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The Career Significance of the Safety through Design Provisions in Z10

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Introduction

When I submitted a proposal in June 2006 to be a speaker at the 2007 ASSE Professional Development Conference, it seemed appropriate for my presentation to relate only to the long term career implications of the safety through design provisions in the standard that is becoming commonly known as Z10. The formal designation for this American National Standard is ANSI/AIHA Z10-2005 and its title is *Occupational Health and Safety Management Systems.*

But, having the opportunity since I submitted a speaker's proposal to reflect on several national and international developments that further the application of safety through design principles, I will broaden the scope of this paper to encompass them. I ask your indulgence as I do so. In this paper, I will:

- Discuss the origin of the term safety through design, define it, and comment on its concept and application
- Indicate how "safety through design" may be transitioning into "prevention through design" because of a NIOSH initiative
- Review safety through design provisions in ANSI/AIHA Z10-2005
- Comment on national and international developments relating to safety through design
- Present my views on the implications the safety through design provisions in Z10 have, long term, on the knowledge and skills that safety professionals will be expected to have

Safety Through Design

In 1995, the National Safety Council created an Institute for Safety Through Design in response to encouragement by several people who recognized, through their studies of incident investigation reports, that design causal factors were not adequately addressed. For example, my studies indicated that although there were implications of workplace or work methods design inadequacies in over 35 percent of the incident investigation reports I analyzed, they were not being addressed. Had the quality of those incident investigation reports been higher, the design causal factors would more than likely have been at a higher level. Some industry specific accident studies show that in as many of 60 percent of cases, design causal factors were apparent, and glossed over.

My colleagues and I also observed that designing for safety was inadequately addressed in the popular safety literature. And we noted that safety and health management system outlines infrequently included safety through design procedures.

The Advisory Committee for the Institute for Safety Through Design, the membership of which represented industry, academia, and organized labor, arrived at the following definition.

> **Safety Through Design**
> The integration of hazard analysis and risk assessment methods early in the design and engineering stages and taking the actions necessary so that risks of injury or damage are at an acceptable level.

Integration means incorporating and combining and working into – early in the design process.

A hazard, for the purposes of safety through design concepts, is defined broadly as the potential for harm to people, property, or the environment. In Z10, which is an occupational safety and health standard, a hazard is defined as a condition, set of circumstances, or inherent property that can cause injury, illness or death. Hazards encompass all aspects of technology and activity that produce risk. Hazards include the characteristics of things and the actions or inactions of people.

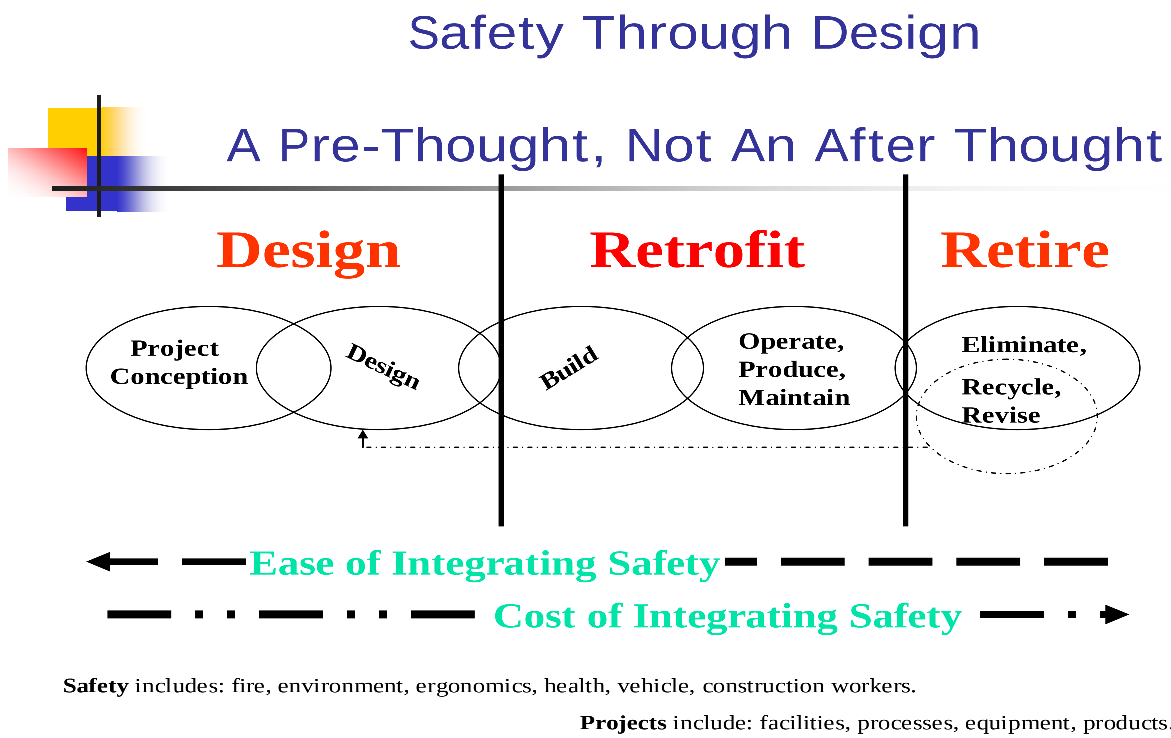
Risk is defined as a combination of the probability of a hazard-related incident or exposure occurring and the severity of the harm or damage that may result. Safety professionals know that obtaining a zero risk level is impossible. They also know that the residual risk, the risk that exists after remediation efforts have been taken, is to be acceptable.

Risk assessment is a process that commences with hazard identification and analysis to estimate the severity of harm or damage that may result if a hazard's potential is realized, and concludes with an estimate of the probability of a hazard-related incident or exposure occurring.

Acceptable risk is 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, and tolerable in the setting being considered.

The intent, in applying safety through design concepts, is to have acceptable risk levels maintained throughout the life cycle of a facility and the equipment, machinery and tools necessary to conduct an operation – all the way through to dismantling and disposal.

As we moved along, we created and modified models that demonstrate the safety through design idea, and what we were talking about. One of them is shown in the following diagram. I suggest that you keep this model in mind, and the definitions just previously given, as I get into the provisions in ANSI Z10 on risk assessments, design reviews, a hierarchy of controls, management of change, and procurement procedures.



Our theme is expressed in the title to the diagram. Applying safety through design concepts requires addressing hazards and risks in the pre-development stage, not as an after thought. For simplification, the term safety is used to include not only employee injury and illness, but also fire prevention, the environment, vehicle safety, and construction safety.

The safety through design concept applies to facilities, processes, equipment, tools and products – **and to the design of the work methods**. My studies of incident causal factors require that I give strong emphasis to the importance of designing work methods that are not overly stressful or error-provocative, not just to the design of machinery and equipment. And I recommend that safety professionals do the same.

In the companies where the safety through design concept is applied best, the concept is a part of the safety culture, and hazards and risks are addressed – beginning in the design concept stage. As the design progresses, the new knowledge developed further influences the risk decisions. In those companies, there is a safety sign-off before work can start to build a product or a facility or a process.

We also promoted the economic and effectiveness aspects of addressing hazards and risks in the concept stage. Our findings were that if the decision makers wait until a system is in place to consider safety needs, retrofitting for safety becomes an add-on and achieving adequate safety levels is more difficult and more expensive. However, the point also has to be made that the same safety through design concepts can be applied by safety professionals who give advice during an organization's operating, maintenance, and continual improvement modes.

One of the many accomplishments of the Institute was to have a book published by the National Safety Council. Its title is, of course, *Safety Through Design*. It is in its second printing. The book is used in some safety science degree college courses. ASSE has sold it. Although the Institute For Safety Through Design was disbanded in 1995, in accord with its sunset provision, there is a lot of on-going activity that supports its concepts.

As an indication of how the safety through design movement moves forward, I cite the January/February 2007 issue of the magazine *Safety Science*, a European publication. Fourteen of its sixteen articles are devoted to safety by design. I suggest that safety professionals also take note of activity initiated by the National Institute for Occupational Safety and Health (NIOSH) that promotes safety through design concepts.

Prevention through Design

A senior executive at NIOSH, mid 2006, communicated with several people who had been promoters of the safety through design idea seeking guidance and support in an initiative to promote “incorporating occupational safety and health considerations in design.” The subject of his Email was Prevention through Design. An initial planning and discussion meeting was held in October 2006. A major workshop to move the idea forward is scheduled for July 2007.

Dr. John Howard, Director of NIOSH, commented on this initiative during his presentation at the National Safety Congress held in November 2006. Among other things, he said that the workshop to be held in 2007 is to “bring together the practitioners of prevention-through-design to take the first steps toward creating a national strategy.”

A working definition of Prevention through Design, as of the date this paper is written, follows.

> Addressing occupational safety and health needs in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment.

Several entities have been invited to assign participants for this venture. ASSE is one of them. This is major undertaking. Long term, it can have considerable influence on the content of the practice of safety. Comments in this paper are relative to this NIOSH initiative. Prevention through Design, as a term, conveys the intent of the undertaking.

ANSI/AIHA Z10-2005

Now, one might ask, how do safety through design concepts relate to provisions in ANSI/AIHA Z10-2005? Before getting into specifics, I want to comment generally on the significance of Z10.

Approval of Z10 was a major development. **For the first time in the US, a national consensus standard for a safety and health management system applicable to organizations of all sizes and types has been issued. Z10 is a consensus ANSI standard. It is not a guideline.**

Z10 is a sound document. Its provisions are **state-of-the-art.** The applicability of its provisions as means to reduce risk and avoid injuries and illnesses can not be refuted. Having occupational safety and health management systems in place that comply with the standard is the right thing to do.

Looking ahead several years, I predict that Z10 will revolutionize the practice of safety. It will have a significant and favorable impact on the content of the practice of safety and on the knowledge and skill requirements for safety professionals. Every safety professional who has responsibilities for occupational safety and health should have a copy of Z10 and be familiar with its provisions.

With your copy, I suggest you do a gap analysis, comparing the provisions in Z10 with those in the safety and health management systems for which you give counsel. All but very few companies will find shortcomings.

ANSI Standards Acquire a "Quasi-Official" Status

Over time, ANSI standards become the societally recognized minimums with respect to the subjects they cover. As Z10 attains that stature, it will become the benchmark against which the adequacy of safety and health management systems will be measured.

Safety consultants who give advice on safety management systems to employers other than their own employer have a particular need to become familiar with the provisions in Z10 in that they are expected to be aware of the state-of-the-art in the field for which they give counsel. A reference on the implications of Z10 with respect to legal liability potential can be found in the paper titled *Legal Perspectives – ANSI Z10-2005 Standard: Occupational Health and Safety Management Systems*. It was written by Adele Abrams, an attorney, at the request of ASSE. Briefly, Ms Abrams writes:

> Safety and health professionals have an obligation to keep abreast of the latest knowledge and to include "best practices" in their safety programs and consultation activities, to the maximum extent feasible. Knowledge and comprehension of the ANSI Z10 standard may be imputed to safety professionals, in terms of determining what a "reasonable person" with similar training would be likely to know. Willful ignorance of the best practices set forth in Z10 and/or failure to incorporate such preventative measures in the workplace or programs under the safety and health professional's direction or oversight could lead to personal tort liability or professional liability.

Table of Contents – Z10

To provide a base for comparison against safety and health management systems with which safety professionals are familiar, the major captions in Z10's Table of Contents are listed here. It looks rather ordinary. It doesn't seem to present any surprises. But many safety professionals will find that being able to give counsel on several of Z10's provisions will require obtaining additional knowledge and skill.

Foreword

1.0 Scope, Purpose, and Application
2.0 Definitions
3.0 Management Leadership and Employee Participation
4.0 Planning
5.0 Implementation and Operation

6.0 Evaluation and Corrective Action
7.0 Management Review

I will review briefly the standard's Scope, Purpose and Application. And I will then address only those provisions that pertain to safety through design concepts. They are in the Planning section and the Implementation and Operations section.

Scope: This standard defines the minimum requirements for occupational health and safety management systems (OHSMS). Note the term – minimum.

Purpose: The primary purpose of this standard is to provide a management tool to reduce the risk of occupational injuries, illnesses, and fatalities.

Application: This standard is applicable to organizations of all sizes and types. There are no exclusions by industry or business type or number of employees.

A Major Theme

Z10's Planning Section says that the planning process goal is to identify and prioritize occupational health and safety management **issues**. And those **issues** are defined as "hazards, risks, management system deficiencies, and opportunities for improvement." Addressing hazards and risks is at the base of safety through design concepts.

Throughout all of the sections of Z10, starting with Management Leadership and Employee Participation and going through to the proposed annual Management Review, there is a prominent theme relating to those **issues**. It follows.

> Processes for continual improvement, applying the Plan-Do-Check-Act (PDCA) concept, are to be in place and implemented to assure that:

1. Hazards are identified and evaluated, and the risks deriving from them are assessed and prioritized
2. Safety design reviews are made
3. A management of change system effectively addresses hazards and risks when operational changes are made
4. Procurement processes – purchasing and contracting processes – avoid bringing hazards and risks into the workplace
5. A prescribed hierarchy of controls is applied to achieve feasible risk reduction
6. Management system deficiencies and opportunities for improvement are identified
7. Risk elimination, reduction or control measures are taken to assure that acceptable risk levels are attained.

Relating Z10 Provisions to Career Potential

Applying safety through design principles will be necessary to fulfill the requirements in the first five items in the foregoing list. Over time, safety professionals will need to be capable of giving counsel on those five subjects for job retention and career enhancement. Each of them is now discussed.

Hazard Identification and Analysis and Risk Assessment

In the literature on problem solving, every model has a problem identification and analysis phase. And so does Z10. Employers are to have processes in place to identify and analyze hazards, assess the risks deriving from those hazards, and establish priorities for amelioration which, when acted upon, will attain acceptable risk levels. Prudent safety professionals will also observe that risk assessment provisions are being included in other safety standards and guidelines. As they observe this noteworthy evolution, they will come to the obvious conclusion that being able to make risk assessments will become a job requirement. A few examples follow.

Risk Assessments: Properties Exposed to Natural and Man Made Hazards

In June 2006, ASTM International sent out a draft standard for ballot approval and comments, the title of which is *ASTM: Standard Guide for Developing a Cost-Effective Risk Mitigation Plan.* Its working designation is WK7175. The standard's framework consists of three steps: (1) risk assessment; (2) identification of alternatives; and (3) economic evaluation. This is a fascinating innovation. This guide presents a generic framework to identify the risks to which planned and existing facilities may be exposed with respect to natural and man made hazards and to develop a cost-effective risk mitigation plan for those facilities.

Fire Prevention and Protection

The National Fire Protection Association (NFPA) has initiated a highly significant research project with respect to risk assessment, the theme of which is *Enhancing Fire Safety Through The Development of Codes and Standards Based on Risk Assessment Concepts.* The Research Objective is "To develop the technical basis and implementation strategy for the incorporation of risk assessment concepts into the NFPA codes and standards making system." Scheduled completion date is April 2007.

This is a grand undertaking with immense potential. Assume that all NFPA codes include risk assessment provisions. That would further define the need for safety professionals to acquire risk assessment knowledge and capability because of the number of NFPA codes that affect their work.

Packaging Machinery

The Packaging Machinery Manufacturers Institute is the secretariat for the B155.1 standard titled *Safety Requirements for Packaging and Packaging-Related Converting Machinery.* An updated version of B155.1 was approved by ANSI in July 2006. The major revisions in the standard are indicative of the acceptance of the premise that hazard analysis and risk assessment provisions should be included in ANSI safety standards.

It is important to note that the standard is largely generic. The Risk Assessment Process in B155.1 covers nearly eight pages in rather small print. In no place in the risk assessment process is there a mention of packaging machinery. Safety professionals must not be surprised if the risk assessment process in B155.1 appears in other standards.

Robots

A noteworthy first was achieved in the United States when approval was given in June 1999 for ANSI/RIA R15.06-1999, which is *The American National Standard for Industrial Robots and Robot*

Systems – Safety Requirements. The Robotic Industries Association is the Secretariat for the Standard.

Why should safety generalists whose field of influence does not include robots pay attention to this standard? It was a precursor in form and content to other safety standards and guidelines that followed. R15.06 was the first occupational safety standard issued by the American National Standards Institute in which conducting a comprehensive risk assessment is presented as a means to determine the design requirements, the safeguarding to be applied, and the subsequent administrative controls that may be needed.

ANSI standards are usually updated on a five year cycle. Rather than update R15.06, the Robotic Industries Association is in discussion as a member of the committee responsible for ISO 10218:1992, a standard titled *Manipulating Industrial Robots – Safety*. That is an important development. The intent is to have an international standard on robots and robot systems that incorporates the risk assessment provisions in R15.06.

ISO is the designation for the Geneva, Switzerland based International Organization for Standardization. It is the world's largest nongovernmental developer of standards. ISO standards have significant international import.

For example, all exporters of machinery and equipment that goes into a workplace in the European Community must meet the requirements of ISO 14121 – *Safety of machinery—Principles of risk assessment* and “certify” that risk assessments have been made.

Machine Tools

TR3 is the acronym for a report issued by the B11.TR3-2000 Subcommittee formed by the Machine Tool Safety Standards Committee (B11) of the American National Standards Institute. TR stands for Technical Report. The Subcommittee’s work is titled *Risk assessment and reduction – A guideline to estimate, evaluate and reduce risks associated with machine tools*. The Secretariat for this work is The Association For Manufacturing Technology.

TR3 became a registered document at ANSI in November 2000. Over ninety percent of TR3 is generic. Thus, it is a basic document on hazard analysis and risk assessment providing guidance on reducing risks. As discussions commenced to update TR3, an industry specific guideline, a proposal was made that TR3 serve as the base for a generic hazard analysis and risk assessment standard. That proposal is receiving favorable consideration.

Semiconductor Industry

Guidelines issued by the semiconductor industry are another indication of a trade group recognizing the value of using hazards analysis and risk assessment techniques to eliminate or control hazards and to attain acceptable risk levels. SEMI S2-0706 was re-issued in July 2006. Its title is *Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment*.

The guideline includes provisions for making hazards analyses and risk assessments “early in the design phase, and updated as the design matures.”

Guidelines issued by SEMI (Semiconductor Equipment and Materials International) are truly international. Many countries are represented on Guideline writing committees. Their representatives have been leaders with respect to having hazard analysis and risk provisions included in safety guidelines.

<u>Canada</u>

In March 2006, the Canadian Standards Association issued CSA Standard Z1000-6, titled "Occupational health and safety management." It contains many similarities to Z10. Not surprisingly, one of its provisions reads as follows:

> The organization shall establish and maintain a process to identify and assess hazards and risks on an ongoing basis. The results of this process shall be used to set objectives and targets and to develop preventive and protective measures.

Allow me to summarize. The message is clear: Safety and health professionals will be expected to have knowledge of hazard analysis and risk assessment methods and how to apply them.

Learning How to Do Risk Assessments Is not Difficult

Thinking about learning how to do risk assessments can be daunting, but it doesn't have to be. I suggest that safety professionals put aside any dread they may experience in thinking about achieving an understanding of risk assessment techniques. I give assurance that acquiring the necessary understanding and capability will not be overly difficult.

As a practical matter, having knowledge of three risk assessment concepts and how they are applied will satisfy nearly all of the needs of safety and health professionals and the requirements of Z10. They are: Preliminary Hazard Analysis; the What-If Checklist Analysis Methods; and Failure Mode and Effects and Analysis.

In the application of these techniques, qualitative rather than quantitative judgments will prevail. For all but the seldomly encountered complex risks, qualitative judgments will be sufficient. Mathematical calculations will be at a minimum and not complex. Getting into advanced algebra is not necessary. Fortunately, the literature on the risk assessment methods I cite is abundant.

Annex E in Z10 provides information on the "Assessment and Prioritization" requirements in the standard. A part of Annex E is a brief outline titled "Hazard Analysis and Risk Assessment Guide." It sets forth an easily understood and applied thought and action process on how to make a hazard analysis and a risk assessment.

Whatever the simplicity or complexity of the hazard/risk situation being considered, the thought and action outline presented in Annex E will apply. This is a condensed version of the outline.

<u>Hazard Analysis and Risk Assessment Guide</u>

1. Select a manageable task, system, or process to be analyzed
2. Identify the hazards
3. Define possible failure modes that result in exposure to hazards
4. Estimate the frequency and duration of exposure to the hazard

5. Assess the severity of injury/illness
6. Determine the likelihood of the occurrence of a hazardous event
7. Define the risk level using a risk assessment matrix, risk ranking, or scoring system
8. Risks can then be listed and ranked
9. The organization selects prioritized OHSMS issues and develops documented objectives and implementation plans

Risk Assessment MatricesItem 7 in the Hazard Analysis and Risk Assessment Guide suggests using a risk assessment matrix. I have collected over twenty-five risk assessment matrices. Some are simple; some are complex. All of them contain, at least, probability, severity, and risk levels. I suggest that safety professionals adopt or develop risk assessment matrices suitable to an entity's particular needs.

An example of a matrix is shown in Z10's Annex E, and it is good one. But it is large and I could not get it on a presentable slide. For illustration, I show you a rather simple Risk Assessment Matrix. As others do, it displays incident probability and severity categories, and risk levels.

Risk Assessment Matrix

	Severity of Consequences			
Occurrence Probability	**Catastrophic**	**Critical**	**Medium**	**Minimal**
Frequent	High	High	Serious	Moderate
Likely	High	High	Serious	Moderate
Occasional	Serious	Serious	Moderate	Low
Remote	Serious	Moderate	Moderate	Low
Improbable	Moderate	Moderate	Low	Low

A risk assessment matrix serves as a method to display the combinations of incident probability and severity and to categorize those combinations as risk levels. A matrix serves well in communicating with and influencing decision makers.

Design Reviews

Section 5.1.2 in Z10 addresses the provisions for both Design Review and Management of Change. Although the subjects are interrelated, each has its own importance and uniqueness. Because of my studies of causal factors for incidents that result in serious injuries, I choose to treat these subjects separately.

Z10 requires that processes be in place to conduct design reviews so as to avoid bringing hazards into the workplace. I recommend that safety professionals stress having such procedures in place as a valuable element in a safety and health management system.

This is the basis for my thinking. Risks of injury derive from hazards. If hazards are eliminated or are well controlled, risks of injury are greatly minimized. If hazards are properly addressed and eliminated or controlled in the design processes so that the risks deriving from them are at an acceptable level, the potential for harm or damage is minimized.

This reasoning is so fundamentally sound that logical arguments against eliminating or controlling risks in the design, and purchasing, processes cannot be put forth.

Z10 requires that design reviews be made for such as:

- New or modified equipment, technology, and design specifications
- New or revised procedures and work practices
- When new or revised safety and health standards are issued.

It must be understood that the design review process can not be implemented effectively until design parameters and specifications are established. This is not a subject to be taken lightly. Allow me to suggest that for medium and smaller sized organizations that are not extensively staffed with engineers, their trade associations can provide valuable assistance in writing design parameters and specifications.

Having written and stressed that the most effective and economical way to minimize risks is to have the hazards from which they derive addressed in the design process, I commend the drafters of Z10 for including design review provisions in the standard. If it becomes the norm that employers include design review elements in their safety management systems, the beneficial impact as respects injury and illness reduction will be substantial.

In a few entities, written procedures establish that safety professionals have a specified responsibility for capital expenditure proposal reviews, project design reviews, and for signing off on new or altered equipment before it can be placed in operation.

More often, safety professionals are not involved in the design of facilities, equipment, processes or work methods. As safety professionals obtain the necessary knowledge and skill and initiate successful participation in safety design reviews, they most likely will be perceived as providing additional value.

Management of Change

Although the term Management of Change is not defined in Z10, its purpose is clearly established. The objective of a management of change system is to have procedures in place to prevent the introduction of new hazards and risks into the work environment when changes are made in technology, equipment, facilities, work practices and procedures, design specifications, raw materials, organizational or staffing changes impacting on skill capabilities, and standards or regulations.

The management of change requirements in Z10 interest me particularly because my research shows that, for all occupations:

> A large proportion of incidents resulting in severe injuries occur in unusual and non-routine work, in non-production activities, and where sources of high energy are present. Also, they occur in what can be called at-plant construction operations. (Others have similarly observed.)

Many such incidents occur when operational changes are being made. The following is an example of the unusual and non-route work that fits within the Z10 management of change provisions. A motor is to be replaced. It weighs 800 pounds, and sits on a platform 15 feet above the floor. The work is to be done by in-house personnel. That is the type of out-of-the-ordinary work for which an effective management of change procedure would be beneficial.

Applying the change analysis concept is at the base of a management of change system. The purpose is to assure that the:

- Hazards and risks that may arise when work is done to achieve a change have been identified and assessed and that appropriate control measures are taken
- New hazards and risks are not created
- Previously resolved hazards are not negatively impacted
- Change does not make the potential for harm of an existing hazard more severe.

As is the case with all management systems, an administrative procedure must be written to communicate what the management of change system is to encompass and how it is to operate. The system must be designed to precisely fit the organizational structure, culture, and work force of a facility. A cumbersome management of change process should not be proposed. However, in the drafting process, consideration should be given to having it include those types of activities that are known to result in serious injuries.

For a large percentage of organizations, it will suffice if their management of change procedure encompasses a basic Pre-Job Planning and Safety Analysis System. An outline for such for such a system is an addendum to this paper.

Some companies, particularly those who have to meet the requirements of OSHA's *Rule for Process Safety Management of Highly Hazardous Chemicals – 1910.119,* have written extensive management of change procedures because the standard requires that such procedures be in place. In the historical and explanatory data OSHA published on 1910.119, it was made plain that the management of change requirement was highly important, as shown in the following excerpts.

> **Management of Change**: OSHA believes that one of the most important and necessary aspects of a process safety management program is appropriately managing changes to the process. This is because many of the incidents that the Agency has reviewed resulted from some type of the change to the process.

> While the Agency received some excellent suggestions concerning minor changes to improve this proposed provision, there was widespread support for including a provision concerning the management of change in the final rule.

Note that there was widespread support for the management of change provisions. That was because leaders in the chemical industry recognized that many incidents resulting in serious injury or property damage occurred when process changes were being made. As an example of that recognition, consider this statement – taken from a publication of the Chemical Manufacturers Association.

> There is considerable evidence that improper changes have directly caused or led to many of the major accidents that have occurred in the chemical process industry and related industries that use hazardous chemicals and technology.

A Major Difference

Safety professionals need to recognize that there is a major difference between the management of change requirements in OSHA's 1910.119 and those in Z10. Companies that comply with 1910.119 do not need to apply their management of change procedures if the work to be done involves a "replacement in kind."

Excluding "replacement in kind" work from the management of change process diminishes the probability of avoiding incidents that result in serious injuries. I repeat the example of in-plant construction given previously: a motor weighing 800 pounds is to be replaced; assume that it is a "replacement in kind;" it sits on a platform 15 feet above the floor; the work is to be done by in-plant personnel. I strongly suggest that this type of work not be excluded when a management of change procedure is drafted.

Procurement

Although the requirements in Z10 for the Procurement processes are plainly stated and easily understood, they are brief in relation to the enormity of what will be required to implement them. As is the case for the provisions on safety design reviews, the Procurement processes are to assist an organization in its attempts to avoid bringing hazards and risks into the workplace.

The standard requires that processes be in place so that reviews are made of purchased products, materials and other goods and related services to identify and evaluate the risks, before their introduction into the work environment. The key phrase here is "before their introduction into the workplace."

I place great emphasis on having the Procurement provisions in Z10 becoming an element in safety and health management systems, particularly as they can serve to prevent the introduction of hazards and risks into the workplace that may become causal factors for incidents that could result in serious injury.

There is a close relationship between establishing safety design specifications and including safety specifications in purchasing documents. It is not feasible to write safety specifications for purchasing orders until design specifications have been determined.

Unfortunately, the practice in many companies in the bid process for acquiring machinery, equipment and materials is that purchasing departments are to choose the lowest bidder. For years, safety professionals have told stories about how the lowest bid on safety-related products or materials was accepted only to find that safety needs were not met.

Getting managements and purchasing personnel to adopt the Procurement provisions in Z10 will not be easy to do. In most places, a culture change will be necessary. An oblique interpretation of the Procurement requirements in Z10 could be – safety and health professionals, you are assigned the responsibility to convince managements and purchasing agents that, in the long term, it can be very expensive to buy cheap.

Hierarchy of Controls

Z10 is a management system standard, with one exception. And the exception is its specifically defined hierarchy of controls. The standard says that an organization "shall" "implement and maintain a process for achieving feasible risk reduction based upon the following preferred order of controls".

A. Elimination;
B. Substitution of less hazardous materials, processes, operations, or equipment;
C. Engineering controls;
D. Warnings;
E. Administrative control; and,
F. Personal protective equipment.

Note that the first element in this hierarchy of controls, in a priority order, is to design out or otherwise eliminate or reduce the hazard. Substitution and engineering controls follow. This version of a hierarchy of controls is a demonstration of safety through design principles. Annex G in Z10 provides a valuable pictorial and verbal display of the Hierarchy of Controls with application examples for each element.

Purpose of a Hierarchy of Controls

Note that the hierarchy of controls in Z10 is described as the "preferred order of controls." The steps in the hierarchy are placed in an order with the expectation that:

- Sequential consideration is to given to each of the ameliorating methods in a descending order
- Reasonable attempts will be made to eliminate or reduce the hazards and their associated risks by taking the more effective steps higher in the hierarchy before lower steps are considered
- A lower step in the hierarchy of control is not to be chosen until practical applications of the preceding higher levels are exhausted.

For many situations, a combination of the risk management methods shown in a hierarchy of controls may be applied. In an occupational setting, the goals of the application of the hierarchy of controls are to:

1. Achieve acceptable risk levels
2. Have work methods and processes in which the probability of

a. errors by supervisors and workers because of design inadequacy is at a practical minimum
b. supervisors and workers defeating the system is at a practical minimum

Conclusions

Z10 represents an important step in the evolution of the practice of safety. Assume that, over time, Z10 becomes the benchmark against which the adequacy of occupational safety and health management systems is measured. That will impact on the content of the practice of safety and on the careers of safety and health professionals.

Employment Implications
As awareness of the provisions in the standard becomes prevalent, it can be expected that employers of safety and health professionals will seek candidates who are equipped with the knowledge and skill to give counsel on meeting the requirements of the standard. In that respect, safety and health professionals should be particularly interested in the safety through design provisions in Z10 discussed in this paper.

Educational Implications
Further, the content of college level safety degree programs will be impacted as employers of safety practitioners seek candidates who are equipped to give counsel on the standard's requirements. Since one of the criteria for success of a technical degree program is the employment possibilities for the graduates, prudent professors responsible for those programs will assure that core courses properly equip students to meet employer needs.

Certification Implications
Z10 will also have an impact on the content of the examinations for the Certified Safety Professional (CSP) designation. Those examinations are reviewed about every five years to assure that they are current with respect to what safety professionals actually do. As the substance of the practice of safety changes, what the safety professionals who participate in the examination review process say about the content of their work at that time will have an influence on the content of the CSP examinations.

It would be folly for safety professionals to ignore the long range impact of Z10. Safety professionals, have a look at it and determine what it means to you with respect to knowledge and skill requirements.

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Addendum 1

Pre-Job Planning and Safety Analysis Outline

1. Review the work to be done. Consider both productivity and safety:
    a. Break the job down into manageable tasks.
    b. How is each task to be done?
    c. In what order are tasks to be done?
    d. What equipment or materials are needed?
    e. Are any particular skills required?
2. Clearly assign responsibilities.
3. Who is to perform the pre-use of equipment tests?
4. Will the work require: a hot work permit; a confined entry permit, lockout/tagout (of what equipment or machinery)?
5. Will it be necessary to barricade for clear work zones?
6. Will aerial lifts be required?
7. What personal protective equipment will be needed?
8. Will fall protection be required?
9. What are the hazards in each task? Consider –

Access	Work at heights	Work at depths	Fall Hazards
Worker position	Worker posture	Twisting, bending	Weight of objects
Elevated loads	Welding	Fire	Explosion
Electricity	Chemicals	Dusts	Noise
Weather	Sharp objects	Steam	Vibration
Stored energy	Dropping tools	Pressure	Hot objects
Forklift trucks	Conveyors	Moving equipment	Machine guarding

10. Of the hazards identified, do any present severe risk of injury?
11. Develop hazard control measures, applying the Safety Decision Hierarchy.
    - Eliminate hazards and risks through system and work methods design and redesign
    - Reduce risks by substituting less hazardous methods or materials
    - Incorporate safety devices (fixed guards, interlocks)
    - Provide warning systems
    - Apply administrative controls (work methods, training, etc.)
    - Provide personal protective equipment
12. Is any special contingency planning necessary (people, procedures)?
13. What communication devices will be needed (two-way, hand signals)?
14. Review and test the communication system to notify the emergency team (phone number, responsibilities).
15. What are the workers to do if the work doesn't go as planned?
16. Considering all of the foregoing, are the risks acceptable? If not, what action should be taken?

Upon Job Completion

17. Account for all personnel
18. Replace guards
19. Remove safety locks
20. Restore energy as appropriate
21. Remove barriers/devices to secure area
22. Account for tools
23. Turn in permits
24. Clean the area
25. Communicate to others affected that the job is done
26. Document all modifications to prints and appropriate files