

ASSE Technical Report

Prevention through Design Guidelines for Addressing Occupational Risks in Design and Redesign Processes



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ASSE Technical Report

Prevention through Design

Guidelines for Addressing Occupational Risks

in Design and Redesign Processes

Prepared by the American Society of Safety Engineers

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FOREWORD

This Technical Report was developed to provide guidance on addressing occupational risks in the design and redesign processes. In the late 1990s, the Advisory Committee of the Institute for Safety through Design at the National Safety Council concluded that the following benefits will derive if decisions affecting safety, health, and the environment are integrated into the early stages of the design and redesign processes:

Significant reductions will be achieved in injuries, illnesses, and damage to property and the environment, and their attendant costs.

Productivity will be improved.

Operating costs will be reduced; and

Expensive retrofitting to correct design shortcomings will be avoided.

Developments since then have given additional importance to management, design engineers, and safety and health professionals having knowledge of the principles and practices applied in addressing occupational risks in the design and redesign processes. For example, there has been a more frequent inclusion of provisions in safety standards and guidelines requiring that hazards and risks be addressed in the design and redesign processes. This Technical Report is related to, and provides assistance in fulfilling, those requirements.

Another development supports the need for these Guidelines. The National Institute for Occupational Safety and Health (NIOSH) held a workshop in July 2007 to obtain the views of a variety of stakeholders on a major National initiative to “create a sustainable national strategy for Prevention through Design.”

Some participants in that workshop expressed the view that the long term impact of the NIOSH initiative could be “transformative,” meaning that a fundamental shift could occur resulting in greater emphasis being given to the higher and more effective decision levels in the hierarchy of controls. For this initiative, the NIOSH Mission is:

To reduce the risk of occupationally related injuries, illnesses, fatalities and exposures by including prevention considerations in all designs that affect individuals in the occupational environment.

The Prevention through Design initiative is based on the premise, as stated in NIOSH literature, that “One of the best ways to prevent and control occupational injuries, illnesses, and fatalities is to design out or minimize hazards and risks early in the design process.”

A definition of PtD was written that limited the activity to “early in the design process.” At the July 2007 workshop, a large number of participants wanted the concept extended to include the redesign activities in which they are participants. Thus, the following revision is applicable.

PtD

Addressing occupational safety and health needs by eliminating hazards and minimizing risks to workers in the design and redesign processes throughout the life cycle of work premises, tools, equipment, machinery, substances, and work processes including their construction, manufacture, use, maintenance and ultimate disposal or re-use..

Enthusiasm for additional knowledge of prevention through design principles and practices was significant. Several attendees said that a guideline, regulation or a standard is needed that sets forth the principles and the methodologies to address hazards and risks in the design and redesign processes. This Technical Report addresses those needs.

One of the most significant subjects discussed at the July 2007 workshop was the need to incorporate Prevention through Design concepts into academic curricula for all disciplines because of the recognition that few curricula include segments on addressing hazards and risks in the design and redesign processes.

Furthermore, this Technical Report is in concert with the stated intent of the Secretariat, the American Society of Safety Engineers. Promoting acquisition of knowledge of and application of Prevention through Design concepts is the subject of the ASSE Position Paper on Designing for Safety approved by the Board of Directors in 1994. The opening paragraph of that Paper reads as follows.

Designing For Safety (DFS) is a principle for design planning for new facilities, equipment, and operations (public and private) to conserve human and natural resources, and thereby protect people, property and the environment. DFS advocates systematic process to ensure state-of-the-art engineering and management principles are used and incorporated into the design of facilities and overall operations to assure safety and health of workers, as well as protection of the environment and compliance with current codes and standards.

In August 2007, the Engineering Practice Specialty group within the American Society of Safety Engineers published an article in a Special Issue of its Newsletter “By Design,” the title of which was “Prevention through Design: Addressing Occupational Risks in the Design and Redesign Processes.” The author of the paper was Fred A. Manuele, CSP, PE. That article was also published in the October 2008 issue of *Professional Safety*.

On September 23, 2008, the National Institute for Occupational Safety and Health held a “Kick-off meeting” with respect to its initiative on Prevention through Design. One of the action items discussed was to: “Develop and approve a broad generic voluntary consensus standard on Prevention through Design that is aligned with international design activities and practice.” That gave impetus for ASSE to consider further action on its paper.

There have been similar initiatives worth noting. As an example, ANSI/AIHA Z10, the *Occupational Health and Safety Management Systems* standard was adopted in 2005. A provision in Z10 requires that processes be in place “to identify and take appropriate steps to prevent or otherwise control hazards and reduce risks associated with new processes or operations at the design stage.” Z10 also says that “The design review should consider all aspects including design, construction, operation, maintenance, and decommissioning.” Several stakeholders have pointed out that Z10 states what needed to be done, but more information needs to be provided on how to meet its requirements.

At a meeting of the ASSE Standards Development Committee (SDC) on November 18, 2008, there was discussion toward further developing the paper published by ASSE into a technical report or a standard. During that meeting, there was an open conference call during which interested parties could offer comments. A decision was made by the committee to move forward on developing a technical report first, and then an ANSI standard.

Suggestions for improvement were obtained on four variations of the draft paper originally published by ASSE. As comments were received and discussions took place, it became obvious that it could take years to develop an ANSI standard if typical standards writing procedures were followed. The process to issue a Technical Report is not as lengthy and allows ASSE to provide Guidelines on Prevention through Design in a relatively short time.

This brief history provides ample evidence demonstrating the need for additional guidance on Prevention through Design. This Technical Report helps fulfill that need.

Revisions: The Z790 Committee welcomes proposals for revisions to this Technical Report. Revisions are made to the Technical Report periodically (usually five years from the date of the report) to incorporate changes that appear necessary or desirable, as demonstrated by experience gained from the application of the Technical Report. Proposals should be as specific as possible, citing the relevant paragraph number(s), the proposed wording, and the reason for the proposal. Pertinent documentation would enable the Z790 Committee to process the changes in a timelier manner.

Interpretations: Upon a request in writing to the Secretariat, the Z790 Committee will render an interpretation of any part of the Technical Report. The request for interpretation should be clear, citing the relevant paragraph number(s) and phrased as a request for a clarification of a specific requirement. Oral interpretations are not provided.

No one but ASSE is authorized to provide any interpretation of this technical report.

Approval: Neither ASSE nor the Z790 Committee "approves," "certifies," "rates," or "endorses" any item, construction, proprietary device, or activity.

Committee Meetings: Persons wishing to attend a meeting of the Z790 Committee should contact the Secretariat for information.

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**ASSE TECHNICAL REPORT TR-Z790.001-2009
PREVENTION THROUGH DESIGN
GUIDELINES FOR ADDRESSING OCCUPATIONAL RISKS
IN DESIGN AND REDESIGN PROCESSES**

1. SCOPE AND PURPOSE

1.1 This Technical Report provides guidance on including prevention through design concepts and processes as a specifically identified element in a safety and health management system so that decisions pertaining to occupational risks are incorporated into the design and redesign processes, including consideration of the life cycle of facilities, materials, and equipment.

1.2 This Technical Report complements but is not intended to replace existing specific standards and procedures, but rather to support those that meet the performance objectives defined in this document or other standards.

1.3 The goals of applying prevention through design concepts are to:

1.3.1 Achieve that state for which risks are at an acceptable level.

1.3.2 Reduce the occurrence of occupational injuries, illnesses, and fatalities.

NOTE: This Technical Report pertains principally to the elimination, reduction or control of occupational safety and health risks. Incidents or exposures that have the potential to result in occupational injuries and illnesses can also result in damage to property and business interruption, and damage to the environment. Reference is made in several places in this Technical Report to those additional loss potentials.

2. REFERENCED AND RELATED STANDARDS

2.1 Referenced Standards and Guidelines.

BS OHSAS 18001, *Occupational Health and Safety Management Systems – Requirements*

CSA Standard Z1000, *Occupational Health and Safety Management*

ISO 12100-1, *Safety of Machinery – Basic Concepts, General Principles for Design; Part 1. Basic Terminology, Methodology*

ISO 14121-1, *Safety of Machinery – Principles for Risk Assessment*

MIL-STD-882D and 882E, *Standard Practice for System Safety*

SEMI S2-0706, *Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment*

SEMI S10-0307, *Safety Guideline for Risk Assessment and Risk Evaluation Process*

2.2 Referenced American National Standards and Technical Reports.

ANSI/AIHA Z10, *Occupational Health and Safety Management Systems*

ANSI/ASSE Z244.1, *Control of Hazardous Energy: Lockout/Tagout and Alternative Methods*

ANSI B11.TR3, *Risk Assessment and Reduction – A Guideline to Estimate, Evaluate and Reduce Risks Associated with Machine Tools*

ANSI-GEIA STD-0010-2009, *Standard Best Practice for System Safety Program Development and Execution*

ANSI/PMMI B155.1, *Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery*

ANSI/RIA R15.06, *Industrial Robots and Robot Systems – Safety Requirements*

ANSI B11 – 2008, *General Safety Requirements Common to ANSI B11 Machines*

ANSI B11.TR7-2007, *ANSI Technical Report for Machines – A Guide on integrating safety and lean manufacturing principles in the use of machinery.*

3. APPLICATION

3.1 This Technical Report may be applied in any occupational setting.

3.2 This Technical Report applies to all of the three major time frames in the practice of occupational risk management:

3.2.1 Pre-operational, in the design and construction process – where the opportunities are greatest and the costs are lower for hazard and risk avoidance, elimination, or control.

3.2.2 In the operational mode – where hazards and risks are identified and evaluated and mitigation actions are taken through redesign initiatives or work methods changes before hazards-related incidents or exposures occur.

3.2.3 Post incident - as investigations are made of incidents and exposures to determine causal factors and the risk reduction measures to be taken, including improvements in the safety management system.

NOTE: Although the focus in this Technical Report is on eliminating, reducing, and controlling occupational risks, the process outlined here is equally applicable in avoiding injury to the public, damage to property and business interruption, damage to the environment, and product liability potential.

4. DEFINITIONS

4.1 Acceptable Risk. That risk for which the probability of a hazard-related incident or exposure occurring and the severity of harm or damage that may result are as low as reasonably practicable (ALARP), and tolerable in the setting being considered.

4.2 As Low As Reasonably Practicable (ALARP). That level of risk which can be further lowered only by an increment in resource expenditure that is disproportionate in relation to the resulting decrement of risk.

4.3 Design. The process of converting an idea or market need into the detailed information from which a product or technical system can be produced.

4.4 Hazard. The potential for harm. Hazards include all aspects of technology and activity that produce risk. Hazards include the characteristics of things (equipment, technology, processes, dusts, materials, and chemicals) and the actions or inactions of people.

4.5 Hazard Analysis. A process that commences with recognition of a hazard and proceeds into an estimate of the severity of harm or damage that could result if the potential of a hazard is realized and a hazard-related incident or exposure occurs.

4.6 Hierarchy of Controls. A systematic approach to eliminating or reducing risks, considering steps in a ranked and sequential order, to choose the most effective means of eliminating or reducing hazards and the risks that derive from them.

4.7 Lifecycle. The phases of the facility, equipment, process, and material, including: design, construction, operation, maintenance, and disposal.

4.8 Occupational Exposure Limit (OEL). The time-weighted average (TWA) concentration for a normal 8-hour work day or 40 hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect for a working lifetime. Occupational exposure limits can also be short term limits (15 minute TWA) or ceiling limits (instantaneous concentration).

4.9 Prevention through Design. Addressing occupational safety and health needs in the design and redesign processes to prevent or minimize work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment.

4.10 Probability. The likelihood of an incident or exposure occurring that could result in harm or damage for a selected unit of time, events, population, items or activity being considered.

4.11 Residual Risk. The risk remaining after risk reduction measures have been taken. No matter how effective the preventive actions, there will always be residual risk if a facility or operation continues to exist.

4.12 Risk. An estimate of the probability of a hazard-related incident or exposure occurring and the severity of harm or damage that could result.

4.13 Risk Assessment. A process that commences with hazard identification and analysis, through which the probable severity of harm or damage is established, followed by an estimate of the probability of the incident or exposure occurring, and concluding with a statement of risk.

4.14 Safety. That state for which the risks are at an acceptable level, and tolerable in the setting being considered.

4.15 Severity. The degree of harm or damage that could reasonably result from a hazard-related incident or exposure.

4.16 Supplier. Any entity that provides or makes available equipment, material, or professional services.

4.17 Worst Conceivable Risk. The worst consequence from an incident that could occur, but probably will not occur within the lifetime of the system.

4.18 Worst Credible Consequence. The worst consequence from an incident that has the potential to occur within the lifetime of the system.

5. ROLES AND RESPONSIBILITY

5.1 Top management is to provide leadership to institute and maintain a policy and procedures for the design and redesign processes through which:

5.1.1 Hazards are identified and analyzed.

5.1.2 Risks deriving from identified hazards are assessed and prioritized.

5.1.3 Risks are reduced to an acceptable level through the application of the hierarchy of controls described in Sections 12 and 13.

5.1.4 The knowledge, skills, experience, insight, and creativity of the workers close to the hazards and risks are utilized in the risk assessment process.

NOTE: The processes of identifying and analyzing hazards and assessing risks improve if management establishes a culture where workers' knowledge is valued and respected and that they are to be involved in every aspect of the Prevention through Design processes. Employees who do the work have made valuable contributions in identifying and evaluating hazards and in risk assessments.

5.1.5 Process effectiveness can be monitored through feedback to provide for continuous improvement.

5.1.6 Appropriate recordkeeping systems are developed and used to document design reviews and to track feedback and safety and health reports over the life cycle of the product, process, or design intervention.

5.2 Top management is to carry out the responsibilities of 5.1 when:

5.2.1 New facilities, equipment, technologies and processes are being planned, designed, acquired or installed.

5.2.2 Alterations are made in existing facilities, equipment, technologies, and processes.

5.2.3 Incident investigations are made and corrective actions taken.

5.2.4 Decommissioning and recycling operations are undertaken.