Featured Articles

Case Studies of Food Defense in Relation to Plant Security Management

Shinsuke Kanai
Sunao Kakizaki, Dr. Eng.
Satoshi Matsutani
Hironari Nakata
Shinya Kaneko

OVERVIEW: In an era of information technology and globalization, major threats to business continuity at the companies that support the social infrastructure include not only issues that are inherent in the nature of business management, such as leaks of personal information, data fabrication, false advertising, or inadequate food hygiene, but also things like malicious acts by staff, malicious postings on the Internet, and corporate terrorism (deliberate contamination of food). Given this environment, establishing measures for food defense is a challenge for food processing plants, and Hitachi supplies a wide range of solutions that use the latest technology to facilitate the management of plant security. The ability to reliably review records and other historic data when an incident occurs is an important aspect of the formulation and implementation of security policies. Hitachi has developed a number of methods that are suitable for this purpose, including surveillance camera systems with ultra-high-resolution and a high level of data compression for long-term recording of high-quality video, and hands-free systems with detection capabilities that include determining the direction of movement and the presence of large numbers of people.

INTRODUCTION

WITH numerous reported cases of food safety issues, such as the incidents of mass food poisoning in Japan caused by milk in 2000 and another of poisoned frozen dumplings in 2007, food defense has been attracting attention since another incident in December 2013 of frozen food that was found to contain pesticide. Incidents like these make it difficult for the company concerned to continue trading, and can indirectly bring a halt to operations at some of the companies with which it deals. In recent times, this has gone beyond simply posing problems to specific companies, and instead poses a risk of a slowdown in overall economic activity.

Food defense, which primarily relates to safety measures for preventing deliberate contamination with poisons, etc., is a poorly understood issue in Japan and the concept has yet to penetrate into corporate thinking. Nevertheless, action by the food industry has picked up pace since the December 2013 incident. The social environment is such that, if an incident occurs, those companies that lack countermeasures face a further loss of trust together with business losses, while companies that do implement such countermeasures gain the respect and trust of their customers. Accordingly, there is a need for the dependable implementation of measures based on internal controls and management rules.

This article uses case studies of food defense to describe security management at food processing plants and the requirements for surveillance camera systems and facility access control systems (two effective ways of achieving this), and profiles distinctive Hitachi systems that are in strong demand, such as hands-free access control and high-compression/ultra-high-resolution video technologies. The article also describes future requirements.

FOOD DEFENSE IN THE PAST

Food Safety and Security Management

The requirements for ensuring food safety can be broadly divided into three elements: food security, food safety, and food defense[1] (see Fig. 1).

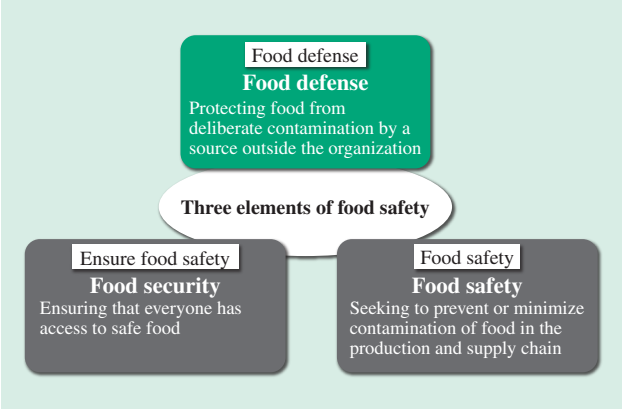


Fig. 1—Three Elements of Food Safety.
Food safety consists of food security and food safety, which are predicated on good intentions, and food defense, which assumes malicious intent.

The aim of food security is to ensure a secure supply of food in the face of international problems associated with things like population and resource depletion, so that everyone has access to safe and nutritious food when they need it. The aim of food safety, meanwhile is to protect against things like agricultural chemical residues or problems with food additives by preventing the sort of contamination that occurs unpredictably due to system failures. In other words, there is a need to ensure that food is kept safe by assessing and managing the risk of hazards in the food supply chain so as to prevent or minimize contamination. Security management that addresses these concerns is based on an assumption of people's good intentions. In contrast, food defense aims to prevent contamination resulting from deliberate attacks on the system. Accordingly, it needs to ensure that food is safe by protecting it from the deliberate introduction of contaminants.

While the concept of food defense existed before the incident described above of pesticide found in frozen food, the main aim of security measures had been to prevent intruders from outside.

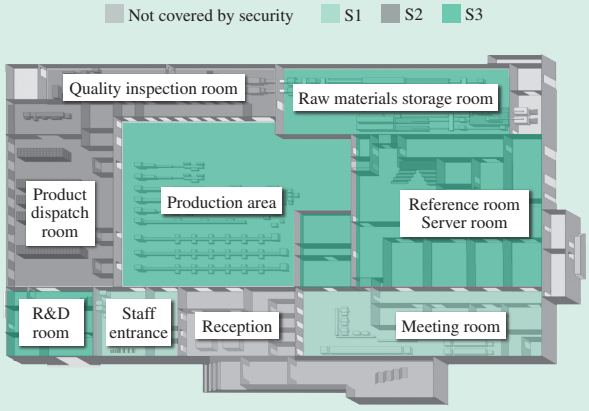
Security Management in the Context of Food Defense

Strengthening internal controls, that is, how to manage company staff, is a key aspect of food defense. And, because recent cases including deliberate food contamination indicate that this needs to include measures that assume malicious intent, the formulation and implementation of company security policies (including company-wide consistency and management rules) play an important role.

The first step is to define security levels for each area of the plant and to assign access permissions accordingly. In terms of food defense, the areas that need to be assigned the highest importance are those production and storage areas that require strict control because they provide an opportunity for direct contact with products or raw materials, or for actions that can adversely affect production. In keeping with this approach, surveillance points need to be located with consideration for the plant's layout, zoning, and access ways (see Fig. 2).

Setting up surveillance points and implementing appropriate access control enables incidents to be minimized. The monitoring of entering and exiting production areas and how staff go about their work is particularly important for preventing deliberate contamination with foreign material. It is also important to conduct a thorough review of work records (such as data and video) to minimize the damage if an incident does occur.

The following section describes trends in current security products and systems for food defense in light of these requirements.



Security level	Definition	Explanation
S1	Controlled area	Visitor access control is needed even though not a production area.
S2	Important controlled area	An area used for production or storage, with employee access control needed even though there is no direct contact with products.
S3	Most important controlled area	An area used for production or storage that requires strict access control because it provides opportunities for direct contact with products or raw materials, or for actions that can adversely affect production.

R&D: research and development

Fig. 2—Zoning of Food Processing Plants.
The security level for each zone is set based on the risk of contamination.

PRODUCTS AND SYSTEMS FOR FOOD DEFENSE

Use of Cameras for Production Line Quality Recording

Prompted by incidents at food company plants of contamination by agricultural chemicals, active steps are being taken to implement food defense measures against deliberate criminal acts from outside forces with malicious intent. Surveillance camera systems are one example of plant security equipment that can be installed quickly and at comparatively low cost.

Based on a relationship of trust with staff, past surveillance camera systems have in many cases only been installed at plant or building entrances and exits, and not inside the buildings themselves. Since the pesticide contamination case, however, surveillance cameras are increasingly being installed indoors on production lines and in other important locations. These are called "quality recording cameras," capturing video data showing staff activities such as entering and exiting areas. This video data is increasingly of high quality and is being kept for longer periods of time, a common requirement being to base the retention of video data on product use-by dates, meaning that for some products video needs to be kept for as long as several years. Satisfying this demand requires recorders with larger capacity. Another feature of cameras installed on production lines is that they need to be designed to withstand dust, water, and other harsh conditions.

Hands-free Access Control System

One of the security solutions Hitachi supplies for factories is a hands-free access control system. The system identifies (IDs) people by having them wear a radio frequency identification (RFID) tag with an omni-directional communications function that uses a proprietary built-in three-dimensional (3D) antenna, which avoids the need for them to pass a card over a reader as required by non-contact smartcard systems. Accordingly, a feature of the system is that staff can carry the RFID tag even when wearing sanitary uniforms with no external pockets. Eliminating the need to present a card makes the system highly practical for sites like food processing plants that use practices such as sanitary uniforms, air blowers, hand washing, and disinfection to rigorously control for dust, microbes, and other contaminants.

The role of the card reader in the system is taken by a transmitter and transmission antenna that activate the semi-active tags, and a receiver and reception antenna that detect radio signals from the tags. Unlike conventional active tags, semi-active tags normally remain dormant (non-transmitting) until they enter an ID area created by the presence of a transmission antenna. Three different ID areas are created in the vicinity of a gate, on the outside, in the middle, and inside respectively. The tags only activate on entering an area, at which point they transmit information indicating the ID area and the tag ID. Depending on the circumstances at the gate and the required security level, the system can be used to detect when people pass, the direction in which they are moving, and whether anyone else is entering with them ("tailgating").

The detection of tailgating in cases where a particularly high level of security is required involves installing a motion sensor in the middle ID area of the gate and only turning it off when the tag is present in this area. This detects tailgating because the motion sensor reacts to any unauthorized person who attempts to pass through the ID area (see Fig. 3). Because the ID areas overlap if placed too close together, it is not possible to determine the area in which the tag is located during these times. Since the system can prevent the tag from detecting when it is in such overlapping ID areas, and the size of the ID areas can be kept small, tailgating can be detected even when the gap between people is as little as about 1 m.

The main system features are as follows.

(1) Hands-free identification of up to about 10 tag-wearing users at a time. Also, because the direction of movement (entering or exiting) can also be determined from the sequence of ID areas and tag IDs, the system can keep track of how many people are present in a room.

(2) The system does not impose any constraints on the interior design of the building. Virtual gates can be set up, with no need to install physical gates such as automatic doors or electronic locks.

(3) Because the tags only transmit during the identification process, their button batteries can last for around three years (depending on frequency of use).

At food processing plants, the first feature is typically made use of on the production floor or at access points, and the second feature at access points. Other benefits include quickly being able to tell how many people are still inside in the event of an emergency.

Hitachi also markets and implements integrated security systems that combine surveillance camera and access control systems.

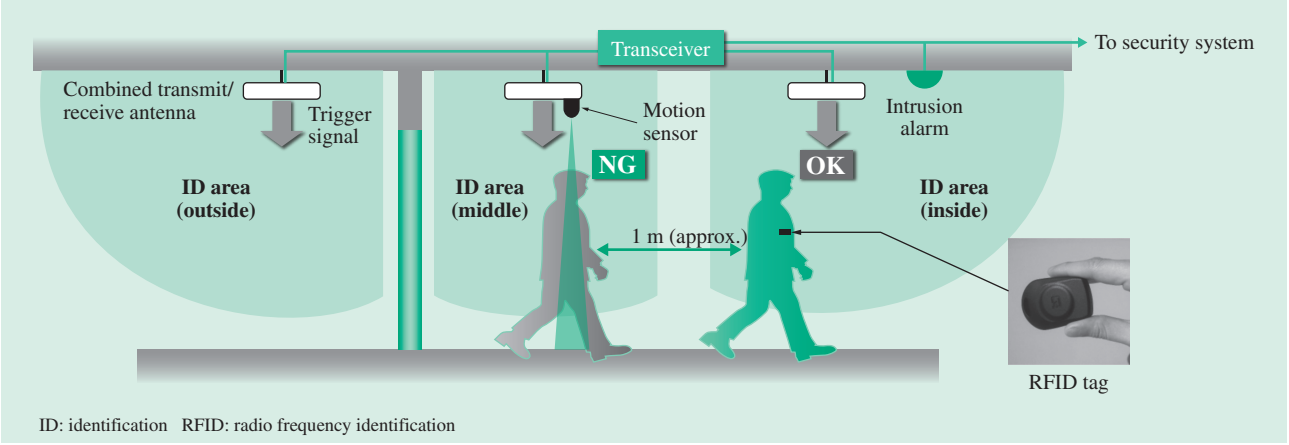


Fig. 3—Tailgating Detection.
Tailgating detection means detecting when an unauthorized person without a tag passes through the detection area immediately after someone who does have a tag.

PROPRIETARY HITACHI TECHNOLOGY

High-level Data Compression for Video

As described above, food processing plants need to keep data for long periods of time, depending on product use-by dates. Accordingly, Hitachi has developed surveillance camera systems that incorporate its own ultra-high-resolution technologies to provide long-term storage at low cost without using high-capacity recorders.

Network cameras with this ultra-high-resolution technology compress high-quality video at full high definition (HD) (1920 × 1080) down to D1 size (704 × 480). Because this video can be converted to HD quality (1280 × 720 resolution) on a personal computer (PC), high-resolution display can be achieved with a small data size. Recording data in D1 format increases storage capacity by around three to four times compared to the previous megapixel (1280 × 960) resolution, enabling the use of recorders with smaller hard disk drives (HDDs). Because data can also be transmitted in D1 format, it also reduces the load on the network by minimizing bandwidth requirements (see Fig. 4).

The system has demonstrated its capabilities and earned a good reputation at sites such as food processing plants that need to record high-quality video covering long periods of time with limited transmission bandwidth.

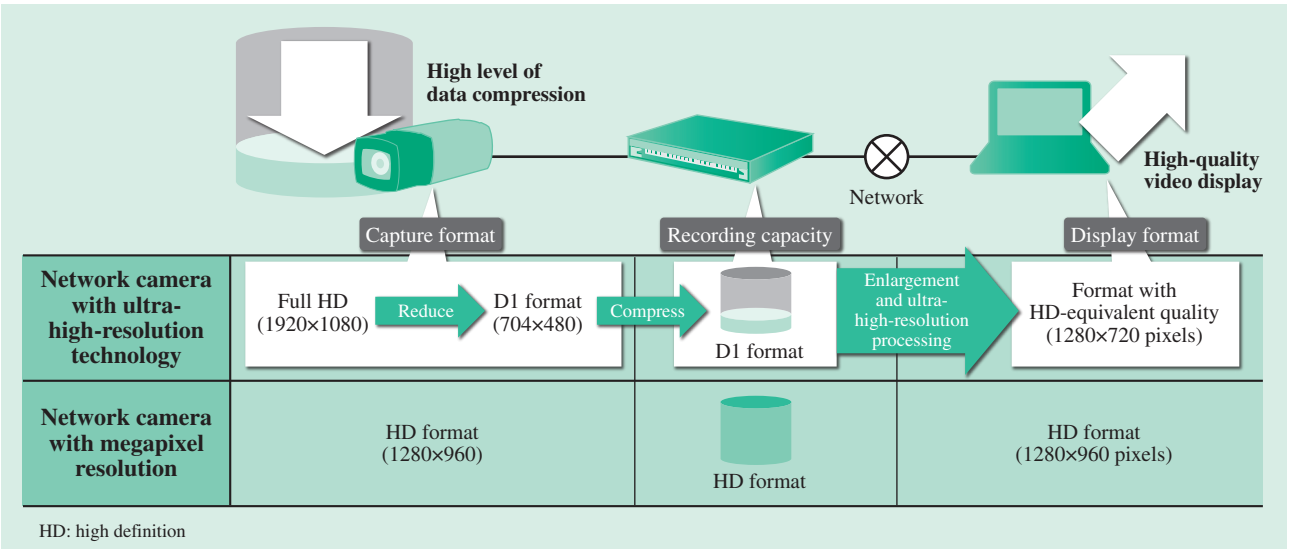


Fig. 4—Surveillance Camera System with Ultra-high-resolution Technology.
Proprietary Hitachi technology for high levels of compression and resolution enables a high level of data compression to be combined with high-quality video display.

Hands-free Applications

In its past installations at food processing plants, Hitachi has implemented measures for tracking in detail who is doing what, and when, by determining the direction in which people, vehicles, or goods pass a detection point. This utilizes the ability to perform high-speed communications and identify individuals even when there are a large number of tag-wearing people coming and going together. Hitachi systems act as reliable deterrents because they ensure that there are no flaws in security management, even in situations where a large number of people enter or exit at the same time, such as during lunch breaks at factories or other large facilities.

Also, even higher levels of security can be provided by combining systems with other surveillance equipment at various locations around a plant. Through integrated management with a surveillance camera system, for example, it is possible to implement a system that triggers a camera or alarm whenever a person passes who is not wearing a tag. The level of protection can also be raised by combining a wide variety of infrastructure based on the requirements, such as only zoning and installing surveillance cameras in work areas, and performing management based on the combinations. This is not necessarily limited to high-security areas, and given that every area can potentially have a need for the gathering of evidence from the scene in the event of something happening, it is possible to find smart ways to implement more robust food defense by operating in tandem with network cameras and recorders.

Numerous vehicles enter and exit a plant site and its various areas, including trucks, forklifts, and other vehicles used for materials handling. Using smartcards or similar techniques to manage such operations poses major challenges for food defense, such as card holder identification being all it takes to enter the site and the inability to identify forklift drivers. Because Hitachi's hands-free system can track the entry and exit of not only the vehicles themselves but also of all of the people riding on them, this tracking of vehicle entry and exit can be performed with greater sophistication than past security systems. The area zoning function of the hands-free system can also track the movements of workers and the forklifts and other vehicles used at a plant. When moving raw materials from a storage area into the factory, for example, for the forklift and driver to gain access, the driver needs to get off the forklift and press a button or use a smartcard or other mechanism to open the door each time they pass through one of the numerous gates, such as when opening or closing roller doors.

With the hands-free system, the driver only needs to wear the RFID tag to be identified, saving the trouble of having to get off the forklift each time.

FUTURE NEEDS

Since the 9/11 terrorist attacks in the USA in 2001, the US government and congress have thoroughly inspected the infrastructure that is important to industry, the public, and their way of life, and have implemented defensive measures in industries such as food and water, information, and finance. While measures against contamination by foreign material were already in place, there has been a growing awareness since the terrorist attacks of the need for actions to defend against such threats as toxins or toxic organisms that had not been within the scope of pre-9/11 measures, including taking a more demanding approach to implementing stricter measures for the manufacturing, processing, distribution, and other processes of food companies.

At the same time, the World Health Organization (WHO) has also been working on this issue in parallel and has published guidelines. It has emphasized the point that, with expanding global trade in agricultural products, a situation has arisen in which past ideas and measures are inadequate on their own, including in those sectors that deal with food safety and hygiene. It highlighted the fact that the threat of deliberate acts of contamination or terrorism in the food or agriculture sector is now a reality, and pointed out the need for people to be aware of the difficulty of dealing with this.

In terms of food defense in Japan, the fact that things like the structure of the economy, labor relations, and information channels are experiencing ongoing change means that Japan needs to initiate a comprehensive investigation. That is, there is a need to pay attention to all areas without exception, from the upstream to the downstream end of the supply chain, and from domestic and overseas production facilities and farms that produce raw materials to production plants, storage and distribution facilities, ready-made meal retailers, and logistics operations. It has also become necessary to flexibly adopt methods that will make routine communications proceed more smoothly, for example, because of the need to adapt to increasingly diverse considerations that encompass not only measures for preventing incidents at workplaces or processing plants, and concerns or dissatisfaction

with working environments, but also things like the handling of whistle-blowing, deliberate obstructive actions targeted at external suppliers, or excessive complaints or requests for redress.

Meanwhile, the economic environment, international trade, environmental degradation, international disputes, income inequality, problems with overseas workers, and other factors associated with globalization are interlinked in a complex manner, such that the various risk factors that arise have more aspects than might be imagined. Furthermore, there is a risk of damage being greater, more widespread, and more devastating. Accordingly, the importance of conducting adequate risk assessments beforehand is growing to encompass the question of how to prevent unexpected events that exceed predictions based on risk analysis.

CONCLUSIONS

This article has used case studies about food defense to describe how plant security management is provided using Hitachi's latest technologies.

In Japan, the 2013 incident of pesticide in frozen food has led to progress on implementing security measures for food defense, with a requirement to comply with common standards such as Food Safety Systems Certification (FSSC) 22000* across all facilities, including those located overseas.

In addition to surveillance camera systems and hands-free access control systems, Hitachi is able to offer a wide range of security management solutions for factories that suit different security levels, including an access control system using finger vein authentication, a vehicle access control system using number plate recognition, and a cloud-based access control service. Hitachi intends to contribute to maintaining the safety and security of the food supply chain by supplying effective solutions for issues that food companies potentially face.

REFERENCE

(1) Food Defense, Food Analysis Technology Center (SUNATEC) in Japanese, http://www.mac.or.jp/mail/090701/02.shtml

* A benchmark approval standard published by the Global Food Safety Initiative (GFSI) that combines the International Organization for Standardization (ISO) 22000 standard for food safety management systems and its associated additional standard, ISO/TS 22002-1 (or ISO/TS 22002-4).

ABOUT THE AUTHORS

Shinsuke Kanai
Security System Engineering Department, Security & Utility Solutions Division, Urban & Electrical Solutions Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in the integrated security solutions business.

Sunao Kakizaki, Dr. Eng.
Security System Engineering Department, Security & Utility Solutions Division, Urban & Electrical Solutions Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in planning for the security business.

Satoshi Matsutani
Information Equipment Engineering Dept., System Integration & Development Div., Information & Control Business Management Div., Hitachi Power Solutions Co., Ltd. He is currently engaged in the integrated security solutions business.

Hironari Nakata
Image & Security System Design Dept., Image System Solution Division, Hitachi Industry & Control Solutions, Ltd. He is currently engaged in the integrated security solutions business.

Shinya Kaneko
Security System Engineering Department, Security & Utility Solutions Division, Urban & Electrical Solutions Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in the security business, dealing with access control systems.