Environmental Monitoring

Definition:

An Environmental Monitoring Program (EMP) is a documented, scientifically valid verification program designed to assess the effectiveness of the cleaning and sanitation program and other controls in minimizing the risk of environmental pathogen contamination of the food.

This is especially important in ready-to-eat (RTE) food production environments, where the food product is exposed to the environment post-lethality before being packaged and does not receive treatment or otherwise include a control (such as a formulation that controls the growing conditions of the pathogen) that would significantly minimize or prevent the pathogen from causing illness.

The EMP involves the development of a systematic sampling and testing plan of surfaces (Zones 1–4), air, humidity, or other environmental factors to detect the presence of target microorganisms such as Listeria monocytogenes, Salmonella spp. or other indicator organisms. It includes, among other activities:

- Procedures for the identification of the locations from which samples will be collected and the number of sites to be tested during routine environmental monitoring.
- Procedures for the determination of the timing and frequency for collecting and testing samples.
- Analytical testing methodology and laboratory qualification.
- Interpretation criteria.
- Statistically significant evaluation of the data collected for trending.

The program serves to verify that the cleaning and sanitation controls are effective in controlling the environmental pathogen. It may also be used as part of a validation process during the cleaning program's initial implementation or design to ensure the facility is working under sanitary conditions.

Implementation & Audit Guidance

What does it mean?

An Environmental Monitoring Program (EMP) is a proactive verification system designed to detect and control environmental contamination of the food, particularly from pathogens such as Listeria monocytogenes or Salmonella spp., in areas where food is handled, processed, exposed, stored, or packed. EMPs could be essential tools for all food processes, regardless of risk level, but are particularly critical in facilities producing ready-to-eat (RTE) foods, where post-lethality exposure may occur before packaging.

These programs focus on assessing the hygienic conditions of the processing environment by identifying microbial risks that may persist on surfaces, equipment, or within the facility's zones that, if uncontrolled, could lead to product contamination and subsequent consumer illness. An effective EMP provides evidence that sanitation and other preventive controls are functioning as intended, supports timely corrective actions when contamination is detected and ensures

the facility remains under sanitary conditions. EMP requirements may also be triggered by regulatory classification of a product as high risk, a history of foodborne illness outbreaks associated with similar products or processes, or customer specifications (e.g., GFSI-benchmarked schemes like SQF, which emphasize risk-based environmental control). Thus, EMPs are not only a compliance tool but also a critical element of modern food safety systems focused on continuous improvement and risk mitigation.

Why is it in the Code & why is it important?

Environmental Monitoring Programs (EMPs) are embedded in the SQF Code, food safety regulations, and industry codes because they provide an essential verification of sanitary conditions in a food facility due to effective cleaning and sanitation controls in high-risk food processing environments.

While environmental monitoring programs provide value to all food companies, their scope and intensity must be based on the risk of cross-contamination with environmental pathogens. The SQF Code requires a risk assessment to determine the type and frequency of controls needed. This means that facilities must first perform a hazard analysis and risk assessment of their processes and environments to determine the likelihood and severity of contamination with an environmental hazard.

In practice, this risk assessment should consider:

- Product type and risk profile: Foods that support pathogen growth (e.g., deli meats, soft cheeses, cut produce) present a higher risk than foods with intrinsic barriers (e.g., low pH or low water activity).
- Process flow and exposure points: RTE products exposed to the environment after a kill step (post-lethality exposed) are high risk, especially if they pass through slicing, peeling, repackaging, or cooling stages, where contamination can occur.
- Facility design and zoning: Poor separation of raw and RTE areas, shared equipment, or inadequate control of personnel and traffic flows increases risk.
- Historical data: Recurring positives in environmental swabs, regulatory findings, or industry outbreak history linked to similar foods/processes indicate elevated risk.
- Environmental conditions: Presence of moisture, condensation, drains, and niches that favor persistent elevated contamination risk.

Facilities identified as low risk (e.g., dry facilities producing baked goods) may justify limited or targeted EMP activities, whereas high-risk facilities (e.g., RTE meat, seafood, produce, and dairy plants) must implement comprehensive EMPs with routine Zone 1–4 sampling, trend analysis, and robust corrections, corrective actions and preventive actions.

The assessment should be documented and periodically re-evaluated, especially when there are process changes, new equipment installations, or product changes. Industry guidance stresses that even when risk appears low, verification through at least some level of environmental monitoring is strongly recommended, because Listeria monocytogenes and other environmental pathogens are known to persist in niches and spread through cross-contamination.

Ultimately, a risk-based EMP ensures resources are allocated proportionally to the risk level:

- Facilities at higher risk devote more sampling sites, more frequent swabbing, stricter corrective actions and the use of statistical tools to identify problematic sites that will require

thorough cleaning.

- Facilities with lower risk demonstrate that their monitoring is adequate to verify the environment remains under sanitary conditions without unnecessary burden.

The risk-based approach aligns with both regulatory requirements and the SQF Code expectations for continuous improvement in food safety risk management.

The timing of environmental swabbing is just as important as its frequency, because environmental pathogens, such as Listeria monocytogenes or Salmonella spp., are most likely to be detected when equipment and environments are under normal production stress. Best industry practice recommends that:

- Swabbing should be performed during production, not immediately after cleaning and sanitizing. Pathogens are unlikely to be detected right after sanitation, so sampling at that time gives a false sense of security.
- Sampling should occur after at least 3–4 hours of production, when equipment has been in use long enough for harborage sites or cross-contamination points to reveal themselves.
- For facilities with short production runs (e.g., small bakeries, specialty processors), swabbing should be conducted at the mid-to-tail end of production to maximize the likelihood of detecting contaminants.
- Additional "for-cause" sampling (i.e., outside routine schedules) should be performed after significant events such as equipment breakdowns, water leaks, changes in production flow, or positive product test results.

The frequency of environmental monitoring must be risk-based, reflecting product type, facility design, and historical data:

- High-risk RTE facilities (e.g., deli meats, seafood, soft cheeses) should swab at least weekly, with many facilities adopting multiple Zone 1–4 samples per line, per shift.
- Moderate-risk facilities (e.g., frozen meals, cut produce) may swab weekly or bi-weekly, depending on exposure and risk analysis.
- Lower-risk facilities (e.g., dry baked goods) may swab monthly or quarterly, but must still include drains, condensate-prone areas, or equipment where moisture intrusions occur.
- Regardless of baseline frequency, trend analysis must be performed on results to detect patterns of recurring contamination, which may trigger intensified or expanded sampling. A statistical approach should be used to trend the behavior of the environmental pathogen.

The inclusion of EMPs in the SQF Code emphasizes that visual inspection and standard cleaning alone are insufficient. Pathogens are often harbored in difficult-to-clean areas (e.g., bearings, drains, conveyor undersides, niches within equipment, or areas where condensation occurs) and can persist in biofilms despite aggressive sanitation. Swabbing strategies must therefore include food-contact surfaces (Zone 1) as well as indirect-contact and non-food-contact areas (Zones 2–4), since these can act as transfer points to the product. This guidance stresses that EMPs must be scientifically valid, risk-based, and adequately frequent to demonstrate that preventive controls are working.

As a reference, the following are acceptable ways to define the "zones" when sampling the environment:

- Zone 1 refers to all direct food-contact surfaces, such as slicers, mixers, conveyors, utensils, racks, and worktables.

  - A food contact surface also includes those surfaces from which drainage, or other transfer, onto the food or onto surfaces that contact the food ordinarily occurs during the normal course of operations. Food-contact surfaces include utensils, tools and food-contact surfaces of equipment.

- Zone 2: Encompasses the areas directly adjacent to food contact surfaces (Zone 1).
- Zone 3: The area immediately surrounding Zone 2. Zone 3 is an area that, if contaminated with a pathogen, could lead to contamination of Zone 2 via the actions of people or the movement of machinery. Examples of Zone 3 areas include: corridors and doorways leading into food production areas or areas in large production room that are further away from food-handling equipment than typical zone 2 areas.
- Zone 4: The area immediately surrounding Zone 3 is generally considered a remote area. Zone 4 is an area that, if contaminated with a pathogen, could lead to contamination of Zone 3 via the actions of people or machinery. Examples of Zone 4 areas include an employee locker room (if not immediately adjacent to food production), rooms, dry goods storage warehouse, finished product warehouse, cafeterias, hallways, and loading dock area.

An EMP is not simply a requirement in the SQF Code but a core safeguard for public health. Without it, environmental pathogens can silently contaminate products, leading to costly recalls, major outbreaks, and loss of consumer trust. For this reason and according to a risk assessment, the SQF Code treats the absence of an effective EMP, without a risk assessment, as a major non-conformance. Properly implemented EMPs not only verify the effectiveness of the cleaning and sanitation program and, hygienic zoning (e.g., segregation of raw and RTE areas, dedicated staff, tools, and uniforms post-process) but also drive a "seek and destroy" or "diligently looking for the environmental pathogen or indicator organism" culture in which facilities actively search for and eliminate contamination sources.

Environmental Monitoring
Guidance Document

RIO Road to Audits (Records, Interviews, and Observations)

Records

The SQF auditor may review the following or similar documents or records:

- *Hazard analysis identifying environmental pathogens as a reasonably foreseeable hazard.*
- *Program Design and Risk assessment justifying the scope and intensity of the EMP (product type, process flow, facility design, historical data).*
- *Written EMP procedures, including sampling plan, frequency and timing of sampling, target organisms, analytical methods used, laboratory qualifications, routine monitoring records, swabbing logs, production conditions during swabbing, laboratory results, trending reports, and as applicable, statistical approach.*
- *Corrections, Corrective Actions, Preventive Actions.*
- *Immediate corrections (e.g., re-cleaning, re-sanitizing of positive area).*
- *Corrective action investigations*
- *Preventive action documentation*
- *Verification that*

Interviews

The SQF auditor may interview the following site personnel:

- SQF Practitioner / HACCP Coordinator
- Person responsible for EMP design, hazard analysis, and verification.
- Sanitation Supervisor / Sanitation Crew
- Quality Assurance (QA) / Microbiology Lab Staff
- Production Supervisors and Line Operators
- Maintenance or Engineering Staff
- Senior Management / Food Safety Team Lead

The SQF auditor may ask the following questions:

- 1. SQF Practitioner / HACCP Coordinator

How did you determine that Listeria monocytogenes is a reasonably foreseeable hazard in this facility?

Can you walk me through how sampling sites were selected?

How do you verify that corrective actions were effective after a positive swab?

How often do you trend

Observations

The SQF auditor may observe the following or similar activities:

An auditor can observe whether the EMP is a "paper program" or a living system, demonstrated through zoning, sanitation, proper swabbing practices, records, corrections, corrective actions and preventive actions follow-up, and staff knowledge, skills and attitudes (Culture). A strong EMP shows not just test results, but active verification and continuous improvement.

- Facility and Zoning Controls

Clear separation of raw and RTE zones (e.g., barriers, airflow direction, physical segregation).

Hygienic zoning in practice: restricted access to high-risk areas, controlled traffic flow, and use of color-coded uniforms, tools, or footwear.

Evidence of dedicated tools and equipment for post-lethality areas.

- Sanitation Practices

Sanitation being performed according to written SSOPs (e.g., correct use of detergents/sanitizers, contact time, concentration).

Cleaning of hard-to-reach areas (bearings, drains, conveyor undersides) that are often linked to Listeria

corrective actions were effective

- *Verification and Validation Records*
- *Validation of EMP design (e.g., scientific support for sample site selection, historical contamination data, literature references).*
- *Verification of EMP effectiveness (routine review of monitoring records by a Preventive Controls Qualified Individual (PCQI) or HACCP Coordinator).*
- *Internal audits of EMP implementation.*
- *Management review minutes*
- *Supporting Sanitation and GHP Records*
- *Sanitation Standard Operating Procedures (SSOPs) linked to EMP results.*
- *Sanitation logs, including pre-op and post-op inspections.*
- *Hygienic zoning and personnel hygiene program records.*
- *Equipment maintenance and deep-cleaning schedules.*
- *Water and condensation control logs (if applicable).*
- *Regulatory and/or Customer-Driven Records*
- *Records of communications with FDA, FSIS, or third-party certification bodies regarding EMP results.*

EMP results, and who reviews the trend reports?

- Sanitation Supervisor / Crew

What do you do immediately if you receive a positive swab result in your area?

Can you explain the difference between a correction and a corrective action?

How do you document re-cleaning or intensified sanitation activities?

How do you prevent cross-contamination between raw and RTE zones during cleaning?

- QA / Microbiology Staff

How do you ensure samples are collected during production (mid- to late-shift) rather than immediately after cleaning?

Which organism(s) are you testing for, and why?

Can you show me how chain of custody is maintained from swab to lab result?

What do you do if you detect Listeria spp. but not Listeria monocytogenes?

- Production Supervisors / Operators

What hygiene zoning rules apply to your area?

How do you prevent movement of tools or employees between raw and RTE areas?

What is your role if environmental monitoring finds a positive in your production line?

Can you explain why drains persistence.

Staff adherence to pre-op inspections and mid-production cleaning schedules.

- Sampling Procedures in Action

Swabs being taken during production, mid-to-late shift, as FDA recommends, not only post-cleaning.

Correct swabbing technique (right pressure, surface coverage, aseptic handling).

Chain of custody maintained — samples properly labeled, stored, and transferred to the lab.

Appropriate zones being sampled (Zone 1 food-contact, Zone 2 near-food-contact, Zone 3 facility surfaces, Zone 4 remote areas).

- Records and Trend Analysis On-Site

EMP records available and consistent with what staff describe (sampling logs, lab results, corrective action reports).

Evidence of trend analysis — charts, graphs, or summaries that demonstrate the facility reviews results over time.

Positive findings followed by documented corrective and preventive actions (re-cleaning, root cause investigations, equipment redesign, intensified sampling).

- Corrections, corrective actions and preventive actions in Practice

Corrections: immediate re-cleaning and re-sanitizing

▪ *Records of any product holds, releases, recalls, or regulatory notifications linked to EMP positives.* ▪ *Customer audit findings and corrective action responses related to EMP.*	and floors are swabbed even though they don't directly contact food? ▪ Maintenance / Engineering Staff How do you design or modify equipment to minimize harborage points? Can you describe how you coordinate with sanitation or QA when equipment repairs are made? How do you validate that new or repaired equipment can be effectively cleaned? ▪ Senior Management / Food Safety Team Lead How often does senior management review EMP results and trend reports? How do EMP findings feed into your CAPA and continuous improvement program? Can you give an example where EMP results led to a facility-wide improvement? How do you ensure adequate resources (staff, time, lab capacity) are available to sustain the EMP?	after a positive. Corrective actions: evidence of root cause elimination (e.g., sealing a cracked floor drain, retraining staff). Preventive actions: facility improvements driven by EMP data trends (e.g., replacing equipment, upgrading sanitation chemicals, adjusting swabbing sites). ▪ Culture and Staff Awareness Employees in high-risk zones following hygiene protocols (handwashing, gowning, footwear changes). Operators and sanitation staff able to explain their role in the EMP and the importance of swabbing. Evidence of management oversight, such as leadership reviewing results, posting trend charts, or communicating findings during meetings. ▪ Regulatory and Customer Compliance The facility demonstrates awareness of compliance with regulatory requirements, as applicable. Corrective actions and follow-ups align with regulatory expectations (e.g., intensified sampling after positives). Records show compliance with customer requirements (e.g., GFSI schemes, like the SQF Code).

Additional References

- Zosi learning
- 3M EMP assessment tool
- Codex Alimentarius Commission. (2022). General Principles of Food Hygiene CXC 1-1969 (Rev. 2022). Rome: FAO/WHO.
- U.S. Food and Drug Administration (FDA) Code of Federal Regulations. (2025). 21 CFR Part 117 — Current Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventive Controls for Human Food (up to date as of Jan 16, 2025). U.S. Department of Health & Human Services.
- FDA. (2017, updated). Draft Guidance for Industry: Control of Listeria monocytogenes in Ready-To-Eat Foods.
- U.S. Department of Agriculture, Food Safety and Inspection Service (FSIS). (2014). Compliance Guideline: Controlling Listeria monocytogenes in Post-lethality Exposed Ready-to-Eat Meat and Poultry Products.
- The Codex Alimentarius General Principles of Food Hygiene (CXC-1 1969) emphasizes, in Section 1.