1 SAFETY THROUGH DESIGN

ANSWERS—QUIZ 1

1. b
2. a
3. b
4. a
5. b
6. a
7. c
8. a
9. b
10. b
11. b
12. d
13. Safety through design is defined as the integration of hazard analysis and risk assessment methods early in the design and engineering stages and the taking of the actions necessary so that the risks of injury or damage are at an acceptable level. This concept encompasses facilities, hardware, equipment, tooling, materials, layout and configurations, energy controls, environmental concerns, and products.
14. "Upstream" includes all aspects of the origination of business concepts, the relative decision making, and the design process, during which the greatest effectiveness can be achieved in hazard avoidance, elimination, or control.
15. Student might mention the following: Significant reduction will be achieved in injuries, illnesses, damage to 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.
16. *Risk* is defined as a measure of the probability of a hazards-related incident occurring and the severity of harm or damage that could result. *Safety* is defined as the state in which the risks are deemed acceptable.
17. A risk assessment is an analysis that addresses both the probability of a hazards-related incident occurring and the expected severity of its adverse effects.
18. Answers might include the following: padding low overheads, rounding corners, using ergonomically designed tools.
19. Student must mention three of the following ten objectives:
    - Safety is to be designed into all processes, the workplace, work methods, and products in a proactive, cost effective manner.
    - Risk assessment is to be an integral part of the design processes.
    - A fundamental design purpose is to have processes and products that are error proof or error tolerant.
    - Hazards must be identified and evaluated and then avoided, eliminated, or controlled so that the associated risks are at an acceptable level throughout the entire life cycle of processes, equipment, and products.
    - Requirements for minimum risk are to be established and applied in the acquisition or acceptance of new materials, technology, or designs, and prior to the adoption of new production, test, or operating techniques.
    - Actions taken to identify and eliminate hazards and to reduce their attendant risks to an acceptable level are to be documented.
    - Retrofit actions required to improve safety are to be minimized through the timely inclusion of safety features during research, technology development, and in purchasing and acquisition.
    - A management-of-change system is to be in place that includes identification of hazards so that an acceptable risk level is maintained when design or work methods changes are made.
    - Consideration is to be given early in the design process to the risks attendant in the eventual disposal of processes and products.
    - Significant safety data reflecting lessons the company has learned are to be documented and disseminated to interested personnel.
20. Student must name each of the following and provide an adequate description.
    - First Priority: Design for minimum risk.
    - Second Priority: Incorporate safety devices.
    - Third Priority: Provide warning devices.
    - Fourth Priority: Develop and implement operating procedures and employee training programs.
    - Fifth Priority: Use personal protective equipment.

ANSWERS—QUIZ 2

1. b
2. a
3. a
4. b
5. a
6. b
7. c
8. b
9. a
10. a
11. d
12. a
13. Student may mention any of the following: facilities, hardware equipment, tooling, material selection, operation layout and configuration, energy control, environmental concerns, worth methods and procedures, personnel selection standards, training content, work scheduling, management of change procedures, maintenance requirements and personal protective equipment needs, industrial, commercial, and consumer products for human use.
14. The safety practitioner can influence the design of the workplace and work methods at three critical points: in the preoperational stage, in the operational stage, and in the postincident stage.
15. A summary of the mission statement is acceptable: To reduce the risk of injury, illness, and environmental damage by integrating decisions affecting safety, health, and the environment in all stages of the design process.
16. Possible answers include the following: violates operator expectations; requires performance beyond what an operator can deliver; induces fatigue; provides inadequate facilities or information for the operator; is unnecessarily difficult or unpleasant; or is unnecessarily dangerous.
17. Student might use the scenario as described in the text: Establish the analysis parameters, identify the hazards, consider the failure modes, describe the exposure, asses the severity of consequences, determine the probability of the hazard being realized, write a concluding statement, and develop proposals to remedy the hazards.
18. Serving as a design review committee member, the SH&E professional will assist in identifying and evaluating hazards in the design process and will provide counsel as to their avoidance, elimination, mitigation, or control. Special training programs for the review committee may be recommended by the safety, health, and environmental professional. Also, consultants who would complete hazards analyses other than for the "what if" system may be recommended.
19. Provide the committee with documentation including: detailed equipment design drawings; equipment installation, operation, preventive maintenance, and test instructions; details of and documentation for codes and design specifications; and requirements and information needed to establish regulatory permitting and/or registration.
20. Student should draw the model for safety through design as found in the text. Student should then write one or two lines explaining that by addressing hazards and risks early in the design, many cost-related and health-related problems can be avoided.

ANSWERS—CASE STUDY

1. In the preoperational design stage: Before a building, system, or piece of equipment becomes operational, the safety professional has the greatest opportunity to identify and analyze hazards and to help engineers and architects design ways to avoid, control, or eliminate them. This stage can avoid costly redesigning, retrofitting, or replacing elements of the workplace. In the operational stage: After a building, system or piece of equipment becomes operational, the safety professional can seek to make them safer through the process of continuous improvement. He or she accomplishes this task by anticipating, identifying, and evaluating current hazards and helping to control or eliminate them before their potentials to cause injury or death are realized. In the postincidental stage: After an incident has occurred, the safety professional can still work to improve safety. By investigating the hazards related to the incident, he or she can determine the causal factors involved and can review the possible impact of design decisions on the incident. These data can then be used to improve future designs and eliminate the factors that led to the current incident.
2. The Order of Design Precedence is as follows: (1) design for minimum risk, (2) incorporate safety

devices, (3) provide warning devices, (4) develop and implement operating procedures and employee training programs, and (5) use personal protective equipment.

3. Because many companies still adopt a reactive mode in designing for safety, safety professionals tend to focus on behavior modification or training as solutions when the problem is workplace or work methods design.