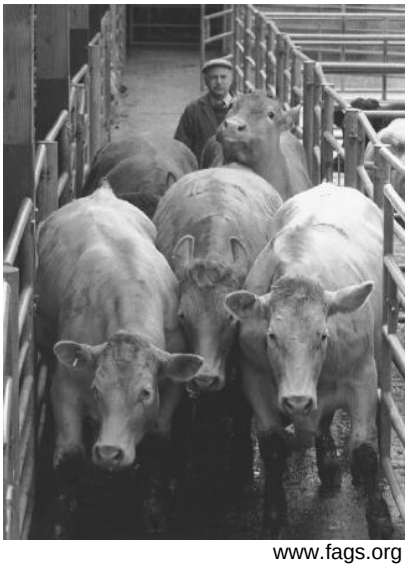
Development of a monitoring system for the assessment of cattle welfare in abattoirs

Utformning av ett övervakningssystem för bedömning av välfärd hos nötkreatur på slakterier

Viveca Sandström



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Appendix A

Abstract

Welfare Quality is an EU-funded project, aiming at integrating animal welfare into the food quality chain, by developing on-farm and abattoir monitoring systems, product information systems, and practical strategies for welfare improvements (21). Welfare Quality is an integrated research project spanning from 2004-2009 and involving 17 institutes and universities within and outside Europe. Within the Welfare Quality subtask 2.2.2, a number of protocols for monitoring of fear and injurious behaviours and of stun quality indicators have been produced by Algers (24-27). The protocols are intended to be used as tools in the assessment of overall cattle welfare in the slaughter house environment. Carcass bruise scoring was also reported as possible to include in the assessment.

The aim of this study was to investigate the potential for using the above mentioned protocols and bruise scoring in a monitoring system that enables overall welfare assessment of cattle at slaughter, from unloading to stunning. A survey of the practicability of measures and also time and labour requirements was made by me during two test trials at five Swedish abattoirs in the summer/autumn of 2008. Changes and refinements are presented, resulting in a final monitoring system proposal.

Results from test trials showed great potential for using the refined protocols in a monitoring system, facilitating overall welfare assessment. However, to complete the system, inclusion of a protocol for monitoring of behaviour in the stun box, a general plant description, space for subjective comments and possibly also inclusion of a bruise scoring sheet, are proposed. It was concluded that monitoring of stun quality should be carefully adapted to the stunning method used, and a specific protocol for electrical stunning has been outlined, but will need further revision. The issue of slaughter without stunning is brought up in short and the need to further develop the definitions of behaviours and events is emphasized. Time and labour requirements for monitoring are roughly outlined. Changes and refinements are summarized in a final monitoring system proposal.

The discussion centres on the assessment system approach chosen by Welfare Quality® and on the main drawbacks and possibilities that can be attributed to the proposed monitoring system.

1. Introduction

Historical background

In 2008 Vessier and colleagues (1) reviewed European historical approaches to ensure animal welfare and described the start of a new era in the animal welfare debate as being the much discussed book “Animal machines”, written in England in 1964 by Ruth Harrison. She described and questioned the modern type of large scale farming that had evolved around that time and raised concerns about the industrialization of farm animal production and rearing (2). The book had large impact on the subsequent formation of the Brambell Commission by the British Government (1), aiming at making enquiries into the welfare of animals. The well-known Brambell report, published in 1965 and including the often cited “five freedoms”, lead to initiation of stronger welfare legislation in the UK. Vessier and colleagues underlined the major impact of the Brambell report on the subsequent European legislation. It increased awareness of politicians and societal groups about the poor conditions under which many farm animals lived and also about animals’ capacity to experience suffering (1). At the time of

publication of the Brambell report, the Council of Europe was the first supra-national organisation that proposed measures to ensure animal welfare (1) by formulating the European Convention for the protection of animals kept for farming purposes in 1976 (3). This Council was founded in 1949 with the aims of achieving greater unity between its members, to develop democratic principles and defend human rights (4). The animal protection issue was brought up with the belief that respect for animals was a common heritage of the European countries, closely linked to human dignity (1).

Animal welfare legislation has been described as being primarily a European phenomenon (1), at least traditionally speaking. Nowadays, the European Union is expanding and new member states must abide by the common legislation and third countries such as Australia, Brazil and the US can be said to be influenced by the general high animal welfare concerns in Europe. Also, the concept of free trade across the world is dependent on a free market, meaning competition also amongst businesses that involve live animals. Initially, this was also the aim of the first initiatives by the EU in setting up legislation around animal welfare, starting in the 1978 with the Directive 78/923/EEC on adoption of the European Convention for the protection of animals mentioned above; that is, to ensure that disparities between national laws to protect animals did not compromise fair competition within the common market (3). The interest for animal welfare issues have strengthened through the years and in amendments to the treaty of the European Union, the Protocol on Protection and Welfare of animals (annexed by the Treaty of Amsterdam in 1997), recognizes animals as sentient beings. This obliges the European Institutions to pay full regard to the welfare requirements of animals when formulating and implementing Community legislation (5) which clearly demonstrates that the statement was a major evolvement from the initial interests behind animal welfare concerns.

During the coming decades, large efforts resulted in further legislative developments in the protection of animals, for example leading to the revised Directive concerning the protection of animals kept for farming purposes (6), regulations on animal transport (7) and specific directives on laying hens, calves and pigs (8, 9, 10).

Before adoption of the European Convention for the protection of animals mentioned above, EU initiated amendments including welfare of animals killed on farm (11). Already in 1974, there was a Council Directive (74/577/EC) dealing with the stunning of animals before slaughter and during the following decades further efforts have been made to develop broader legislation, resulting in the Directive 93/119/EC which offers protection during slaughter and killing (12) covering a wide rage of animals and slaughter circumstances.

The Office International des Epizooties (OIE) was established in 1924 with the aim of preventing world spreading of animal diseases (13). The responsibilities of the OIE (now named The World Organisation for Animal Health) has been extended into improving animal health world wide, in order to secure public safety. The OIE has focused on food safety by aiming to eliminate potential hazards existing prior to slaughter or in the animal products. Since the OIE has also recognised the essential link between animal health and welfare, an Animal Welfare Mandate was included in the strategic plan for the period 2001-2005. With this initiative, the OIE aimed at developing policies and guiding principles to provide a scientific foundation from which to elaborate specific recommendations and standards relevant to animal welfare. In their work, priority is given to issues regarding animals used in agriculture and aquaculture and within this group transportation, humane slaughter and killing for disease control are given special attention, followed by housing and management.

Guidelines for the stunning and slaughter of livestock have been included in the Terrestrial Animal Health Code in 2007 (14). OIE states that the strategic plan for the coming years include the promotion of animal welfare by ensuring animal health and adopting international rules to strengthen it.

In the aftermath of the BSE crisis, the EU published a so called White Paper on Food Safety, followed by a series of regulations and directives, together known as the "Hygiene package" (15). In 2002, the European Food Safety Authority (EFSA) was established as an independent body, with the aim of providing scientific advice for EU legislation and policies in order to restore and maintain confidence in the EU food supply chain (16). EFSAs recognition of welfare as highly influential on the health of animals is reflected in the formation of a Panel on Animal Health and Welfare. EFSA states that stress factors and poor welfare can lead to increased susceptibility to disease among animals, which poses risks to consumers. The welfare is stated to depend largely on for example housing, transport conditions and stunning and slaughter methods. The institution has produced a number of scientific reports and opinions, with focus on reduction of unnecessary pain, distress and suffering and increasing welfare where ever possible. One such report, published in 2004, deals with welfare aspects at stunning and killing of the main commercial species of animals (17). The working agenda described by organisations such as OIE and EFSA clearly demonstrate the increasing interest in animal welfare concerns and underlines the importance of such issues at the time of slaughter.

In 2003, the Food and Veterinary Office (FVO), carried out a series of missions, including controls at slaughterhouses, in nine EU Member states with the objective to evaluate the implementation of provisions laid down in directives concerning animal transport and slaughter (18). Results revealed that there was a higher level of compliance in countries where there was supervision and/or auditing of the work of slaughterhouse veterinarians. It was concluded that, although there were currently no legislative requirements to record or report the results of animal welfare checks within slaughterhouses, such procedures would enable better monitoring of compliance and identification of areas where there is insufficient knowledge. In the report it was emphasized that there was a need to strengthen EU controls for animal welfare during transport and at the time of slaughter. It was also stated that inspections must be organised in a more systematic way and that training of inspectors needed to be provided.

In 2006-2007 the FVO carried out a new set of missions aiming to further evaluate the measures taken to ensure implementation of the legislative welfare requirements at slaughter and also how checks had been integrated with requirements concerning official controls of animal health and feed/food law (63). It was reported that entry into force of such requirements had led to more systematic animal welfare checks in slaughterhouses, which had been increasingly based on more structured procedures. However, it was concluded that there was a need to develop a better legal framework which would require a greater knowledge of animal welfare at slaughter for both slaughterhouse staff and officials carrying out the controls.

The European Commission has long been monitoring the evolution of public opinion in the Member States, in order to facilitate decision-making and evaluate relevancy of the ongoing work. Monitoring is primarily done by surveys from the "Eurobarometer", which is the public opinion analysis sector of the European Commission. With the Eurobarometer survey "Attitudes of EU citizens towards Animal Welfare", published in 2007 (20), the Commission

sought to further investigate the public knowledge of farming conditions, purchasing behaviour and perceptions of legislation relating to animal welfare. It was shown that EU citizens had considerable interest in animal welfare and the demand for more information on the subject was great (20). A majority thought that animal welfare standards had improved over the last decade, however, there was also a strong belief that further improvements were necessary (20). The survey also demonstrated that the information enabling citizens to determine the welfare conditions that lie behind specific products must be improved. Just over half of all respondents stated that the current labelling of food products was not helpful when trying to find information about animal welfare. The citizens considered the farmers to be most important in ensuring welfare improvements, but veterinarians and national governments also had important roles in this regard. A majority of citizens also thought that producers should be financially compensated to alleviate any higher costs associated with improving welfare standards. Almost all respondents believed that the same welfare standards applied within the EU should also be applied to products imported from third countries.

These conclusions bring us to the matter of concern for the present study. Citizens of the EU seems to have increasing appreciation for high animal welfare standards and, as stated by many, it lies within the responsibility of the European Commission to sharpen legislation and set up practical guidelines for the implementation and control of animal welfare within the Union. There is also clearly a great need for labelling schemes which enable consumers to make informed choices about the products they purchase.

One of many initiatives to take on these responsibilities is the Welfare Quality® project (hereafter abbreviated WQ-project). This project, funded by the EU, aims at integrating animal welfare into the food quality chain, by developing on-farm and abattoir monitoring systems, product information systems, and practical strategies for welfare improvements (21). Institutes and universities, representing thirteen European and four Latin American countries, participate in this integrated research project, spanning from 2004-2009. In 2006, a Community Action Plan on the Protection and Welfare of animals was set up by the European Commission for the period 2006-2010 (22). The Plan is said to embody the commitment to EU citizens and stakeholders and to show a clear map of animal welfare initiatives for the coming years (5). The following five main areas of action are presented in the plan:

1. Upgrading existing minimum standards for animal protection and welfare
2. Giving high priority to promoting policy-orientated future research on animal protection and welfare
3. Introducing standardised animal welfare indicators
4. Ensuring that animal keepers/handlers as well as the general public are more involved and informed on current standards of animal protection and welfare
5. Continue to support and initiate further initiatives to raise awareness and create greater consensus on animal welfare

The first issue, concerning the upgrading of legislative minimum standards, is ongoing and has resulted, for instance, in a new proposed Regulation on the protection of animals at the time of slaughter and killing (23), to replace the legislation currently in force. The WQ-project involves issue 2 and 3 and based on the outcome of the project, the further application of measurable welfare indicators in Community legislation will be reported to the Council and Parliament in 2010. The project involves issue 4 by aiming to implement welfare

standards and develop a product information system. By 2010 decisions should be made regarding the establishment of a European Quality Standard for products emanating from high animal welfare production systems, where results from the project will be highly relevant.

The present study, as part of the WQ-project, deals with the development of a standardized abattoir monitoring system for the assessment of cattle welfare at slaughter, from the moment of unloading until animals are stunned prior to slaughter, including quality of the stun. In the proceeding work of the WQ-project, this monitoring system will form the basis for development of a labelling standard, enabling accreditation of abattoirs showing high animal welfare consideration. Expert groups have worked in collaboration to establish a number of specific parameters to be used in assessment of cattle welfare at slaughter and a number of protocols for registration of these parameters have been produced (24-26). The possibility of using carcass bruise scoring in the assessment was also evaluated by Algers (27) and the Australian Carcass Bruise Scoring System (ACBSS) was found reliable.

The aim of the present study was for me to investigate suitability and feasibility of the proposed protocols and bruise scoring system. In collaboration with my supervisors and an expert scientist from Bristol University, changes and refinements were made and the measures were assembled into an inspection procedure proposal, which will facilitate overall assessment of cattle welfare at abattoirs.

The main hypothesis was that that the original protocols would work well in practical application. However, I expected that it would be necessary to include additional parameters and that changes and refinements to the original protocols would have to be made, in order to create a functional system of monitoring. I had, however, more doubts about the suitability of including bruise scoring according to the ACBSS.

Animal welfare assurance

Different approaches in the development of assurance schemes

Quality assurance can be defined as "a planned and systematic set of activities to ensure that requirements are clearly established and the defined process complies with these requirements" (75). The idea of establishing welfare standards and measures to assure that those requirements are being met is not by any means a novel phenomenon in the animal production industry. Fraser describes in a report from 2006 how different programmes have been developed since the end of the 20th century (28). Most quality assurance programmes were set up for food safety reasons, but many have later developed towards involving other issues such as biosecurity, traceability, environmental concern and also, animal welfare (74, 76). Edge and co-workers have also reported on the considerable efforts that have been made to establish quality assurance programmes incorporating animal welfare, bringing up examples from for instance Europe, Australia and the US (76). In Australia, specific welfare standards have been developed and integrated into existing industry quality programmes for several livestock sectors, including the meat processing industry (76). There is also an ongoing work of developing an agreed set of standards within a quality assurance framework, thereby avoiding the need for multiple auditing procedures (76). In Europe assurance schemes involving animal welfare often have standards that go beyond the minimum requirements of common legislation (1). In this context, it should also be mentioned that official veterinarians within the EU have responsibilities to assure animal welfare, mainly through Regulation

882/2004 (concerning official controls performed to ensure the verification of compliance with feed and food law, animal health *and animal welfare)* (63) and Regulation 853/2004 (laying down specific hygiene rules for food of animal origin) (81).

It lies in the interest of consumers that animals are kept under acceptable welfare conditions on farm, where animals spend most of their lives. But the conditions during transport are also very important and in recent years, eyes have also turned towards the slaughter industry. Increasing scientific understanding and public concern have led to developments of assessment systems with regards to both transport and slaughter. In the US, animal scientist Temple Grandin has been much acknowledged for her work in the field of livestock handling and welfare at slaughter. On the basis of both scientific knowledge and personal experience she has written a great deal about specific factors that can impede animals movement, such as high-pitched noise, surface reflections and differences in illumination (29) and she has also stressed the importance of taking principal animal behaviour into account when animals are being moved, with special consideration to animal flight zone and the point of balance (30). Principles of livestock handling and the impact of staff training are major recurrent topics (64, 65) in her work. In 1996 the American government initiated a survey on the handling and stunning practices at federally inspected beef slaughter plants (31). In order to perform this survey an assessment system was developed by Grandin including five main critical control points; stun quality followed by insensibility during the slaughter process, electric prod use, vocalizations, slips and falls (31). In the same time frame McDonald's started assessing their meat suppliers, not only for food safety reasons but also for the welfare of animals slaughtered and Grandin was involved also in the development of the programme. Other major fast food companies, such as Burger King Corp and Wendy's followed this trend and these initiatives are often seen as the starting point of the developments of assessment systems for handling and stunning at slaughter. A survey of the assessments performed by the fast food companies was made in 2005 and it showed that these audits had maintained improvements reached at the start of the audits in 1999 (32). The work of Grandin and many other scientists have contributed to important attitude changes within the slaughter industry globally, allowing management to put higher priority on animal welfare. Still, there seems to be an increasing need for further development of tools for the assessment of animal welfare in areas such as transport and slaughter (73).

In his report from 2006 on animal welfare assurance programmes Fraser presents five main formats by which various assurance programmes used can be grouped (28). These formats are summarized below, based on descriptions in Fraser's study.

1. Non-mandatory welfare codes and guidelines

One of the earliest responses to public animal welfare concern was the creation of non-mandatory codes and guidelines for animal production, generally taking the form of recommended practices based on the available scientific research but also practical experience (28). Codes and guidelines have most often been created by animal industry players, sometimes in consultation with other groups or involvement by governments (28). In some countries, such codes have been published as governmental documents, although having no status under the law (28). Fraser points out that non-mandatory welfare codes provide little assurance to the public, unless some form of monitoring is practiced and for this reason different measures have been developed to assure compliance. Auditing or inspection programmes following up recommended guidelines have been developed and are sometimes combined with requirements from a central body of the industry (28).

2. Labelling programmes

Animal welfare assurance may also involve more pronounced labelling programmes, based on a product differentiation approach, where products produced according to defined methods or standards are labelled and sold at a premium price (28). The programmes can be established by producers, retailers or independent bodies such as animal welfare organisations or organic certification agencies (1, 28). Programmes set up by the industry are most often intended to enable companies to attract a specific group of consumers and enter a specific market (1). For example, Scan, a large actor in the Swedish slaughter and meat processing industry, has implemented a set of welfare standards for animals at slaughter in addition to their general quality assurance scheme. The company performs internal audits and, following the company's animal welfare training, staff and transporters delivering animals to the slaughter plants are certified (79). This type of scheme has been described by other authors as being a *general* quality assurance approach that includes welfare requirements but mainly focuses on other aspects of food quality, such as safety, traceability and product taste (1). Health and environmental concerns are other aspects of farming that often involve elements of animal welfare. For example in Sweden, the KRAV-association was founded in 1985 aiming to promote and to introduce a label for organic farming (78). The membership-based mandatory requirements developed by KRAV later came to involve standards for animal welfare both on farm and at slaughter, with audits carried out by trained assessors at a regular basis. In some aspects these standards go beyond the legal requirements of Swedish animal welfare law, which is generally considered as being stringent, even from a European perspective.

More specific animal welfare schemes with main objectives of maintaining or improving welfare have also been developed, for example through the American organisation Humane Farm Animal Care which initiated an assurance scheme involving a label termed "Certified humane raised and handled", including requirements at slaughter (80). Another example is the Freedom Food scheme, funded in the UK in 1994 by a non-governmental animal protection organisation. Species-specific standards for farming, slaughter and other areas have been set up in consultation with animal welfare science expertise, veterinarians and industry players and a label has been developed (77).

Alternatively, labelling may be *mandatory*, often providing information on the major production method used, for example set up by the EU in 2004, requiring labelling of eggs to specify housing of hens in cages, loose-housing or free range systems (28).

3. Assurance programmes at corporate customer level

Programmes have also been developed by private companies to ensure compliance at corporate customer level (28). This was the case for example with the McDonald's Corporation, who started assessing their suppliers, especially in the egg and slaughter industry, as mentioned above. To avoid confusion caused by having different restaurant chain audits at the same supplier, the US-based chain restaurants commissioned their national trade association to develop a harmonised audit programme that could be adopted by the different member companies (28).

4. Regulations

Governmental regulations are sometimes used to provide assurance about animal welfare. In many countries there is a history of giving animals legal protection, beginning, generally, with illegalizing individual acts of cruelty or violence and later also requiring humane transportation and slaughter and finally, setting standards for animals on farms (28).

5. Inter-governmental agreements

For example in the UK, regulations lead to banning of the traditional ”veal crate” used to house calves for the production of white veal (28). However, calves were still exported abroad to be reared in those same systems that had been banned in the UK, and the meat was also imported back and sold in the country. This example illustrates the need for inter-governmental agreements in order to avoid that welfare regulations loose their intended effect if trading partners do not agree to follow similar standards (28).

The requirements involved in welfare assurance

According to Fraser the effectiveness of a given welfare assurance programme will depend on several factors including the support received by industry players and if the programme is easily maintained, enforceable and comprehensive (28). The main purpose of the programmes is of course to assure the public that welfare standards are being met and to be effective it is therefore crucial that they generate public confidence. Fraser describes that programmes based on non-mandatory standards generally are more easily accepted by industry players but, on the contrary, with more governmental involvement and mandatory standards, the public considers programmes to be more reliable (28). Naturally, the specific requirements involved in the programmes are of greatest importance to both industry and public and in his report Fraser tries to group the requirements used into four main types:

- Type 1 requirements- involve the fulfilment of quite basic needs, such as space allowance and species-specific feed. Such factors were often included in early welfare standards.
- Type 2 requirements- focus on unpleasant states of pain, distress and hunger and they involve, for example, effective stunning prior to slaughter and avoiding the use of electric prodding. Such requirements have a long history, particularly regarding welfare at slaughter, were reduction of pain and distress is commonly seen as an important goal.
- Type 3 requirements- these can be said to involve elements of the animal’s natural behaviour, such as perching, dust bathing and nesting for layers and feed seeking behaviour in pigs. Such requirements are common in alternative production systems, such as organic farming, but they are also becoming more pronounced in EU legislation.
- Type 4 requirements- often involve components relative to more of a “natural life”, such as access to the outdoors and natural daylight and they are required mainly in alternative production systems.

Fraser expresses that type 2, 3 and especially type 4 requirements are those that are most likely to generate public confidence in an assurance programme. Type 1, 2 and also type 3 requirements are those that are supported by the strongest scientific rationale but only type 1 and 2 requirements are concluded to be easily incorporated into production systems and supported by the existing industry (28). However, Fraser wrote his report in 2006 and during recent years, there have been focus on developing the scientific proof basis for type 3 and 4 requirements and one could say that greater acceptance is evolving, both within the scientific community and the farming and slaughter industries.

2. Presentation of the originally proposed monitoring components

The proposed monitoring system involves the assessment of four key areas in the abattoir, important in relation to animal welfare. These areas are: 1. unloading of animals from the vehicle, 2. driving of animals into the stun box, 3. the stunning and sticking procedure and 4. carcass bruise scoring. These four areas will be discussed below, explaining the reasons for choosing those specific areas and the underlying facts of specific behaviours and events.

Unloading and driving into the stun box

In general, unloading of animals is recognised as a critical moment, highly relevant to welfare and some authors believe that loading and unloading can be more stressful to animals than the journey itself (Trunkfield and Broom, 1990, cited in 33). In figure 1 the originally proposed monitoring protocol for unloading and driving into the stun box is shown.

	Locomotion				Others		Comment
1	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
2	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
3	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
4	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
5	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
6	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
7	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
8	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
9	Rn	Mb	Fr	No	Slip/Fall	Vocalize	
10	Rn	Mb	Fr	No	Slip/Fall	Vocalize	

Abbreviations: Rn- run, Mb- move backwards/turn around, Fr- Freeze, No- no locomotion behaviour occurred.

Figure 1. Monitoring protocol for unloading and driving into stun box

Slipping, falling and running

Slipping and falling are major welfare risks that can cause injury and, consequently, sever pain and distress. A study of cattle in UK markets by Gregory and co-workers (in press, cited in 34) showed that the key welfare issues were slips and falls during unloading and movement at the market site. Slips and falls occurred mostly when concrete floors were wet with rain, urine or manure and it occurred especially at bends were cattle were running and made a turn. Running will consequently increase the risk of slipping and falling. As animals walk off a vehicle on a steep ramp there is a risk of injury from both jumping, slipping and falling (35).

Vocalization, freezing and moving backwards

Cattle have been shown to respond to injury, fear and distress by vocalizing (36, 37, Watts & Stookey, 1999, cited in 4) and it is therefore generally considered as a reliable indicator of poor welfare. In the EFSA report on animal welfare at transport (38) recommended behaviour measures to be used in assessment of welfare at transport and associated handling (including unloading) are described. Among others, freezing, moving backwards and vocalizing are mentioned. Also in a report from the Farm Animal Welfare Council (FAWC) on the welfare of animals at slaughter or killing (35) there are extended discussions on welfare issues relevant to unloading and lairage conditions.

Stunning

In figure 2 the originally proposed monitoring protocol for stunning is shown. Stun quality assessment is often based on evaluation of the presence and severity of a number of symptoms indicative of *poor* or *uncertain* stunning effect. In practice, several methods of stunning cattle are in use. The most common stunning method in Europe is the use of a penetrating captive bolt. Electrical stunning of cattle is practiced in some countries and weapons with non-penetrating bolts are sometimes used. Irrespective of method, stunning should instantly render the animal unconscious and it should remain in such a state until sticking and bleeding procedure has been carried out and, consequently, until death occurs by exsanguination. However, stunning can also cause irreversible loss of consciousness due to severe head trauma, and in those cases exsanguination is not needed to guarantee good welfare of the animal, but is performed for meat quality purposes (39). During the last two decades scientists have focused a lot on research involving examination of brain damage following penetration of the bolt and the concussion effect related to captive bolt stunning (40-44, 69). These efforts have aimed to establish the definition and signs of a good quality stun. As in many other areas of research, scientists have not always come to the same conclusions on absolute measures of stun quality. The area of research on stunning gives a good example of the ongoing work of gathering new facts and re-evaluate former knowledge. However, some specific symptoms can be concluded as generally accepted indicators of poor stunning effect, involving the risk of conscious perception of pain and suffering in the animal.

Carlsson (cited in 39), reported in 1994 that damage to the frontal lobes of the brain do not have any effect on consciousness, unless it is also associated with a concussive blow. More severe damage by bilateral ablation of the frontal lobe does not disturb crude consciousness, but it will affect the will, initiative, foresight and inhibitory powers (39). Unconsciousness can however be obtained if the entire forebrain is removed (39). These evidences clearly show that damage to the forebrain of an animal by the use of a captive bolt does dot necessarily cause unconsciousness. On the other hand, damage to regions in the brain stem is associated with a rapid onset of complete unconsciousness (39). Therefore, unconsciousness should be induced by a stun that creates rapid and massive arterial bleedings around the area of the brain stem (46). Haemorrhaging in this area and at the base of the brain will cause unconsciousness and also have high probability of causing death (46). In 2007 Algers and Atkinson compared brain damages and bleedings caused by captive bolt gun and a pneumatic bolt weapon in bulls and found that the latter had more sever impact on the back of the brain (46). It was suggested that the more powerful pneumatic weapon caused a greater concussion effect and also that the power of the hit on the animals forehead tended to give more of a “counter-coup effect”, meaning that bleedings occur at the opposite part to were the gun is placed (46). In this study huge difference in stunning effect was shown in comparison between the two mentioned weapon types. It was concluded that the main problem area was the stunning of large bulls (46), which also have been concluded in other studies (Daly 1991, cited in 49).

Sample No.	Animal type, size	Eye movements	Others	Reshooting	Comments
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		
		DilPup CorRef SpBli EyeRot Nyst	Resp RightRef ExKick		

Abbreviations: DilPup- dilated pupil, CorRef- corneal reflex, SpBli- spontaneous blinking, EyeRot- eye rotation, Nyst- nystagmus, Resp- respiration, RightRef- righting reflex, ExKick- excessive kicking

Figure 2. Monitoring protocol for stun quality

Eye movements

Corneal reflex is checked by lightly touching the eye to determine if this gives rise to a blinking response. The absence of corneal reflex can be used to assess depth of concussion, as it indicates that the pathway between the eye and brain stem is affected (39). It is usually assumed that this is due to disruption of function in the brain, but Karnik and colleagues (1981, cited in 39) reported that optic nerve impairment can occur during concussion in different ways, and that absence of corneal reflex as an indicator of deep stunning could be questioned. However, it has been reported that this symptom becomes absent in conjunction with EEG (electroencephalographic) patterns indicative of insensibility in animals (42) and there is a strong general believe that the presence of a corneal reflex is a reliable indicator of poor stunning (17). Furthermore, eye rotation should not be present in an adequately stunned animal and the pupils should gradually dilate following an effective stun (17).

Rhythmic breathing

According to Gregory (39) absence of respiration (meaning rhythmic breathing) can be used as an indicator of unconsciousness during concussion, as the arrest of respiration is indicative of brain stem impairment. It is stated that breathing does not necessarily signify consciousness, but its presence is however an accepted indicator of poor stunning (47, 17).

The righting reflex

Tonic spasms are normal during the first seconds after stunning (47), but sufficiently stunned animals should not raise the neck and head in a so called “righting reflex”. This reflex is defined as “a postural reaction that turns a falling animal's body in space so that its paws or feet are pointed at the ground or,..., returns the animal to sternal recumbency after being placed on its back or side. A normal reaction is dependent on normal vestibular, visual and proprioceptive functions” (48). Presence of a righting reflex is generally considered indicative of poor stunning (47, 17).

Extensive kicking

An adequately stunned animal will collapse instantly and the skeletal muscles of the body will go into spasms, with the immediate onset of tonic seizure lasting several seconds (17). The convulsions seen following effective stunning originate in the brain or are provoked through spinal reflexes (68). Under normal circumstances, such activity is controlled by the nervous

system and mediated trough the spinal cord (68). When the brain is severed at stunning the inhibitory functions of the brain are lost, resulting in convulsions and kicking movements due to both the concussive blow (82) and injuries caused by the penetrating bolt. The mechanisms of traumatic head injury in ruminants have been described elsewhere (see for example 42, 40, 69). The animals´ forelegs and hind legs are flexed and after 5 seconds the forelegs will straighten and become extended (17). The tonic phase is immediately followed by the clonic phase, which is characterised by uncontrolled physical activity (kicking) (49). Kicking is hence normal following an effective stun but in some circumstances kicking motion can be regarded as being excessive and thereby indicative of return-to-sensibility (50).

Re-stunning

In work by Daly & Whittington and Daly (1989 and 1991, cited in 39), stunning effectiveness was evaluated by recording visual-evoked responses, eye rotation and rhythmic breathing. Re-stunning by repeated shots was also included in the evaluation. Evidently, one would assume that the need for re-stunning proves that the first attempt was unsuccessful and that re-stunning therefore is a welfare concern. Nevertheless, the training, experience and attitude of the operator may affect the occurrence of re-stunning. A well educated operator will perform re-stunning only after evaluation of its effectiveness by certain established criteria and/or through working experience. In other cases, re-stunning may be performed based on inexperience and/or a lack of knowledge. For example, employee training has been shown to significantly increase the efficiency of captive bolt stunning in cattle (70). The presence of an inspector may also affect the operator, often causing a higher incidence of re-stunning, regardless if it is necessary or not from a welfare point of view. It would hence not be suitable to use re-stunning as welfare criteria in comparison between slaughter plants, without taking into consideration the reasons behind re-stunning and the training and experience of stunning operators.

Other indicators

In the EFSA report on welfare aspects at stunning and killing (17) and also in the FAWC report (35) there are extended discussions on the symptoms indicative of poor stunning and other welfare issues relevant to the stunning of cattle.

Bruise scoring

Scoring of carcass bruising is often recognised as an indirect measure of welfare (38, 51) and the possibility to use bruise scoring in the assessment at slaughter was evaluated by Algers (27). The Australian Carcass Bruise Scoring System (ACBSS) was found to be reliable and promising in this context. It may however be difficult and time consuming to determine the precise age of carcass bruise damages and it is important to keep in mind that bruising may arise from incidents occurring before animals reach the abattoir, for instance during transport. Such matters have been studied in great detail (see for instance reference 52), but will not be further elaborated in this report.

3. Method and material

The study involved two test runs during which monitoring was performed, based on the proposed protocols. In table 1 below a schedule for the project procedure is shown. The final report (see appendix A) was delivered to the Welfare Quality cattle work group in December 2008. Materials used during the practical tests are presented in table 2 (p. 17).

Table 1. Schedule showing the project procedure

	Slaughter plants visited	**Slaughter line speed (heads/h)**	**Duration**	**Objective**
First test run (July 2008) Performed by me alone	2	Medium (11-100)	Three days at each plant	• Monitoring by the use of original protocols. • Outline recommendations for observer positioning
Continued work (during Sept 2009)				• Revision in collaboration with an expert working group, with members from Bristol University and SLU • Changes and additions were made to the original protocols and to the system as a whole
Second test run (Oct 2008) Performed by me alone	3	Medium (11-100)	Two days at each plant	• Monitoring by the use of refined and added protocols • Possibility to include bruise scoring was evaluated • Recommendations for time and labour requirements based on timekeeping of different monitoring sections were outlined
Continued work (during Nov-Dec 2009) Performed by me alone				• Measures were gathered into a system of monitoring • Final report delivered to the Welfare Quality cattle work group in December 2008

Table 2. Material used during practical tests

	Material
First test run	Monitoring protocol for unloading and driving into stun box Monitoring protocol for stunning Timer Torch
Second test run	Revised Monitoring protocol for unloading, driving into lairage and into stun box Monitoring protocol for behaviour in box Revised Monitoring protocol for stun quality Plant description sheet General comments sheet Timer Torch Footstool (height 55 cm)

4. Results

Results from the test runs and subsequent discussions are summarised below, showing tables of key points and new proposals of monitoring protocols. A detailed discussion on the basis for all changes and additions presented can be found in the report that was delivered to the Welfare Quality group (see appendix A). In that same report there is a more detailed presentation of labour and time requirements for performing inspection.

Plant description

In order to gather key information, enabling to put the monitoring results in perspective and in relation to the interior facility design and activities of the abattoir, a record sheet was developed. In this plant description sheet (shown in appendix A) general information about the abattoir, working routines, lairage conditions and stunning procedures, directly or indirectly related to animal welfare, should be registered. This information was concluded to be very relevant to the continuous work of improving cattle welfare at the plant, since obvious shortcomings or disadvantageous changes to working procedures and facility design can be detected. The plant description sheet still needs some refinements in terms of lay-out and standardization of questions, but in principle it worked well during practical tests. It is however important to consider who would be best suited to answer questions since reliability is affected by this choice. Some information on, for example, pen measurements and stunning maintenance, may require some time to compile and therefore it would possibly be most efficient to ask the plant to answer some relevant questions before the visit. These questions are marked with *(asterisk) in the record sheet in appendix A.

Monitoring of unloading and driving into lairage and into stun box

In table 3 (page 20) changes and additions to the original proposal developed by Algers (24) are presented. The modified protocol is shown in figure 3 (page 21). Monitoring of unloading and driving into lairage is performed at the same animal groups arriving at the plant. Practical tests showed that it is crucial that these areas are prioritised during inspection, since the number of vehicles arriving each day often is very limited. Labour requirements are highest in these areas, since monitoring often demands a number of different Observation Points (OPs) where inspectors are situated in order to observe the animals. Moreover, two inspectors will often need to cooperate with respect to record keeping. Test runs also showed that there are often visibility problems in these areas, mainly due to high solid walls and the characteristic design of long driving races. It is therefore crucial that OPs are selected to facilitate the best possible visibility, taking into account the risk of disturbance to animals that observers may pose. In order to have good visibility, a raised position is often necessary. If such optimal OPs cannot be found, monitoring by the use of video surveillance should be considered.

Stun quality

In the original proposal, stun quality monitoring was brought up in the context of mechanical stunning with captive bolt weapons. Discussions following practical tests lead to the conclusion that monitoring of electrical stunning should also be covered in the Welfare Quality system. Different stunning methods have some quality indicators in common, but there are also those symptoms that are interpreted very differently depending on the method used. A specific protocol for monitoring of electrical stunning was roughly outlined during this project, but will need further refinement. In the discussions, the issue of slaughter without prior stunning (religious slaughter) was also brought up and it was concluded that it would be possible to develop monitoring points for this type of procedure; a subject that needs to be

further addressed. In table 4 (page 22) changes and additions to the original protocol developed by Algers (26) are presented. Modified protocols relevant to mechanical and electrical stunning are shown in figure 4 and 5, respectively (page 23).

Behaviour in the stun box

Animal behaviour in the stun box is highly relevant to welfare, especially considering boxes that involve restraining devices. After the first test run a monitoring protocol for animal behaviour in the stun box was developed (shown in figure 6, page 23) and later tested during the second test run, where it showed great potential. However, in some plants, there may be difficulties due to problems with visibility in this area and risks of disturbing animals and staff. The suggested protocol is a rough outline and needs further refinement.

Bruise scoring

Determining the feasibility of bruise scoring with the ABCSS was proven difficult due to the test person's lack of experience in this area. It could, however, be concluded that bruise scoring would be very difficult to perform in plants where a suitable position from which examination of carcasses could take place was unavailable. Also in plants where examination was made possible, there may be a conflict of interests affecting the ability to perform scoring, since such positions are commonly used by official veterinary assistants performing meat hygiene controls. Moreover, the area in which bruise scoring can be performed is located between the point where the hide is removed from the carcass and where possible damages are trimmed. The duration of carcasses in this area was short in all plants and therefore the available time for bruise scoring is very limited. A detailed discussion of the inclusion of bruise scoring and a monitoring sheet is found in appendix A. The outlined record sheet will need further refinement before it can be taken into use.

General comments

A record sheet for general comments has been developed (shown in appendix A) with questions related to facility design and handling of animals at the plant. These questions have been produced to enable the gathering of important information in areas were it is hard to overlook the subjective opinion of the assessor. Instead, these opinions are highlighted as they can be very useful in order to get an overview of the situation in the plant.

Table 3. Changes and additions to the original protocol and also recommendations for the monitoring procedure

	Original protocol	**Modified protocol**
Changes	Same protocol for unloading and driving into stun box	Three separate monitoring areas have been recognized; unloading, driving into lairage and driving into the stun box. In the same monitoring protocol it is noted which of there three areas is being monitored. Move backwards/Turn around are separated and Turning is divided into Turning around and Trying to turn around Slip/Fall are separated and Slip is divided into General slipping and Heavy slipping The definition of Vocalization is adjusted so that it only includes vocalization occurring as a result of obvious and serious pain- or stress related events
Additions	*Parameters included:* Run Move backwards/Turn around Freeze No locomotion behaviour occurring Slip/Fall Vocalize	*Additional parameters:* Jump Mount Try to turn around Hit by gate; type of gate also recorded Coercion; type of item used also recorded
Recommendations for the monitoring procedure	A set of observation points (OPs) should be determined before the start of monitoring. From these points monitoring of the different sections is conducted between two imaginary lines, illustrating starting and stopping point. Animals are monitored while in this area. Total number of animals coming off a vehicle is recorded in monitoring of unloading and driving into lairage. In these areas, monitoring is performed at group level, although some behaviours/events are recorded with frequency. In monitoring of driving into stun box, information on vehicle number should not be given, but the size of *each individual group* studied is recorded. Monitoring is performed at group level, although some behaviours/events are recorded by frequency. The animal first in line, entering the box, should at the same time be monitored at the individual level. Video surveillance is recommended when direct monitoring is difficult due to safety reasons or because of visibility or disturbance factors. The use of a dictaphone is recommended to facilitate monitoring in these areas. Alternatively, two inspectors should cooperate during record writing. During monitoring, a raised position is recommended, for example by the use of a 55-70 cm footstool	

Monitoring of Unloading ___ or driving into Lairage ___ or driving into Stun box ___

Abbreviations: TTr-try to turn around, Tr-turn around, Mount- mounting, Voc- vocalizing, Gate- the animal is hit by a gate, Coersion- the animal is coerced with an item in order to move

Truck no. & total no. of animals	Group no.	Anim. categ.	Monitoring										
			1 Rn Yes / No	*2* Jump Yes / No	*3* Mb Yes / No	*4* General slipping Yes / No	*5* TTr Yes/no	*6* Tr	*7* Fr	*8* Slips	*9* Fall	*10* Mount	*11* Voc
			12 Gate	Front	Middle	Rear	*13* Coersion	Front	Middle	Rear		Comment	
			GG				Electric						
			PG					< 3	> 3	Used on head/face			
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						
			1 Rn Yes / No	*2* Jump Yes / No	*3* Mb Yes / No	*4* General slipping Yes / No	*5* TTr Yes/no	*6* Tr	*7* Fr	*8* Slips	*9* Fall	*10* Mount	*11* Voc
			12 Gate	Front	Middle	Rear	*13* Coersion	Front	Middle	Rear		Comment	
			GG				Electric						
			PG					< 3	> 3	Used on head/face			
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						

Figure 3. Modified monitoring protocol for both unloading, driving into lairage and driving into the stun box

Table 4. Changes and additions to the original protocol and also recommendations for the monitoring procedure

	Original protocol	**Modified protocol**
Changes	One protocol for monitoring of mechanical stunning	Monitoring of mechanical and electrical stunning should be recorded in separate protocols. The number of times re-stunning occurs should be recorded Excessive kicking was determined difficult to record and was therefore adjusted in its definition, to facilitate a more objective recording.
Exclusions	*Parameters included:* Dilated pupil Corneal reflex Spontaneous blinking Eye rotation Nystagmus Respiration Righting reflex Excessive kicking	*Parameters excluded:* Dilated pupil Nystagmus
Additions		*Parameters added:* Response to painful stimuli Stun-stick interval was added to monitoring of electrical stunning
Other recommendations	Safety precautions is most important in this monitoring area and such factors will affect monitoring ability Line speed will influence the ability to monitor all animal stunned. Higher line speed will often result in monitoring of every second or third animal. Monitoring parameters and a protocol needs to be developed for slaughter without prior stunning	

Abbreviations: CorRef- corneal reflex, SpBli- spontaneous blinking, EyeRot- eye rotation, Resp- respiration, RightRef- righting reflex, ExKick delay- delay in line due to excessive kicking

Sample No.	Animal category & size	Monitoring	Comment
		1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 8 Reshot ___ times	
		1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 8 Reshot ___ times	
		1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 8 Reshot ___ times	
		1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 8 Reshot ___ times	
		1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 8 Reshot ___ times	

Figure 4. Monitoring protocol for mechanical stunning

Abbreviations: CorRef- corneal reflex, SpBli- spontaneous blinking, EyeRot- eye rotation, Resp- respiration, RightRef- righting reflex, ExKick delay- delay in line due to excessive kicking

No.	Animal category & size	Stun time	Monitoring	Stick time	Comment
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		

Figure 5. Monitoring protocol for electrical stunning

Abbreviations: TTr- try to turn, Tr- turn around, Voc- vocalize

			Rx pre-restraint												Rx to restraint												
Sample no.	Animal category (& size)	Time at entering box	General slipping	Heavy slip	Fall	Climb	Jump	Kicking	TTr	Tr	Struggling	Heavy struggling	Lowering head	Voc	Head retraction	General slipping	Heavy slip	Fall	Climb	Jump	Kicking	Struggling	Heavy struggling	Lifting/turing head	Voc	Time at first shot	Comment

Figure 6. Monitoring protocol for behaviour in the stun box

The proposed monitoring system in summary

The proposed monitoring system includes:

- **Initial visit** (including setting up OPs and deciding if camera surveillance is necessary)
- **Plant description sheet** (some questions may be presented to the plant in advance)
- **Monitoring of unloading**
- **Monitoring of driving into lairage**
- **Monitoring of driving into stun box**
- **Monitoring of behaviour in stun box**
- **Monitoring of stun quality**
- **Bruise scoring sheet**
- **General comments sheet**

Time and labour requirements

In table 5 (page 25) an example is presented showing a time schedule for one day inspection at a medium throughput plant. All figures are estimated based on practical experience. If inspection is to be prolonged, the time schedule should be adapted to fit the needs for further monitoring of certain sections.

Labour requirements are discussed in detail in appendix 1. Practical tests showed that those requirements depend very much on the interior design of the plant and thereby the ability to monitor animals in a reliable and efficient way. Such factors influence the number of observation points needed and the record keeping strategy (for example the use of dictaphones and video recording and monitoring in teams of two inspectors), which in turn determines the labour needed for inspection.

Table 5. Example of time schedule for medium-high throughput plants

Time requirements		Monitoring area
Prior to inspection		
2 hours		Preparatory work at the plant (choosing OPs and informing staff)
The day of inspection		
2-3 hours	Approx. 4-8 trucks, each taking 5-25 minutes to monitor	Unloading and driving into lairage
45 min-1 hour	No. of animals monitored following line speed (approx. 25-50 slaughtered/hour With app 6 minutes/group, 7-8 groups are studied during 45 minutes	Driving into stun box
45 min-1 hour	No. of animals monitored are according to line speed	Behaviour in stun box
1-2 hours	No. of animals monitored are according to line speed or, if every second animal is monitored, half of line speed (12-25 animals/hour)	Stun quality
45 min-1 hour	No. of animals monitored are according to line speed	Bruise scoring
30 min-1 hour		Plant description + general comments
Following inspection		
0-8 hours		Possibly additional work (going through dictaphone recordings and filmed material)

5. Additional background material relevant to the method modifications

In the section below some key issues are presented to give background information relevant to protocol changes and other developments that were presented in the "Result" section.

Behaviours and events added to protocols for unloading and driving

Jumping and mounting behaviour

In 2004 a Spanish research group developed a scoring method for assessment of welfare at loading and unloading of cattle (33). In this study, assessment of unloadings involved recordings of slips, falls, jumps, turns, bulks (animals stopping for more than 10 sec, sometimes also called "freezing"), mounting behaviour and the use of an electric prod. These behaviours or events was shown to describe over 95 per cent of events observed during the study (33) which gives/provides important proof that these specific behaviours/events are important welfare indicators at unloading. Results showed that over half of all 40 unloadings monitored involved slips and turns. It also showed that jumps and falls were common and that mounting behaviour and freezing occurred during unloading. Vocalisations were not recorded during unloadings in this study; although it has been established as an important indicator of stress, injury and rough handling (37, 53). The main reason for not recording vocalisations was the general level of noise in the unloading area that made it difficult to hear and evaluate the source of vocalisations.

Mounting behaviour is a greater problem in male than female cattle (54) and its incidence in holding pens is largely affected by stocking density (SD), with medium SD (0.19-0.35 animal per m^2) having higher incidents than both low ($\leq$0.19 animal per m^2) and high ($\geq$0.27animals per m^2) SD. Mounting is a sexually related behaviour, but it is often also used as a way of establishing hierarchy within cattle groups. It is generally believed that mounting is stressful and it can cause injury to the back and legs of animals involved.

Coercion

The use of an electric prod in order to move animals is generally considered to be highly aversive and it is common for animals to vocalize when an electric prod is applied on their body (31). There is also a wide variety of other devices used in the same context; for instance flappers, rattles and sticks. The latter tools, however, are regarded as less aversive and stressful to the animals than electric prods. There is a risk that such items are being used excessively and carelessly, for example when applied at improper places on the animal's body (35).

Hit by gate

In slaughter plants, different types of gates are often manually handled by the staff and they can be heavy and inflexible to manoeuvre. This often results in animals getting hit in the head or back or that the gate is pushed down over the rear of the animal, sometimes also hitting the tarsal region. This can also be the case with pneumatically manoeuvred gates. Gates are either operated manually or with the help of air pressure and consequently the impact pressure on the animal differs very much depending on gate control and design.

Animal category

There are strong reasons to believe that animal category is an important factor affecting animal behaviour. It is generally accepted that for instance cows, bulls, heifers and steers tend to behave differently in situations that involves handling. These differences may be due to factors such as breed (55, Minka & Ayo 2007, cited in 34), gender, age and hormonal status. Factors related to the rearing system and the animals previous experiences can also have large impact on how animals cope and behave in the novel environment presented at the abattoir.

Behaviours and events added to protocols for stun monitoring

Animal category

As described in previous sections the category of an animal may have high influence on stunning effectiveness, especially considering large sized bulls. Hence, it is important to also record animal category at stun monitoring, according to the proposed definitions in appendix A.

Response to painful stimulus

Response to pain stimulus in the form of a nose prick with a hypodermic needle or an ear pinch is indicative of inadequate stunning effect and it has been suggested to include such a measure in stun quality evaluation (17). At a nose prick, the pain-sensitive animal will show withdrawal or shaking of the head, sometimes followed by the righting reflex, while ear pinching will induce an ear movement (17). In plants were it is possible from a safety point of view to approach stunned animals to check for corneal reflex, it would also be possible to perform a nose prick at the same time.

Stun-to-stick interval

It has been found that induction of head-only electrical stunning results in an average interval of 50 seconds before the return of intrinsic signs of recovery (Wotton & Gregory, 2000). It lies therefore in the interest of animal welfare to include stun-to-stick interval in monitoring of head-only stunning. Penetrative captive bolt stunning has been shown to last up to 10 minutes and stun-stick interval is not such an important risk factor when using that method, provided the equipment used is designed for the type of animal in question, well maintained and the positioning of the gun is correct. In electrical stunning that causes cardiac arrest, stun-to-stick interval is not either relevant to animal welfare, provided that the stunning is effective.

Key factors in the development of a plant description record sheet

Stocking rate

The stocking rate in it self is thought to have large influence on cattle welfare in lairage but this is also related to other factors such as the gender of the animals in the group, pen design, climatic conditions and group constitution (56). High density can for example lead to reduced access to water and resting opportunity (56). In a review on the subject of animal welfare in lairage, it is emphasized that space requirements also are dependent on lairage time (56) and in the same review space allowances for adult cattle (700 kg) is suggested at a minimum of 1.7 m^2 per head (short time lairage, less than 3h) or 3.6 m^2 per head (long time lairage, more than 3h).

Noise

In abattoirs, the level of noise can be high, mainly due to operations such as unloadings, vocalisations, animal movement, gate manoeuvring, stunning and shackling procedures. Moreover, the design of wall surfaces and other interior details often have the effect of amplifying rather than absorbing sound (56). Cattle have an auditory range between 25 Hz and 35 kHz and are able to detect lower pitched sounds than other farm species (Heffner & Heffner 1992, cited in 56) and also humans, who hear within the range of 20 Hz to 20 kHz (56). Many studies have shown the possible negative impact on cattle welfare due to noise (see for instance reference 57).

Factors that may affect stun quality

For the most common types of captive bolt guns, the different calibre cartridges are indicated by a colour code, ranging from green (lowest cartridge) to red and then black. In the early 80ies Lambooy concluded that black, but not red cartridge for guns of the Cash-manufacturer was sufficient for stunning of bulls (58). It was also reported that there is an optimal point on the animal's forehead were the weapon should be placed and that good stunning effect is possible to achieve within 2 cm area from this optimal point. According to Gregory and Lee (unpublished, cited in 34), cartridge-fired bolt guns do not cope with high line speeds, due to the temperature rise in the gun. Two main problems follow on this; firstly, at high shooting rates the weapon gets to hot to hold, if not wearing a protective glove and there has to be two weapons in order to rest the first one and allow it to cool (Gregory and Lee, unpublished, cited in 34). Secondly, some of the energy that should be transferred to the animal as a concussive blow is instead retained in the gun in the form of heat (Gregory and Lee, unpublished, cited in 34). Consequently, the effectiveness of stunning depends on matching the right equipment (gun type and cartridge strength) for a given animal, the accuracy of shooting position and gun maintenance (39). Poor storage conditions for cartridges may also influence the effect of the shot.

The plant description gives opportunity to record key information involving lairage conditions, with special attention to pen/stall measures and design, stocking rate and noise level at specific sites. Information on the stunning method is also recorded, especially regarding suitability and maintenance of the equipment used.

Key factors in the development of a record sheet for general comments

Handling of nonambulatory (downer) cattle

The care, handling and transport of nonambulatory, or so called "downer" cattle has been described as a major welfare issue facing the livestock industry (59) and it is, as expressed by Gregory in 2008 (34), "one of the ugliest aspects of pre-slaughter handling at abattoirs". A downer is most often defined as an animal that is unable to stand and hence also to walk (34). The cause of such a state could be, for example, fractures or other major injuries, metabolic derangements, general illness or exhaustion. In some incidents animals are unable to use their hind legs, but can propel themselves short distances by using their forelimbs (59) and in this text the term "downer" also applies to those animals.

In a review by Stull et al (59) it was reported that almost all downer cases seen at arrival to abattoirs originated on farm. Transport regulations of the EU states that severely sick or injured animals should not be transported (7) and therefore, downers should consequently be

treated or euthanized on farm. The problem of downers seen at abattoirs within the Union should therefore be assumed to originate from transport conditions or accidental incidents on the slaughter plant. The greatest danger to welfare with regards to downers is, except for the condition in itself possibly being extremely stress- and painful, would be the moving of downers out of vehicles and through the abattoir facilities in order to slaughter or kill them. In the US several states have adopted specific law regulations on the issue of downer cattle (59) and there is much concern with the different ways of moving such animals. Often, it is stated as prohibited to drag or push downers by the limbs or extremities and that only sled-like equipment should be used to move them (59). In some countries, like Sweden, the legislation requires downers to be killed on the spot (in this case for example on the vehicle or in the lairage pen), i.e. not moved at all. It becomes obvious that the means of handling downers is crucial for their welfare. In the Welfare Quality monitoring system it is therefore included to comment on incidents involving downers, by describing the event and the perception of handling care.

The use of excessive violence

According to Grandin, rough handling is the most important welfare problem of farmed animals during handling, transport and slaughter (60), causing stress, fear and injuries. In case incidents involving non-ambulatory cattle or physical abuse are witnessed during inspection, the General comments sheet provides the observer with an opportunity to describe the event in an objective manner and, thereby, such greatly important welfare problems are reported and taken into account in plant assessment.

Discussion

The Welfare Quality Project aims to develop international animal welfare standards and audit programmes, which should be used to assess welfare of livestock on farms and at slaughter plants in Member states of the EU. The aim is also develop a system for translation of assessment data on animal welfare into product information, most likely in the form of a labelling scheme. The definitive outline of the implementation of welfare auditing has not yet been established by the Welfare Quality group, but the information presented so far indicates that a non-mandatory labelling scheme will be adopted and offered to those that wish to take part in the Welfare Quality programme (50). Developing a mandatory welfare labelling system across Europe has also been mentioned as a possible alternative (50).

As described earlier in this report, welfare assurance programmes based on inter-governmental agreements may not receive high support from industry players but it is very important to bring comprehensiveness to the application of the programme all across, and possibly beyond, Europe. Inter-governmental involvement will most certainly have positive impact on public confidence in the programme, at least in countries where government reliability is great. Support within the industry will presumably rely on the mandatory nature of the programme, but inter-governmental involvement means that all players will abide by the same standards, which is positive in the perspective of competition in the free market. The mandatory approach is not easily enforceable, but this is counterbalanced by the product differentiation idea of introducing a labelling scheme, hopefully resulting in motivating industry players to strive for a profitable labelling.

The measures involved in monitoring at slaughter plants are basically type 1 and 2 requirements, as described in the introduction of this report. Type 1 and 2 requirements have

the advantage of being strongly supported as relevant measures by industry players (28) but they are less reliable in generating public confidence. The public often wishes for aspects of animals natural lives to be taken into account and requirements that protects them from obvious pain and that fulfils basic needs are not enough to secure welfare. However, at slaughter, the public will certainly put less emphasis on such aspects of natural life, baring in mind the short time that animals spend at abattoirs. It is reasonable to believe that a majority of the public consider that the main goal at slaughter must be to eliminate obvious pain and stress related events, before and during the killing procedure.

Over and all the inter-governmental, non-mandatory labelling approach and the candidate measures chosen to develop an assessment system for welfare at slaughter seem very reasonable and there is high probability that it will facilitate the public to make deliberate purchasing choices, where animal welfare can be taken into consideration. Naturally, the welfare assurance programmes are of little use unless the implementation of standards and the monitoring and assessment procedures are reliable and efficient. To facilitate such procedures, the importance of adequate training of auditing inspectors, to achieve a high level of agreement between auditors and audits, must be emphasised. A framework for the assessment of auditing results and a labelling scheme needs to be developed, however those objectives lie beyond the scope of this report (for an extended discussion on this issue, see for example 71, 72). The aims of the Welfare Quality project, as expressed by project coordinator Harry Blockhuis in 2008 (61), are not only to develop protocols for welfare assessment on farm and at slaughter and integrate specialist expertise in the large field of animal welfare in Europe but also to develop protocols by which assessment data can be translated into product information and to develop practical strategies to improve animal welfare. In the Community Action Plan for 2006-2010 (22) it is suggested to establish a European Centre for the protection and welfare of animals and national Centres of Reference in each Member State has also been proposed by the Commission (23). The idea of a European Quality Standard for products emanating from high animal welfare production systems has been presented (22). Hopefully, reliable slaughter plant assessment, a labelling scheme and a constructive feed-back improvement mechanism to the abattoirs will be the future developments within Welfare Quality, strongly connected to the new authority establishments.

Attention should nevertheless be paid to some important disadvantages when considering the type of monitoring system proposed and the problems that were noticed during practical tests.

The Welfare Quality project deals with animal welfare on farm and at slaughter; however welfare during transport is not covered directly within the framework of the project. This would seem as the most serious discrepancy of the project as a whole, since transports are an often inevitable component in the animal production industry, highly relevant to animal welfare and the “farm-to-fork” concept described by the European Commission. Understandably, monitoring of animal welfare in moving vehicles is practically a very difficult task. However, it would be possible to monitor the loading of animals into trucks on farm. Loading have been shown to be even more stressful than unloading (33). It would however be practically difficult to include loading, since it occurs sporadically on the farms. As animals arrive at abattoirs, it would be possible to also look at more direct factors relevant to transport conditions, vehicle design and handling by drivers. Hopefully, such possibilities will be further addressed in the continuous work of Welfare Quality and elsewhere in the European Union. In today’s proposal, animals are monitored as they come off the vehicle and obvious problems with severe injuries or deaths will be noted. Also, the general health status of animals will be noted during unloading and serious problems will be detected. If bruise

scoring is to be included in the system, this will further enable detection of problems that arise during transport.

The outline of one day inspections may be inadequate in order to place judgement on the welfare status of slaughter plants. Such relatively short inspections will provide the observer with an on-the-spot impression of the situation at the plant. Inevitably in such a system, the perception of the situation is influenced by chance to a high degree and a serious consequence would be that scarcities are overlooked and the assessment results in an overestimation of animal welfare. Naturally, with longer duration of inspections, covering larger sample sizes, results would be less influenced by chance and thus give a better possibility to detect welfare problems, including those occurring less frequently. This issue becomes even more obvious when considering small plants, where long-term planning might be needed in order to monitor representative samples and acceptable numbers of animals. For practical reasons, there may be a risk that small plants are set aside in the further development of an assessment system. Even though a smaller number of animals are affected, it would be detrimental to exclude small or low throughput plants from the system, since animal welfare is equally important in such establishments.

The monitoring system proposal involves a minimum of one day inspections with at least two inspectors working together. This time and labour requirement is likely to be an underestimation of the actual needs in order to perform reliable and efficient inspection. There are concerns that the labour recourses and the duration of inspections will be limiting factors in the proposed system and a more thorough discussion is needed to set up reliable guidelines covering these issues. It is also highly important to acknowledge the need for proper training of Welfare Quality inspectors. Without rigorous training and continuous education the monitoring system in itself is of little value and it will not be perceived as trustworthy within the industry or by consumers. The key components of inspector training should be sound knowledge of animal physiology and behaviour, adequate practical experience, knowledge about human and animal safety aspects and, last but not least, conformity between inspectors. Behaviour/event definitions are the basis for achieving high inter-inspector agreement and therefore further refinements to the definitions presented in appendix A are needed.

In producing a reliable and feasible monitoring system, there is a tendency for measures to become too simplified. Measures must also be minimized in number, to avoid ending up with a monitoring system that is too extensive, complicated and difficult to implement. Measures should furthermore be standardized and objective. Based on experience from the practical tests runs the system was perceived as being a somewhat blunt tool, leaving little room for events occurring outside the frame of the monitoring protocols, and the interpretations of such events. The inclusion of a record sheet for making general comments and expressing the overall impression of a plant attempts at counterbalancing such disadvantages.

There is a risk that the level of tolerance has been set too high when the monitoring protocols were elaborated. For example, at the test plants, the use of rattles to physically move animals was so high that it was often impossible to register the number of times they where used while moving a group or even an individual animal. For this reason it was decided for rattle use to be registered by options ≤ 3 or >3. By this choice of options one will certainly get the impression that the use of a rattle is more common and more accepted that if it would have been recorded by frequency. Dividing slipping behaviour into “general slipping” and “heavy slips” was also an attempt to make registration easier, since general light slipping was very common and occurred to such extent that it was impossible to record it by frequency. There

would have been no point in demanding that inspectors should try to register all slips under such circumstances, but on the other hand, some "general slipping" might not be regarded as a serious animal welfare risk. Consequently, the efforts to make registrations feasible and also practical with regards to labour requirements may have large influence on the perception of the different measures. It is important consider such possible consequences in the further development of this monitoring system and to make sure that the definitions of behaviours/events leave little room for interpretation.

There are great differences when considering the seriousness of the measures included in monitoring. Some measures, such as vocalization resulting from restraining or electric prodding and animals falling, affect welfare negatively in a direct way, while others, such as animals jumping, are more of indirect measures, indicating risks of compromised animal welfare. Consequently, it is very important that the measures are weighted carefully with regards to their relevance to animal welfare in the development of overall assessment.

As described earlier, tests indicated that bruise scoring would be difficult to include in monitoring system, for practical reasons. Checking for carcass bruising was intended to be used chiefly as an indirect way of assessing the lairage conditions, but also to verify other possible injury risks in the plant. Major injury risks in the unloading area, driving races, and stun box area should be detected in the monitoring of these areas. Lairage conditions, on the other hand, are not covered in the proposed system as a specific area of monitoring, although some relevant information is received through the plant description. Exclusion of bruise scoring will therefore have most serious consequences for the ability to evaluate lairage conditions. Further discussion is needed to evaluate if bruise scoring should be performed or if direct monitoring of animals in lairage could be a suitable alternative approach.

It was not an easy task to outline monitoring protocols for electrical stunning and these must be further developed before taken into use. Symptoms of ineffective stunning differ not only between mechanical and electrical stunning but also between different methods of electrical stunning, and hence separate monitoring protocols may be needed for head-only and cardiac arrest stunning. In all stunning, the suitability and maintenance of stunning equipment is of utmost importance. Also, operator skill and a correct application are equally important factors. In electrical stunning, it can be said that equipment characteristics are especially important in order to assess stun quality, since incorrect use of the electrical current may conceal the symptoms of ineffective stunning. Therefore, plants practicing electrical stunning, the rather complex equipment information needs to be registered with extra care. In the plant description (see appendix 1) there is a record sheet where information on electrical stunning equipment should be noted. The record sheet will need further revision to ensure that all relevant information needed to facilitate stun quality assessment is included; for instance, information on the application of electrical stunning needs to be added.

It is a very important future task to deal with the issue of slaughter without pre-stunning and incorporate this type of slaughter into the system of monitoring. Since slaughter without stunning is practiced in several European countries (66) and large quantities of animals may be subjected to this procedure, Welfare Quality needs to offer information to consumers that such a slaughter method has been used but also, the quality of such a procedure should likewise be judged and labelled. Understandably, one could argue that slaughter without stunning stands in conflict with animal welfare to such an extent that it cannot be seen as anything other than unacceptable. On the other hand, the European Union has taken no standpoint regarding the religious and cultural basis for practicing slaughter without stunning

and as a tool for providing consumers with information on the welfare of animals, Welfare Quality should provide information relevant to *all* commercial methods of slaughter. The scientific basis for the development of monitoring points is readily available today (see for example 17, 36, 62) and should be used and incorporated promptly. This would possibly lead to a specific labelling for slaughter without stunning, but a more detailed classification should also be offered through Welfare Quality. It can be argued that up until the point of stunning (or not), the animal welfare requirement regarding lairaging and handling of animals at the abattoir should be similar and thus audited in a similar way, irrespectively of the procedures later applied to the animals during the actual slaughter (67). Such an approach would probably raise a lot of future debate and perhaps there will be resistance within Welfare Quality to perform inspection on plants practising the method. However, such discussions are likely to have positive influence on the scientific developments in the area and may contribute to animal welfare improvements.

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Appendix A

Proposal of monitoring system for the assessment of cattle welfare in abattoirs

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5. Monitoring protocol for mechanical stunning
6. Monitoring protocol electrical stunning
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8. General comments record sheet

Executive summary

Within the Welfare Quality subtask 2.2.2, a number of protocols for monitoring of fear and injurious behaviours and of stun quality indicators have been produced by Algers (2006*a*-*d*). The protocols are intended to be used as tools in the assessment of overall cattle welfare in the slaughter house environment. Carcass bruise scoring and cleanliness evaluation was also reported as possible to include in the assessment.

The aim of this study was to investigate the potential for using the above mentioned protocols, bruise scoring and cleanliness in a monitoring system that enables overall welfare assessment of cattle at slaughter. A survey of the practicability of the measures and also time and labour requirements was made during test trials at five Swedish abattoirs. Changes and refinements are presented, resulting in a final monitoring system proposal.

Results from test trials showed great potential for using the refined protocols in a monitoring system, facilitating overall welfare assessment. However, to complete the system, inclusion of a protocol for monitoring of behaviour in the stun box, a general plant description, space for subjective comments and possibly also a bruise scoring sheet, are proposed.

The importance of adequate training of inspectors and a constructive feed back mechanism to abattoirs following inspection are brought up in short. A note on the issue of slaughter without pre-stunning underlines the importance of further discussion on how to monitor and assess welfare in such situations. Time and labour requirements for monitoring are roughly outlined, but will need further revision.

Background

Within the Welfare Quality subtask 2.2.2, a scoring protocol for monitoring of behaviours related to fear and injury has been developed and evaluated (Algers, 2006*a*). The protocol is meant to be used as a tool in the assessment of overall welfare of cattle in the slaughter house environment. The protocol was reported as promising in the monitoring of cattle during driving into the stun box. It also showed potential for monitoring during unloading. Scoring of carcass bruising is an indirect measure of welfare and the possibility to use bruise scoring in the assessment at slaughter has been evaluated (Algers, 2006*c*). The Australian Carcass Bruise Scoring System was found to be very reliable. Welfare at slaughter is also highly dependent on quality of the stun. Therefore, a protocol for monitoring of stun quality was developed (Algers, 2006*d*). Cleanliness scoring was evaluated and reported as possible to include in the monitoring system (Algers, 2006*b*). Also, the usefulness of considering the number of animals arriving dead to the abattoir was evaluated, though it was concluded that this parameter was not a good candidate to be included in monitoring due to difficulties in receiving reliable data on this from the abattoirs (Algers, 2006*b*).

The aim of this study was to investigate the potential for using the above mentioned protocols in a monitoring system that enables overall welfare assessment of cattle at slaughter, from unloading to stunning.

Project procedure

To be applicable, a relatively simple and effective system for welfare monitoring at slaughter needs to be established. Therefore, a survey of the practical procedure and time needed to use the described protocols was made. The original protocols were tested by an assistant at two Swedish slaughter plants in July 2008. Results from these tests were evaluated by looking at relevance of parameters, practicability of registrations and total time needed for monitoring. Refinements were made and an overall system for monitoring of cattle welfare at slaughter, including a general plant description and carcass bruise scoring, was outlined (all presented in section 1). This monitoring system was tested in a second test run at three Swedish plants in the autumn of 2008 and after extensive evaluation further changes and refinements (described in section 2) lead to a final method proposal (summarized in section 3). Finally, definitions of behaviours/events and explanations of abbreviations are listed.

1. Method developments

1.2 General issues

1.2.1 A note on the training of inspectors

The importance of developing an appropriate training regime for WQ-inspectors is noted, so that a consistent methodology can be applied between visits, between abattoirs and between EU countries, although the subject lies beyond the scope of this report and will not be elaborated closer. In this report it will therefore only be emphasised that, in order to facilitate a reliable and uniform assessment system across Europe, the training of inspectors needs to receive top priority. For example, the educational material must include examples of all behaviours/symptoms/events used in monitoring and there should be large focus on discussion of border line cases. Education should also involve information on how to behave, dress and communicate with staff in order to minimize safety risks and disturbances to animals and workers.

1.2.2 A note on observer positioning

In many situations the visibility aspect is an important limiting factor in the context of performing inspection in a satisfactory manner. Consequently, the positioning of inspectors is of greatest importance during monitoring, which should be emphasized during inspector training. Throughout Europe the interior design of abattoirs differ hugely and it is therefore important to stress that the optimal positioning for monitoring needs to be established taking into account the specific conditions of each individual plant. This involves taking into consideration aspects of animal behavioural and injury risks and also the opinions of working staff. However, to enable better visibility a collapsible stool should be brought to inspection. The stool should optimally have adjustable height, with a maximum of at least 70 cm.

1.2.3 A note on safety risk prevention

There are a number of specific risks related to the special environment of the abattoir that needs to be addressed in order to ensure the safety of inspectors, working staff and animals. For example, it is important for inspectors to:

- follow staff instructions in case of an emergency
- not open gates were animals are passing without consulting staff
- consider the specific risks in the stun-stick area, including responsible behaviour around weapons and evaluation of dangers involved in approaching stunned animals

1.2.4 A note on the presentation of results and feed back to the abattoir

It is of great importance that inspections are followed by a feed back mechanism, where the abattoir is informed of the findings during inspection and where results are presented in such a way as to facilitate improvements schemes. The principles of such follow-up procedures will not be further elaborated in this report.

1.2.5 A note on cleanliness scoring

Cleanliness scoring has been established as being a good indicator of welfare and there are reliable systems for scoring already in use within the industry (Algers, 2006*b*). In spite of this, it is proposed not to include cleanliness scoring in the monitoring system; the main reason for this being that cleanliness is not strongly related to the conditions of *the abattoir*. Problems with dirty animals often arise on farm or possibly during transport and therefore, cleanliness evaluation should be performed in the earlier stages of production rather than at slaughter. In abattoirs, cleanliness scoring is mainly performed for food safety reasons and the importance of this should not be ignored, but the suitability of indicating *welfare at slaughter* by this measure is low.

1.3 Labour and time requirements

The time needed to perform monitoring is estimated to a minimum of one working day. In the text below plants will be described as having “low”, “medium” or “high” throughput of animals. Low throughput is here defined as the slaughter of up to 10 cattle during a working day. The medium throughput is defined as slaughtering 11-100 cattle per day and high throughput as slaughtering more than 100 cattle per day.

In abattoirs across Europe there are large differences in working procedures and line speed. Therefore, it is hard to determine a certain number of animals to be monitored. Instead, a minimum of one-day visits are proposed. The time of visit should be chosen on a day when the abattoir is slaughtering at normal speed and volume, in order for the assessment to cover a representative sample, especially regarding the typical animal categories normally handled at the plant. Later in this report the outline of monitoring routines during the visit is described in more detail. If possible in low throughput plants, *all individual animals* slaughtered should be monitored during visits.

It is proposed to have a minimum of two inspectors working together during plant inspections. The main reason for this labour requirement is to better facilitate that monitoring and recording are performed in a reliable and efficient way, especially at unloading and driving of animals.

1.4 Plant description

General information about the abattoir, working routines, lairage conditions and stunning procedures, directly or indirectly related to animal welfare, should be filled out in a special document at each visit. The aim of the plant description is to sum up key information, enabling to put the monitoring results in perspective and in relation to the interior facility design and activities of the abattoir. Information from the plant description will also be valuable in the continuous work of improving cattle welfare at slaughter. At initial inspection the Plant Description should be filled out carefully and at following visits changes in equipment and working routines will be efficiently recorded. The plant description facilitates detection of important changes or obvious shortcomings related to animal welfare.

1.5 Record sheet for general comments

In the proposed monitoring system a record sheet for general comments has been included, with a number of questions related to facility design and handling of animals. These questions have been produced to enable the gathering of important information in areas were it is hard to overlook the subjective opinion of the inspector. Instead, these opinions are highlighted as they can be very useful in order to get an overview of the situation in the plant. Five issues are discussed below; these are all formulated into questions in the general comments sheet. The basis of the remaining questions in the sheet is discussed elsewhere in this report.

1.5.1 Noise level

Noise has a significant impact on animal welfare, especially transient noise, in abattoirs usually resulting from the closure of gates and fittings, shouts from staff etc. Such noise is likely to induce startle reactions which, in turn, may lead to injury. Also, continuous high noise levels such as those produced by ventilators or conveyor machinery may induce stress reactions. Noise level should therefore be measured, as the dB(A)Leq1min. in each position, at the entrance into the lairage area and at the entrance into the stun box.

1.5.2 Lighting

Lighting conditions can have a major impact on animal welfare, mainly by affecting animal movement due to differences in illumination or blinding. Measure and evaluation of lighting by means of a technical approach has been concluded inappropriate within the framework of Welfare Quality inspection. Therefore, some specific factors that are generally accepted as having negative influence on animal movement are included in the monitoring system by answering key question on the matter of lighting conditions under general comments.

1.5.3 Routines for casualties/downers

In case of incidents involving casualty animals or “downers” (animals too ill or injured to stand and walk) it should be noted under general comments how such situations are handled if seen during inspection.

1.5.4 Routines for unusual categories

In case of incidents involving unusual animals (such as extremely small or large or those that have very big horns) it should be noted under general comments how such situations are handled if seen during inspection.

1.5.5 Routines for animals "dead on arrival"

The number of animals "dead on arrival" was not considered a suitable candidate measure due to difficulties in receiving reliable data from the abattoirs (Algers, 2006*b*). Nevertheless, if "dead on arrivals" are seen during the inspection, the number of animals involved and the procedure of handling the situation should be described under general comments.

1.6 Unloading

1.6.1 Several animal groups in the vehicle

In the vehicle there are often several groups of animals divided into different compartments. These groups, in the same truck, should be monitored separately. It is important to note from which vehicle animal groups come off, to be able to relate possible problems to specific trucks or drivers.

In the protocol for unloading columns should be added for:

- Truck number (1-)
- Group no. (a-) and size
- Animal category

1.6.2 Adjustment to group monitoring

In groups with ≤10 animals, the group should be monitored as a whole, but the frequency of behaviours or events occurring in the group should also be recorded. In groups with ≥10 animals, ten animals in front in the group will be monitored at each instance and the frequencies of behaviours/events are recorded for these animals only.

1.6.3 Animal category and size

There is a need for some simple guidelines on how to describe a group of, or individual, animals. This can be valuable in order to relate problems and interpret results with regards to animal category. If groups are mixed, all categories included should be noted.

The categories should be:

- Bull- defined as intact male cattle older than 6 months. To the category of bulls it should also be noted if they are "large", defined as very heavy or high animals, with sturdy body physique.
- Steer- defined as castrated bulls older than 6 months
- Cow- defined as female cattle that have calved
- Heifer- defined as female cattle older than 6 months that have not yet calved
- Calf- defined as cattle younger than 6 months

1.6.4 Starting point of monitoring

Monitoring of animals inside vehicles does not fit into the limits of the abattoir inspection. Nevertheless, if inspectors notice obvious welfare related problems arising inside the truck, it should be recorded under general comments. Monitoring of unloading should begin when animals start moving down the ramp of the vehicle, that is to say, when they are leaving the interior of the truck. It is recommended that two observers monitor each section of unloading together, with one looking at the animals and the other making recordings. Alternatively, one observer could monitor unloading by using a dictaphone although this method will demand a greater share of supplementary work.

1.6.5 Stopping point of monitoring

The principle should be to monitor unloading until animals enter the abattoir building, most often through an opening from the gathering area/pen outside the vehicle. In situations were there is no clear spot of entrance into the abattoir, monitoring should stop as animals enter the system of driving races. Past this point there will most often be an overlapping area where a transition from monitoring of "unloading" to "driving into lairage" will occur.

1.6.6 Numbered parameters

When a comment is made in the protocol it should be possible to link this to a specific behaviour or event. Therefore, parameters in the protocols should be numbered.

1.6.7 Slipping and falling

Slipping is commonly seen in abattoirs and indicates poor flooring conditions. Falling is more serious and often results from high speed or stressful events (such as reaction to coercion or getting stuck). Therefore, "Slip/Fall" should be two separate columns.

1.6.8 Moving backwards (Mb) and turning around (Tr)

Although both Mb and Tr indicate a threat from in front of the animal, there are important differences in how to analyse the causative factors. Therefore, the two should be recorded in separate columns. Animals sometimes try to turn around unsuccessfully. This indicates the same probable cause as does turning around, but the measures of improvements differ between the two. Therefore, turning should be divided into turning around (Tr) and trying to turn around (TTr).

1.6.9 Jumping

There are great injury risks when animals jump as it is often followed by slips or falls. For example, jumping often occurs at the vehicle ramp, which indicates unwillingness to pass. "Jump" should consequently be included as a protocol parameter.

1.6.10 Mounting

There is a risk of injury when animals perform mounting behaviour; both leg injuries in general and injuries to the back of the animal being mounted. At unloading and in the driving races "mounting covers" are often absent and the behaviour can therefore be performed to a high extent. "Mounting" should be included as a protocol parameter.

1.6.11 Overcrowding/jamming

Jamming may occur as animals are trying to pass an entrance and the situation can be stressful and cause injuries. Jamming often occurs in doorways or other openings where a group of animals are coerced to enter. It indicates that the route is narrowed too fast so that animals cannot form a line and pass in a controlled manner and it may also indicate too much pressure from the driver. In the occurrence of jamming, this should be noted under general comments. The probable cause and specific spots or areas with high risk of overcrowding/jamming should also be described.

1.6.12 Hit by gate

Different types of gates are often manually handled by the staff and they can be heavy and inflexible to manoeuvre. This will often result in animals getting hit in the head or back or that the gate is pushed down over the rear of the animal, sometimes also hitting the tarsus region. The same problem may arise with pneumatically powered gates. Gate manoeuvring is sometimes used as a technique to separate animals moving in a line or to push them forward or backward, especially where there is trouble reaching into the driving route to touch the animals. Gates are either operated manually or with the help of air pressure and, consequently, the impact pressure of a gate on the animal differs very much depending on gate control and design.

A protocol parameter for animals being hit by a gate should be added, including frequency of hits and gate type. The gate types are:

- PG (pen gate)
- GG (guillotine gate)
- NRG (non return type gate, for example saloon doors)
- MG (mechanical push gate)

1.6.13 Coercion

The use of coercion tools that could cause strong aversion in the animal is an important indicator of poor driving technique and/or poor facility design. Coercion in this sense is defined as trying to drive the animal by physically touching it with an item other than the hand of the driver. Means of coercion often cause animals to kick, slip, fall, freeze or move backward and it can also lead to panic and attempts to escape. When coercion is used on an animal standing in line, there is a risk that the animal behind is severely kicked.

Protocol parameter for “coercion” should be added and the frequency of use should also be noted. The options for different types of coercion are:

- Electric goad
- Rattle
- Flapper
- Stick
- Other (with short description of the item used)

1.6.14 Driving technique

Incidents involving improper driving technique are sometimes seen in abattoirs. The use of coercion with the help of different items is discussed above, but improper technique can also involve operators moving in an unsuitable way in relation to the animal. If such incidents are noted by the inspector, they should be described under general comments in order to get an idea of operator knowledge in this area.

1.6.15 Excessive violence

If the use of excessive violence is seen (e.g. handlers kicking or hitting animals with great force or by other means handling animals in an unnecessarily rough manner), this should be described under general comments.

1.6.16 A note on the evaluation of results from monitoring of unloading

In the report "Assessment of fear and injurious behaviours in cattle" by Algers (Algers, 2006*a*) the following suggestion on how to evaluate results from monitoring of unloading was presented:

From the scoring results, "the percentage of unloadings where animals display behaviours related to fear or injury" and "the percentage of animals driven into stun box that display behaviours related to fear or injury" can be calculated.

This evaluation outline should be adapted to the fact that new proposed protocols involve not only behaviour but also "events" related to fear and injury. It should also take into account that the driving of animals is considered in two separate parts; one into *lairage* and the other into *stun box*. Moreover, protocol parameters have been both added, excluded and modified in their definitions, which must also be taken into account.

1.7 Driving into lairage

All adjustments proposed for the unloading protocol are also applied to the protocol for monitoring of "driving into lairage or into stun box". The two protocols differ only in the first three columns, which will be discussed in the text below.

1.7.1 Adjustment to group monitoring

As for the monitoring of unloading, if group size is ≥10 animals, only ten animals in front in the group should be monitored at each instant during driving into lairage.

1.7.2 Starting and stopping point of monitoring

As mentioned above, the starting point of monitoring of driving into lairage will be were monitoring of unloading ends. The principal should then be to monitor as much as possible of driving into lairage, permitted by the specific circumstances of the plant.

As for unloading, it is recommended that two observers monitor each section of driving into lairage or that individual observers monitor by using a dictaphone.

1.8 Driving into stun box

1.8.1 Adjustment to group monitoring

As for the monitoring of unloading and driving into lairage, if group size is ≥10 animals, the ten animals in front of the group should be monitored at each instant during driving into the stun box and the frequency of behaviours/events should be recorded. However, when animals are just about to enter the stun box they should be monitored individually. The driving protocol can be used for either group or individual monitoring.

1.8.2 Starting and stopping point of monitoring

Driving into stun box can be said to begin already at the place of lairage, continuing all the way into the box. The principal should be to monitor as much as possible of the driving into stun box, permitted by the specific circumstances of the plant. However, most often, problems arise when animals are about to enter the box and it is important to prioritize, under all circumstances, a position from where monitoring of the box entrance is made possible. Therefore, it is proposed to divide the area into different sections to facilitate group monitoring of animals moved from lairage and individual monitoring of animals entering the stun box.

As for unloading and driving into lairage, it is recommended that two observers monitor each section of driving into the stun box. Depending on facility design and the number of animals moved at the same time, monitoring could be managed by only one observer. Monitoring of a group of animals until they have all entered the stun box often takes a considerable amount of time, why it is less suitable to use a dictaphone.

1.9 Lairage

Cattle welfare at abattoirs is highly dependent on the conditions of the lairage system. However, the possibility to inspect lairage conditions by monitoring animal based parameters is considered to be limited within the framework of the Welfare Quality inspection, mainly due to time and labour constraints. As described later in this report, carcass bruising will be included in the monitoring system and the occurrence of Dark Cutting Beef (DCB) or Dark Firm Dry meat (DFD) should also be included by using slaughter plant data. Both bruise scoring and the occurrence of DCB/DFD will, in part, reflect lairage conditions. Therefore, data on occurrence of DCB/DFD should be recorded in the plant description (see app. 1). The inclusion of bruise scoring will be discussed later in this report. Moreover, in order to form an even more reliable picture of lairage conditions, a number of key parameters and measures related to welfare in lairage should be recorded in the plant description.

If data on the occurrence of DCB/DFD is not available at the plant, this would indicate that the issue of DCB/DFD evaluation and recording needs to be addressed further within the scientific community, to establish general standards in this area.

1.10 Behaviour in the stun box

It is proposed to include measures of animal behaviour in the stun box and a specific protocol for this has been outlined (see appendix 4) and it has also been suggested to measure the interval between entrance into stun box and the first shot. There is apprehension that such a measure would cause stress to the operator, resulting in a risk of influencing work-, and thereby also shooting performance, negatively. However, the welfare of animals in this situation can be highly dependent on time spent in the box, before stunning occurs. It is generally believed that it is absolutely crucial to minimize the time animals are held in any sort of close restraint. Even without restraining device, animals sometimes struggle hard to escape from the stressful situation inside the stun box. Prolonged time spent in such a situation can be assumed to lower animal welfare considerably. The issue of recording the time spent between box entrance and stunning (entry-stun interval) needs further evaluation to conclude if it should be monitored in WQ-inspection.

1.11 Stun quality

1.11.1 Short presentation of stunning methods for cattle

The evaluation of stunning and the symptoms used to indicate efficiency differ in some aspects, depending on the stunning method used. Cattle may be stunned by the use of mechanical or electrical methods. The mechanical method most often involves captive bolt weapons that are powered by either a blank cartridge or compressed air. The bolt in these weapons can be penetrative or non-penetrative. The electrical method involves application of electric current to the head of the animal or, alternatively, applied to both head and body to induce cardiac arrest. In the European Union the mechanical method is most commonly used, usually with a penetrative, cartridge fired weapon. The *general issues* of monitoring starting and stopping point and observer positioning discussed below are relevant to both mechanical and electrical stunning, although some of the *symptoms* brought up are discussed in relation to a specific method. It needs to be emphasised that inspectors must have proper training to enable evaluation of quality symptoms with regards to both mechanical and electrical stunning.

General information on stunning procedure, such as method used, equipment parameters and maintenance is recorded in the plant description.

1.11.2 A note on slaughter without pre-stunning

Slaughter without pre-stunning does occur in member states of the European Union, usually for religious and cultural reasons. The obvious welfare issues surrounding this practice has been much discussed and in the EFSA report (2004) much effort has been put into describing the physiological and neurological basis of throat cuts without prior stunning and the subsequent loss of consciousness. Efforts have also been undertaken in the scientific area by examining the consequences of different restraining and cutting procedures involved in slaughter without stunning. From this scientific knowledge base one can conclude that there are a number of important factors affecting animal welfare in this situation and it would therefore be possible to assess welfare of cattle slaughtered without pre-stunning.

The monitoring system outlined in this report will be applicable also to those plants that practice this type of slaughter, up to the point of entrance into the slaughter box/area, from where on different additional measures are needed to assess welfare during the slaughter procedure.

1.11.3 General issues relevant to both mechanical and electrical stunning

Re-stunning

When re-stunning occurs it would be valuable to ask the operator to state the reasons for re-stunning, in order to indicate if there is a lack of knowledge on what symptoms to look for. The operator should be informed of this procedure before monitoring starts, to avoid as much as possible of disturbances or delay due to questioning. The statement from the operator should be noted under general comments.

Starting and stopping point of monitoring

Monitoring will start at the first stunning attempt (e.g. at the first shot or the start of electrical current flow). As mentioned earlier, monitoring ability will be dependent on safety precautions, not least regarding the stunning area. Optimally, monitoring should start by observing the stunning process, but in order not to disturb animals or operatives it will often start as animals fall out of the stun box. Stopping point of monitoring of stunned animals should be no less than 30 seconds after the sticking procedure. This could mean that the inspector must skip observing every second or third animal if line speed does not allow monitoring of bleeding before the next animal is shot.

In regards to monitoring of stun quality, there is a tendency for problems to arise due to operator fatigue and poor weapon maintenance and the risk of this is higher towards the end of working shifts. Therefore, at least half the time spent monitoring of stun quality should be conducted at the end of a working shift.

Observer positioning

The possibility to check e.g. stunning symptoms is dependent on observer positioning which, in turn, is dependent on safety precautions. Hence, a position must be chosen taking into account limitations related to facility design and safety aspects and stunning symptoms should consequently be checked where is it possible from a design and safety point of view.

Righting reflex

This symptom, shown by animals as an attempt to recover normal body position, can also be shown as animals lie on the floor or shackle table and it should not be ignored in this position. It's important that the definition does not limit this symptom to when animals *are hanging on the shackle rail*.

Nystagmus

Opinions among expert scientists differ when it comes to the absence of nystagmus as an indicator of good stunning. Therefore, nystagmus should be excluded as a protocol parameter.

Pupil dilation

Opinions among expert scientists differ on whether pupil dilation is a reliable indicator of stun quality. Therefore, pupil dilation should be excluded as a protocol parameter.

Excessive kicking

The definition of excessive kicking is hard to establish. Recording delays in the shackling or sticking procedure due to kicking would be a more objective score and the definition has been adjusted according to those circumstances.

Response to pain stimulus

Response to pain stimulus in the form of a nose prick with a hypodermic needle or an ear pinch is indicative of inadequate stunning effect and it has been suggested to include such a measure in stun quality evaluation (EFSA, 2004). At a nose prick, the pain-sensitive animal will show withdrawal or shaking of the head, sometimes followed by the righting reflex, while ear pinching will induce an ear movement (EFSA, 2004). In plants were it is possible from a safety point of view to approach stunned animals to check for corneal reflex, it would also be possible to perform a nose prick at the same time. Therefore, it is suggested to include this parameter.

1.11.4 Mechanical stunning

An adequately stunned animal will collapse instantly and the skeletal muscles of the body will go into spasms, with the immediate onset of tonic seizure (tetanus), lasting several seconds (EFSA, 2004). Forelegs and hind legs are flexed and after 5 seconds the forelegs will straighten and become extended (EFSA, 2004). The tonic phase is immediately followed by the clonic phase, which is characterised by uncontrolled physical activity (kicking) (S.B. Wotton, personal communication). Rhythmic breathing stops from the point of stun and there is no corneal reflex, eye rotation or response to painful stimulus (EFSA, 2004). The pupils will gradually dilate.

Re-stunning with non-penetrative bolt

It has been explained that subsequent shots with a *non-penetrating* captive bolt may not be effective due to swelling of the skin following the first shot, and that re-stunning using that weapon type should not be allowed (EFSA, 2004). Therefore, incidents of re-stunning with a non-penetrative bolt should be recorded.

1.11.5 Electrical stunning

Since electrical stunning of cattle is not performed in Sweden, testing of the monitoring protocol for this type of stunning has not been possible to conduct. Before a final monitoring protocol can be outlined, such tests need to be performed.

1.11.5.1 Head only electrical stunning

An adequately stunned animal will collapse instantly and the skeletal muscles of the body will go into spasms. The passage of sufficient electrical current will produce an epileptic fit, characterized by a tonic phase followed by a clonic phase. During the tonic phase, seen during and following application of the current, the animals´ body shows tetanus, breathing stops, the front legs are extended and the hind legs flexed under the body (S.B. Wotton, personal

communication). The tonic phase lasts app. 10-20 seconds and it is immediately followed by the clonic phase, recognized by the presence of un-coordinated kicking or paddling movements during the next 15-45 seconds. Apnoea lasts throughout the tonic-clonic phases. In electrical stunning, eye movements can occur and indicates an epileptic fit (S.B. Wotton, personal communication). In the case of electrical stunning such movements should therefore be carefully used as symptoms of poor stunning effect.

Stun-to-stick interval

It has been found that induction of head-only stunning results in an average interval of 50 seconds before the return of intrinsic signs of recovery (Wotton & Gregory, 2000). It would hence lie in the interest of animal welfare to include stun-to-stick interval in monitoring. Penetrative captive bolt stunning has been shown to last up to 10 minutes and stun-stick interval is therefore not such an important risk factor in this method of stunning. In electrical stunning that causes cardiac arrest, stun-to-stick interval is not either relevant to animal welfare, provided that the stunning is effective.

1.11.5.2 Electrical stunning systems that initiate a stunned state and cardiac arrest

An adequately stunned animal will collapse immediately, however the animal may be held-up within the stunning box and the skeletal muscles of the body will go into spasms. The passage of sufficient electrical current will produce an epileptic fit, recognised by the tonic phase described above for head-only electrical stunning. Because the current pathway includes the spinal cord and the circulation of oxygenated blood is halted, there is little expression of a clonic phase. Effective head and body stunning, is characterized by decreasing muscle tone in the fore limbs and the free hind leg, slow lowering of ears and extension of the tongue out of the mouth. Occasionally effectively stunned and fibrillated animals will demonstrate rhythmic breathing for a short period at sticking. This has been recognized as residual brain-stem function in a cortically dead animal and is therefore not a welfare concern.

In addition to general parameters relevant to all stunning methods, the protocol for monitoring of electrical stunning inducing cardiac arrest should also include:

- Loss of muscle tone:
  - Decreasing muscle tone in the fore limbs
  - Decreasing muscle tone in the free hind leg (dropping)
  - Ears lowering slowly
  - Tongue extending from mouth (given that the mouth is open)
- No initial presence of rhythmic breathing. However, rhythmic breathing may return at approximately one minute after initiation of head-to-body current

Notable

Respiration (S.B. Wotton, personal communication) or similar movements (gasping, gagging) and also eye movements and reflexes (Wenzlawowicz *et al*., 1999; Gilbert, 1993) may be seen at some stages after initiation of the stunning current and therefore, their occurrence should not be evaluated during the epileptic fit and only with great care at the following stages until death is induced. For these reasons, it is not an easy task to produce monitoring protocols applicable to

different types of electrical stunning. Monitoring and interpretation of results from electrical stunning demands for highly experienced observers, since it relies greatly on fine details in body movements, observing the right symptoms at the right time and also on the ability to evaluate and interpret key equipment parameters and usage. The importance of specialized training in order to recognize symptoms in electrical stunning cannot be emphasized enough. Separate monitoring protocols for head-only and cardiac arrest electrical stunning have been roughly outlined, but will need further revision.

1.11.6 A note on the evaluation of results from stun quality monitoring

Algers suggested in "Assessment of stun quality in cattle" (2006*d*) to monitor stunning of at least 200 animals, of which 80 should be bulls. Based on the recordings in the monitoring protocol, it would be possible to evaluate the stun of each animal as being good, poor or undefined.

After recordings of protocol parameters suggested in this original report, the evaluation was suggested according to the following reasoning:

- *Good stun – The animal shows no signs of eye movements and has dilated pupils, fixed in a staring gaze and no corneal reflex.*
- *Poor stun – The animal show one or several of the following symptoms: corneal reflex, spontaneous blinking, righting reflex and respiration.*
- *Undefined stun – The animal show eyeball rotation up to sticking, nystagmus, gasping/groaning or excessive kicking in combination with eyeball rotation, nystagmus or gasping/groaning.*

A sum-up of all animals displaying symptoms in each category will finally give:

- *the number or percentage of animals deeply stunned at first attempt*
- *the number or percentage of animals poorly stunned at first attempt*
- *the number or percentage of animals with an undefined stunning*

The proportion of bulls deeply/poorly stunned compared to non-bulls should also be calculated since the stunning of bulls is identified as a problem area.

Considering the fact that the requirements for monitoring of bulls have been amended and also that stunning symptoms have been both added, excluded and modified in definition, the evaluation approach of stun quality must be reassessed. Also, requirements for the total number of animals monitored have been changed.

1.12 Bruise scoring

Bruise scoring has been considered an important measure in overall welfare assessment at slaughter (Algers, 2006*c*) and the Australian Carcass Bruise Scoring System (ACBSS) has been established as a reliable method. Bruise scoring should therefore be included in the Welfare Quality monitoring system and it is proposed to perform bruise scoring according to the ACBSS at a minimum of 60 carcasses at the time of the slaughter plant visit. Bruise scoring should be performed during a time of day when it has minimal negative influence on the time spent monitoring live animals.

Bruise scoring according to the ACBSS does not, in a direct way, take into account the age of the carcass damage. Bruising can occur at the abattoir, but it can also be caused by incidents on farm or during loading and transport. Therefore, it is important to emphasize that problems with heavy bruising detected at abattoir inspection must undergo further investigation to examine the causative factors.

2. Changes and refinements after second test run

2.1 Plant description

The questionnaire should be filled out by the inspector, while walking through the facilities for live animal handling, gathering information on stable/lairage conditions and stun box design. Information such as number of employees, line speed, routines for dead on arrivals and stunning equipment and maintenance must be provided by authorized slaughter plant personnel. It is important to consider who should answer these types of questions, since reliability is affected by this choice. There is a need for a recommendation stating which employee would be best suited to answer questions or otherwise provide the inspector with reliable information. Some information on, for example, pen measurements and stunning maintenance, can require some time to compile and therefore it would possibly be most efficient to ask the plant to answer some relevant questions beforehand. These questions are marked with an asterix.

The plant description sheet still needs some refinements in terms of lay-out and standardization of questions, but in principle it worked well during practical tests. Estimated time requirement for filling it out is 30 minutes. With two inspectors, one could look at plant facilities while the other speaks with authorized personnel and time needed to fill out the sheet would then be lowered to app.15 minutes. If the questionnaire would be sent in advance to the plant, time requirements would be minimized further.

The proposed record sheet for plant description is found in appendix 1.

2.2 Unloading

2.2.1 Observation points and the need to set them up in advance

Observation should be conducted between imaginary lines that indicate starting and stopping point of monitoring (e.g. representing a “monitoring section”). The fixed point were the observer should be positioned in order to monitor animals in this area is hereafter termed Observation Point (OP). For each monitoring section OPs should be set up in advance at a preparatory visit; otherwise a considerable amount of time will be lost due to this, before monitoring starts. The initial visit could take place in association with inspection or this could be done in a coordinated phase where all plants are prepared for inspection.

One OP is often satisfactory in order to observe unloading and animal movement through the unloading area, although in some plants additional OPs may be necessary. This is the case, for example, when the unloading area has a sharp bend behind which animals disappears out of sight if you are observing from a point in line with or slightly behind the vehicle ramp. In this

particular case, it would be optimal to have an additional OP covering the section after the bend. Based on experience from the test runs in this study, 1-2 observation points are needed at unloading.

At all times it should of course be avoided to stand directly in front of animals that are being moved in a direction towards the observer. Practical tests showed that positioning *behind* animal groups is not suitable either when the purpose is to monitor the whole group, since only animals in the back of the group are seen (or if moved through a single file route, only the last animal is seen). If the observer is located in a raised position, the negative effect of monitoring from behind animal groups will be somewhat reduced, but this is still something that must be taken into consideration when the aim is to monitor *all* animals in the group properly. If OPs can only be found directly in front or behind areas where animals are moved, it should be evaluated if that particular area is important enough from a welfare risk point of view to consider camera surveillance. In these and in other cases where monitoring is made difficult for safety reasons, or due to risk of disturbance of animals or workers, it would be worth while considering the use of camera surveillance. This method would of course demand more recourse to be put into the supplementary work of going through filmed material. The issue of camera surveillance is delicate in the relation to the interests of abattoirs and their employees, and it will therefore need further discussion to conclude whether it is possible to use. A suggestion would be to begin inspection by visiting the plant the day before inspection, to set up suitable OPs and, if needed, camera equipment at certain points. Alternatively, plants could be visited in an initial phase to determine and document optimal OPs and the need for camera surveillance at each individual abattoir. The estimated time required for this preparation would be up to two hours at each plant.

High walls surrounding areas were animals are moved are generally considered preferable from an animal welfare point of view, since it limits distraction through limiting the animals´ sight of such things that could cause fear and distress and hinder animal movement. However, high walls are problematic in terms of monitoring ability for official veterinarians and other observers. Therefore, a raised position is most often necessary in order to perform inspection, despite the fact that this can cause greater disturbance to animals compared to monitoring from ground level. A raised position better facilitates monitoring of groups because of the advantageous angle, which reduces the negative effect of animals blocking the sight of others in the group.

The practical tests showed satisfactory result with a simple footstool, 50 cm in height, which could easily be moved between OPs. Nevertheless, depending on the height of walls at different plants, the footstool should be adjustable to at least 70 cm.

2.2.2 Motives for recording of all parameters in each group

In small, medium and sometimes also in high throughput plants the number of vehicles coming in each day is very limited. It is important to take the opportunity to record all the essential parameters presented in the protocol in each group at unloading and driving. It would not be acceptable to reduce the amount of data even further by recording only one or two parameters in each unloading. This mode of procedure could result in, firstly, that there are not enough unloadings to cover all parameters and, secondly, individual parameters would be recorded in as little as one unloading, which is not satisfactory.

2.2.3 Labour requirement and record keeping

Since frequencies of some parameters should be recorded and since a relatively large number of parameters should be monitored in each group, the need for two observers monitoring together is evident. However, the observer looking at the animals need to communicate to the one keeping records. This can cause disturbance to animals, since the strength of voice must be loud enough to overpower general noise level. Alternatively, a dictaphone could be used, a tool that proved to be practically applicable during test runs. Of course, you still need to speak into the device, but in a much lower tone of voice. The use of a dictaphone would demand greater supplementary work.

2.2.4 Group monitoring

It was proposed to select and monitor ten animals in front in the group, but practical tests showed that this was very difficult and that it drew attention from the monitoring of behaviours and events. Therefore it is recommended to monitor the entire group of animals, and for this reason, simplifications to frequency recording and slight changes to protocol parameters have been made, as will be discussed in the text below. Since no plants in Sweden, were practical tests were performed, have a very high throughput, the feasibility of monitoring of large groups (e.g. app. >15 animals) has not been fully examined and there is a need for further experiences in this area. Therefore, if group monitoring should prove to be problematic when it comes to larger group sizes, this recommendation will need reassessment.

Practical test showed that recording of group size was difficult at unloading. Concentration is drawn from behaviour monitoring if the observers should count and record group size. Moreover, animals from a previous group can linger or turn back to mix in with the next and some animals might stop while others in a group continue. These examples make it hard to sometimes distinguish one group from another and to keep track of group size. It is therefore recommended not to record the size of individual groups but to only record the total number of animals unloaded from the vehicle. Should the observers arrive late to an unloading (or leave before all animals are off) staff must help informing how many animals that should be excluded from total group size.

With this mode of procedure, results from monitoring of unloading would not give information on specific groups. It will also be more difficult to see possible connections to animal category. Although group size is unknown you could however study such details further, by looking at monitoring results from specific groups.

2.2.5 Animal category

Category/categories of animals in the group should be recorded. Practical tests proved that this draws attention from behaviour monitoring and, at times, the category is not obvious, especially if it is a mixed group. The driver, or members of staff, should inform observers on animal category and it is of great importance that there are instructions on how and when this information should be given, so that it will not interfere with monitoring, but is presented in a smooth way.

2.2.6 Frequency recording

The proposal protocol for unloading included frequency recordings of the different behaviours and events. During practical tests it was concluded that frequency recording was very difficult

and with the new recommendation of monitoring of whole groups, rather than the first 10 animals, it was especially so, which has lead to new proposals on frequency recording.

As described in the report by Algers (2006*a*), locomotion behaviours related to fear and injury are often performed by more than one animal in a group at unloading, since cattle are highly influenced by other herd members in such situations. For practical reasons, it is therefore suggested not to record frequency of Run, Move backwards, Jump and Congestion. These behaviours should only be recorded as occurring in a group or not (one/zero sampling).

It is however still recommended to record the frequency of Freeze, Try to turn around, Turn around, Slip, Fall, Mount and Vocalize, since tests showed that these parameters are more easily detected as individual incidents. Hit by Gate should also be frequency recorded, but the frequency of different means of coercion used must be simplified. Electric prodding is generally regarded as a serious form of coercion and frequency recording should be done. Other means of coercion than the electric prod are often used to such an extent that precise frequency recording is impossible. Also, there can be more than one person involved in the use of coercion at unloading and driving, which also makes recording difficult. Frequency recordings of the use of Rattle, Flapper, Stick or Other objects should therefore be simplified by noting 1-3 or >3. If any means of coercion is used in the face of animals, this should be noted in a separate column.

2.2.7 Behaviour definitions

Slip

Slipping should be divided into "General slipping", which should be recorded if occurring at group level, and "Serious slips", meaning incidents where the observer notices lowering of the animal's body due to sliding of hooves or folding of legs and a more obvious interruption of movement. General slipping by many animals in a group is often impossible to discern as individual events due to crowding and visibility aspects. Moreover, this type of slipping is often *heard* by the observer, rather than actually seen. Heavier slips, on the other hand, is more apparent and can be distinguished as separate events. It is important to stress that all slips should be regarded as potential animal welfare risks, regardless of whether they can be distinguished by observers as individual events.

Vocalize

As mentioned in Algers (2006*a*), vocalizations are often associated with stressful events such as electric prodding, slipping and restraining. At unloading, animals are faced with a novel environment and they are also presented to the scents, sounds and presence of unknown animals. These factors are very likely to cause vocalization at unloading, as animals come off the truck into the new surroundings and use vocalization a way of communication. Therefore, vocalization should only be recorded if it can be connected to an obvious fear- or pain related event, such as slipping, falling and physical means of coercion. Cattle are herd animals that can be assumed to find comfort in other members of the same species when presented to new environments. Therefore, cattle often vocalize if they are left alone, with no other cattle in sight. These situations can arise in the abattoir for example when animal groups are split up and one is left behind or when animals are alone behind gates or turns that blocks the sight of others. In those cases, vocalization is considered as an indicator of poor welfare and it should be recorded at individual level. Vocalizations can be recorded provided that they can be distinguished from

those coming from other areas in the plant. Although, by limiting the definition as described above, vocalization related to fear and injury will be more easily distinguished.

The proposed monitoring protocol for unloading is found in appendix 2.

2.3 Driving into lairage

2.3.1 Group monitoring

As discussed above for unloading, group size should not be recorded but the total number of animals from one vehicle should be noted. The animals should be studied as they are within the limits of the monitoring section set up beforehand.

As animal groups are moved towards lairage, they can be split up and moved into different lairage systems. When this occurs it is often impossible to keep monitoring *all* animals. To avoid this problem OPs should be situated were it is unlikely that groups will be split up.

Driving into lairage can be said to involve two sections; one is the driving of animals in a common single file route into the stable and up to the lairage system. Then, animals are moved into a particular system, for instance a box or a row with individual stalls. Monitoring of driving in the single file route demands for a varying a number of OPs and sometimes also camera surveillance, depending on distances, visibility and risks for disturbances. From the point where animals move into different lairage systems monitoring is concluded to be very difficult, especially in rows with individual stalls, due to the following factors:

- The observer standing in a fixed position to monitor driving in the common route does not necessarily know into which lairage system animals should go, for example, which individual stall row the are entering.
- If the observer is told were the next group will be held in lairage, the observing position still cannot easily be adjusted since it would often involve opening of gates and crossing routes were animals are moved.
- Animals and groups are seen from behind and gates used to divide the row into individual stalls are blocking the sight of animals in front.
- There would have to be separate OPs basically for each row
- Groups are sometimes split up, entering different rows
- The area between individual stall rows is narrow and the observer can not stand and monitor here without being in front of the animals and disturbing them. It is also inconvenient for workers to pass by observers in this area.

With all these factors in mind, monitoring of driving into row systems with individual stalls is not considered practically applicable in the Welfare Quality system, unless it involves camera surveillance. If cameras are used it is however important that video recording covers representative samples of animals and surveillance areas would have to be carefully chosen. For

instance, the first row might be used preferably for cows, since they should be slaughtered the day of arrival.

The proposed monitoring protocol for driving into lairage and into stun box is found in appendix 3.

2.4 Driving into stun box

2.4.1 Observation points

Driving into stun box actually starts already at the point where animals leave lairage. However, most welfare related problems are likely to arise in connection with stun box entrance and monitoring of this area should therefore be prioritised. An evaluation of risks must be conducted when choosing OP as to weather more points are needed on the way from lairage to the stun box area. Generally, it could be said that at least 15-30 meters prior to stun box entrance should be monitored. It is indeed very important to monitor the individual entering the box.

To monitor driving into stun box with the help of a dictaphone is not suitable because of time consuming supplementary work. At some plants it might be possible for one observer to monitor one OP alone, if there is good visibility. Otherwise, two observers must monitor together at each OP.

At some plants it may be possible to monitor a group and, at the same time, look closely at the animal entering the box, but in others this will demand for two OPs; one for monitoring of the group in the area before the box and another for monitoring of individuals entering the box. These two modes of procedure produce different results; in the later example you will also monitor individuals, separate from the group. This difference must be taken into account in the interpretation of results.

The proposed monitoring protocol for driving into lairage and into stun box is found in appendix 3.

2.5 Behaviour in stun box

2.5.1 Observer positioning

In principal, monitoring of behaviour in the stun box worked well during practical tests, although there is a need for further discussion on protocol refinements and better definition of parameters. It should however be stressed that this monitoring demands for extra caution with regards to disturbance to animals. It is of great importance that the observer is not seen by an animal that is about to walk into the box. This means that the observer must keep out of sight while an animal is driven in. Some animals react strongly to people that are ducking and refuse to move towards that area. It is very important that the observer is sensitive to such indications from animals or from the workers, and adjust position if problems arise. When the box gate is closed behind an animal, the observer appears, preferably looking into the box from the side, behind the animal. This enables to start monitoring as soon as the animal has entered, as compared to when it is time

for stunning, as is often the case when following the movements of the shooter. If monitoring is made impossible for safety reasons or for the risk of disturbing animals so that they are reluctant to enter the box, video surveillance would be preferred. Video surveillance should be done from in front of the animal.

The proposed monitoring protocol for behaviour in the stun box is found in appendix 4.

2.6 Stun quality

Monitoring of stun quality should involve studies towards the end of working shifts. Therefore, monitoring of this section could preferably be performed for example one hour prior to lunch break and an hour at the end of the day shift.

2.6.1 Corneal reflex

In most cases, the face of the stunned animal can be monitored from a distance and it would be possible to let the staff check for presence of corneal reflex. In order to make this work, staff must learn how to check this properly, so that it is a reliable measure for the observer to use. In many cases a staff person puts a gloved finger too forcefully into the animals´ eye, so that blinking in response to touch is easily missed. With instructions, personnel could be asked to check for corneal reflex so that the observer can see from a distance if there is a response.

2.6.2 Response to painful stimulus

Unfortunately, inclusion of this parameter was suggested after practical test had been performed. Therefore, there is still a need to test feasibility of this measure.

The proposed monitoring protocol for mechanical stunning is found in appendix 5 and proposed monitoring protocol for electrical stunning is found in appendix 6.

2.7 Bruise scoring

It was initially proposed to perform bruise scoring, according to the ACBSS, at a minimum of 60 carcasses. During the second set of practical tests a number of obstructive factors were found:

- Trimming of carcasses due to damages, including bruised tissue, was performed before chilling of carcasses in all plants visited. This means that scoring cannot be performed on carcasses after trimming. Instead, scoring must be done between hide removal and trimming. Time duration of carcasses in this area is short (up to app. 15-30 minutes) and the slaughter area is often precisely designed to fit in the necessary components, with not much free space in between. This leads to the conclusion that the only suitable position for inspectors to perform bruise scoring would be at the station for meat and hygiene control, provided that such a station exists.

- To score bruising in a reliable way, you need to be able to study the whole of the carcass closely and in the ACBSS you should also evaluate the depth of the bruise by cutting tissue. In order to do this you will need an elevated platform to reach the middle and

Many plants are already performing some type of meat- and hygiene control that includes bruising and personnel performing this control are of course placed in the optimal position for this purpose. To perform bruise scoring, the WQ-inspector would have to be positioned in this spot. This would seem like a rather odd situation, for the inspector to crowd with another inspector on the same platform, performing basically the same job. Also the slaughter men use elevated platforms to perform carcass dressing, but it would not be suitable for inspectors to try and perform bruise scoring from those platforms, since it would be dangerous and cause disturbance to the worker. An alternative approach would be to note if the abattoir practices some kind of internal inspection including bruising and describe how this is performed and reported. Plants that do not have such internal control will most likely not have suitable design as to facilitate bruise scoring by WQ-inspectors.

The proposed record sheet for bruise scoring is found in appendix 7.

2.8 General comments

The proposed record sheet for general comments is found in appendix 8.

2.9 Time requirements

2.9.1 General figures

Table 1 illustrates experience-based numbers on time requirements for different areas of monitoring, relevant to plants with app. line speed of 25-45/hour.

Table 1. Illustration of experience-based numbers on time requirements for different areas of monitoring

Monitoring area	**Time required**
Unloading or animals from one vehicle	2-30 min
Driving into lairage	1-3 minutes/group and up to 25-30 minutes to monitor animals from one vehicle
individual animals entering the stun box	0,5-3 minutes
Group monitoring of driving into stun box until all animals are stunned	2-10 min
Behaviour in stun box	According to line speed, or rather the speed of entrance into the box. Time to monitor a group of animals until all has been stunned Is estimated to 2-11 min
Stun quality	
with line speed of 30-35/h or less	According to line speed
with line speed above 30-35/h	Half of line speed or less
Bruise scoring	According to line speed, although detection of damages could need more thorough investigation, which would reduce the no. of carcasses scored/time unit

2.9.2 Specific figures concerning monitoring of unloading and driving into lairage

Taking into account the number of OPs needed to cover important areas, monitoring of animals from trucks coming in should be evenly distributed between unloading and driving into lairage. This means that the inspector needs to be informed how many trucks are expected during the day.

In table 2 below three scenarios are illustrated, to give an idea of the number of vehicles and groups of animals that could possibly be monitored given some general presumptions.

Presumptions:

- The examples concerns monitoring of unloading and driving into lairage
- Two observers are monitoring together
- To cover unloading, 1-2 OPs are normally needed
- To cover driving into lairage 2-3 OPs are normally needed.
- If animals should be monitored further into the lairage system, additional OPs would be needed, the number depending very much on interior plant design. Just as an estimation, the need for OPs in this area is set to 2.
- Approximately 4-8 vehicles, each containing 2-7 groups and each group having 2-10 animals, are arriving at the plant during one work day, which could be considered normal at medium throughput plants.

Table 2. Illustration of three scenarios and their effect on the number of groups/individuals monitored

Scenario	**Monitoring of unloading**	**Monitoring of driving into lairage, part 1**	**Monitoring of driving into lairage, part 2**
"At best" • Minimum of OPs • Maximum no. of trucks/day • Max no of groups in each truck • Max no of animals/group	2 trucks Up to 14 groups and 140 animals	4 trucks Up to 28 groups and 280 animals	2 trucks Up to 14 groups and 140 animals
"Worst case scenario" • Max OPs • Min no of trucks/day • Min no of groups in each truck • Min no of animals/group	2 trucks 2 groups and 4 animals	3 trucks Error! There are not enough trucks to cover the first part of driving.	– To cover all OPs, 7 trucks would be needed and this would mean observation of as little as 2 groups and 4 animals/OP
"Realistic example" • Four OPs in total • 6 trucks/day • 5 groups in each truck • 5 animals/group	2 trucks 10 groups and 50 animals	1 truck 5 groups and 25 animals	2 trucks 10 groups and 50 animals

It may well be that data sampled throughout one full working day may not be sufficient for an assessment of the welfare quality at an abattoir. In such cases one or more inspection days must be added to reach a conclusive result.

3. Summarized proposal of monitoring system

The initial visit could take place in association with inspection or this could be done in a coordinated phase where all plants are prepared for inspection. Preparation should include gathering of general information, deciding on monitoring sections, OPs and camera spots, weather one or two observers need to monitor OPs together or if dictaphones could be used and the instruction of staff members on how to inform observers of arriving trucks, animal numbers and categories. Time and labour requirements could be estimated based on this information.

The proposed monitoring system includes:

- **Initial visit**
- **Presenting some relevant questions to the plant in advance so that information, which may otherwise be time consuming to receive, can be delivered efficiently at inspection** (these questions are indicated by * in the plant description sheet, app. 1)
- **Plant description** (app. 1, which will include meeting with authorized personnel)
- **Monitoring of unloading** (app. 2)
- **Monitoring of driving into lairage** (app. 3)
- **Monitoring of driving into stun box** (app. 3)
- **Monitoring of behaviour in stun box** (app. 4)
- **Monitoring of stun quality** (app. 5 and 6)
- **Bruise scoring** (app. 7)
- **General comments** (app. 8)
- **Possibly additional recording of data from film and dictaphone recordings**

In table 3 an example is presented showing a time schedule for one day inspection at a medium throughput plant. All figures are estimated from practical experience. As mentioned above, time frame for monitoring of other sections than unloading and driving into lairage cannot be fixed, but must be interrupted and later continued if trucks arrive, since vehicles coming in sporadically must be prioritized. Staff must be instructed to communicate whenever a truck is arriving, meaning that inspectors need to be paged, phoned or otherwise contacted before unloadings are initiated.

If inspection is to be prolonged, the time schedule should be adapted to fit the needs for further monitoring of certain sections.

Table 3. Example of time schedule for medium-high throughput plants

Time requirements		Monitoring area
Prior to inspection		
2 hours		Preparatory work at the plant (choosing OPs and informing staff)
The day of inspection		
2-3 hours	App. 4-8 trucks, each taking 5-25 minutes to monitor	Unloading and Driving into lairage
45 min-1 hour	Animal no. monitored follow line speed (app. 25-50 slaughtered/hour With app 6 minutes/group, 7-8 groups are studied during 45 minutes	Driving into stun box
45 min-1 hour	Animal no. monitored are according to line speed	Behaviour in box
1-2 hours	Animal no. monitored are according line speed or, if every second animal is monitored, half of line speed (12-25 animals/hour)	Stun quality
45 min-1 hour	Animal no. monitored are according to line speed	Bruise scoring
30 min-1 hour		Plant description + general comments
Following inspection		
0-8 hours		Additional work (going through dictaphone recordings and filmed material)

List of behaviours and events and their definitions

Fear and injurious related behaviours and events relevant to unloading and driving

- *Run*– the animal runs, by itself or as a reaction to handling.
- *Move backwards*– the animal moves backwards, by itself or as a reaction to handling. When an animal takes a few steps backwards to parry balance or change position in relation to other animals when crowding it is not considered as moving backwards.
- *Turn around*– the animal turns around more than 90 degrees, by itself or as a reaction to the handling regime. When/if the animal turns back again more that 90 degrees, the behaviour should not be recorded again, but it may then be recorded as "trying to turn around" (see below).
- *Try to turn around*– the animal makes an unsuccessful attempt to turn (less than 90 degrees), by itself or as a reaction to handling regime. An animal that is simply turning its´ head in an investigative way should not be regarded as trying to turn. An animal that has turned around (more than 90 degrees) may make attempts to try and turn back again, in which case "trying to turn around" should be recorded.
- *Freeze*– the route is free in front or behind the animal but it refuses to move forwards or backwards within 4 seconds from being touched/coerced by the handler. If the animal takes more than one step and stops again, or moves backwards, Freeze is recorded again when a new driving attempt is made. An animal that stops but continues to walk when the handler drives it forwards is not frozen.
- *General Slipping*– loss of balance so that the animal looses its foothold or that the hooves slide along the floor surface. No other body parts except hooves and/or legs are in touch with floor surface. The noticing of characteristic sounds of hooves slipping or gliding against floor surfaces is sufficient to record presence of General Slipping.
- *Heavy Slip*- loss of balance so that the animal looses its foothold or that the hooves slide along the floor surface. No other body parts except hooves and/or legs are in touch with floor surface. To record Heavy Slip the observer must notice lowering of an animals´ body due to the gliding or folding of leg/legs, possibly in combination with interruption of movement.
- *Fall* – loss of balance so that other parts of the body but hooves and legs are in contact with floor surface.
- *Vocalize* – the animal vocalizes in response to fear- or pain related events, such as falling, physical means of coercion, restraining and strikes by gates. Vocalizations that occur without involvement of any obvious fear- or injury related event should not be recorded. Repeated bellowing should only be recorded as one incident of vocalization.
- *Mounting*– the animal mounts another animal, i.e. it raises its´ front legs and places them over the rear/back of another animal. Only successful attempts are considered as mounting, i.e. an animal that raises the front of its´ body towards another animals´

- *Jump*– the animal jumps so that all four feet are above ground at the same time
- *Overcrowding/jamming*– when two or more animals get stuck between walls. This often occurs between walls of driving routes in sharp bends or at entrances or narrowing of areas into single file routes. It should only be regarded as congestion if any animal involved is getting stuck, unable to move in any direction for more than 2 seconds.
- *Coercion*– meaning the use of any of the following items when handling live animals: electric goad, stick, flapper, rattle, other. "Other" means any item except the ones listed above and use of the drivers own body. If "other" means of coercion is recorded, the observer should remark on the type of item used. Incidents involving these items shall only be recorded as coercion if the items are used by physically *touching* the animal. The number of times coercion is used and also where on the animal's body it is used should also be recorded by using the options "front, middle, rear", meaning on the animals head region, the middle or back part of the body, or the rear end.
- *Hit by gate*– for example when a gate is closed on an animal. Type of gate involved should be stated, by using the options: "pen gate", "guillotine gate", "non return gate" and "mechanical push gate". The number of times gates are closed on an animal should be recorded. When staff members shut a pen gate on the animal or when a pen gate is used to push an animal forwards or backwards, it is considered as a hit.

Fear and injurious related behaviours and events relevant to behaviour in the stun box

- *Turn around- same definition as above*
- *Try to turn around- same definition as above*
- *General slipping- same definition as above*
- *Heavy slip- same definition as above*
- *Fall- same definition as above*
- *Vocalize- same definition as above*
- *Climb- an animal tries (or succeeds) to escape the stun box by putting leg/legs or a part of leg/legs over the limits of the box*
- *Jump- a sudden startled fright reaction*
- *Kicking- hind leg kicking, often as a reaction to touch/pain (e.g. gate push or touch by handler) or agitation*
- *Heavy struggling- defined as continuous struggling/panicking movements of escape, such as general slipping, forward and backward movements and body trembling lasting for more than 3 seconds. This reaction does not involve breaks of calm behaviour*

- *Struggling- defined as above, except for being less pronounced with slower movements and/or including breaks of calm behaviour. If a struggling animal is stunned within 3 seconds, it is recorded as "struggling".*

  NOTE! Calm behaviour in this situation does not involve breaks due to complete exhaustion, which may or may not be followed by a new struggling period

- *Lowering head- lowering of the head so that stunning is delayed and/or that stunning is made more difficult for the operator*

- *Head retraction- retraction of the head and/or the whole body when restraining is fastened or in place.*

- *Lifting/turning head- the head is lifted and/or turned so that stunning is delayed and/or made more difficult for the operator*

Symptoms of inadequate stunning effect

NOTE! It is normally only possibly to look at one eye as it is often impossible to evaluate the eye on the side facing the floor when animals lie on the shackle table. Also when animals are hanging on the shackle rail it can be very hard to get a good look at both eyes.

- *Corneal reflex*– response to light touching of the eyeball

- *Spontaneous blinking* – the animal blinks spontaneously without physical stimulation

- *Eye ball rotation* – one or both eye balls rotate so that the pupil/pupils are partly or completely hidden.

- *Rhythmic breathing*– the presence of rhythmic breathing (repeated inhale/exhale in a rhythmic fashion).

  NOTE! Air filling the lungs at the moment of stunning is often expired right after the animal is stunned which can be misinterpreted as breathing. This expire of air is never followed by any inspire of new air and hence not regarded as "rhythmic breathing". Respiratory gasps can also occur, with or without vocalisation, which are of spinal origin and therefore do not indicate recovery. Rhythmic breathing is best detected by observing the chest and abdomen for movements and by putting the hand in front of the nostrils to feel the air blow. The animal can start breathing immediately after stunning or after some time when shackled on rail.

- *Righting reflex* – arched back righting reflex with the head bent straight back. The symptom can be shown while an animal is lying in horizontal position or while hanging on the shackle rail.

  NOTE! This is not to be confused with spinal reflexes such as kicking with the legs which naturally occur when the inhibiting function of the brain on the spinal nerves is lost due to stunning. Remember that spinal reflexes never involve the head. If the head is "loose and floppy" the animal is stunned properly and shows no righting reflex. If the animal tries to lift its head, the brain is partly functioning

- *Response to painful stimulus*- at a nose prick with a hypodermic needle, the pain-sensitive animal will show withdrawal or shaking of the head, possibly followed by the righting

- *Excessive kicking and subsequent delay of shackling or sticking procedure*– considerable or severe physical movement of the limbs that produces a delay to the operation and a potential danger to operator safety.
- *Re-stunning– the incident of more than one stunning attempt to the same individual animal.*
- *Casualty animal*- an animal that is unfit or injured in such a way that it requires immediate stunning and slaughter.
- Downer/nonambulatory animal- an animal that cannot stand or walk or can only stand/walk for short periods.

List of abbreviations used in the monitoring protocols

Abbreviation	Explanation
Animal categories	
B + additional L	Bull and possible addition “L” for Large
S	Steer
C	Cow
H	Heifer
Calf	Calf
Protocol for unloading	
Truck no. & total no. of animals	Truck number, recorded by figures 1-, and the total number of animals in the vehicle
Group no.	Group number, recorded by letters a-
Anim. categ.	Animal category
Rn	Run
Mb	Move backwards
Tr	Turn around
TTr	Try to turn around
Fr	Freeze
Voc	Vocalize
<u>Gates:</u>	
PG	Pen gate
GG	Guillotine gate
NRG	Non return gate
MG	Mechanical push gate
<u>Coercion:</u>	
Electric	Electric goad
Rattle	Plastic paddle containing beads
Flapper	Elephant ear shaped flexible plastic
Stick	
Other:	Describe other items used for coercion
Protocol for driving into lairage and into stun box	
Total no. in truck	Total number of animals in the truck from which animal groups are monitored

Anim. categ	Animal category
Stunning	
CorRef	Corneal reflex
SpBli	Spontaneous blinking
EyeRot	Eye rotation
Resp	Respiration (rhythmic breathing)
RightRef	Righting reflex
ExKick delay	Extensive kicking that causes a delay of shackling or sticking procedure
Cont m.tone forelegs	Continuous muscle tone in forelegs
Cont m.tone free hind leg	Continuous muscle tone in the free hind leg

Literature

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General Plant Description

Equipment needed to perform inspection: monitoring protocols, General Comments sheet and Bruise Scoring sheet, noise level meter, dark coloured writing pad, stool, timer, flashlight, hypodermic needle

Date:

Abattoir:

Inspection performed by:

General issues

No. of employees handling live animals

(including stunning and sticking procedures)

***Line speed** (no. of cattle slaughtered per hour or,

alternatively, mean no. of cattle slaughtered during one work day)

Animal species slaughtered	Cattle Pig Sheep Horse Other:
Categories of cattle slaughtered	Bull Steer Cow Heifer Calf
***Mean no. of animals staying over night**	

Stable/lairage conditions

Noise

Note down any specific sources of aversive noise (e.g. high pitched sounds from ventilation or air pressure manoeuvring, slamming of gates or metal objects, voice and tools used by handlers)

Noise measured at entrance to lairage from unloading facility: _____dB(A)Lin,1min.

Noise measured at entrance to stun box: _____dB(A)Lin,1min.

Gates (types and how they are operated)

Gate type	Manoeuvring (mechanic, pneumatic, other):
Pen	
Guillotine	
Non return	
Push	
Other (please describe type):	

Lairage system/systems used

Crowd pens (boxes) ☐ Individual pens (boxes) ☐ Individual stalls ☐

Individual stalls, tethered ☐ Other ☐ (please describe system):

***Pen/stall measures**

Pen/stall	Length	Width	Wall Height
Crowd pens (boxes)			
Individual pens (boxes)			
Individual stalls			
Individual stalls, tethered			
Other (please describe system):			

***Animal density/maximum weight allowed in different lairage systems**

Figures could be expressed as:

Stocking rate (*i.e.* animals per unit floor area, head/m^2) or

Space allowance (*i.e.* floor area allocated per animal, m^2/head) or

Stocking density (*i.e.* weight of animal per unit of floor area, kg/m^2)

Pen/stall	Maximum, daytime	Maximum, overnight
Crowd pens (boxes)		
Individual pens (boxes)		
Individual stalls		
Individual stalls, tethered		
Other (please describe system):		

Flooring material (note with X)

Pen/Stall	Concrete	Rubber mattress	Slats, concrete	Slats, rubber covered	Drained proportion	Proportion comfort/lying area
Crowd pens (boxes)						
Individual pens (boxes)						
Individual stalls						
Individual stalls, tethered						
Other system:						

Bedding material (note with X)

Pen/stall	Straw	Wood shavings	Saw dust	Peat
Crowd pens (boxes)				
Individual pens (boxes)				
Individual stalls				
Individual stalls, tethered				
Other system:				

Water- and feed supply

Pen/stall	Water supply (yes/no) and no. of water sources in each pen/stall	*Water flow rate in nipples (l/min)	Feed supply (yes/no)	When are animals fed? (e.g. after 12 hours in lairage)	Type/types of feed
Crowd pens (boxes)					
Individual pens (boxes)					
Individual stalls					

Individual stalls, tethered	
Other system	

Routine procedures

***Routines for recording "dead on arrival"**:

***Dark Cutting Beef/DFD**

Is there record keeping of the occurrence of Dark Cutting Beef or DFD? Yes ☐ No ☐
If "yes", please describe record keeping procedures (e.g. measurement of ultimate pH or colour evaluation and when this is done):

and the latest result available (e.g. monthly mean value in % of total meat):

Stunning and bleeding

Method/methods used for cattle

Penetrative bolt ☐ Non penetrative bolt ☐ Pneumatic bolt ☐

Electrical head-only stunning ☐ Electrical head-to-body stunning (cardiac arrest) ☐

Free bullet ☐ Pre-slaughter stunning not practiced ☐

Electroimmobilization used between stun and stick ☐

Stunning position

Penetrative bolt: Frontal bone ☐ Occipital bone ☐

Pneumatic bolt: Frontal bone ☐ Occipital bone ☐

Non penetrative bolt: Frontal bone ☐ Occipital bone ☐

Head-only electrical stunning: Manual application (hand-held tongs) ☐ Automatic, built in device ☐

Flexible ☐ Non flexible ☐

Head-to-body electrical stunning: Manual application (hand-held tongs) ☐ Automatic, built in device ☐

One cycle ☐ Two cycle ☐

*Application site of body current electrodes (e.g. back or foreleg):*_____

Stun box design (please describe floor, walls and entrance gate with regards to material and design)

Restraining

Head restraint: Neck ☐ Chin lift ☐

Body restraint: Squeeze chute ☐ Conveyor belt ☐ Other ☐ : _____

Please describe material, design and manoeuvring:

***Stunning equipment**

	Bolt weapon type 1	**Bolt weapon type 2**	**Bolt weapon type 3**
Manufacturer & model			
Cartridge (C) fired or pneumatic (P) powered			
Trigger (T) or contact (Co) fired			
Calibre			
Air line pressure (if air pressure powered)			
Cartridges (grain size and colour code) Please also state which cartridges are being used for different animal categories			
		Electrical head-only	**Electrical stunning inducing cardiac arrest**
Manufacturer & model			
Year of installation			
Voltage (Vrms)			
Current (Arms)			
Frequency (Hz)			
AC waveform (sinewave)			
		Free bullet weapon type 1	**Free bullet weapon type 2**
Manufacturer & model			
Calibre			

Cartridge			
			Non penetrative weapon
Manufacturer & model			
Calibre			

***Back up stunning equipment**

Penetrative bolt ☐ Pneumatic bolt ☐ Non penetrative bolt ☐ Free bullet ☐

Electrical stunning ☐

Storage for back up stunning equipment (state were back up equipment is placed):

***Stunning equipment maintenance**

	Daily used equipment	**Back up equipment**
Daily maintenance (yes/no)		
Performed by		
Including		
Record keeping (yes/no)		
Long term[1] maintenance (yes/no)		

Frequency of long term maintenance		
Performed by		
Including		
If electrical stunning is used: Last calibration performed (year/month/date)		
Record keeping (yes/no)		

[1]Long term meaning more thorough inspection either weekly, monthly or yearly

Bleeding procedure

Chest stick ☐ Neck (gash) stick ☐

*Minimum bleeding period/bleeding rate and time:

Questions marked with * should be sent to the plant in advance

Appendix 2. Protocol for monitoring of Unloading

Truck no. & total no. of animals	Group no.	Anim. categ.	Monitoring										
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front	Middle	Rear		Comment	
			GG				Electric						
			PG					< 3	> 3	Used on head/face			
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front	Middle	Rear		Comment	
			GG				Electric						
			PG					< 3	> 3	Used on head/face			
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front	Middle	Rear		Comment	
			GG				Electric						
			PG					< 3	> 3	Used on head/face			
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						

Appendix 3. Protocol for monitoring of Driving into Lairage____or into Stun box____

Truck no. & total no. of animals	**Group no.**	**Anim. categ.**	**Monitoring**										
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front		Middle	Rear	Comment	
			GG				Electric						
			PG					< 3	> 3		Used on head/face		
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front		Middle	Rear	Comment	
			GG				Electric						
			PG					< 3	> 3		Used on head/face		
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						
			1 Rn Yes / No	2 Jump Yes / No	3 Mb Yes / No	4 General slipping Yes / No	5 TTr Yes/no	6 Tr	7 Fr	8 Slips	9 Fall	10 Mount	11 Voc
			12 Gate	Front	Middle	Rear	13 Coersion	Front		Middle	Rear	Comment	
			GG				Electric						
			PG					< 3	> 3		Used on head/face		
			NRG				Rattle						
			MG				Flapper						
							Stick						
							Other:						

Appendix 4. Monitoring protocol for Behaviour in stun box

			Rx pre-restraint												Rx to restraint												
Sample no.	Animal category (& size)	Time at entering box	General slipping	Heavy slip	Fall	Climb	Jump	Kicking	TTr	Tr	Struggling	Heavy struggling	Lowering head	Voc	Head retraction	General slipping	Heavy slip	Fall	Climb	Jump	Kicking	Struggling	Heavy struggling	Lifting/turing head	Voc	Time at first shot	Comment

Appendix 5. Protocol for monitoring of Mechanical Stunning

Sample No.	Animal category & size	Monitoring	Comment
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	
		1 Pain response; 2 CorRef; 3 SpBli; 4 EyeRot; 5 Resp; 6 RightRef; 7 ExKick delay; 8 Reshot ___ times	

Appendix 6. Protocol for monitoring of Electrical Stunning

No.	Animal category & size	Stun time		Stick time	Comment
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		
			1 Pain response 2 CorRef 3 SpBli 4 EyeRot 5 Resp 6 RightRef 7 ExKick delay 11 Restun ___ times		

Record sheet for bruise scoring

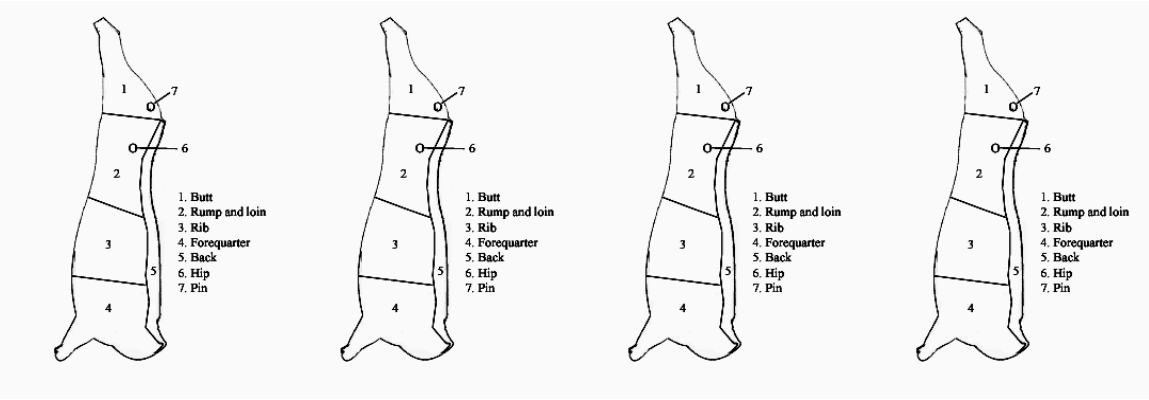
The severity of trimmable bruising on the carcase is classified into three basic categories as follows:

- **Slight *(S)*** – from 2 to 8 cm in diameter.
- **Medium *(M)*** – from 8 to 16 cm in diameter.
- **Heavy *(H)*** – greater than 16 cm in diameter

Bruises below 2 cm in diameter, fire bruises (superficial bleedings in the subcutaneous fat) and bruises caused by shackling are not recorded.

In addition to the spread of the bruise, the depth is assessed. If the bleedings involve other than surface muscle tissue the bruise is considered to be **deep *(d)***. All concluded this makes a total of six categories: ***S, Sd, M, Md, H, Hd.***

In the carcass picture, the location of bruises shall be notes by writing letters (a-o) in at the site of the bruise



Carcass 1 Left	Right	Carcass 2 Left	Right
S			
Sd			
M			
Md			
H			
Hd			

General Comments

Did you notice specific welfare problems related to vehicle conditions or design? If such situations occurred, please try to specify the problems

Have you noticed any improper lighting causing dazzling of the animals eyes or reflections that animals react strongly to?

Have you noticed animals being moved from well lit areas into darker areas and if so, did any specific problems occur at these sites?

Does congestion occur (and if “yes”; at any particular sites)?

Does improper driving technique occur?

Have there been any incidents with excessive violence?

_____
_____
_____
_____
_____
_____

In case of casualties/downers, how was the situation handled and reported?

_____
_____
_____
_____
_____
_____

In case of “dead on arrival”, how was the situation handled and reported?

_____
_____
_____
_____
_____
_____

In case of slaughtering “unusual categories”, describe the animal/animals and how the situation was handled:

_____
_____
_____
_____
_____
_____

Reasons for re-stunning (symptoms stated by the stunning operator):

_____
_____
_____
_____
_____
_____

Please describe your general impression of overall cattle welfare at this plant, and try to include *interior facility design, lairage conditions, handling and staff attitude to animals*:_____

_____
_____
_____
_____
_____
_____
_____

_____
_____

Please make a note on the line below to indicate your overall impression of animal welfare at this abattoir:

Very poor welfare ----------**I**---------- Very good welfare

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