Waste Stream

The general abattoir trade waste stream consists of equipment and floor wash water. It is expected to contain blood, fat and small pieces of meat product. Waste water treatment proposed will involve the following:

- Screening (0.5mm to 0.75mm) with a manually cleaned screen or strainer to remove larger solids.
- Treatment through a non-chemical dissolved air flotation (DAF) system to remove a major proportion of the fat and solids that may be in that waste stream.
- Depending on locations and circumstances, the effluent may be passed through anaerobic and aerobic ponds for treatment prior to disposal to irrigated agriculture or discharge to municipal waste system.
- Discharged to irrigated agriculture in rural areas.

Note that the temperature of effluent through the DAF should be less than 40°C to maximise the capture of fat. Screened solids and DAF skimmings should be incinerated on site in the condemned product incinerator.

Yards Manure Disposal

Cattle yards will be cleaned manually with a shovel and scraper. For this reason, this stream is expected to be relatively small, consisting primarily of wash water that is required to keep the yard drains clear. Manure is to be taken offsite to be used for fertiliser. Following basic manual screening (settling pit or simple screen), this stream will join the plant waste stream at exit from the anaerobic and aerobic ponds prior to discharge to appropriate irrigated agriculture.

Green Stream

The paunch content material and paunch wash water will drain to a green stream collection system consisting of a concrete bunker located outside the building adjacent to the white offal area as shown in Drg #17. The bunker has a basic screen system to allow excess wash water to drain, separating solids from liquid which would be pumped to the plant's (DAF) treatment system (part of the plant waste stream treatment system). Space is provided for a vehicle to pull alongside the bunker for solids to be loaded out manually. The material is taken offsite to be composted or for use directly as fertiliser. Bunker volume will be matched to expected removal truck capacity and frequency.

Green waste (paunch contents and manure) may be collected and used to generate biogas for water heating. A number of projects in Indonesia support the construction of collection and processing systems to recover biogas and this would be an appropriate disposal technique for these materials from a small abattoir site. The resulting solid waste can then be further used as fertilizer.

Condemned Material

Any meat, bone or offal that is identified as being affected by disease or physical bruising that makes it unacceptable for human consumption should be retained on site and disposed of by a process that ensures that it cannot re-enter the food chain. It is recommended that all such materials be destroyed using an on-site incinerator. This should be designed so as to handle all condemned materials as well as solids from the effluent screen and skimmings from the DAF system.

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7.4 Amenities

Amenities as listed below have been excluded from the current scope but should be included in final design considerations.

- Clothing change areas
- Staff access
- Separate eating areas
- Laundry and clothing store
- Hazardous chemical storage
- Veterinary Officer or Inspectors facilities
- Laboratory
- First Aid

8. Referenced drawings

Drawing No.	Description	Issue
#1	Site Plan	C
#2	Slaughter Process Diagrams	E
#3	Process Plan	C
#4	Single Rail Alternative	C
#5	Single Cradle Alternative	C
#6	Modular Slaughter Process	B
#7	Abattoir Process-5 Head per Night	B
#8	Roof Plan	C
#9	Building Elevations	C
#10	Detail Wall Sections	C
#11	Detail Wall Variations	C
#12	Process Cross Sections 1 & 2	C
#13	Process Cross Sections 3 & 4	C
#14	Process Cross Section 5	C
#15	Slaughter Floor Drainage Plan	C
#16	Typical Coves and Drain	C
#17	Under Floor Drainage	C
#18	Beef Abattoir Services Layout	C
#19	Proposed Lighting Layout	C
#20	Rail/Frame Loads	C

9. Bill of materials

The estimated quantities of building materials for the concept abattoir design are shown in Table 3. This Bill of Quantities should enable estimation of building costs in the Indonesian context.

Table No. 3: Concept Abattoir Design Bill of Materials

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
1	**PRELIMINARIES**						
	a	Design Consultants			%		Arch / Struct / Mechanical / Services
	b	Authorities			%		Permits
	c	Site Establishment			$		Site sheds and fencing
	e	Project Management			$		Overall Management
	f	General Foreman			$		Site Supervision
	g	Labourers			$		General Site labour
2	**EARTHWORKS/EXTERNAL WORKS**						
	a	Process Building - preparation strip	m2	1134	m3	227	200mm site strip
	b	Process Building - cut	m2	666	m3	140	210mm slab strip
	c	Process Building - fill	m2	468	m3	515	1100mm compacted granular fill
	d	Process Building - footing trenching	m	266	m3	53	500deep x 400wide strip footings
	e	Process Building - column pads	No.	23	m3	36	1100deep x 1200 x 1200 pads
	e	Cattle Yards - preparation strip	m2	725	m3	152	210mm slab strip
	f	Cattle Race - preparation strip	m2	110	m3	23	210mm slab strip
	g	Column / Post pads	No.	32	m3	13	500deep x 900 x 900 pads
3	**PROCESS MAIN BUILDING**						
		Concrete Works:					
	a	Column Pad Footings Process building - reinforced concrete	No	23	m3	17	1200x1200x500deep - reinforced concrete pads for columns. Includes 5200 kg reinforcing steel
	b	Column Pad Pedestals - reinforced concrete	No	23	m3	4	500x500x700 high - approx.. Reinforced concrete pedestals of sufficient length to locate column base plates 100mm above natural surface level. Includes 300 kg reinforcing steel.
	c	Strip Footings	m	266	m3	53	400wide x 500deep reinforced concrete strip footings for the masonry walls, the same profile and reinforcement is maintained for the external and internal strip footings. Inc;udes 200 kg reinforcing steel.
	d	150mm thick reinforced concrete slab on polythene moisture barrier on 50mm sand bed on prepared natural sub base, graded 1:100 central 4m x 4m square and prepared for tile finish	m2	335	m3	50	Generally to the slab on ground area of the Process building. Includes 3400 kg reinforcing steel.
	e	150mm thick reinforced concrete slab with moisture resistant additives on polythene moisture barrier on 50mm sand bed on prepared natural sub base, graded 1:100 central 4m x 4m square with broomed finish	m2	130	m3	22	Generally in the Storage Accumulation Area and Stalls area. Includes 1300 kg reinforcing steel.
	g	150mm thick reinforced concrete slab on polythene moisture barrier on 50mm sand bed on prepared natural sub base, graded 1:100 central 4m x 4m square and prepared for tile finish, on 1100 compacted granular fill.	m2	414	m3	53	The general floor area of the upper level process area. Includes 4300 kg reinforcing steel.
	h	Stairs - Internal			No	3	5 No Risers of 180mm max x 4 No treads of 250mm width minimum constructed of combination of masonry and concrete as per details to suit level change of 900mm with 1000 wide landings or as required by regulations
	i	Stairs - External			No	2	2 No stairs of 166mm (or 6 equal risers) x 5 No. treads of 250mm minimum width by required landing width constructed of masonry surround with reinforced concrete infill to suit level change of 1000mm.

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
		Structural Steelwork:					
	a	P1 - Column - 355x170x52kg/m Hbeam	m	60	tonnes	3.1	External Hot dipped galvanised columns
	b	P1 - Column - 355x170x52kg/m Hbeam	m	15	tonnes	0.8	External Hot dipped galvanised columns
	c	P3 - Column - 139x3.6x11.8kg/m Pipe	m	18	tonnes	0.5	External Hot dipped galvanised mullion columns
	d	P4 - Column - 203x133x25kg/m H beams	m	32	tonnes	0.8	Internal hot dipped galvanised intermediate prop columns on reinforced concrete pedestals
	e	RI - Rafter Beam - 355x133x25kg/m H beams	m	102	tonnes	2.5	Internal hot dipped galvanised common portal rafter
	f	RI - Rafter Beam - 355x133x25kg/m H beams	m	7	tonnes	0.2	Internal hot dipped galvanised common truncated portal rafter
	g	R2 - Rafter beam - 410x178x60kg/m H beam	m	51	tonnes	3.0	Internal hot dipped galvanised portal rafters located over the slaughter / hide removal area.
	h	HB1 - Hoist beam - 256x146x37kg/m H beam	m	32	tonnes	1.2	Internal hot dipped galvanised process support beam.
	i	HB2 - Hoist beam - 307x166x46kg/m H beam	m	20	tonnes	0.9	Internal hot dipped galvanised process support beam.
	j	W/B - Wall Bracing - 114x3.6x9.3kg/m Pipe	m	40	tonnes	0.4	External hot dipped galvanised wall bracing to the 4 No. longitudinal building corner bays
	k	Tie - Bracing 114x3.6x9.3kg/m Pipe - 17 No	m	14	tonnes	1.1	External hot dipped galvanised pipe bracing running longitudinally between the haunch connections of the portals, and at the roof framing of the East and West portal bays
	l	Roof Bracing - r/b - 75x75x5x5.27kg/m Angle	m	18	tonnes	0.6	14 x 8.43 metres roof bracing hot dipped galvanised finished located in the East and West end portal bays.
	m	Sill and Head beams - 150x17.7kg/m PFC	m	70	tonnes	3.0	Hot dipped galvanised finished PFC channel section to run at the head and sill of the Insect Screening bays.
	n	Roof Purlins - C20024x7.2kg/m	m	900	tonnes	6.5	
	o	Wall Girts - C15024x5.67kg/m	m	305	tonnes	1.7	Hot dipped galvanised finished wall girts
	p	Ridge vent - Stub Cols - 76.12x3.2 CHC	m	20	tonnes	0.1	16 x 1.250m 76.12x3.2x5.75kg/m fixed to main rafters HDG finished
	q	Ridge vent - Screening sill - 152x76x5x16.5kg/m RHS	m	80	tonnes	1.3	HDG finished spanning between stub cols below insect screening.
	r	Ridge vent - Rafters - 101.6x3.2x7.77kg/m	m	40	tonnes	0.3	10x3.995mx101.6x3.2x7.77kg/m, HDG finish rolled 7.5m radius fixed to columns
	s	Ridge vent - Purlins - 101.6x3.2x7.77kg/m	m	8	tonnes	1.6	5x41.650mx101.6x3.2x7.77kg/mx41.650 HDG weld fixed to rafters
		Masonry:					
		Reinforced hollow concrete blockwork - 150x190x390 locally produced blockwork or similar	m	266	m2	1035	Internal and external walls 3.900m high x 265.5 metres - reinforced and concrete filled to engineers detail, on 400wx500d reinforced strip footings to both external and internal walls Render finish internal and external
		Metalwork:					
	a	Insulated Sandwich Panel Wall system			m2	63	Insulated sandwich panel wall system to extend from the top of the internal masonry wall to the underside of the ceiling sheeting, around the Hides and Condemned Material areas.
	b	60 dia HDG hand railing and balustrade to all stairs			No.	5	60 mm dia HDG pipe fabricated to produce balustrading and handrails to suit the internal and external stairs and to later detail.

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
		Windows and Doors:					
	a	Insect Screening - stainless steel or similar non corrosive insect mesh in aluminum framing, to the lower mesh bays and upper ridge venting bays			m2	286	Mesh framed with aluminum section - to both lower mesh bays and upper ridge vent bays - total length - 564 metres
	b	Single pedestrian door - external			No	5	920x2040 external quality doors complete with hinges latches and locks - viewing panels as required
	c	Single pedestrian door - internal			No	7	920x2040 internal quality doors complete with hinges latches and locks viewing panels as required.
	d	Double pedestrian doors - internal			No	2	2x820x2040 internal quality doors complete with hinges, latches, slide bolts and locks - viewing panels as required
	e	Sliding Doors - internal			No	5	1800 wide x 3000 high sandwich panel quality doors on proprietary brand sliding equipment and seals
	f	Roller Doors - external			No	4	3600 wide x 3000 high pressed metal colorbond finished roller shutter doors - manually operated.
	g	Cripple door			No	1	1.5 panel double door 2400mm high x 1600mm wide galvanised pressed plate on mild steel angle framed doors complete with required hinges, latches and slide bolts. HDG finished plate and angle framing.
	h	Cattle Entry door			No	1	1100 wide x 3000 high pressed plate sheet door on mild steel angle framing to suit top mounted sliding mechanism mounts. Manually operated. HDG finish.
		Roofing and Wall Sheeting:					
	a	Process Building - Colorbond finished pressed metal profiled roof sheeting on required safety mesh, insulation and sarking fixed to galvanised finished pressed metal roof purlins with required length tech screws.			m2	1178	Roof sheeting to be fixed to roof sheeting and the curved ridge vent assembly
	b	Process building - Ridge vent area - rolled to suit			m2	175	All as per roof sheeting but formed to suit 7.5m radius.
	c	Colorbond finished pressed metal profiled Internal wall sheeting to match ceiling on required insulation and sarking fixed to galvanised finished pressed metal wall girts with tek screws.			m2	92	Wall sheeting located at gable ends - East and West and around the articulated internal wall line above the insect mesh area.
	d	Colorbond finished pressed metal profiled External wall sheeting located at the East and West gable ends, above the insect mesh bay line and along the articulated external wall line above the insect mesh bayline			m2	523	Wall sheeting generally located at the gable ends and above the mesh line in the articulated bay the North West corner
		Plastering/Render					
	a	Cement render finish to internal masonry walls final finish in Storage/Stall area, and subtile finish required to all other walls			m2	1400	Cover to all internal - final finish to Store/Stall area with subtile finish required to all other areas
		Wall and Floor Finishes-Tiling					
	a	Floor Tiles - Metz or equivalent quality acid resistant textured non-slip floor tiles and coving profile applied to required graded floor area on prepared sub base.			m2	737	Tile sub base preparation, laying and grouting to be undertaken to Metz specifications and by trained contractors
	b	Wall Tiles - Metz or equivalent quality acid resistant wall tiles complete with coving at wall junctions (35mm radius) sitting on floor coving profiled tile (75mm radius)			m2	1212	The proposed wall tile render sub base and grout application are to be undertaken to Metz specifications and by trained contractors

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
		Ceiling:					
	a	Colorbond finished pressed metal mini profiled ceiling sheeting fixed to the underside of the roof purlins and returned up to the ridge vent insect screening bay line.			m2	857	Sheeting to follow the line of the portal profile and roof sheeting
		Drainage/Plumbing:					
	a	200dia. Stainless steel Effluent pipe			m	8	200mmdia stainless steel effluent pipe subfloor drainage that will be trenched, laid, joined, graded, bedded, connected and covered as required prior to preparation of the ground floor slab.
	b	Blood Drain			m	11	600wide x 11.500 long concrete spoon drain with stainless steel grated cover, discharging into the Blood pit
	c	Equipment drain collector outlets			No.	7	50mmdia, above floor level, stainless steel equipment discharge collection points
	d	50mmdia stainless steel equipment drains			m	12	installed as required and run from the equipment discharge point to the floor waste pipe junction point.
	e	Floor wastes			No	28	Stainless steel Blucher type floor wastes to suit 100mmdia subfloor drainage pipe work
	f	Grated Pits			No.	10	10No. 800x800x900 deep pits formed from concrete complete with steel trafficable and removable grated pit covers.
	g	Run Off - Spoon Drain (in loadout area)			m	12.5	300m wide x 12500 long x 75mm deep external recessed drain graded to collection pit.
	h	100mmdia stainless steel Floor waste line			m	59	100mm dia stainless steel waste pipe line connected and subfloor trenched and bedded as required.
	i	150mmdia stainless steel Waste collection line			m	132	150mm dia stainless steel pipe sub floor drainage line trenched, bedded, graded, laid and covered as required prior to ground floor slab.
	j	200mmdia sub ground external Discharge Line			m	70	200mm dia Cast Iron or equivalent pipeline located external to building that is to be trenched, bedded, jointed, laid, graded, connected to external grated pits and directed to legal point of discharge, prior to completion of external works.
		Electrical:					
	a	RL1 - Light fittings			No.	99	Twin tube, corrosion resistant fluorescent luminaire, Pierlite PWP236H, IP65. composite acrylic diffusers, (Note similar fitting substitution will require approval) - to be installed - as suspended fittings with zoned operational pattern (3No.) .
	b	OL1 - Light fittings			No.	7	External Light fitting - COMET or similar floodlight, switching controlled by photoelectric daylight switch . Auto / Off / On Master switch to be surface mounted on pressed metal colorbond eave or wall cladding finish.
	c	Electronic Insect Control - Rentokil			No.	10	Sizing, final location and suitability to be determined on site
	d	Single phase power outlets			No.	20	16 No. minimum outlets located as required for process system and general use, wall and benching mounted as required to maintain regulatory requirements
	e	Three phase power outlets			No.	10	10 No. minimum outlets located in the Services, Paunch & Runners and Hide Edible areas
		Mechanical Ventilation:					
		Air curtains to be located at all external doors of the process building sized to suit			No	9	

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
4	**YARDS**						
		Concrete Works:					
	l	Cattle Yard slab - 170mm thick slab with 200x200x8 mesh located to suit V pattern 300 square embedded non slip and drained yard pattern	m2	725	m3	145	Drainage pattern - 300 square V pattern with the V 45 deep, with the base of the V being graded to drain the area. Pattern stamped into wet concrete. 35 MPa concrete
	m	Cattle Race slab - 200mm thick slab with 200x200x8 mesh located to suit V pattern 300 square embedded non slip and drained yard pattern	m2	150	m3	30	Drainage pattern - 300 square V pattern with the V 45 deep, with the base of the V being graded to drain the area. Pattern stamped into wet concrete. 40 Mpa concrete.
	n	Column Pad Footings Cattle Yards- reinforced concrete	No	26	m3	19	26 No pads1200x1200x500deep - reinforced
	o	Cattle Yard posts -	No	26	m3	5	26 No post holes 300dia x 1000 deep
	p	Cattle Unloading Ramp	No	1	m3	3	Reinforced concrete ramp infill walkway formed into stepped pattern - the steps will be 900 wide treads x 75 risers with impressed longitudinal pattern 950 longx75widex25deep recess separated by 75mm gap. The tread nosings will be protected by 75x75 mild steel nosing angles with embedded ties. The minimum concrete depth will 100mm from the formplate
	q	Stun Box Feed Ramp	No	1	m3	3	Reinforced concrete ramp infill walkway formed into stepped pattern - the steps will be 900 wide treads x 75 risers with impressed longitudinal pattern 950 longx75widex25deep recess separated by 75mm gap. The tread nosings will be protected by 75x75 mild steel nosing angles with embedded ties. The minimum concrete depth will 100mm from the formplate
	r	Manure Pit	No	1	m3	3	3.8m x 1.4m x 1.5m Deep concrete pit. No cover to pit. Note - Raking / sloping pit base grading to pump pit. Reinforced concrete wall and floor 100 thick.
	s	Blood Pit	No	1	m3	1	1.0m wide x 1.2m long x 1.0 Depth concrete pit. Reinforced concrete walls and floor 1
		Structural Steelwork:					
	a	P5 - Column - 203x133x25kg/m Hbeam	m	39	tonnes	1.0	External Hot dipped galvanised columns on concrete pedestal
	b	P6 - Column - 139x3.6x11.8kg/m Pipe	m	66	tonnes	0.8	Internal Hot dipped galvanised pipe central prop columns on concrete pedestal
	c	P7 - Column - 139x3.6x11.8kg/m Pipe	m	6	tonnes	0.1	External central hot dipped galvanised finished intermediate columns on concrete pedestal
	d	R3 - Rafter Beam - 355x133x25kg/m H beams	m	141	tonnes	3.5	common portal rafter beam - hot dipped galvanised
	e	Tie - Bracing 114x3.6x9.3kg/m Pipe - 17 No	m	14	tonnes	1.1	External hot dipped galvanised pipe bracing running longitudinally between the haunch connections of the portals, and at the roof framing of the East and West portal bays
	f	Roof Bracing - r/b - 75x75x5x5.27kg/m Angle	m	18	tonnes	0.6	14 x 8.43 metres roof bracing hot dipped galvanised finished located in the East and West end portal bays.
	g	Roof Purlins C20024x7.2kg/m	m	900	tonnes	10.4	30 No. bays x 6.00m x 8 No. Roof Purlins
	h	Ridge vent - Stub Cols - 76.12x3.2 CHC	m	15	tonnes	0.1	12 x 1.250m 76.12x3.2x5.75kg/m fixed to main rafters HDG finished
	k	Ridge vent - Rafters - 101.6x3.2x7.77kg/m	m	40	tonnes	0.2	6x3.95mx101.6x3.2x7.77kg/m, HDG finish rolled 7.5m radius fixed to columns
	l	Ridge vent - Purlins - 101.6x3.2x7.77kg/m	m	8	tonnes	1.2	5x101.6x3.2x7.77kg/mx30.000m HDG weld fixed to rafters
	m	Fence Posts - 139 dia x 3.6 x 11.8 kg/m Pipe			tonnes	0.9	Note : 26 No. pipe posts x 3.00m long = (1.850m high fence posts) hot dipped galvanised finish.

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
	n	Fence Rails 65dia Nominal Bore x 5.75kg/m	m	456	tonnes	2.6	24No.x 3.80 metre Bays x 5No. Rails per bay hot dipped galvanised finish.
	o	Fence Rails 65dia Nominal Bore x 5.75kg/m	m	390	tonnes	2.2	26No.x 3.0 metre Bays x 5No. Rails per bay - hot dipped galvanized finish
	p	Gates - 10No. Double - 2x3.00m x 1.550m high	No	10			50dia nominal bore x 6.7kg/m 5 rail gates hot dipped galvanised finish complete with 6No.required hinges, slide catch latches and central slide bolts.
	q	Gates - 4No. - Single - 3.00m x 1.550m high	No	4			50dia nominal bore x 6.7kg/m 5 rail gates hot dipped galvanised finish complete with 3No.required hinges and slide catch latches.
	r	Gates - 10No - Single - 1.50mx 1.550 high	No	10			50dia nominal bore x 6.7kg/m 5 rail gates hot dipped galvanised finish complete with 3No.required hinges and slide catch latches.
	s	Cattle race fence posts - 139 dia x 3.6 x 11.8 kg/m Pipe	m	135	tonnes	1.6	45 No. x 3.0 metres long posts capped with hot dipped galvanised finish. Posts to both the cattle race and drover path.
	t	Cattle race fence rails-3.0m x 1.55m high sections, from 65dia Nominal Bore x 5.75kg/m. Cost as large gates.	No	45			45 No. bays x 3.0m lengths x 5No. Rails x 65dia nominal borex5.75kg/m pipe hot dipped galvanied finish. Cost as large gates.
	u	Unloading Ramp Posts - 139 dia x 3.6 x 11.8 kg/m Pipe	m	45	tonnes	0.5	11 No post varying in height from 4600 to suit a rise of 1500mm high landing, to lower discharge height. 3100 minimum allowing for 1000 footing encasement
	v	Unloading ramp fence rails 65dia Nominal Bore x 5.75kg/m	m	100	tonnes	0.6	8 No bays x2.500 approx x 5 rails x65dia NB pipe HDG fixed to posts
	w	Unloading ramp raking floor channel	m	42	tonnes	0.7	180PFCx17.7kg/m floor channel edging to support ramp and landing galv plate formplate base
	x	Stun box feed ramp posts - 139 dia x 3.6 x 11.8 kg/m Pipe	m	45	tonnes	0.5	11 No post varying in height from 4600 to suit a rise of 1500mm high landing, to lower discharge height. 3100 minimum allowing for 1000 footing encasement
	y	Stun box feed ramp fence rails 65dia Nominal Bore x 5.75kg/m	m	100	tonnes	0.6	8 No bays x2.500 approx x 5 rails x65dia NB pipe HDG fixed to posts
	z	Stun box feed ramp raking floor channel	m	42	tonnes	0.7	180PFCx17.7kg/m floor channel edging to support ramp and landing galv plate formplate base
		Metalwork:					
	c	Cattle Troughs - Food			No.	11	Metal feeding troughs 1.2 long x 600 wide x 600 high profiled and fabricated to suit yard fencing mounting accessible to external filling
	d	Cattle Troughs - Water			No.	11	Pressed metal water troughs 1.2 long x 450 wide x 450 high profiled and fabricated to suit yard fencing mounting plumbed with ball valve for automatic filling.
		Roofing and Wall Sheeting:					
	e	Cattle Yards - Colorbond finished pressed metal profiled roof sheeting on required safety mesh, insulation and sarking fixed to galvanised finished pressed metal roof purlins with required length tech screws.			m2	725	Roof sheeting only to the cattle yards
	f	Cattle Yards - Ridge vent area - rolled to suit			m2	126	All as per roof sheeting but rolled to suit 7.5m radius.
5	**OTHER-HARDSTAND/ROADS.FENCES**						
	a	External Process building hard standing	m2	1091	m3	164	.150mm site strip and level
	b	Access hard standing to Process building - Eastern Despatch	m2	580	m3	87	150mm compacted aggregate on prepared natural sub base (option 150mm conc. Sla
	c	Access hard standing to Cattle Yards & Process building - Southern Delivery	m2	546	m3	82	150mm compacted aggregate on prepared natural sub base or 150mm con slab
	d	Roads					

		Description	TRADE		VOLUME		
			Measured Units	Quantity	Measured Units	Quantity	Comments
6	**UTILITIES/OTHER**						
	a	Services Utilities - electrical connection and distribution					Connected load approximately 30 KW , 3 phase
	b	Services Utilities - water connection and distribution					Estimated supply 3 KL per hour max, 50 KL per day, including storage
	c	Services Utilities - gas connection and distribution (if applicable)					LPG or other fuel as available
	d						
7	**BUILDINGS/OTHER**						
		Security					
		Amenities					
		Office/Admin					

10. Equipment list

The Stage One concept design is for a process arrangement consisting of a combination bed and rail process utilising three dressing cradles. Alternative process options which could be incorporated into the same building footprint are a single cradle dressing process and a conventional rail dressing process. The equipment requirements for all three options are detailed below in Table 4.

Some items are identified as being part of the building and the cost of providing these is most appropriately attributed to the building cost. Additionally, some equipment items are considered to be optional. In both these cases, no equipment cost is recorded.

The cost shown is the estimated Australian dollar price for internationally sourced and Australian fabricated equipment. In addition, an estimated Indonesian price is shown for each item. The Indonesian price is based on an exchange rate of 9550 IDR per AUD for internationally sourced equipment, and an estimate of the Indonesian fabrication cost for equipment that could be manufactured in Indonesia.

The end of the table indicates total equipment cost for each of the three process alternatives in both Australian dollars (for internationally sourced and Australian fabricated equipment) and Indonesian rupees (for internationally sourced but Indonesian fabricated equipment).

Table No. 4: Abattoir Equipment List

	AUD Cost ($ K)	IDR Cost (Rp millions)	Ref.	Single Cradle	Triple Cradle	Rail
Yards:						
Unloading ramp	-		Building	1	1	1
Races to holding yards	-		Building	1	1	1
Holding yards including yard for cows with calves	-		Building	1	1	1
Isolation yard	-		Building	1	1	1
Isolation yard crush	-		Building	1	1	1
Isolation yard HWB for veterinarian	900	3.5		1	1	1
Isolation yard locker for veterinarian	300	1.2		1	1	1
Race to slaughter floor	-		Building	1	1	1
Slaughter Floor:						
Knocking box, operator platform,bleed area and dry landing area-shared	60,000	280.8		1	1	1
Stunner including pressure amplifier-shared	15,000	143.3		1	1	1
Blood collection drum (if blood is to be collected by individual butchers)	25	0.1		2	6	6
Blood pit	-		Building	1	1	1
Blood pit coarse screen	100	0.6		1	1	1
Blood pit pump/valving or changeover plug arrangement	8,000	43.9		1	1	1
Paunch clip applicator	250	2.4		1	3	1
Rod	250	2.4		1	3	1
Shackle arrangement-both legs for bed dressing	400	1.5		1	3	
Shackle arrangement-right leg for rail dressing	400	1.5				1
Shackle wall hooks-storage			Optional			1
Hoist #1 (powered or manual-1 tonne)	500	4.8		1	3	1
Monorail beam #1	-		Building	1	3	1
Monorail push trolley for hoist #1	150	0.8		1	3	1
Horn removal device	150	1.4		1	1	1
Cradles for bed dressing-including chain to “clamp” hide	3,000	11.6		1	3	
Brisket cleaver	100	0.4		1	3	
Brisket saw	1,500	14.3				1
Brisket saw steriliser	600	2.3				1
Slides (skids with a swivel hook) with notches for swingle grips if cradle	30	0.2		50	100	100
Slide storage and transport crates	100	0.5		2	6	3
Swingle with tong grips	400	1.5		2	6	
Carcass rail (per metre)	700	2.7		17	20	27
First leg changeover hoist	500	4.8				1
Second leg changeover hoist	500	4.8				1
Legging platform-high/front side only, galv frame	9,000	49.4				1
Hoist #2 (powered or manual-2 tonne)	750	7.2		1	3	
Monorail push trolley for hoist #2	150	0.8		1	3	
Monorail beam #2			Building	1	3	
Transition aid-hoist swingle to rail	1,000	3.9		1	3	
Platform-hide/tail removal, split brisket (high and low/both sides), SS	15,000	94.5				1
Evisceration platform (high and low/one side)	1,000	5.5		1	3	1
Changeover platform-hoist to carcass rail	1,000	5.5		1	3	

	AUD Cost ($ K)	IDR Cost (Rp millions)	Ref.	Single Cradle	Triple Cradle	Rail
Splitting station access platform (high and low)	1,000	5.5		1	1	1
Slide spreader (for splitting)	8,000	21.2		1	1	1
Carcass splitting cleaver	150	0.6		1	3	
Splitting saw-reciprocating	10,000	95.5				1
Splitting saw sterilizer	10,000	46.8				1
Retain rail (per metre)	700	2.7		10	10	10
Retain rail diverters	250	1.0		2	2	2
Retain rail platform	1,000	5.5		1	1	1
Trim station fat catch tray	800	4.4		1	1	1
Trim station platform (high and low)	1,000	5.5		1	1	1
Carcass scale	3,000	28.7		1	1	1
Quartering rail arrangement	10,000	46.8		1	1	1
Boning Room:						
Carcass rail system (per metre)	700	2.7		10	35	35
Carcass rail diverters to butcher stations	250	1.0		2	6	6
Boning/cutting stations (c/w table, hooks, and off floor storage)	5,000	31.5		2	6	6
Dropped meat inspection and trim station	500	2.7		1	1	1
Boning room HWB (at each entry)	900	4.9		2	2	2
Boning room knife steriliser	300	1.6		2	2	2
Platform scales for meat cuts-optional			Optional			
Plastic bag dispenser	10	0.1		1	3	3
Storage racking	1,000	5.5		1	3	3
Red Offal Room:						
Infeed chutes	1,000	5.5		1	3	1
Offal prep stations (c/w trim, wash with hooks, drain, pack)	3,000	18.9		1	3	1
Red offal room HWB (at entry)	900	3.5		1	1	1
Red offal room knife steriliser	300	1.2		1	1	1
Plastic bag dispenser	10	0.1		1	3	1
Storage racking	1,000	5.5		1	3	3
White Offal Room:						
Infeed chute	1,000	5.5		1	1	1
Paunch prep stations (c/w trim, wash with hooks, drain, pack)	5,000	31.5		1	3	1
Intestines prep station (c/w trim, wash with hooks, drain, pack)	1,000	6.3		1	3	1
Bible washer	10,000	95.5		1	1	1
Intestines wash tube	500	1.9		1	3	1
Umbrella paunch washer	2,000	7.7		1	3	1
Red offal room HWB (at entry)	900	3.5		1	1	1
Red offal room knife steriliser	300	1.2		1	1	1
Plastic bag dispenser	10	0.1		1	3	1
Storage racking	1,000	5.5		1	3	3

	AUD Cost ($ K)	IDR Cost (Rp millions)	Ref.	Single Cradle	Triple Cradle	Rail
Hide-On Offal Room:						
Infeed counter	200	1.1		1	1	1
Offal prep stations (c/w trim, wash with hooks, drain, pack)	3,000	18.9		1	3	1
Hide-on offal room HWB (at entry)	900	3.5		1	1	1
Hide-on offal room knife steriliser	300	1.2		1	1	1
Plastic bag dispenser	10	0.1			3	1
Storage racking	1,000	5.5		1	3	3
Despatch:						
Quarter scale-optional	-		Optional			
Storage areas/racks-optional	-		Optional			
Hand wash basin for despatch staff	900	3.5		1	1	1
Manual Handling Aids:						
Head Trolley-contains head/tongue and feet and hide on tail	2,500	13.7		3	9	6
Viscera Trolley-contains gut and pluck	2,000	11.0		2	6	4
Hide trolley-contains hide and horns	1,000	5.5		1	9	2
Condemned material trolley	1,000	5.5		1	3	2
Hook return trolley-for tubs from boning/despatch to slaughter floor	200	0.8		2	3	2
Steriliser/HWB/Etc:						
Hide-on entry multiple hand wash basin	1,800	9.9		1	1	1
Hide-on entry multiple apron wash/boot wash	1,800	9.9		1	1	1
Hide-on entry apron hooks	200	1.1		1	1	1
Hide-off entry multiple hand wash basin	1,800	9.9		1	1	1
Hide-off entry multiple apron wash/boot wash	1,800	9.9		1	1	1
Hide-off entry apron hooks	200	1.1		1	1	1
White offal room entry hand wash basin	900	4.9		1	1	1
White offal room entry multiple apron wash/boot wash	1,000	5.5		1	1	1
White offal room entry apron hooks	200	1.1		1	1	1
Restraining box HWB-shared	900	3.5		1	1	1
Restraining box knife steriliser-shared	300	1.2		1	1	1
Restraining box rod steriliser-shared	300	2.9		1	1	1
Restraining box weasand clip applicator steriliser-shared	300	2.9		1	1	1
Cradle #1 HWB	900	3.5		1	1	
Cradle #1 knife steriliser	300	1.2		1	1	
Cradle #1 brisket cleaver steriliser	500	4.8		1	1	
Cradle #2 HWB	900	3.5			1	
Cradle #2 knife steriliser	300	1.2			1	

	AUD Cost ($ K)	IDR Cost (Rp millions)	Ref.	Single Cradle	Triple Cradle	Rail
Cradle #2 brisket cleaver steriliser	500	4.8			1	
Cradle #3 HWB	900	3.5			1	
Cradle #3 knife steriliser	300	1.2			1	
Cradle #3 brisket cleaver steriliser	500	4.8			1	
Cradle #3 HWB other side	900	3.5		1	1	
Cradle #3 knife steriliser-other side	300	1.2		1	1	
Cradle #1 head wash/prep station	2,500	13.7		1	1	
Cradle #1 head wash HWB and knife steriliser	1,200	4.6		1	1	
Cradle #2 head wash/prep station	2,500	13.7			1	
Cradle #2 head wash HWB and knife steriliser	1,200	4.6			1	
Cradle #3 head wash/prep station	2,500	13.7			1	
Cradle #3 head wash HWB and knife steriliser	1,200	4.6			1	
Rail system head wash/prep station	2,500	13.7				2
Rail system head wash HWB and knife steriliser	1,200	4.6				1
Legging platform HWB	900	3.5				1
Legging platform knife steriliser	300	1.2				1
Hide/tail removal platform HWB	900	4.9				1
Hide/tail removal platform knife steriliser	300	1.2				1
Evisceration platform HWB	900	3.5				1
Evisceration platform knife steriliser	300	1.6				1
Carcass splitting/inspection HWB	900	3.5		1	1	1
Carcass splitting cleaver steriliser	600	2.3		1	1	1
Trim station HWB	900	3.5		1	1	1
Trim station knife steriliser	300	1.2		1	1	1
Hosereel-cold water at restraining box c/w nozzle	1,000	7.9		1	1	1
Hosereel-cold water at slaughter floor general c/w nozzle (cradle #1)	1,000	7.9		1	1	
Hosereel-cold water at slaughter floor general c/w nozzle (cradle #2)	1,000	7.9			1	
Hosereel-cold water at slaughter floor general c/w nozzle (cradle #3)	1,000	7.9			1	
Hosereel-cold water at slaughter floor general c/w nozzle (cradle #3)	1,000	7.9		1	1	
Hosereel-cold water at slaughter floor general c/w nozzle	1,000	7.9				1
Hosereel-cold water at slaughter floor general c/w nozzle	1,000	7.9				1
Hosereel-warm water at slaughter floor general c/w nozzle	1,500	12.5		1	1	1
Hosereel-warm water at slaughter floor general c/w nozzle	1,500	12.5		1	1	1
Suspended wash nozzle-cold for wash bay	1,000	7.9		1	1	1
Suspended wash nozzle-hot for wash bay	1,500	11.9		1	1	1
Hosereel-cold water at red offal room c/w nozzle	1,000	7.9		1	1	1
Hosereel-cold water at white offal room c/w nozzle	1,000	7.9		1	1	1
Hosereel-cold water at hide-on offal room c/w nozzle	1,000	7.9		1	1	1

	AUD Cost ($ K)	IDR Cost (Rp millions)	Ref.	Single Cradle	Triple Cradle	Rail
Hosereel-cold water at boning room c/w nozzle	1,000	7.9		1	1	1
Hosereel-warm water at boning room c/w nozzle	1,500	12.5		1	1	1
Hosereel-cold water at despatch area c/w nozzle	1,000	7.9		1	1	1
Utilities:						
Hide scale-optional	-		Optional	1	1	1
Hide rail/rack/storage-optional	-		Optional	1	1	1
Hide inspection table	700	2.7		1	1	1
Paunch contents bunker and truck loading area	-		Building	1	1	1
Water treatment (chlorination) as needed for potable quality	4,000	28.5		1	1	1
Potable water storage tank	500	3.2		1	1	1
Potable water pressure pump	500	3.2		1	1	1
Water heater/storage (at 85 degC)	6,000	37.8		1	1	1
Fuel storage tank- leased by fuel vendor	-		Leased	1	1	1
Hot water reticulation pump (circulated in loop through plant)	500	3.2		1	1	1
Handwash water mixer/tank (could be SS 205 litre drum of Schultz IBC)	1,500	10.7		1	1	1
Warm water (hand wash) reticulation pump	500	3.2		1	1	1
Air compressor and filter	500	2.3		1	1	1
Red effluent screen (manual mesh strainer)	1,500	8.2		1	1	1
Effluent DAF-concrete tank	-		Building	1	1	1
DAF aeration pump or air mixing arrangement	12,000	65.9		1	1	1
Effluent pumps as required	1,000	6.3		1	1	1
Manure screen/settling pit	1,000	6.3		1	1	1
Paunch contents water pump and pipework	500	2.7		1	1	1
Cleaning equipment-napsack sanitiser sprayer	500	3.2		1	1	1
Knife sharpening powered stone	150	0.6		1	1	1
Hand knife sharpening stones	25	0.1		2	2	2
Condemned meat disposal (incinerator)	10,000	95.5		1	1	1
Insect zappers (in staff entries)	300	2.9		4	4	4
Doorway air curtain (to exclude insects)	1,800	9.9		6	6	6
TOTAL ESTIMATED EQUIPMENT COST (AUD thous)				**299**	**445**	**411**
TOTAL ESTIMATED EQUIPMENT COST (IDR millions)-local fabrication				**1726**	**2525**	**2375**

11. Bibliography

Documents and standards referenced in the preparation of this report include:

- HAS23103 Guidelines of Halal Assurance System Criteria on Slaughterhouses (Indonesia).
- Guidelines for Veterinary Control Certification for Food of Animal Origin Enterprises, Number: 381/Kpts/OT.140/10/2005.
- Requirements for Ruminant Slaughterhouses and Meat Cutting Plants, Number: 13 /PERMANTAN/OT.140/1/2010.
- Office International des Epizooties (OIE) Terrestrial Animal Health Code (Chapter 7.5).
- Codex Alimentarius.
- Construction and Equipment Guidelines for Export Meat-Second Edition 1988 (Department of Primary Industry and Energy, Australian Quarantine and Inspection Service).
- Australian Export Supply Chain Assurance System (ESCAS).
- AS 4696-2007: Hygienic Production and Transportation of Meat and Meat Products for Human Consumption.
- Standard design for small scale modular slaughterhouses-FAO
- Abattoir development-Options and designs for hygienic basic and medium sized abattoirs-FAO
- Guidelines on small slaughterhouses and meat hygiene for developing countries-FAO

12. Conclusions and recommendations

The work to date has shown that the concept of an abattoir in Indonesia is not a simple, standard off the shelf model (one size fits all), even in a wet market abattoir application. The recent visit and presentation to DGLAHS demonstrated that the government itself has obligations under the law to provide abattoir services to every village and community within Indonesia and that these facilities are able to cater for low volumes of 2 to 5 head per night, and be inexpensive to construct and operate. The expectations of the stakeholders are quite diverse and in some cases quite complex in accommodating the commercial outcomes of a particular market environment.

The separation of the operational process that underpins food safety and hygiene and the supporting infrastructures, buildings, and services opens up a range of functional and practical options that can be applied to any situation in a cost effective and functional manner. The range of abattoir applications is endless and can range from a modular abattoir application to a fully integrated abattoir complex that supports a cold chain supply arrangement that provides products that can be supplied to the modern market competing against imported meat products.

The proposed abattoir concept would be able to produce a product that is equal to any imported product under international food safety and hygiene standards and if required gain international equivalency through the Codex and OIE protocols. This would require Government to Government negotiations on a range of structural and operational issues that would be reflected in the approved arrangement developed and supported by the abattoir operator.

Recommendation one

The following figures 5, 6 and 7 summarise the the concept process options for the abattoir design. It is our recommendation that the combined bed and rail option (Figure 6) provides the most efficient and hygienic process for a 20 to 50 head non refrigerated facility**.**

System A: Basic bed dressing system

The primary simple cradle dressing system which keeps product off the floor and allows for hygienic processing. It allows hide to be removed without contaminating the carcass meat. By retaining all parts of the carcass as an animal group it permits an international level of veterinary inspection to be achieved.

By locating this operation in a building envelope that allows hygienic cleaning and vermin management, an acceptable level of food safety can be achieved. This system is based on stunning animals to Halal requirements in a restraining pen and having an adequate supply of potable hot and cold water available for personal and equipment hygiene.

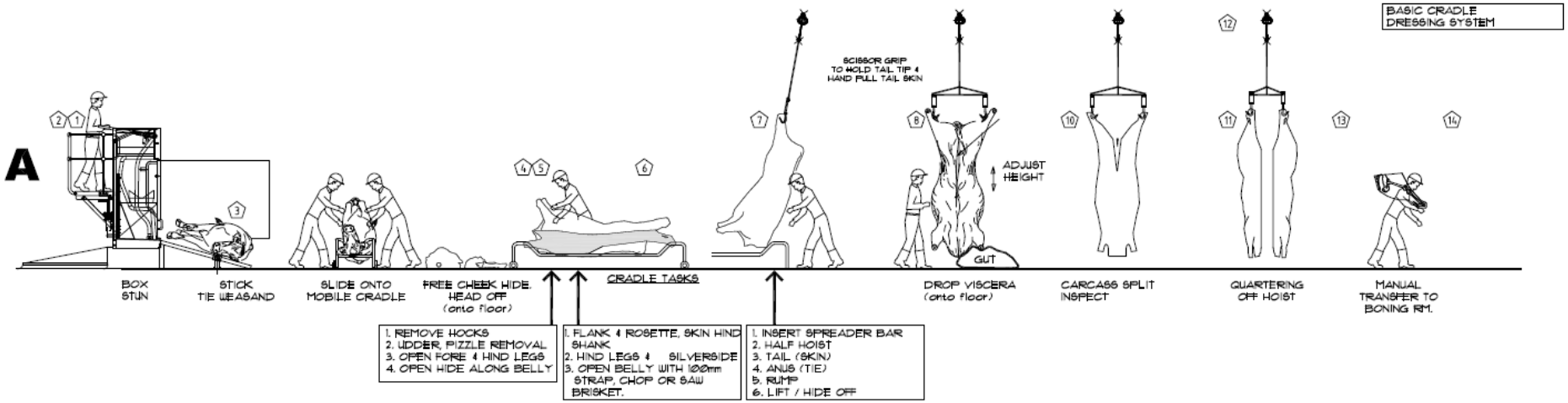

Figure No. 5: System A: Basic bed dressing system

System B: Combined bed and rail dressing system

This layout is an extension of the basic bed dressing concept with a more identified separation of tasks that makes the operation more controlled and repeatable to meet a more strict 'food safe' process. It lands the animal on an elevated rail/roller system for splitting, inspection, trim and quartering operations. The tasks are the same as in system "A", but separated to involve additional people in their designated skill areas.

One reason for spreading out the process is so that people can be trained to do a set number of tasks correctly, and not require only possibly two people to do the total operation as may be required with the setup shown in system 'A'.

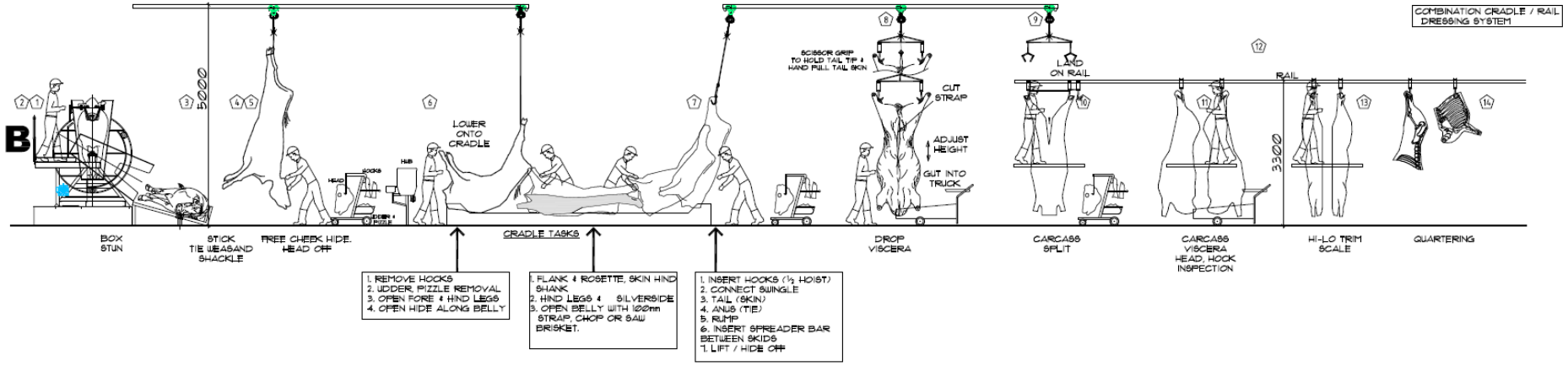

Figure No. 6: System B: Combines bed and rail dressing system

System C: Rail dressing system

This system illustrates the relatively minor upgrade needed to modify the system 'B' combined bed and rail dressing system to a full 'on rail' dressing system. With additional staff, this arrangement would be capable of handling 70 – 100 animals per 6-8 hour shift. This requires increased equipment and services installation cost, and allows for tasks to be training specific.

It also allows the flexibility of staff movement and variable production rates achieved with the bed dressing system 'B' option. The Standard Operating Procedure schedule also covers tasks illustrated on this rail system in comparison to the bed dressing operation.

This rail dressing operation can be upgraded with additional equipment to assist dressing tasks which may be difficult to justify in the low labour cost situation that applies in Indonesia. It is seen as a 'modern' system but cannot be justified on a hygienic or ergonomic basis compared with the flexibility of a well set up bed dressing model.

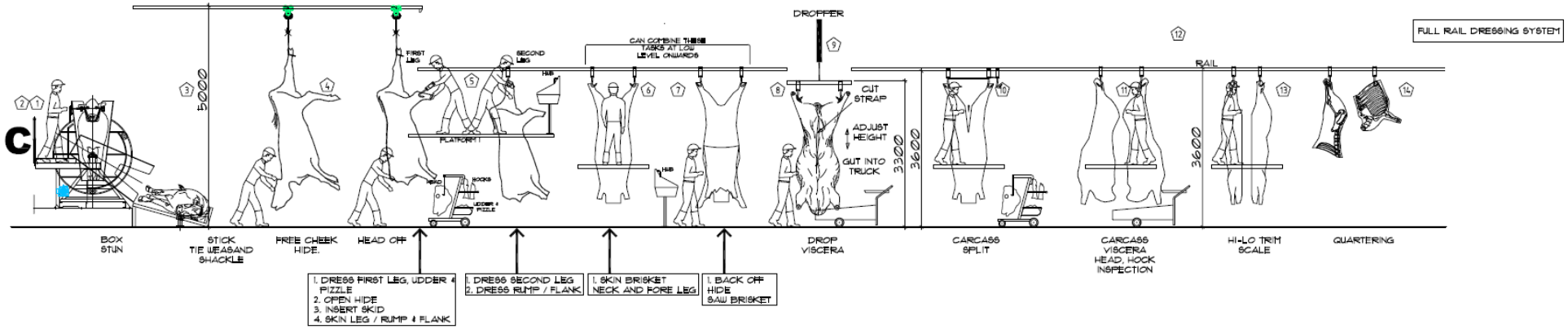

Figure No. 7: System C: Rail dressing system

Recommendation two

One of the issues observed on site visits in Indonesia was that there were often adequate buildings that required a more manageable process system to be installed. We noted that refurbishment often looked straightforward and a simple low cost solution. However any upgrade or refurbishment requires significant custom design and site installation of the required equipment and services.

To overcome this it is recommended that a modular abattoir containing process equipment be considered (see figure 8). Such a system could be manufactured in sections, transported to site and assembled as a floor mounted system requiring no load bearing roof structure. This would allow rapid conversion of existing and quite adequate building structures (with their existing infrastructure of road access, drainage, offices and amenities) to hygienic, compliant food grade processing facilities at little more than the equipment cost.

This concept should be the subject of a separate study.

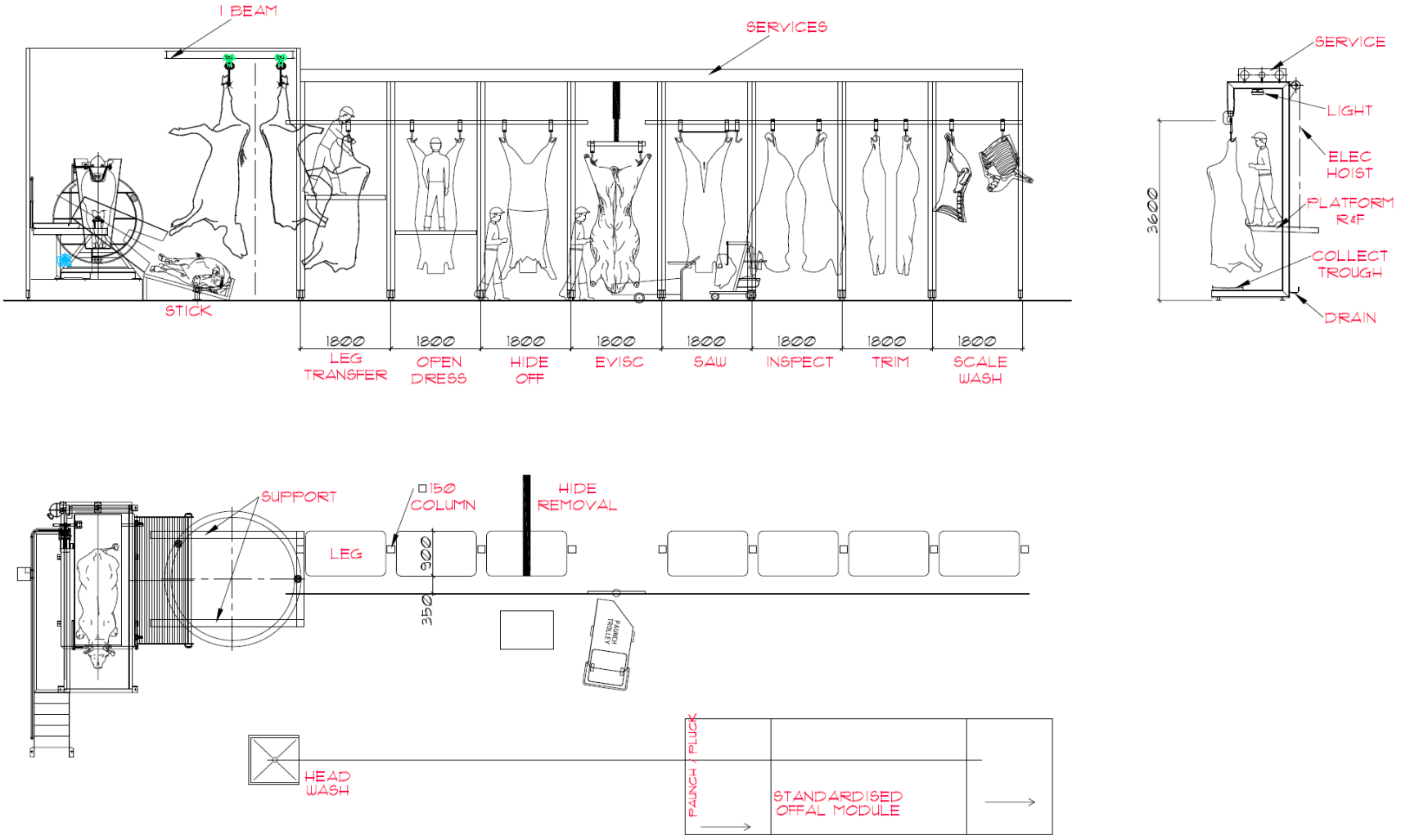

Figure No. 8: Modular abattoir process concept

Recommendation three

A similar recommendation for simple low volume slaughter facility should also be considered. A basic compliant facility could be located on existing sites with minimal building construction costs in order to provide a slaughter process for wet markets. This could be a simple drained slaughter slab with a metal wall and roof structure that houses slaughter and offal recovery for say five animals per night.

This concept could be installed as an equipment package bolted down on a pre formed, standardised concrete slab base. The process and all above slab items to be available as a package for mechanical installation (figure 9).

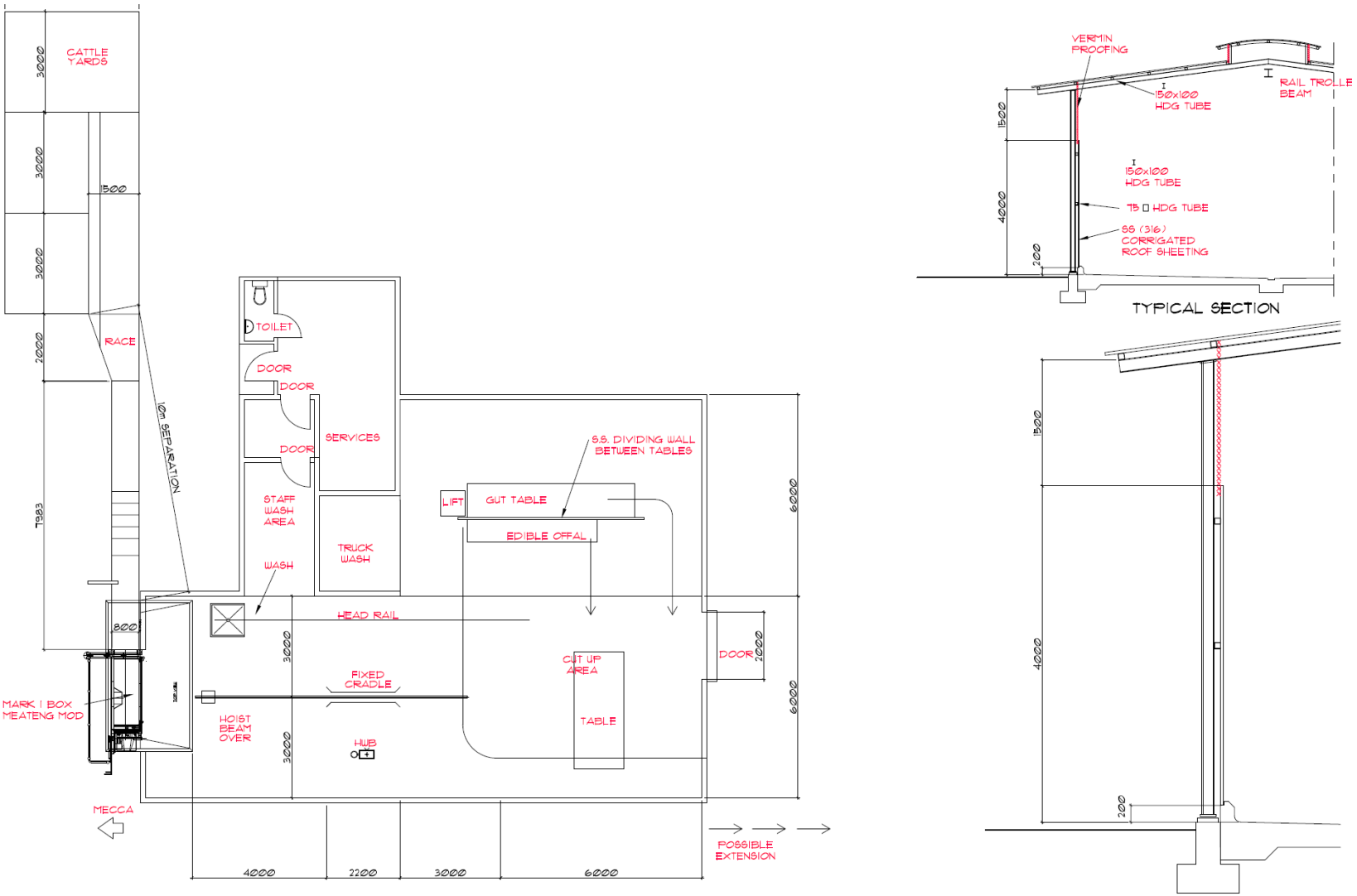

Figure No. 9: Simple Low Volume Slaughter Facility (3-5 Head per Night)

Recommendation four

It is recommended that a services module capable of providing clean hot and cold water for the abattoir process be designed. This needs to be made up of currently commercial available components including:

- Water tanks to feed from existing supply.
- Filtration (ultra filtration) and sterilising (UV) treatment which is a common practice in Indonesia.
- Storage tank.
- Pressure pump for cold water as with a domestic pressuring system.
- Hot water heating, preferably gas fired commercial modular hot water heating and storage units. This should be sized so that a normal system would include say three heaters with one on standby at any one time.
- Hot water circulation tank and pumped system (82°C).
- Mixing valves to supply hand wash and cleaning hose water (45°C),
- Supply to floor and equipment wash down, preferably with a detergent injection system.
- Detergent dosing pump and storage.

This module would ensure that the requirements of any site can be certified for potable water and temperature requirements.

This should be the subject of a detail design and be based on all equipment being available in the commercial market in Indonesia and to complement local maintenance ability.

Recommendation five

It is expected that all items shown on layouts or in process descriptions would be manufactured in Indonesia. As part of a detail design package, a Meateng consultant could provide construction drawings for all standardised equipment items, and as part of a development package, these items could be sourced from Indonesian fabricators.

It was not an objective of this project to provide detailed equipment drawings as further on-site review is necessary to establish designs that can be readily sourced in Indonesia. This equipment must be built to standards acceptable to international veterinary agencies to ensure the development of a culture that delivers hygienic equipment to a developing industry.

Recommendation six

The construction of a “best practice”, demonstration abattoir facility would have the most benefit in improving the food hygiene standards and productivity of Indonesian abattoirs. Such a facility would provide a real life example of an abattoir operating in compliance with local and international food safety and animal welfare standards. Industry representatives could visit the operation and see first hand the process equipment, services and building construction methods required to achieve this standard.

In addition, the facility could be used for demonstrating and training abattoir staff and management in the required processing procedures to achieve an international standard of food safety. Without such a demonstration facility, it would be very difficult to improve the existing culture in design, maintenance and operation of Indonesian abattoirs.

The DGLAHS is also required to provide abattoir facilities in regional areas to allow each province to have the commercial opportunity provided by an abattoir. These abattoirs will invariably be of various capacities, depending on the local demand. Most regional abattoirs would however, be very small, typically of the order of 3-5 head per night. To provide such a facility that is inexpensive to build, economical to operate and meets acceptable food safety standards is a challenge. The concept small abattoir facility referred to above is an example of the simple arrangement which might address this need.

Additionally, the DGAHS may wish to selectively develop an abattoir with a cold chain to expand the volume of Indonesian product able to support the refrigerated product being supplied to supermarkets and restaurants. This could be a new (green field) abattoir or an upgrade to an existing facility.