THE SLAUGHTER OF AUSTRALIAN CATTLE IN INDONESIA: AN OBSERVATIONAL STUDY

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RSPCA

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Contents

Executive summary 4

Introduction 7

Methods 10

Restraint methods 10

Data collection 12

Results 14

General handling 14

Restraint method 15

Handling from restraint to slaughter 18

Slaughter 22

Discussion 24

Welfare impacts of handling 24

Welfare impacts of restraint 25

Welfare impacts of slaughter 28

Conclusions 31

Acknowledgements 34

References 34

Appendix: Case studies 35

Case study 1 35

Case study 2 38

Case study 3 40

Case study 4 42

Case study 5 44

Case study 6 45

Case study 7 46

Executive summary

Australia has exported a total of 6.4 million cattle to Indonesia over the past 20 years. In 2010, 60% of live cattle exports (521,002 cattle) went to Indonesia: these cattle are sourced from properties in the north of Australia and are unused to human handling. Rope casting, where cattle are forcibly tripped onto their sides, followed by slaughter using multiple throat cuts while animals are fully conscious, are all normal practice. There are no enforceable animal welfare regulations or penalties in Indonesia.

In 2000, the live export industry identified that pre-slaughter stress was leading to poor meat quality and Australian beef being discounted in the marketplace. As a result, a Mark 1 restraint box was designed which provided a means of holding Australian cattle in an enclosed space to facilitate the traditional Indonesian method of roping slaughter. In 2001, the first four Mark 1 restraint boxes were built and installed in Indonesia. There are now 103 Mark 1 restraint boxes in more than 50 different locations in Indonesia, installed using a combination of Australian industry and government funding. Problems with the operation and animal welfare outcomes of the Mark 1 box were identified as far back as 2003, and the design has since progressed to a significantly modified Mark 4 box. Yet Mark 1 boxes have continued to be installed as recently as 2010. An unknown number of 'copy boxes' (Indonesian-built boxes or pens based on the Mark 1 design) have also been installed and brought into use over this time.

A 2010 Meat & Livestock Australia (MLA)/Livecorp commissioned report into welfare conditions for Australian cattle in Indonesia concluded that animal welfare was "generally good". However, this report did not address the design of the Mark 1 box or the acceptability of casting as a restraint method, and did not include a clear account or any images of these boxes in use. The report also reached that conclusion despite indicating significant animal welfare problems at the point of slaughter.

The mixed messages from the 2010 report highlighted the urgent need for a fully independent and transparent investigation of the slaughter of Australian cattle in Indonesia. This study attempts to address that need by providing a detailed assessment of video footage obtained by Animals Australia during an investigation in March 2011, where a total of 50 slaughters were filmed at 10 different locations. Cattle were restrained using Mark 1 boxes, copy boxes, traditional rope casting and, in one location, a Mark 4 box. Footage of traditional rope casting of nine local animals, obtained by the World Society for the Protection of Animals (WSPA) during a 2010 investigation, was also included for comparison. Assessments were made of the handling and behaviour of cattle, duration of restraint, casting, slaughter, duration of consciousness following slaughter, and whether slaughter was conducted according to halal requirements. The assessment criteria were based on standard slaughter audits and previous research. The results of these assessments are discussed in terms of the impacts on the welfare of the cattle involved and the OIE Terrestrial Animal Health Code – Slaughter of Animals (OIE Code).

Painful handling techniques, such as the use of physical force (poking, hitting, kicking, tail twisting) to move animals were observed in 90% of locations. Techniques that cause extreme pain and injury (eye gouging, tail bending or breaking and tendon slashing) were used when difficulties arose moving or handling animals. Handling during rope casting involved every animal being subjected to multiple painful procedures. The risk of an individual animal being subjected to at least one painful handling procedure was extremely high (>57%) in all methods of restraint. Workers did not seem to understand how to encourage cattle to move forward without resorting to pain, nor were they at ease dealing with Australian animals. This

is particularly concerning given that 80% of the slaughterhouses visited had Mark 1 boxes installed, indicating that standard operating procedure (SOP) training under the MLA/Livecorp program was delivered to workers in these locations. Handling across all locations breached multiple clauses of the OIE Code.

Restraint is one of the most stressful and potentially painful aspects of the slaughter process thus it is critically important to minimise both the severity and duration of its impact. An efficient and humane means of restraint will consistently hold animals in a set position without undue discomfort for as short a time as possible – this is also a requirement of the OIE Code. Rope casting was obviously neither efficient nor humane: the process for Australian cattle took an average of nearly 8 minutes and involved multiple insults to animal welfare, including the deliberate and repeated infliction of pain to move animals. This study also clearly demonstrates that the Mark 1 box is neither an efficient nor humane means of restraint. The variation in presentation and casting of cattle means that the box is not able to consistently hold animals in a set position. The pain and distress associated with casting animals onto a sloping concrete slab means that this method will inherently result in extreme distress and, in some cases, physical injury. During casting, all animals restrained in Mark 1 and copy boxes were observed attempting to rise up off the concrete slab in order to regain their feet. This repeated head lifting (also referred to as 'head slapping') was sufficiently violent to chip the concrete edge of the blood drain. Cattle were restrained for an average of 5 minutes in Mark 1 boxes, exposing them to unnecessary and prolonged suffering (for comparison, restraint takes only a few seconds in upright systems in Australia). The breadth of this suffering is indicated by 50% of animals vocalising during restraint in Mark 1 boxes.

Cattle are stunned before slaughter in Australia. This is because cutting the throat of a fully conscious animal is considered to cause very significant pain and distress. The selection of the knife and the cutting technique employed are critical in reducing this pain: the knife must be long, razor-sharp and the cut must be made using a single continuous motion. On only seven occasions during this study was a single cut observed: the average number was 11, and the maximum 33. As with the poor level of pre-slaughter handling observed, the lack of skill observed during slaughter is particularly concerning given that 80% of slaughterhouses should have received training under the MLA/Livecorp program.

Twelve Australian cattle (50%) exhibited indicators of possible consciousness in the period 1.5-2 minutes after the throat cut. Nine (38%) exhibited rhythmic breathing in combination with a positive corneal reflex, indicating that brain and spinal function were still present. Six were observed to have a positive corneal reflex or to spontaneously blink in response to an external stimulus more than 2 minutes after slaughter. These results indicate that Australian cattle in Indonesian slaughterhouses are at extremely high risk of experiencing extended suffering during slaughter without stunning. A number of factors are likely to have contributed to this situation, including the size of Australian cattle, the selection of Brahman-cross breeds, exposure to multiple stressors during slaughter, the use of casting to facilitate restraint, extremely poor cutting technique and swelling or occlusion of arteries reducing blood loss.

The Australian cattle observed in this study were exposed to multiple insults to their welfare. The breadth of this investigation and the lack of control over the dispersal of cattle exported to Indonesia strongly suggest that this is reflective of the treatment of Australian cattle in general in that country. Reference to national and international standards indicates that the handling, restraint and slaughter process breached several fundamental animal welfare principles and resulted in significant and unnecessary pain, suffering and distress. This treatment is completely unacceptable according to Australian standards and would be subject to prosecution under Australian animal welfare legislation.

Rather than protect the welfare of Australian cattle, the installation and use of the Mark 1 box has entrenched a system of restraint that causes significant suffering. The delivery of training programs in conjunction with the installation of these boxes has failed to have sufficient impact on Indonesian workers to prevent the abuse of animals or ensure a basic understanding of animal welfare, knowledge of the OIE Code, or ability to perform an efficient throat cut.

Unless the slaughter of Australian cattle could be restricted to locations where a skilled, permanent workforce was employed, stunning was effectively used, and training and auditing programs and enforceable animal welfare legislation were in place, it is difficult to see how their treatment could be reliably and sustainably improved. Fundamental change to both cultural and legislative approaches to animal welfare in Indonesia is needed in order to achieve that goal. This, at best, would be a long-term undertaking. The continued suffering of millions of Australian cattle while such change was attempted against all the known impediments is totally unacceptable. The only practical and ethical solution is for the export of cattle to be replaced by the export of meat products. It is time to accept the evidence and act accordingly.

Introduction

Indonesia is the largest importer of Australian cattle and has held this position for 13 of the past 15 years. In 2010, 60% of live cattle exports from Australia went to Indonesia: a total of 521,002 cattle. Over the past 20 years a total of 6.4 million cattle have been exported to this destination (Livecorp 2011). Export numbers peaked in 2009 at 772,868 (Livecorp 2011), but since an announcement by the Indonesian Government of targets for self-sufficiency in cattle breeding and the enforcement of a maximum weight limit placed on imported cattle, the numbers have declined.

In 2000, the live export industry, through Meat & Livestock Australia (MLA) and Livecorp, identified improving the traditional pre-slaughter and slaughter handling of imported Australian cattle in Asia as a priority (Beere & Pettiford 2005). The driving force behind this was to improve meat quality, operator safety and processing efficiency and thus increase the market price of imported Australian cattle (Beere 2004). Workers and slaughter facilities in Asia used to dealing with highly domesticated local breeds were unable to cope with the large, extensively raised Australian cattle unused to human contact. Thus the focus of investment in Indonesia was the installation of restraint boxes and associated training to facilitate handling and slaughter without stunning. In 2000, a prototype cattle restraining box was designed and built in Darwin which became known as the Mark 1 restraint box (Figure 1). The Mark 1 box provided a means of holding Australian cattle in an enclosed space while their legs could be roped: it did not alter the traditional method of casting (forcing animals to trip over onto their sides) and then being held down for the throat cut while fully conscious. In 2001 the first four Mark 1 restraint boxes were built and installed in Indonesia. There are now 103 Australian-designed Mark 1 restraint boxes installed in more than 50 different locations.

Problems with the operation and animal welfare outcomes of the Mark 1 box were identified in 2003, and a Mark 2 design was proposed which allowed animals to be slowly tilted into a horizontal position, rather than tripped onto their side to fall onto a sloping concrete slab (Beere 2004). However, it appears that only two of these boxes were ever installed in Indonesia. In 2005, a consultants' visit to Indonesia was conducted to observe the MLA boxes in operation and advise on infrastructure and training issues. The consultants' report recommended an auditing process be introduced to measure performance on an animal-by-animal basis, but it appears that this suggestion was not taken up (Beere & Pettiford 2005). In 2008, modifications to the Mark 2 design were proposed, but a technical review resulted in this design being abandoned (Beere 2008; Stark 2010). As a result of this review, a new Mark 4 design based on a rotating calf crush was developed (Figure 2) four of which have since been installed in Indonesia (Stark 2010; MLA & Livecorp 2011;). Despite these developments, under the Australian Government Live Trade Animal Welfare Partnership (LTAWP) with industry, Mark 1 boxes have continued to be built and used in Indonesia throughout this period, with a further 10 installed in 2010. An unknown number of 'copy boxes' (Indonesian-built restraint boxes or pens based on the Mark 1 design) have also been brought into use as a result of this program.

The claim that the installation of restraining boxes has resulted in improved animal welfare during slaughter in Indonesia has been made in multiple MLA/Livecorp reports, mostly by the designers of the boxes themselves (Beere 2004, 2008; Beere & Pettiford 2005; MLA & Livecorp 2011). However, these perceived improvements have been viewed against the prevailing conditions for animal welfare in Indonesia. This starting point reflects a largely uneducated workforce with little or no understanding of animal welfare, no enforceable animal welfare regulations or penalties, and where the rope casting and throat cutting of fully

conscious cattle using multiple cuts is standard practice (Blaszak 2011; OIE 2007). This is in contrast to the situation in Australia where there are long-standing enforceable animal welfare laws, quality assurance programs within the meat processing industry (that include specific standards for animal welfare far above the requirements of the OIE Code), competency requirements for workers and independent auditing. It is also a legal requirement that stunning is used in the slaughter of all cattle in Australia, including during religious slaughter.

In 2009, RSPCA Australia made a formal request to Livecorp and the Australian Government to visit Indonesia and independently assess the handling and slaughter of Australian cattle. This request was refused, but in 2010 MLA and Livecorp commissioned a consultant to undertake an "independent expert review" of the animal welfare conditions for Australian cattle in Indonesia. The review involved a visit to Indonesia in March 2010 by the consultant together with a team of four industry-appointed scientists and included observations of the slaughter of 29 cattle in 11 locations. These locations were determined by MLA and Livecorp and included observations of slaughter using 15 Mark 1 boxes. The report of this visit was published in January 2011 (Caple et al. 2010).

Figure 1 Mark 1 restraint box with blood drain, installed in an Indonesian slaughterhouse

Figure 2 Mark 4 restraint box with local Indonesian animal

The report covered the general treatment of cattle from unloading to slaughter, and concluded that the welfare of Australian cattle in Indonesia was “generally good”. This conclusion was reached despite a series of comments in the body of the report indicating significant animal welfare problems at the point of slaughter. The report made no comment on the design of the Mark 1 restraint box or the acceptability of casting or restraining cattle on their sides during slaughter without stunning. Indeed there was no reference to any other studies or to the animal welfare science literature in the report. Yet it was clear from the information presented that the welfare of cattle restrained and slaughtered using these devices was extremely poor.

These concerns highlighted the urgent need for a fully independent and transparent investigation of the treatment of Australian cattle at the point of slaughter in Indonesia, in order to give a detailed and considered account of their welfare. The present study attempts to provide that account, through a detailed assessment of video footage of the slaughter of 50 individual animals in Indonesia in March 2011.

Methods

Detailed assessments of the welfare of cattle during handling and slaughter without stunning were made from video footage obtained by Animals Australia during a March 2011 investigation in Indonesia. The investigators were given unfettered access to slaughterhouse facilities and were permitted to openly film and photograph slaughter and handling. Visits were either pre-arranged on the day prior to slaughter or impromptu visits during the night when slaughter was taking place.

The footage was taken using two hand-held video cameras and recorded onto high-quality mini-DV tapes. Where the same animal was filmed with both cameras, cross-checks of individual slaughters were conducted during the assessment to validate durations and signs of possible consciousness.

A total of 50 slaughters were filmed at 10 different slaughterhouses located in or around four different cities on the Indonesian islands of Java and Sumatra. The facilities had been chosen because they slaughtered Australian cattle, were known or likely locations where Australian-designed restraint boxes had been installed or were located near to one of these facilities. At the time of the investigation the locations of the slaughterhouses visited during the 2010 study reported in Caple et al. (2010) were not known. It was subsequently confirmed that there was one overlap in the slaughterhouses (Location 2).

Slaughters were observed in a total of 18 settings: 10 Mark 1 boxes, 6 copy boxes and one Mark 4 box were observed in operation. Five slaughters using traditional rope casting methods were also observed. In all but one of these cases, rope casting was used in a slaughterhouse where a Mark 1 box was installed and available for use.

Slaughter generally took place between 10pm and 3am in order to service wet markets the following day. Slaughterhouse capacity varied from five to 60 head per night.

To allow comparison of the slaughter of Australian cattle with traditional rope casting of local Indonesian cattle, a second set of observations of 9 animals were also assessed from video footage obtained during an August 2010 investigation of cattle slaughter at two government slaughterhouses on the islands of Lombok and Sumbawa. This footage was made available by the World Society for the Protection of Animals (WSPA). The traditional slaughter of a single local animal at a government slaughterhouse in Banderlampung filmed during the 2011 investigation was also included in this data set.

Table 1 shows the general location of slaughterhouses visited, the type of facilities in place and the number of animals observed at each facility.

Restraint methods

Four types of restraint were observed during the assessment:

- ***Mark 1 restraint box*** – designed and built through funding from MLA and Livecorp, the Mark 1 box consists of a galvanised metal holding pen at the end of a straight or curved raceway. The pen is mounted on a concrete slab which slopes down towards the ground. The end and sides of the pen are raised off the slab to allow access to the animal's legs for roping. In most cases the slab has a blood drain with a single metal bar across it (see Figure 1).

Table 1 Location of slaughterhouses and details of restraint and slaughter

Location		Animals observed	Restraint method	Blood drain	Washing	Head restraint	Throat cuts/ animal (mean)
1	**Bayur,** Jakarta, Banten (Java)	1	Mark 1	Y	N	Y	2.7
		2	Mark 1	Y	Y (hose)	N	
		3	Mark 1	Y	N	Y	
2	**Gondrong**, Jakarta, Banten (Java)	3	Mark 1	N	Y (buckets)	N	1.6
		5	Mark 1	Y	Y (buckets)	N	
3	**Terpadu**, Bogor, West Java	2	Mark 1	N	Y (hose)	Y	4.9
		2	Copy box	N	Y (hose)	Y	
		4	Mark 4	Y	Y (hose)	Y	
4	**Depok**, Jakarta, Banten (Java)	2	Copy box	N	N	Y	10.0
5	**Z Beef**, Banderlampung, Sumatra	5	Mark 1	Y	N	Y	4.4
6	**Kaliawi**, Banderlampung, Sumatra	1	Rope cast		N	Y	17.4
		8	Mark 1	Y	Y/N	Y	
7	**Mabar**, Medan, Sumatra	3	Rope cast		Y (hose)	Y	16.3
		1	Mark 1	Y	N	Y	
8	**Jalan Stasiun**, near Medan, Sumatra	5	Copy box	N	Y/N	Y	19.8
9	**Tani Asli,** near Medan, Sumatra	1	Copy box	N	N	Y	19.8
		1	Mark 1	Y	Y	Y	
10	**Kota Binjai**, near Medan, Sumatra	1	Rope cast		Y (hose)	Y	14.0
11	**Mataram**, West Nusa Tenggara, Lombok	5	Rope cast		Y	Y	20.8
12	**Taliwang**, West Nusa Tenggara, Sumbawa	4	Rope cast		Y	Y	10.0

- ***Copy boxes*** – these are Indonesian-built restraint boxes or pens based on the Mark 1 box design.
- ***Traditional rope casting*** – the use of ropes to trip the animals over and bring them down onto their side. This is usually followed by trussing of the legs to avoid further movement.
- ***Mark 4 box*** – a modified tilting calf crush with a scissor-frame squeeze to restrain the animal prior to and during rotation. When the animal is partially rotated a rope is applied to restrain the head against the side of the box. When the box is fully rotated the animal is at 90 degrees to the vertical.

Data collection

All cattle were classified as being Australian or local animals. An animal was positively identified as Australian if it was of an appropriate breed and size, had ear tags indicating Australian origin, or had been identified as coming from a feedlot holding Australian animals. All local animals had a head rope or tether which passed through the nose.

General observations were made of the handling and behaviour of animals in the lairage and prior to each individual being singled out for slaughter. These were assessed in terms of the impacts on the welfare of the cattle involved and the provisions for the moving and handling of animals in the *OIE Terrestrial Animal Health Code – Slaughter of Animals* (OIE 2010). Once an animal had been singled out for slaughter, observations focused on the individual animal. Observations focused on the behaviour and treatment of each animal during handling, restraint and slaughter and included criteria previously proposed for the audit of Indonesian slaughterhouses to measure individual animal performance (Beere & Pettiford 2005).

Handling and behaviour

The use of any painful acts or procedures to compel animals to move was noted from when the animals were first restrained to the point of slaughter: these were separated into (a) the use of goads (the use of hands, feet, sticks or other aids, including slapping, kicking, whipping and poking) to create physical force on the body of the animal; (b) tail pulling or twisting; (c) tail bending; (d) eye gouging; and (e) dragging of animals. Because the washing of animals has been noted as a potential cause of stress in Indonesian slaughterhouses (Caple et al. 2010), any use of water and the way in which it was applied (buckets, hose) was also recorded. Any slips or falls, and the number of distinct vocalisations (moos, bellows) made by each animal prior to and during restraint was also recorded.

Duration of restraint

The duration of restraint was recorded in two ways: the duration from the start of restraint to the start of the throat cut, and from casting to the start of the throat cut. Where animals were slaughtered using a Mark 1 or copy box, restraint was deemed to start from when the animal was confined in the box (i.e. when the sliding or guillotine door from the raceway was closed) or, in those cases where animals were pulled into the box using a neck rope, from when the neck rope was applied. Casting was measured from when the door of the box was opened to the start of the throat cut. Where animals were slaughtered using traditional rope casting, restraint was deemed to start when the first rope was applied. In the case of local animals where head ropes are constantly worn, this was taken as the point where the head rope was first tightened prior to casting. Because the traditional rope casting process usually involved making the animal repeatedly fall over and then get up again, animals were deemed to be cast when adequately trussed and no longer able to get up.

Casting

The severity of the fall during casting was scored on a scale of 1-3, where 1 = mild (when an animal fell gradually onto the concrete with mild force), 2 = moderate (when the animal's head and body hit the concrete with moderate force) and 3 = severe (when the head and body hit the concrete with severe force). No score was recorded when animals were already lying down when observations began. A subset of animals was initially assessed to provide a baseline for this scale before scoring commenced. This scoring system was based on the scale reported in Caple et al. (2010) but has been clarified to include descriptions of each category.

The number of times each animal regained a standing position or attempted to rise (raised his head and fell back; got up on front/rear legs) were also recorded. The use and type of head restraint was also noted.

Slaughter process

Any actions relating to halal requirements during slaughter were noted. The number of cuts made in the neck was recorded for each animal. One cut represented the movement of the knife in one direction only, i.e. before a change of cutting direction or withdrawal of the knife (Gregory et al. 2008). The video was slowed to half speed for this purpose as the action of cutting was often a rapid sawing motion which was difficult to assess at normal speed.

Any handling subsequent to the throat cut was noted (cutting at the throat, cutting elsewhere, water directed at the head or neck area, handling of the wound, dragging of animals) as well as the duration from the start of the throat cut to the first subsequent handling.

Consciousness following the throat cut

In order to evaluate the effectiveness of the throat cut and subsequent loss of consciousness in animals, the following indicators were noted in the 120 seconds following the start of throat cutting: gross purposeful movements; tongue movement; nose movement (wrinkling, flaring of nostrils); blinking; eyeball rotation; rhythmic breathing and vocalisation (Table 2; Grandin 2010; Adams & Sheridan 2008; Limon et al. 2010). Because of the varied conditions under which animals were filmed, not all indicators of consciousness could be seen at every point in time. For this reason, scoring was divided into 30-second intervals, starting 30 seconds after throat cutting commenced. The first 30 seconds post-cut were not scored as this is the minimum time allowed for death after bleeding out under the OIE Code, i.e. all animals are assumed to be conscious and sensible to pain for this period of time. The estimated duration of consciousness for each animal was recorded as the last interval during which two or more of these indicators were observed. A subset of eight animals was assessed blind by a second observer: there was a complete match in the assessment of duration of consciousness following slaughter between the two assessments. The timing of any checks for corneal reflex (response to touching the eye) or palpebral reflex (response to touching the corner of the eye) was also noted.

Table 2 Indicators of possible consciousness after slaughter

Indicator	Description
Gross purposeful movement	Deliberate and purposeful movement: arched back, head/neck lifts, tail flicking (not leg kicks or spasms)
Tongue movement	Tongue movement in/out or thrusting of stiff, curled tongue (not a straight limp tongue)
Nose movement	Twitching of nose, response to touch, rhythmic flaring of nostrils
Blinking	Blinking in response to movement near eye or response to direct touch (not a blank glassy stare)
Eyeball rotation	Eyeball rotation, nystagmus (involuntary eye movement)
Rhythmic breathing	Regular movement of the ribcage/diaphragm (not irregular or occasional movement)
Vocalisation	Moo, bellow

Results

Of the 50 slaughters observed from the March 2011 footage, 40 animals were positively identified as Australian and 10 of local origin. Two local animals slaughtered using Mark 1 restraint boxes and three using copy boxes were excluded from the subsequent analysis. Footage of four local animals slaughtered using a single Mark 4 box was incomplete and as no Australian animals were slaughtered using this method it was not included in the subsequent analysis. A single local animal restrained by rope casting was included for the comparison between rope casting of Australian and local animals. The nature of opportunistic filming meant that not all data points were able to be captured for every animal: where this applied in the analysis the sample size (n) is indicated. All of the slaughters observed were carried out on fully conscious animals.

General handling

Handling of cattle in the lairage and raceways was observed in four of the ten slaughterhouses where Australian animals were slaughtered (Locations 1, 5, 6 and 7). All of these slaughterhouses had Mark 1 boxes installed, indicating that at some time workers should have received basic training in the handling of Australian cattle. In each of these slaughterhouses, difficulties were observed in moving animals from the holding pen into the restraint box or onto the slaughter floor. When animals did not move easily, handling techniques were observed that demonstrated a lack of understanding of animal welfare and basic cattle behaviour. These included repeatedly poking sticks into the hindquarters, anogenital area and eye area; slapping or kicking of restrained animals; tail pulling, tail bending, eye gouging and dragging. One of the key sources of problems in moving animals into the slaughter area was the poor design of some facilities. In many cases floors and ramps were slippery and this was exacerbated when they were wet from being hosed down. It was also difficult to move animals through some raceways due to their open-sided design and position relative to the lairage and restraint box (Figure 3).

Figure 3 Poorly designed raceway leading into Mark 1 restraint box

An incident involving an injured steer at one slaughterhouse provides a graphic example of the lack of consideration for cattle welfare observed in this study. This took place in the lairage at Location 7. An Australian steer, selected for slaughter using rope casting was roped around the neck and was in the process of being pulled onto the slaughter floor when he slipped and broke his left rear leg and was unable to walk. At this point, according to the OIE Code, the animal should have been humanely killed *in situ*. Instead, he was subjected to repeated acts of cruelty in an attempt to move him into the slaughter room. Eventually the workers gave up and slaughtered him in the pen. The entire process took 28 minutes. The full experience of this animal is documented in Case study 1 (Appendix).

Restraint method

Mark 1 boxes

The entry of animals into Mark 1 boxes varied according to the design of the raceway. In some settings, usually where the entrance to the ramp was curved and had solid sides, cattle moved into the restraint box with little difficulty. In others, where animals were reluctant to enter the raceway they were subjected to one or more painful acts to move them forward, or forcibly pulled into position using a neck rope (Case study 2 – Appendix).

Once in the box, the restraint process using the Mark 1 box consisted of three stages. The first stage began with the closure of the guillotine door behind the animal. During this stage one or two workers attempted to loop a rope around the near front and rear legs of the animal (Figure 4). These ropes were then tightened to cleats on the far side of the box. This process took an average of 131 seconds (n=18): the duration varied depending on the level of agitation of the individual animal and the skill and number of workers. The second stage (casting) began when the door of the Mark 1 box was opened. In response to the sudden exposure and contrast to the confines of the box, the animals attempted to move, but due to the restriction of the leg ropes they instead tripped over on their sides onto the sloping concrete slab (Figure 5). Cattle would then attempt to regain their feet by lifting their head, neck and forequarters: most attempts were unsuccessful and they would fall back with force against the concrete slab. Where a blood drain was present, there was a high risk of injury to the animal's head from hitting the metal bar or edge of the drain during these attempts to rise. In some cases buckets of water or a hose was directed at the animal during this period (Case study 3 – Appendix). The third stage began when the head was held in place for the throat cut: in some cases this was done manually with two or more workers; in others a rope was tied around the head of the animal and then around the muzzle (see Table 1). The slaughter consisted of several cuts to the throat, followed by a period of bleeding out which was prolonged in many cases. A number of animals were interfered with (hosed or cut) while still showing signs of consciousness: in most cases no action was taken by the workers to check that the animal had died before further processing commenced. Blood was only observed to be collected on three occasions during slaughter.

Copy boxes

The use of copy boxes varied according to their design, but they were generally used in the same way as Mark 1 boxes. The main differences were that copy boxes tended to have open, metal-barred sides, the area of the sloping concrete slab was smaller and continuous with the floor and there was no embedded blood drain (Figure 6). In some locations, multiple boxes had been constructed by converting raceways into individual holding pens with hinged doors. Where these were used simultaneously, animals were slaughtered in full view of others in the neighbouring pens (Case study 4 – Appendix).

Figure 4 Roping of legs prior to opening of a Mark 1 restraint box

Figure 5 Tripping and pulling a steer over after opening a Mark 1 restraint box

Figure 6 A cast steer after the throat cut in a copy box

Rope casting (Australian animals)

Rope casting of Australian cattle commenced with a rope being thrown over the head of the animal and then tightened around the neck. The animal was then pulled onto the slaughter floor using a combination of the rope and various goads aimed at keeping the animal moving forward. Animals that resisted moving were subjected to various painful procedures in an attempt to move them forward. Once on the slaughter floor, the exact order of events varied according to the restraint method, but there was generally a process of using the neck rope to secure the head of the animal and application of leg ropes to pull the animal over. The floor was usually wet and slippery to assist with casting and animals were observed to slip multiple times. The casting process usually involved the animal repeatedly falling over and being forced to get up again (using various painful procedures) while the workers attempted to get them into a convenient position for the throat cut. Once animals were cast, their legs were tightly bound or tied to bollards to prevent further movement (Figure 7). In some cases this meant that the head was suspended off the floor by the neck rope, making it difficult for the animal to breath normally. A detailed account of the rope casting of an Australian animal is provided in Case study 5 (Appendix).

Figure 7 Rope casting of an Australian steer

Figure 8 Example of traditional rope casting of local Indonesian cattle

Rope casting (local animals)

Rope casting of local animals commenced with the animal being led onto the slaughter floor using the head/nose tether (Case study 6 – Appendix). The head rope was then held firmly by the handler or tied to a ring on the floor. A rope was then looped around one leg and pulled to bring the animal down (Figure 8). The legs would then be tied together or to external rings or fixings so that the animal was fully trussed. If the animal was not in a convenient position for slaughter they were dragged by the ropes and/or the tail into the desired position. Where the head rope was tied to a bollard the head was often suspended above the ground with tension on the nose rope. In one of the two slaughterhouses, a tray was placed under the neck of each animal prior to the throat cut to collect blood. The animal's neck was manually held in place over the tray by the worker holding onto the flesh around the wound.

Use of head restraint

Most slaughterhouses used some form of roping to restrain the head of each animal after casting when using a Mark 1 box. All locations using copy boxes used a head restraint. In some locations a neck rope was used to pull animals into the restraint box: this rope was then used to tie down the animal's head to the concrete slab after casting. In others, a head restraint was applied around the neck and muzzle after casting. In three slaughterhouses using Mark 1 boxes, a second rope was used to turn the head and neck into a position where the ventral aspect (underside) was uppermost for the throat cut (Figure 9).

Handling from restraint to slaughter

Handling from restraint to slaughter was observed in a total of 48 individual animals: 38 Australian cattle and 10 local cattle.

Painful handling procedures

Painful handling procedures were observed in nine of the 10 locations where Australian animals were slaughtered. Table 3(a) shows the percentage of animals in each type of restraint subjected to painful handling procedures, and 3(b) the prevalence of these procedures per animal. For Australian cattle, the risk of painful handling procedures was

Figure 9 Head restraint for exposing the neck prior to cutting in a Mark 1 box

highest for animals restrained by rope casting, where all of the four animals observed were subjected to physical force in the form of goads or other aids. Tail bending (in some cases this resulted in the tail being deliberately broken) and tail pulling, eye gouging and dragging were also observed. The prevalence of these painful acts during rope casting was extremely high, with animals subjected to an average of 22.5 goads, 2.00 tail pulls/twists, 5.75 tail bends and 8.00 eye gouges (Table 3b).

Eighty percent of local animals restrained by rope casting were subjected to physical force in the form of goads, tail pulling/twisting, tail bending or dragging (Table 3a). However, compared with Australian animals, the prevalence of these acts per animal was relatively low and no eye gouging of animals was observed (Table 3b).

Animals restrained using Mark 1 boxes were at a lower risk of painful procedures during handling when compared to rope casting, but 67% of animals were subjected to at least one painful procedure, with tail pulling/twisting (59%) and the use of goads (19%) the most common. Tail bending and eye gouging were also observed in 7% and 11% of animals respectively (see Table 3a). In one case where an animal regained his feet after the throat cut, his rear left leg was slashed with a knife to sever the tendon in order to bring him down (Case study 7 - Appendix). The lowest risk of painful handling procedures was for cattle slaughtered using copy boxes where the use of goads and/or tail pulling/twisting was observed in 57% of animals and no incidents of tail bending or eye gouging were recorded.

Table 3a Percentage of cattle subjected to painful handling procedures during restraint

Restraint method	N	% All painful procedures	% Goads	% Tail pulling/ twisting	% Tail bending	% Eye gouging	% Dragging
Australian cattle							
Mark 1	27	67	19	59	7	11	4
Copy box	7	57	43	14	0	0	0
Rope casting	4	100	100	50	100	25	25
Local cattle							
Rope casting	10	80	20	80	20	0	40

Table 3b Prevalence of painful handling procedures during restraint (mean occurrences)

Restraint method	N	Goads	Tail pulling/twisting	Tail bending	Eye gouging	Dragging
Australian cattle						
Mark 1	29	3.74	1.30	0.23	0.18	0.05
Copy box	7	2.29	0.29	0	0	0
Rope casting	4	22.50	2.00	5.75	8.00	0.50
Local cattle						
Rope casting	10	0.44	2.30	0.22	0.00	0.78

Washing

Water was used to wash cattle in a variety of ways and delivered via buckets or a running hose. In some slaughterhouses, cattle were hosed down prior to entering the restraint box or slaughter area. In others, cattle were hosed down or had buckets of water thrown at them during restraint and/or after the throat cut. Eight of the 10 facilities where Australian cattle were slaughtered used water on at least some animals during restraint (see Table 1). Water was used on 48% of Australian cattle in Mark 1 boxes, 29% in copy boxes, and all rope cast animals. The slaughter of local animals included washing in 80% of cases. Throwing buckets of water or directing the hose at cast animals prior to slaughter resulted in a number of animals

attempting to rise or move their heads away from the water source. Where water was used after slaughter, it was often directed at the throat/neck area and sometimes directly on the neck cut; in some cases this resulted in animals shaking their (half-severed) heads or attempting to rise.

Vocalisations

Over half (54%) of Australian cattle vocalised at least once during restraint. All four Australian animals restrained by rope casting, 50% of Australian animals in Mark 1 boxes, and 43% of animals in copy boxes vocalised during restraint (Table 4). Only 20% of local animals were observed to vocalise during rope casting.

Table 4 Vocalisation of cattle during restraint

Restraint method	N	No. of vocalisers	% Animals vocalised	Range (no. of vocalisations)
Australian cattle				
Mark 1	28	14	50%	0-22
Copy box	7	3	43%	0-4
Rope casting	4	4	100%	1-30
Local cattle				
Rope casting	10	2	20%	0-5

Duration of restraint

There was considerable variation in the total duration of restraint across all restraint methods. This was due to a range of factors including: no sense of urgency in dealing with restrained animals; no demonstrated understanding of the need to minimise time spent in restraint; difficulties in attaching leg ropes for casting; difficulties in moving Australian cattle unused to handling; poorly designed raceways; slippery surfaces; and where several animals were restrained simultaneously, a lack of sufficient slaughterhouse staff to deal with each animal.

All restraint methods held animals for an average of more than 3 minutes. In the worst case, where animal handling and the design of the facility was particularly poor, an individual animal was restrained for nearly 20 minutes prior to slaughter; in the best case the total duration of restraint was 1 minute 18 seconds (78 seconds). Both of these examples were using Mark 1 boxes.

The average total duration of restraint was similar for local animals rope-cast using the traditional method (3 min 23 sec) and Australian animals restrained using Mark 1 boxes (5 min 1 sec). This was primarily due to none of the local animals requiring restraint to move them onto the slaughter floor as they were used to being led using their head/nose tether. Data using copy boxes was limited to only two animals: the mean total duration of restraint was 10 min 30 sec; similarly, for rope casting the mean from three animals was 7 min 40 sec (Table 5).

Once animals were cast, the time to the throat cut was shortest with Mark 1 boxes (1 min 37 sec) and rope-cast local animals (1 min 57 sec). Time to throat cut for copy boxes was longer at 2 min 12 sec for rope-cast Australian animals and 3 minutes for those slaughtered using copy boxes.

Table 5 Duration of restraint

Restraint method	Casting to throat cut			Total restraint period		
	N	Duration (s)	± SE	N	Duration(s)	± SE
Australian cattle						
Mark 1	24	97	± 22	18	301	± 122
Copy box	5	180	± 48	2	630	± 533
Rope casting	3	132	± 109	3	460	± 181
Local cattle						
Rope casting	8	117	± 34	6	203	± 55

Table 6 Head lifts (pre- and post-cut) of Australian cattle with and without head restraint

Restraint method	Head restraint?	Pre-throat cut			Post-throat cut	
		N	Head lifts (mean)	±SE	Head lifts (mean)	± SE
Mark 1	No	10	4.30	1.83	1.50	0.94
	Yes	17	3.47	1.01	0.94	1.16
Copy box	Yes	7	5.14	1.79	0.14	0.28

Casting

Severity of the fall

Severity of the fall was measured on a scale of 1-3 (mild to moderate to severe). For all restraint methods for both Australian cattle, the fall was rated on average as severe. For rope-cast local cattle the average score was moderate to severe.

Attempts to rise

During casting, animals restrained in Mark 1 and copy boxes were observed attempting to rise up off the concrete slab in order to regain their feet. Fifteen percent of animals were successful in regaining their feet on release from the restraint box, but then fell over again or were forced onto their side. In one case where a rear leg rope had come loose, an animal in a Mark 1 box regained his feet after the throat cut and staggered across the slaughterhouse floor. This animal then had a rope put around the neck wound and had his rear left leg tendon slashed to prevent further rising (see Case study 7: Appendix).

All but one animal made at least one unsuccessful attempt to rise following casting. This involved lifting the head and neck, and sometimes the forequarters, up off the concrete slab and then falling back to hit the slab with considerable force. In Mark 1 boxes this occurred an average of 3.78 times (n=27) and in copy boxes 5.14 times (n=7). Where a blood drain had been installed in the concrete slab, this was in the area where the head was positioned. This head lifting (also referred to as 'head slapping') was sufficiently violent to chip the concrete edge of the blood drain, or to be felt by an observer standing nearby, or to be heard over the general noise of the slaughterhouse. Individual animals were observed to roll their eyes back, gape open their mouths and extend their tongue after their head had hit the concrete with severe force, indicating significant pain and potential injury.

The number of head lifts prior to the throat cut was compared for animals with and without head restraint in Mark 1 boxes. The average number of lifts without head restraint prior to the throat cut was 4.30 and with head restraint 3.47. Attempts to rise decreased after the throat cut but were still observed in both types of restraint box (Table 6). There was no

significant difference between these two groups either pre- or post-cut[1], indicating that the use of head restraint was unsuccessful in reducing the number of attempts to rise and subsequent hitting of the head against the concrete slab.

Attempts by rope-cast animals to rise during casting were not directly comparable to those in restraint boxes, as they were often prompted by painful acts (applying an aversive or painful stimulus) carried out by the workers to reposition the animal for further roping. These acts included tail twisting, tail bending, tail breaking, slapping, kicking, hitting with rope, poking with a stick, eye gouging or dragging. It was noted that while local animals were also subjected to painful acts, the risk of these was considerably lower as the restraint period was shorter and it was much easier to move these animals into position for casting. Rope-cast Australian animals were observed to slip an average of 8 times and fall 3.75 times prior to final casting (n=4).

Slaughter

Throat cuts

On average, Australian animals were subjected to 11 cuts to the throat during slaughter: on only seven occasions was a single cut performed. In most cases the neck was severed using a sawing action, indicating an extremely low skill level on the part of the slaughtermen and poor selection of knives in terms of both their length and sharpness. The mean number of throat cuts in each slaughterhouse is shown in Table 1. When cuts were broken down by restraint method (Table 7), those animals slaughtered using Mark 1 boxes had a mean of 8 throat cuts (from 1 to 33); those using copy boxes, 18 cuts (from 12 to 28) and those rope cast 21.5 cuts (from 14 to 30). Local animals slaughtered after rope casting were subjected to an average of 16 cuts (from 3 to 25).

Table 7 Number of throat cuts by restraint method

Restraint method	N	Mean	Range	± SE
Australian cattle				
Mark 1	28	7.86	1-33	3.67
Copy box	7	18.14	12-28	3.84
Rope casting	4	21.50	14-30	6.62
Local cattle				
Rope casting	9	16.11	3-25	4.96

Consciousness following slaughter

A total of 24 animals were able to be observed for at least 2 minutes after throat cutting commenced. The percentage of cattle showing at least two consciousness indicators in each 30-second interval is shown in Figure 10. Half of all Australian animals observed (12 out of 24) continued to show two or more consciousness indicators in the period 1.5-2 minutes after slaughter. This represented 50% of animals restrained in Mark 1 boxes, 60% of those in copy boxes and 33% of rope cast animals. Nine of these animals showed signs of rhythmic breathing in combination with a positive corneal or blink reflex during this period. Six animals were observed to have a positive response to a corneal reflex or to blink in response to an external stimulus (movement or water sprayed near the eye) more than 2 minutes after slaughter.

[1] No significant difference found between attempts to rise with or without head restraint: non-parametric Mann-Whitney U test (U=96, p=0.290 pre-cut; U=115, p=0.066 post-cut).

Of the 7 local animals slaughtered after rope casting that were observed for 2 minutes or more, 5 (71%) continued to show two or more consciousness indicators in the period 1.5-2 minutes after slaughter. All five of these animals were also observed to blink in response to an external stimulus (movement or water sprayed near the eye) more than 2 minutes after slaughter.

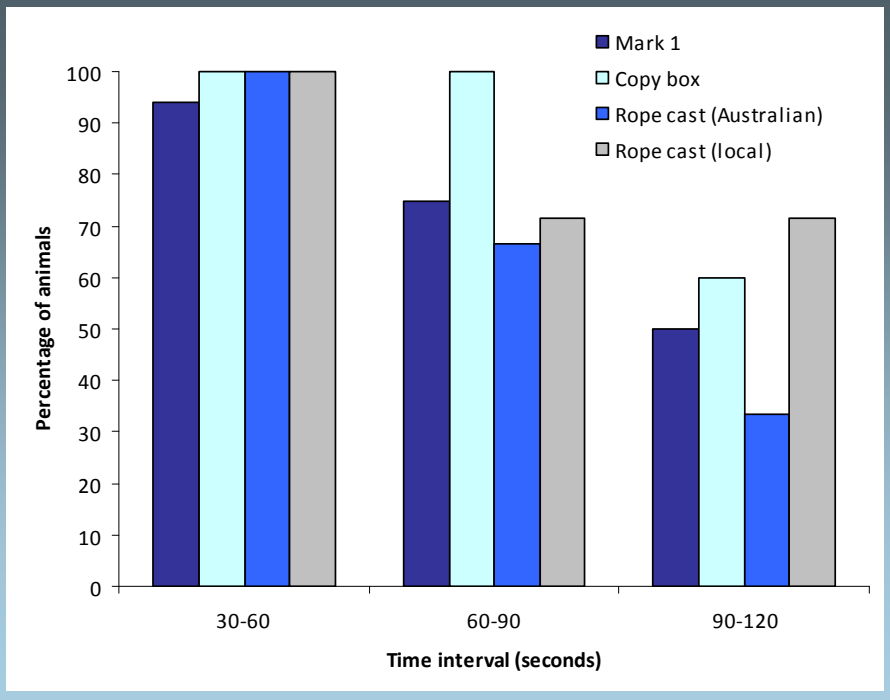

Figure 10 Percentage of cattle showing at least two indicators of consciousness following slaughter (30-second intervals)

Handling after the throat cut

Practices varied greatly between facilities in terms of the timing and type of handling after the throat cut. In one location, the slaughterman returned to the animal soon after slaughter and cut further into the neck, perhaps to remove possible swollen or occluded arteries to increase blood loss, and then decapitated the animal within 90 seconds of slaughter. In some cases a corneal or palpebral reflex was sought prior to handling, but this only occurred in 29% of slaughters and on average 2 minutes after the throat cut.

Halal requirements

There was little evidence to indicate that slaughter was being carried out according to halal requirements. In one location slaughtering Australian cattle only, slaughtermen were seen to pause prior to the throat cut after placing the knife on the neck of the animal which may have indicated a prayer was being said. This was also seen during the slaughter of local animals. However, other requirements of halal slaughter, including animals facing Mecca, avoiding the slaughter of animals in front of other animals, and the requirement of a single swift knife cut were not observed. All slaughters observed were carried out in a setting where animals could see, hear and smell other cattle being processed and in several cases where they could see, hear and smell other members of their group being slaughtered.

Discussion

Welfare impacts of handling

Observations of the handling of Australian cattle in the lairage, raceways and during restraint and slaughter indicated that slaughterhouse workers had only minimal understanding of cattle behaviour or how to minimise the stress associated with moving and handling cattle. Painful handling techniques, such as tail pulling and twisting or the use of physical force in the form of goads or other aids were observed in 9 of the 10 locations visited where Australian cattle were slaughtered (Location 4 being the only exception). These were carried out while attempting to move cattle from the lairage to the restraint box or slaughter floor, or in order to reposition animals during the casting process. Techniques that cause extreme pain and injury (tail bending or breaking, eye gouging) were used when difficulties arose moving animals. The risk of an individual animal being subjected to at least one painful handling procedure was extremely high (between 57% and 100%) in all restraint methods. Handling during rope casting involved every animal being subjected to multiple painful procedures: over half the animals restrained in Mark 1 boxes and copy boxes were also subjected to at least one painful procedure during handling.

Poorly designed exits, raceways and slippery or wet floor surfaces were the main structural problems hindering the easy movement of animals. But it is clear that most workers simply did not understand how to encourage cattle to move forward without resorting to inflicting pain, nor were they at ease dealing with large extensively-raised Australian animals that were unused to human handling. The contrast between the pre-slaughter handling of Australian and local Indonesian animals was stark. Local cattle are smaller, tethered through the nose and can be led onto the slaughter floor with considerably less resistance (Blaszak 2011). Only when the casting process began were these animals also subjected to painful handling procedures. The prolonged torture of an Australian steer with a broken leg documented in Case study 1 (Appendix) is a graphic example of the lack of understanding of basic animal welfare and the deliberate use of pain to move animals observed during this study. This treatment would undoubtedly constitute prosecutable animal cruelty in Australia, but there are currently no regulations or penalties to prevent such abuse in Indonesia.

Caple et al. (2010) noted only a few concerns with handling of animals in the slaughterhouses they visited: poor handling was observed in smaller facilities, there was one incident where an electric goad was used inappropriately, and some instances of “unnecessary stimulation involving interference with the eyes and tail twisting” were listed. These actions are all contrary to the OIE Code. The report claimed that overall handling at slaughterhouses was “generally acceptable” and that practices were “noticeably better and consistent with the OIE Code where SOP [standard operating procedure] training had taken place”. This refers to the training in handling and restraint delivered under the joint MLA and Livecorp program. It is impossible to determine how accurate this statement is since no other comparison was made between facilities with or without SOP training. It is not known exactly what the SOPs cover as they have not been made publicly available, however, it is likely that they would relate to the principles set out in the OIE Code. In the present study, eight of the 10 facilities where Australian cattle were slaughtered had Mark 1 boxes installed, indicating that SOP training should have been delivered in all of these locations. Some of the slaughter procedures seen, such as the use of a second restraint rope to turn the head prior to the throat cut, or the holding of animals by the tail after casting (seen in locations 5 and 6) appeared to have been trained in a consistent manner. Yet one of these locations was the source of some of the

worst pre-slaughter handling observed (see Appendix Case study 2), and the handling across all locations breached multiple clauses of the OIE Code (Table 8).

Welfare impacts of restraint

Restraint is one of the most stressful and potentially painful aspects of the slaughter process (EFSA 2004) thus it is critically important to minimise both the severity and duration of its impact. An efficient and humane means of restraint will consistently hold animals in a set position without undue discomfort for as short a time as possible. Minimising the duration of restraint is a requirement of the OIE Code, as is ensuring that restraint does not cause avoidable suffering.

It is abundantly clear from the present study that rope casting of cattle is neither an efficient nor humane means of restraint. The process for Australian cattle took an average of nearly 8 minutes and involved multiple insults to animal welfare, including the deliberate and repeated infliction of pain to move animals, numerous slips and falls, and excessive pressure from roping during the final casting process. The more pertinent question, given that one of the stated objectives of designing and installing Mark 1 boxes is to improve animal welfare (MLA & Livecorp 2010), is whether the Mark 1 box can be considered efficient or humane. This question is examined in terms of the consistency, discomfort and duration of restraint.

Table 8 Breaches of the OIE Code during handling and slaughter

No.	Clause	Slaughter location
7.5.1	**General principles**	
3	Animal handlers should be experienced and competent in handling and moving farm livestock, and understand the behaviour patterns of animals and the underlying principles necessary to carry out their tasks	1-10
7.5.2 (1)	**Moving and handling animals**	
1(b)	Injured/sick animals requiring immediate slaughter should be killed without delay	6, 7
1(d)	Animals should not be forced to walk over the top of other animals	6
1(e)	Under no circumstances should animal handlers resort to violent acts to move animals	1, 3, 5-7, 10
1(f)(i)	Animals that have little or no room to move should not be subjected to physical force of goads and other aids which compel movement	1-3, 6-10
1(f)(iv)	Painful procedures (whipping, tail twisting, pressure on eyes, ears or external genitalia) or use of goads or other aids which cause pain and suffering should not be used to move animals	1-3, 5-10
1(f)(vii)	Conscious animals should not be thrown, dragged or dropped	6, 7, 10
7.5.2 (4)	**Restraining and containing animals**	
4(a)(i)	Provision of non-slippery floor	6, 7, 10
4(a)(ii)	Avoidance of excessive pressure applied by restraining equipment that causes struggling or vocalization in animals	1, 2, 5-7, 10
4(a)(iii)	Equipment engineered to reduce noise of air hissing and clanging metal	1-3, 5-9
4(a)(iv)	Absence of sharp edges in restraining equipment that would harm animals	1-3, 5-7
4(a)(v)	Avoidance of jerking or sudden movement of restraining device	1-3, 5-9
4(b)	Methods of restraint causing avoidable suffering should not be used in conscious animals because they cause severe pain and distress	1-10
7.5.7 (5)	Bleeding. After incision of blood vessels, no dressing procedures should be performed on the animals for at least 30 seconds, or in any case until all brain-stem reflexes have ceased	1, 2, 4-6, 8

1 Consistency of restraint

The consistency of outcomes for animals restrained in a Mark 1 box was low: each animal presented differently on opening the box and these differences persisted in the way the animal fell, the position of the fall, how many times they attempted to rise, whether they were successful in regaining their feet; how many times their head hit the concrete slab; where it hit the slab; the position of the head and neck prior to slaughter; and the response of the animal during and after slaughter.

Mark 1 boxes do not restrain animals consistently because they are reliant on roping for the actual restraint. The box itself provides only a defined area for the animal to stand which protects slaughterhouse workers during the roping process. Once the box is opened, it is only the combination of the leg ropes and the sloping floor that prevents the animal from regaining its feet. If these ropes are too long, or become loose during casting, then the animal has more opportunity to move and sometimes to break free. The shortcomings of the Mark 1 design in terms of achieving a consistent outcome have been known to the industry for some time and are what led to the development of the Mark 2, 3 and 4 boxes (Beere 2004, 2008; Stark 2010).

2 Discomfort during restraint

The Mark 1 box relies on the use of leg ropes to trip the animal from a standing position onto its side on a sloping concrete slab – the same process involved in rope casting. The severity of the fall for both methods was rated as moderate to severe. Fifteen percent of animals in the Mark 1 box regained their feet and thus endured a repeat fall. After casting, animals attempted to rise on average 3.8 times resulting in their head repeatedly hitting the concrete slab. A similar rate of 'head lifting' (3.5 per animal) was observed by Caple et al. (2010) and was stated as posing a "significant risk to animal welfare". The rolling of the eyes and gaping of the mouth observed in several animals in response to this indicates that the impact was causing significant pain and possible injury. This action of the head hitting the concrete slab has previously been noted to result in broken jaws in some animals (Stark 2010). The use of head restraint applied after casting did not result in a significant reduction in the number of attempts to rise.

Various reports describe casting, or other methods of restraint where animals are inverted or rotated prior to slaughter, as being stressful and unacceptable (EFSA 2004; FAWC 2003; Grandin 2009). Upright slaughter is the only accepted method for cattle in the UK (FAWC 2003); the American Meat Industry Foundation states that animals must be held in a comfortable, upright position and that "trip floor boxes or leg clamping boxes are unacceptable" (AMI Foundation 2005). In Australia, the Animal Welfare and Product Integrity Committee (a subcommittee of the Primary Industries Ministerial Council) has formally stated that "restraint for all species should maintain the conscious animal in an upright position". The Committee has also stated that "the use of inverting restraint boxes for cattle is in itself an animal welfare risk and not acceptable".

Physiological measures of acute stress have been found to be significantly raised in animals restrained in poorly designed equipment (Grandin 1994; Ewbank et al. 1992). Inversion has been found to double cortisol levels when directly compared to upright restraint (Dunn 1990). The level of stress of casting an animal onto its side may be less than full inversion, but the behavioural experience may be similar. When a prey animal is forced into a vulnerable position on its side or back, its instinctive response is to attempt to right itself in order to escape this threat. When they cannot get up, this instinct is severely frustrated. The fear and agitation caused by this experience will be heightened in animals relatively unused to human handling.

Water was used to 'wash' cattle during restraint in eight slaughterhouses, but not during every slaughter (see Table 1). It was clear that animals reacted adversely to water being thrown over them during or after casting and this added to the stress already experienced through the restraint and casting process. The use of water during restraint of Australian cattle was recognised by Caple et al. (2010) as "causing unnecessary stimulation and reaction", yet a year after that conclusion was reached, it is still common practice.

The presence or absence of vocalisations during restraint provides a simple but very efficient and effective method of assessing cattle welfare at slaughter (Grandin 1998; AMIC 2009; AMI Foundation 2005). Vocalisation during restraint prior to stunning or slaughter is indicative of pain or suffering, although its absence does not indicate an absence of pain or suffering (EFSA 2004). In a standard animal welfare abattoir audit, more than 5% of cattle vocalising during restraint, or 3% during handling, is considered unacceptable (AMIC 2009; Grandin 2009). Caple et al. (2010) does not provide any quantitative data on vocalisation rates but merely states that slaughterhouses were "typically free… of animal noise". The report does not indicate how this was measured, but states that excessive noise is indicative of underlying animal welfare issues. In the present study, 54% of Australian cattle vocalised at least once during restraint, a rate that would fail an audit ten times over. Vocalisation rates were alarmingly high across all types of restraint, indicating a very serious underlying welfare problem.

3 Duration of restraint

In a typical Australian abattoir, cattle are stunned within a few seconds of entering the restraint box. Similarly for slaughter without stunning in an upright restraint box, cattle should have their throats cut within 10 seconds of the head being restrained (AMI Foundation 2005; Grandin 2009). In contrast, the average duration of restraint of Australian animals slaughtered through Mark 1 restraint boxes was 5 minutes. This was shorter than restraint during rope casting (just under 8 minutes), however this difference was due more to the installation of raceways leading into restraint boxes than to the use of the box itself. Much of the time taken for rope casting was in roping the animal to bring it onto the slaughter floor in the absence of raceways. Poor design of some raceways and the lack of non-slip flooring in raceways and ramps meant that workers sometimes resorted to roping to bring animals into a Mark 1 box. After casting, it took an average of 1 minute 37 seconds before the throat was cut in a Mark 1 box.

While it was possible to complete the roping to slaughter process in a Mark 1 box in less than 2 minutes, in practice this was rarely achieved. The main reasons for this appeared to be the labour involved in roping the legs, the variation in presentation and reaction of individual animals to restraint, and the generally languid and indifferent approach of the workers involved.

Based on the above three criteria, the Mark 1 box is clearly neither an efficient nor humane means of restraint. The variation in presentation and casting of cattle means that the box is not able to consistently hold animals in a set position. The pain and distress associated with casting animals onto a sloping concrete slab means that this method of restraint will inherently result in excessive discomfort and in some cases, physical injury. The breadth of this suffering is indicated in the unusually high percentage of animals vocalising during restraint. The difficulties in moving animals into the restraint box, and the time taken to rope the legs, cast and slaughter each animal means that they are each restrained for several minutes, compared to a few seconds when animals are held in upright restraint systems. This exposes animals restrained in Mark 1 boxes to unnecessary and prolonged suffering.

Welfare impacts of slaughter

Pain of slaughter without stunning

A proficient throat cut will, in a single motion, sever the skin, muscle, trachea, oesophagus, carotid arteries, jugular veins, major nerve trunks and numerous minor nerves. The resultant tissue damage and effect on pain receptors is a major assault on the brain considered to result in “very significant pain and distress” (FAWC 2003). The subsequent rapid decrease in blood pressure detected by the conscious animal adds to this distress (EFSA 2004). Research examining the electroencephalographic responses of anaesthetised calves to a neck cut has provided physiological evidence of pain associated with even a single expertly performed cut (Gibson et al. 2009). Poor welfare also occurs when bleeding into the trachea causes conscious animals to inhale blood and experience a drowning sensation (EFSA 2004).

The selection of the knife and the cutting technique employed are critical in reducing the pain associated with slaughter without stunning. The knife must have an undamaged razor-sharp blade and must be long (twice the width of the throat is suggested) and the cut must be made using a single continuous motion (Grandin 1994; Adams & Sheridan 2008). Where slaughter involves multiple cuts using a sawing action, the associated pain and distress will be intensified due to the increased tissue damage and risk of incomplete severance of the carotid arteries. Slaughter using a short knife and a sawing action has been associated with a vigorous reaction from cattle (Grandin 1994).

On only seven occasions during the slaughter of 39 Australian cattle in Indonesian slaughterhouses observed in the present study was a single continuous knife motion used. The average number of cuts was 11, and the maximum 33. This is 2.5 times the average number of cuts observed by Caple et al. (2010) in Indonesia, and twice the number observed by Gregory et al. (2008) during halal slaughter in Bangladesh and France. This reported difference may, in part, be attributed to the increased accuracy obtained by counting blade movements using slow motion video footage rather than the naked eye. It may also reflect a real difference in the skill of the slaughtermen.

The avoidance of suffering resulting from the throat cut was a primary driver for the introduction of pre-slaughter stunning in abattoirs. The extremely poor slaughter technique observed in this study would have been obviated if all cattle were required to be effectively stunned prior to slaughter.

Assessing consciousness

There is no single definitive measure of the onset of insensibility during slaughter (Blackmore 1984), therefore a range of potential indicators must be used. In an observational study indicators are limited to behavioural parameters or to checks of insensibility carried out as part of routine handling. This is further complicated by the fact that some physical responses to external stimuli can occur in both a conscious and unconscious state.

An example of this conundrum is the corneal reflex or blink response. Animals that have been stunned effectively do not have a corneal reflex and in a welfare audit its presence post-stunning is regarded as unacceptable (Gregory & Shaw 2000). In Australian abattoirs, absence of a corneal reflex is routinely checked prior to sticking (bleeding out) and a positive response requires immediate corrective action. Yet a positive corneal reflex can occur in both conscious and unconscious animals, so does not constitute proof that the animal is conscious. It can, however, be interpreted as a warning sign of a return to consciousness in a stunned animal. An animal that blinks spontaneously after stunning would be scored as sensible (conscious) during a welfare audit (AMIC 2009; AMI Foundation 2005).

Limon et al. (2010) used a range of indirect and direct responses to indicate consciousness in animals slaughtered without stunning using a puntilla (neck stab). Brain and spinal function were said to be present if one or more of the following were observed: rhythmic breathing, palpebral reflex, eyeball rotation; nystagmus and papillary reflex. A number of responses to external stimuli were also measured, including eye closing in response to movement, ear movement in response to sudden noise, and movement of the nostrils in response to different odours. Where cattle are restrained in an upright position, the time from slaughter to collapse can be used as a reliable indicator of time to insensibility (Gregory et al. 2010). However, this is an inherently conservative measure indicating loss of central control of postural reflex only, and unfeasible when cattle are already on their sides and are prevented from rising by restraint during slaughter.

In the present study, the presence of two or more of a series of observable responses were used to indicate the duration of possible consciousness after the throat cut. Twelve Australian cattle (50%) exhibited indicators of possible consciousness in the period 1.5-2 minutes after the throat cut. Nine of these animals (38%) exhibited rhythmic breathing in combination with a positive corneal reflex, indicating that brain and spinal function were still present. Six were observed to have a positive corneal reflex or to spontaneously blink in response to an external stimulus (movement or water sprayed near the eye) more than 2 minutes (up to 3 minutes 46 seconds) after slaughter. While this indicator alone does not confirm continued consciousness, in a welfare audit this would indicate a failure of the slaughter method to ensure a rapid death. These results indicate that Australian cattle in Indonesian slaughterhouses are at extremely high risk of experiencing extended suffering during slaughter without stunning.

Risk factors for extended consciousness

Time to unconsciousness in cattle for slaughter without stunning varies widely. Following an efficient cut where both carotid arteries are severed, cattle have been reported to remain conscious for 34-85 seconds (Newhook & Blackmore 1982), 19-113 seconds (Daly et al. 1988), 22-40 seconds (FAWC 2003) and up to 120 seconds (EFSA 2004). As mentioned earlier, where cattle are restrained in an upright position, the duration of consciousness can be estimated using time to collapse (Gregory et al. 2010): abattoir audits have reported the average time to collapse following an efficient throat cut is 17 seconds (Grandin 2010).

Compared to sheep, which can lose consciousness within 10 seconds, cattle remain conscious for longer and are at greater risk of experiencing extended consciousness (Grandin 2011). The primary reason for this difference is that in cattle there is an alternative route to the carotid arteries for supplying oxygenated blood to the brain. In cattle, the vertebral arteries link to the blood supply to the brain through the basioccipital plexuses (a connection that is not present in sheep or goats) (Baldwin & Bell 1963). As the vertebral arteries are not severed by the throat cut, they can provide the brain with a continued blood supply for as long as adequate blood pressure is maintained.

Most published studies have reported on the effects of a cut severing both carotid arteries in a single continuous motion with a suitably long and sharp knife under controlled conditions. Even under these circumstances, a proportion of animals will experience extended consciousness lasting more than 120 seconds (Daly et al 1988; Gregory et al. 2008).

Factors contributing to prolonged consciousness in cattle slaughtered without stunning may be related to the selection of animals, handling prior to slaughter or to the slaughter process itself. Stressed cattle, those with visible signs of agitation prior to slaughter or those that resist restraint, have been reported as being likely to have prolonged sensibility (Grandin 1994). The slaughter of large cattle is considered to increase the risk of a poor cut because of the relatively smaller size of the knife compared to the neck or the difficulty of applying

sufficient force during the cut (Adams & Sheridan 2008). Where the cut is poorly executed and the carotid arteries have not been fully severed, this will also prolong consciousness and thus the duration of suffering. A study of religious slaughter in a number of commercial settings reported an average of 3.2 cuts for shechita slaughter and 5.2 for halal slaughter (Gregory et al. 2008). In 9% of shechita and 1% of halal slaughter a carotid artery was incompletely cut or not cut at all.

Occlusion of the carotid arteries will further extend consciousness by reducing the rate of blood loss following slaughter and prolonging oxygenation of the brain via the vertebral arteries. Swelling of the cephalic end of the artery has been noted in 7% of halal slaughtered cattle and has been associated with prolonged consciousness (Gregory et al 2008, 2010). Occlusion of the cardiac end of the carotid artery (known as a false aneurysm) has been associated with extreme cases of prolonged consciousness in cattle. Large false aneurysms have been found in 10% of cattle slaughtered without stunning in six commercial premises in Europe and Asia (Gregory et al 2008). Caple et al. (2010) reported that bleeding was impaired in 10% of Australian cattle slaughtered in Indonesia due to false aneurysm formation in both carotid arteries: an even higher proportion of animals would have had one swelling/occlusion in one carotid artery and would also have suffered prolonged consciousness.

Compared to most other studies of slaughter without stunning, the proportion of Australian animals at risk of prolonged consciousness in Indonesian slaughterhouses appears to be extremely high. This confirms comments made in 2005 that significant numbers of animals being slaughtered in Indonesia were experiencing prolonged consciousness (Beere & Pettiford 2005). Based on the information discussed above, there are a number of factors that are likely to have contributed to this situation:

- Australian cattle are relatively large (approximately 500kg), unused to handling and easily agitated.
- Brahman-cross cattle have been reported as taking longer to lose consciousness than European breeds (Beere & Pettiford 2005)
- Cattle were exposed to multiple stressors prior to slaughter and during restraint due to poor handling and restraint box design, and the use of casting to facilitate restraint.
- The throat cut was poorly executed, with an average of 11 cuts per animal. Under these circumstances it is likely that in some cases the carotid arteries were not completely severed. The most extreme example of this was where an animal regained his feet after the throat cut and moved away from the restraint box across the slaughter floor before finally being brought down.
- Based on prevalence rates in previous research, bleeding is likely to have been impaired in at least 10% of cases, leading to extremely prolonged consciousness.

There is another important difference between the present study and other reported studies. Most assessments of the duration of consciousness in halal and shechita slaughter have been on animals slaughtered upright. In the present study all animals were restrained on their sides. It is possible that the method of restraint, the level of resistance against restraint, and the position of the head may influence time to loss of consciousness (Cranley 2011). The use of tight head restraint around the neck during a proportion of slaughters may have also acted to reduce the rate of blood loss.

Conclusions

This observational study provides a detailed assessment of the welfare of Australian cattle in Indonesian slaughterhouses during handling, restraint and slaughter. The results reveal an unequivocally dire situation, one of unacceptable, but entirely avoidable, stress and suffering.

Observations of the handling of Australian cattle prior to slaughter indicated that slaughterhouse workers had little or no understanding of animal welfare or how to minimise the stress associated with moving cattle. Painful handling techniques, such as tail pulling and twisting or the use of physical force in the form of goads or other aids were observed in 9 of the 10 slaughterhouses visited. Techniques that cause extreme pain and injury (tail bending, breaking or eye gouging) were used when difficulties arose moving animals. The risk of an individual animal being subjected to at least one painful handling procedure was extremely high in all methods of restraint. This is particularly concerning given that 80% of the slaughterhouses visited had Mark 1 boxes installed, indicating that SOP training under the MLA/Livecorp program was delivered to workers in these locations.

An efficient and humane means of restraint will consistently hold animals in a set position without undue discomfort for as short a time as possible. It is abundantly clear that rope casting of Australian cattle is neither efficient nor humane. Examination of the welfare impacts of the Mark 1 box indicates that it too is neither efficient nor humane. The design of the box means that it is not able to consistently hold animals in a set position, resulting in variation in the presentation and casting of cattle. The pain and distress associated with roping and casting animals onto a sloping concrete slab means that this method of restraint will inherently result in excessive discomfort and in some cases, physical injury. This suffering is indicated in the unusually high percentage of animals vocalising during restraint. The difficulties in moving animals into the restraint box, and the time taken to rope the legs, cast and slaughter each animal means that each animal is restrained for several minutes exposing them to unnecessary and prolonged suffering. These problems were summed up by Dr Temple Grandin on viewing footage of cattle restrained using the Mark 1 box, where she stated that “tripping cattle down on a sloped slippery surface as a method for restraining them is absolutely atrocious” (Personal communication, 2 May 2011).

A proficient throat cut requires a long knife with an undamaged, razor-sharp blade with the cut a single, rapid continuous motion. On only seven occasions in the present study was a single continuous knife motion used. The average number of cuts was 11, and the maximum 33. This extremely poor slaughter technique will have resulted in intense suffering for the animals involved. As with the poor level of pre-slaughter handling observed, the lack of skill observed during slaughter is particularly concerning given that 80% of slaughterhouses visited should have received training in slaughter technique under the MLA/Livecorp program.

Twelve Australian animals (50%) exhibited indicators of possible consciousness in the period 1.5-2 minutes after the throat cut. Nine of these animals exhibited rhythmic breathing in combination with a positive corneal reflex, indicating that brain and spinal function was still present. Six were observed to have a positive corneal reflex or to spontaneously blink in response to an external stimulus (movement of workers or water sprayed near the eye) more than 2 minutes after slaughter. These results indicate that Australian cattle in Indonesian slaughterhouses are at extremely high risk of experiencing extended and intense suffering during slaughter without stunning.

In summary, the Australian cattle slaughtered in Indonesia observed in this study were exposed to multiple insults to their welfare. The breadth of this investigation and the lack of control over the dispersal of cattle exported to Indonesia strongly suggest that this is reflective of the treatment of Australian cattle in general. Reference to national and international standards indicates that the handling, restraint and slaughter process breached

several fundamental animal welfare principles and resulted in significant and unnecessary pain, suffering and distress. The treatment of Australian animals outlined in this report is completely unacceptable according to Australian standards and would be subject to prosecution under Australian animal welfare legislation.

The apparent focus of previous reports on the live export industry's program in Indonesia has been on comparing animal welfare outcomes with prevailing standards in the importing country. Where these standards are low, any changes can easily be described as an improvement, even when the resultant practices would be regarded as cruelty in Australia. A new approach is needed if the appalling treatment of animals documented in this report is to be prevented in the future. This involves a fundamental shift away from measuring animal welfare improvements relative to existing poor outcomes, towards one that aims to meet what is considered an acceptable standard in Australia and, indeed, internationally.

Potential for change in Indonesia

The handling, restraint and slaughter practices observed in this study require fundamental change if the welfare of Australian or local Indonesian cattle is to be protected. The investments made in Indonesia over the past 10 years through the programs funded by MLA, Livecorp and the Australian Government, have improved the capacity of Indonesian slaughterhouses to handle Australian cattle and thus assisted in increasing exports to this destination. At the same time, the program has failed to ensure acceptable animal welfare outcomes for those animals. It is acknowledged that the installation of Mark 1 boxes has delivered some reduction in the stress and duration of handling when compared to traditional rope casting, but the welfare of cattle subjected to this method of restraint remains extremely poor and well below acceptable levels. Rather than protect the welfare of Australian cattle, the continued installation and use of the Mark 1 box has acted to entrench a system of restraint and slaughter that causes significant suffering. MLA and Livecorp have continued to install Mark 1 boxes despite clear and long-standing evidence that animals should be restrained in an upright position to reduce stress, and despite problems with its design being identified as far back as 2003. This problem goes well beyond Indonesia, as Mark 1 boxes have also been installed in Libya, Malaysia, the Middle East and Brunei (Beere 2004; DAFF et al. 2007; MLA & Livecorp, undated).

It is also very concerning that the delivery of training programs in conjunction with the installation of restraint boxes has not had sufficient impact on Indonesian workers to prevent the abuse of animals or ensure a basic level of understanding of animal welfare, knowledge of their requirements under the OIE Code, or ability to perform an efficient throat cut. This is despite the majority of slaughterhouses being government owned and Indonesia being a signatory to the OIE.

There is no evidence to suggest that the Australian live export industry is in any position to have a significant impact on the welfare of cattle in Indonesian slaughterhouses, or to be able to reach all locations where Australian cattle are slaughtered. There are approximately 750 registered slaughterhouses in Indonesia, and potentially hundreds more unregistered slaughter locations (Hadi et al. 2002). Estimates of the number of locations where Australian cattle are slaughtered vary between 120 and 300, but given that there are no restrictions on their dispersal, there is the potential for Australian cattle to be slaughtered in any location. Workers at slaughterhouses tend to be unskilled and subcontracted on a temporary basis. Unless the slaughter of Australian cattle could be restricted to locations where a skilled and permanent workforce was employed, pre-slaughter stunning was effectively used, training and auditing programs were in place, and enforceable animal welfare legislation was introduced, it is difficult to see how their treatment could be reliably and sustainably improved.

MLA and Livecorp are not alone in providing training in cattle slaughter in Indonesia. A series of training workshops were conducted between 2002 and 2007 in government slaughterhouses in Bali, Lombok and Sumbawa, primarily funded by non-government organisations (WSPA and the Humane Society International). This included training (conducted by the same expert consultants used by MLA and Livecorp) in the use of non-penetrative captive bolt stunning equipment. Subsequent visits to one of the slaughterhouses involved revealed that workers had abandoned the use of stunning and reverted to traditional slaughter methods. An assessment of the slaughter of local cattle in 2010 found that slaughter practices had not been substantially changed since first assessed in 2001 and in some cases had even worsened (Blaszak 2011).

The widespread use of effective stunning in Indonesian slaughterhouses could, theoretically, eliminate some of the welfare problems identified in this report. There is acceptance of stunning at a government level and by the Indonesian halal certifying body, Majelis Ulama Indonesia. But only four of the 750 registered abattoirs in Indonesia are licensed to use stunning, with an estimated 8.52% of cattle slaughtered in Indonesia processed through these facilities in 2000 (Hadi et al. 2002). Stunning has been a projected goal of the MLA/Livecorp program in Indonesia for many years (while at the same time, Mark 1 boxes, which are unsuitable for use with stunning as they do not hold the animal in a consistent, stable position, were being installed). Yet a proposed trial of stunning planned for 2009 under the MLA/Livecorp program was apparently not conducted because of “significant impediments in Indonesia to a more constrained slaughter practice”. Caple et al. (2010) acknowledged that “non-lethal stunning was observed to deliver the single most significant improvement in animal welfare conditions for cattle in Indonesia”, but described the uptake of stunning as an “aspirational goal”. The problems identified by WSPA in maintaining training outcomes and use of stunning equipment indicate that even where stunning could be introduced, there is no guarantee of its uptake in the long term under the current Indonesian regulatory and market circumstances.

Even if the impediments to expanding the use of stunning could be overcome, ensuring that it is effectively carried out requires a system of independently auditable animal welfare standards to be in place in all slaughterhouses, and fundamental change is needed to animal welfare legislation and enforcement in Indonesia in order to achieve that goal. This, at best, would be a long-term undertaking. The continued suffering of millions of Australian cattle (521,002 were slaughtered in Indonesia last year) while such a program was attempted against all the known impediments, is totally unacceptable. The only practical and ethical solution is for the export of cattle to be replaced by the export of meat products. It is time to accept the evidence and act accordingly.

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References

Adams, D.B. & Sheridan, A.D. (2008) Specifying the risks to animal welfare associated with livestock slaughter without induced insensibility. Australian Government Department of Agriculture, Fisheries and Forestry, Available: www.daff.gov.au/animal-plant-health/welfare/aaws/specifying_the_risks_to_animal_welfare_associated_with_livestock_slaughter_without_induced_insensibility (Accessed 5 May 2011).

AMI Foundation (2005) Recommended animal handling guidelines and audit guide 2005 edition, American Meat Industry Foundation, Washington, D.C.

AMIC (2009) National animal welfare standards for livestock processing establishments. Second edition. Australian Meat Industry Council, Sydney. Available: www.amic.org.au (Accessed 10 May 2011).

Baldwin, B.A. & Bell, F.R. (1963) Blood flow in the carotid and vertebral arteries of the sheep and calf, *Journal of Physiology*, **167**: 448-462.

Beere, G. (2004) Developing an improved pre-slaughter restraining box for cattle, Project LIVE.309, November 2004, Meat & Livestock Australia Ltd, North Sydney.

Beere, G. (2008) Upgrade of an existing mark II cattle restraining box for ritual slaughter, Project B.LIV.0346, October 2008, Meat & Livestock Australia Ltd, North Sydney.

Beere, G. & Pettiford, S. (2005) Opportunities to improve slaughter standards and profitability in Indonesia, Project LIVE.229, June 2005, Meat & Livestock Australia Ltd, North Sydney.

Blackmore, D.K. (1984) Differences in behaviour between sheep and cattle during slaughter, *Research in Veterinary Science*, **37**: 223-226.

Blaszak, K. (2011) Final Report on cattle industry and welfare in Indonesia. Internal report to WSPA (World Society for the Protection of Animals).

Caple, I., Cusack, P., Gregory, N. et al. (2010) Final Report. Independent study into animal welfare conditions for cattle in Indonesia from the point of arrival from Australian to slaughter. May 2010. Meat & Livestock Australia and Livecorp. 56pp. In: MLA & Livecorp (2010) Live Trade Animal Welfare Partnership 2009/10. Final Report – Public Release. Indonesian point of slaughter improvements.

Cranley, J. (2011) Sensibility during slaughter without stunning in cattle, *Veterinary Record*, **168**: 437-438.

DAFF, MLA & Livecorp (2007) Libya animal welfare improvements project – Stage 1. September 2007, Department of Agriculture, Fisheries and Forestry, Canberra.

Daly, C.C., Kallweit, E. & Ellendorf, F. (1988) Cortical function in cattle during slaughter, *Research in Veterinary Science*, **37**: 325-329.

Dunn, C.S. (1990) Stress reactions of cattle undergoing ritual slaughter using two methods of restraint, Veterinary Record, 126: 522-525.

EFSA (2004) Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to welfare aspects of the main systems of stunning and killing the main commercial species of animals. *The EFSA Journal* **45**: 1-29. European Food Safety Authority, Parma, Italy.

Ewbank, R., Parker, M.J. & Mason, C.W. (1992) Reactions of cattle to head-restraint at stunning: A practical dilemma, *Animal Welfare*, **1**: 55-63.

FAWC (2003) Report on the welfare of farmed animals at slaughter or killing. Part 1: Red meat animals. Farm Animal Welfare Council, London, Available: www.fawc.org.uk/reports.htm (Accessed 4 May 2011).

Gibson, T.J., Johnson, C.B., Murrell, J.C. et al. (2009) Electroencephalographic responses to halothane-anaesthetised calves to slaughter by ventral-neck incision without prior stunning, *New Zealand Veterinary Journal*, **57**(2): 77-83.

Grandin, T. (1994) Public veterinary medicine: Food safety and handling. Euthanasia and slaughter of livestock, *Journal of the American Veterinary Medical Association*, **204**(9): 1354-1360.

Grandin, T. (1997) Assessment of stress during handling and transport, *Journal of Animal Science*, **75**(1):249-257, Available: www.grandin.com/references/handle.stress.html (Accessed 9 May 2011).

Grandin, T. (1998) The feasibility of using vocalization scoring as an indicator of poor welfare during cattle slaughter, *Applied Animal Behaviour Science*, **56**: 121-128.

Grandin, T. (2009) Evaluation of methods of restraint for holding (fixation) of cattle, calves, and sheep for kosher and halal slaughter, Available: www.grandin.com/ritual/evaluation.restraint.methods.kosher.halal.html (Accessed 5 May 2011).

Grandin, T. (2010) Auditing animal welfare at slaughter plants, *Meat Science*, **86**: 56-65.

Grandin, T. (2011) Welfare during slaughter without stunning (kosher or halal) differences between sheep and cattle, Available: http://www.grandin.com/ritual/welfare.diffs.sheep.cattle.html (Accessed 4 May 2011).

Gregory, N.G., Fielding, H.R., von Wenzlawowicz, M., et al. (2010) Time to collapse following slaughter without stunning in cattle, *Meat Science*, **85**: 66-69.

Gregory, N.G. & Shaw, F. (2000) Penetrating captive bolt stunning and exsanguination of cattle in abattoirs, *Journal of Applied Animal Welfare Science*, **3**(3): 215-230.

Gregory, N.G., von Wenzlawowicz, M., Alam, R.M. et al. (2008) False aneurysms in carotid arteries of cattle and water buffalo during shechita and halal slaughter, *Meat Science*, **79**: 285-288.

Hadi, P.U., Ilham, N., Thahar, A. et al. (2002) Improving Indonesia's beef industry, ACIAR Monograph No. 95, vi + 128p., Australian Centre for International Agricultural Research, Canberra.

Limon, G., Guitian, J. & Gregory, N.G. (2010) An evaluation of the humaneness of puntilla in cattle, *Meat Science*, **84**: 352-355.

Livecorp (2011) Cattle export by country of destination, Available: www.livecorp.com.au/Public%20Files/Cattle%20Stats/Annual%20Cattle%20Exports%20by%20Country%20of%20Destination%201990-2010.pdf (Accessed 6 May 2011).

MLA & Livecorp (2011) Live Trade Animal Welfare Partnership 2009/10. Final Report – Public Release. Indonesian point of slaughter improvements, Meat & Livestock Australia and Livecorp, North Sydney. Available: www.daff.gov.au/__data/assets/pdf_file/0005/1886477/indonesia.pdf (Accessed 6 May 2011).

MLA & Livecorp (undated) Installation of restraining boxes to improve animal welfare in Malaysia, Meat & Livestock Australia and Livecorp, North Sydney.

Newhook, J.C. & Blackmore, D.K. (1982) Electroencephalographic studies of stunning and slaughter of sheep and calves – Part 2: The onset of permanent insensibility in calves during slaughter, *Meat Science*, **6**: 295-300.

OIE (2007) Animal Welfare Workshop, 6-7 November 2007, Siam City Hotel, Bangkok, Thailand. Available from: www.rr-middleeast.oie.int/download/pdf/bang.pdf (Accessed 6 May 2011)

OIE (2010) Slaughter of animals. Chapter 7.5 in: OIE Terrestrial Animal Health Code. OIE (World Organisation for Animal Health), Paris, France. Available: www.oie.int/international-standard-setting/terrestrial-code/access-online/ (Accessed 6 May 2011)

Stark, G. (2010) Review of mark three and development of mark four cattle restraining box, Project W.LIV.0374, July 2010, Meat & Livestock Australia, North Sydney.

Appendix – Case studies

Case study 1

Slaughter of Australian steer with broken leg, Location 7, 21 March 2011

Time	Description
04:50*	Rope thrown around neck while steer is standing with group in holding pen. Floor is wet and covered in faeces
06:29*	Steer is moving around pen, resisting the rope.
07.34	Man walks behind steer with stick. Steer is poked with stick in hindquarters, kicks out and flicks tail. This is repeated 10 times for next 20 sec
08.08	Steer slips and falls, back legs are splayed out, tries to get back up
08.19	Gets up. Rear left leg is broken, hanging and not bearing weight
08.30	Man approaches, pokes steer twice with stick in left shoulder. Steer backs into corner with group, stands next to the food trough. A second man climbs over railings and walks around.
09.37	Rope is pulled tighter, steer collapses onto food trough
09.48	Man walks to front right, pokes steer in face repeatedly (11 times in total)
09.54	Steer vocalises twice
10.00	Front legs slip, steer vocalises twice
10.06	Man walks to rear, picks up tail and bends it over. Steer vocalises but is unable to rise
10.22	Steer repeatedly vocalises
10.27	Man approached front, pulls at head. Steer slips down so now only hindquarters are supported by the trough
10.40	Steer attempts to rise
10.49	Rope slackens off
10.56	Man approaches rear, picks up tail and pulls. Steer does not respond
11.03	Man bends tail over and twists it. Steer does not respond
11.05	Man pushes hindquarters off trough
11.24	Steer starts to kick and turn around
11.27	Steer regains feet but slips then falls over
12.07	Man approaches front, slaps face. Pulls rope from under animal. Steer is lying without moving at this stage.
12.20	Man sticks finger into right eye and swivels it around in the eye socket (eye gouging). This lasts for about 3 sec
12.23	Steer reacts and attempts to stands, slips and falls down
12.46	Man walks to rear, picks up tail and bends it backwards against itself. Steer reacts by attempting to rise. Tail bending continues with no response
13.01	Man walks to front, gouges with finger at left eye for 10 sec
13.15	Man sticks fingers in steer's nostrils. Steer vocalises and flinches. Man gouges right eye for 6 sec, steer flinches
13.32	Gouges in left eye for 9 sec. Steer vocalises and tries to move head away. Animal is clearly extremely distressed, vocalising and has mouth gaping with tongue out
13.49	Man walks to rear, picks up tail and bends it over. No response
14.03	Man pulls tail to try to move steer. Steer vocalises
14.26	Man walks to front, gouges left eye for 4 s, then pulls on rope, slaps the steer's face, grabs its nose
14.36	Man slaps steer's face 3 times, steer vocalises, gouges in right eye, slaps face, gouges left eye
14.46	Steer reacts by getting up, stands and moves forward a few steps. Broken leg is dangling off ground. Rope around neck is tightened
15.20	Man at rear pokes steer in hindquarters with stick. They are trying to move the steer in line with the doorway into killing floor

15.35	Steer slips and falls over. Man approaches front, gouges left eye for 3 sec. Steer turns head away
15.56	Man walks to right of steer, grabs rope, sticks finger in right eye and pulls. Steer gets up, slips and falls back
16.11	Man gouges left eye for 7 sec, steer moves head away. Repeats this for 7 sec, same response. Repeats for 8 sec, grabs nose, pulls on rope.
16.55	Man pulls on tail, no response. Bends tail over 6 times
17.16	Steer gets up, slips and falls back down
17.22	Steer rolls onto right side. Breathing is laboured
17.41	Running hose brought to head of steer, water directed into nose and face. Steer lifts head away
17.49	Hose directs straight into nostrils, steer keeps moving face away and closing eyes
18.02	Man gouges left eye for 5 sec, steer flicks head away. This is repeated three more times in same eye for total of 15 sec.
18.26	Man pulls rope – trying to drag steer into slaughterhouse
18.27	Man gouges left eye for 4 sec, stick fingers in nostrils. Steer struggles and tries to rise, slips
18.45	Rope is tightened
18.58	Man sticks fingers in nostrils, gouges left/right eyes nine times for a total of 27 sec
19.55	Steer lying on side, head down, eyes closed
20.00	Man gouges left eye for 10 sec, steer tries to get up, manages to turn and sit with head up
20.21	Man sticks fingers in nostrils
20.35	Man gouges left eye then right for 9 sec, steer moves slightly forward in response, rope pulled tighter
20.54	Tail pulled by man at rear, tail bent. Steer tries to move in response onto broken leg. Poked with stick
21.13	Steer falls over. Man gouges left eye for 3 sec, steer shakes head. At same time man at rear is continually pulling the tail
21.40	Man gouges left eye for 9 sec, steer shakes head. Repeats with right eye for 7 sec
21.54	Hose directs in nose for 20 sec, steer tries to move head away, attempts to rise, rolls over to lie down on left side, laboured breathing
22.56	Man at front redirects rope through railing. Intention is to drag animal under rail into slaughterhouse
23.18	Man grabs nose and forces head to other side of railing, steer vocalises, does same with front right leg. Rope is tightened. Steer is lying down, not moving
23.37	Man kicks steer with full force of boot heel in face. Repeats this eight times. Steer vocalises, lifts head
24.00	Hose is directed in nose and face for 30 sec, steer tries to move head away. Man gouges at left and right eyes for 8 sec
25.00	Steer tries to get up, hose is still running in face
25.13	Man gouges in right eye for 5 sec, man at rear pulls on tail
25.18	Steer tries to get up. Man gouges at right eye for 11 sec, steer tries to move head away. Hose is still running in face
25.56	Steer tries to get up, hoses continues in face for 20 sec
26.12	Steer tries to get up (man at rear is still pulling tail)
26.27	Hose in face for 8 sec, steer cannot move head away. Man sticks fingers in nostrils, gouges right eye for 5 sec. Steer struggles, tries to get up. Man gouges right eye for 6 sec
28.15	Steer is lying without moving while men decide what to do next
28.21	Man goes to rear and pulls steer round by rear right leg
29.12	Man at front pulls rope from under head. Steer is unresponsive except for blinking. Eyes are mostly closed
29.38	Decision has been made to slaughter the steer in the holding pen. Man pulls neck rope, head slaps against metal post, steer vocalises quietly
29.48	Man pushes head around post, three men drag steer around to face other way
30.35	Rope tightened to pull head out from body. Steer is having difficulty breathing
31.30	Slaughterman stabs at neck with knife and starts to cut, steer vocalises. Knife makes

	several back and forth movements, cuts on left side only. Man moves away as steer struggles, then returns to finish cutting
31.59	Cutting lasts for 30 sec with a total of 23 knife movements
32.54	Slaughterman returns to cut 'clots' from neck, steer vocalises and twitches nose in response
32.36	Steer vocalises and twitches nose
	Recording ends. Events lasted for 28 minutes.

* Initial times recalculated from second camera footage to remove lost seconds from edit.

Case study 2

Australian steer trampled in raceway leading to Mark 1 box, Location 6, 20/21 March 2011

Time	Description
11:35	5 men stand at end of raceway pulling a rope tied to the steer outside. Men are in front of the steer trying to pull it inside.
12:19	Steer is pulling against the rope trying to go backwards away from the men.
12:55	Steer is still momentarily. Men start pulling again and steer jumps, shakes its head and pulls against the rope. Steer vocalises.
13:04	Still pulling against the rope, the steer vocalises then shakes and hits head on the raceway railing.
13:17	Steer pulls back against rope and hits head 3 times on the raceway railing
13:37	Steer continues to pull back against rope and vocalises/grunts.
13:49	Men continue to pull on rope and steer stops pulling against it and walks into the raceway. Steer stops before ramp. Steer is breathing heavily. Another animal is sent in behind it and they both stand before the ramp.
14:08	Steer defecates.
14:10	Steer suddenly walks backwards quickly out of the raceway, forcing the animal behind him to do the same.
14:16	Steer reaches the end of his tether and walks back in to the raceway.
14:24	Man removes rope from around steer's neck.
14:45	Man hits steer in the rump with a stick twice. Steer moves forward up the raceway.
14:48	Steer is moving forward. As man hits steer on rump with a stick for the 3rd time the animal behind him jumps forward half on top of the first steer's back. That animal comes back down to walk behind the first steer as he enters the ramp.
14:53	Man tries to shut gate behind steer as he walks onto the ramp but the steer behind him tries to get onto ramp as well which blocks the gate from being shut completely. The second steer slips and steps backwards allowing the gate to be shut. The steer on the ramp also slips over.
14:55	Steer on ramp has slipped over and is lying down with his near side back leg hanging over the side of the ramp. Steer is breathing heavily and is not making any attempts to rise.
15:10	Man hits steer hard in the rump and ribs 10 times. Steer doesn't attempt to rise.
15:22	Man hits steer on the back foot with stick. Steer doesn't attempt to rise. Steer is breathing heavily. Man throws stick to the side.
15:43	Man climbs the wall on side of ramp looking down on steer's back.
15:47	Another man kicks the steer in the rump.
15:57	Man is now inside the ramp jumping on the steer's back. The steer does not attempt to rise.
16:14	Another man passes a rope to the man who is still on the steer's back and he ties it around the steer's neck.
16:48	Steer is still lying on ramp, breathing heavily and peering out from under the wall of the ramp raceway.
17:01	Man climbs down off wall of raceway and kicks steer in the rump. Steer is looking at man but does not attempt to rise.
17:15	Men in front of steer pull on the rope around his neck. Steer fights against it and doesn't

	get up.
17:20	Man at back of steer bends his tail. Steer tries to get up on ramp but falls back down. Steer is lying on his front knees and his back legs are straight half standing up. Steer is breathing heavily and peering out from under the raceway wall.
17:33	Man climbs raceway wall and kicks steer hard on the back 3 times. The steer doesn't attempt to stand up properly. Steer falls down completely.
17:41	Man jumps on steer's back then kicks him again. Steer is breathing heavily and vocalises.
17:55	It's unclear what the man standing on the steer's rump does but the steer flinches violently, hits his nose on the raceway wall and his back leg falls off the side of the ramp. The steer just lies there and doesn't attempt to rise.
17:58	The steer is struck on the back again. Steer is vocalising/groaning.
18:03	Man hits steer in the face and gouges his eye. Man on the end of the rope tries to pull steer up the ramp. Steer is not attempting to move forward or rise. Steer is breathing heavily and vocalising/groaning.
18:28	Man opens the gate and another animal runs up the ramp over the top of the steer still lying there. The second steer is slipping as it climbs over the downed steer but manages to get over the top of him.
18:44	*The second animal is now in the restraint box.*
18:49	The first steer is still lying on the ramp and has not attempted to rise. He is breathing heavily.
19:18	Steer on ramp is still lying down. Man approaches and kicks him twice on the back leg. Steer is breathing heavily and doesn't attempt to rise.
19:58	Steer is still lying down on ramp. Man bends his tail. The steer flinches and looks up suddenly towards his rump. He then kicks out and falls over onto his side.
20:05	The man grabs the steer's tail and bends it. The steer reacts violently, kicks out and attempts to stand up. He keeps slipping up the ramp onto his knees and can't stand up properly.
20:42	The steer has stood up and is trying to walk backwards down the raceway but keeps falling on his knees.
20:53	A man throws what appears to be dirt or sand onto the ramp.
22:56	*Second animal in restraint box is slaughtered.*
EDIT	*Footage from second camera*: Steer stands in raceway. Man is poking him with a stick. Man ties rope around head of steer. Man hits steer on rump. Steer is fidgety and appears stressed. Man hits steer on the rump again. Another man throws a bucket of water on the ramp. Man continues hitting the steer on the rump and tries to push him up the ramp. Man throws another bucket of water on the ramp.
24:38	Steer is still standing in raceway. Man stands above steer on raceway wall and kicks him 5 times in the back. Steer moves backwards and falls onto his knees.
24:44	Steer stands back up. Man kicks him 17 times on the back and continues to kick him until he eventually walks up the ramp.
24:59	Steer slips up ramp, tries to get up but keeps slipping and falling on his knees.
25:10	Steer falls completely down on ramp with back leg hanging off the side. Steer is breathing heavily.
25:21	Man throws bucket of water onto steer from under the wall of the ramp. Steer just lies there and doesn't attempt to rise.
25:31	Man kicks steer in rump. Steer just lies there and doesn't attempt to rise.
25:50	Steer is still lying on ramp. Man puts rope around steer's neck.
26:06	Man tightens top around steer's neck.
26:25	5 men in front of steer start pulling on the rope around his neck. Steer isn't fighting against it but he isn't attempting to rise either. They are pulling in a rhythmic motion.
26:58	The men pulling the rope start to make progress and steer's body inches up the ramp.
27:13	A 6th man has grabbed the rope and they start pulling again and the steer's body inches further up the ramp. The steer isn't making any attempt to rise.
27:39	Steer is dragged on his abdomen up the ramp and into the restraint box. His back legs are splayed behind him. His front knees are tucked under him. He is breathing heavily and not

	making any attempt to rise.
28:10	Now in the restraint box the man attempts to tie the rope around the steer's front legs but they are tucked up tightly underneath him.
28:14	Man hits steer 4 times in the leg and abdomen but steer doesn't respond.
28:32	Man starts to tie rope around back leg of steer.
28:37	Man pulls steer's front leg out and ties rope around it. Steer doesn't appear to be resisting or making any attempt to rise.
29:05	Leg tying is complete. Steer just lies there on the floor of restraint box.
29:29	Man tightens back leg rope and ties to end of restraint box. It's unclear what happens near his rump but steer flinches violently but stays lying down.
29:46	Man opens door of restraint box. Steer just lies there and is breathing heavily.
29:54	Steer attempts to get up but struggles against the ropes.
30:01	Man grabs steer's tail and another man helps him pull the steer by his tail down the plinth. Steer struggles momentarily then rolls over onto his side.
30:17	Man starts to tie rope around steer's nose and head.
30:31	Man pulls rope to bring head down over the blood drain. Steer just lies there not resisting.
31:14	Head rope is tightened and head is turned over so throat is exposed for the throat cut.
31:27	Man makes 9 cuts to the throat in a sawing motion. Steer snorts and kicks out.
31:52	Steer flinches and flicks his tail as man approaches to put bucket under blood drain.
31:59	Steer moves his nose and mouth and flicks his tail.
32:10	Steer is breathing heavily and his tongue is hanging out.
32:17	Man makes more cuts to the throat.
32:21	Man makes a hard jab with the knife into the steer's throat and the steer flinches violently, rolls onto his back and kicks out with his legs.
32:26	Man makes more cuts to the throat then again jabs the knife into the throat and the steer flinches.
32:37	Man makes another jab with the knife into the throat and the steer flinches and his whole body jerks.
32:47	Man unties head rope. Animal appears still.

Case study 3

Slaughter of Australian steer in Mark 1 box, Location 2, 16 March 2011

Time	Description
28:53	Ramp and blood drain are covered in blood. Steer is standing in restraint box. Man taps steer on the front left hoof 5 times with his hand then twice with the rope and as the steer lifts his foot he flings the rope around it. Man then ties the end of the rope to the poll diagonal to the tied hoof. Steer is attempting to peer out from under the restraint box. There is lots of noise in the background – people talking and some kind of machinery.
29:43	Man approaches steer again – still in the restraint box – taps the steer twice with his hand and 3 times with the rope to get the steer to lift his back left hoof then pulls the rope tight around it. Man ties end of rope to the same poll as above. Steer is restless, picking up his hooves as ropes are being tightened.
30:38	Man opens restraint box. Steer walks out and trips over, nose first into the blood drain. Steer tries to get up 3 times, each time falling down onto the concrete.
30:51	Steer attempts to get up a 4th time and slaps his head hard on the concrete as he falls down.
30:58	Steer seems stunned from the head slap and is lying on the concrete – breathing heavily, tail flicking. Man walks past with a bucket of water and steer tries to get up a 5th and 6th time then falls down, first slapping his head into the blood drain and then slapping his head onto the concrete.
31:03	Steer is lying on concrete. Man throws 3 buckets of water on the steer and on the 3rd bucket the steer attempts to get up for the 7th time, falling down and slapping his head

	into the blood drain.
31:09	Steer is lying on concrete. Man throws 4th and 5th buckets of water on steer and on the 5th bucket of water the steer starts to struggle more fiercely. A 6th bucket of water is thrown onto the steer and he tries to get up for the 8th time then falls down, slapping his head into the blood drain.
31:18	Four more buckets of water are thrown onto the steer but he just lies there breathing heavily and flicking his tail. Man is washing blood from concrete with more water as steer lies there.
31:35	An 11th bucket of water is thrown onto the steer and he tries to get up for the 9th time, slapping his head hard into the blood drain as he falls down.
31:40	Man walks up to steer and gouges him in the eye twice with his fingers. Steer tries to get up for the 10th time and again falls down, slapping his head into the blood drain.
31:48	Man cuts ear tag from steer's ear with a knife. Steer vocalises.
31:53	Man gouges steer in eye with fingers. Steer tries to get up for the 11th time and vocalises. Steer falls back down slapping his head onto the concrete.
32:08	Man hits steer in the same eye that he had previously gouged twice. Steer vocalises. Man puts fingers in steer's mouth to drag steer's head up into the slaughter position. Steer is vocalising as his head is pulled and his tongue is rolling and hanging out.
32:04	Steer breaks free from head hold and tries to get up again but falls slapping his head down nose first into the blood drain.
32:08	Steer's head is lying in the blood drain. Man hits steer in the eye twice. Steer vocalises. Man puts fingers in steer's mouth again to drag head into slaughter position. Steer is vocalising and his tongue is hanging out.
32:16	Two men are holding steer down with his neck exposed. Steer vocalises 3 times.
32:22	Man cuts throat with one quick cut. Steer struggles, kicks his legs and is vocalising.
32:28	Man grabs steer by the nose and drags his head back over the blood drain. Steer is vocoalising and his tongue is hanging out.
32:37	Steer is vocalising. One man is holding steer by nose. Another man makes 2 more cuts to the throat. Man puts his hand inside throat and makes more cuts. Man continues to hold steer by nose with head over blood drain.
32:59	Man is still holding steer by nose with head over blood drain. Steer opens mouth and sticks out tongue 4 times and vocalises.
33:13	Man lifts up skin flap and looks in throat. Steer is vocalising and his tongue is hanging out.
32:27	Man walks up to steer and puts his hand in throat, steer vocalises.
33.32	Man makes more cuts in the throat. Steer struggles to get up.
33:38	Man puts hand in throat and makes another cut. Steer is vocalising/gurgling.
33:45	Man hits steer in the eye. Man walks away.
33:50	Steer's tongue is hanging out and is drooling. Man is sharpening knives.
33:52	Steer tries to get up. As his head comes back down onto the concrete he is making a bellowing/gurgling noise. Man continues to sharpen knives. Steer vocalises.
34:01	Man checks for corneal reflex.
34:03	Steer tries to get up 7 times. Steer is vocalising/gurgling.
34:18	Steer is blinking, vocalizing and his ears are twitching.
34:54	Man checks for corneal reflex. Steer is vocalising/gurgling.
34:56	Man cuts a hole in the steer's ear. Another man grabs the steer through that hole. Then the first man starts to cut the steer's head off.
35:06	Steer reacts to the man's cutting and tries to get up. Man continues to make cuts to the neck. Steer is twitching and legs are kicking.
35:23	Decapitation complete.

Case study 4

Slaughter of Australian steer 3 in one of 4 copy boxes, Location 8, 22 March 2011

Time*	Description
0:00	Man is tightening leg rope on steer (Steer 1) that is standing in copy box. Front, back and sides of copy box have metal bars so steer has full vision of what is occurring around him. Copy box is attached to three others in a straight line with one steer standing in front of the other.
0:09	Camera moves to reveal 3 more steers, one in each copy box. Three have their leg ropes tied, one steer (Steer 3) has no leg ropes tied yet.
EDIT	
0:22	Steer 2 is struggling against the leg ropes. You can see the hindquarters of Steer 3 trembling.
EDIT	Man opens door where Steer 4 stands. Steer 4 walks out, trips onto his side onto a downward sloping plinth and is struggling to get up.
0:43	Door is opened where Steer 2 stands. Steer 3 is looking around at what is occurring.
0:51	Man opens door where Steer 1 stands. Steer 2 is still struggling against his leg ropes in the box and hasn't yet walked out.
0:54	Steer 1 walks out, trips then falls head first down the plinth. Steer 3 looks around at what is happening and is visibly trembling. Men walk away leaving Steer 1 lying at the bottom of the plinth in the blood drain.
1:11	Steer 2 is still standing in the box. Man approaches Steer 1 and he struggles to get up.
1:16	Steer 4 is now out of the box and is lying in the drain in full view of Steer 3. Man puts head rope around Steer 4's neck and he struggles unsuccessfully to get up.
1:23	Steer 2 is still standing in the box. Man approaches and attempts to grab his tail but he flicks it away. Steer vocalizes twice and continues to struggle against the rope. Steer 1 is still lying in the drain struggling against the ropes.
1:55	Man is tightening leg ropes of Steer 2. Steer 3 is looking around him at what is happening.
2:02	Seer 1 struggles to get up and slaps his head against the concrete floor hard twice. Snorting can be heard coming from the other animals.
2:32	Man grabs Steer 2 by the tail and twists it and pulls him down the plinth. He struggles but eventually falls down.
2:45	Man throws head rope around Steer 1 and tightens. Now Steer 3 is the only one still standing in the box.
3:44	Man cuts throat of Steer 1. Snorting and vocalising can be heard throughout the room.
4:13	Steer 3 has backed up into the railing behind him. He has his head down looking under the railing away from the other 3 steers.
4:22	Man put head rope around Steer 2 and he struggles to get up, slapping his head against the concrete.
4:51	Man cuts throat of Steer 2. Snorting and vocalising can be heard in the room.
5:20	Steer 3 is still standing in box, looking under the railing and away from the other 3 steers.
5:23	Steer 4 has had his throat cut in full view of Steer 3. Steer 4 is vocalizing/gurgling and kicking out. Steer 4 is being hosed and is kicking out forcefully; there is blood on the floor in front of him. Vocalising can be heard in the room.
5:32	Steer 3 has stood up straight and is standing in the box. Man begins to hose Steer 2, which is shaking his head as he is bleeding out.
5:40	Man begins to hose around Steer 1, which is kicking forcefully as he bleeds out. Vocalising can be heard in the room.
7:05	Steer 3 is standing in box looking at Steer 4 motionless in front of him. Man grabs Steer 4 by the tail to move his body slightly. Steer 3 is watching and trembling.
7:29	Still visibly trembling, Steer 3 looks behind him at Steer 2 which is being hosed and continues to bleed out. Steer 3 vocalises.
7:37	Man hoses Steer 3 in the hindquarters as he stands in the box. He kicks out against the back railing, at one point getting his back leg stuck in the railing. He continues to kick out. Vocalising can be heard in the room.

7:51	Hosing of Steer 1 and Steer 2 continues. Both are kicking out and vocalizing can be heard in the room.
7:58	Man hoses Steer 3 as he walks past him. Steer 3 kicks out and kicks the railing.
8:04	Steer 4 is on his back with his legs in the air. Vocalising can be heard in the room. Steer 3 has his head down.
8:15	Man starts to untie Steer 2 and he begins kicking out. Vocalising can be heard in the room. Steer 1 also kicks out.
9:09	Steer 3 is still standing in box, watching the man beside him and Steer 4 in front of him being skinned by 3 men on the floor.
9:23	Steer 3 continues to watch. He is visibly trembling.
EDIT	
9:30	Steer 3 is trembling and watching Steer 4 being skinned. Men are whistling.
EDIT	
9:45	Steer 2 is on his back with his legs in the air and is being hosed. Vocalising can be heard in the room (most likely from Steer 3).
EDIT	
9:52	Man is hosing box where Steer 3 stands. Steer 3 vocalises. He continues to tremble.
EDIT	
10:04	Steer 2 and 4 are being skinned. Steer 1 is on his back with his legs in the air. Steer 3 is still standing in the box watching – trembling, ears twitching.
EDIT	
10:44	Man is chopping up Steer 4 with an axe. Steer 3 is watching.
EDIT	
10:56	Man ties Steer 3's front leg to the poll and tightens. Steer 3 kicks out and vocalises.
EDIT	Steer 3 is kicking out with his front leg that is now tied. He is trying to back up but struggles against the rope. He is flicking his tail and kicking his front tied leg against the rail.
11:38	As man attempts to tie Steer 3's back leg, the steer backs up into the railing and slips, struggling to release his front leg that is tied. His tail is flicking and his becoming increasingly agitated.
11:53	Man hits Steer 3 in the back leg with the rope to get him to lift it into the rope loop on the floor. The steer backs up and the man tightens the rope around his leg.
12:12	Steer 3 kicks out as the man ties his back leg to the pole and tightens. He struggles violently against the ropes that now tie his front and back leg and slips on the wet floor, a number of times getting his leg stuck through the railing. He kicks out violently with his back leg, each time kicking the rail behind him.
12:27	Still struggling violently, the steer slips over then gets back up and continues to struggle and kick out against the ropes.
12:57	Steer 3 is now tied, struggles against the rope and watches man as he starts to open the door to the box.
13:06	Door opens, steer stands there momentarily then his back leg slips and he falls head first down the plinth. Man shuts the door immediately. Steer is breathing heavily.
13:21	Steer 3 struggles to get up and slaps his head down onto the concrete twice.
13:26	Man drags what entrails of another steer past Steer 3's face. Steer 3 is breathing heavily. He is watching the carcass of Steer 4 being cut up. Knives can be heard being sharpened.
13:56	Steer 3 struggles to get up, slapping his head down onto the concrete.
14:01	Man puts rope around Steer 3's neck and kicks him in the head to move his head into position.
14:05	Man grabs Steer 3 in the nose to move his head, he resists, tries to get up and slaps his head back down onto the concrete twice.
14:10	Man tightens neck rope, ties rope around Steer's nose then ties the end to the pole and tightens. The carcass of Steer 4 continues to be processed in front of Steer 3. Sounds of men cutting up carcasses with an axe can be heard.
14:53	Man is standing over the steer's head sharpening his knife on a rock.
15:01	Man taps steer on the neck once with knife then makes 19 cuts to the throat. Steer begins bleeding out. He vocalises/snorts continuously for the next 26 seconds. His tails is flicking.

15:38	Steer again starts to vocalise/gurgle. His tail is flicking.
15:52	Hosing begins near Steer 3 as he bleeds out. He is blinking and making a gurgling noise continually.
16:26	Steer 3 blinks as the hose reaches his head again. He is still making a gurgling noise.
16:34	Hosing of head stops. Steer 3 vocalises 5 times.
EDIT	
17:04	Man is hosing Steer 3's body and head. He kicks out and moves about forcefully for the next 27 seconds.
EDIT	
17:51	Steer 3 is now on his back with his legs in the air, reading for processing. The carcasses of the other 3 steers are still being processed.
EDIT	
18:15	A new steer is moved down into the copy box as the carcasses of the 4 steers that have just been slaughtered continue to be processed.

* Time includes 11 short edits so length of time is actually slightly longer

Case study 5

Slaughter of Australian steer by rope casting, Location 10, 21 March 2011

Time*	Description
00.00	Steer is standing against far wall of slaughterhouse while another animal is being butchered on the other side of the room. Pieces of the carcass are being dragged across the floor and loaded into the back of a ute parked by the entrance.
02:05	Man walks to right side of room; pick up several coils of rope
02:54	Man swings looped rope at head of steer, misses; swings again and loop closes around steer's neck. Man calls out and steer walks to front of room
03:17	Neck rope is tightened against metal bollard; steer slips on wet tiled floor and turns towards bollard
03:33	Steer defecates. Man walks over to second bollard and tightened rope around it. Waits for help. A second man approaches from the right. Steer moves away and slips again.
04.36	Second man moves around back of steer, approaches and slaps hard on hindquarters. Steer reacts by shaking head and swishing tail, moves to front of room, trips in drain and slips again
05:05	Steer slips and falls down
05:12	Second man kicks downed steer twice in hindquarters, then picks up tail and bends it over; steer struggles and gets up in response
05.23	Steer walks towards open drain, trips and falls over
05:27	Second man picks up tail and bends it over; steer gets up, slips, and regains footing. Steer stands, breathing heavily with tail swishing repeatedly.
06:30	Man approaches on left and swings a rope at left rear leg; steer reacts and moves away, slipping and splaying rear legs. Tail is flicking vigorously from side to side
06:44	Rope catches on leg; steer slips and falls down.
06:50	Rope is caught under steer; man pulls it out and whips steer hard on back twice with it, then picks up the tail and bends it over; steer struggles and gets up in response. Steer slips with rear legs splayed out four times, until he falls down again and exhales loudly.
07:34	Steer is panting; man loops rope around rear left leg and ties it around bollard on left; neck rope is transferred from this bollard to one on the right
07:50	Second man kicks steer in hind quarters twice and then picks up tail and bends it; steer snorts in response and struggles to get up, slipping three times before falling down again. Third man comes to hold leg rope around bollard
08:45	Man picks up coiled rope and walks over to front of steer; hits steer 5 times full in face and neck with rope coil. Steer bellows in response but does not get up. Man kicks steer in neck, then uncoils rope and whips him on the back, then picks up tail and bends it over: steer struggles to get up, slips three times and falls down again

09:20	Man whips steer on back; steer bellows; whips again; steer bellows. Man picks up tail and bends it over three times; steer bellows and on third time tries to get up, splays feet and slips over onto left side.
09:48	Man ties rope around front right leg and wraps it around both front legs; steer bellows twice
10:20	Man loosens rope from rear left leg and wraps it around both rear legs before tightening it again
10:35	Man takes rope from front legs and wraps it around rear legs, pulls it tight so that front and rear legs are touching; steer is breathing heavily
11:16	First and third men pick up leg rope and steer's tail and start to drag steer away from the open drain; as second man kicks steer in face and neck 14 times; steer bellows repeatedly (10 times in total)
11:47	First man comes round to front of steer, kicks steer in face twice, steer bellows twice. First and second men now drag steer back using neck rope while the third man pulls on his tail. Steer gasps, opens mouth and pushes tongue out.
12:20	Man loosens neck rope and ties it around steer's mouth while steer is gasping and vocalizing (4 times). He kicks steer in neck three times while tightening rope around bollard; steer bellows five times
13:10	Man moves to left bollard and tightens leg rope to ensure steer cannot move and neck is stretched out for the throat cut
13:39	First man picks up knife; third man picks up skin fold at steer's neck; steer vocalizes 3 times before throat cut. Cuts in a sawing action with 14 strokes. Steer gasps repeatedly; blink reflexes indicating consciousness are seen at 63 and 68 seconds after throat cut; steer continues to gasp for more than two minutes. None of the men check for signs of consciousness before beginning to move the carcass.

* Total time during restraint includes two short edits

Case study 6

Slaughter of Balinese bull by traditional rope casting, Location 11, 18 August 2010

Time	Description
29:47	Bull is led into slaughter area by male handler. Has a rope through nose and around head. This rope is pulled through a ring fixed into the concrete floor.
29:54	Bull is resisting rope as his head is pulled down, tail is flicking rapidly. Man ties rope around ring so that head is approximately 30cm from ring.
30:07	Second man approached from left with rope in hand. Hits animal with rope three times to get him to lift his leg. Throws rope around rear left leg and tightens it. Bull resists rope and moves around.
30:28	Bull falls over onto knees, man loops rope around left front leg. A third man is now holding the rear leg rope. Animal is struggling violently and trying to get back up on all four legs. Tail is flicking rapidly.
30:38	Second man tightens leg rope on front leg and throws end of rope to first man who holds it tight. Second man then grabs back and tail of animal and pulls him over onto his left side.
30:48	First man uses wraps front leg rope around front legs to secure them together.
31:00	Third man does same with rear legs, then ties front and rear legs together with leg rope. Second man is holding tail tightly during leg trussing.
31:19	Third man continues to tie all legs together tightly, Second man eases off pressure on tail.
31:27	Second man drags animal 90 degrees around by tail.
31:37	Second man starts to re-tie head rope to ring in floor so head and nose are tightly bound to the ring. A fourth man crouches by the animal's head, holding a rectangular tray for collecting blood. Animal is breathing heavily but is unable to move.
32:20	Man pours a bucket of water over the body of the animal: he arches his back and snorts, but no other movement is possible due to roping.
32;39	Second bucket of water is poured over bull's body. He flinches and breathes heavily.

32:49	Man lifts head up and slides blood tray under the neck
32:54	Man grasps skin around neck and stretches it out in preparation for the throat cut
32:58	Another man puts knife in position and starts cutting with a sawing action – 23 cuts in total
33:06	Animal snorts and blinks several times
33:10	Man puts hand into neck wound (not clear what he is doing). Animal snorts loudly and flinches
33:19	Man's hand is still in wound, holding neck over blood tray. Animal is kicking and snorting, still breathing
33:28	Animal opens mouth and closes eyes, tongue is thrust out, gasping.
33:56	Animal is breathing slowly and heavily, whites of eyes are showing
34:30	Man is scooping blood from blood tray into a separate container. One hand is still in the wound.
34:49	Animal appears to have ceased breathing
35:15	Man slides blood tray away from under animal's neck. Another man pours a third bucket of water over the body and neck of the animal. Animal shakes head in response to water.

Case study 7

Slaughter of Australian steer that regains feet after throat cut, Location 1, 15 March 2011

Time*	Description
0:22	Steer standing in restraint box. There is another animal in the raceway behind him standing on the ramp. APFINDO, MLA & LIVECORP logos on the outside. Legs are already tied. Lifting legs and peering out from underneath box.
0:34	Man opens door of restraint box. Steer walks out, steps on metal pipe in the blood drain and is immediately hosed in the face. Steers slips over, hits head on the blood drain and slides down the plinth – hosing continues.
0:38	Steer tries to get up three times, each time slapping his head on the blood drain. During the struggle the rope tied to the back leg comes off. Hosing continues.
0:42	Steer's rump falls over the edge of the plinth as back leg is no longer tied to the restraint box. Steer kicks out with one leg tied to the box and gets his rump back up onto the plinth.
0:48	Steer's rump falls back off the end of the plinth and man pushes him back up with his hand.
0:51	One man grabs steer's ear and another grabs his eye. Steer vocalises. A third man attempts to push the steer's rump back up onto the plinth.
0:58	Two men hold the steer by head and mouth. A third man makes 4 cuts to the throat in a sawing motion. Steer is bleeding out.
1:01	Men walk away. A fourth man starts hosing the steer. The steer attempts to rise then slaps head back down onto the blood drain. Hosing continues. Bleeding out continues.
1:07	Steer again attempts to rise, his rump has fallen off the end of the plinth. Steer's chin hits the blood drain. Steer is almost completely on the floor with just his head over the plinth. Hosing continues. Bleeding out continues.
1:11	Steer attempt to rise and falls completely onto the floor. Hosing continues. Bleeding out continues.
1:15	Still bleeding out, the steer stands up. Man is attempting to retie the steer's front leg to the blood drain. Steer trips then starts walking away from the crowd of men. Trips again.
1:20	Steer falls, hits chin on the floor. Attempts to rise but is slipping on the floor. Gets up and slips down 4 times then stays down. Steer is flicking his tail and vocalising/gurgling.
1:33	Hosing of the steer starts again. Man approaches steer with a rope. Steer is rocking and vocalising/gurgling.
1:36	Man puts rope around steer's head. Steers attempts to rise – slaps his head on the door of the restraint box then the plinth and falls back down. Steer is flicking his tail.
1:43	Man slashes steer's back near side tendon. Steer vocalises and kicks back, pushing himself along the wet floor. Steer is kicking and vocalising and breathing heavily. Hosing of the steer continues.

EDIT	
1:57	Steer is lying on the floor and vocalising/gurgling and breathing heavily. Man is hosing steer. Another man approaches to untie the rope around the steer's neck.
EDIT	
2:13	Man stomps on steer's head. Same man makes more cuts in the steer's throat. Steer vocalises. His eyes are rolling, his mouth is moving and his tongue is hanging out. In the meantime the steer that had been waiting in the raceway is now in the restraint box having his legs tied. He is peering beneath the box in the direction of this steer that is lying on the floor vocalising.
2:26	Steer is vocalising/gurgling. Hosing of the steer continues and moves to his head.
EDIT	
2:32	Steer is vocalising/gurgling. Tongue is hanging out and he is opening and closing his mouth.

* Includes three short edits