# Prevention Through Design: Long-Term Benefits

**PS: As a member of the Z590.3 subcommittee for prevention through design (PTD), what is your role and why did you decide to become involved?**
**Wayne:** My role in developing the technical report and draft standard was to ensure that adequate consideration was given to identification of hazards, risk assessment and mitigation early in the design stage, seeking an acceptable level of risk (ALOR) in designs, rather than retrofitting for safety, as has been practiced for decades.

I have been involved with safety in the design phase of projects for years. For example, when working as corporate director of safety, programs were instituted and we worked closely with and audited engineering projects for incorporation of safety in designs.

Subsequently, my roles as project manager for NSC's Institute for Safety Through Design, coeditor of the book Safety Through Design and author of several articles for Professional Safety and CAD publications led me to become involved and to share my expertise in the PTD technical report and draft standard.

**PS: What is the PTD concept and what is its place within the SH&E profession?**
**Wayne:** The need to determine hazards and risks in projects, whether they are new facilities, equipment, processes, technology, products or redesigns, is increasingly recognized worldwide. This attention is the result of the effort of safety professionals and many disasters that have occurred. It is important to have the culture and methodology necessary to achieve ALOR.

Safety practitioners, as well as engineers, architects, contractors, vendors and management, should be concerned with having suitable policy, plans, checklists, benchmarks, marketing concepts and demonstrated PTD culture. They must develop design objectives and measurable performance standards and audit this effort. There must be collaboration between safety, engineering and other functions.

It will be necessary to identify the knowledge and skills designers and other professionals need to acquire and to foster and create education programs (in-house or elsewhere) to ensure that all have an opportunity to contribute their full potential. Finally, hazard analysis and risk assessment policy and procedures must be established to ensure that engineering projects achieve ALOR.

**PS: What is management's role in the PTD process?**
**Wayne:** CEOs and CFOs are key leaders in PTD. If the culture, desire and management support are not evidenced and demonstrated at all levels, the concept will fail as have so many other programs proposed in recent years. We must find techniques to market the concept so it will be sustainable. Managers should not assume that bad things will not occur.

PTD is especially vital with the current decrease in time between project concept and completion, coupled with concern for budget, time and funds that are generally not available for costly retrofitting after the project has been finalized. Failure to retrofit can leave projects with higher risk levels than desired. Our approach must be substantially modified to ensure that it can be attained. Unfortunately, retrofitting has been the norm for decades, but PTD may be the key to eliminating retrofit.

**PS: How soon into the PTD process should a safety design review be performed? What key elements should a safety design review cover?**
**Wayne:** The PTD process must be started almost as soon as the project is conceptualized. A project team should be selected and include individuals from engineering, safety, procurement, personnel and operations. They must decide on the design objectives and agree that as hazards are identified, the associated risk will be assessed and mitigation techniques determined to reach ALOR. A tracking method is essential.

Risk identification and assessment must be an integral part of the design activity and not something where once a design is completed or construction has started, a safety person is contacted and a review is initiated. This generally results in retrofitting.

**PS: How are hazard analysis and risk assessment incorporated into the PTD process?**
**Wayne:** These are key functions in the procedure to ensure that ALOR is accomplished. Before we can perform a hazard analysis, engineers, architects and others involved in the design process must have knowledge and skills and be capable of identifying hazards. Generally, their past education and experience cannot be relied upon nor can we accept any substituted view, such as that they always comply with published standards.

Education programs should be established (by ASSE and others, including companies) to enable engineers to become adept in hazard recognition and risk assessment. At the same time, in-house design checklists for engineers can and should be developed. A special checklist for designers is necessary, not a compilation of checklists used to inspect facilities, equipment, etc., which are essentially for the purpose of retrofitting rather than incorporating SH&E items into designs. Risk assessment is becoming increasingly recognized as necessary to ensure that hazards are reduced to ALOR. Therefore, it must be incorporated as a necessary function in design activity.

Alphonse Chapanis offered a challenge to engineers at ASSE's 1986 professional development conference:

> "Everyone is at some time careless, complacent, overconfident, stubborn. Each of us becomes distracted, inattentive, bored, fatigued. We occasionally take chances, misunderstand, misinterpret, misread. As a result of these and other completely human characteristics, we sometimes do not do or use things in ways expected of us. Because we are human. These traits are fundamental and built into each of us, the equipment, machines and systems that we construct for our use have to be made to accommodate us the way we are and not vice versa. That is the second part of my title, a challenge. 'To err is human, to forgive, design.' Are you good, ingenious and dedicated enough to meet the challenge?"

We must convey this challenge to engineers who are involved in our design or redesign projects. Do not assume; make sure they have accepted the challenge.

**PS: Benefits of PTD include reduced occupational injury/fatality rates and an improved bottom line. What are other long-term benefits of PTD?**
**Wayne:** Long-term benefits of PTD include better designs and reduction of the time from project conception to completion. In addition, the cost and time involved in retrofit actions are eliminated when design reviews are completed after the design is finished or construction has started or is completed, thereby continuing to improve the financial status of corporations.

As time passes, we note more and more experienced engineers, architects, safety professionals and other personnel retiring, thereby depleting accumulated experiential knowledge that aids in ensuring safe designs. We must ensure that incoming personnel in all of these categories have developed the knowledge and skills necessary to recognize hazards and assess risks via educational programs.

**PS: In what ways have other countries introduced PTD initiatives into their workplaces?**
**Wayne:** Consideration of safety in the design stage goes far back in history when individuals were responsible for their buildings. More recently, it was clearly stated in the 1946 Accident Prevention Manual. It has been considered in the years since then, but a substantial growth of concern for hazard recognition and risk assessment has been evident worldwide since 2000.

Section 5.1.2 of ANSI/AIHA Z10-2005, Occupational Health and Safety Management Systems, states, "The organization shall establish and implement processes to identify and take appropriate steps to prevent or otherwise control hazards and reduce potential risks associated with: A. New processes or operations at the design stage."

**Europe**
- ISO 14121-1 2007: Safety of Machinery—Principles for risk assessment
- ISO/IEC 31010 2009: Risk Management—Risk assessment techniques
- ISO 12100-2010: Safety of Machinery. General principles for design. Risk assessment and reduction.

**Australia**
•AS/NZS 4360:2004. Risk Management.
•Guidance on the Principles of Safe Design for Work (2006). Safety and Compensation Council.

**Canada**
•CSA Z1000-2006, Occupational Health and Safety Management Standard.

**China**
•State Administration of Work Safety published (2008) provisional regulations on risk assessment.

**Japan**
•Industrial Safety and Health Act—revised (2006) to stipulate (without penalty) that employers should make efforts to implement risk assessment procedures.

**Singapore**
•Standard SS 506. (2009) Occupational safety and health management systems, Part 1: Requirements.

**U.K.**
•BS OHSAS 18001 2007 revision, Occupational health and safety management systems—requirements.

**U.S.**
•ANSI/PMMI B155.1-2006: Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery
•ANSI B11.TR3-2000: Risk Assessment and Risk Reduction
•ANSI B11.0-2010: Safety of Machinery—General Safety Requirements and Risk Assessments
•ANSI/ASSE Z244.1-2003 (R2008): Control of Hazardous Energy Lockout/Tagout and Alternative Methods
•MIL-STD 882D, Standard for System Safety—Fourth Edition—2000. (Currently under revision.)
•SFPE Engineering Guide to Application of Risk Assessment in Fire Protection Design, 2006
•NRC 2010, regulations allow adoption of NFPA 805, Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants voluntarily in lieu of existing licensing provisions.
•FRA Dec. 8, 2010 FR, Advance notice of proposed rulemaking for certain railroads to have a risk reduction program and such programs to have a risk analysis and a risk reduction program plan.
•Semiconductor Industry SEMI S10-0307—Safety Guideline for Risk Assessment and Risk Evaluation Process.

**PS: What are the Z590.3 subcommittee's expectations for the draft Z590.3-201x standard if it is approved?**
**Wayne:** First, I feel confident the standard will be adopted. Second, as a group, expectations have not been discussed, but knowing other involved members, it seems safe to say that one major hope would be that there will be extensive communication, early recognition and implementation by large numbers of safety practitioners and members of management; that the practice will be to incorporate SH&E concerns in the design stage of projects.

Finally, within a corporation's social concerns, it is hoped that PTD will be a strong factor, and safety can be improved for users (employees, contractors, vendors and the public). Essentially, it would be super to observe an explosion of companies taking action to implement PTD in their design work.

**PS: If there is one point you would like to emphasize to readers, what would that be?**
**Wayne:** It is that safety professionals, engineers, architects and others who frequently assume compliance with standards, regulations and codes produce safe operations would recognize that adopted standards and codes are valuable and must be followed. It is also important to remember they are minimum consensus documents that were agreed to by a fairly large and diverse group and do not necessarily represent the achievement of ALOR in individual design projects.

An interesting example of minimum standards is in the National Institute of Building Sciences' Whole Building Design Guide information: ". . . intent of codes . . . to mandate minimum standards that provide acceptable safety at an affordable cost. . . . Many features of building codes are understood to represent a minimum standard . . . almost always

exceeded for reasons of comfort and amenity . . . agreed . . . minimum floor area of a bedroom is 70 sq ft with a minimum dimension of 7 ft in any horizontal direction" (www.wbdg.org/design/env_introduction.php). Would this size room be "acceptable" in your home?

ALOR can only be achieved if the hazards are identified, a risk assessment is completed, and risks are eliminated or mitigated to reach ALOR. It is important to recognize that the discussion relates to reaching an acceptable level of risk rather than zero risk, which may be unattainable or extremely costly.

**Wayne Christensen, P.E., CSP,** is president of Christensen Consulting for Safety Excellence Ltd. in Crystal Lake, IL, providing incident prevention program consulting with a focus on smart design. He previously was corporate director of safety for a Fortune 500 company and a fire chief for NASA-Mississippi Test Facility (now Stennis Space Center). He also served as managing director and manager of technical services for ASSE, as well as an adjunct instructor for the National Safety Council (NSC) and project manager for NSC's Institute for Safety Through Design. Wayne is a member of the Z590.3 subcommittee for prevention through design. An ASSE curricula evaluator for the Accreditation Board for Engineering and Technology, he also serves on several ANSI, ASTM and ASME standards committees and on NIOSH's Prevention Through Design Council. He is an ASSE Fellow and holds a B.S. in Fire Protection and Safety Engineering.