Hygienic Design in Legacy Food Manufacturing Facilities: Risk Evaluation, Prioritization, and Practical Compromises

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WEBINAR MODERATOR: Jason White, Chair of Sanitary Equipment and Facility Design PDG

Organized by Sanitary Equipment and Facility Design PDG

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Neil Bogart is the Asst. Director of Sanitation CoE at Post Consumer Brands. With over 25 years of food industry experience—including roles at Ecolab and founding his own consulting firm—he specializes in CIP systems, sanitary design, and microbiological support. The 2024 IAFP Sanitarian of the Year, Neil holds a Food Science degree from Mississippi State University, a Le Cordon Bleu certification, and multiple advanced food safety credentials.

Paul Mitchell

Paul Mitchell is the founder and owner of PM Food Safety, a sanitation and hygienic design consultancy for the food, feed, beverage, and biopharma industries.

He has a degree in Food Science from Kansas State University, has spent the last 13 years drinking from the fire hose that is the food safety discipline

He is the husband of another amazing food scientist, the father of two small humans, the owner of four large cats, and when he isn’t crawling around spray dryers or cereal extruders, he can be found fishing, gardening, and making bacon.

Hygienic Design in Legacy Food Manufacturing Facilities

Evaluating Risk for Infrastructure & Equipment, Prioritizing Upgrades, and Managing Practical Operational Compromises

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WEBINAR LEARNING OBJECTIVES

1. Evaluate Risks

Learn a practical risk-based approach to assessing legacy facilities, aging infrastructure, and old processing equipment.

2. Manage Compromise

Discover structured strategies for aligning food safety, personnel safety, and inevitable production throughput demands.

3. Program Reassessment

Identify the proactive operational and environmental triggers that necessitate dynamic design re-evaluations.

WEBINAR STRUCTURE & TIMING

A Decisions-Based Agenda

This webinar is designed specifically for cross-functional stakeholders in operations, food safety, sanitation, and engineering. It avoids static design-standards checklists and instead presents dynamic decision-making frameworks.

> *"The goal is simple: map historical plant constraints to modern microbiological expectations."*

Section & Theme	Timing
Introduction & Why Legacy Plants Matter	5 Mins
Understanding & Evaluating Hygienic Design Risk	10 Mins
Hygienic Risk Assessment Frameworks	12 Mins
Operational Prioritization & Strategic Compromise	10 Mins
Reassessment Triggers & Continuous Improvements	10 Mins
Business Case & Project CAPEX Justification	8 Mins

DEFINING THE LEGACY SCOPE

50

YEARS OF IMPACT

The Reality of Inherited Infrastructure

In food manufacturing, a "legacy" plant is any facility operating with layout structures, utilities, or processing equipment designed and executed before current global hygienic regulations.

"We are constantly dealing with the outcomes of previous decisions. The structural and layout paths chosen today will lock in operational risk limits for the next 50 years."

NORMALIZATION OF OPERATIONAL RISK

Slipping Into Silent Vulnerability

When design flaws persist across years of clean operation, teams develop a false sense of security. "Daily workarounds" cease to be categorized as hazards and become normalized operating conditions.

- **Normalized Behaviors:** Overuse of sanitizer to compensate for an unsealable lap joint.
- **Ignored Gaps:** Visualizing a design flaw but relying on "the fact that it hasn't caused a positive test yet."

WHY WE REPEAT PAST MISTAKES

"We've Always Done It"

Defaulting to legacy institutional comfort. "It was good enough for the founders" acts as a cultural shield against modern hygienic retrofitting.

Capital Compartmentalization

Sanitation sits on "maintenance expense lines" while engineering owns CAPEX. Siloed KPIs prioritize purchase price over ease of sanitation.

Immediate Runtime Focus

The operational pressure to "never miss a shipment" treats short-term cleanability issues as acceptable collateral risk.

GLOBAL SANITARY DESIGN PILLARS

To transition legacy assessments from subjective opinion to authoritative design science, audits must align with established international standards:

EHEDG Guidelines

European Hygienic Engineering & Design Group. Focuses primarily on thermodynamic physics, fluid flow behaviors, geometry mechanics, and valid cleanability metrics.

3-A Sanitary Standards

Focuses strictly on specific material processing types (mainly dairy/liquid) requiring stringent, uniform mechanical surface finish measurements and component validation.

NAMI Sanitary Principles

North American Meat Institute. Highly specialized for open product exposure layouts, focusing intensely on material degradation under extreme wet sanitizing environments.

EHEDG GUIDELINE 8: CORE CLEANABILITY

Geometry and Cleanability Science

EHEDG Guideline 8 focuses on minimizing soil accumulation risk by analyzing surface geometries. It mandates avoiding sharp, 90-degree internal transitions.

- **Internal Radii:** Must maintain a minimum radius of to prevent micro-traps.
- **Gravitational Drainage:** All equipment surface layouts must maintain a minimum of a self-draining slope.
- **Avoid Lap Joints:** Metal-to-metal lap joints create persistent capillary spaces.

3-A SSI: MATERIAL & SURFACE FINISHES

The 3-A Sanitary Standards criteria establish strict rules for product contact metals and maximum allowable micro-roughness, aiming to eliminate microscopic crevices.

Parameter	3-A SSI Standard Baseline	Legacy Plant Gap Concern
Surface Finish (Roughness)	Roughness average of $R_a \le 0.8\ \mu m$ (32 micro-inches)	Scratches from aggressive physical pads, chemical etching.
Primary Contact Metals	AISI 300 Series Stainless Steel (or equivalent high performance)	Pitted 304 series, plated steel parts, cast-iron frame connections.
Exposed Pipe Dead Ends	Branch length (L) must not exceed 2 x D (pipe diameter)	Abandon-in-place process bypass lines, legacy dead-legs.

NAMI PRINCIPLES 1-5: SANITARY FRAMEWORK

The North American Meat Institute (NAMI) established ten essential principles for sanitary processing layouts. The first five focus strictly on core mechanical configurations:

1. Cleanable to a Microbiological Level: Surfaces must allow quick, consistent soil removal without harboring microflora.

2. Accessible for Inspection and Maintenance: Disassembly must be rapid, preferably without requiring complex specialized tooling.

3. Compatible Materials: Non-porous, corrosion-resistant metals and stable plastics that do not degrade or absorb moisture over time.

4. No Product or Liquid Accumulation: Avoidance of horizontal shelves, flat framework, or surface dips that collect moisture and product debris.

5. Hollow Areas Hermetically Sealed: Absolute exclusion of hollow rollers or structural tubes that act as inaccessible pathogen reservoirs.

NAMI PRINCIPLES 6-10: INTEGRATION

The remaining five NAMI design guidelines focus on operations, enclosures, and systemic facility compatibility to prevent cross-contamination:

6. No Niches, Pits, or Cracks: Seams must be seal-welded and ground smooth to eliminate protected bacterial microenvironments.

7. Sanitary Operational Performance: Components must not drop lubricants, debris, or moisture onto active product lines during production.

8. Hygienic Enclosure Design: Utility panels, buttons, and switches must be sloped, sealed, and capable of withstanding heavy washdowns.

9. Hygienic Compatibility: Mechanical equipment designs must not compromise adjacent plant systems, such as utility pathways or air-handling systems.

10. Validated Cleaning Protocols: Equipment architecture must remain cleanable with standardized chemical concentrations and clean-in-place designs.

GFSI SECTION JI: REGULATORY COMPLIANCE

The Auditing Benchmark Scope

The Global Food Safety Initiative (GFSI) benchmarking standards have made hygienic evaluation a mandatory audit parameter under Section JI. This shift transitions design assessments from optional engineering reviews to mandatory compliance checkpoints.

"Audit schemes (SQF, BRCGS, FSSC 22000) now demand formal gap analysis documentation comparing legacy plant hardware to Section JI guidelines."

MAPPING STANDARDS TO LEGACY REALITIES

Legacy food plants cannot easily shift to completely seal-welded or brand-new designs. We must establish a clear mapping methodology to apply these rigorous standards:

1. Audit and Score

Apply NAMI or EHEDG mechanical checklist scores directly to individual production components. Document design gaps as physical assets.

2. Filter Gaps

Sort design issues into categories: "Unacceptable Contact Hazards" (requires immediate replacement) vs. "Manageable Non-Contact Defects."

3. Programmatic Patching

Leverage scheduled component modifications, tooling replacements, and regular maintenance windows to incrementally upgrade layout surfaces.

THE HYGIENIC RISK EQUATION

Evaluating Risk as a Calculated Vector

$$\text{Risk} = \text{Probability} \times \text{Severity} \times \text{Detectability}$$

In legacy facilities, **Detectability** is usually the weakest component of the equation. If a microbial harborage is physically nested in an uninspectable area (like a hollow frame), you have zero real-time detectability of a building pathogen vector.

DRY PROCESSING: SALMONELLA THREATS

The Threat of Long-Term Persistence

Salmonella can survive in dry food dust for years. In dry processing zones, introduction of moisture during cleaning is the ultimate operational trigger for bacterial blooms.

- **Dust Shelving:** Uncovered high-bay piping collects particulate organic dust.
- **Micro-Condensation:** Temperature swings in uninsulated metal ceilings introduce trace amounts of water.
- **Dry-Cleaning Limits:** Restricted tools prevent deep validation of hidden crevices.

WET PROCESSING: LISTERIA CONTROLS

Managing the Biofilm Highway

Listeria monocytogenes thrives in cold, wet, organic-rich environments. The primary contamination pathways involve continuous water flow across unsloped structures.

- **Moisture Accumulation:** Standing pools of process water due to settling concrete slabs.
- **Drain Interlinks:** Sump drains with poor backflow prevention trap biological biofilms.
- **Sanitizer Dilution:** Leaking water lines continuously dilute surface protection zones.

LOW-MOISTURE FOODS: THE "WATER EVENT"

Dormant Pathogen Reservoirs

In dry environments, Salmonella typically exists in a metabolically inactive state. It cannot reproduce but can persist indefinitely inside floor cracks or dry equipment joints.

The Triggering Liquid Blast

The introduction of liquid water (via a roof leak, process steam blowdown, or localized cleanup) acts as a high-velocity metabolic trigger. This turns dormant, safe contamination nodes into active, multi-generational bacterial growth zones.

MIXED ZONES: TRANSITION RISKS

Legacy sites often expand incrementally, creating a labyrinth of mixed hygienic zones where raw ingredients and ready-to-eat (RTE) process lines intersect:

Air Pressure Gaps

Uncontrolled airflow paths that pull micro-dust from raw reception areas straight into positive pressure packaging areas.

Traffic Collisions

Shared corridor spaces where sanitation workers, maintenance carts, and waste bins cross paths with finished product logistics.

Zoning Barriers

Lack of logical footbaths, hand wash portals, outer garment checkpoints, or physical line transitions.

PRODUCT RISK CATEGORIZATION

Hygienic design requirements are relative to the final microbial risk of your product. High-risk profiles demand zero structural variance:

Product Exposure Class	Hygienic Design Sensitivity	Critical Infrastructure Demands
Ready-to-Eat (RTE) / Infant Formulas	**Critical**	Hermetic isolation, HEPA airflow, strict visual cleanability access.
Ready-to-Cook (RTC) Process Lines	**Moderate to High**	Controlled cleanability, allergen washdown segregation patterns.
Retorted / Sealed Thermal Processing	Baseline Standard	Operational cleanability to prevent severe mold/spoilage issues.

FLOORING & FOUNDATIONS: THE BEDROCK

Cracks, Pores, and Water Sinks

Concrete in legacy facilities acts like a rigid sponge. When protective epoxy coats wear away, high-load traffic cracks create direct access to sub-slab soil zones.

- **The Squeegee Audit:** Squeegee water across the floor; localized pooling identifies settling foundations.
- **Acid Corrosion:** Dairy acids or citrus juices etch unsealed joints, transforming them into micro-crevices.
- **Thermal Shock:** Steam traps, CIP discharge, fryer oil discharge, can crack monolithic flooring.

DRAINAGE: THE RESERVOIR RISK

Drains as Facility Microbial Sinks

Drains collect all biological debris. In legacy plants, cast iron, unlined gutters, and rough interior welds are common vectors for Listeria harboring.

- **Aerosolization Hazard:** High-pressure water hoses used directly on drains disperse pathogen biofilms into active room air.
- **Backflow Prevention:** Old plumbing pipes lack modern double-check mechanisms.

WALLS & CEILINGS: THE TOP-DOWN DROP

Fiberglass Delamination

Old Fiberglass Reinforced Panels (FRP) with unsealed joints collect water behind the boards, turning the interior wall void into a pathogen harborage.

Condensation Dripping

Uninsulated utility corridors develop persistent surface condensation. Gravity forces these droplets onto active processing lines below.

Flaking Epoxy Paint

Exposed painted structures delaminate under high-chemical washdown pressures, causing severe physical foreign material hazards.

UTILITY ROUTING: PATHOGEN HIGHWAYS

Overhead Forest Accumulations

Legacy facilities are often cluttered with networks of steam lines, pneumatic tubes, and electrical conduits. This complex structural congestion is difficult to inspect or clean.

- **Horizontal Run Risks:** Horizontal pipes collect ambient dust, yeast, and mold spores.
- **Thermal Bridging:** Cold water lines routed directly beside steam conduits trigger severe localized sweating.

ZONING: DESIGNING AROUND TRAFFIC

Mapping the Personnel Matrix

When historical facility blueprints restrict your ability to build physical walls, you must control contamination risks through strict behavioral zoning maps.

- Define absolute paths for raw and cooked personnel.
- Establish clear transitional boundaries on floors with safety tape.
- Dedicate tools to specific zones using color coding.

CLEANABILITY: MICRO VS. ALLERGEN-FREE

Microbiological Cleanliness

Focused on reducing viable microbial populations to safe levels. Allows localized clean-in-place (CIP) recirculation and chemical sanitization, provided surfaces are smooth and lack biological recesses.

Goal: Kill and sanitize active microflora.

Allergen-Free Cleanliness

Demands complete physical removal of allergenic proteins. This requires direct access for scrubbing and visual inspection of all product contact areas. Residual proteins are unaffected by chemical sanitization.

Goal: Complete material extraction.

ACCESSIBILITY: THE TOOL-LESS MANDATE

100% Visual Access

If sanitation technicians cannot physically see a surface, they cannot reliably clean it. Designs must allow direct visual confirmation of clean surfaces.

Ergonomic Reach

Internal components must be accessible within standard reach limits. Forcing workers into awkward physical postures leads to skipped cleaning steps.

Quick-Release Levers

Replace hex-head bolts and machinery fasteners with hand-turned levers, wing nuts, or tool-less clamps to encourage frequent teardowns.

MATERIALS: 316L VS. 304 STAINLESS

Combating Chemical Pitting

While AISI 304 stainless steel is common, it is susceptible to corrosive pitting in high-acid, salty, or heavily chlorinated environments.

- **Molybdenum Protection:** AISI 316L contains 2% molybdenum, providing superior resistance to crevice corrosion and chemical pitting.
- **Preventing Micro-niches:** Pitted surfaces create microscopic harborages that shield bacteria from sanitizing washes.

Stainless Grade	Chemical Resistance	Sanitary Pitting Risk
AISI 304	Moderate	High (in brine/acid lines)
AISI 316L	Very High	Low

IDENTIFYING MECHANICAL GAPS

Lap Joints

Overlapping metal plates without continuous, ground welds create tight crevices. Liquid and food soil enter via capillary action but cannot be cleaned out.

Exposed Threads

Bolts inside product contact zones expose raw, spiral threads. These threads collect soil and are impossible to sanitize without complete disassembly.

Metal-to-Metal Slides

Sleeve fittings and sliding metal collars lack proper gasket seals. Soil penetrates the interface, creating a protected microbial harborage.

HOLLOW AREAS: OUTBREAK SOURCES

The Internal Harborage Risk

Hollow conveyor rollers, square tubing frames, and unsealed support legs are major sources of Listeria in food processing plants.

During high-pressure washdowns, microscopic pinholes in welds act as straws, drawing water and nutrients inside. This creates a highly protected breeding ground that leaks pathogens during production runs.

HUMAN SAFETY VS. FOOD SAFETY

The Machine Guard Dilemma

Machine guards are essential for protecting operators from moving parts. However, these safety structures often block physical and visual access, making thorough sanitation difficult.

Result: Cleaning is skipped, or operators cheat safety protocols.

The Hygienic Solution

Design guards with safety-interlocked hinges that swing open. This allows tool-less access for cleaning while ensuring machine power is cut off before a worker can reach moving components.

Result: Food safety and personnel safety are aligned.

CASE STUDY: BOLTED GUARDS

$1.2M

TOTAL RECALL COST

The High Cost of Inaccessibility

A liquid filler unit was designed with stainless steel guards requiring 12 hex-head bolts to remove. Because disassembly was time-consuming, the sanitation crew skipped cleaning behind the guards.

"Over time, a thick biofilm developed and broke off during a long production run, contaminating the product stream. The resulting microbial recall cost $1.2 million in product losses and brand damage."

LOTO: INTEGRATING SAFETY & SANITATION

Centralized LOTO Stations

Locate Lock-Out Tag-Out isolation points near the equipment. Long walks to remote electrical rooms lead to skipped safety steps.

Sanitation-Specific LOTO

Train sanitation teams on specialized energy-isolation procedures, treating them with the same rigor as maintenance personnel.

Streamlined Verification

Ensure isolation designs allow quick verification of zero-energy states, enabling crews to begin cleaning safely without delay.

DESIGNING FOR THE OPERATOR

Designing for Human Factors

Legacy equipment was often built without considering the physical demands of sanitation. If cleaning is painful, awkward, or dangerous, it will not be done consistently.

- **Safe Work Heights:** Avoid requiring workers to clean high-overhead areas from unstable ladders.
- **Proper Access Gaps:** Ensure machinery clearances allow employees to clean deep inside structures without risk of injury.

Human Factors = Food Safety Success

Making sanitation physically sustainable ensures consistent execution and reliable food safety outcomes.

CHEMICALS & MATERIAL COMPATIBILITY

Using aggressive chemicals to compensate for poor sanitary design can damage materials and create new microbial niches:

Substrate Material	Incompatible Chemistry	Degradation and Risk Outcomes
Aluminum Components	Strong Alkaline / Caustic Cleaners	Rapid chemical corrosion, pitting, and creation of microscopic niches.
Painted Carbon Steel	Chlorinated Foams / High Moisture	Rust formation and flaking paint, creating physical contamination hazards.
Low-Grade Plastics / Gaskets	High-Temperature Sanitisers	Cracking, shrinkage, and material degradation, leading to product harborages.

THE REALITY OF OPERATIONAL COMPROMISE

"We Can't Shut Down"

In commercial operations, shutting down a production line for an ideal engineering upgrade is not always possible. Gaps must be managed through structured operational controls.

The primary danger is allowing a temporary workaround to quietly become the permanent standard operating procedure. (e.g., "we will skip deep disassembly today and catch it on the weekend")

Document All Deviations: Maintain a formal log of design issues that cannot be resolved immediately.

Apply Interim Controls: Use targeted sanitation steps to manage known design gaps.

Establish Safe Operating Limits: Define clear operational boundaries that, if crossed, require a line shutdown.

PRIORITIZING RISKS: THE MATRIX

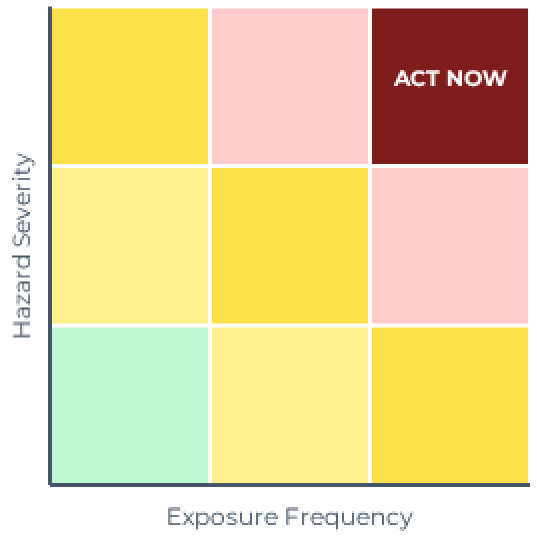
The Risk Prioritization Heatmap

Evaluate known design gaps by plotting

Severity of Exposure against **Likelihood of Contamination**.

- **High Priority (Red):** Direct product-contact surface with zero visual access (Requires immediate modification).
- **Medium Priority (Yellow):** Non-contact surfaces near exposed product (Requires targeted daily sanitizing).
- **Low Priority (Green):** Outer structural frames away from food zones (Include in long-term capital plan).

Contamination Likelihood Map



TEMPORARY RISK MITIGATION

When capital constraints delay a permanent engineering solution, implement a structured hierarchy of temporary controls:

1. **Eliminate:** Can you bypass this piece of equipment or remove the redundant process step?
2. **Isolate:** Install temporary, hygienic shields to protect product from overhead drip hazards.
3. **Monitor:** Increase environmental swab frequencies from weekly to daily around known design gaps.
4. **Validate:** Run extended pre-operational ATP or microbiological testing to prove cleaning protocols are working.

THE BUSINESS CASE: 10 MINUTES

10

MINUTES SQUEEZED

The Hidden Cost of Rushing Sanitation

Operations often pressures sanitation teams to trim 10 minutes off their cleaning schedules to increase production runtime.

- **The Compromise:** Trimming drying time, skipping deep teardowns, or rushing safety checks.
- **The Business Reality:** Saving 10 minutes yields a small production gain, but a single contamination recall can cost millions. Allying sanitation ease with design ROI is the only viable corporate path.

PRESENTATION CONCLUSION

Questions & Discussion

Thank you for your commitment to food safety and operational excellence. Let's open the floor to discuss your specific facility challenges.

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IMAGE SOURCES

https://www.food-safety.com/ext/resources/Images/2025/Sept/HygienicDesignOfFoodProcessingFacilities-900.webp?t=1757692881&width=696

Source: www.food-safety.com

https://blog.aibinternational.com/hubfs/Blog%20Post%20Pictures/blog_foodmanufacturingequipment.jpg

Source: blog.aibinternational.com

https://www.velecsystems.com/wp-content/uploads/sites/2/2023/06/visuel-article-blog-1024x523.jpg

Source: www.velecsystems.com

https://www.provisioneronline.com/ext/resources/Issues/2019/December/1219np_supplierspersp_img1.webp?t=1578340851

Source: www.provisioneronline.com

https://woneclean.com/wp-content/uploads/2025/04/%E5%B0%81%E9%9D%A2-5.png

Source: woneclean.com

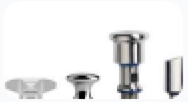
https://sika.scene7.com/is/image/sika/glo-worker-power-wash-cleaning-floor?wid=1920&hei=1280&fit=crop%2C1

Source: www.sika.com

IMAGE SOURCES

https://www.foodengineeringmag.com/ext/resources/Issues/2023/12-Dec/2312drains001.webp?t=1702403807

Source: www.foodengineeringmag.com



https://www.ganternorm.com/fileadmin/user_upload/microsite/hygienic_design/hygienic_design-titelbild.png

Source: www.ganternorm.com

https://danshang.com/wp-content/uploads/2025/12/Key-Requirements-For-Food-Processing-Plant-Flooring.webp

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