Global EHS - Design Performance Standard

Control Information

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Document Number	2W4373RQWREN-1568922467-722
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1 Purpose

The purpose of this standard is to establish minimum EHS design criteria for new constructions at Micron facilities worldwide. This document presents EHS design requirements and considerations related to CSA and MEP design, and Room Readiness. Additional EHS design requirements may be called out in Facilities System Standards as well as National Codes and Standards. Therefore, it is necessary for the project design team to comply to the requirements outlined in this document as part of the Facilities Global System Standards and not as a stand-alone document.

2 Scope

Items	Details
Site(s) Impacted	All Micron sites worldwide
Target Audience	Global and Site EHS, Global and Site PSM, Global Facilities Construction & Engineering Team, Site Construction and Tool Install Teams, Procurement, Equipment Procurement Team, Site IE Planning Teams Equipment
Applicability	This Standard is applicable for any greenfield construction, or any new addition and alteration to an existing facility under Micron's control This Standard is not applicable to workplaces located in buildings not managed directly by Micron

3 Roles and Responsibilities

Roles	Responsibilities
Project Director/ Manager	• Responsible for Design for Safety and Engineering integrity and functions. • Allocate design work to appropriately qualified and experienced personnel. • Organize workshops to engage appropriately qualified and experienced personnel. • Ensure the requirements of the EHS Standards are implemented. • Implement this standard to deliver the required safety outcomes by incorporating Design for Safety within the design process. • Ensure construction work is planned and managed in a way that prevents or minimizes negative safety outcomes for all persons undertaking the construction work and persons at or near the workplace during the construction work. • Consultation with the designer. • Ensure that a Facility Siting Analysis, addressing all credible hazards to all occupied facilities, is performed and that all necessary actions are carried out. • Purchase, fabricate and install the required Safety Signs for new building before the site is handed over to Site Leadership and Facilities team. • Ensure the Safety Signs conform to local standards/international standards and are installed according to the design drawing before handed over to Micron.
Design Coordinators	• Responsible for coordinating design implementation. • Allocate work to the design team. • Ensure the requirements of the Design for Safety and Engineering System are implemented.
Designer	• To plan, manage and monitor the pre-construction stage Design for Safety process. • To ensure the requirements of Micron Engineering and EHS requirements are implemented.

Roles	Responsibilities
	• To assist Micron site leadership in preparing pre-construction information related to design. • To assess the Design for Safety and ensure that, where reasonably and practicable, foreseeable risks to those involved in the construction and future use of the structure are avoided. • To ensure risks are eliminated or controlled and consider hazards which can reasonably be identified through design work. • To provide adequate information about any significant risks/hazards associated with the design and pass information to contractors and other so that they can be made aware of the risks/hazards. • To provide information and prepare the 'Design for Safety Register' which must contain information relating to the project which is likely to be needed during any subsequent construction work, such as the significant residual risks, to ensure the health and safety of any person. • To ensure full cooperation and coordination with other duty holders in order to improve the way in which risks are managed and controlled. • Ensure that the Safety Signs design, placement, and location for new building are clearly indicated in the 100% design drawing. • Communicate to the Construction Manager for purchase, fabrication, and installation.
Project-specific design change review board	• A panel consisting of Designer, Project Manager, Representatives from Global Facilities, Global Construction and Global EHS responsible to review and approve deviations from this design standard during design phase.
Site Leadership, Site EHS, or designee	• To appoint a competent designer to undertake the Design for Safety project. • To ensure designers, contractors and other members appointed are competent and adequately resourced to carry out their responsibilities. • To ensure construction works can be carried out safely with Design for Safety program. • To provide the relevant information that is needed by the project team to enable them to carry out their duties properly at different stages of the project especially for Design for Safety. • To ensure the contractual relationships within the project are clear and their responsibility on Design for Safety are clearly allocated. • To request details from the designers and contractors of the Design for Safety arrangements they propose to implement throughout the project. • To ensure Contractors are competent to address the Design for Safety issues likely to be involved in the construction stage and to do so in a safe manner.
Site Facilities/Operation /Engineering team	• To participate in meetings with designers at the design stage and raise their ideas to ensure that the finished structure can safely be used as a place of work. • To manage the "Design for Safety Register" with Designers that records all the details specific to the construction and operation stages. • To appoint and ensure that the contractors engaged to carry out the construction/ installation works is competent and adequately resourced. • To ensure the construction works are properly planned, managed, and monitored, with adequately resources site management appropriate to the risk activity. • Work with site EHS team to ensure that the Safety Signs design, placement, and location for existing building are clearly indicated and determined. • Purchase, fabricate and install the required Safety Signs before the location is handed over to respective department.

Roles	Responsibilities
	• Ensure the Safety Signs conform to local standards/international standards and are installed according to the design and requirements.
Site EHS	• Provide advice on the design, placement, and location of the Safety Signs for existing building. • Verify with site Facilities team on the right installation during installation. • Review the requirements and subsequent changes of this standard and identify actions to ensure the requirements are effectively implemented. • Evaluate continuous compliance to the updated requirements of this standard at least once every 3 years or more frequently (when risk of noncompliance is present) and implement actions to correct deficiency(ies) identified during the compliance evaluation process.
Global EHS	• Develop, communicate, review, and update the standard regularly. • Enforce the requirements outlined in this standard. • Audit the compliance to the standard through regular audit and site reviews.
Contractors	• To coordinate with designers on all information regarding the identified risks and control measures for Design for Safety. • To ensure that the construction phase is properly planned, managed, and monitored. with adequate resources, competent site management deployed to implement Design for Safety requirements. • To ensure all sub-contractors are provided with the Design for Safety information about the project that they need to enable them to carry out their work safely. • To take reasonable steps to ensure that the identified risks identified are properly managed.
Procurement	• Include Global EHS Standards into Procurement supplier onboarding process. • Inform designers of changes and updates to Global EHS - Design Performance Standard and relevant Standards and Checklists.

4 Terms and Definitions

Terms	Definitions
AEC	**Architecture, Engineering & Construction**
ALARP	**As Low As Reasonably Practicable** Refers to reducing the residual risk within practicable limits of construction, operation, and cost. In order for a risk to be considered ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.
ANSI	**American National Standards Institute**
CFR	**Code of Federal Regulations**
CHAIR	**Construction Hazard Assessment Implication Review** Hazard assessment tool Published by Work cover NSW, Australia. CHAIR-1 Study: Conceptual Design Review, CHAIR-2 Study: Detailed Design Construction or Demolition Review, and CHAIR-3 Study: Detailed Design Maintenance & Repair Review

Terms	Definitions
CHAZOP	**Controls Hazards & Operability Analysis** Structured hazard identification tool for instrument, control, and computer systems.
CSA	**Civil/Structural/Architectural**
CUB	**Central Utilities Building**
DFS	**Design for Safety** Process of identifying and reducing safety and health risks through good design at the conceptual and planning phases of a project.
DMP	**Design Management Plan** Document describing “how” the design work will be carried out.
DVB	**Distribution Valve Box**
EIA	**Environmental Impact Assessment** Regulatory requirement for projects with the potential to cause environmental, social, or economic impacts.
EPA	**Environmental Protection Agency** The Environmental Protection Agency is an agency of the United States federal government whose mission is to protect human and environmental health.
FFL	**Finished Floor Level** Finished floor level (FFL) refers to the uppermost surface of a floor once construction has been completed but before any finishes have been applied. So, in concrete construction it may be the uppermost surface of a screeded finish.
FMEA	**Failure Mode and Effect Analysis** Reliability analysis intended to identify potential failures of components that have significant consequences upon the system performance.
FMECA	**Failure Mode, Effect and Criticality Analysis** Means to identify and understand the importance of a component failure upon the system in order to recognize the level of additional controls that are required.
FMS	**Facilities Management System**
GATE REVIEWS	A formal review conducted at prescribed points in the project's life cycle. The purpose is to determine whether a project/phase has approval to proceed (“Go”), will be terminated (“No Go”), or will be asked to complete specified actions before the gate decision can be made.
HAZAN	**Hazard Analysis** Structured process which forms part of the HAZID study to identify risks in the design and record the actions to address the issues. Includes risk analysis to identify priorities and acceptability of the risk.
HAZID	**Hazard Identification Study** Structured process to identify risks in the design and record the actions to address the issues. May exclude risk analysis (HAZAN) where a simple record of risks and actions needs to be recorded and tracked.
HAZOP	**Hazard & Operability Study** A structured risk assessment designed to identify potential deviations from the design intent through the use of guidewords. HAZOP is applied to process and material flows.

Terms	Definitions
HPD	**Hazard Prevention by Design** Design for Safety Process where engineering methodologies are used in a structure manner to identify potential hazards and to eliminate them by appropriate design.
HPM	**Hazardous Production Material** Any gas, liquid or solid that has the potential to be hazardous or impact a person's health and safety. A chemical or specialty gas that is used in processing wafers that has a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by the Uniform Fire Code (UFC)
IBC	**International Building Code** The International Building Code establishes minimum requirements for building systems using prescriptive and performance-related provisions. It is founded on broad based principles that make possible the use of new materials and new building designs.
IFC	**International Fire Code** The International Fire Code contains minimum requirements to safeguard life and property from fires and explosion hazards.
LSS	**Life Safety System** Any interior building element designed to protect and evacuate the building population in emergencies, including fires and earthquakes, and less critical events, such as power failures.
MEP	**Mechanical/Electrical/Plumbing** Refers to the systems that exist in a construction site that must have technically competent design and installation if the building is to be safe and function correctly.
NEC	**National Electrical Code** NFPA 70, National Electrical Code (NEC) is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.
NFPA	**National Fire Protection Association** An international nonprofit organization devoted to eliminating death, injury, property, and economic loss due to fire, electrical and related hazards. Leading information and knowledge resource on fire, electrical and related hazards.
NIOSH	**National Institute for Occupational Safety and Health** United States federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness.
ODA	**Oxygen Dissociation Assay** Spectrophotometric based screening platform for hemoglobin-O2 affinity modifiers.
OSHA	**Occupational Safety and Health Administration** A large regulatory agency under the United States Department of Labor that is charged to assure safe and healthy working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. http://www.osha.gov/
POC	**Point of Connection** The physical location where the equipment connects to the facilities electrical source.

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Terms	Definitions
PPE	**Personal Protective Equipment** Any of a series of specialized devices, clothing or equipment's worn by employees for protection against hazards. PPE includes anything from gloves to full-body suits with self-contained breathing apparatus.
SA	**Siting Analysis** A mandatory analysis for occupied facilities to ensure that occupied facilities are properly located and that personnel inside the building are at no more risk than necessary.
SDS	**Safety Data Sheet** Document that describes hazard information for a specific material especially chemicals. More commonly referred to as MSDS (Material Safety Data Sheet).
SRL	**Self-Retracting Lifeline** A self-retracting lifeline is a type of lanyard that allows a user to move around freely within an area. The lanyard rolls out and retracts based on the user's movement. The retracting function ensures the lifeline is always kept taut.
TLV	**Threshold Limit Value** Refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be exposed to day-after-day for a working lifetime without adverse effects. Established by the American Conference of Governmental Industrial Hygienists (ACGIH).
UPS	**Uninterrupted Power Supply** An uninterruptible power supply or uninterruptible power source (UPS) is an electrical apparatus that provides emergency power to a load when the input power source or mains power fails.
UPW	**Ultra-Pure Water** Water that has been purified to high levels of specification.
UV	**Ultraviolet** Ultraviolet" means "beyond violet" (from Latin ultra, "beyond"), violet being the color of the highest frequencies of visible light. Ultraviolet has a higher frequency (thus a shorter wavelength) than violet light.
VOC	**Volatile Organic Compound** An air pollutant regulated in the U.S. by the EPA. Per the EPA, VOCs are compounds that break down in the atmosphere in the presence of sunlight to form ground-level ozone. Some organic (containing carbon) compounds like acetone that are volatile (usually defined as having a boiling point lower than 250C) do not form ozone and so are technically not "VOCs" according to the EPA.

5 References

Internal References	Link
Global EHS - Confined Space Program Standard	2W4373RQWREN-1568922467-146
Global EHS - Construction Performance Standard	2W4373RQWREN-1568922467-118
Global EHS - Control of Hazardous Energy (CoHE) Standard	2W4373RQWREN-1568922467-29
Global EHS - Distracted Walking and Stairwell Safety Standard	2W4373RQWREN-1568922467-26

Internal References	Link
Global EHS - EHS Risk Assessment Standard	Q6ACPCUHTZ6P-1302918059-213
Global EHS - Electrical Safety Standard	2W4373RQWREN-1568922467-388
Global EHS - Excavation Standard	2W4373RQWREN-1568922467-695
Global EHS - Lifting and Rigging Standard	2W4373RQWREN-1568922467-82
Global EHS - Incident Reporting and Investigation Standard	2W4373RQWREN-1568922467-279
Global EHS - New Facilities Equipment Safety Standard	2W4373RQWREN-1568922467-752
Global EHS - Toxic Gas Monitoring and Double Containment Standard	2W4373RQWREN-1568922467-11
Global EHS - Work At Heights Standard	2W4373RQWREN-1568922467-48
Global Facilities - Design & Construction Standard - Site Establishment	A3YRXSD74VDV-57553043-410
Facilities Global System Standards	Link
Construction Plant, Machinery and Tools Safety Requirements	TEDSZF665RUJ-644690799-163
Micron Construction Safety Guidebook	TEDSZF665RUJ-644690799-168
Micron's Product Content Specification	ZN5YQVW54AFP-201381568-8232

External References	Link
Please refer to specific sections	Nil

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6 Standard

The effective implementation of Design for Safety (DFS) involves the continuous project risks review from the tender through the design, construction, commissioning, and, into the operation and maintenance phase. It is a staged review of risks with a continual risks elimination or reduction strategy leading to a register of residual risks.

Implementation of DFS is integrated with design development as part of the Design Review and monitored via design review process where issues are discussed and captured during the Design Review meetings. The entire process is managed with the use of Design for Safety Registers.

Eliminating hazards at the design or planning stage is often easier and cheaper to achieve than making changes later when the hazards become real risks in the workplace.

Safe design can result in many benefits, including:

- more effective prevention of injury and illness
- improved usability of structures
- improved productivity and reduced costs
- better prediction and management of production and operational costs over the lifecycle of a structure, and
- innovation, in that safe design can demand new thinking to resolve hazards that occur in the construction phase and in end use.

6.1 Global & Regulatory

The design of a new facility or an addition and alteration to an existing facility shall be consistent with:

- Local legal environment, health, and safety regulations (including environmental permits, utility agreements and any other ordinances applicable to specific projects),
- International building, fire, and equipment safety standards,
- Industry best-known methods, and
- This standard

It is not the intent of this Standard to supersede the international as well as national codes and regulations. The design team shall bring to Micron’s attention any areas whereby Micron requirements conflict with international or national requirements for review and resolution. Any deviations from this design standard must be reviewed and approved by a project-specific change review board.

Design for Safety work carried out on the project shall comply with the appropriate local Acts and Regulations, relevant National Standards, recognized International Standards, and specified Micron requirements. Review of these standards forms part of the Design for Safety process. They are not listed in this document.

Irrespective of regulatory requirements, this Design for Safety standard is the minimum Micron requirement for projects.

6.2 Safe Design Principles

During the planning, design, construction, and operations phase of any project, safeguarding the property from potential risks is critical to the project's success.

Incorporating safe design principles from the initial phases of the project guarantees the best possible outcomes (safety measures, processes, and materials) from the beginning.

The Principles of Safe Design requires those involved in the planning, design, construction, and operations phase of the project to consider the following six essential principles:

6.2.1 Collaboration

Developers, architects to trades contractors, everyone involved in the project must ensure the project meets all safety standards. In addition to the architects and engineers who create the design, any decision-makers who influence the final outcome (including project managers, EHS professionals, and more) has a responsibility to ensure project safety. A collaborative approach amongst stakeholders makes for a smoother, and more fail-safe process. Measures to incorporate safe design principles during the early phases of the project include:

- Conducting workshops with clients and project managers during the conceptual design stage to ensure potential issues are identified early,
- Involving specialists such as engineers or building service designers during the initial risk assessment process, particularly for unusually complex designs,
- Documenting any issues identified during the research, consultation, and user input phases to inform subsequent risk assessment, and
- Incorporating Best Known Methods and Lessons Learnt.

6.2.2 Lifecycle Assessment

Safe design applies to every phase of the building lifecycle, from the initial conception through to a building's maintenance, development, and demolition. Project Managers, both from the developers as well as the as the contractors shall not neglect the post occupancy phase of the building even amidst the tight deadlines for the project. Measures to incorporate during the construction phase of the project include:

- Preparing a safe workplan, work method statement and an on-site emergency plan factoring in environmental and spatial conditions,
- Project site-specific EHS training and inductions,
- Providing the right PPE for all workers,
- Conducting regular EHS audits during construction,
- Maximizing the use of components with off-site or on the ground prefabrication to prevent high-risk/critical risk incidents,
- Scheduling the construction of permanent stairways at the beginning of construction to minimize the hazards of temporary stairs and scaffolding.

Once the construction has concluded, the project team must ensure the site is safe for public use. This is to be achieved through:

- Research and designing for the likely workflows of the building's intended function, including site-specific hazards,

- Use of slip-resistant materials, tread and nosing on floor surfaces to ensure pedestrian safety, while still conforming to aesthetics requirements,
- Separating vehicles and pedestrians in the design of any traffic areas, and designing for forward-only vehicle movements,
- Incorporating space and floor loadings with capacity for any heavy machinery/tools/equipment that may be used in the building.

The design shall also take safe maintenance and alteration into consideration:

- Ensure building safety assessments are performed regularly to remain compliant with changing regulations over time,
- Design safe access and ample space so that maintenance can be performed safely, ideally at ground level, interstitials, above ceiling space and sub-fabs,
- Reduce the need for cleaning and maintenance by avoiding dirt traps through features such as entry mats and frames.

6.2.3 Systematic Risk Management

The project team is required to identify and control potential hazards arising throughout all the project phases. Adopting a risk-based approach early on in the design process, will enable the project team to identify hazards and mitigate it well in advance, lessening the potential costs and time delays of surprises, accidents or mishaps during construction.

A risk-based approach requires the project team to:

- Collate and review a list of potential risks based on past projects at the project outset,
- Identify causes, triggers, and responses for each risk,
- Use the Risk Management tools to carry out collaborative risk management with key stakeholders throughout the project,
- Utilize the hierarchy of control-based approach to risk assessment so that the hazards that can’t be eliminated are dealt with appropriately wherever possible,
- Consider measures to mitigate possible emergency or natural disaster occurring through factors such as egress and siting,
- Develop stringent control systems to address deviations from intended workplan,
- Ensure the project site effectively implement the risk and workplan.
- Develop Asset Integrity Management (AIM) - Life Cycle Activities (please refer to Appendix 8). Please refer to Global PSM for more information.

6.2.4 Design Competence

Knowledge and capability in ensuring safe design is extremely important. Those involved in or influencing the project design shall have a comprehensive and up-to-date understanding of the vast array of relevant codes of practice and legislation, both national and international, state planning principles, regulations, ministerial specifications, local environmental plans and more. Where necessary the project team shall seek expert advice to address any knowledge gaps and ensure compliance.

6.2.5 Effective Communication

The project team is to ensure that safety standards are adhered to even after the building construction is complete. There needs to be an effective flow of information between all the stakeholders involved in the process. Rigorous documentation and open communication shall be established to ensure accurate information is shared with the stakeholders.

6.2.6 Building a Design for Safety Culture

Another crucial safe design principle is to prioritize long-term objectives of safety and wellbeing rather than the minimal short-term payoff of cutting corners on subpar products. A Design for Safety culture shall be created and supported via planning, consultation, training, auditing, studies and/or project focus groups, corporate specialists, and a community of practice.

Cost-cutting measures can backfire, with tragic consequences in the form of illness, accidents, structural failure, legal action, use of non-conforming products and even death.

The project team shall, where possible, use premium quality building supplies with a long lifespan to eliminate safety risks in the project and ensure legal compliance. The project team shall utilize independently fire-tested materials that meets rigorous fire safety standards. Independent safety testing for luminance contrast and slip resistance shall be considered. In such cases, the project shall obtain proper accreditations to ensure product's claims are trustworthy.

6.3 Safe Design Methodology

6.3.1 Integrating Design and Systematic Risk Management

Risks are inherent to any activity and cannot always be eliminated. The risk management process is therefore based on contemporary risk management involving the systematic identification of hazardous events, their associated causes and control measures to define the extent and likelihood of the potential loss, and hence risk. The risks can then be prioritized and assigned actions or treatments appropriate to the level of risk. These treatments are to be used to reduce the risks. The guiding principle is that the project shall be able to demonstrate that risks have been reduced to an acceptable level (ALARP). The following concepts are central to this philosophy:

- The selection of applicable techniques for risk assessment should agree with the project's context and ensure the proper risk identification, assessment, and control,
- Applying the correct risk assessment techniques to the scope of work early and at major milestones to improve the outcomes and provide for a sustainable risk managed outcome,
- Involve a range of stakeholders (e.g.: construction, operations, maintenance) in risk workshops that affect their work and the results of their work,
- The systematic identification of risk includes the assessment of the associated causes and the potential impacts. This is used to define the level of risk and to prioritize and assign the appropriate control actions,
- Risks are reduced and controlled in an effective manner through the proactive integration of risk management thinking through prompt identification, reduction, and control of risks,
- Each treatment action must be allocated to the most appropriate responsible person for its execution and implementation. There shall be only one name allocated to each action,
- Monitoring risks throughout the project and update the risk mitigation strategies and risk register accordingly,
- Actively accepting risks where required due to their nature and treatment options, and
- Transferring the residual risks at completion of the scope of work for on-going treatment and review.

The objective of Micron's Design for Safety risk management during the delivery of projects is the identification, assessment and elimination or mitigation of design related safety risks for construction, commissioning, plant operation and disposal, and the transfer of this knowledge to downstream designers, builders, and operators of the facility. This is to be achieved by the various Design for Safety activities, Design Reviews and Risk Assessments applied throughout the project stages, and their associated deliverables.

DFS Risk Management Process:

Process	Techniques and Descriptions	By Whom
Identify solutions from regulations, codes of practice and EHS standards	Consult with all relevant persons to determine which hazards can be addressed with applicable regulations, codes of practice and EHS standards. Plan the risk management process.	Designer. Micron team approves decisions.
Apply risk assessment techniques with the help of checklists	Further detailed information may be required on risk controls, for example by: 1. leveraging "Design for Safety Checklist" for reference and refer to codes of practice and Micron Global EHS Standards, and 2. job/task risk management analysis techniques. A variety of quantified and/or qualitative risk assessment methodology can be used to check the effectiveness of control measures. See Appendix 2 Risk Assessment Tools. Scale models and consultation with SME (GFTT, Global Facilities etc) and experienced industry personnel may be necessary to achieve innovative solutions to longstanding issues that have caused safety hazards and problems.	Designer and DFS Stakeholders.
Discuss design options	Take into account how design decisions influence risks when discussing control options.	Designer/Micron
Risk Assessment Review and Design finalisation	Check that the evaluation of risk control measures in the design is complete and accurate. Prepare information about risks to EHS after the design process and include it into the "Design for Review Register".	Micron, Designer and Contractors agreed on final design results.
Potential changes in construction stage	Ensure that subsequent changes, which affect design do not increase risks, for example substitution of flooring materials which could increase slip/fall potential.	Construction team in consultation with designer.

Design Risk Assessment Review verify that EHS issues have been adequately addressed during design. Examples of Micron's specific hazard identification and risk assessments include Hazard Identification (HAZID) and resulting Design for Safety Risk Register, Hazard and Operability Studies (HAZOP), Safety Integrity Level (SIL) Studies, 3D Model Design Reviews, Constructability Reviews etc. and their action closeouts. Please refer to Appendix 2 for Risk Assessment Tools.

- ISO/TR 31004:2013, Risk management — Guidance for the implementation of ISO 31000
- ANSI/NFPA 551-2022, Guide for the Evaluation of Fire Risk Assessments

6.3.2 Design Competence

The discipline head for each discipline determines the design competencies required for various aspects of design pertinent to their respective discipline. Competencies are made up of:

- Qualifications or units of competence recognized by national or international qualification framework. These include qualifications issued by schools, colleges, universities, and other registered training organizations,
- Knowledge and skills, and
- Experience.

Competency requirements for various types and aspects of design shall be setup for each discipline and be available in a manual or a competency matrix. Please refer to Appendix 7.

6.3.3 Design for Safety Checklist

The designer shall leverage the "Design for Safety Checklist" to assist in identifying hazards and controlling risks associated with the design of a structure throughout its lifecycle. The checklist consists of the following EHS sections:

1. Layout Placement
2. Building Design
3. Fire Protection
4. Process Safety
5. Utilities
6. Emergency Response
7. Ergonomics
8. Security
9. Social Commodities
10. Environment

As the design objectives differ from one project to another, the recommendations of the checklist may not comprehensively address the scope and specific hazards of a project. The designer should use this checklist in conjunction with other Micron internal design standards, applicable codes, regulations, and industry design guidelines.

The "Design for Safety Checklist" is at below:

(To be updated)

Use Instruction: The designer should indicate "Y", "N" or "NA" in the "Status Y/N/NA" column against the design recommendations.

Abbreviation	Denotes
Y	Yes - meet or exceed the design recommendation
N	No - does not meet the design recommendation
NA	Not Applicable - design recommendation is not applicable

The designer should provide a brief description of the provision in the "Comments" column. If the design recommendation is not met or not applicable, the designer should explain why the recommendation is not considered and whether alternative solution is proposed. Additional notes, references and drawings could be attached to this guide as supporting documents.

6.3.4 Lifecycle Assessment

Design for Safety applies to every stage in the lifecycle of the asset from conception to disposal. It involves eliminating hazards, preventing, or minimizing risks as early as possible in the design process. The engineers and designers need to understand the procurement, construction, operation, maintenance, and disposal requirements for the asset before starting the design. Adequate information shall be gathered and included with the design file.

6.3.5 Ergonomic

Safe design also incorporates ergonomic principles. Ergonomics is a scientific, user centered discipline which plays a major role in design, but it is also a philosophy and way of thinking. An ergonomic approach ensures that the design process considers a wide range of human factors, abilities and limitations affecting end users. Ergonomics considers the physical and psychological characteristics of people, as well as their needs in doing their tasks - how they see, hear, understand, make decisions, and act. User Safety, efficiency, productivity, and comfort are indicators of how effective the design is in fulfilling its purpose.

When analyzing the needs for a designed product or space, an ergonomic approach shall address five main elements:

- The user - their characteristics, including the physical, psychological, and behavioral capacities, skills, knowledge, and abilities.
- Project and task characteristics - what the users are required to do or does. This includes task demands, capacity to make decisions, work organization and time requirements.
- The work environment - the work area and space, lighting, noise, and thermal comfort.
- Equipment design and the interface with the user - including the ‘hardware’ needed to perform the work and including electronic and mobile equipment, protective clothing, furniture, and tools.
- Work organization - including the patterns of work, fluctuations in workload, timing of work and the need to communicate and interact with others, as well as broader industry or economic influences.

Safe design will largely focus on the ‘hardware’ of the design, but the effectiveness of safe design will be optimized by addressing ‘hardware’ within the broader system of work as defined above.

6.3.6 Fire Safety

A Fire Safety Study shall be carried out to demonstrate that all potential fire and explosion events associated with the facilities have been identified and preventative measures addressed for each scenario. It shall address thermal radiation, explosion overpressure and flammable gas dispersion distances from typical releases. The study shall examine the soundness of the facilities’ layout with respect to fire and explosion events. It also identifies the necessary passive controls (containment, fire proofing, separation distance etc.), and active fire protection controls (fire water, foam systems, etc.) required to adequately protect the facilities and personnel from the potential fire and explosion scenarios it identifies. It determines the fire detection, alert, and response requirements, and examines the consequences of potential fire scenarios to determine the firewater and foam requirements, deluge spray, fire monitor and fire hydrant locations, and fire protection design requirements. The overall objective is to ensure safety for on and off-site personnel, and to protect equipment and the environment.

6.3.7 Misconception Management

Designs can fail to meet their Safety goals due to the design being influenced by the misconceptions of the designers. These include making subconscious assumptions, working from a base of wrong beliefs or by not considering certain scenarios.

Appendix 3 contains a list of designer's potential misconceptions. This tool shall be used in the design process when carrying out observations and hazard identifications and in the formal review workshops and focus groups. It provides the user with a series of prompts to guide the review process

6.3.8 Information Transfer

Effective communication and documentation of Design for Safety risk controls and standards shall be set up and maintained between all team members and between projects and to downstream designers, constructors, and owners. This is to be done by incorporating Design for Safety risk controls and standards into project design management and execution plans, design criteria, safety study reports, risk registers, and lessons learnt.

6.3.9 Best Known Method and Lesson Learnt

Best Known Methods and Lessons Learnt must be captured and communicated to all stakeholders for actions and integration in future works. The designer shall (where possible) review the Best-Known Method and Lessons Learnt database before starting the design to familiarize themselves with any relevant Design for Safety information, applicable standards, and details relevant to the design being developed.

The engineer and designer shall communicate any new Design for Safety outcomes and relevant standards, Best Known Methods, and Lessons Learnt to their Leader for integration into the corporate data base. The Project / Engineering Manager shall inform downstream designers, constructors and owners of the Design for Safety risk controls and residual risk in the finished design.

6.3.10 Incident & Audit CAPA

Incident and audit corrective and preventive action focuses on the systematic investigation of root causes of unexpected incidences to prevent their recurrence (corrective action) or to prevent their occurrence (preventive action). Therefore, where applicable, the outcome or lessons learnt from the incidences shall be captured and communicated to all stakeholders for consideration and inclusion into existing or future works.

6.4 Safe Design Risk Management

During design, the relevant risks shall be revisited at several stages:

- At the design plan stage to ensure all foreseeable risks have been included,
- At the concept review (10%) stage a HAZOP shall be conducted to ensure the proposed design has not introduced any new risks particularly in the operability and construction areas. This review should be a plant wide operation review. The construction methods for the more significant, larger pieces of the plant should be reviewed at this stage through CHAIR-1 review.
- At the material procurement stage (30 - 60%) stage to ensure the plant items can be safely operated, maintained, set to work, and shut down. At this point, a CHAIR-2 review for detailed construction

hazards shall be performed. In addition, CHAZOP shall be performed as the control system concepts is expected to be completed at this stage.

- As the detailed design approaches conclusion (90%), a final review shall take place to update the project risks register. This will ensure risks that have eliminated are removed from the risks register and those that have been reduced are appropriately tagged. At this point of time the register shall only reflect residual risks and those that the constructor and the operator need to manage.

    - ISO 10252:2020, Bases for design of structures - Accidental actions

6.4.1 Project Design for Safety Register

The Project Design for Safety Register shall be a live document. It shall be updated on a continuous basis. When the tender commences, the project Design for Safety register shall contain foreseeable risks for design, construction, operation, and maintenance phase added. Before the tender document is complete, the project Design for Safety register shall outline all known risks, proposed risks mitigation methods and associated cost.

The register shall be handed over to the project/facilities/operational team when the project commences.

6.4.2 Engineering Issues Register

The Engineering Issues Register, a live document, shall outline issues relevant to the design development of the plant.

When the design commences, the Engineering Issues Register shall be populated with the design issues as they arise. Each issue shall be adequately described, assigned actions and responsible person. As the agreed solutions progress, the register is updated with comments and useful notes. It shall be populated and updated on a regular basis to capture the decision and resolution process relevant to the design development.

At the end of the engineering phase, the remaining unresolved issues in the register shall be handed over the downstream stakeholders e.g., construction, commissioning, operations teams for resolution.

6.5 Safe Design Planning and Governance

At the start of a study or project a Design for Safety Management Plan must be developed and implemented. The Design for Safety Management Plan shall identify the activities necessary to establish and maintain design safety, including Microns', and regulatory design safety requirements. A Design for Safety Action Plan shall be produced and used to guide the development and management of Design for Safety and provide input into the Design for Safety Management Plan. All project participants are to be made aware of the Design for Safety aspects of the Design for Safety Management Plan.

The governance practices of Design for Safety on a project include Design for Safety Management Plan; Design for Safety Representative; Design for Safety Program, Safety Moments in Project Meetings and Toolbox Talks; Design for Safety leading KPIs; Design for Safety Audits; and closeout reporting.

6.5.1 Design Representative

At the kick-off of the study or project, the Project / Engineering Manager shall nominate a Design for Safety Representative. The Project Design for Safety Representative is a nominated engineer on the project to act as a liaison between the designer team, the EHS Manager, Engineering Manager, and other stakeholders.

The role of the representative is to support the Project / Engineering Manager in his safety responsibilities and to maintain a link between the Project and management. The mandate of this representative will be to support the Project / Engineering Manager by reviewing this procedure and to ensure adequate implementation through plans, training, and audits.

6.5.2 Program

Design workflow and the engineering schedule must integrate Design for Safety concepts, related design tools and appropriate control points. The design program shall integrate the Design for Safety process. Please refer to Appendix 6.

Design for Safety is not a standalone process or a single milestone to complete. It is an on-going activity incorporated into the elements of the design process across all disciplines.

6.5.3 Design Review and Project Meetings

A competent facilitator and knowledgeable participants shall be selected to take part to ensure the review meetings are meaningful. Without the right expertise the full extent of the risks cannot be determined. A Design Safety Review checklist shall be used to facilitate and guide review meetings so that the approach is methodical and thorough.

EHS shall be made a specific agenda item in all project meetings, including the Toolbox. Topics such as Safe Design Principles; Inherent Safety; Risk Controls, Best Known Methods, Lessons Learnt, etc., shall be discussed.

6.5.4 Key Performance Indicators

Key performance indicators (KPI) shall be identified, communicated, monitored, and reported during a project. It shall be used to assess Design for Safety performance. Examples of Design for Safety KPIs include:

Leading KPI	Measurement	Monitoring Mechanism	Target
Involvement in Design for Safety related reviews e.g., JHA/RA/HAZID/layout/HAZOP/ Constructability, etc.	Attendance	Attendance Register	Key operations, health and safety, maintenance, engineering, and project management personnel attendance - 100 % attendance.
Review Actions	On-time review actions closeout.	Register maintained with regular reviews	100% of actions closed out by due dates
Project Meetings	Design for Safety topics incorporation	Meeting minutes	Agenda item in at least 1 project meeting in a month

6.5.5 Audits and Reviews

Discipline technical and Design for Safety audits (including Safety considerations) shall be carried out by Micron's respective discipline Engineers or their delegate, during the engineering phase of projects in accordance with the Project Audit Schedule.

6.5.6 Facility Siting Analysis

A Siting Analysis (FSA) shall be performed for all Micron controlled occupied facilities. The proposed locations of all Micron occupied facilities shall be carefully evaluated by a subject matter expert to ensure that the safety hazards are identified, the risk of harm to personnel is assessed, and the appropriate actions are taken to mitigate the risk to an acceptable level. The FSA serves primarily as a screening tool to identify hazards, assess risk to buildings and personnel, guide the location of occupied facilities, and to develop criteria for building design. One of the primary goals of the FSA is to ensure that occupied facilities are properly located and that personnel inside a building are at no more risk than necessary. Prior to mobilization and assignment of Micron's or Contractors' personnel to either permanent or temporary site facilities, the Siting Analysis shall be validated at site.

The Construction/Project Manager is responsible for ensuring that an FSA, addressing all credible hazards to occupied facilities, is performed and that all necessary actions to mitigate the risk to an acceptable level are implemented prior to taking occupancy of those facilities.

The site EHS Manager is responsible for supporting the siting of Micron and contractors' occupied facilities by providing or identifying Subject Matter Experts to perform the FSA and validation of the SA at site prior to mobilization (may include a site visit).

Please refer to Appendix 5.

6.5.7 Close Out

6.5.7.1 Deliverable Review

A safety review shall be conducted at the end of the design phase of a project to ensure the integrity of the design by confirming that the current design, including changes and additions, has undergone the relevant Design Hazard Reviews (e.g., HAZID, HAZOP, etc.) and that action items and recommendations produced from safety reviews including Take 5 reviews have been satisfactorily addressed and implemented into the design. All discipline lead engineers, and project engineers are responsible for the closeout of actions from Design Hazard Reviews.

6.5.7.2 Review Report

As part of the design closeout process, a report listing remnant risks, existing at the end of the design process, must be prepared and handed to Micron for use in the construction, operation and maintenance of the asset which was the subject of the design. The report would normally include a commentary on inherent design assumptions relevant to the construction, operation, maintenance, disassembly, and demolition of the asset. This report can form part of the study or project design phase closeout report.

6.6 Human Factors

Human factors are elements that enhance or improve human performance in the workplace. It is concerned with understanding interactions between people and other elements of complex systems. Human factors apply scientific knowledge and principles as well as lessons learned from previous incidents and operational experience to optimize human wellbeing, overall system performance and reliability. The discipline contributes to the design and evaluation of organizations, tasks, jobs and equipment, environments, products, and systems. It focuses on the inherent characteristics, needs, abilities and limitations of people and the development of sustainable and safe working cultures.

Therefore, the designers shall undertake human factors engineering assessment to ensure that the building is designed in a way that optimizes the human contribution to production and minimizes potential for design-induced risks to health, personal or process safety or environmental performance.

Impairment	Enhancement
Physical	Dedicated parking slot complete with shelter and access
	Ramp to facilitate drop-off and pick-up
	Automated door or remotely controlled access/egress
	Wheelchair friendly access throughout the plant including security check points, pantry, cafeteria, toilet
	Height adjustable workstation
	Control panel within lifts to be lowered and made accessible
	Food displayed on bain-marie to be made visible
	Adequate seating space in the cafeteria
	Panic button at toilets and emergency hold points

- SEMI S8 - Safety Guideline for Ergonomics Engineering of Semiconductor Manufacturing Equipment
- ANSI/ASSE A10.38-2013, Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment
- ISO 26800:2011, Ergonomics — General approach, principles, and concepts
- ISO 6385:2016, Ergonomics principles in the design of work systems
- ISO 10075-2:1996, Ergonomic principles related to mental workload — Part 2: Design principles
- ISO 11428:1996, Ergonomics — Visual danger signals — General requirements, design, and testing
- ISO 11429:1996, Ergonomics — System of auditory and visual danger and information signals
- ISO 24502:2010, Ergonomics — Accessible design — Specification of age-related luminance contrast for colored light
- ISO 11428:1996, Ergonomics — Visual danger signals — General requirements, design and testing
- ISO 24509:2019, Ergonomics — Accessible design — A method for estimating minimum legible font size for people at any age
- ISO 7731:2003, Ergonomics — Danger signals for public and work areas — Auditory danger signals
- ISO 19029:2016, Accessible design — Auditory guiding signals in public facilities
- ISO 28803:2012, Ergonomics of the physical environment — Application of International Standards to people with special requirements
- ISO 8201:2017, Alarm systems — Audible emergency evacuation signal — Requirements
- ISO/DIS 23617, Ageing societies — Guidelines for an age-inclusive workforce
- ISO 11064-5: Ergonomic design of control centres — Part 3: Control room layout
- ISO 11064-5: Ergonomic design of control centres — Part 4: Layout and dimensions of workstations
- ISO 11064-5:2008, Ergonomic design of control centres — Part 5: Displays and controls
- ISO 16817:2017, Building environment design — Indoor environment — Design process for the visual environment

6.6.1 Access & Egress

Safe access to and egress from the site shall be planned at the design stage. The designer shall be aware of, and assess the risks from, the following principal hazards:

- Falls from height caused by inadequate or unsafe access to places of work or unsafe working platforms.
- Contact with moving vehicles caused by non-separation of people and vehicles.
- Struck by moving plant or machinery, inadequate visibility, height, clearance, width for moving and maneuvering plant and machinery.
- Struck by falling objects, lifting, lowering, slewing, slinging of loads in confined space.
- Hazards of working in confined spaces caused by poor access.

Designers shall refer to ANSI/ASSE A1264.1-2017, Safety Requirements for Workplace Walking/Working Surfaces & Their Access; Workplace Floor, Wall & Roof Openings; Stairs & Guardrails Systems when designing access.

- ISO 14122-2:2016, Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways
- ISO/DIS 9241-20, Ergonomics of human-system interaction — Part 20: An ergonomic approach to accessibility within the ISO 9241 series

6.6.2 Lighting

Designers shall refer to ANSI/IES RP-7-17 Recommended Practice for Lighting Industrial Facilities when deciding on lighting intensity for a given workspace taking into consideration the needs of the task being performed. As a quick reference, the designers can refer to the table below:

#	Area of Operation	Recommended Illumination	
		(fc = lm/ft^2)	(Lux)
1	Accessways, exits, gangways, stairs	10	107.6
2	Changing rooms, showers, break areas	20	215.3
3	First aid stations, infirmaries, and offices	50	538.2
4	Roads leading to dock areas or where there is potential for heavy vehicle and pedestrian interaction	10	107.6
5	Dock areas where crating and uncrating activities take place	28	300

Approved LED lights are to be used to achieve the desired lighting intensity for a given workspace.

- ANSI/IES LP-10-2020, Lighting Practice: Sustainable Lighting - An Introduction to the Environmental Impacts of Lighting
- ANSI/IES LP-11-2020, Lighting Practice: Environmental Considerations for Outdoor Lighting
- ANSI/IES LP-3-2020, Lighting Practice: Designing and Specifying Daylighting for Buildings
- ANSI/IES LP-4-2020, Lighting Practice: Electric Light Sources - Properties, Selection and Specification
- ANSI/IES LP-6-2020, Lighting Practice: Lighting Control Systems - Properties, Equipment and Specification
- ANSI/IES LP-7-2020, Lighting Practice: The Lighting Design and Construction Process
- ANSI/IES LP-8-2020, Lighting Practice: The Commissioning Process Applied to Lighting and Control Systems

- ANSI/IES RP-38-2017, Recommended Practice for Lighting Performance for Small-to-Medium-sized Videoconferencing Rooms
- ANSI/IES RP-41-2020, Recommended Practice: Lighting Theatre and Auditorium Spaces
- ANSI/IES RP-42-2020, Recommended Practice: Dimming and Control Method Designations
- ANSI/IES RP-6-2020, Recommended Practice: Lighting Sports and Recreational Areas
- ANSI/IES TM-32-2019, Lighting Practice: Building Information Management
- ISO 8995-1/CIE S 008, Lighting of workplaces — Part 1: Indoor
- ISO 30061/CIE S 020, Emergency lighting
- IEC 60598 (all parts), Luminaires
- ISO/CIE 20086:2019, Light and lighting — Energy performance of lighting in buildings
- ANSI C136.32-2020, Standard for Roadway and Area Lighting Equipment Enclosed Setback Luminaires and Directional Floodlights
- ISO/CIE 22012:2019, Light and lighting — Maintenance factor determination — Way of working

6.6.3 Temperature

When testing extreme temperatures, OSHA uses heat stress monitors to check temperature, humidity, air circulation, and the amount of heat radiating from heat sources. Meanwhile, freezing temperatures are much more easily spotted with a thermometer. Determining the safety of an extreme temperature is based on a worker’s ability to maintain a safe body temperature. Therefore, the designer shall ensure that the climate in the work environment does not cause anyone’s body temperature to exceed 100 (37.7^{0}C) degrees Fahrenheit or higher. As this will interfere with an employee’s ability to perform his or her job.

- ANSI/ASHRAE 55-2013, Thermal Environmental Conditions for Human Occupancy

6.6.4 Ventilation and Indoor Air Quality

An effective ventilation system shall be designed and installed to safely evacuate hazardous material or hazardous chemical byproducts or fumes from tools or equipment.

Local exhaust ventilation may be used as a primary control if other engineering control systems are not feasible or cannot be included. Depending on the situation, the ventilation system shall meet the following criteria:

- Locally alarmed static pressure monitoring devices (e.g., Photohelic) should be installed on all primary and secondary ventilation control systems where the exhaust is required continuously to control exposure or an accidental release (i.e., gas cabinets, wet benches, etc.).
- At a minimum, a static pressure monitoring device (e.g., Magnehelic) shall be installed on exhaust systems where chemicals/hazardous materials are present only when personnel are using the exhausted equipment (i.e., lab hoods, and parts clean hoods etc.). In this case, the requirement for a local alarm may be replaced with administrative procedures and signage to require that the person verify there is adequate exhaust ventilation by visually checking the monitoring device prior to starting work. Locally alarmed devices may be used and eliminate the need for administrative controls. Note: In some cases, the equipment may be delivered with a manufacturer-provided static pressure monitoring device. In this case, an installed device between the equipment and control damper may not be required as determined by site EHS.
- The monitoring device port shall be placed in the exhaust duct between the enclosure or hood and the first control damper. For static pressure, the port shall be at least one duct diameter from an inlet

and shall not be placed in an elbow. If velocity pressure or flow is monitored for process reasons, the port must be at least five duct diameters from any inlet or elbow.

- The monitoring device for static pressure shall produce a local alarm (if alarm is required) at +/- 25% of design specifications.
- If a ventilation system failure could result in potential releases above the controlled substances threshold limit value, latched alarm with no reset is required. This would ensure that the process could not continue with inadequate exhaust. This does not apply to lab hoods where the hazard potential is present only when employees are present.
- All monitoring devices shall be labeled with the established set point, alarm settings and response procedure if the alarm sounds. Monitoring devices should be made as tamper-proof as possible to prevent inadvertent changes (i.e., set points cannot be changed or alarms disengaged without tools).

  - SEMI S6 - Environmental, Health, and Safety Guideline for Exhaust Ventilation of Semiconductor Manufacturing Equipment
  - ANSI/ASHRAE 62.1-2016, Ventilation for Acceptable Indoor Air Quality
  - ANSI/NFPA 90A-2021, Standard for the Installation of Air-Conditioning and Ventilating Systems
  - ANSI/NFPA 90B-2021, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
  - ISO 16814:2008, Building environment design — Indoor air quality — Methods of expressing the quality of indoor air for human occupancy
  - ISO 16000-40:2019, Indoor air — Part 40: Indoor air quality management system

6.6.5 Noise

The workplace shall be so designed that the noise levels shall not exceed permissible exposure, this includes both occupational and also ambient noise, levels stipulated in the local legal requirements.

Micron and NIOSH Recommended Exposure Limits for occupational noise is 85 decibels, using the A-weighting frequency response (often written as dBA) over an 8-hour average, usually referred to as Time-Weighted Average (TWA). Exposures at or above this level is considered hazardous. As for the ambient noise level, the Environmental Protection Agency (EPA) has pegged permissible ambient noise levels in residential areas at 55 decibels (dB) during the day and 48 dB at night, for educational and health facilities at 55 dB during the day and 50 dB at night.

Machinery, Equipment and Products purchased and placed within the workplace shall conform to ANSI/ASA S12.61-2020, Declaration and Verification of Noise Emission Values of Machinery, Equipment, and Products.

The General Contractor shall submit a Noise Assessment Report for the build facilities in conformance to

  - ANSI/ASA S12.19-1996 (R2020), Measurement of Occupational Noise Exposure.
  - ISO 15664:2001, Acoustics — Noise control design procedures for open plant
  - ISO 17624:2004, Acoustics — Guidelines for noise control in offices and workrooms by means of acoustical screens
  - ISO 22955:2021, Acoustics — Acoustic quality of open office spaces

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6.7 Fall Prevention/Protection

The Designer is expected incorporate fall prevention systems into the building design. The fall prevention systems incorporated into the building design shall conform to the standards outlined below or other equivalent international standards. The fall prevention systems shall be clearly labelled with design load for ease of reference and use.

The Designer shall as far as reasonably practicable, place frequently used controls at ground level and within reach. Where this is not practical, a working platform complete with adequate toe board, handrails and access shall be provided.

Fall protection systems shall be incorporated into the design where the risk of fall cannot be eliminated. The fall protection system incorporated into the building system shall complement the fall prevention system.

There will be a need to install fall protection device above some of the manufacturing tools to facilitate tool maintenance. Manufacturing tools with such needs shall be identified and communicated to the designers. Upon receiving such information, the designers shall incorporate stronger structures that are capable of withstanding the force from a fall to anchor the SRLs. In addition, the designers shall ensure the process pipeline are routed safely to prevent it from being installed at locations where it would be exposed to potential damage when the fall protection device is deployed.

Where required, the building design shall consider potential dropped objects hazard and include safety nets or other appropriate engineering controls into the design.

- Global EHS - Work At Heights Standard
- ANSI ASSE Z359.15-2014, Safety Requirements for Single Anchor Vertical Lifelines & Fall Arrestors for Personal Fall Arrest Systems
- ANSI ASSE Z359.16-2016, Safety Requirements for Climbing Ladder Fall Arrest Systems
- ANSI ASSE Z359.6-2016, Specifications and Design Requirements for Active Fall Protection Systems
- ANSI/ASSE Z359.14-2014, Safety Requirements for Self-Retracting Devices for Personal Fall Arrest & Rescue Systems
- ANSI/ASSE Z359.18-2017, Safety Requirements for Anchorage Connectors for Active Fall Protection Systems
- ANSI/ASSE Z359.2-2017, Minimum Requirements for a Comprehensive Managed Fall Protection Program
- ANSI/ASSP Z359.1-2020, The Fall Protection Code
- ANSI/ASSP Z359.12-2019, Connecting Components for Personal Fall Arrest Systems
- ANSI/ASSE A10.32-2012, Fall Protection Systems for Construction and Demolition Operations
- ANSI/ISEA 121-2018, Dropped Object Prevention Solutions

6.7.1 Staircase

There shall be railing on both sides of the stairs for grip:

- Railing height shall be no less than 1100mm from FFL unless otherwise stated by local code,

- Railing shall be continuous with no break or vertical drop when turning a stair flight to ensure the user can have a firm grip on the railing even during fire/emergency where sight may be impeded by smoke/fire within the escape staircase,
- All balustrades should primarily be fitted with vertical members (instead of horizontal members) to avoid having climbable toehold between 250mm to 850mm from FFL,
- Spacing between balustrade shall be no more than 100mm center-to-center,
- There shall be continuous toe-guard of minimum 75mm from FFL along the entire path of the escape staircase (include landings and stair flight),
- There shall be adequate headroom clearance for the entire route along the escape staircase, no less than 2100mm clear. If the pitch of the stairs is steep, additional headroom shall be considered for safety. In case where additional headroom is not available, suitable warning sign shall be placed strategically to alert the user,
- The surface of the threads and landing shall be rendered anti-slip,
- Nosing installed on the staircase shall be flush and not present a trip hazard,
- Photoluminescent strips shall be included in the staircase design to ensure the staircase and the threads are visible to users when there is a power outage.

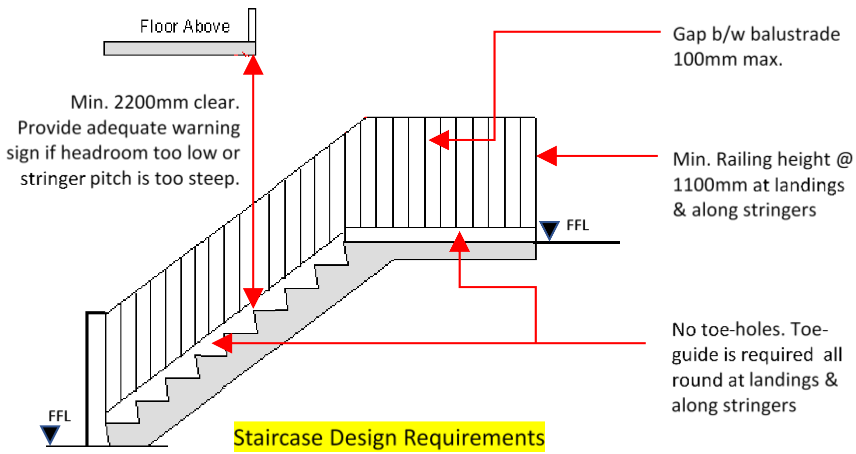

Figure 1 Staircase Design Requirements

6.7.2 Leading Edge Protection

Leading edge protection made of suitable material, which is structurally sound, shall be installed at areas where there is a potential for a person to fall e.g., elevator shaft opening, etc.

- ANSI/ASSE A10.18-2007 (R2012), Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations

6.7.3 Floor Opening

Floor openings that present potential dropped object or fall hazard shall be adequately covered. The protection shall include:

- Pre-laid BRC of adequate strength to prevent materials or a man from falling through,
- Guardrail system, which includes top-rail, mid-rail, and a toe-board, of adequate strength,
- Suitable cover made of structurally sound material e.g., plywood,

- Warning signs shall be affixed on guardrail system as well as the cover,
- Such areas shall not be used as debris storage area where access or removal of such protection shall be through a permit-to-work system.

Safety nets to arrest falling objects shall be installed where there is a potential for objects to fall from gaps in the working platforms or from the working platforms.

Tools used by the workforce shall be fitted with lanyards and secured to the tool belt to prevent it from dropping down.

The safety net shall be used for falling objects protection and NOT fall protection.

Such safety nets shall be able to take the impact load of a tool and installed in a manner where the sag caused by the tools does not harm the workforce working directly underneath.

Where there is a need to join two safety nets, the seams must be secured in a way that it does not allow tools or materials pass through it.

- ANSI/ASSE A10.18-2007 (R2012), Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations

6.7.4 Fixed Ladder Access

Cat ladder and corresponding access way complete with a guard rail system shall be installed at locations where access to monitor, service and maintain equipment or services installed in interstitial/ceiling space.

Where vertical ladders are installed to provide access to the catwalk, a vertical lifeline shall be installed to allow workers to access the catwalk safely.

Please refer to Global EHS - Work At Heights Standard for detail requirements for fixed ladder.

Figure 2 Fixed Ladder

Note: Ladder/Safety cage is not required if a horizontal lifeline is affixed to the vertical access ladder.

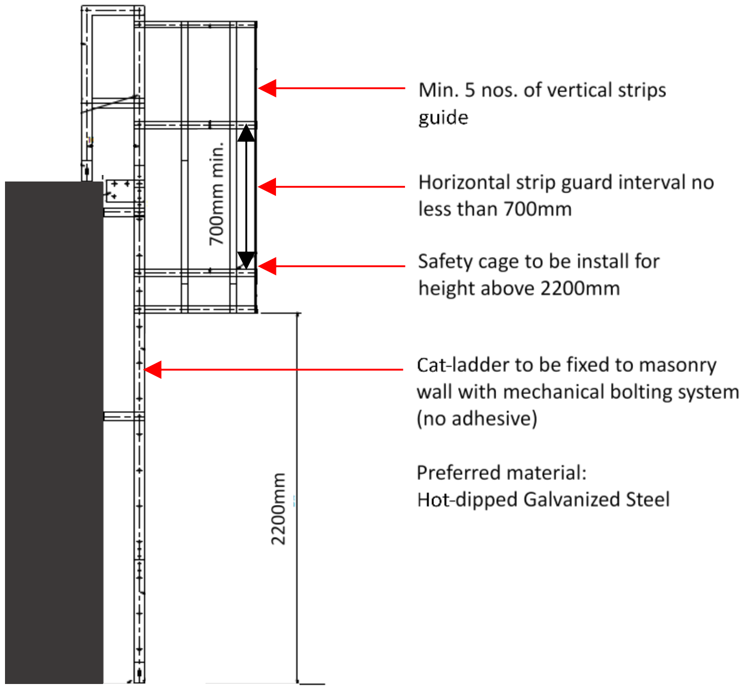

Figure 3 Cat-Ladder Design Requirements

6.8 Confined Space

As far as reasonably practical, confined spaces shall be eliminated from the building design. If this is not practical, the confined space shall be designed with the adequate:

- Safe access and egress,
- Mechanical ventilation,
- Space to facilitate rescue work, and
- Gas detection and monitoring

As far as reasonably practicable, pipes, drains or exhaust systems conveying hazardous substances or fume shall not be designed to pass through a confined space. Where this is not practicable, the following controls shall be designed and installed:

- Double containment system, and
- Hazardous substances conveyance system isolation,

Fall protection such as anchorage points shall be included in the design where work within the confined space will require the use of fall protection devices.

The labelling of confined spaces shall meet the requirements set out in the Global EHS - Confined Space Program Standard.

Following are considerations that the designer shall take into consideration when designing confined spaces:

Parameter	Requirements
Exiting and access	• Exiting distances consistent with code requirements for occupied areas, and • Occupational Safety & Health (OSHA)-compliant stairs for access/egress • Ensure that doorways are a minimum of 2.0m/80” high
Exhaust and ventilation	• Comply with criteria for occupied area, • Eliminate potential for a hazardous atmosphere, and • Inert gas (e.g., LN2) fill stations are located outside of and away from trenches
Deck over trench	• Prevent leaks/spills from entering trench, • Openings curbed to prevent spills from dripping into trench, and • Openings grated or railed to prevent large objects from dropping into trench
Life Safety Systems	• Evacuation alarms, PA system, emergency lighting, fire protection, safety showers consistent with Group B, F & H occupancy criteria, depending on the area within the facility
Lighting	• Lighting shall be provided in trench and pit areas requiring routine access. Illumination levels shall comply with local regulations
Drainage	• Adequate drainage to prevent safety hazard: flat floor with sumps provided at regular intervals to allow use of portable pumps for liquid removal
Electrical equipment, tools, and fittings	• Shall conform to area classification

Designers shall refer to the standards outlined below or other equivalent international standards for guidance in constructing a confined space.

- ANSI ASSE Z117.1-2016, Safety Requirements for Entering Confined Spaces
- ANSI/NFPA 350-2022, Guide for Safe Confined Space Entry and Work

6.9 Hazardous Energy

The Designer and the Project Management Team shall ensure that systems storing or conveying hazardous energies are equipped with lockable features that would enable it to be isolated in section and physically locked with a Lock-Out/Tag-Out device.

Facility piping, excluding fire protection water (e.g., chilled water, storm drain, etc.) shall not be routed over or within 0.3m (1 foot) of electrical, LSS, telecom, or FMS equipment where any mechanical joint (threaded or flanged) might leak onto the equipment.

Pressurized facility piping mechanical joints, excluding fire protection water, shall also be shielded to prevent any leak from spraying onto the electrical, LSS, telecom, FMS equipment or personnel in walkways or maintenance spaces. In addition, flexible mechanical connections (e.g., suction and discharge of pumps) within 6.0m (20 feet) of the above listed equipment must also be shielded to contain sprays.

The standards outlined below, or other equivalent international standards shall be referred to for guidance.

Lighting fixtures, power outlets/receptacles, motors and other electrical equipment shall be NRTL/CE/UL certified and appropriate to the hazardous area classification. Test reports from the accredited testing facilities shall be made available where applicable. Electrical installations in classified hazardous areas shall comply to the hazardous area installation requirements.

Refrigerators, freezers, chemical storage equipment using electrical power in classified hazardous areas must be rated and certified by NRTL / CE or national certification bodies. The protection class label shall be marked on the equipment with the explosion proof rating, type of protection and temperature class.

Ultra-cold freezers that store flammable liquids below their flashpoints, when installed in non-hazardous areas, are not required to be rated for Hazardous area protection. However, the equipment requires provisions to ensure that a flammable atmosphere cannot be developed during a power outage or other unplanned event (power monitoring, backup power or equivalent method). In cases where the Ultra cold Freezer is installed in a classified hazardous room, the freezer must comply to the hazardous area equipment protection and installation requirements.

Please refer to the examples of typical labels:

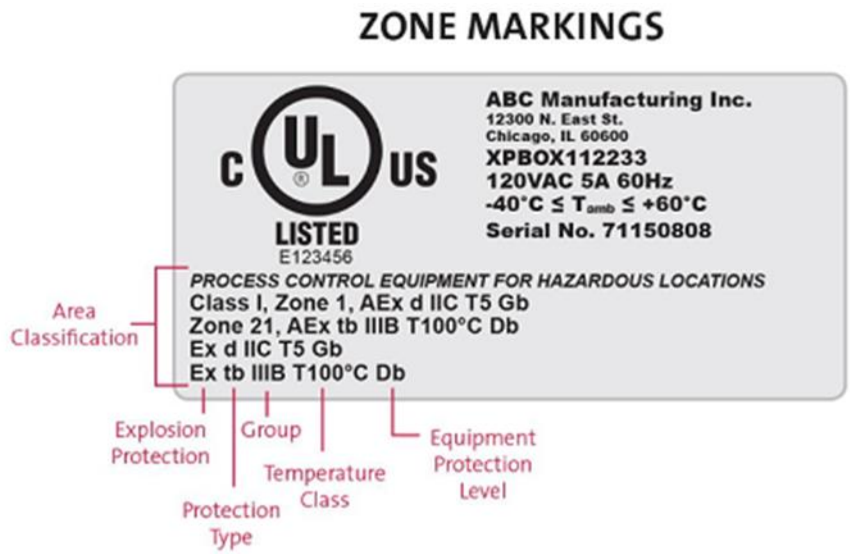

Figure 4 Safety Label - USA

IECEx MARK EXAMPLE

Figure 5 Safety Label - Europe

- SEMI S20 - Safety Guideline for Identification and Documentation of Energy Isolation Devices for Hazardous Energy Control
- ANSI/ASSE Z244.1-2016, The Control of Hazardous Energy Lockout, Tagout and Alternative Methods
- ANSI/NFPA 70E-2021, Standard for Electrical Safety in the Workplace
- ISO 14118:2017, Safety of machinery — Prevention of unexpected start-up
- ISO 4126-10:2010, Safety devices for protection against excessive pressure — Part 10: Sizing of safety valves for gas/liquid two-phase flow
- ISO 11933-5:2001, Components for containment enclosures — Part 5: Penetrations for electrical and fluid circuits

6.10 Uninterrupted Power Supply & Battery Charging Rooms

Ventilation of the battery room is required to prevent buildup of hydrogen.

The ventilation system shall be so configured that it limits hydrogen gas concentrations to less than 1% concentration by volume. Early gas and fire detection system shall be installed to detect incipient fire and to prevent hydrogen gas concentration from rising above 4%.

Continuous ventilation shall be provided at a rate of not less than 1 ft3/min/ft2 (5.1 L/sec/m2) of the floor area of the room or cabinet.

- ANSI/NFPA 505-2018, Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations
- ANSI/UL 583-2020, Standard for Safety for Electric-Battery-Powered Industrial Trucks
- ANSI/NECA 411-2014, Standard for Installing and Maintaining Uninterruptible Power Supplies
- ANSI/NECA 416-2016, Recommended Practice for Installing Stored Energy Systems
- ANSI/ATIS 0600003-2018, Battery Enclosure and Rooms/Areas

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- ANSI/UL 1236-2016, Standard for Safety for Battery Chargers For Charging Engine-Starter Batteries
- ANSI/UL 1564-2020, Standard for Safety for Industrial Battery Chargers

6.11 Docks

Open dock areas and dock loading areas that are 4 feet (1.2 meters) or higher above the dock pad or adjacent areas are required to have guardrails. Fixed stairs shall be required for access from one level to another where operations necessitate daily travel. Ladders should not be installed at dock exit ways, where daily travel is required, or where the dock exit way may be used for evacuation purposes.

Light fixtures shall be designed to provide illumination (300 lux) on the pathways for movement on the dock and the dock apron. Special purpose light fixtures shall be provided at dock doors to permit illumination of the interiors of closed trucks or trailers, these fixtures shall be mounted to minimize the possibility of accidental damage.

Dock bumpers shall be provided at all docks.

A device that secures the truck to the dock through positive latching mechanism shall installed and used if approved by site EHS, but the use of such device shall not remove the need for wheel chocks. Arrangements shall be made for the chocks to be permanently tethered to the dock.

Permanent ramps shall be provided at each dock where powered lift trucks or other mechanical material handling equipment are required to operate on both the dock and apron levels. Such ramps shall have a maximum slope of 1 3/16 inch per foot. Curbs with fixed or removable handrails shall be provided.

Note: Protecting the open side of docks is not required for docks that are designed with a roll-up door or other barrier flush with the edge of the dock.

Power operated dock boards and lifts shall be designed and installed in accordance with the most recent revision international standards.

- ANSI MH30.1-2015, Performance and Testing Requirements for Dock Leveling Devices
- ANSI/MH32.1-2018, Stairs, Ladders, and Open-Edge Guards for Use with Material Handling Structures

6.12 Lightning

The Designer shall design the lightning protection system to ensure the building is adequately protected against lightning strike. The lightning protection or its component shall be designed to dissipate energy from a lightning strike effectively and not in any way expose the building occupants as well as the equipment/tools to lightning strikes.

- ANSI/NFPA 780-2020, Standard for the Installation of Lightning Protection Systems
- ANSI/UL 96-2016, Standard for Safety for Lightning Protection Components

6.13 Sustainability & Environment

Environmental sustainability is defined as responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality. The designer shall take into consideration environmental sustainability into the building design to ensure that the needs of today's population are met without jeopardizing the ability of future generations to meet their needs.

- ASQ/ANSI/ISO 14006:2011, Environmental management systems - Guidelines for incorporating eco-design
- ISO 16813:2006, Building environment design — Indoor environment — General principles
- ISO 16817:2017, Building environment design — Indoor environment — Design process for the visual environment
- ISO 19454:2019, Building environment design — Indoor environment — Daylight opening design for sustainability principles in visual environment
- ISO 20887:2020, Sustainability in buildings and civil engineering works — Design for disassembly and adaptability — Principles, requirements, and guidance
- ISO 14055-1:2017, Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification — Part 1: Good practices framework
- ISO 26000:2010, Guidance on social responsibility
- ISO 20400:2017, Sustainable procurement — Guidance
- ISO 21930:2017, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
- ISO 14009:2020, Environmental management systems — Guidelines for incorporating material circulation in design and development
- ISO/TR 26368:2012, Environmental damage limitation from fire-fighting water run-off
- ISO 13315-6:2019, Environmental management for concrete and concrete structures — Part 6: Use of concrete structures
- ISO 13315-8:2019, Environmental management for concrete and concrete structures — Part 8: Environmental labels and declarations

6.13.1 Air Emissions

Air pollution caused by unabated emissions that contain contaminants or pollutant substances in the air has a potential to interfere with human health or welfare or produce other harmful environmental effects. Therefore, the designer shall incorporate effective air abatement systems that can remove pollutant substances to extend that it is in compliance with applicable local legal requirements or international standards.

- ANSI/NFPA 91-2020, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids
- ANSI/ASTM F1431-1992 (R2021), Specification for Water Trap for Diesel Exhaust

6.13.2 Energy

Sustainable energy is about finding clean, renewable sources of energy. Therefore, the designer shall consider several energy forms to render the building energy efficient.

- ISO 23045:2008, Building environment design — Guidelines to assess energy efficiency of new buildings

- ANSI/IREC 14732-2014, General Requirements for the Accreditation of Clean Energy Certificate Programs
- ISO 17772-1:2017, Energy performance of buildings — Indoor environmental quality — Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings
- ISO/TR 17772-2:2018, Energy performance of buildings — Overall energy performance assessment procedures — Part 2: Guideline for using indoor environmental input parameters for the design and assessment of energy performance of buildings
- ISO 14009:2020, Environmental management systems — Guidelines for incorporating material circulation in design and development
- ANSI/ISO/MSE 50001-2011, Energy management systems - Requirements with guidance for use
- ISO/TR 16822:2016, Building environment design — List of test procedures for heating, ventilating, air-conditioning, and domestic hot water equipment related to energy efficiency
- ANSI/NFPA 900-2019, Building Energy Code
- ANSI/UL 9540-2016, Standard for Safety for Energy Storage Systems and Equipment

6.13.3 Waste Management

The goal of sustainable waste management is to reduce the amount of natural resources consumed, confirm that any materials that are taken from nature are reused as many times as possible and that the waste created is kept to a minimum. Therefore, the designer shall recommend the use of highest quality construction and demolition debris management, resource recovery and disposal services.

- ANSI/AWWA G510-2013, Wastewater Treatment Plant Operations and Management
- ANSI/AWWA G520-2017, Wastewater Collection System Operation and Management
- ANSI/AWWA J100-2020, Risk and Resilience Management of Water and Wastewater Systems
- ANSI/ASTM F917-2019, Specification for Commercial Food Waste Disposers
- ANSI Z245.30-2018, Waste Containers - Safety Requirements
- ANSI Z245.60-2018, Waste Containers - Compatibility Dimensions

6.14 Hazardous Substance

When hazardous substances are present in the workplace, it's very important the risks associated with in are properly recognized and dealt with to ensure the safety of all employees. The designer shall take the requirements outlined in the following standards to ensure safe hazardous substance conveyance and disposal.

This includes areas where there is a potential for hazardous substance spills, leaks, sprays, and splashes e.g., chemical loading/unloading docks (including waste) must be designed to prevent releases to the environment. Such design may include, blind sumps, lock-out valves, appropriate drain covers, plugs, etc.

Spill release devices (e.g., lock-out valves) must always be accessible e.g., dock equipment (e.g., levelers) must not be designed to block access to lock-out valves.

- SEMI F6 - Guide for Secondary Containment of Hazardous Gas Piping Systems
- SEMI S5 - Safety Guideline for Sizing and Identifying Flow Limiting Devices for Gases
- SEMI S25 - Safety Guideline for Hydrogen Peroxide Storage and Handling Systems

- SEMI S29 - Guide for Fluorinated Greenhouse Gas (F-Ghg) Emission Characterization and Reduction
- SEMI S3 - Safety Guideline for Process Liquid Heating Systems
- ANSI/NFPA 400-2022, Hazardous Materials Code
- ANSI Z223.1/NFPA 54-2021, National Fuel Gas Code
- ANSI/NFPA 30-2021, Flammable and Combustible Liquids Code
- ANSI/NFPA 55-2020, Compressed Gases and Cryogenic Fluids Code
- ANSI/NFPA 58-2020, Liquefied Petroleum Gas Code
- ISO 10648-1:1997, Containment enclosures — Part 1: Design principles
- ISO 14123-1:2015, Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers
- ANSI/NFPA 497-2021, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- ANSI/NFPA 499-2021, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- ANSI/ISA 12.10.02 (IEC 61241-0-2006) (R2015), Electrical Apparatus for Use in Zone 20, Zone 21, and Zone 22 Hazardous (Classified) Locations - General Requirements
- ANSI/ISA 61241-1 (12.10.03)-2007 (R2015), Electrical Apparatus for Use in Zone 21 and Zone 22 Hazardous (Classified) Locations - Protection by Enclosures "tD"
- ANSI/ISA 61241-11 (12.10.04)-2007 (R2015), Electrical Apparatus for Use in Zone 20, Zone 21 and Zone 22 Hazardous (Classified) Locations - Protection by Intrinsic Safety "iD"
- ANSI/ISA 61241-18 (12.10.07)-2007 (R2015), Electrical Apparatus for Use in Zone 20, Zone 21 and Zone 22 Hazardous (Classified) Locations - Protection by Intrinsic Safety "mD"
- ANSI/ISA 61241-2 (12.10.06)-2007 (R2015), Electrical Apparatus for Use in Zone 21 and Zone 22 Hazardous (Classified) Locations - Protection by Pressurization "pD"
- ANSI/UL 1203-2021, Standard for Safety for Explosion-Proof and Dust-Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations
- ANSI/UL 122001-2009 (R2019), Standard for Safety for General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2 Hazardous (Classified) Locations
- ANSI/UL 122701-2017, Standard for Safety for Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
- ANSI/UL 2225-2020, Standard for Safety for Cables and Cable-Fittings for Use in Hazardous (Classified) Locations
- ANSI/UL 674-2020, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
- ANSI/UL 698A-2018, Standard for Safety for Industrial Control Panels Relating to Hazardous (Classified) Locations
- ANSI/UL 844-2020, Standard for Safety for Luminaires for Use in Hazardous (Classified) Locations
- ANSI/UL 913-2019, Standard for Safety for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations
- ANSI/ISEA Z358.1-2020, Emergency Eyewash and Shower Equipment

6.15 Emergency Shower and Eyewash

Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.

Location

- Must be accessible within 10-seconds of the hazard, equivalent to 17 meters (55 feet).
- Must be located on the same level as the hazard.
- Path of travel must be free of obstructions (a step into an enclosure where emergency equipment is located is not considered an obstruction).
- Cannot be separated from the hazard by a wall or partition which would require passage through a door unless the hazard requires escape from the immediate area.
- Located in such a manner to avoid exposing users to the source of the hazard (such as gas rooms) or other hazards (electrical, etc.)
- Location must be well lit and identified with a highly visible sign.

Performance specifications

- Water temperature must be in the tepid range of 16 to 38 °C (60 to 100 °F).
- Showers must have an easily located, accessible, and hands-free valve that activates in one second or less and remains open until manually closed. The valve shall be no more than 173 cm (69 inches) above the surface on which the user stands.
- Plumbed unit must deliver 76 liters (20 gallons) of water per minute for 15 minutes at 207 KPa (30 psi).
- The height of water column must be between 208 cm (82 inches) and 244 cm (96 inches) above the surface on which the user stands.
- At 152 cm (60 inches) above the surface on which the user stands, the water pattern is at least 51 cm (20 inches) in diameter.
- The center of the water pattern must be at least 41 cm (16 inches) from any obstruction.
- Select corrosion resistant materials such as PVC, PP, PVDF, or stainless steel for piping. Avoid using carbon steel or steel for piping.
- If shut-off valves are installed in the supply line for maintenance purposes, provisions must be made to prevent unauthorized shut-off.

Enclosures and Drains

- Showers shall either be enclosed or provided with shower curtain that provides 360° coverage to provide user privacy and minimize spraying/splashing.
- Shower enclosures must have a minimum diameter of 86 cm (34 inches).
- Emergency shower equipment shall be installed with plumbed drains/sumps where feasible.

Remote Units

- Remote units shall be provided with an alarm that reports back to a central reporting station upon activation.
- Where freezing is a potential, units shall be insulated and heat-traced to prevent the water in the safety shower from freezing. Tepid water must be supplied via the mains supply, these units do not heat the water to a tepid temperature.

Designers shall refer to the standard below or other equivalent international standards for guidance on emergency showers.

- ANSI/ISEA Z358.1-2014, Emergency Eyewash and Shower Equipment

6.16 Prohibited Materials

When designing and building facilities and facility systems, materials that are generally known to be carcinogenic or acutely hazardous, and which present a significant risk to people, the surrounding community or to the environment, are prohibited from use. These includes items listed in Micron's banned and restricted substances list, but are not limited to:

- Asbestos containing construction materials (i.e., insulation, ceiling tiles, fire resistant or retardant materials, etc.),
- Asbestos containing cement and adhesives,
- Materials, equipment or products containing poly-chlorinated bi-phenyls (e.g., transformers, ballasts in light fixtures),
- Materials, equipment or products containing or manufactured with any Class I ozone-depleting substance (e.g., chlorofluorocarbons, methyl chloroform, carbon tetrachloride),
- In the European Community, hydrochlorofluorocarbons (HCFC) listed in European Regulation 1005/2009 (or most recent version of the same).

Please refer to Micron's Product Content Specification for further details.

6.17 Traffic

The Designer shall consider the peak traffic flow for the given facility to eliminate or mitigate potential conflicts between pedestrian traffic, small and medium sized vehicular traffics, and large vehicular traffic. A Swept Path Analysis is required for determining the space required by large vehicular traffic when making a turn. The controls shall include, but not limited to, the following:

- Designated pedestrian walkways and crossings,
- Bollards to prevent vehicular traffic from colliding into assets within the site,
- Segregated pathway for large vehicles,
- Well luminated pathways, access, and egress,
- Speed breakers,
- Higher road curbs, etc.

In addition to determining turning radius for large vehicular traffic, the Swept Path Analysis shall be used to test parking arrangements, loading areas, emergency access, or construction routes to determine the number and/or types of vehicles the site can logistically and safely accommodate.

- ISO 39001:2012, Road traffic safety (RTS) management systems - Requirements with guidance for use
- ISO 39002:2020, Road traffic safety — Good practices for implementing commuting safety management

Please refer to Appendix 9 for details of expected traffic controls.

6.18 Lifting

The designers shall ensure that the overhead and gantry cranes constructed and installed inside Micron's building shall meet the following design specifications.

- ANSI/ASME B30.2-2016, Overhead and Gantry Cranes
- ANSI/ASME NOG-1-2020, Rules for Construction of Overhead and Gantry Cranes
- ISO/TR 16880:2004, Cranes — Bridge and gantry cranes — International Standards for design and manufacturing requirements and recommendations
- ISO 11660-5:2001, Cranes — Access, guards, and restraints — Part 5: Bridge and gantry cranes
- ISO 10972-5:2006, Cranes — Requirements for mechanisms — Part 5: Bridge and gantry crane
- ISO 8686-5:2017, Cranes — Design principles for loads and load combinations — Part 5: Overhead travelling and portal bridge cranes
- ISO 10245-5:1995, Cranes — Limiting and indicating devices — Part 5: Overhead travelling and portal bridge cranes
- ISO/DIS 12210, Cranes — Anchoring devices for in-service and out-of-service conditions
- ISO 22986:2007, Cranes — Stiffness — Bridge and gantry cranes
- ISO 16881-1:2005, Cranes — Design calculation for rail wheels and associated trolley track supporting structure — Part 1: General
- ISO 17096:2015, Cranes — Safety — Load lifting attachments
- ISO 8566-5:2017, Cranes — Cabins and control stations — Part 5: Overhead travelling and portal bridge cranes
- ANSI/ASME NOG-1-2020, Rules for Construction of Overhead and Gantry Cranes

6.19 Tools

Tools purchased to manufacture semiconductors within the building shall be designed and constructed according to Semi S2 guidelines. Each tool shall be certified by a third-party accreditation body and accompanied by an assessment report for the end-user's reference.

- SEMI S2 - Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

6.20 Equipment

Equipment purchased to support the manufacturing of semiconductors within the building shall conform to local legal requirements or international standards. The equipment shall be accompanied product safety certification where applicable.

- ISO 12100:2010, Safety of machinery — General principles for design — Risk assessment and risk reduction
- ISO 13849-1:2015, Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design
- ISO 14120:2015, Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards

- ISO 14119, Safety of machinery — Interlocking devices associated with guards — Principles for design and selection
- ISO 14955-1:2017, Machine tools — Environmental evaluation of machine tools — Part 1: Design methodology for energy-efficient machine tools
- ISO 14159:2002, Safety of machinery — Hygiene requirements for the design of machinery
- ISO 13851:2019, Safety of machinery — Two-hand control devices — Principles for design and selection
- ISO 14119:2013, Safety of machinery — Interlocking devices associated with guards — Principles for design and selection
- ISO 15534-1:2000, Ergonomic design for the safety of machinery — Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery
- ISO 15534-2:2000, Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings
- ISO/TR 22100-3:2016, Safety of machinery — Relationship with ISO 12100 — Part 3: Implementation of ergonomic principles in safety standards
- ISO 19353:2019, Safety of machinery — Fire prevention and fire protection

6.21 Life Safety System

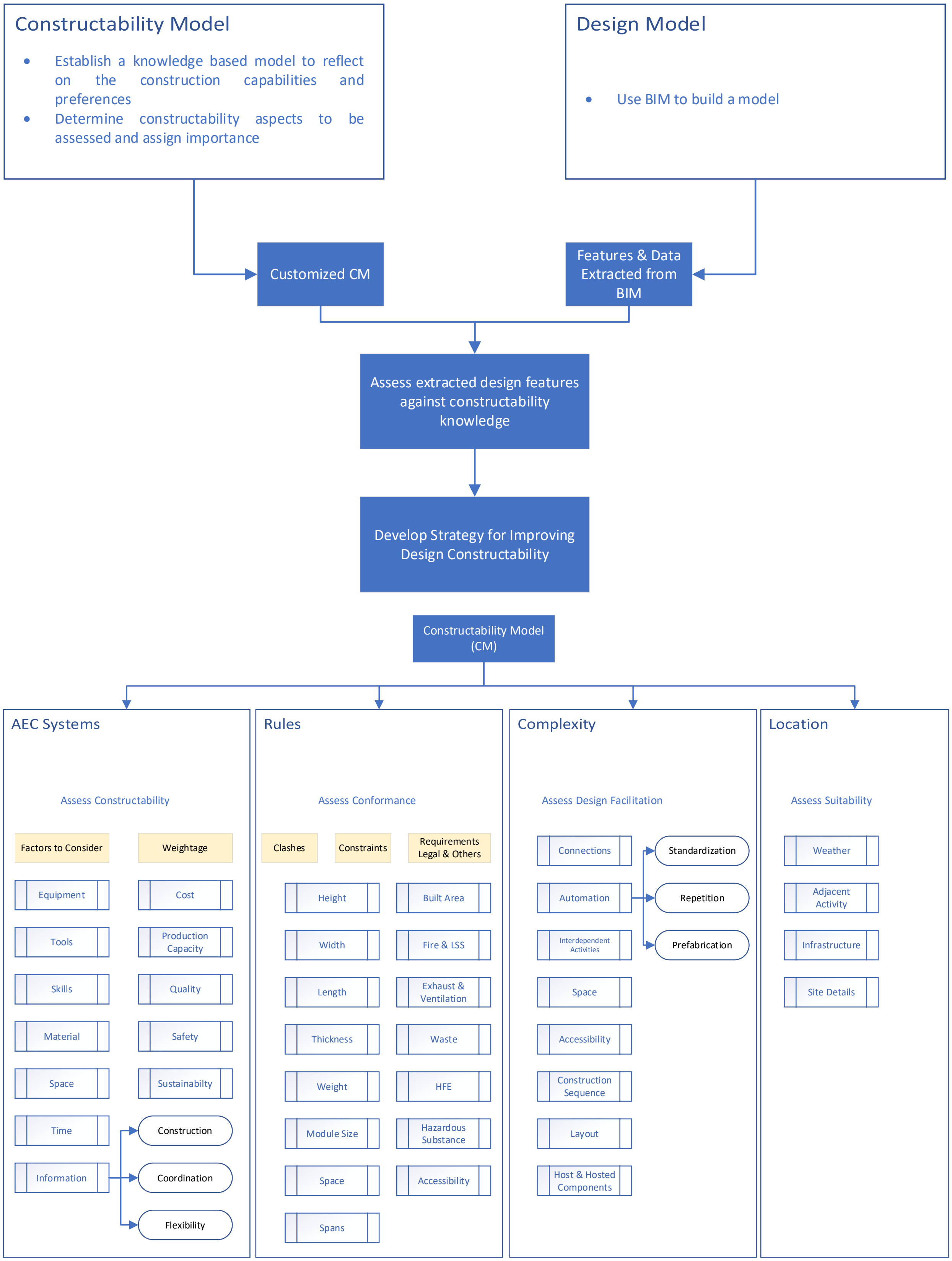
The designer shall ensure that any interior building element designed to protect and evacuate the building population in emergencies, including fires and earthquakes, and less critical events, such as power failures complies to the following standards in addition to local legal requirements.

- ANSI/NFPA 101-2021, Life Safety Code
- ANSI/NFPA 101A-2022, Guide on Alternative Approaches to Life Safety
- ANSI/NFPA 3-2021, Standard for Commissioning of Fire- Protection and Life Safety Systems
- ANSI/NFPA 4-2021, Standard for Integrated Fire Protection and Life Safety System Testing
- Requirements stipulated in Responsible Business Alliance (RBA) Guidelines

6.22 Construction Methodology & Constructability

Efficiency, both time use and cost, in building construction can be attained by applying the principles of constructability. Incorporating these principles into initial stages of design maximize outcomes for all stakeholders including designers, contractors, and Micron.

To be effective such a tool shall be deployed at the conceptual design stage so that constructability is factored into the design solution starting from its inception. Therefore, the designer shall use a BIM-based model with embedded information within the design environment to conduct the assessment. The modelling framework is composed of three key parts: The Constructability Model (CM) which formulates user-based knowledge; the BIM Design Model which provides required data for the assessment; and the Assessment Model (AM) which reasons with the formulated knowledge and the BIM Design Model.


Constructability Model
Establish a knowledge based model to reflect on the construction capabilities and preferences
Determine constructability aspects to be assessed and assign importance
Design Model
Use BIM to build a model
Customized CM
Features & Data Extracted from BIM
Assess extracted design features against constructability knowledge
Develop Strategy for Improving Design Constructability
Constructability Model (CM)
AEC Systems
Assess Constructability
Factors to Consider
Weightage
Equipment
Cost
Tools
Production Capacity
Skills
Quality
Material
Safety
Space
Sustainabilty
Time
Construction
Information
Coordination
Flexibility
Rules
Assess Conformance
Clashes
Constraints
Requirements Legal & Others
Height
Built Area
Width
Fire & LSS
Length
Exhaust & Ventilation
Thickness
Waste
Weight
HFE
Module Size
Hazardous Substance
Space
Accessibility
Spans
Complexity
Assess Design Facilitation
Connections
Standardization
Automation
Repetition
Interdependent Activities
Prefabrication
Space
Accessibility
Construction Sequence
Layout
Host & Hosted Components
Location
Assess Suitability
Weather
Adjacent Activity
Infrastructure
Site Details

- ISO 13824:2020, Bases for design of structures — General principles on risk assessment of systems involving structures
- ISO 10137:2007, Bases for design of structures - Serviceability of buildings and walkways against vibrations
- ISO 22111:2019, Bases for design of structures — General requirements
- ISO 21542:2011, Building construction — Accessibility and usability of the built environment
- ISO 13824:2020, Bases for design of structures — General principles on risk assessment of systems involving structures
- ANSI/ASHRAE/IES Standard 202-2013, Commissioning Process for Buildings and Systems
- ANSI/NFPA 5000-2021, Building Construction and Safety Code
- ANSI/ASSE A10.18-2007 (R2012), Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations

6.23 Temporary Works

Temporary works relates to work activities undertaken during construction work or works to stabilize or protect an existing building or structure, neither works of which are intended or required to form part of the completed construction works e.g., scaffold erection/demolition, formwork installation/dismantling, etc. Such work activities are to be performed in accordance to approved design drawing provided by the professional engineer. The professional engineer is expected to provide on-side supervision and attestation to ensure the temporary works are carried out in accordance with the work method statement and approved design drawing.

- ISO 22966:2009, Execution of concrete structures
- ANSI/ASSP A10.8-2019, Scaffolding Safety Requirements
- ANSI/UL 1322-2017, Standard for Safety for Fabricated Scaffold Planks and Stages
- ANSI/UL 1323-2020, Standard for Scaffold Hoists
- ISO 10721-2:1999, Steel structures — Part 2: Fabrication and erection, Section 11.3

6.24 Fire Prevention and Protection

In addition to the safety of occupants with business continuity an ever-increasing issue, protection from fire is an integral aspect in reducing downtime at any facility. A combination of fire prevention and fire protection strategy can reduce hazards and maintain safety. Therefore, the designer shall ensure buildings are constructed in accordance with the version of the building code that is in effect when an application for a building permit is made.

- ANSI/NFPA 1-2021, Fire Code
- ISO 16732-1:2012, Fire safety engineering — Fire risk assessment — Part 1: General
- ISO 14520-1:2015, Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements
- ISO 6183:2009, Fire protection equipment — Carbon dioxide extinguishing systems for use on premises — Design and installation
- ISO 20338:2019, Oxygen reduction systems for fire prevention — Design, installation, planning and maintenance

- ISO 7240-3:2020, Fire detection and alarm systems — Part 3: Audible alarm devices
- ISO 7240-14:2013, Fire detection and alarm systems — Part 14: Design, installation, commissioning and service of fire detection and fire alarm systems in and around buildings
- ISO 21927-5:2018, Smoke and heat control systems — Part 5: Powered smoke exhaust systems — Requirements and design
- ISO/TS 21805:2018, Guidance on design, selection and installation of vents to safeguard the structural integrity of enclosures protected by gaseous fire-extinguishing systems
- ISO 7240-19:2007, Fire detection and alarm systems — Part 19: Design, installation, commissioning, and service of sound systems for emergency purposes
- ISO 23932-1:2018, Fire safety engineering — General principles — Part 1: General
- ISO 24679-1:2019, Fire safety engineering — Performance of structures in fire — Part 1: General
- ISO/TR 16576:2017, Fire safety engineering — Examples of fire safety objectives, functional requirements, and safety criteria
- ISO 7240-16:2007, Fire detection and alarm systems — Part 16: Sound system control and indicating equipment
- ISO 7240-19:2007, Fire detection and alarm systems — Part 19: Design, installation, commissioning, and service of sound systems for emergency purposes
- ISO/DIS 20710-1, Fire safety engineering — Active fire protection systems — Part 1: General principles
- ISO 7240-16:2007, Fire detection and alarm systems — Part 16: Sound system control and indicating equipment
- ANSI/NFPA 318-2018, Standard for the Protection of Semiconductor Fabrication Facilities
- ANSI/NFPA 820-2020, Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- ISO 14520-1:2015, Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements
- ANSI/NFPA 13-2019, Standard for the Installation of Sprinkler Systems
- ANSI/NFPA 14-2019, Standard for the Installation of Standpipe and Hose Systems
- ANSI/NFPA 15-2022, Standard for Water Spray Fixed Systems for Fire Protection
- ANSI/NFPA 17-2021, Standard for Dry Chemical Extinguishing Systems
- ANSI/NFPA 17A-2021, Standard for Wet Chemical Extinguishing Systems
- ANSI/NFPA 1961-2020, Standard on Fire Hose
- ANSI/NFPA 1963-2019, Standard for Fire Hose Connections
- ANSI/NFPA 1964-2018, Standard for Spray Nozzles
- ANSI/NFPA 20-2022, Standard for the Installation of Stationary Pumps for Fire Protection
- ANSI/NFPA 2001-2018, Standard on Clean Agent Fire Extinguishing Systems
- ANSI/NFPA 2010-2020, Standard for Fixed Aerosol Fire-Extinguishing Systems
- ANSI/NFPA 204-2021, Standard for Smoke and Heat Venting
- ANSI/NFPA 214-2021, Standard on Water-Cooling Towers
- ANSI/NFPA 22-2018, Standard for Water Tanks for Private Fire Protection
- ANSI/NFPA 24-2022, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- ANSI/NFPA 3-2021, Standard for Commissioning of Fire Protection and Life Safety Systems
- ANSI/NFPA 45-2019, Standard on Fire Protection for Laboratories Using Chemicals

- ANSI/NFPA 497-2021, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- ANSI/NFPA 499-2021, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- ANSI/NFPA 652-2019, Standard on the Fundamentals of Combustible Dusts
- ANSI/NFPA 67-2019, Guideline on Explosion Protection for Gaseous Mixtures in Pipe Systems
- ANSI/NFPA 68-2018, Standard on Explosion Protection by Deflagration Venting
- ANSI/NFPA 69-2019, Standard on Explosion Prevention Systems
- ANSI/NFPA 72-2019, National Fire Alarm and Signaling Code
- ANSI/NFPA 750-2019, Standard on Water Mist Fire Protection Systems
- ANSI/NFPA 77-2019, Recommended Practice on Static Electricity
- ANSI/NFPA 770-2021, Standard on Hybrid (Water and Inert Gas) Fire Extinguishing Systems
- ANSI/NFPA 80A-2022, Recommended Practice for Protection of Buildings from Exterior Fire Exposures
- ANSI/NFPA 92-2021, Standard for Smoke Control Systems
- ANSI/FM 3265-2017, Spark Detection and Extinguishing Systems
- ANSI/FM 5560-2017, Water Mist Systems
- ANSI/FMRC FM 3260-2004 (R2014), Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling
- ANSI/FM 4910-2013, Cleanroom Materials Flammability Test Protocol

6.25 Earthquake

At locations where earthquakes may undermine the operations of the building, the designer shall ensure the building structure is designed and constructed to the following international standards:

- ISO 2394:2015, General principles on reliability for structures
- ISO 13823:2008, General principles on the design of structures for durability
- ISO 22111:2019, Bases for design of structures — General requirements
- ISO 3010:2017, Bases for design of structures - Seismic actions on structures
- ISO 13822:2001, Bases for design of structures - Assessment of existing structures
- ISO 23469:2005, Bases for design of structures — Seismic actions for designing geotechnical works
- ISO/TR 22845:2020, Resilience of buildings and civil engineering works
- ISO 13033:2013, Bases for design of structures — Loads, forces, and other actions — Seismic actions on nonstructural components for building applications
- ISO 13824:2020, Bases for design of structures — General principles on risk assessment of systems involving structures
- ISO/TR 22845:2020, Resilience of buildings and civil engineering works
- ISO 13823:2008, General principles on the design of structures for durability
- ANSI/FM 1950-2016, Seismic Sway Brace Components for Automatic Sprinkler Systems

6.26 Safety Signs

Safety signs communicate hazards effectively. Therefore, the designer is required to specify suitable locations to place safety signs at the workplace. The safety signs installed at the workplace shall conform to the standards outlined below:

- ISO 3864-1:2011, Graphical symbols — Safety colors and safety signs — Part 1: Design principles for safety signs and safety markings
- ISO 3864-3:2012, Graphical symbols — Safety colors and safety signs — Part 3: Design principles for graphical symbols for use in safety signs
- ISO 7010:2019, Graphical symbols — Safety colors and safety signs — Registered safety signs
- ISO 20560-1:2020, Safety information for the content of piping systems and tanks — Part 1: Piping systems
- ANSI/NFPA 170-2021, Standard for Fire Safety and Emergency Symbols

6.27 Emergency Management

In addition to meeting relevant design codes for emergency management, the designer shall ensure the building design incorporates features and facilities that consider the capabilities of those with different capabilities. Examples are included in the following table:

Impairment	Enhancement
Vision	Marking on the floor for spatial recognition Color coding for color blindness
Hearing	Audio-visual aids e.g., strobe lights combined with emergency alarms
Hearing	Signboards in-addition to public announcement system to indicate evacuation routes

- ISO 30061:2007, Emergency lighting
- ISO/TS 18870:2014, Lifts (elevators) — Requirements for lifts used to assist in building evacuation
- ANSI/NFPA 110-2022, Standard for Emergency and Standby Power Systems
- ANSI/NFPA 111-2022, Standard on Stored Electrical Energy Emergency and Standby Power Systems
- ANSI/NFPA 1616-2020, Standard on Mass Evacuation, Sheltering, and Re-entry Programs
- ANSI/NFPA 704-2022, Standard System for the Identification of the Hazards of Materials for Emergency Response

6.27.1 Hazardous Material Spill

Where there is a potential for hazardous material spill, the designer shall design-in a secondary containment system to capture and channel the spill to a suitably constructed collection pit. The collection pit shall be suitable to collect and hold the spilled hazardous substance and shall be located away from other hazards, heavy vehicular and human traffic areas, and public.

6.27.2 Flood

In locations where there is a potential for flooding caused by rainwater or breach in process pipes conveying liquid, the designer shall incorporate adequate abatement equipment or system to prevent interruption to the building operations. This includes areas housing electrical equipment e.g., transformer room, switch rooms, etc.

- ANSI/FM 2510-2020, Flood Abatement Equipment

6.27.3 Indoor Evacuation & Assembly Area

During an emergency it is normal for the building occupants to be evacuated to an interior open area away from the impending emergency. ~~Where possible the designer shall consider the provision of a covered area for emergency mustering to facilitate evacuation during inclement weather.~~

The designer shall consider the provision of safe refuge, an isolated area with positive pressure ventilation, where there is a potential for gas leak into work environments.

- ISO/TS 18870:2014, Lifts (elevators) — Requirements for lifts used to assist in building evacuation
- ISO/DIS 22578, Graphical symbols — Safety colors and safety signs — Natural disaster safety way guidance system
- ISO 16069:2017, Graphical symbols — Safety signs — Safety way guidance systems (SWGS)
- ANSI ASA S3.41-2015 (R2020), Audible Emergency, Evacuation (E2) and Evacuation Signals with Relocation Instructions
- ANSI/ASTM F1297-1999 (R2018), Guide for Location and Instruction Symbols for Evacuation and Lifesaving Equipment
- ANSI/RESNA ED-1-2019, RESNA Standard for Evacuation Devices - Volume 1: Emergency Stair Travel Devices Used by Individuals with Disabilities

6.27.4 Outdoor evacuation assembly area

During an emergency it is normal for the building occupants to be evacuated from the building to an open area away from the impending emergency. Requirements shall include, but are not limited to:

- Where possible the designer shall consider the provision of a covered area for emergency mustering to facilitate evacuation during inclement weather.
- Be located away from structures a minimum distance of 1.5x the height of the surrounding building(s) OR at least 200 feet / 60 meters whichever is greater.
- Be located well away from other hazards such as chemical storage
- Be out of the paths where emergency apparatus response may be anticipated.
  - Where applicable, snow removal plans should be considered as well.
- A unique color beacon light or similar illuminated indicator to indicate location
  - It is recommended that the light color be green as that is associated with Safety.
  - Light shall be bright enough to be visible in a variety of conditions for the location, typically this is 50-100 lux.
- Route to, and the area itself, shall be accessible for all personnel including persons with disabilities
- Sufficient lighting along the path and at the assembly location
  - Average of 10.8 lux and no less than 1.08 lux at any point
- Be of sufficient size to assemble the expected volume of personnel
- Verbal communications
  - An affixed/permanent means to ensure effective communication with a large group of people, such as a public address system.
  - The system shall be sufficient to be heard by the anticipated volume of personnel. This should take into consideration the anticipated volume of people and ambient noise levels
- Signage

- The assembly location shall be identified with a sign. Signage shall be of a green background with a white arrow in each corner pointing inward towards a graphic of people. See figure 6
- Paths to assembly points shall have guidance where line of sight is obstructed and/or where there are changes in direction.
- If using printed language on the signage the languages shall be in native and English. Font size shall be 1” / 25mm for every 100 feet / 30.5 meter of anticipated line of sight from the furthest point.
- The sign dimensions and mounting height shall be sufficient to be visible from the furthest anticipated distance

Figure 6 Evacuation Assembly Point Signage Example

- References
  - Department of Homeland Security (US) - Planning Considerations: Evacuation and Shelter-in-Place
  - ISO 7010:2019 - Graphical symbols — Safety colours and safety signs — Registered safety signs
  - NFPA 101 – Life Safety Code

7 Appendices

Appendix 1 Preventing Hazard Through Risk Management Approaches

This procedure sets out the engineering design Hazard Prevention by Design principles and methodology requirements. The purpose of the procedure is to identify, assess and control hazards associated with the construction, operability, and maintainability of a facility. It is based on the Risk Matrix from AS/NZS 4360:2004.

Risks are inherent in any human activity and cannot always be eliminated. The Hazard Prevention through Design process is based on identification of hazards and their associated causes in order to define the extent and likelihood of the potential loss. This shall be used to assign appropriate actions to the identified risk, to reduce the hazard to an acceptable level. This will have been achieved if the hazard has been reduced to As Low As Reasonably Practicable (ALARP). ALARP refers to a risk level that is tolerable only if further reduction is impracticable or if its cost is grossly disproportionate.

Traceability and Communication

The Hazard Register Sheet of this procedure when completed must be stored with each instance of design on a study or project as an integral part of the design report. Any item which requires cross discipline input to close out shall be raised with the lead engineer and project manager, who take joint responsibility for the close out of that risk.

Contents of this Procedure	**Notes on the application of this**
Information (This Sheet)	For information purposes only - not needed to be included in calculation pack
Hazard Register	To be completed, signed, and included in calculation pack or study report
Risk Assessment	For reference purposes only - not needed to be included in calculation pack.

Procedure

Scope

All works must incorporate a Hazard Prevention by Design risk assessment. A separate assessment must be undertaken for each facility, by each discipline (i.e., civil, structural, mechanical, electrical etc.). Assessments must be documented on the Hazard Register and included in the calculation pack or study report.

Any hazards identified with a high or very high residual risk must be highlighted to the Lead Engineer and the Project Manager for review and formal submission to the Client.

All disciplines must review all other disciplines Hazard Prevention by Design review forms as part of the Design for Safety process. Any hazards identified by one discipline which require the action of another discipline to lower the risk ranking must be communicated to the other discipline Lead Engineer, Design Engineer, and their own Lead Engineer. These items must then appear in both disciplines' Hazard Registers. The Lead Engineers and Project Manager are responsible for coordination of this task.

Projects Resulting in New Equipment, Structures or Modifications to existing

Hazard Prevention by Design Risk assessments must be undertaken for projects that result in new equipment or structures or in modifications to existing plant, including sustaining capital projects. New facilities require a risk assessment for the complete facility. Where a project results in modifications to an existing facility, the risk assessment must cover the area(s) that have been modified. It must also cover any adjacent areas whose functionality, access/egress or maintainability has been affected by the new works. Other areas of the existing structure do not need to be assessed for risks. The premise is that existing structures will already have had a risk assessment undertaken for them by others, and/or that the Client is currently managing any existing risks for the particular facility.

Projects with no New Equipment, Structures or Modifications to existing

Projects that do not result in the construction of new structures, modifications to existing structures, or changes to the way that an existing structure is used do not typically require a Hazard Prevention by Design risk assessment to be undertaken. These works typically take the form of reviews of existing structures or facilities for increased production, or asset inspections.

The Process

The Hazard Prevention by Design process is not fixed and must be adapted to suit the task and/or facility. Prior to commencing the process, the following must be completed:

- Gain an understanding of the scope of works.
- Review the relevant standards applicable; and
- Review the construction, operations, and maintenance procedures applicable.

Hazard Identification

An initial assessment must be undertaken. Specific hazards must be identified and recorded on the Hazard Prevention by Design register by the Lead Engineer and/or Designer.

Initial Risk Ranking

Using the Qualitative Measures of Severity matrix and the Qualitative Measures of Likelihood matrix, determine the risk ranking of the hazard. The spreadsheet is automatically populated with the risk ranking once severity and likelihood are selected.

Controls

Using the hierarchy of controls, implement measures to reduce very high or high risks. If risks are low or medium, new controls may still be identified or existing controls adjusted to reduce the risks further provided that the controls are justifiable from a time and cost perspective.

Residual Risk

Close out of items is to be progressive during the design, with final assessment undertaken at completion. This assessment must be undertaken by the lead engineer and/or designer. The hazards initially identified must be reviewed with the new controls in place. The final design must also be reviewed for any new hazards that were not initially identified, or that have occurred because of the design process. Using the Qualitative Measures of Frequency matrix and the Qualitative Measures of Severity matrices, determine the residual ranking of the hazards.

Any hazards that cannot be reduced below a high ranking must be highlighted to the Project Manager for client discussion and resolution.

Hazards must not be signed off as closed out on the Hazard Register until they have been resolved or achieved a low or medium risk ranking.

RISK ASSESSMENT MATRIX

Qualitative Measures of Consequence or Impact:

Level	Severity (S)	Occupational Safety and Health Impact
5	Catastrophic	Fatality, fatal diseases or multiple major injuries
4	Major	Serious injuries or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, severe chronic diseases, occupational cancer, acute poisoning).
3	Moderate	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, work-related upper limb disorders)
2	Minor	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
1	Negligible	Not likely to cause injury or ill-health

Qualitative Measures of Likelihood:

Level	Likelihood (L)	Likelihood definition
5	Almost Certain	Possible injuries could recur within 1 year *(Consult EHS for any known occurrences with less than 1 year of operation history in Micron)*
4	Frequent	Possible injuries could recur within 1 - 3 years
3	Occasional	Possible injuries could recur within 3 - 5 years
2	Remote	Possible injuries could recur within 5 - 10 years
1	Rare	Possible injuries could recur within > 10 years

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Level of Risk:

Severity \ Likelihood	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Risk Level	Risk Tolerance	Recommended Actions
Low Risk	Acceptable	• No additional risk control measures may be needed • Regular review (not more than 2 years) is required to ensure that the risk level assigned is accurate and does not increase over time
Medium Risk	Tolerable	• A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonably practicable (ALARP) within a defined time period • Interim risk control measures, such as administrative controls, may be implemented • Management attention may be required.
High Risk	Not Acceptable	• High Risk level must be reduced to at least Medium Risk before work commences • There should not be any interim risk control measures that are overly dependent on personal protective equipment or appliances • If practicable, the hazard should be eliminated before work commences • Management review is required before work commences

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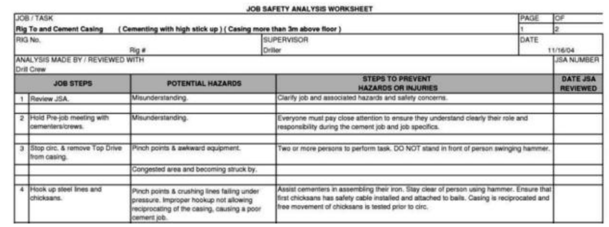
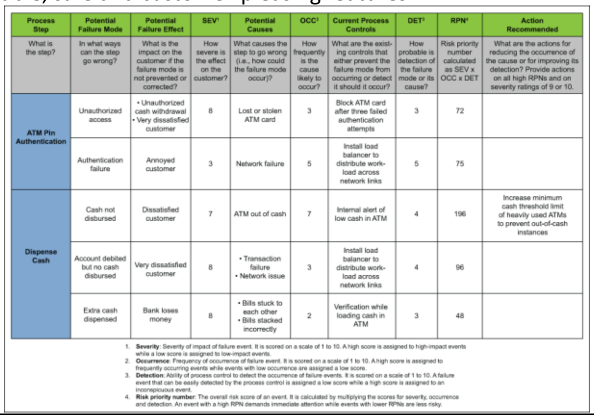
Appendix 2 Risk Assessment Tools

Tool	Description	Use
RA/JHA/JSA	**Risk Assessment / Job Hazard Analysis / Job Safety Analysis** A risk assessment tools that enables users to discover potential hazards that exist in the workplace. It is used to find hazards that are specific to one task, to one job type, or even to an entire facility.	Used to identify the dangers involved in a specific task so that controls can be put in place to reduce the risk of injury to workers. 
HazID	**Hazard Identification** Hazard Identification (HAZID) is a brainstorming workshop with a multi-disciplinary team to identify potential hazards. HAZID studies may be broad in their scope and thus have a wide applicability. HAZID typically examines all reasonably possible sources of hazard during project design, construction, installation, and decommissioning activities, and for proposed changes to existing operations. The study considers the process and non-process hazards in a workplace.	• During the appraise stage or early select stage of a project as part of the selection process for conceptual design • During operations of existing facilities to update risk register, identify hazards associated with proposed change. 
FMEA	**Failure Mode Effects Analysis** A qualitative and systematic tool to help assessors anticipate what might go wrong with a product or process. In addition to identifying how a product or process might fail and the effects of that failure, FMEA also helps find the possible causes of failures and the likelihood of failures being detected before occurrence.	One of the best ways of analyzing potential reliability problems early in the development cycle, making it easier for manufacturers to take quick action and mitigate failure. The ability to anticipate issues early allows practitioners to design out failures and design in reliable, safe and customer-pleasing features. 

JOB SAFETY ANALYSIS WORKSHEET

JOB / TASK		PAGE	OF
Rig To and Cement Casing (Cementing with high stick up) (Casing more than 3m above floor)		1	2
RIG No. Rig #	SUPERVISOR Driller	DATE 11/16/04	
ANALYSIS MADE BY / REVIEWED WITH Drill Crew		JSA NUMBER	

	JOB STEPS	POTENTIAL HAZARDS	STEPS TO PREVENT HAZARDS OR INJURIES	DATE JSA REVIEWED
1	Review JSA.	Misunderstanding.	Clarify job and associated hazards and safety concerns.	
2	Hold Pre-job meeting with cementers/crews.	Misunderstanding.	Everyone must pay close attention to ensure they understand clearly their role and responsibility during the cement job and job specifics.	
3	Stop circ. & remove Top Drive from casing.	Pinch points & awkward equipment.	Two or more persons to perform task. DO NOT stand in front of person swinging hammer.	
		Congested area and becoming struck by.		
4	Hook up steel lines and chicksans.	Pinch points & crushing lines failing under pressure. Improper hookup not allowing reciprocating of the casing, causing a poor cement job.	Assist cementers in assembling their iron. Stay clear of person using hammer. Ensure that first chicksans has safety cable installed and attached to bails. Casing is reciprocated and free movement of chicksans is tested prior to circ.	

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
What is the step?	In what ways can the step go wrong?	What is the impact on the customer if the failure mode is not prevented or corrected?	How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.
ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3	72	
	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	
Dispense Cash	Cash not disbursed	Dissatisfied customer	7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Increase minimum cash threshold limit of heavily used ATMs to prevent out-of-cash instances
	Account debited but no cash disbursed	Very dissatisfied customer	8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	
	Extra cash dispensed	Bank loses money	8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	3	48	

1. **Severity**: Severity of impact of failure event. It is scored on a scale of 1 to 10. A high score is assigned to high-impact events while a low score is assigned to low-impact events.
2. **Occurrence**: Frequency of occurrence of failure event. It is scored on a scale of 1 to 10. A high score is assigned to frequently occurring events while events with low occurrence are assigned a low score.
3. **Detection**: Ability of process control to detect the occurrence of failure events. It is scored on a scale of 1 to 10. A failure event that can be easily detected by the process control is assigned a low score while a high score is assigned to an inconspicuous event.
4. **Risk priority number**: The overall risk score of an event. It is calculated by multiplying the scores for severity, occurrence and detection. An event with a high RPN demands immediate attention while events with lower RPNs are less risky.

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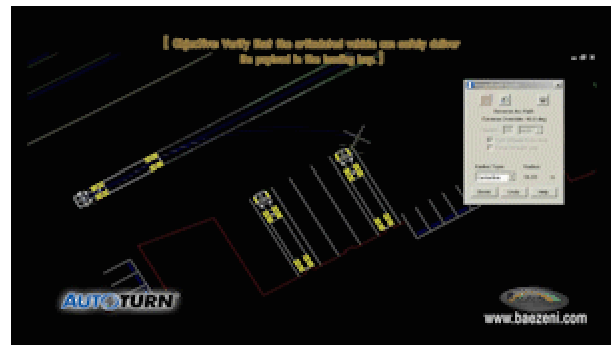
<table>
<tr>
<td>HazOp</td>
<td>Hazard and Operability
Hazard and Operability (HAZOP) is a systematic approach to determining potential problems that may be uncovered by reviewing the safety of designs and revisiting existing processes and operations in chemical, pharmaceutical, oil and gas, and nuclear industries.</td>
<td>Used to find potential situations that would cause an element to pose a hazard or limit the operability of the process.
<table>
<tr><td colspan="8">STUDY TITLE: PROCESS EXAMPLE</td><td colspan="2">SHEET: 1 of 4</td></tr>
<tr><td colspan="3">Drawing No.:</td><td colspan="5">REV. No.:</td><td colspan="2">DATE: December 17, 1998</td></tr>
<tr><td colspan="3">TEAM COMPOSITION:</td><td colspan="5">LB, DH, EK, NE, MG, JK</td><td colspan="2">MEETING DATE: December 15, 1998</td></tr>
<tr><td colspan="3">PART CONSIDERED:</td><td colspan="7">Transfer line from supply tank A to reactor</td></tr>
<tr><td colspan="3">DESIGN INTENT:</td><td colspan="7">Material: A Activity: Transfer continuously at a rate greater than B
Source: Tank for A Destination: Reactor</td></tr>
<tr><th>No.</th><th>Guide word</th><th>Element</th><th>Deviation</th><th>Possible causes</th><th>Consequences</th><th>Safeguards</th><th>Comments</th><th>Actions required</th><th>Action allocated to</th></tr>
<tr><td>1</td><td>NO</td><td>Material A</td><td>No Material A</td><td>Supply Tank A is empty</td><td>No flow of A into reactor
Explosion</td><td>None shown</td><td>Situation not acceptable</td><td>Consider installation on tank A of a low-level alarm plus a low/low-level trip to stop pump B</td><td>MG</td></tr>
<tr><td>2</td><td>NO</td><td>Transfer A (at a rate >B)</td><td>No transfer of A takes place</td><td>Pump A stopped, line blocked</td><td>Explosion</td><td>None shown</td><td>Situation not acceptable</td><td>Measurement of flow rate for material A plus a low flow alarm and a low flow which trips pump B</td><td>JK</td></tr>
<tr><td>3</td><td>MORE</td><td>Material A</td><td>More material A: supply tank over full</td><td>Filling of tank from tanker when insufficient capacity exists</td><td>Tank will overflow into bounded area</td><td>None shown</td><td>Remark: This would have been identified during examination of the tank</td><td>Consider high-level alarm if not previously identified</td><td>EK</td></tr>
</table>
</td>
</tr>
<tr>
<td>CHAZOP</td>
<td>Controls Hazards and Operability Analysis
A HAZard and OPerability study for instrument, control, and computer systems.</td>
<td>Used to assess the control loops - the set of instruments that operate the functions being controlled—are adequate for the process that they are applied to and at the same time evaluate whether the control system is properly integrated with the underlying process to prevent an unintended operational interference or obstruct the operation of another control system.</td>
</tr>
<tr>
<td>ALMOP</td>
<td>Access, Lifting, Maintainability & Operability
The practice of integrating operations and maintenance experience in the planning and design process to achieve safe operations throughout the life of an infrastructure. A lack of operability and maintainability considerations at the onset of a building project often creates avoidable operations and maintenance demands which can lead to higher upkeep costs and manpower needs.</td>
<td>Used during the appraise stage or early select stage of a project as part of the selection process for conceptual design.
<table>
<tr><th>A1.</th><th><u>Access</u></th><th>Y / N / NA</th><th>Description of provision
(Attach relevant drawings or references, etc. where necessary)</th><th>If No or Not Applicable, please explain</th></tr>
<tr><td>A1.1</td><td>Protruding façade features
Avoid extensive niches, fins and ledges that protrude more than 600mm. If the protrusions exceed 600mm, designers should make specific considerations for safe and easy access.</td><td>NA</td><td></td><td>No protruding features on façade.</td></tr>
<tr><td>A1.2</td><td>Internal Access
Façade design should promote minor cleaning and repair works to be carried out from within the building, while major repair works can take place from the outside.

Use modularised window panels which are not too large (max 750mm) or reversible windows for ease of cleaning from within the building, i.e. within reach of a cleaner's arm and his/her handheld tools.</td><td>Y</td><td>• Gondola system and elevated walkway access provided</td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td>CHAIR</td>
<td>Construction Hazard Assessment Implication Review
CHAIR (Construction Hazard Assessment Implication Review) is a tool to assist designers, constructors, clients, and other key stakeholders to come together to reduce construction, maintenance, repair and demolition safety risks associated with design.</td>
<td>Used during the appraise stage or early select stage of a project as part of the selection process for conceptual and detailed design.</td>
</tr>
</table>

5. CHAIR-3 EXAMPLE ONLY

DETAILED MAINTENANCE / REPAIR SAFETY IN DETAILED DESIGN (CHAIR-3) STUDY				Reference:
System: ROADWAY	Sub-System:	Item/Component:	DRAIN	
Maintainability Aspect	**Assessment**	**(Good, Fair, Poor, N/A) and WHY**	**Recommendation/Comment**	**Who/Date**
POSTURE / MANUAL HANDLING	GOOD	Drain cover will have handles and should be lightweight	Satisfactory	—
SIZE / WIDTH	POOR	Construction vehicle may have limited shoulder space to stop on road	Widen shoulder width to allow for safe stopping during maintenance work	D.F.
ACCESS / EGRESS	POOR	Current drain design is that it is a confined space, and that confined space procedures need to be prepared	Drain design should avoid where possible the need to be classed as a confined space	D.F.
HEIGHTS / DROPPED OBJECTS	N/A	—	—	—
WEIGHT	FAIR	Drain cover could be too heavy	Ensure drain cover design such that it can be easily lifted	P.B.
DISCOMFORT / STRESS	FAIR	Do not expect long term drain maintenance	Satisfactory	—
PERSONNEL PROT. EQUIPMENT	N/A	—	—	—
VISIBILITY	N/A	—	—	—
SLIPS, TRIPS, FALLS	N/A	—	—	—
ROTATING / MOVING EQUIPMENT	N/A	—	—	—
IS REPAIR DIFFERENT?	NO	—	—	—
OTHERS THAT MAY APPLY (list below)				
None identified				

SPA	**Swept Path Analysis** Refers to the analysis of the way a vehicle moves. A software is used to calculate and measure the exact path a vehicle takes when that vehicle does not move in a straight line but turns for instance.	Used to design roads specially to determine the path that vehicle will take and how much maneuvering space it requires to avoid any mishaps. 
LOPA	**Layer of Protection Analysis** A risk assessment and hazard evaluation method which provides a simplified balance between qualitative process hazard analysis (PHA) and detailed and costly quantitative risk analysis. An identified accident scenario is established where some simplifying rules are used to allow for the analysis of the initiating event frequency, along with the independent layers of protection. This results in an estimate of risk by order of magnitude.	Used when companies are striving to achieve a specific risk target or to lower risk as low as reasonably practicable (ALARP). Using the LOPA method, the user can ascertain the level of risk that is associated with hazardous events in the workplace. The analysis is based on the severity of the event and the likelihood of it taking place.

<table>
<tr>
<td>What-If Analysis</td>
<td>What-If Analysis
It is a structured brainstorming method of determining what things can go wrong and judging the likelihood and consequences of those situations occurring. The answers to these questions form the basis for making judgments regarding the acceptability of those risks and determining a recommended course of action for those risks judged to be unacceptable.</td>
<td>Used to assess risks concerning a process or system.
<table>
<tr><th>What If?</th><th>Answer</th><th>Likeli-hood</th><th>Conse-quences</th><th>Recommendations</th></tr>
<tr><td>Granular powder is not freely owing?</td><td>1. Back injury potential when breaking up clumps</td><td>Quite Possible</td><td>Serious</td><td>Design delumping equipment</td></tr>
<tr><td>Drum is mislabeled?</td><td>2. Quality issue only</td><td>Remote</td><td>Serious</td><td>Contact vendor</td></tr>
<tr><td>Wrong powder in the drum?</td><td>3. If wet, could cause exotherm</td><td>Unlikely</td><td>Minor</td><td>Include inspection in procedure</td></tr>
<tr><td>Drum hoist is not used?</td><td>4. Back injury potential</td><td>Possible</td><td>Serious</td><td>Train personnel & ensure use</td></tr>
<tr><td>Two drums are added?</td><td>5. Quality issue only</td><td>Remote</td><td>Minor</td><td>None</td></tr>
<tr><td>Drum is misweighed?</td><td>6. Quality issue only</td><td>Possible</td><td>Serious</td><td>Require 2nd check on weight</td></tr>
<tr><td>Drum hoist fails?</td><td>7. Leg, foot, back, arm injury</td><td>Remote</td><td>Serious</td><td>Ensure hoist on PM program</td></tr>
<tr><td>Drum is corroded?</td><td></td><td>Remote</td><td>Serious</td><td>None</td></tr>
<tr><td></td><td>8. Iron contamination as well as drum failure & injury</td><td>Unlikely</td><td>Minor</td><td>Include vent check in SOP</td></tr>
</table>
</td>
</tr>
<tr>
<td>Facility Siting Analysis</td>
<td>Facility Siting Analysis
A facility siting study is a look at the spacing and placement of both permanent and temporary buildings and equipment in chemical processing plants. Its purpose is to make sure that buildings are located at safe distances in relation to process units.</td>
<td>A facility siting study will usually be initiated during an OSHA Process Hazard Analysis (PHA). The PHA is a more extensive study, completed every 5 years. Another time that a facility siting analysis could be initiated is when new buildings and equipment are added.</td>
</tr>
</table>

Appendix 3 Designer's Guide - Misconceptions Checklist

Designers' wrong beliefs	Explanation about the belief	Example
Active monitoring	The belief that contractors will seek information about the system condition whereas they are often passive recipients	Soil movement which required regular monitoring
Adaptive behavior	The belief that contractors will update their knowledge when they use new equipment - whereas they sometimes rely on knowledge acquired from using old ones	No cues provided on load handling characteristics to crane operators accustomed to different types of cranes
Benign conditions	The belief that operating conditions are benign or have little effect on the use of the system - or that operators use systems differently in difficult environments	Operating tower crane during inclement weather
Boundary knowledge	The belief that operators have good knowledge from experience about a system limit states - whereas operators cannot explore limit states because of the risks	Operating an excavator in a trench without understanding soil condition.
General practices	The belief that design practices for various operating environments are general - whereas operating environments are more varied than the design practices recognize.	Scaffold design for scaffold erected on cantilevered platform
Guaranteed operating procedures	The belief that operating procedures can avoid a harm that is inherent in the design - whereas procedures may be too general and are often violated	System left in hazardous state without indication after failure to observe permit-to-work procedures
Reliable aids	The belief that precautionary aids will increase system reliability - whereas operators will not routinely check and operate aids not in routine use.	Emergency stop buttons or windsocks
Specific emergency conditions	The belief that emergency conditions will only be of a particular kind - whereas emergency conditions are highly unpredictable by their nature	Evacuation system not taking into consideration gas density and wind direction
Sustained attention	The belief that operators will sustain high attention levels - whereas attention is degraded in a variety of conditions	Lack of device to alert sleeping operator to hazardous condition

Designers missing belief	Explanation about the belief	Example
Confounded goal	Not anticipating how the design could stop an operator meeting a reasonable goal and resorting to a hazardous behavior	Worker not able to secure fall protection device while working at height
Transmission mechanism	Not anticipating how a hazard could be quickly transmitted between locations in a complex system	Water drains carried burning hydrocarbons
Need for control	Not anticipating how the design requires operator to exercise control	Controls located out of view of affected operation
Need for cues	Not anticipating how the design fails to provide cues needed by operators	No visible indication of equipment in hazardous state
Need for precautionary instruction	Not anticipating how the design requires operator to perform precautionary actions	No service life stated for devices needing replacement
Activating a hazard	Not anticipating how the design allows operators to activate hazards	Operator fully opened wrong valve during start-up
Ambiguity during emergency	Not anticipating how the design is opaque to operators during emergency conditions	Layout was disorienting when filled with smoke
Information needed in emergency conditions	Not anticipating how the design requires operator to have particular information needs in emergency conditions	Lack of valve position indication during manual control
Biased information seeking	Not anticipating how the design is vulnerable to characteristic human biases in information seeking or processing	Operators are biased toward looking for hazards straight ahead
Component interference	Not anticipating how the design could be vulnerable to operators causing components to interfere	Interference between rope and chain caused rope to part
Gambling behavior	Not anticipating that the design is vulnerable to operators knowingly taking risks for some payoff	Safe work platform not provided to carry out maintenance causing workers to take shortcuts
Interrupted attention	Not anticipating that the design is vulnerable to operators suffering interruptions and hence lapses	System alarms and building alarms causing confusion
Over-dependence	Not anticipating that the design is vulnerable to operators depending on a system beyond its safe regime	CO2 total flooding system activating while operators working in protected area.
Repeated attempts	Not anticipating that the design is vulnerable to operators having to make multiple attempts to make it work	Docking system destroyed after repeated attempts
Unintended use	Not anticipating that the design appears to be capable of being used in unintended ways	Drain connections incorrectly used for depressuring causing low temperatures

Designers missing belief	Explanation about the belief	Example
Wrong-sense interpretation	Not anticipating that the design gives a display which can be interpreted in a wrong sense	Operator read emergency display as though it were the primary display

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Appendix 4 General Hazard Management Prompts

1. General Requirements

1.1. Design Thought Process

Get the right……	▪ Information, Standards, Procedures and People
Think about……	▪ Existing plant/equipment/services/personnel ▪ Construction, Operations and Maintenance ▪ Special tools and Access requirements ▪ Regulators' requirements
Show…….	▪ Existing obstacles ▪ Services Access ways ▪ Equipment Clearances
Who needs to provide information?	▪ Operations, Maintenance, Vendors ▪ Electrical, mechanical, structural, disciplines, civil & earthworks

1.2. Hazard Identification

Visualise and be observant:

*Do not only **Look** but **See**: Look Close, Look Wide, Look Above, Look Below, Walk Through*

Will any of the following interaction create hazard?
Vehicle with Vehicle
Vehicle with personnel
Vehicle with environment
Vehicle with rail
Entanglement
Entrapment
Engulfment
Fire/explosion
Dropped objects - product
Dropped objects - tools/equipment
Cranes, Lifting, jacking
Spillage or overflow

Will the following exposure be hazardous to personnel?		
Working at heights	Crushing injury	Lack of signage/labelling
Working in confined spaces	Explosives	Lack of guarding
Lack of access	Fly rock	Chemicals
Dropped objects	Extreme weather	Vibration
Drowning	Wildlife	Noise
Stored Energy	Manual handling	Dust
Electrical energy	Poor lighting	Heat/cold
Electrical shock	Equipment/structural failure	

Is there exposure to the following and what are the controls?		
Leaks/discharges	Sacred sites	Dust generation
Effect on flora	Effect on fauna	Noise generation
Heritage sites	Land disturbance/clearing	Existing contamination

2. Control Measures

Discuss	Assess	Apply
With subject matter specialists	Alternative options	Hierarchy of Controls: See below for details
With other affected parties	Providing solutions	Standards

2.1 Hierarchy of Controls

Hazard elimination shall be given the priority.

If the hazard cannot be eliminated completely there are a number of control options that can be used to prevent or minimise exposure to the risk:

- **Substituting** a less hazardous material, process, or equipment
- **Redesigning** the equipment or work process
- **Isolating** the hazard through engineering - separating the worker from the hazard
- **Administrative** controls involve minimising exposure to a risk through the use of procedures or instruction
- **Personal Protective Equipment (PPE)** is used as a last resort when exposure to risk is not acceptable or cannot be minimised by other means.

3. Complete Design Review

Has the following been documented?	
Document on-going risk management procedures	Drawings to highlight methodologies
Training documentation	Produce/update procedures
Operations/maintenance manuals	Specific commissioning procedures
Construction sequence diagrams	

4. Construction Requirements

Does the design consider the following?	
Alignment with construction execution plan	Stability during construction/Deconstruction
Greenfield construction	Crane access, Monorail requirements
Brownfield construction	Minimise work in confined spaces
Modular construction	Traffic management plans
Flat pack construction	Designated laydown areas
Preassembly	Engineered lifting points
Underground services	Personnel respite areas
Above ground services	Construction fire protection
Personnel access/egress	Access to excavations

Emergency access/egress	Access to excavations equipment
Dust minimisation	Access to joints, splices etc.
Noise minimisation	Access - welding
Potential for engulfment	Access - piling rigs
Clearance for personnel to access bolts, nuts, splices	Access - concrete pumps
Stability of excavations	
Is design information required for the following?	
Erection methodology	Torque requirements for belt tightening
Lift studies	Pressure testing
Estimated weights	Pipe Pickling
Centre of gravity	Load testing requirements
Welding	Commissioning documents
Erection sequence	Construction verification
Personnel access	Test certificates
Deconstruction sequence	
Construction tolerances	

5. Operations and Maintenance

Has clearance and safe access been considered for?		
Personnel	Maintenance equipment	Cranes and removal of plant
Isolation of energy sources	Component change-out	Trucks
Purging	Maintenance lay-down	Manual handling
Bins and chutes	Sample and test points e.g., oil, vibration without removal of guards	Condition monitoring
Cleaning	HV Electrical Equipment	Lubrication access points
Moving equipment	Muster points	Lubrication storage
Drainage	Power lines clearance for vehicles and cranes and for safe maintenance access	Stockpiles and tunnels
Segregation of personnel/equipment		Escape / evacuation

Has the design considered provision of services for?	
Cleaning	Disposal of waste/spillage
Lighting	Uncontrolled discharge to the environment
Maintenance	Water
Lubrication	Air
Lift and pulling points	Power
Sampling	

Has the design considered the requirements of?		
Operations	Heavy vehicle access	Spare parts
Maintenance	Isolation	
Component change out	Rescue plans	Detailed work procedures
Disaster recovery	Training	Traffic Management Plans
Crane lift studies	Confined spaces	

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Is protection required from?	
Equipment under load/overload	Slips, trips, falls
Removal of guarding	Flooding
Lack of guarding	Drowning
Explosion /Burst	Excessive weight (spillage)
Impact	Equipment failure
Equipment failure	Awkward lifting position
Lack of equipment protective devices	Ejected products/parts
No interlocks	Awkward object to lift
Interlock failure / bypass	Moving equipment
Vibration	Over-turning
Minimize confined space entry requirements	Dropped object

Appendix 5 Facility Siting Analysis

Facility Siting involves the assessment of the possible impacts of fire and explosion on life safety, structures, and equipment as well as the effects of releases of toxic substances and their ingress into buildings.

Traditionally, facility siting has a broad interpretation. OSHA's interpretation of facility siting includes the spatial relationship between the hazards of a process and the location(s) of people in the facility, particularly in occupied buildings such as control rooms.

Issues that should be addressed in a facility siting study include:

- Identifying hazardous scenarios that could have significant effects on occupied buildings
- Identifying vulnerable locations of control rooms, and other buildings that may be occupied by people
- Spacing between the hazards in a process and the locations of employees in occupied buildings,
- Spacing of process units and equipment,
- Spacing between potential sources of flammable releases and ignition sources,
- Domino effects, i.e.: the potential for an incident to propagate from one process area to another separate area,
- Emergency response issues, e.g.,
    - Availability of emergency equipment
    - Location of fire suppression systems
    - Accessibility for fire trucks
    - Accessibility of fire hydrants / monitors
    - Locations of emergency refuges and muster points
    - Ability of an occupied building to provide sheltering-in-place
    - Suitability of evacuation routes
- Adequacy of hazardous area classifications

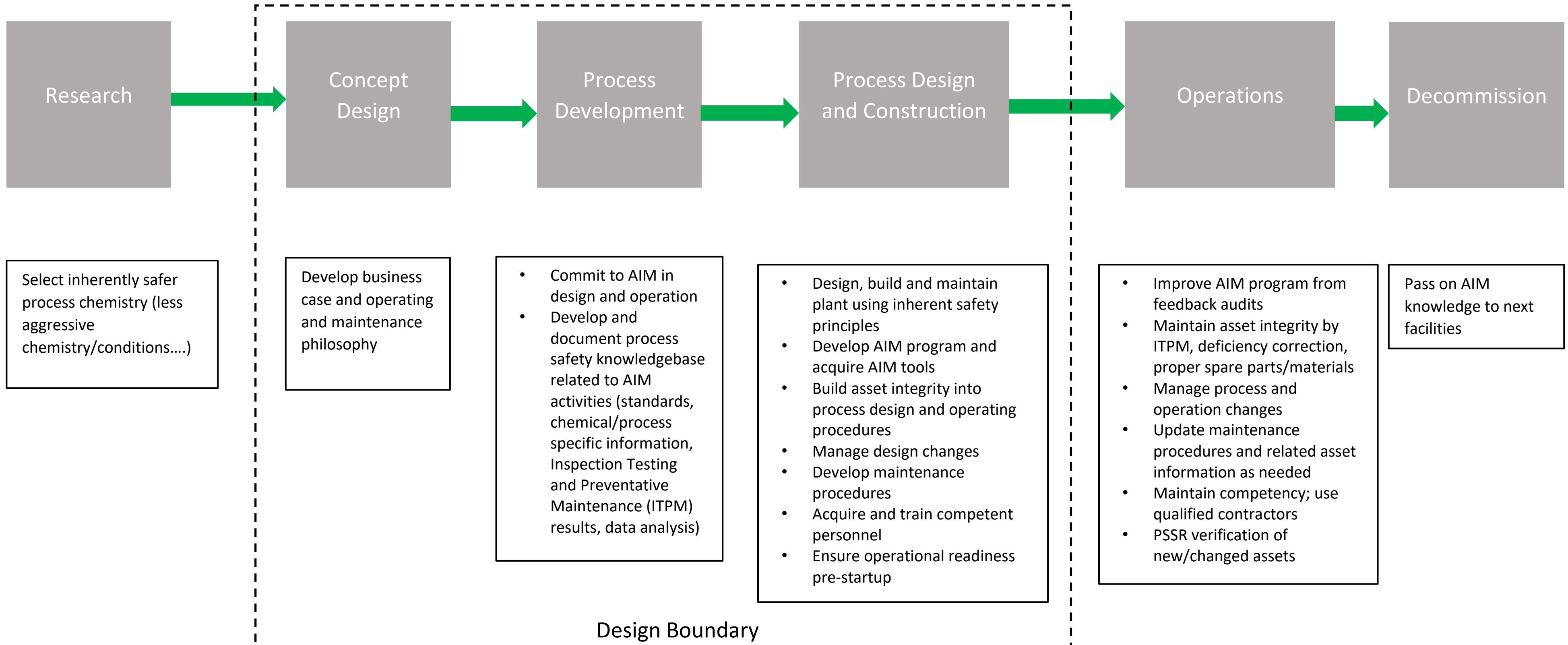
Appendix 6 Typical EHS Design Management Plan Template

1. PURPOSE AND SCOPE
2. DEFINITIONS
3. REFERENCES
4. DESIGN FOR SAFETY PHILOSOPHY
5. PROJECT EHS ORGANISATION AND RESPONSIBILITIES
    - 5.1 Project Sponsor
    - 5.2 Project Manager / Project Director (Tailor according to Project)
    - 5.3 Project Engineer / Engineering Manager (Tailor according to Project)
    - 5.4 Design Team
    - 5.5 Project Design for Safety Representative
    - 5.6 Project EHS Manager (Remove if EHS Manager not appointed in the design phase)
    - 5.7 Design for Safety Coordinator
6. STANDARDS AND STATUTORY REQUIREMENTS
7. PROJECT DESIGN FOR SAFETY PRINCIPLES & REQUIREMENTS
8. SITE VISITS
9. HAZARD IDENTIFICATION AND RISK MANAGEMENT
    - 9.1 Key Project EHS Risks
10. ENGINEERING DESIGN PRACTICES
11. KEY EHS ACTIVITIES & REVIEWS SPECIFIC FOR PROJECT
    - 11.1 Design for Safety Activities
    - 11.2 Design for Safety Reviews
12. DESIGN FOR SAFETY TRAINING
13. DESIGN FOR SAFETY MEETINGS & TOOLBOX TALKS
14. DESIGN FOR SAFETY KPI’S
15. DESIGN FOR SAFETY AUDITS
16. DELIVERABLE VERIFICATION REVIEW
17. OCCUPIED FACILITY SITING ANALYSIS
18. DESIGN FOR SAFETY DELIVERABLES REGISTER
19. EXCLUSIONS

Appendix 7 Design for Safety Competency Matrix

Design for Safety Competency Matrix	Basic Skills					Technical Skills					Qualification & Experience		
	Induction - Design for Safety	Ability to understand and interpret Global EHS & Site EHS Standards and Procedures	Ability to understand and interpret EHS legal requirements, codes of practice, guidelines and international standards	Ability to understand and interpret Management Systems e.g. ISO14001, ISO45001 and RBA 7.0	Ability to use Microsoft Office Suit	Problem Solving Skills	Knowledge of Semiconductor Plant Design, Construction, Operation and Maintenance	Knowledge of Risk Management and Assessment Tools	Knowledge of MEP & CSA	Knowledge of BIM360 / ACC	Diploma/Degree in related engineering field with 3 to 5 years in Semiconductor Plant Design, Construction, Operation and Maintenance	Degree in related engineering field with 6 to 10 years in Semiconductor Plant Design, Construction, Operation and Maintenance	Degree in related engineering field with more than 10 years in Semiconductor Plant Design, Construction, Operation and Maintenance
Designer	4	3	3	3	2	3	4	3	4	4			4
Engineering Manager	4	4	4	4	2	3	4	3	4	4			4
Design Manager	4	2	2	2	2	3	4	3	4	4			4
Design Coordinator	4	3	3	3	2	3	4	3	4	3		3	
Construction Manager	4	2	2	2	2	3	4	3	4	3		3	
Project Manager	4	3	3	3	2	3	4	3	4	3		4	
EHS Engineers/Professionals	4	4	4	4	2	3	3	4	2	2		4	
MEP & CSA Engineers	4	2	2	2	2	3	3	2	3	3	3		
1: Has basic knowledge. Can do the task task independently.	2: Has the skills for independent task completion and quality that go beyond the basics					3: Has the skills for independent and qualitative task completion and can effectively pass this knowledge on				4: Has the skills for independent and qualitative task completion, Initiates optimization approaches, sources for error fix and solutions.			

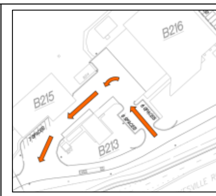
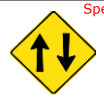
Appendix 8 Asset Integrity Management (AIM) - Life Cycle Activities



Source: Guidelines for Asset Integrity Management CCPS

Appendix 9 Micron Traffic Safety Checklist

Traffic Safety Checklist for Micron Sites

Area	Recommendation/Consideration	Figure	Effect/Impact	Remarks:	☑
	Ensure sufficient road width and space is provided for the all types of vehicles using the road i.e Large Car, 20 Footer Truck, Coach, 40 Footer Truck etc.				
	If insufficient road width and space for two way traffic circulation, consider:				
	One Way traffic circulation		•Improve traffic circulation in the carpark. •Minimise encroachment of opposing vehicle paths.		
Road Width and Space	Cautionary road signs (list some examples)	  Speed limit	•Alerts driver of the direction of traffic ahead.	• Traffic signs used would differ based on the local traffic standards and regulations	
	At the turning corners, consider:				
	Convex Mirrors		• Improves visibility for drivers turning the corner. • Allows one vehicle to give way to another should there be insufficient space for two vehicles to turn the corner simultaneously.		
	Prohibitory signs for vehicle parking near corners	 	• Ensures sufficient space for vehicles to turn the corner without encroachment.	• Traffic signs used would differ based on the local traffic standards and regulations	

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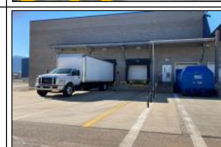
Traffic Safety Checklist for Micron Sites

Area	Recommendation/Consideration	Figure	Effect/Impact	Remarks:	☑
Bus-Stop/ Pick-Up/Drop-Off Point	Shuttle bus pick-up/drop off points should minimally incorporate marked out bus bays.		• Marked out bus bay will be more noticeable to pedestrians, avoiding potential conflict.		
	Separation of pedestrians from vehicle movements can be in the form of fixed concrete bollard, flexible bollard or metal bollards.	 	• Protect a barrier to separate pedestrian and vehicular traffic. • Improves safety and accessibility for pedestrians.		
	Shelters can be considered to further improve the accessibility for pedestrians.				
Loading/Unloading Docks	Loading docks to include: •Clear loading bay markings •Dedicated walkway for drivers/co-drivers.		•Dedicated pathway for drivers allows better management and flow of loading/unloading activity. •Avoid staff being in the path of vehicles reversing into loading docks.		
	To install barrier along the path leading to the doorway to ensure that pedestrians don't walk across the dock. •Barrier can be in the form of horseshoe bollard(U bollard) or reflective bollards. To install reflective road studs along proposed pathway for drivers.	   	•Minimise pedestrians walking across the loading dock. •Encourages pedestrians to use dedicated walkways and crosswalk. •Improves visibility of walkway especially for drivers.		
	If space is constraint at the loading docks, consider: •Beacon light warning system •Cautionary road signs	 	• Provide visual aid for both pedestrians and motorists that loading/unloading activity of larger vehicles are in progress. • Discourages pedestrians from using the walkway ahead when there is loading/unloading activity.	• Traffic signs used would differ based on the local traffic standards and regulations	

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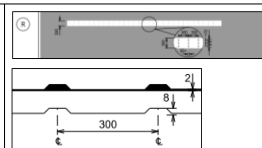
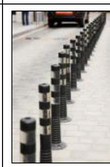
Traffic Safety Checklist for Micron Sites

Area	Recommendation/Consideration	Figure	Effect/Impact	Remarks:	☑
Pedestrian Walkway	Ensure pedestrian walkway is clearly painted and well connected throughout the site. •Carpark to lobby •Block to block	 	•Improves safety and accessibility for pedestrians throughout the development. •Encourages pedestrians to use designated external and internal walkways, minimising conflict with traffic circulation.		
	When walkway is adjacent to traffic circulation, consider:				
	Raised Profile Markings	 	• Raised profile line marking generates a noise and vibration when a vehicle's tyre rolls over it. • They are useful to alert drivers if they tend to drift too close to the left. In fog, when the line is less visible, they provide tactile and auditory feedback of the lane. • In wet weather at night they provide better visibility of the line.		
	Raised Walkway		• Raised pedestrian walkway allows clearer distinction between road and footpath. • Improves safety and accessibility for pedestrians.	• Raised pedestrian walkway would mean a decrease in accessibility for road users.	
	Reflective Bollard		• Provide a barrier to separate pedestrian and vehicular traffic. • Improves safety and accessibility for pedestrians.	• Reflective bollard would reduce useable road width and space for road users.	
	Footprint/Pedestrian Silhouette Marking	 	• Improves usage and accessibility for its users.		

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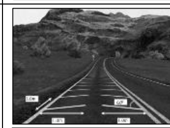
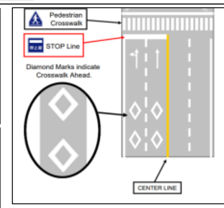
Traffic Safety Checklist for Micron Sites

Area	Recommendation/Consideration	Figure	Effect/Impact	Remarks:	☑
	For pedestrian crossings, consider:				
	Reflective road studs.	  	• Improve visibility of the pedestrian crossing. • Alert pedestrians to look out for incoming vehicles. • Alert driver of pedestrian crossing ahead.		
	Installation of Belisha Beacon that flashes light to alert driver of pedestrian crossing ahead.				
	"LOOK" painted on the two ends of the crossing.				
	For traffic approaching pedestrian crossing, consider:				
	Road Hump		•Reduces speed of approaching vehicles and warn motorists of crosswalk ahead		
Pedestrian/ Zebra Crossing	Raised Crossing				
	Traffic Calming Measures: • Dragon's Teeth road marking • Peripheral Tranverse Lines • Diamond Road markings	  		• Approach to traffic calming measures would differ based on the local traffic standards and regulations	

STANDARD OPERATING PROCEDURES

Additional measures and Standard Operating Procedures (SOPs):

- Maintain a schedule for the usage of the loading/unloading bays,
- Avoid having vehicles stopping by the side of the road near demarcated pedestrian walkway,
- Deploy ground guide/traffic marshal to help regulate traffic flow when heavy vehicles are reversing into/out of loading/unloading bays. Ground guide will also help to guide drivers when reversing and look out for safety,
- Cautionary triple horns from driver prior to moving a stationary vehicle to warn pedestrians in the vicinity,
- As new staffs are likely unfamiliar with road signs. A group briefing might need to be conducted to increase the awareness of staff, and
- Pedestrian movements near loading/unloading points should be limited to related personnel.

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8 Document Control

Items	Details
ECN Facility	CORP EHS
ECN Area	EHS CONST
Approval	This document is approved by: GLOBAL_EHS_SEAL_LT
Notification	Notification of changes to this document is managed through Micron's Engineering Change Notification (ECN) process to the following: **Leadership Team** • FLT • ATLT **EHS** • GLOBAL_EHS • GLOBAL_EHS_MANAGERS • GLOBAL_EHS_SEAL_LT • GLOBAL_EHS_TEAM_MEMBERS **Facilities** • GLOBAL_FAC_MANAGERS • GLOBAL_FAC_NOTIFY • GLOBAL_FAC_ALL_SITES_NOTIFY • GLOBAL_FAC_PM_MANAGERS • GLOBAL_FAC_CONSTRUCTION_NOTIFY **GFTT / FCT Chem & Gas** • GFAC_PDR_GFTT_CHEM • FCT_GAS • FCT_CHEM **Procurement** • GP_ALL_LEADERS
Review	This document will be reviewed at least biennially (once per two years) by Global EHS / PSM through the Periodic Document Review (PDR) process.

9 Revision History

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