Resilience in factory and equipment hygienic design

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Director, Pioneering Safe Food Association

What is resilience?

- *BS 65000:2022 Organizational resilience. Code of practice* defines resilience as the capability of an organisation to be prepared for and adapt to disruption
- **Situational awareness** of current and upcoming events, and an awareness of their likely and potential impacts, based on past events and industry knowledge
- Followed by organisational aspects of **Coherence, Agility, Alignment, culture and leadership** to progress
- Identify the likely hazards/threats that can be controlled and control them

BS 6500 resilience benefits

BENEFITS OF RESILIENCE

- Resistance to supply chain threats
- Service continuity
- Ability to manage change and overcome disruption
- Integration and clarity of purpose across the organisation
- Alignment of short- and long-term goals
- Efficiency and cost-effectiveness
- Good reputation
- Long-term viability prospects
- Ability to capitalise on opportunities
- True continuous improvement

BS 6500 resilience benefits

BENEFITS OF RESILIENCE

- Resistance to supply chain threats
- Service continuity
- Efficiency and cost-effectiveness
- Good reputation
- Ability to capitalise on opportunities

Benefit drivers

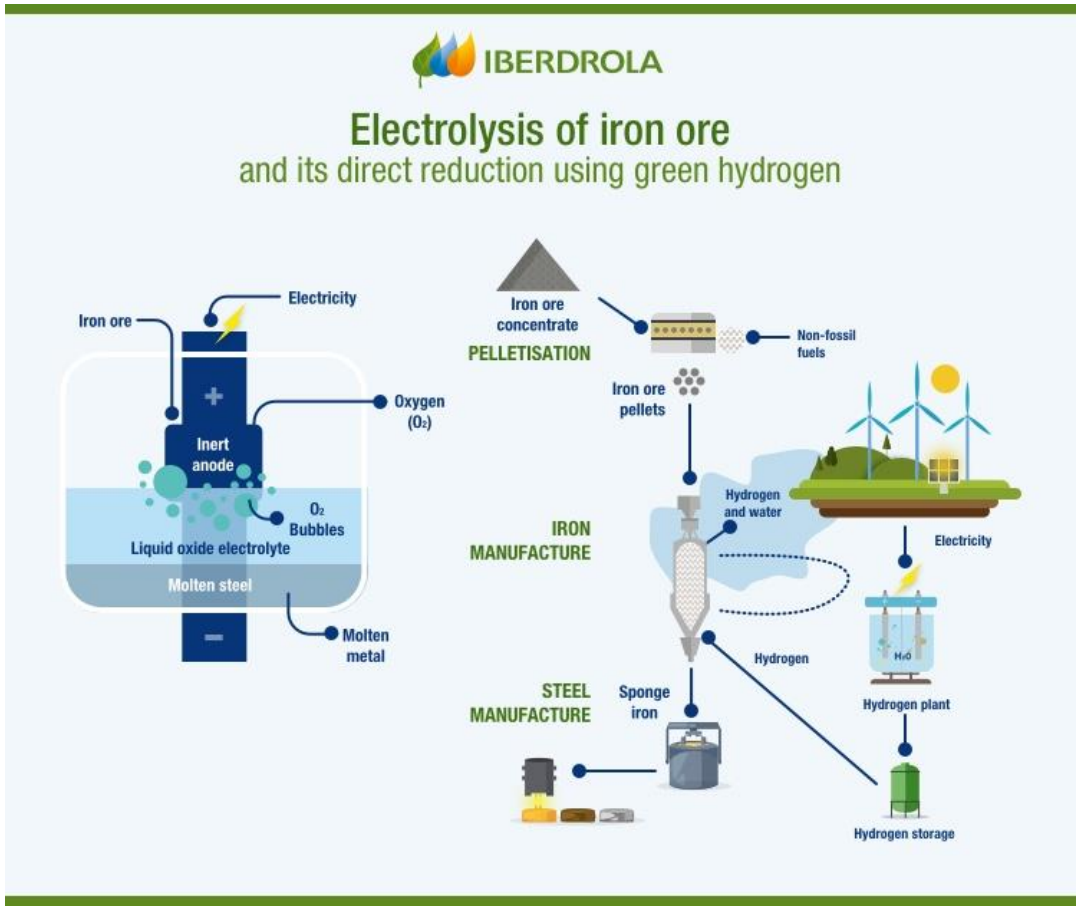
- **Service continuity**
  - Extreme weather events - extreme temperatures, wildfires, floods, droughts and poor crop yields
  - Pandemic – respiratory disease – process/operative safety
  - Labour shortages – automation
  - Preparedness for AI
  - New hazards (pathogens, spoilage, allergen), increased hazard numbers
- **Resistance to supply chain threats**
  - Unable to source required ingredients; available but of varying or unacceptable quality; authenticity issues / food fraud and other malpractices; food safety issues
  - May need thorough and validated cleaning/decontamination
  - From a ‘just in time’ material requirement planning towards a ‘just in case’ mindset warehouse capability
  - Civil unrest, bioterrorism
- **Good reputation**
  - Prevention of recalls by knowing and controlling hazards
  - Impending legislation/GMP – GFSI JI and JII
  - Food safety culture

Benefit drivers cont.

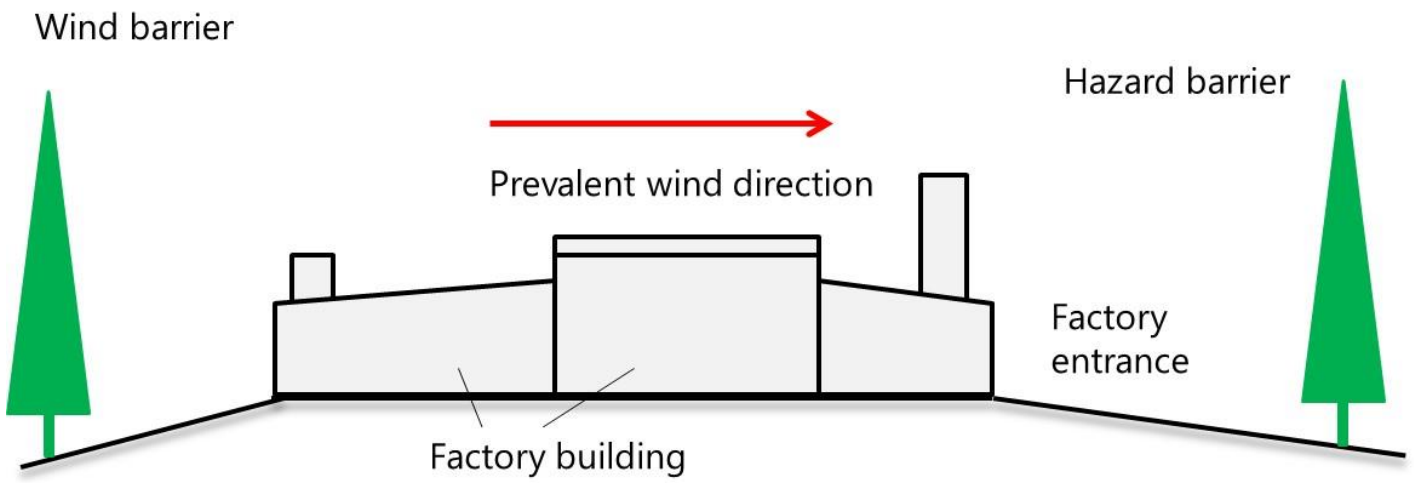
- **Efficiency and cost-effectiveness**
  - Sustainability, waste reduction, waste/water reuse, zero emissions, whole life carbon
  - Understanding of the hygienic design lifecycle – short term/long term costs – total costs of ownership
  - Transport to work, solar panels, wind turbines
  - Waste valorisation
- **Ability to capitalise on opportunities**
  - 5-10 year plan
  - New customer trends – free from
  - Flexibility of build

Other non-resilience drivers

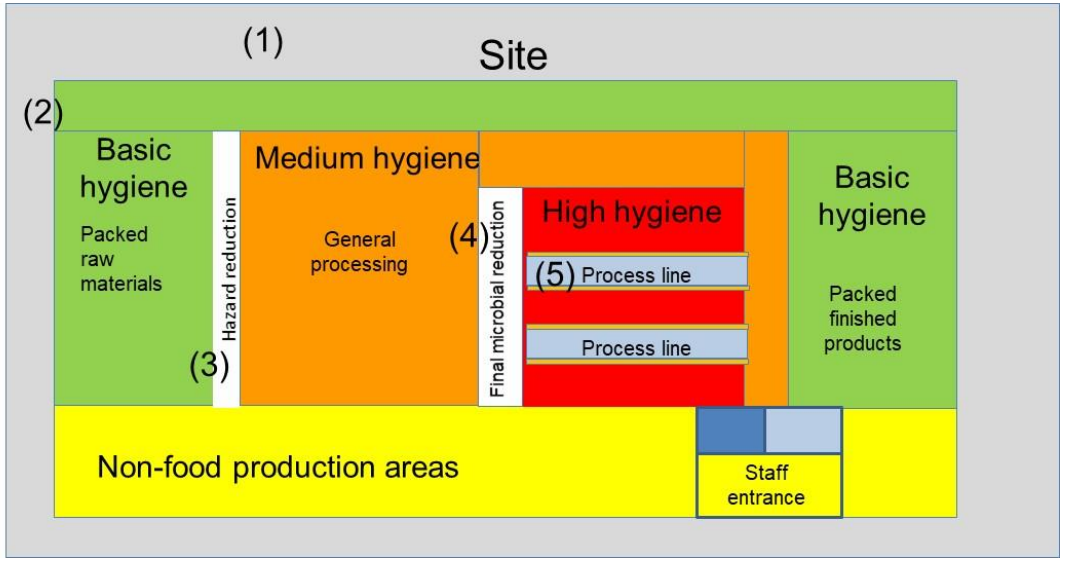
- Building material development, green steel, changes in cleaning mechanisms
- Vertical farming – urban/city food supply



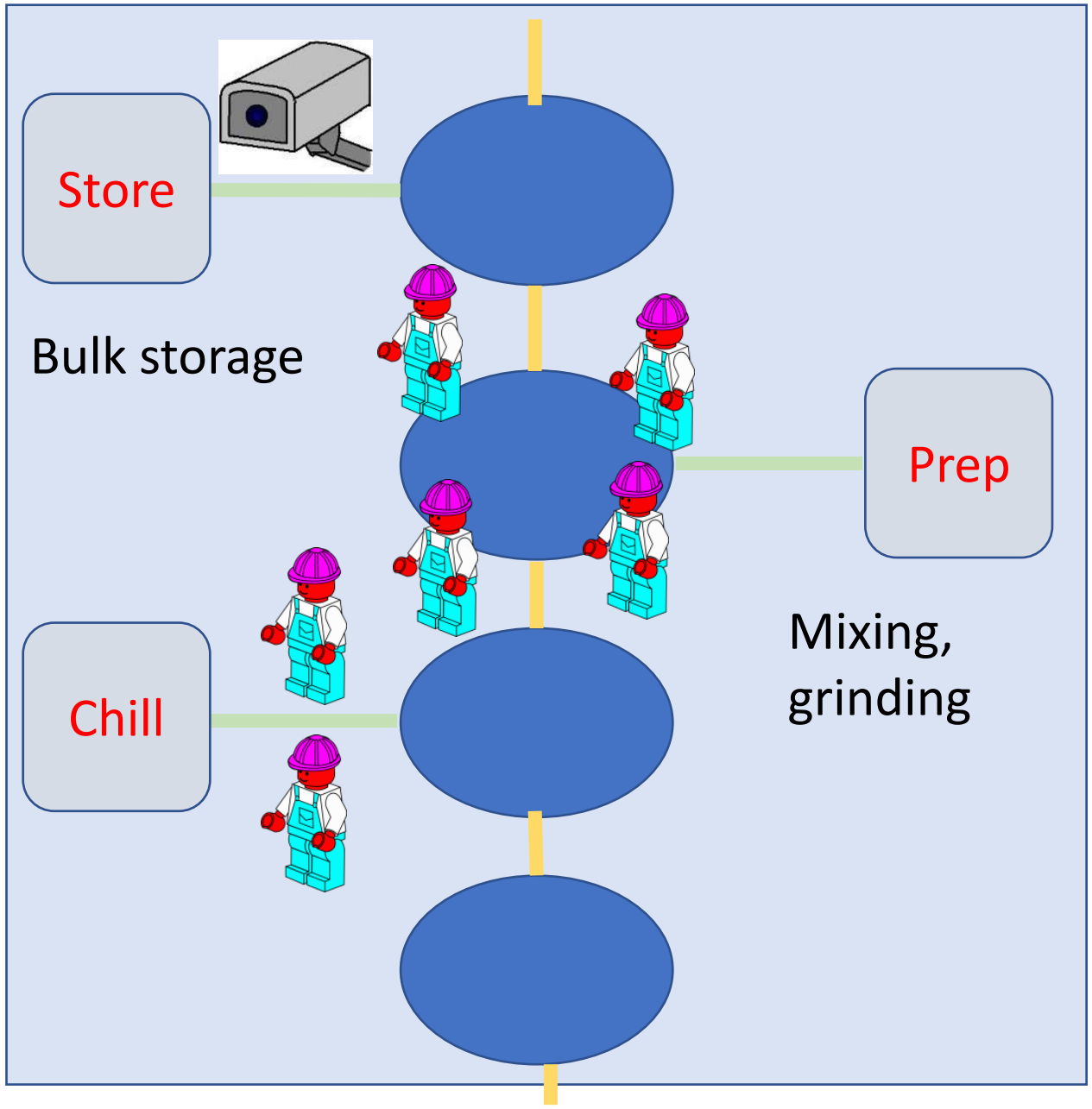
Climate change



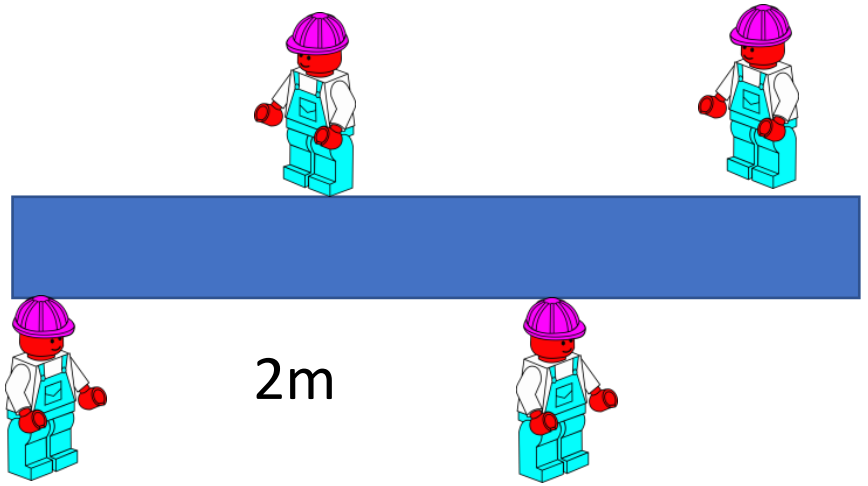
Bioterrorism /fraud control

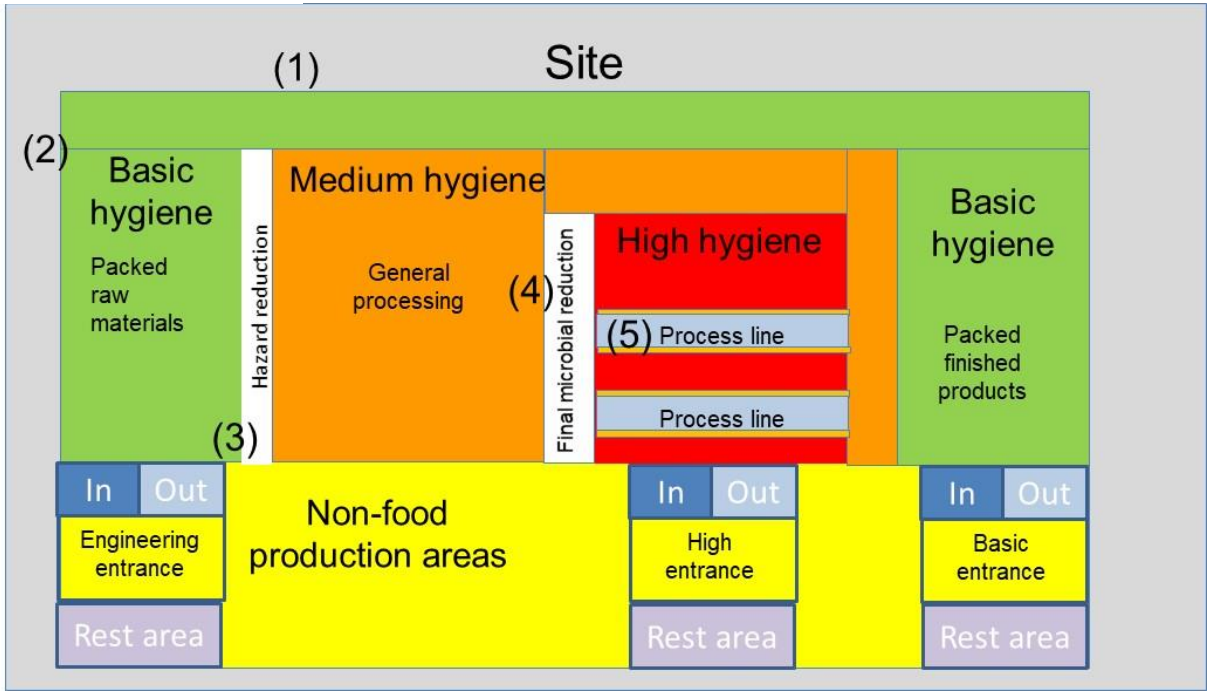


Single entrance
Close together
Mutual surveillance



Respiratory control





Multiple entrance
Staff separation – distance/time
Automation

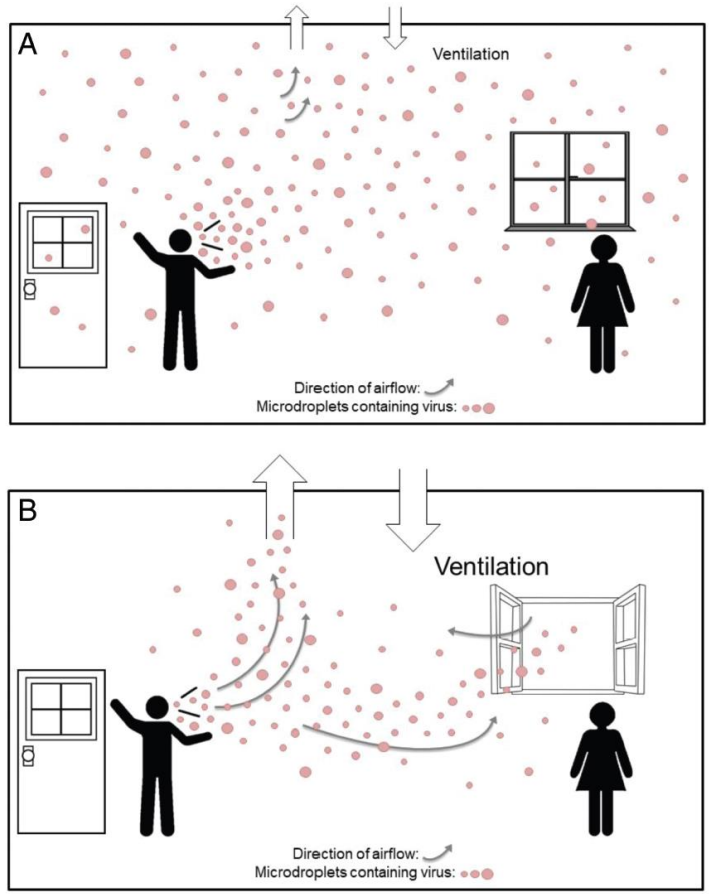


Figure 1. Distribution of respiratory microdroplets in an indoor environment with (*A*) inadequate ventilation and (*B*) adequate ventilation.

Clinical Infectious Diseases

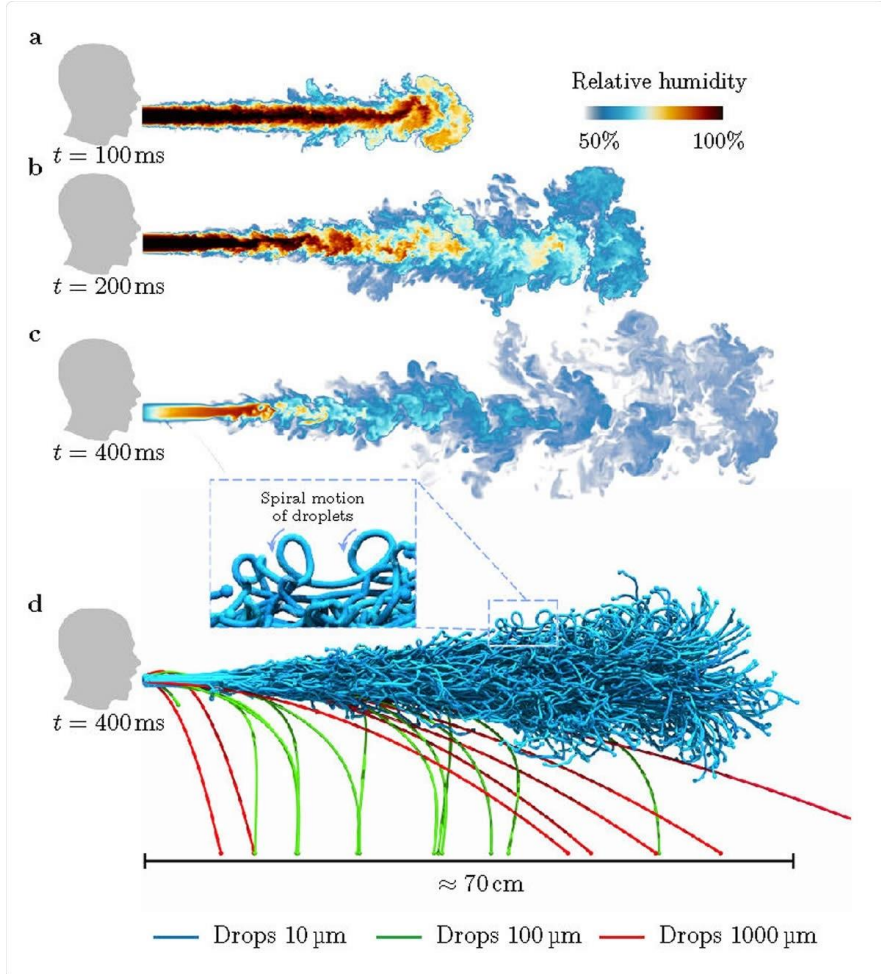
INVITED COMMENTARY

IDSA Infectious Diseases Society of America · hivma hiv medicine association · OXFORD

It Is Time to Address Airborne Transmission of Coronavirus Disease 2019 (COVID-19)

Lidia Morawska[1] and Donald K. Milton[2]

[1]International Laboratory for Air Quality and Heath, WHO Collaborating Centre, Queensland University of Technology, Brisbane, Australia, and [2]Institute for Applied Environmental Health, University of Maryland School of Public Health, College Park, Maryland, USA



SARS-CoV-2 droplets travel further and last longer than thought, and even more in humid air

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Revised

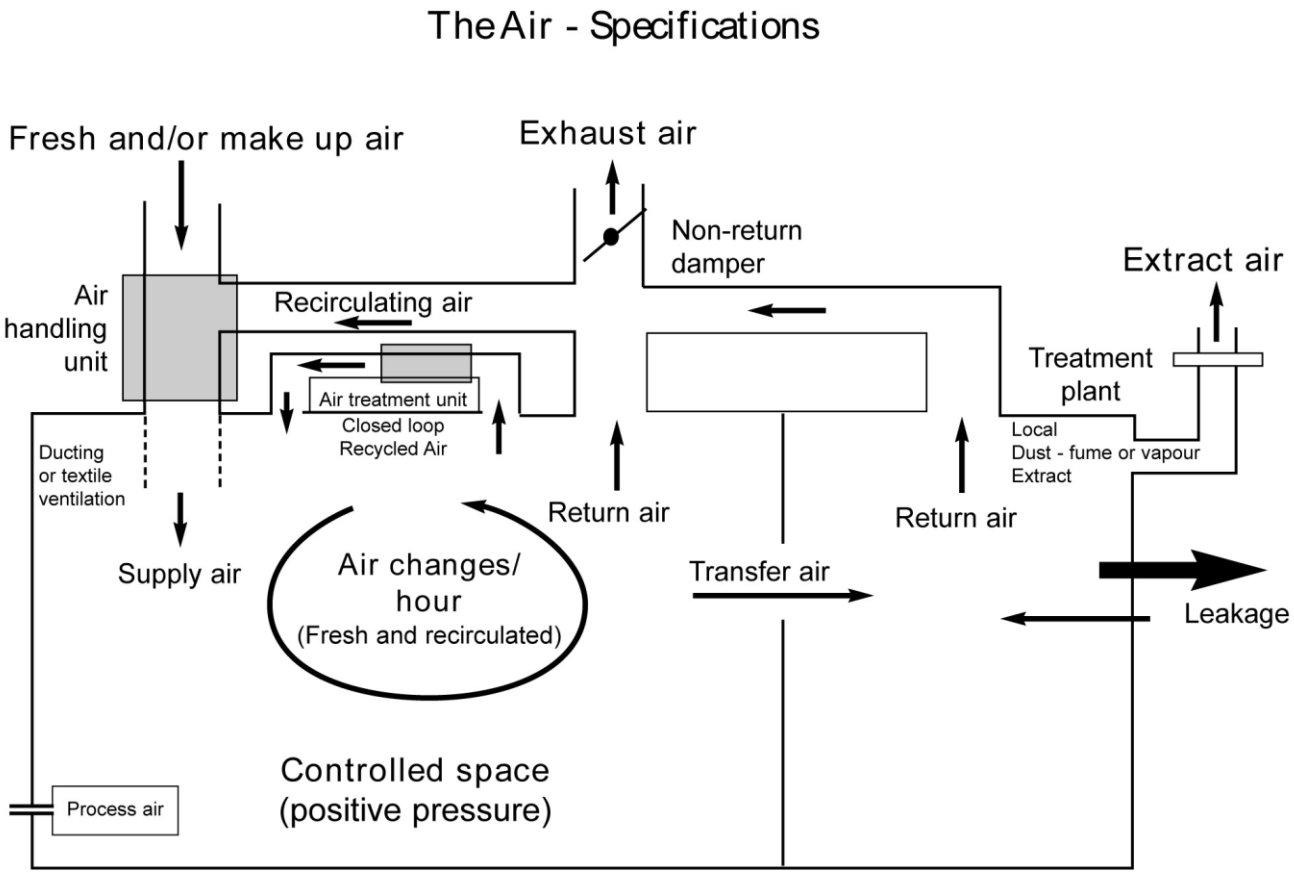
By Dr. Liji Thomas, MD

Aug 10 2020

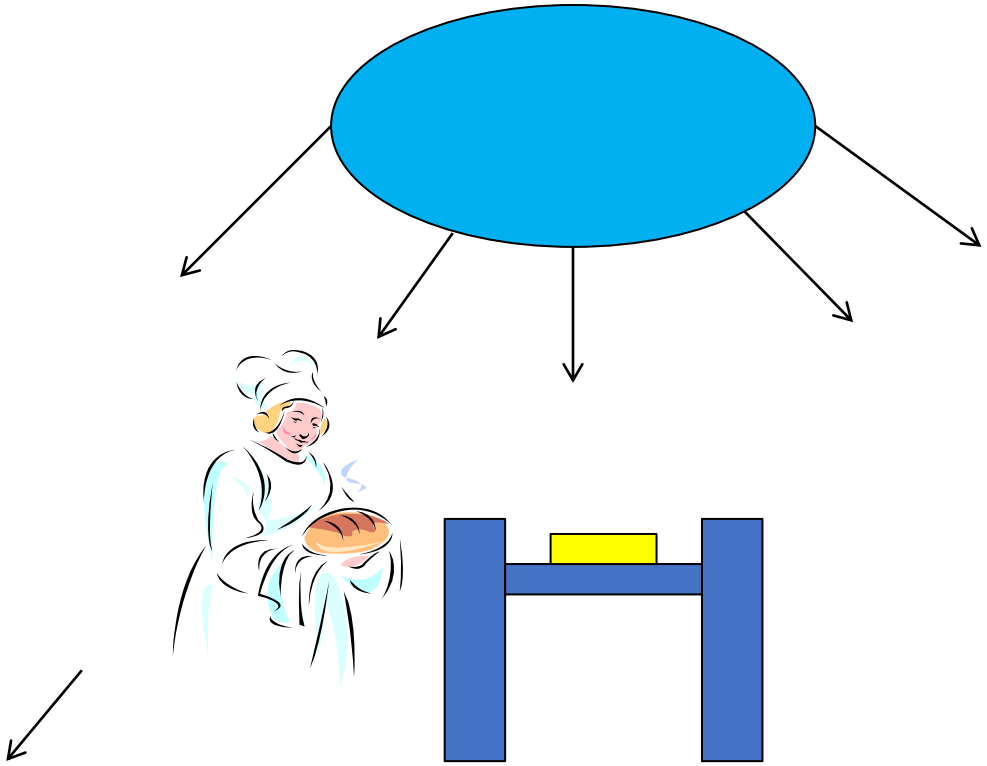
Environmental air terminology

Operational states
- Manufacturing
- Cleaning
- Idle

Requirements
- Fresh air for operatives
- Temperature control
- Filtration for external contaminants
- Air change for internal contaminants
- Overpressure against lower hygiene zones
- Humidity control

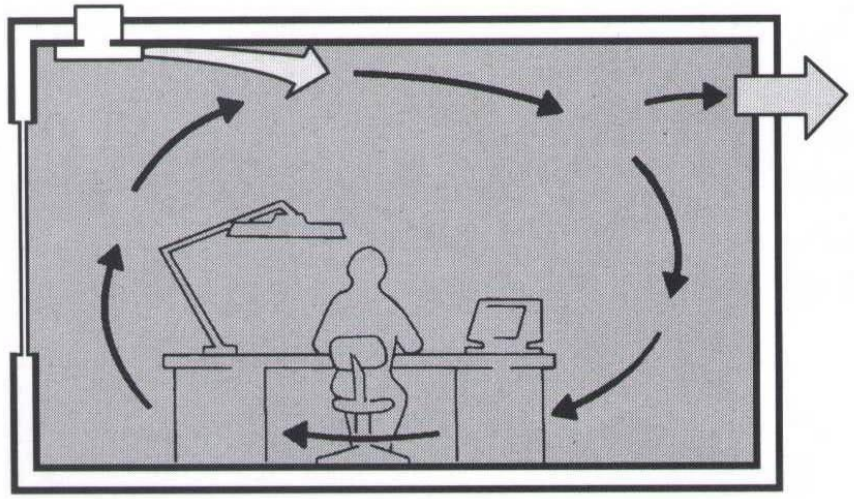


Air socks



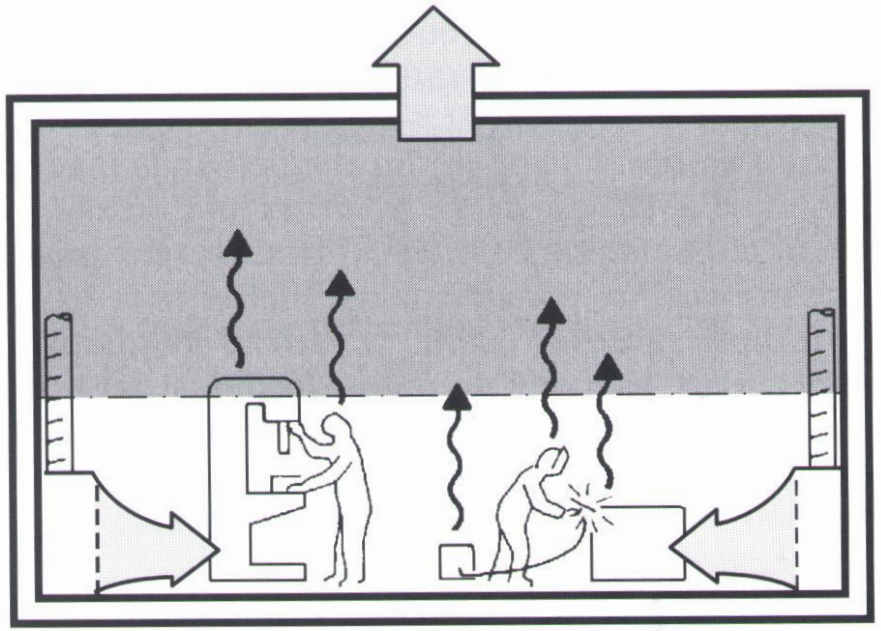
- Reduce air velocity below 0.3m/sec to facilitate cold environments
- Some directional air movement

Types of Air System



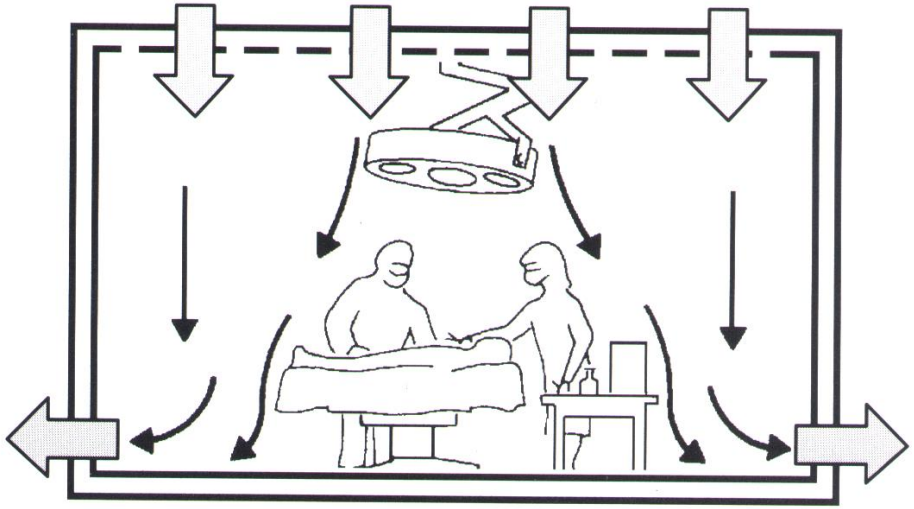
Mixing

Displacement

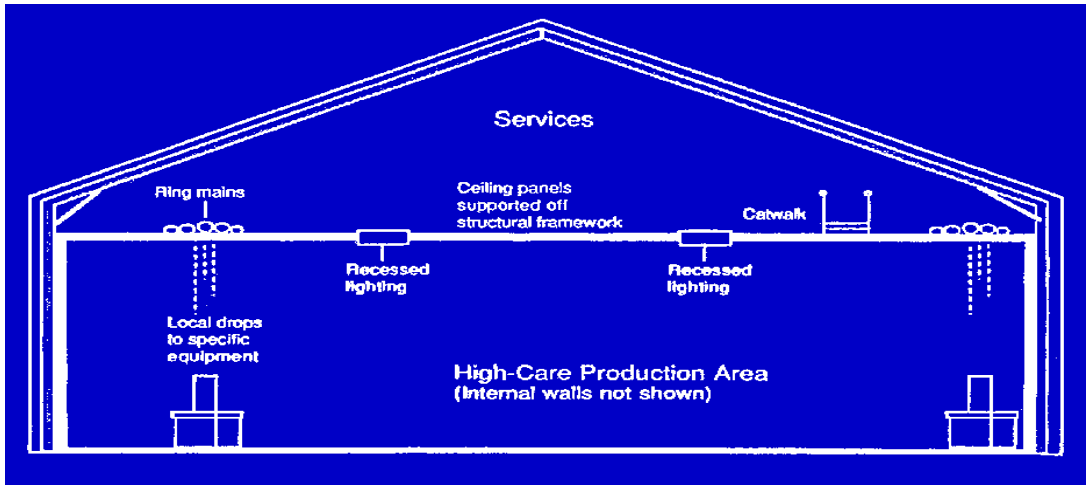


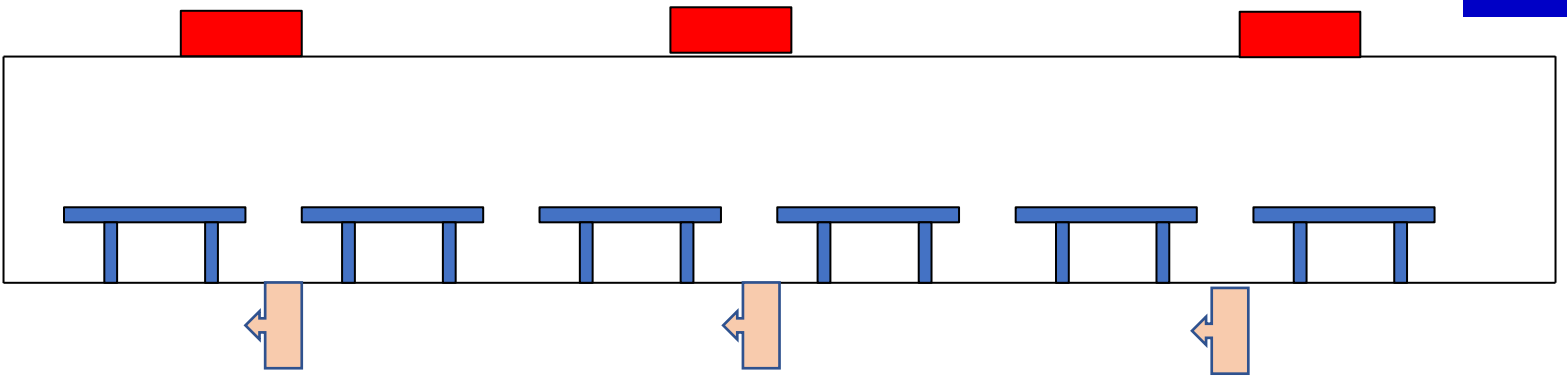
High air changes/hour
Slight negative pressure

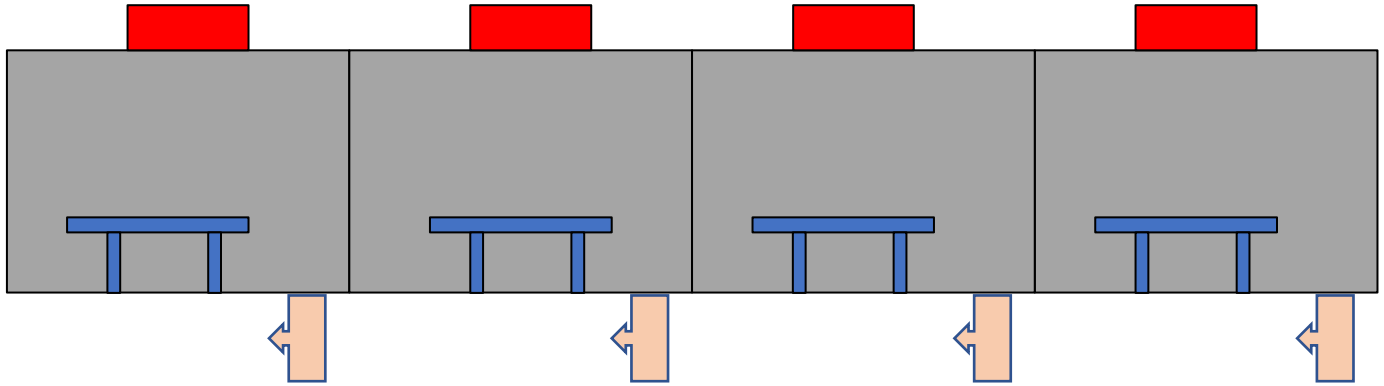
Laminar



Boxes within boxes





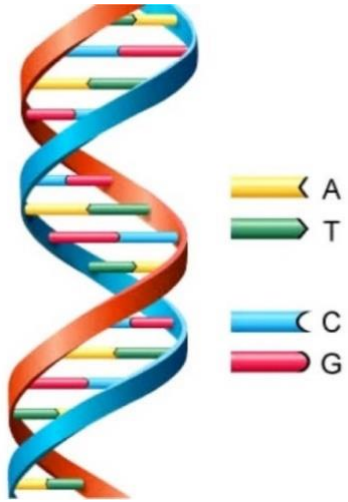


Easy to manage?

- Manufacturing flexibility
- Infection control
- Allergens, higher mo products, brand protection

GMP/legal <1% product
1000kg batch = 10kg residue

Protein (allergen), DNA detection limit 1-2pg/ml



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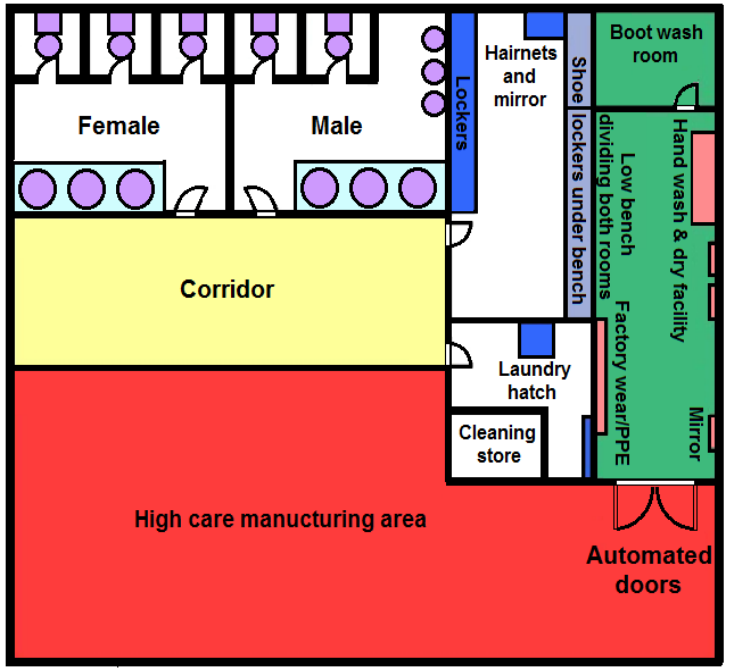
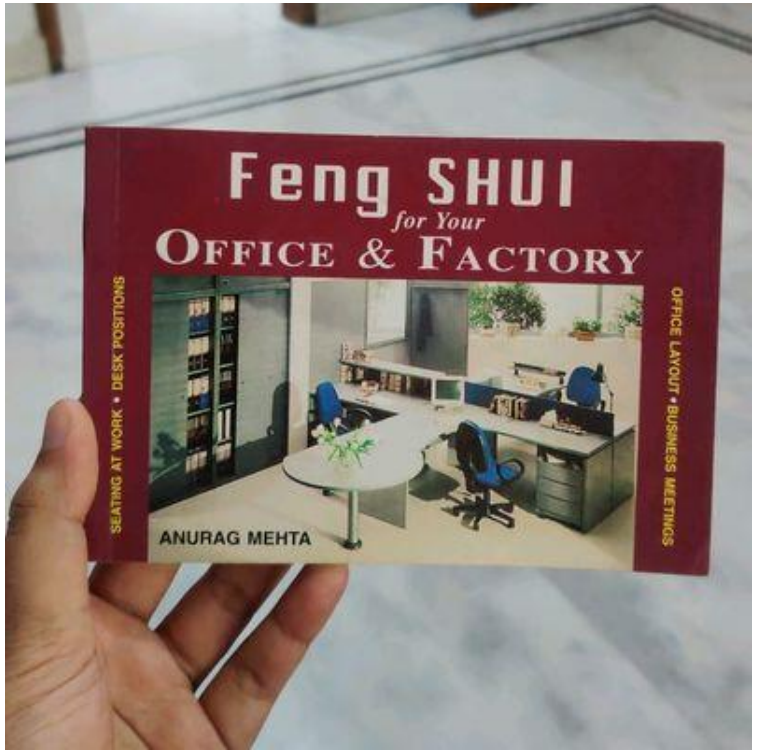
We may never be able to design or segregate a factory to ensure products are free of some hazards/brand protection issues if those elements are on site e.g.

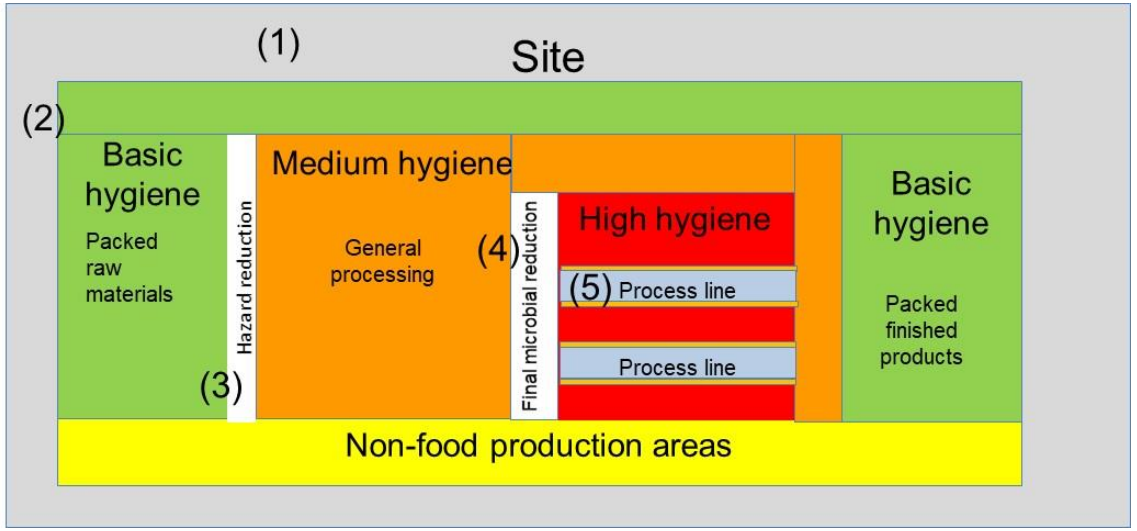
- Allergenic protein
- Meat in a vegetarian product
- Animal proteins in a vegan product
- A meat species – e.g. pork in a beef product

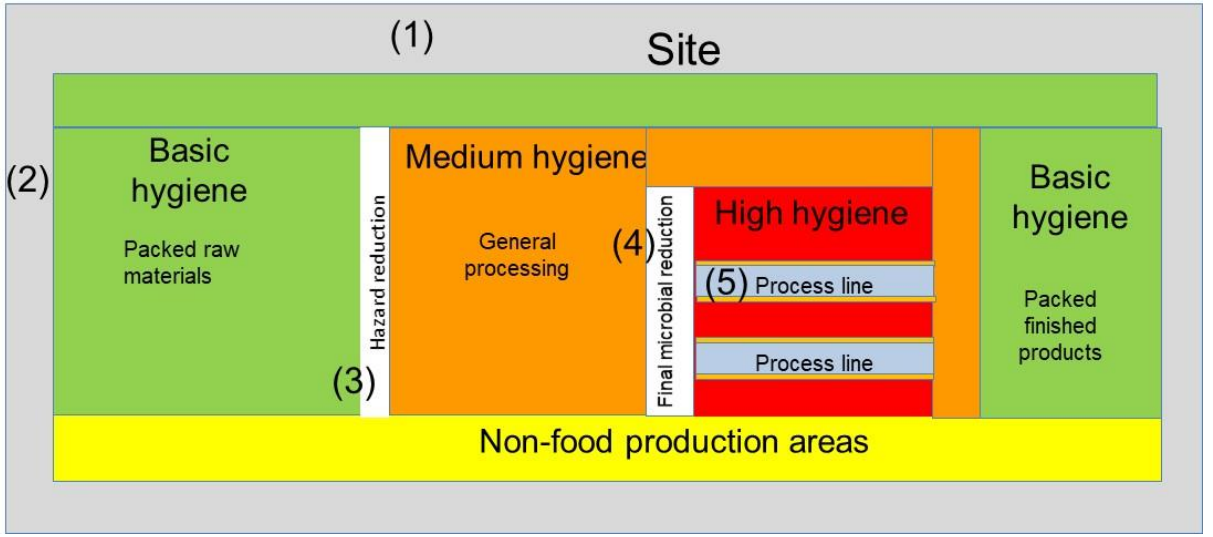
Food safety culture

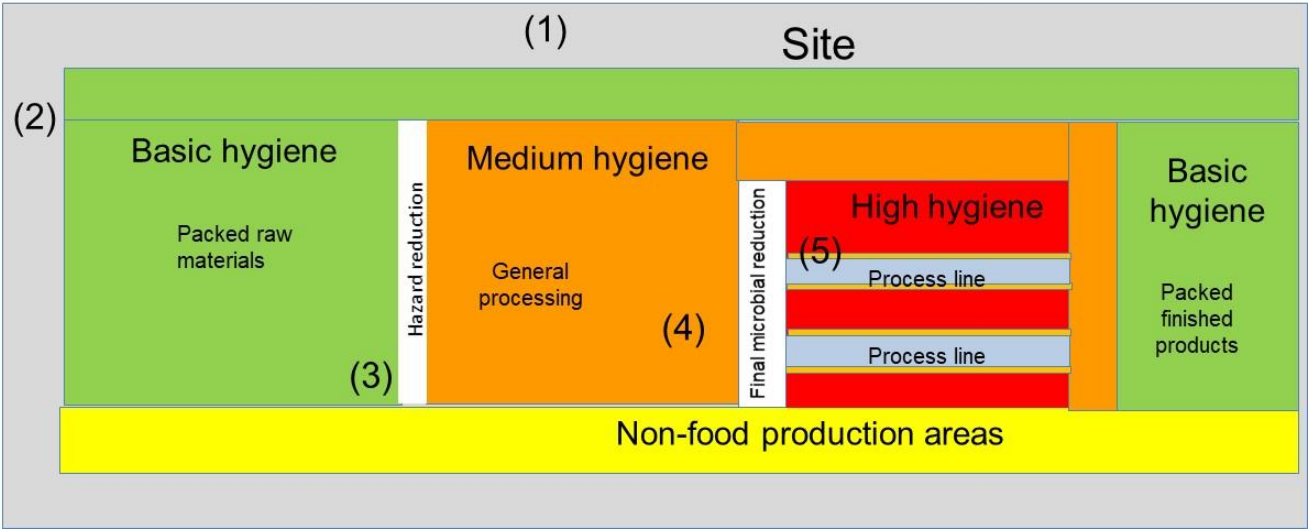


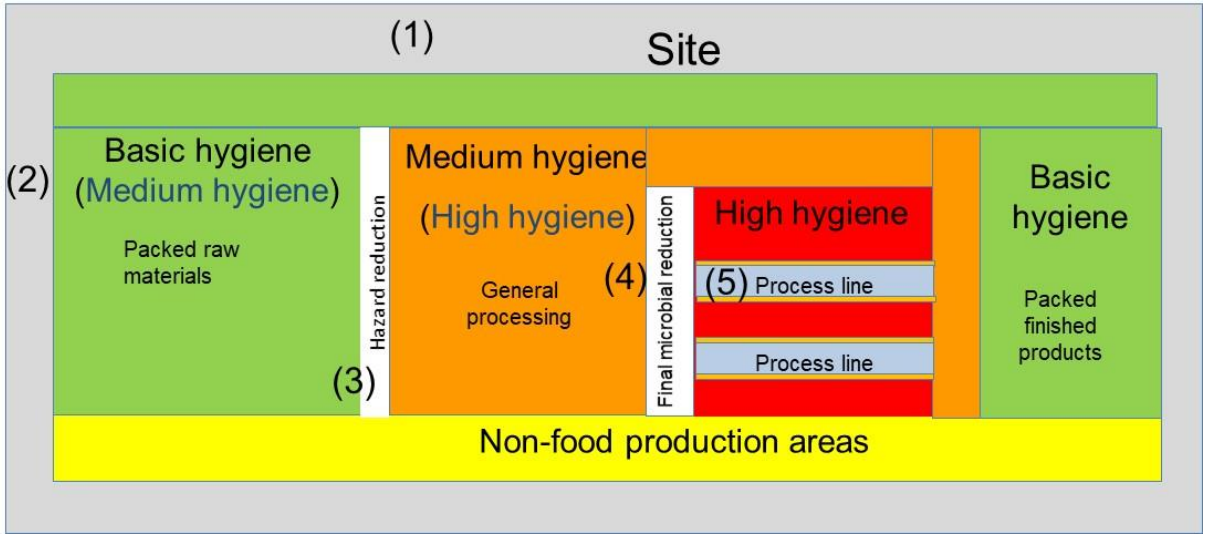


Future expansion

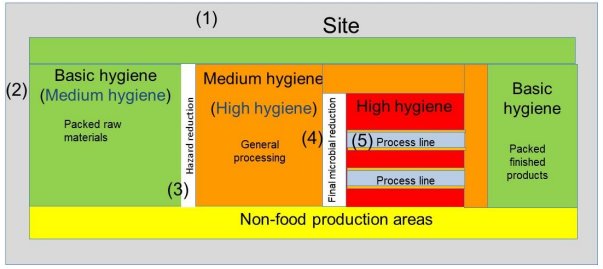






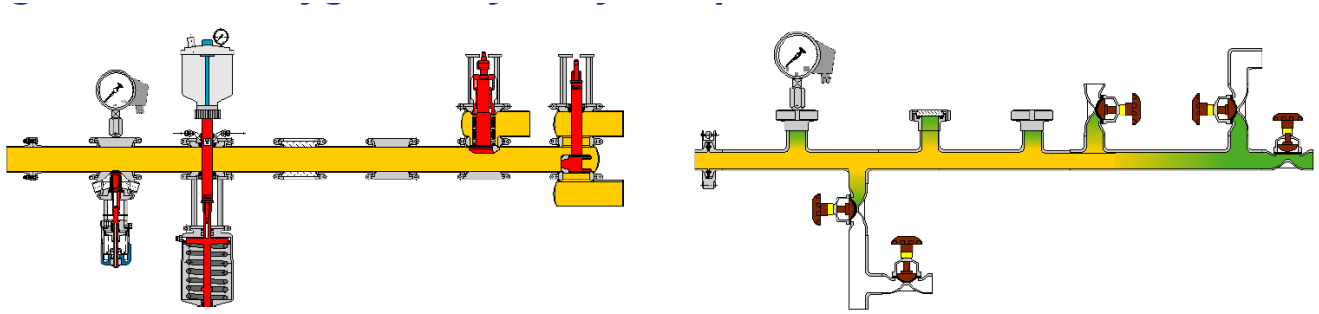


Demand for power



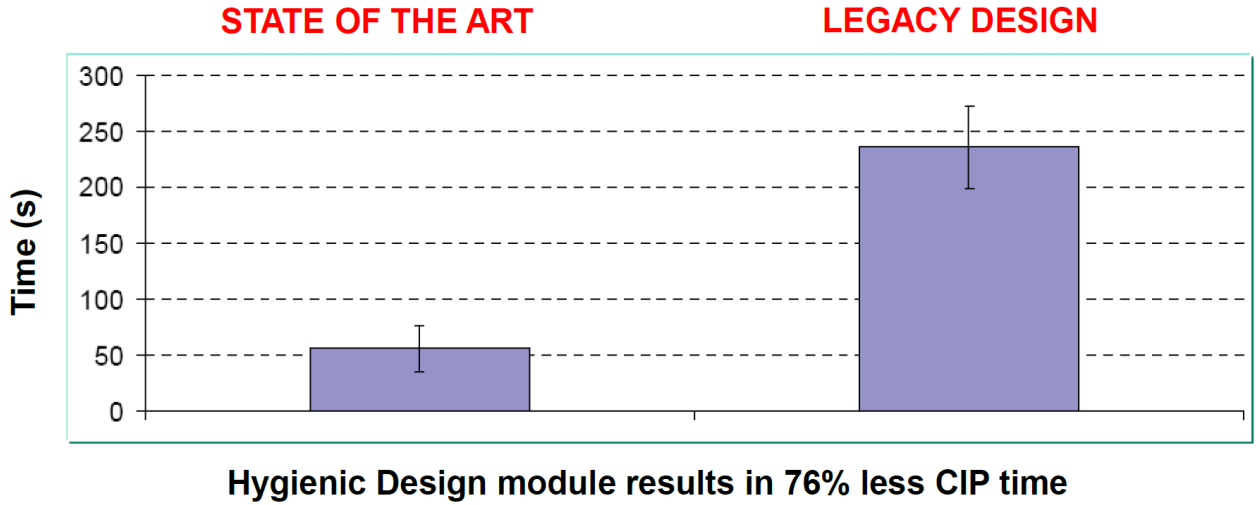
Soaring demand for AI could see the technology consume enough energy to power a small country

Lifecycle costs



- Cleaning costs - 80-90% labour
- £15/hour labour approx. £17 total/hour
- A saving of one hour per day = £4420-6188 year
- Over 20 years = £123,760 (without inflation)
- Maintenance costs = £2000

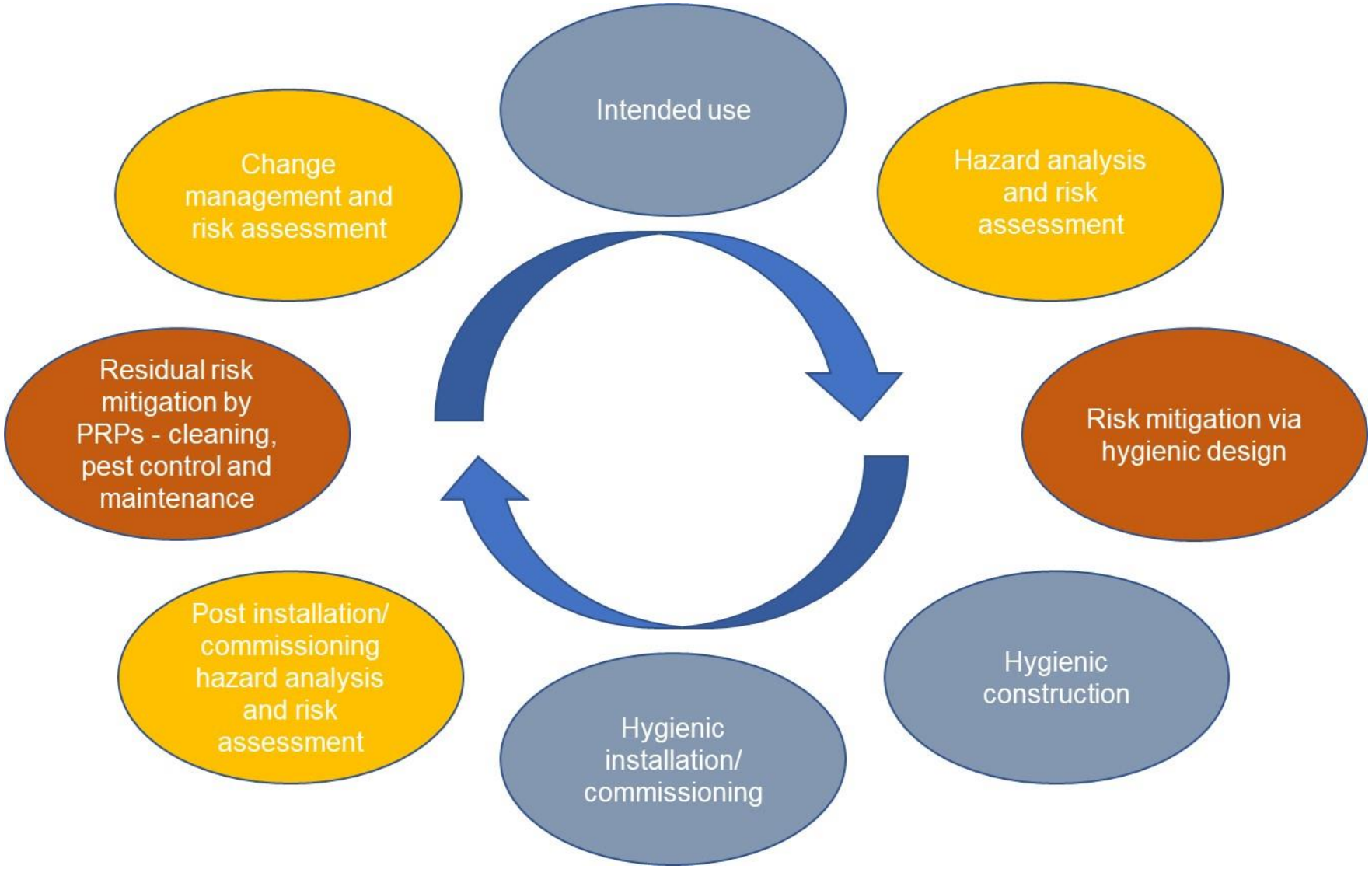
- What entity, that could take an hour more to clean, is £125,000 cheaper!



PhD thesis – A. Dorner, TUM

Hygienic design lifecycle

HDRM team



Resilience needs foresight

- New build/retrofitting requires thorough risk assessment for a comprehensive user requirement specification
- Some requirements (weather, respiratory disease, flexibility, power etc.) engineering led
- Product process requirements (and new opportunities) marketing/production led
- Some requirements (hazard control) hygiene led (becomes critical)
- With more hazards likely, need to ensure plant decontamination
- Cannot be undertaken if plant is not designed for purpose
- Requires hygienic design lifecycle approach based on risk
- Potential high purchase cost has to be countered by lifecycle costs

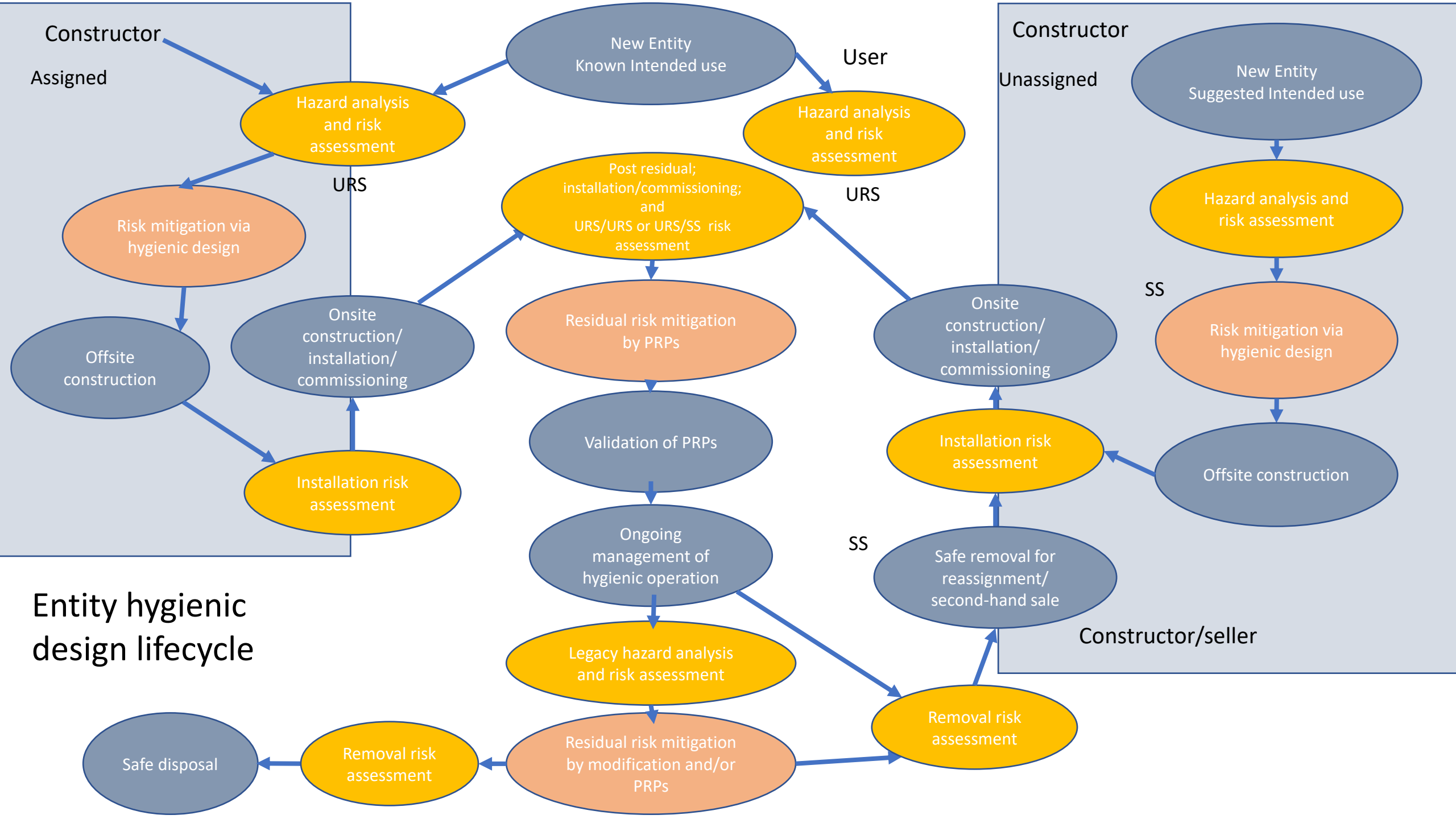
(Resilience) HDRM multidisciplinary team

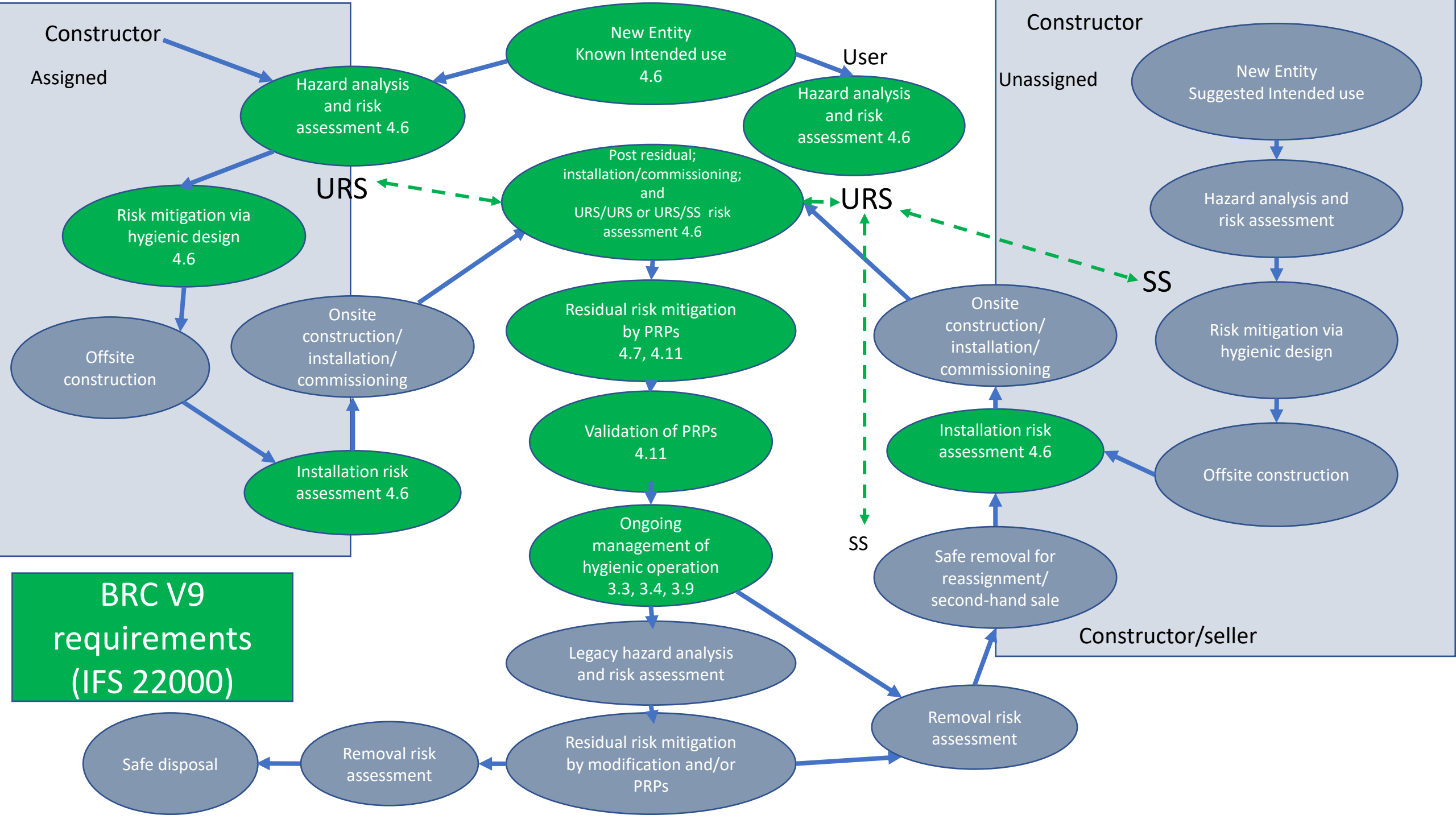
Disciplines

- Design
- Architecture and building construction
- Engineering
- Production/Operations/
- Food Technology/Safety and Quality
- Cleaning & Disinfection (Sanitation)
- Purchasing

Intended use

- Products
- Process
- Final consumer
- Cleaning conditions
- 5-10 years business plan
- Legal requirements and industry standards
- Horizon scanning (TACCP/VACCP)
- Lifecycle costs


Constructor
Assigned
New Entity
Known Intended use
User
Hazard analysis and risk assessment
Hazard analysis and risk assessment
URS
URS
Post residual; installation/commissioning; and URS/URS or URS/SS risk assessment
Risk mitigation via hygienic design
Onsite construction/ installation/ commissioning
Residual risk mitigation by PRPs
Onsite construction/ installation/ commissioning
Offsite construction
Validation of PRPs
Installation risk assessment
Installation risk assessment
Ongoing management of hygienic operation
SS
Safe removal for reassignment/ second-hand sale
Legacy hazard analysis and risk assessment
Removal risk assessment
Residual risk mitigation by modification and/or PRPs
Removal risk assessment
Safe disposal
Constructor
Unassigned
New Entity
Suggested Intended use
Hazard analysis and risk assessment
SS
Risk mitigation via hygienic design
Offsite construction
Constructor/seller
Entity hygienic design lifecycle


Constructor
Assigned
New Entity
Known Intended use
4.6
User
Hazard analysis
and risk
assessment 4.6
Hazard analysis
and risk
assessment 4.6
Constructor
Unassigned
New Entity
Suggested Intended use
URS
Post residual;
installation/commissioning;
and
URS/URS or URS/SS risk
assessment 4.6
URS
Hazard analysis and
risk assessment
SS
Risk mitigation via
hygienic design
4.6
Onsite
construction/
installation/
commissioning
Residual risk mitigation
by PRPs
4.7, 4.11
Onsite
construction/
installation/
commissioning
Risk mitigation via
hygienic design
Offsite
construction
Validation of PRPs
4.11
Installation risk
assessment 4.6
Offsite construction
Installation risk
assessment 4.6
SS
Ongoing
management of
hygienic operation
3.3, 3.4, 3.9
Safe removal for
reassignment/
second-hand sale
Constructor/seller
BRC V9
requirements
(IFS 22000)
Legacy hazard analysis
and risk assessment
Removal risk
assessment
Safe disposal
Removal risk
assessment
Residual risk mitigation
by modification and/or
PRPs

HDRA

HDRA – URS/design		Negative impact of contamination		
		Low	Medium	High
Likelihood of occurence	High			
	Medium			
	Low			

HDRA – URS/design		Negative impact of contamination		
		Low	Medium	High
Likelihood of occurence	High			
	Medium			
	Low			

Task	Hazard	Raw risk			Proposed controls	Residual risk			Comments
		Severity	Likelihood	Risk		Severity	Likelihood	Risk	
Movement of hazards into adjoining food production area	Microorganisms Foreign bodies				Construct a temporary wall between work area and food processing area				Engineering to check barrier integrity QC to swab for microbial ingress

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