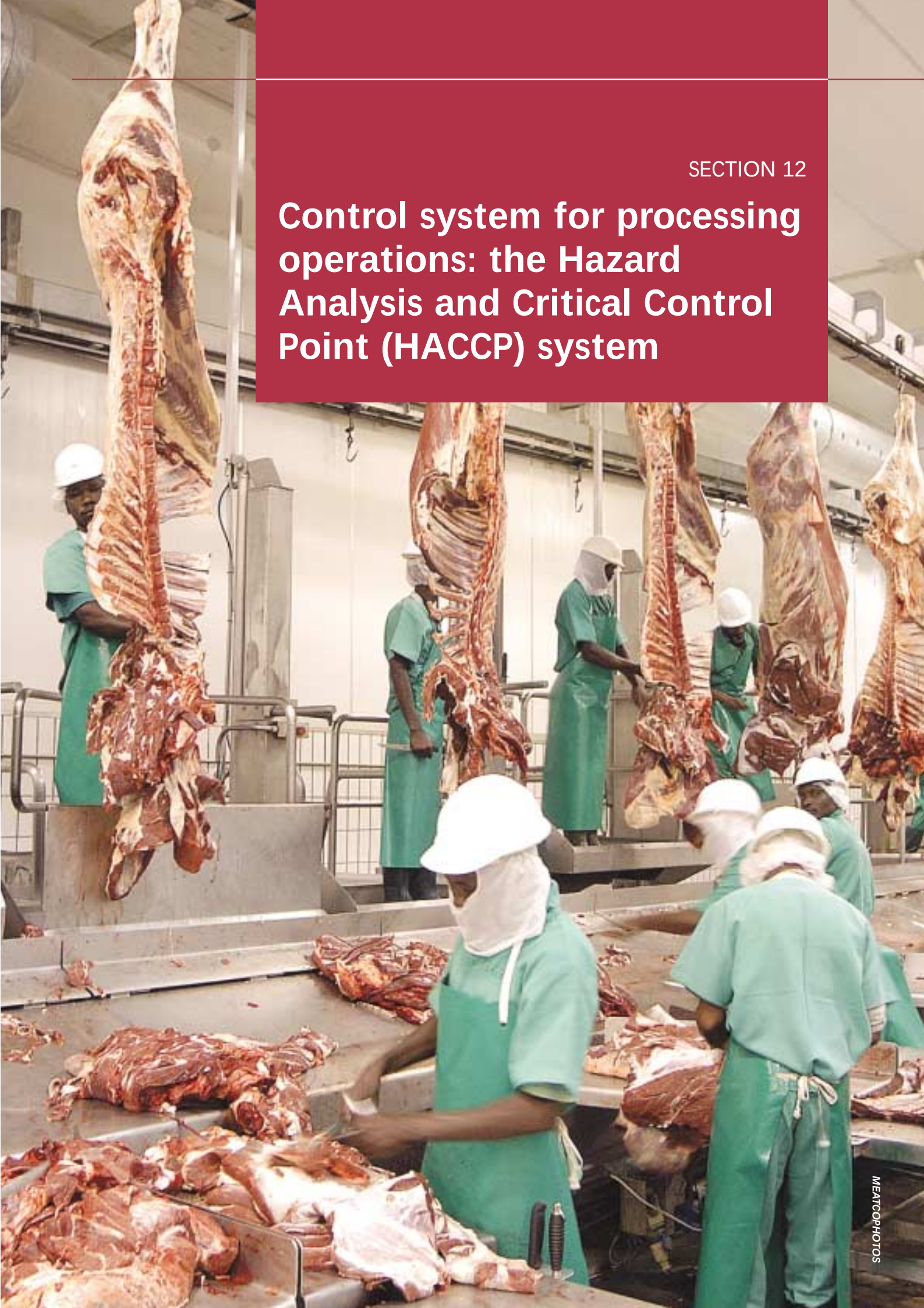
SECTION 12

Control system for processing operations: the Hazard Analysis and Critical Control Point (HACCP) system



MEATCOPHOTOS

INTRODUCTION

The Hazard Analysis and Critical Control Point (HACCP) system is the most widely used and internationally accepted food safety management system in the world. The main goal of applying HACCP plans in abattoirs is to ensure that animals are slaughtered and dressed under conditions that mean the meat will carry minimal public health risk. A HACCP plan has the following advantages:

- it is proactive and preventive;
- it is owned by the meat plant;
- it is systematic, plant-specific and documented.

However, one should also be aware that HACCP implementation is time-consuming and creates extra work for staff. Thus a HACCP system is not easy to accommodate, particularly for small, multispecies operators. Nevertheless, HACCP is currently the meat safety management system of choice; no better alternative is presently available.

PREREQUISITE PROGRAMMES

General hygiene principles known as good hygienic practice (GHP) or good manufacturing practice (GMP) are the foundations on which a more specific HACCP system is built. Therefore, GHP is a prerequisite and there can be no effective implementation of a HACCP plan without pre-existing, effective GHP. While some lower-level risks for public health can be managed through GHP principles only, GHP alone is insufficient for managing some higher-level risks that require additional, more specifically targeted control measures provided by a HACCP system. Therefore, with respect to the frequently asked question regarding the need for a HACCP plan when GHP could be sufficient in abattoirs, the answer is: "not either GHP or HACCP" but rather "both GHP and HACCP".

GHP incorporates several prerequisite programmes:

- **Plant maintenance**: surroundings; vehicles; hygienic plant layout (e.g. separation of "clean" and "dirty" areas); use of resistant and easy-to-clean materials (e.g. no wood); routine building maintenance; emergency maintenance procedures; equipment/ machinery maintenance and calibration; and related records.
- **Cleaning and sanitation**: storage of cleaning equipment and chemicals; procedures for cleaning/sanitation of vehicles, premises and equipment; cleaning/sanitation schedules; checks and microbiological sampling schedules; and related records.
- **Water**: supplies; sampling schedules; testing results; and related records.
- **Waste disposal**: storage and dispatch of low-risk waste materials; disposal of high-risk materials (e.g. specified risk material [SRM]); effluent disposal; and related records.
- **Pest control**: control procedures; bait plan; list of pesticides and their handling; and related records.
- **Suppliers and customers**: lists of suppliers and customers; animal/lairage records; other incoming material records and specifications; delivery records; and procedures for product recall.
- **Staff**: induction and further training of staff; routine medical certification and records; reporting of daily health problems; storage and laundering of protective clothing; and related records.

Hygienic operating procedures for the slaughter and dressing of animals (Sections 7 and 9) also represent elements of GHP.

SUMMARY OF HACCP PRINCIPLES

The seven principles of the HACCP approach are commonly explained as shown in Table 12.1

Principle 1. Hazard analysis

This is probably one of the most important and elaborate elements of the HACCP system; all other HACCP elements are either based on, or directly/indirectly generated from thorough hazard identification. It should address all individual steps, including technical aspects and any inputs (e.g. raw materials) along the production process.

Hazard definition

A hazard is any biological, chemical or physical agent present in, or condition of, food that can cause harmful effects on human health. Biological hazards are probably of greatest concern in abattoirs, and they include pathogenic micro-organisms (bacteria, fungi,

TABLE 12.1 **Principles of HACCP**

Principle	General scope
1. Hazard analysis	Identification of all likely public health hazards associated with the operation, assessment of the risk of their occurring, identification of related control measures.
2. Identification of critical control points (CCPs)	Identification of the process steps where hazards pose a high-level risk and so must be controlled.
3. Establishing critical limits at each CCP	Defining the line between acceptable and unacceptable hazard-related values, from the safety aspect, at individual CCPs.
4. Monitoring of each CCP	Establishing the system for monitoring whether hazards are effectively controlled at all the CCPs.
5. Corrective actions at each CCP	Development of actions/procedures to prevent transfer of hazards posing unacceptable risk to consumers if CCPs get out of control.
6. HACCP verification/validation	Proving that all the measures are working and that all hazards are controlled.
7. HACCP documentation	Practical, record-based proof that the checking/action activities are carried out and are effective.

viruses), microbial toxins and/or toxic metabolites, parasites and prions. Chemical hazards include residues (e.g. pesticides, polychlorinated biphenyls [PCBs], heavy metals, mycotoxins), veterinary medicines, growth promoters, cleaning/sanitation chemicals, lubricants/solvents, and pest baits. Physical hazards can include glass, plastic, metal, wood, rubber bands, string, hair, buttons, jewellery, bone splinters and insects.

Hazard identification and characterization

At each process step, every hazard and the related source/route of its transfer, as well as distribution/redistribution, on or in meat, have to be considered. Simultaneously, available control measures are determined. Using risk assessment, the risk score (e.g. a scale of 1 to 4 can be used) for a given hazard at a given production process step is allocated by considering the relationship between the probability of the occurrence and the seriousness of the consequences (Table 12.2). In the case of a low risk score (e.g. 1), no particular control measures for the hazard are required apart from those already provided by GHP. In the case of a very high risk score (e.g. 4), a CCP must be allocated to this process step (see below). If this is not possible, the step needs to be redesigned.

Control measures

Control measures can provide prevention, elimination or reduction of hazards. Most control measures are actually hygienic operating procedures normally used as part of GHP. In abattoirs, most available control measures are effective in reducing hazards, rather than in eliminating them.

Principle 2. Identification of critical control points (CCPs)

CCPs are those process steps that are vital for obtaining safe meat, and the points where the hazards must be effectively controlled (prevented, eliminated or reduced) through specified measures. Consideration as to whether a given step is a CCP or not is based on the following questions:

a) Is the hazard at this step at an unacceptable level? (If not, the step is not a CCP.)
b) Are control measures to prevent unacceptable levels available at this step? (If not, the step is not a CCP.)

TABLE 12.2 **Risk evaluation: a template example for determining risk categories**

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	Very high 4	Very high 4	High 3	High 3	Medium 2
Critical	Very high 4	High 3	High 3	Medium 2	Low 1
Moderate	High 3	Medium 2	Medium 2	Low 1	Low 1
Negligible	Medium 2	Low 1	Low 1	Low 1	Low 1

Note: on a scale of 1 to 4, low risk is 1, medium risk 2, high risk 3 and very high risk is 4.

c) If the answer to both a) and b) is yes, the step is a CCP.

d) However, when the two answers above are "no" and the step cannot be considered a CCP, it should be considered whether control measures are available at the previous step. If this is the case, a CCP should be assigned retrospectively to the previous step.

Although CCP allocation can differ among abattoirs depending on the specifics of the production process, including the technologies used, some generic CCPs are common to all abattoirs. For both large and small ruminant abattoirs, CCPs may include:

- acceptance of animals for slaughter,
- skinning,
- evisceration,
- chilling,
- dispatch.

For pig abattoirs, CCPs may include:

- scald and/or singe,
- evisceration,
- chilling,
- dispatch.

Principle 3. Establishing critical limits at each CCP

Critical limits are applicable only at CCPs. They represent a measurable and/or observable indicator of whether previously identified hazards have reached unacceptable levels of risk. Critical limits can differ in their nature and how they are measured. For example, chilling temperature (e.g. 4 °C) is a critical limit because it prevents the growth of some pathogenic bacteria; exceeding that temperature would pose a high risk from multiplication of the pathogens. The temperature can be measured by thermometer. Another example of a critical limit is the absence of meat contamination by digesta during evisceration because it can contain enteric pathogens; the contaminated meat would pose too high a risk. Such meat contamination can be detected by either visual or instrument-aided observation, or both.

Principle 4. Monitoring of each CCP

For each CCP, regular monitoring procedures have to be established, to ensure that the CCP is controlled effectively and to detect proactively any danger from exceeding critical limits. The monitoring should include established parameters such as the methods used (e.g. sampling plans and temperature recording checks are meaningful), the frequency, the allocation of related responsibilities and recording. Although regular, monitoring is not always a continuous activity. Ideally, CCP monitoring should provide an early warning of the danger of losing control, before critical limits are exceeded.

Principle 5. Corrective actions at each CCP

Immediately when there is an indication that for any CCP the critical limit has been exceeded and the process is getting out of control, a specific, pre-planned corrective action must be taken.

Immediate effects

The immediate aim of corrective actions is a rapid regaining of control. Examples include retaining a contaminated carcass on the slaughter line and/or altering its disposition, or moving carcasses to another chiller if the temperature is moving out of control.

Longer-term effects

However, corrective actions should also include

elements that aim to prevent reoccurrence, together with determining what went wrong and considering any need for retraining staff, amending instructions and procedures, maintenance works, or replacement of equipment.

Organization

Crucial preconditions for corrective actions to be effective include specifying who is responsible for carrying out a given action, and maintaining accurate/updated records.

Principle 6. HACCP verification/validation

To be effective, the HACCP plan needs to be followed in terms of both the operations and the operators, resulting in identified hazards being effectively controlled.

HACCP verification

Verification procedures need to be defined, in order to prove that what was planned and what is actually happening do not differ. Various checks can be used for HACCP verification; either the HACCP team or external auditors, or both, can carry them out. Verification checks do not need to be carried out for the whole HACCP system simultaneously; different parts of the plan can be checked at different times. Nevertheless, all the parts have to be checked within a specified time frame. Examples of verification checks include microbiological sampling of the carcasses and the environmental surfaces, auditing by customers or regulatory authorities, and on-site review of the process flow diagrams.

HACCP validation

Validation procedures need to be defined, in order to prove that the HACCP plan is effective in controlling the identified hazards. The effectiveness of HACCP-based control of hazards should be at least equivalent to, but preferably exceed, those of controls based only on GHP. Validation checks include assessment of completeness, appropriateness, adequacy and justification of all aspects of the HACCP plan. Generally, it is good practice if validation includes comparison with in-house and national performance. A HACCP plan should be revalidated if any changes are made to the plan or the production process.

Principle 7. HACCP documentation

Documentation should provide general information, details of the HACCP plan itself, and records. All documentation should be updated, complete and informative, but be as simple as possible and accessible.

General information

This includes a description of prerequisites, operating instructions, training records and similar information.

Plan information

This includes all necessary information on the HACCP team and responsibilities, product and production processes, and review procedures.

Records

These include data on monitoring, corrective actions and verification.

PREPARATIONS TO DEVELOP A HACCP PLAN

Assembling the HACCP team

A person trained in the HACCP approach should take the lead. The team should incorporate members who can provide key knowledge and skills and/or who hold responsibilities of particular interest within the company. A multidisciplinary team is beneficial, but an excessively large team will not necessarily result in increased effectiveness. The team can always call in “outside” experts on particular issues as required, including specialized HACCP consultants.

Gathering necessary information

The necessary background information relates to current production processes, premises and equipment, prerequisite programmes, instructions and records related to GHP, suppliers and customers, and similar.

Defining the production process

A HACCP plan is product- and process-specific. Therefore, the scope of any future plan should specify the type of product (e.g. beef, lamb or pork) and its intended use (e.g. carcass meat or processed meat).

TABLE 12.3 **Hazard analysis: a template example at selected process steps**

Process step	Hazard identification, characterization	Risk evaluation			CCP?	Control measures
		Probability	Severity	Risk category		
1.						
2.						
Etc.						

TABLE 12.4 **Summary of CCPs: a template example**

CCPs	Critical limits	Monitoring				Corrective actions		
		Procedure	Frequency	Responsibility	Records	Procedure	Responsibility	Records
CCP 1								
CCP 2								
CCP 3								
CCP 4								
Etc.								

TABLE 12.5 **HACCP validation and verification: a template example**

Validation carried out by:	Name:	Position:	Date:	Signature:

VALIDATION CARRIED OUT *BEFORE* THE PLAN IS FIRST IMPLEMENTED

Is the scope accurate?	Is process flow chart complete?	Are all hazards addressed?	Are control measures in place?	Are CCPs justified?	Are critical limits acceptable?	Are monitoring procedures given?	Are records adequate?	Does the plan cover all hazards?	Does the plan control all hazards?
YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO

VERIFICATION CARRIED OUT *AFTER* THE PLAN IS IMPLEMENTED

People responsible for verification:			Part of the plan verified:		Part of the plan verified:		Part of the plan verified:		Whole plan verified:
			Part*	Date	Part*	Date	Part*	Date	Time frame
Person 1									
Person 2									
Person 3									
Person 4									
Etc.									

* For each part, a separate signed verification record must be prepared, including any corrective actions required, whether these have been carried out and by whom.

Drawing the process diagram

The process diagram should cover the whole process that the company is in charge of, and show every step of the process. It is essential that not a single step be omitted, as this could invalidate the whole future plan.

Checking the process diagram

Confirmation of the process diagram through careful observation of the real situation across the whole process, including cross-checking with the staff operating at individual steps, will significantly improve a future plan's effectiveness.

Generic examples for development/implementation of a HACCP plan

Examples of the main elements included in HACCP plan development and/or implementation are summarized in:

- Table 12.2. Risk evaluation
- Table 12.3. Hazard analysis
- Table 12.4. Summary of CCPs
- Table 12.5. Validation and verification.