PRINCIPLES OF
ACCIDENT POTENTIAL RECOGNITION

Presented

By

AMERICAN SOCIETY OF SAFETY ENGINEERS

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NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH
CENTER FOR DISEASE CONTROL - U.S. D.H.E.W.

THE BEGINNER AND INEXPERIENCED PERSON, REVIEWING ANY FACILITY OR OPERATION, OFTEN BYPASSES CLUES THAT HE SIMPLY DOES NOT RECOGNIZE BECAUSE HE HAS NEVER KNOWN THEM BEFORE.

THE EXPERIENCED SAFETY SPECIALIST ALSO TENDS TO BYPASS CLUES BECAUSE OF A TENDENCY TO BECOME HIGHLY SPECIALIZED IN SPECIFIC AREAS.

PRIME OBJECTIVE

...TO IMPROVE YOUR CAPABILITY OF RECOGNIZING SITUATIONS WHICH APPEAR TO REPRESENT ACCIDENT POTENTIAL.

SPECIFIC OBJECTIVES

PROVIDE EDUCATION AND TRAINING FOR NEW PERSONS IN THE SAFETY FIELD WHICH WILL IMPROVE THEIR CAPABILITY IN RECOGNIZING ACCIDENT POTENTIAL IN A WIDE RANGE OF TOPIC AREAS AND A BROAD SCOPE OF OPERATIONAL ACTIVITIES.

PROVIDE A REFRESHER TRAINING PROGRAM FOR EXPERIENCED SPECIALISTS AND PART-TIME SAFETY PEOPLE WHICH WILL WIDEN THEIR AREA OF FOCUS AND RECOGNITION OF ACCIDENT POTENTIAL.

HAZARDS

RECOGNITION EVALUATION CONTROL

The word HAZARD is a signal that some evaluation has already been made.

Narrow our view of the depth of consideration BUT broaden the subject areas and operations being reviewed.

FOUR TOPIC AREAS

SITE AND STRUCTURES

OPERATING MACHINERY & EQUIPMENT

MATERIALS

ENERGY

1. RECOGNIZE ACCIDENT POTENTIAL

2. EVALUATION

3. RECOGNIZE HAZARDS OR RECOGNIZE NO HAZARD

4. EVALUATION

5. DETERMINE DEGREE OF HAZARD AND PRIORITIES

6. ESTABLISH METHODOLOGY TO ELIMINATE OR MITIGATE

7. IMPLEMENT CONTROLS

8. MEASURE

1. ETC.

THE PROCESS OF RECOGNITION

ACCORDING TO MOST DICTIONARIES, "RECOGNIZE" MEANS "TO KNOW AGAIN". THE WORD AGAIN INDICATES THAT RECOGNITION REQUIRES PRIOR EXPERIENCE. THIS COURSE DESCRIBES AND EXPLAINS CLUES THAT EXPERIENCED PEOPLE HAVE LEARNED TO RECOGNIZE AS ACCIDENT POTENTIAL. THE WAYS IN WHICH RECOGNITION OCCUR ARE NOT RESTRICTED TO "SEEING".

MANY OF THE CLUES TO RECOGNITION ARE SUBTLE, BEING DEGREES OR LEVELS OF INTENSITY. THIS IS TYPICAL OF TEMPERATURE, MOTION, NOISE AND LIGHT.

FIVE MEASURABLE GOALS

1. LIST THE MAJOR TOPIC AREAS OF ACCIDENT POTENTIAL RECOGNITION AND IDENTIFY "15" CLUES IN EACH TOPIC AREA.

2. IDENTIFY, WITHIN A ONE-HOUR TIME LIMIT, 80% OF ACCIDENT POTENTIAL SITUATIONS DEPICTED IN 'FINAL' PROBLEMS.

3. IDENTIFY, WITHIN 15 MINUTES, 90% OF ALL ACCIDENT POTENTIAL SITUATIONS RELATED TO A SPECIFIC PIECE OF EQUIPMENT.

4. IDENTIFY AND DESCRIBE THE PRINCIPLES OF ACCIDENT POTENTIAL RECOGNITION. INDICATE HOW THE PRINCIPLES ARE RELATED TO THE ACCIDENT PROBLEM AND THE IDENTIFICATION OF HAZARDOUS SITUATIONS BEFORE ANY ACCIDENTS OCCUR.

5. PREPARE A REPORT SHOWING YOUR RECOGNITION OF ACCIDENT POTENTIAL AS THE FIRST STEP OF A HAZARD RECOGNITION AND CORRECTION CYCLE. THIS REPORT IS TO BE IN A FORM THAT WILL PERMIT MARKETING YOUR ANALYSIS TO MANAGEMENT.

RECOGNIZE THE SYSTEM CONCEPT OF SAFETY. CONCERN MUST BE APPLIED TO THE MAN/MACHINE/ENVIRONMENT COMPONENTS OF A TASK ORIENTED SYSTEM.

INTERACTION BETWEEN THE COMPONENTS OF A SYSTEM ARE PRIME SOURCES FOR ACCIDENT POTENTIAL. CHANGES, DEVIATIONS, AND STRESS CAN DEGRADE THE SYSTEM.

THINGS MIGHT REPRESENT ACCIDENT POTENTIAL BUT THEY ARE NOT ALWAYS HAZARDS. EVENTS AND SEQUENCES OF EVENTS CREATE HAZARDS.

STEP BACK AND OBSERVE THE BIG PICTURE.

LOOK FOR UNSAFE BEHAVIOR AS WELL AS THINGS.

USE ALL OF YOUR SENSES.

EYES SEE MOTION AND OVERBALANCE, FEEL IRRITATION FROM AIRBORNE CONTAMINANTS.

EARS IDENTIFY PRESSURE, NOISE AND CHANGES.

THE SKIN NOTIFIES US OF TEMPERATURE EXTREMES AND IRRITANTS.

YOUR WHOLE BODY SENSES CHANGES IN WORK LEVEL.

1. Complex traffic patterns

LAND	WATER	AIR	ADVACENT ROADWAYS
PUBLIC HIGHWAY			RAILROAD SIDINGS

2. Undesirable landscaping or vegetation

HIGH GRASS	EXCESSIVE PLANTING	LANDSCAPING

3. Questionable location of utilities

POWER LINES TRANSFORMERS GAS PIPING WATER SUPPLY

TELEPHONE

4. Unusual neighborhood problems

CONDITIONS OF BUILDINGS NEIGHBORHOOD PLANTS

LOW INCOME AREAS SUSPICIOUS MATERIALS ADDITIONAL SIGNS

5. Opportunities to fall below ground

DEPRESSIONS WATER GROUND LEVEL

CHILDREN

6. Opportunities to fall to the ground level

ABOVE THE GROUND ELEVATED STRUCTURE

7. Unusual weather conditions

SPECIAL CONDITIONS TEMPERATURE EXTREMES HUMIDITY

TORNADOES AND HURRICANES SNOW AND ICE

ELECTRICAL STORMS TEMPERATURE INVERSION EARTHQUAKES

8. Discharge to the environment

VISABLE ODORS AIR WATER GROUND

ACCIDENT POTENTIAL EXISTS CAN'T SEE DISCHARGE

9. Inadequate lighting

ADEQUATE LIGHTING JUDGEMENTS

SPECIAL CONSIDERATION INTERWOVEN

REVIEW I - General Site Characteristics

Nine clues

Others

Add clues

10. Large single areas

10,000 SQUARE FEET — THREE STORIES

ESCAPE PROBLEM — ROOF COLLAPSE

11. Isolated structures

SUSPICIOUS — PROCESSING

12. Special construction

HEAVY CONSTRUCTION	REINFORCED CONCRETE	LIGHT WEIGHT PANELS
NOT EXCLUSIVE		SUSPICIOUS

13. Temporary structures

NOT ALL BUILDINGS	NEVER WELL-EQUIPPED	BE CURIOUS

14. Recent change

NEW HOUSE START-UP

REVIEW II - Nature of Structures

Five clues

Reason for building collapse

15. Deterioration

SIGNS OF DETERIORATION BASES OF SUPPORT EVIDENCE

16. Deformation

SURFACE OF METAL STRUCTURES CAVITATION

DEFLECTION SAGGING POOR MAINTENANCE

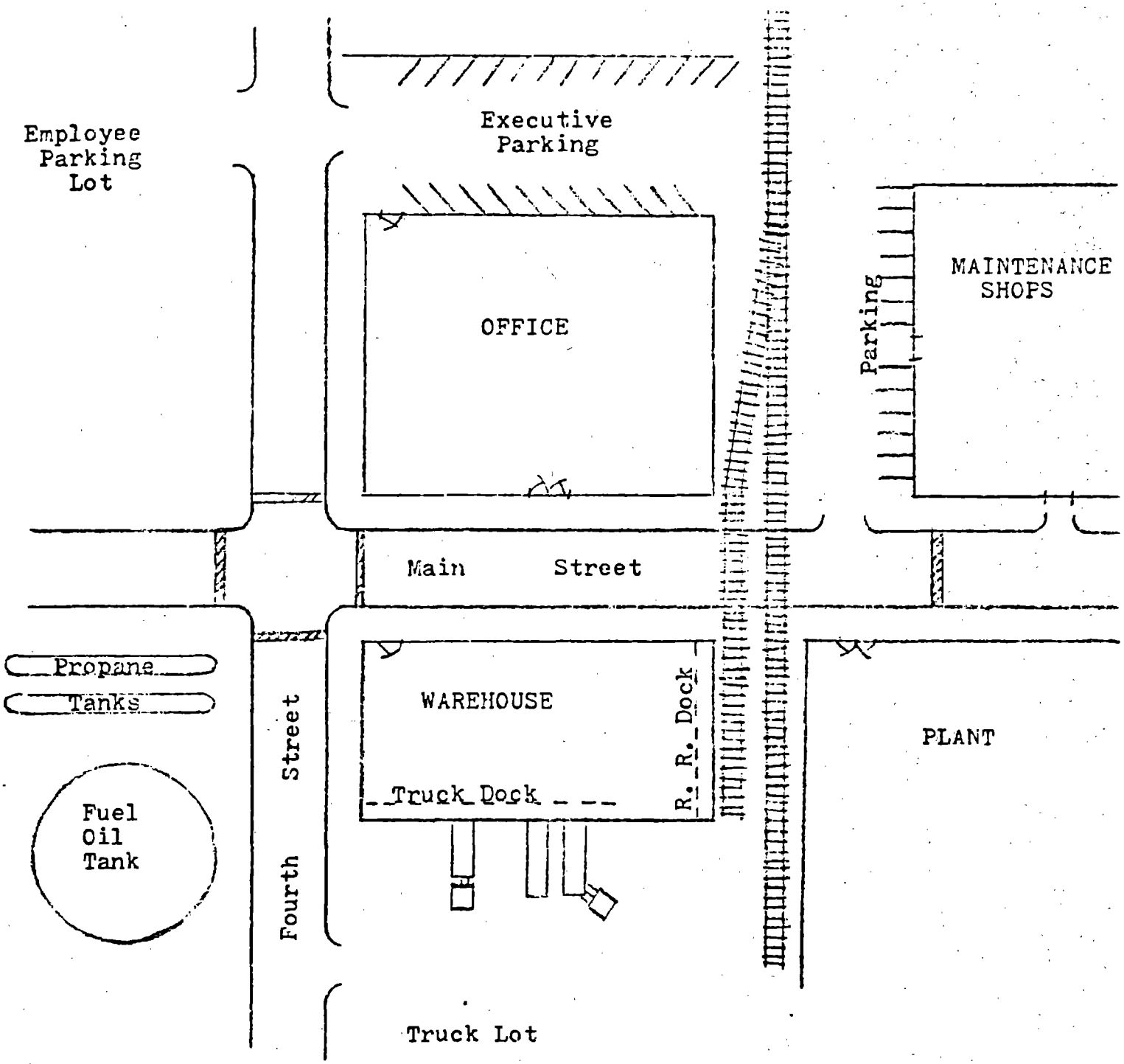
17. Evidence of poor housekeeping

OVERFLOWING TRASH FIRE PROBLEMS SNOW AND ICE

QUESTIONS FOR DISCUSSION

I. SITES AND STRUCTURES

I-1. Number accident potentials in traffic patterns below.



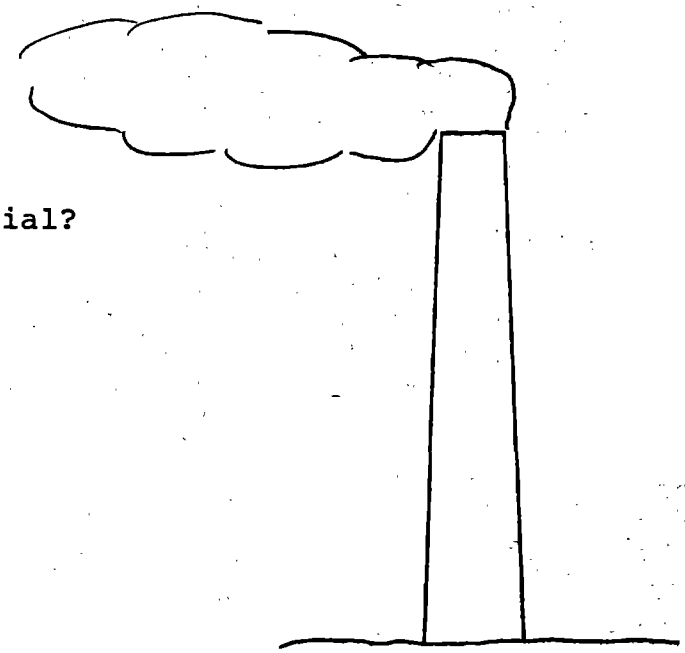
I-2 Four horizontal propane tanks are located in an unpaved area. Grass is 3 feet high in August. List the accident potentials.

I-3 List sources of information about neighborhood character that could indicate hazard potentials.

I-4 A factory parking lot is situated over an area where utility pipe lines and cables are laid. Several manholes and junction rooms are in the area. Precast concrete blocks are used to lay out parking lot into proper rows. What potential for falls do you see?

I-5 After a severe storm dropped hail stones one-inch diameter in the next county, you are surveying your plant for accident potential associated with hail. What items might you list?

I-6 On a cold day you observe a white stack discharge which disappears 1/4 mile from the stack. Is this accident potential? How could you be sure?



I-7 List accident potentials that could be present if a poorly lighted ramp is used by fork lift trucks.

I-8 Visualize a large department store or supermarket where you have shopped. What accident potentials attributable to large unbroken space can you recall?

I-9 A one-story structure about 20' by 20' is located 200' from the nearest building and near an artificial earth mound. What accident potential do you see possible? What questions do you plan to ask about it?

I-10 Two spheres about 30' diameter seem to be insulated and are painted white. No identification other than numbers is seen. Do you think they could have accident potential? Why?

I-11 A possible shortage of natural gas led to the installation of oil burners on the boilers. List the accident potentials possible with the new equipment and its installation.

I-12 How could you use the help of the plant draftsman in finding accident potentials related to structures?

I-13 Nuts and steel plates are on the ends of large rods extending through the wall of a 4 story brick mill building. What is the purpose? Why were they necessary?

I-14 The machine shop is neat, orderly, and has no extraneous material anywhere visable. The punch press shop is poorly laid out, dirty, and has all sorts of materials left wherever dropped. Compare the accident potentials of the two shops.

I-15 If conditions permit, the class will be sent out to a point a short distance away from the building in which the classroom is located to develop a listing of accident potentials that can be recognized.

18. Rotating motion

ROTATING MECHANISMS CASE OR SHELL PROTRUDING PARTS

PROJECTIONS

19. Reciprocating motion

BACK AND FORTH GUILLOTINE INDUSTRIAL OPERATIONS

20. Cutting operations

CUTTING ACTION	DANGER

21. Punching, shearing, and forming operations

RAM	POINT OF ACTION	PUNCHING ACTION

22. In-running nip points

ROTATING OBJECTS TYPICAL INCIDENTAL OTHER NIP POINTS

POINT OF OPERATION FUNCTION WRINGER

REVIEW III - Mechanical Action

Five clues

Dangers

Areas of machine operation

23. Inconvenient location of 'start and stop'

POSTION OF SWITCHES MULTIPLE OPERATOR STATIONS UNIFORMITY

24. Special control devices

SUSPECT TRIPPING REMOTE CONTROL

25. Absence of 'lock out' provisions

UNEXPECTED OPERATION LOCKING

REVIEW IV - Machine Controls

Three clues

26. Portable power tools

ELECTRIC SHOCK AIR ACTUATED

27. Powder actuated equipment

REVOLVER TWO TYPES HAZARDS

28. Gauges and regulators

GAUGES GAUGES AND REGULATORS

OXYGEN AND FUEL CYLINDER

29. Relief devices

SAFETY RELIEF DEVICES MAINTAINED AND TESTED

30. Lifting Equipment

HOISTING APPARATUS COMMON ITEMS INSPECTED

31. In-plant vehicles

SAFETY PRINCIPLES DRIVER QUALIFICATION

32. Unusually heavy electrical equipment

EXPLOSION PROOF DUST TIGHT

33. Pressure vessels

15 POUNDS LIQUID GAS STORED/ENERGY

CONSTRUCTION OF CONTAINER

REVIEW V - Special Equipment

Eight clues

34. Continuous Repetitive Motions

SPECIAL CONSIDERATION	MANUAL MANIPULATION
ALL	

35. Awkward body motion

LIFTING AND TWISTING	TABLE HEIGHT

36. Physical overload

TOO DEMANDING OTHER OPERATIONS

37. Vibration exposure

CAUSES CONSTANT & EXPOSURE DISCOVERED

38. Noise exposure

NORMAL CONVERSATION IMPACT DEVICE

39. Seeing problems

DIMLY LIGHTED HIGH INTENSITY GLARE

40. Heat exposure

EXCESSIVE HEAT RECOGNIZED

REVIEW VI - Operator Stress

Seven clues

41. Improved guarding

MACHINE GUARDS GENERAL MAINTENANCE

42. Electrical repair problems

ELECTRICAL EQUIPMENT MACHINERY AND EQUIPMENT

43. Deficiencies in housekkeeping

CLEANLINESS WASTE MATERIALS

44. Distortion and damage

GENERAL REPAIR UNUSUAL SOUNDS

45. Certificate of inspection

QUESTIONS FOR DISCUSSION

II OPERATING MACHINERY AND EQUIPMENT

II-1 List the accident potentials of a portable electric drill fitted with a 3/8 inch drill bit.

II-2 A crane is swinging a heavy ball to demolish walls of a masonry building. What accident potentials will you list for further evaluation?

II-3 You watch a butcher cut a steak, then cut the bone with his hand saw. Identify the accident potentials.

II-4 A punch press, stamping out spoons from sheet metal, is fed manually. List the accident potentials during normal operation, during setup, during maintenance.

II-5 What is the importance of adequate, conveniently located, properly integrated control switches and emergency stop buttons on the agitator of a 1000 gallon chemical reactor vessel during operation, during charging, during cleaning, during vessel entry?

II-6 You observe personnel connecting some new circuits in an electrical service. The master switch is off, but not tagged or locked. Upon inquiry you find the establishment has no lock-out procedure or regulation. What accident potentials would you present to convince management that a lock out procedure is essential?

II-7 An electric drill having a two conductor cord is being used in a damp basement area. What accident potential do you see?

II-8 A powder actuated device is to be used for applying furring strips to masonry walls in a large building. Outline a safe operating procedure to cover the accident potentials.

II-9 A 500 gallon tank containing a corrosive liquid (20% caustic soda) has a vertical glass tube outside the tank to show liquid level. A centrifugal pump drawing liquid from the tank has a 100 psi pressure gauge on the discharge and a rotameter is in the discharge line. What accident potentials would you consider in developing a maintenance program for the tank, pump, and metering system?

II-10 An air tank of 50 cubic feet capacity is supplied by a motor driven compressor. The design pressure of the tank is 240 psi and its 1¼" relief valve is set to pop at 225 psi. The pressure control valve starts the compressor at 190 psi and shuts it off at 200 psi. The system has been in use at a paper mill for 15 years. What are the accident potentials?

II-11 What accident potentials would you consider in developing an operator training program for fork lift truck operators working in a grocery warehouse?

II-12 A heavily insulated vessel about 4 feet diameter and 7 feet high has a 200 pound pressure gauge. You find no identification plate and conclude it is somewhere under the insulation. How would you go about assessing the accident potential?

II-13 A man is using a table saw in a furniture factory to cut the ends off of 5000 pieces of wood. He is paid on a piece-work basis. Consider the accident potential.

II-14 Men working in a pit under buses must reach overhead to perform service work such as oil changes, lubrications, brake adjustments, and replacement of worn or defective parts. What is the accident potential associated with this work position?

II-15 Discuss the accident potential associated with daily use of an air hammer for breaking up concrete paving.

II-16 The noise level near a can filling machine is so high that you must shout to make the operator hear you (he is two feet away). What accident potentials are related to the high noise level?

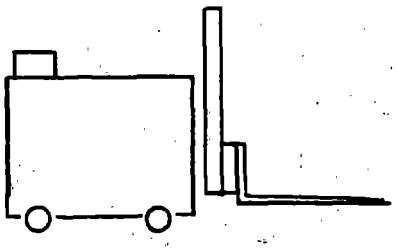
II-17 A welder goes into a four foot diameter vessel as soon as its temperature has been lowered sufficiently to make a repair. Discuss the accident potential.

II-18 Unguarded belt drives and open rotating machinery is located in a securely locked room. Strict orders prohibit entry while the equipment is operating. What do you think of the accident potential?

II-19 Heavy electric wires on poles and on insulators attached to the outside of building walls supply 480 volts, 3-phase power for a chemical plant. Wires pass over pipe racks with one foot clearance and are within a foot of elevated walkways. Detail the accident potential.

II-20 Small pieces of welding rod and miscellaneous pieces of steel are dropped on the welding shop floor. Cleanup is erratic and welders (paid on piece-work basis) are content to walk on the debris. What does this tell you about the accident potential of the shop as a whole?

II-21 The forks on a lift truck extend about five feet from the mast and curve downward toward the extreme ends. What accident potential is indicated?



II-22 A freight elevator in constant use is subject to breakdowns and shows evidence of heavy use. You look for an inspection certificate but cannot find one. What are the accident potentials?

46. Special building features

INTERNAL	FLOORS	CURBING
WALL FEATURES	COLUMNS	ROOF

47. Unique electrical equipment

HEAVY CASTINGS	CABLES	COPPER BARS

48. Special room feature

LOCKED DOORS SMALL ROOMS

49. Isolation of materials

ISOLATION MATERIALS

50. Questionable piling or stocking

RAW MATERIALS	UNBALANCED	HIGH
EQUIPMENT		CEILING

51. Overcrowded conditions

TIPS	AISLES

52. Elaborate fire protection

SPECIALIZED DETECTORS

REVIEW XII - Storage

Seven clues

53. Drums and barrels

CONTENTS MANUAL HANDLING

54. Presence of sacks or bags

HANDLING CONTAIN EVALUATING

55. Heavy construction or appearance

CONSTRUCTED SHIELDING VACUUM CASKS

56. Small carrying and storage containers

DECREASE LABORATORY CARRYING CANS BUCKETS

SAFETY CANS

57. Fixed tanks and storage bins

LARGE TANKS	BIND	POWDERS

58. Awkward packaging

TYPICAL CLUSTERED	ODDLY SHAPED	ENVISION

59. Gas cylinders

TYPICAL	LARGE	CLUES
COLOR		

REVIEW XIII - Special Containers

Six clues

60. Symbols

ADVANTAGES TYPICAL NUMBERS COMMON

OTHER SYMBOLS

61. Legends

'NO SMOKING' BASIC IDENTIFYING

62. Color

NEVER GENERAL PRACTICE COMBINED EFFECT

63. The absence of identification

COMPLEX MATERIALS TOTAL ABSENCE

REVIEW IX - Signs and Markings

Four clues

Combinations

NFPA Markings

64. Manual Handling

APPROACHES DIFFICULT SHAPE MANIPULATION

65. Remote handling equipment

EXAMPLES	COMPLETE ISOLATION

66. Transfer operations

TRANSFER	POWERED	UNPOWERED
ONE LOCATION		

67. Lifting and hoisting

GRAVITY RECOGNIZE INCLUDE

REVIEW X - Materials Handling

Four clues

Combination

Significance

QUESTIONS FOR DISCUSSION

III MATERIALS

III-1 Discussion of this topic included:
- Floors
- Curbing
- Walls
- Ventilation
- Fire protection on support columns
- Roofs and ceilings

Name six other parts of buildings that might be clues to accident potential.

III-2 In a 30' x 40' one story building there is little activity, but motors, switches, and lights are all explosion-proof. In a corner you observe a refrigerator and an electric drill in use. What observations and questions are needed to determine whether there may be accident potential?

III-3 Special Room Features

A small metal building in a refinery is posted as follows:

Keep Out
Lead Tetroethyl
Authorized Personnel Only

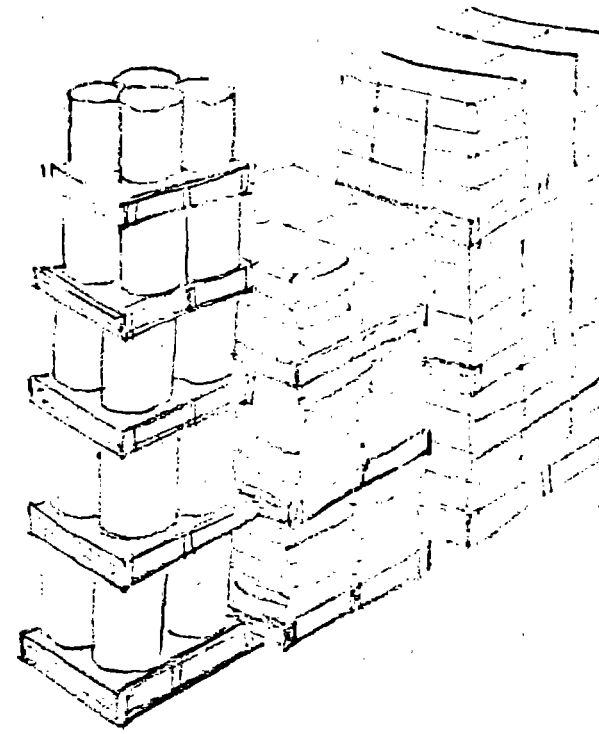
What do you conclude about the accident potential?

III-4 In a metal working plant you see 20 rusty drums in apparent disuse. A yellow plastic tape has been stretched around them. What do you think might be the accident potential? List the possibilities you see.

III-5 Questionable Piling or Stacking

In a food processing plant warehouse you observe:

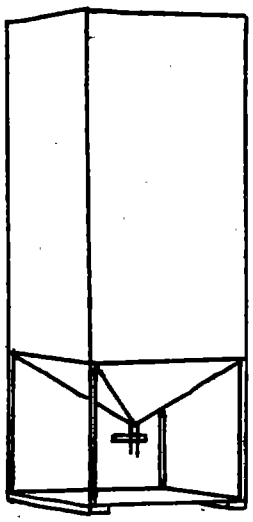
Bage of starch and powdered sugar on pallets, stacked three pallets high;
Drums of vegetable oil on pallets, stacked five pallets high, three feet from ceiling joists;
Cartons of canned and packaged products on pallets, stacked three pallets high



III-6 In the warehouse described in problem 5, the aisles are 6-6' wide and palleted goods are in piles 25' wide. Ford truck traffic is heavy. Damaged packages are observed at intersections of aisles. How does your assessment of accident potential change:

III-7 An agricultural chemical warehouse stores and ships daily hundreds of kraft paper bags filled with insecticides and other dry powders used by farmers. Some bags are on pallets but others are lined up on the floor. They are moved manually as well as by fork truck. What is the accident potential?

III-8 Large stainless steel portable bins, (see sketch), are filled with a fine powder and moved by fork truck either to a warehouse or into a truck trailer for shipment. What accident potentials do you see in operations with this this type of container?



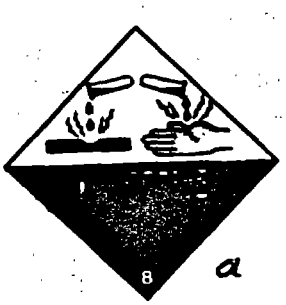
III-9 In a laboratory you see a number of red cans of about 5 gallons capacity, each being used for disposal of solvent used for extracting oil from a fibrous material. Some of the lids are propped open and you see screens inside with substantial amounts of fibre in them.

What accident potentials can you list?

III-10 A nursery has dug up a number of large trees and is preparing to deliver them to a customer and plant them. Root balls 6-8 feet in diameter must be handled carefully. What accident potential do you see due to this shape?

III-11 At a municipal water treatment plant you see a flat bed truck unloading some cylinders about 2 feet diameter and 7-8 feet long. You aren't close enough to read the markings. What are the accident potentials?

III-12 Identify the accident potential associated with each of the following symbols.



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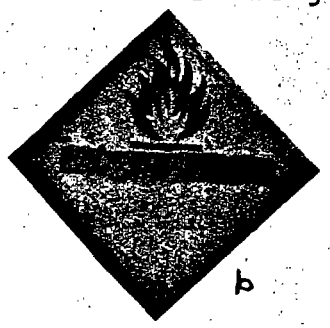
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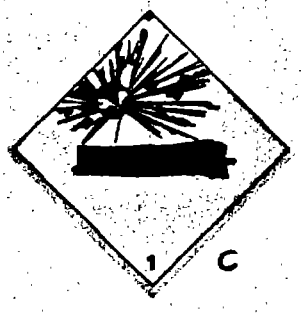

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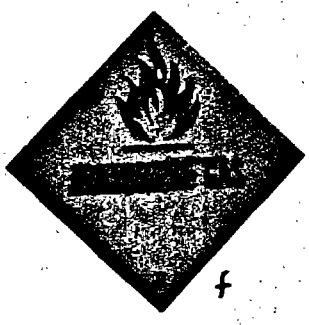
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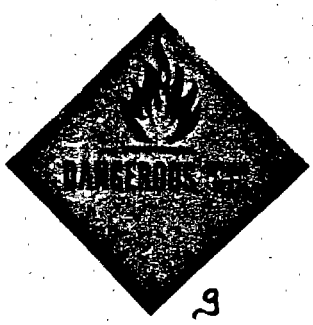
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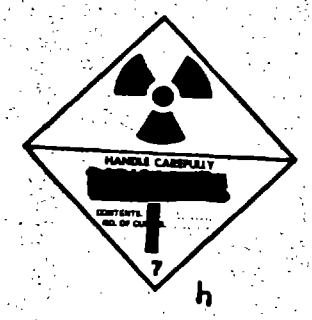

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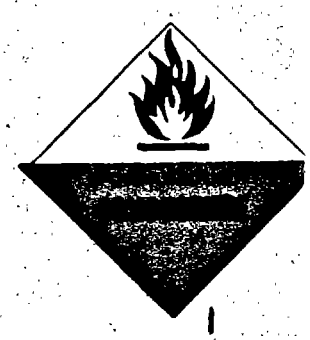
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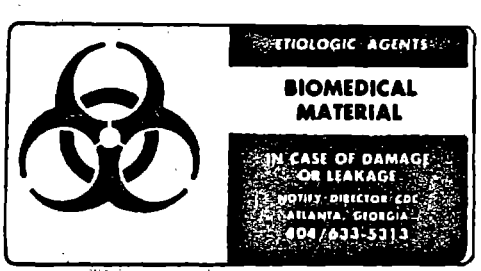

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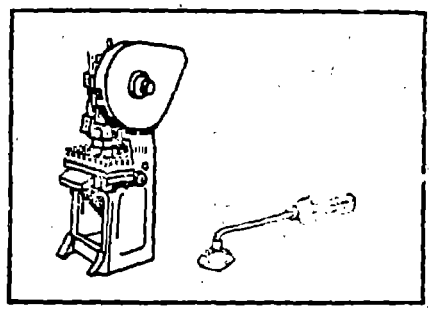
III-13 In a pharmaceutical packaging plant a large number of pipes are used for utilities and products. Most lines appear to be stainless steel or are painted white. One set of pipes is painted red. What accident potential do the red lines indicate to you?

III-14 In a storage shed at a steel mill you see a large number of drums and cans that have obviously been exposed to the weather. Labels and tags are obliterated, torn, or missing. What accident potential is created by this absence of identification?

III-15 You observe airline employees handing luggage up into the baggage compartment of a plane from the bed of a small transfer vehicle. Some bags are so large and heavy that much effort is obviously required. List the accident potentials of this operation.

III-16 A punch press is manually fed by means of a vacuum lifter. An interlocked guard also excludes hands or toolsfrom the dies when operating. Do these safeguards eliminate accident potential? Explain



III-17 Cases of soft drinks in cans move by conveyor belt from the filling machine to an automatic pallet stacker. Filled pallets are moved to storage by fork trucks. A pallet is filled every eight minutes. What accident potential do you see? If the soft drink is in bottles, how would this change your evaluation?

68. Abnormal amount of electrical equipment

OBSERVABLE COMPLEX BUS BARS

69. Voltage signs and barriers

SIGNS BARRIERS

70. Evidence of poor maintenance

TYPIFIED CLOSER LOOK COMMON SIGN

71. Sparking and arcing

SHORT CIRCUIT ARCING PROCESSING OPERATORS

REVIEW XI - Electrical Energy

Five clues

72. Sensation of heat

DELIBERATELY GENERATED ACCLIMATED STEAM PIPES

73. Existence of low temperature

EXPANDING GASES FACILITIES

74. Open flame

OPEN FLAMES BLOWS OUT

75. Heat evidence

SIGNS COMPOSITION

REVIEW XII - Thermal Energy

Five clues

76. High velocity motion

SMALLEST OBJECT CLUES OPERATIONS WIND MAN

77. Sharp and pointed objects

PENETRATION INDUSTRIAL EXPOSURES EFFECT SHAPE

78. Heavy objects

EXTREME WEIGHT MAN COMBINATIONS TYPES OF ENERGY

79. Personal irritation

MANY FORMS ODORS NOT ALL

80. Observable fumes, vapors and mists

EMISSION WHITE VAPORS NOT ALWAYS VISIBLE

81. Particle accumulation

82. Corrosion and deterioration

DAMAGING OBSERVABLE

REVIEW XIII - Chemical Energy

Four clues

83. Special storage and containers

NOT LIKELY CLUE

84. Unusual light

INFRARED ULTRAVIOLET LASERS MICROWAVES

85. Personal protective equipment

VARIED CYEMICAL MECHANICAL THERMAL RADIATION

86. Existence of machine guarding

MECHANICAL ELECTRICAL CHEMICAL RADIATION

87. Existence of ventilation

HEAT MECHANICAL CHEMICAL RADIATION

88. Energy absorbing materials

MATS EMBANKMENTS CEILING TILE BARRICADES CAGE

89. Operator location

RE,PTE:U COMBINATIONS

90. Operator reactions

PERSPIRATION JERK BREATHING RUBBING SUDDEN MOVEMENT

HEAR SHIVERING DROWSINESS PROTECT THEMSELVES CONSIDER

Ionizing Radiation

Non-Ionizing Radiation

Operating Provisions

QUESTIONS FOR DISCUSSION

IV ENERGY

VI-1 A large exhibit hall is filled with booths, lightly lighted and containing numerous pieces of operating equipment and displays. Based on your recollection of such an exhibition, discuss the accident potential represented by the use of electrical energy.

IV-2 A wire mesh cage surrounds a bank of transformers in the basement of a building. The door of the cage is locked, and a sign reads, DANGER-HIGH VOLTAGE--KEEP OUT. What are the accident potentials?

IV-3 You visit the control room for a process operation. Behind the panel board you see coats hanging on equipment, shoes and boots on the floor, tools and miscellaneous hardware lying around. A coffee maker and associated materials are not so neatly cared for. Discuss the accident potential indicated.

IV-4 On a hot afternoon you observe a large transformer is quite warm and tendrils of vapor are coming from a vent at the top. What is the accident potential?

IV-5 Large steam jacketed kettles are used in a food processing plant to cook various products. The temperature and humidity in the room are very high. What accident potential exists.

IV-6 A laboratory uses liquid nitrogen at - 1960 (-320F) in cooling baths. The liquid is withdrawn from a special 150 gallon tank into a 5 gallon thermos-type container for transfer into the laboratory. It is withdrawn from this portable container for use in the test equipment. What accident potential do you see?

IV-7 A large bakery bakes its bread in a gas fired continuous oven. You learn that the gas is supplied by a small distributing company and service failures are occasionally experienced. Discuss the accident potential.

IV-8 Paint is discolored and blistered on the wall and ceiling above an electrical ceramic kiln. Is there accident potential?

IV-9 Discuss the velocity effects of riding on a snowmobile.

IV-10 Discuss the accident potential involved in use of an ice pick, an office stapler, a nail.

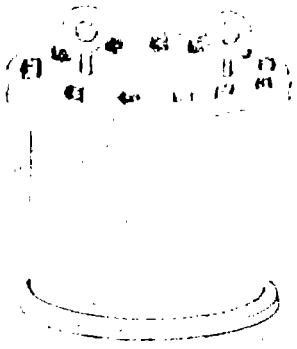
IV-11 In a railway yard trains are made up by starting freight cars down various stretches of track and allowing them to coast to the string of cars with which they are to be dispatched. Discuss the accident potential.

IV-12 You are well acquainted with the flare that burns at the top of a tall pipe in an oil refinery. One day you notice that there is no flame, but a white vapor is emitted. Is this accident potential? Discuss.

IV-13 Powdered coal is fed to the boilers of a power plant. In the room where crushers are operating you observe dust in the air rising from the crushers and also see accumulations on all horizontal surfaces, including structural steel members. Discuss the accident potential.

IV-14 In a chemical plant there are a number of reactors and other processing equipment at various levels in a large room. You notice a faint pungent odor and then observe severe rusting of structural steel, electric conduit, in strument cases and other steel. What accident potential does this indicate?

IV-15 During salvage operations following a freight terminal fire, a heavy steel container is discovered. Label- is obliberated. It can be lifted only by a crane or neavy fork lift. What accident potential do you see? What precautions would you take pending identification?



IV-16 A contractor installing accoustical tile in an office building is using an instrument to make straight lines across the ceiling. He tells you it is a laser. Despite his assurances that it it perfectly safe, what accident potential can you see.?

IV-17 What accident potential is suggested by each of the following?

a. Workman wearing aluminized cloth suit
b. Workman wearing thick gloves and leather apron
c. Workman wearing special inflated plastic suit

IV-18 (a) A pedestrian walkway over Interstate 70 at a school is completely screened on top as well as sides. What accident potentials are indicated?

(b) The technician doing your chest x-ray steps out of the room while the current to the machine is on. What accident potential motivates this?

IV-19 A large ceiling fan is situated immediately above a reactor in a chemical plant. What accident potential may it indicate?

IV-20 Guard rails and median barriers on major highways indicate what accident potential?

VI-21 In a laboratory where reactions are carried out at high pressure, the equipment is located in heavy concrete cubicals and is operated entirely from the outside. You see a man turning valve wheels attached to rods that project through the walls. Gages read 20,000 psi, and hr ondrtbrd yhr rquipment on a television screen. What is the accident potential?

IV-22 Air traffic control personnel complain of the severe pressure which often results in ulcers and other evidences of tension. What accident potential is indicated by these complaints?

I-1. Ans.
1. Pedestrian crossings at intersection
2. Cars leaving exployees parking lot
3. Cars leaving executive parking
4. Office building exit onto executive parking - crossing of street probable at this point
5. Executive parking borders on railroad siding
6. Switch can cause derailments
7. Railroad cars have close clearance alongside office
8. Railroad cars have close clearance alongside warehouse
9. Railroad crosses sidewalks
10. Railroad crosses Main St.
11. Cars leaving Maintenance Shop parking
12. Pedestrian crossing between Plant and Maintenance Shop
13. Exit from Maintenance Shop into parking area
14. Exit from Maintenance Shop onto Main St.
15. Trucks entering and leaving truck lot
16. Trucks maneuvering in truck lot
17. Tanks and building prevent seeing cross traffic before reaching intersection
18. Exit from Plant near rail crossing
19. Railroad cars can overrun end of sidings

I-2. Ans.
a. Grass fire could cause relief valve to discharge with ignition of released gas uncertain
b. Grass would hide anyone tampering with valves
c. Tractor cutting grass could strike and breach piping
d. Substantial leak could be undetected because obscured by grass

I-3. Ans.
a. Chamber of Commerce
b. Newspaper articles
c. Welfare agency
d. Social Service agencies
e. YMCA, etc.
f. Police
g. Fire Department
h. Shopkeepers in area
i. Personal observation
j. Inhabitants
k. Commercial and industrial establishments

I-4. Ans.
a. Employees can trip over concrete blocks
b. Pins used to fasten blocks can protrude and add to tripping potential
c. Manhole covers could be removed
d. Barricade at manhole obstructs auto movement
e. Manhole cover could be tilted and unstable
f. Employees could fall into trenches opened for repairs
g. Employees could drive car into trenches
h. Trenches filled with water might not be recognized as depressions

I-5. Ans. a. Skylights or greenhouses
b. Canvas or plastic covered areas
c. Roof of light gage aluminum, inadequately supported tar paper, or rusty steel
d. Open ventilation equipment
e. Employees without head protection

I-6. Ans. a. Observe for fall of particulate
b. Find out what equipment this stack serves
c. If a boiler, find out what fuel is used and what controls are in service
d. If a ventilation stack, find out what materials can get into the system
e. Sample and analize stack gases

I-7. Ans. a. Could reach bottom of ramp unawares and tip or spill the load
b. Could reach top of ramp unawares and not have opportunity to turn around and back down
c. Could run off side of ramp
d. Could fail to climb ramp with load
e. Could skid on ramp especially if wet or oily
f. Could fail to see depression or obstruction in ramp surface
g. Could fail to see pedestrian on ramp
h. If ramp is not permanently fixed, driver could fail to see that it is misplaced or even absent

I-8. Ans. Large Single Areas
a. Substantial distances to exits in case of emergency
b. Spill of ammonia or chlorine compound could not be closed off, could make entire area toxic
c. In case of fire, smoke and toxic gases would affect entire area, could not be confined
d. Seat of fire might be harder to locate
e. Fire in roof might be beyond reach of hoses
f. Snow loading on long roof spans could cause failure

Discussion Answers, Section I

I-14. Ans. a. Building may contain hazardous, possibly explosive materials
b. Building may house a hazardous operation
c. Building may house a noisy operation
d. Building may be entry to explosives storage inside mound
e. Building may house ultra sensitive instruments
f. Building may be on plot arbitrarily assigned by the engineering department. The intervening space is reserved for another large building

Questions to be asked-

a. What is in the building?
b. What is the building used for?
c. What is the purpose of the mound?
d. Is there anything in the mound or covered by it?
e. Is the building associated with the mound?
f. Why is the building isolated?

I-15. Ans. a. Spheres may contain liquified petroleum gas--extremely flammable
b. Spheres may contain liquified ammonia--toxic and moderately flammable
c. Spheres may contain liquid chlorine--toxic and an oxidizing agent (increases burning rate)
d. Pressure in spheres probably does not exceed 50 psi--storage temperature is reduced to keep pressure down
e. Spheres may be empty

I-16. Ans. a. Tankage for oil will be required. Installation must be protected from vehicular traffic, fire exposure, pilferage, loss of contents, water pollution, etc.
b. Oil lines to burner may constitute tripping potential
c. Steam to atomize and heat oil can cause burns
d. Industrial oil burners are often noisy
e. Flame-out safety devices designed for gas may not function well with oil burner
f. Oil combustion may leave a toxic vanadium oxide deposit in combustion chamber

I-17. Ans. a. Would know design load for structure, floor, etc.
b. Could identify lines and services into structure
c. Would have date of construction
d. Would have certification of architect or designer
e. Would know materials of construction
f. Would know special provisions for materials or operations
g. Would know capacities of ventilating fans
h. Would know design of electrical service
i. Would know design of sprinkler system and fire water supply

I-16. Ans. a. Purpose is to prevent spread of the upper walls. The rods extend all the way across the building.
b. They were used because the walls were showing signs of spreading due to aging, overloading, foundation inadequacy, or combinations of these and other factors

I-17. Ans. a. Punch press shop is more likely to have tripping and slipping potentials
b. Punch press shop is much more likely to have collisions of trucks and people
c. Punch press shop is probably more subject to fire
d. Fire would be more difficult to fight
e. Improvisation more likely because correct tool or device cannot be found
f. Shortcuts more likely with resultant accidents

Discussion Answers, Section II

II-1. Ans.
a. Point of drill bit could cut exposed person
b. Clothing, hair, etc. can get caught and pulled in
c. Chips can fly from drill
d. Oil, if used, will fly from drill
e. Work piece can turn if not adequately clamped
f. Torque is transmitted to drill handle if bit binds
g. Drill can become hot enough to cause burns
h. Drill bit can snap, throwing broken pieces
i. Torque of drill can produce instability of person if working on a ladder or other elevated surface
j. Key left in chuck can fly
k. Motor becomes hot with prolonged use

II-2. Ans.
a. Ball can strike person working in building
b. Ball can strike person on ground at middle of swing
c. Ball can strike person on back swing
d. If cable breaks, ball can strike people anywhere
e. Glancing blow can cause eratic behavior of ball
f. Ball can strike crane, possibly causing collapse of boom
g. Momentum of ball could overturn crane

II-3. Ans.
a. Could cut own hand with knife
b. Could cut own hand with saw
c. Saw blade could break, resulting in injury
d. Might store knife and saw improperly
e. Untrained person might use the tools improperly

II-4. Ans. Normal operation
a. Operator could put hands into die area
b. Trimmings can fly and injure
c. Trimmings can cut
d. Operator may bypass safety devices to increase production

During setup
a. Mechanic may fail to block press open and lock out
b. Press may be operated unintentionally during work on dies
c. Dies are heavy, could cause injury if dropped
d. Limited work space can create "knuckle busters"

During Maintenance
a. Mechanic may fail to lock out and block press open
b. Press may be operated unintentionally while hands are in danger area
c. Mechanic may deliberately bypass safety devices to make necessary adjustments; may fail to remove bypass
d. Mechanic may attempt to lubricate or adjust while machine is operating
e. Mechanic removes guards to gain access, may fail to replace

II-5. Ans. During operation
a. Agitator is more likely to be started and stopped at just the correct time.
b. Corrective action can be taken more quickly
c. Unusual noise or other indication of malfunction can be dealt with rapidly

During charging
a. Can be shut down fast if something goes wrong
b. Can be started up by operator required to operate valves, take readings, or add materials at hatch
c. More likely to be operated in proper sequence in startup
d. Operator may need to observe effects of agitation

During cleaning
a. Operator can avoid splashing by turning on agitator after blade is covered with liquid
b. Agitator can be rotated during hosing of interior of vessel
c. Shaft and blade can be observed for alignment and integrity

During vessel entry
a. Lockout of switch is more likely if switch is near point of entry
b. Lockout can be conveniently checked and tested

II-6. Ans. Inadvertant or unauthorized closing of a switch could:
a. Cause an electrocution by contact with live wire
b. Cause fingers to get caught in gears, chains and sprockets, or belts and pulleys
c. Cause crushing in rolls
d. Cause lacerations by cutting actions, etc.

II-7. Ans. a. Fault in drill service cord or extension could cause electric shock
b. Fault in drill case could cause electric shock
c. Drilling into an electric service line would cause se[illegible]ectric shock
d. U[illegible]d be cut by tip [illegible]rill bit
e. U[illegible]d be burned by [illegible]d tip of drill bit

Discussion Answers, Section II

II-9. Ans. a. Store device carefully-out of the reach of children
b. Store charges separately- out of the reach of children
c. Do not load until ready to use
d. Think carefully who or what is on the far side of the surface. Sometimes projectiles can go on through the surface intended
e. Read manufacturers instructions completely and carefully
f. Hold device firmly and square on the surface
g. Wear quality eye protection when using device
h. Use proper fastener and charge for the job to be done

II-7. Ans. a. Caustic soda solution is very destructive to the skin and especially harmful to the eyes
b. The surface tension of 20% caustic is so low that leakage is probable
c. Caustic soda seriously weakens glass
d. Caustic soda at 20% concentration is destructive to steel
e. Vertical level glass may be weakened and may be subject to mechanical damage
f. Valves may need frequent maintenance due to corrosion
g. Pump parts, especially packing glands, may need frequent repair
h. Rotameter is subject to caustic soda
i. Rotameter is subject to pump pressure and clamping tension
j. Safety shower and eye wash are required by OSHA

II-10. Ans. a. Corrosion of the tank could have weakened it below its rated pressure
b. The control device may fail to shut the compressor down
c. The relief device may not be big enough to discharge as much as the compressor puts in
d. The relief device may not function at the set pressure
e. The relief connection may be plugged
f. The system may be involved in a fire when the pressure is maximum

II-11. Ans. a. Overloading of trucks
b. Stability of load
c. Manipulations at extreme height
d. Traffic patterns
e. Aisleways, adequacy for loading, unloading, passing
f. Collision potential at corners
g. Pedestrian problems
h. Negotiation of slopes
i. Tail end support of trailer
j. Dockboard use
k. Lights and other markings on trucks
l. Fueling of truck
m. Maintenance of truck

Discussion Answers, Section II

II-15. Ans. ~~a. Hydrogen~~
~~b. Butadiene~~
c. Ethylene oxide
d. ~~Propylene oxide~~
e. ~~Manufactured gas containing more than 30% hydrogen by volume.~~

II-13. Ans. a. Draftsman probably has information on design rating of the vessel. He may have a tracing of the identification plate
b. Inquire the normal operating pressure
c. Inquire the normal operating temperature
d. Determine whether the gauge is on the reactor interior or the steam jacket
e. Inquire what reactions are carried out in the vessel
f. Get an evaluation of the reaction rates for normal operation
g. Get an evaluation of reaction rates with foreseeable abnormal or incorrect operation
h. Determine the size and rating of the relief device
i. Trace the discharge piping from the relief
j. Review the instrumentation and controls on the reactor

II-14. Ans. a. May remove guard to get faster rate
b. Irregularity such as a knot could cause piece to bind or kick back
c. Distraction could cause him to place hands too close to the blade

II-15. Ans. a. Overhead work is extra tiring to arms and neck
b. Vision is limited because of upward angle of sight
c. Employee can trip or slip on things underfoot since his vision is directed upward
d. Might not be observed if disabled or asphyxiated
e. Egress might be difficult in case of fire

II-16. Ans. a. Can cause pain and distress in hands, arms, shoulders, and back
b. Can cause temporary loss of sensitivity to touch in fingers and hands
c. Can result in excessive fatigue
d. Can cause temporary loss of visual accuity
e. Fingers and hands can be caught in pinch points
f. Flying fragments can strike operator and others--especially harmful to eyes

II-16. Ans.
a. Noise level is probably over 90 dBA
b. Can result in temporary threshold shift of hearing ability
c. Continued exposure can result in permanent hearing loss
d. Oral communications may be inadequate in high noise
e. Sign language may be misunderstood
f. Personnel may not hear warnings such as fork truck horn or fire alarm
g. Increased tension may result in physical and nervous disorders

II-17. Ans.
a. Can be burned by touching hot surface
b. Feet may get hot if thin soles are worn
c. Body temperature may be elevated if exposure is extended
d. Heat stroke or heat exhaustion may result
e. Perspiration may interfere with vision
f. May not wear necessary respiratory protection because of heat
g. Could ignite clothing from arc or flame if overcome by heat

II-18. Ans.
a. Entry in violation of orders is almost certain
b. Emergencies will seem to justify entry and exposure
c. Such rooms are often used for storage, thus promoting unauthorized entry

II-19. Ans.
a. Insulation deteriorates on aging
b. High current causes heating and sag
c. Contact by personnel possible from walkways
d. Contact with grounded objects can cause shorts which result in fires
e. Short could cause power failure to instruments or vital mixing equipment and a runaway chemical reaction could occur

II-20. Ans.
a. Could lead to slips and falls
b. Sharp objects could penetrate shoes
c. Combustibles among debris may be ignited
d. Irritant materials such as fluxes could be contacted
e. Dermatitis could be promoted by dirty conditions
f. Poor housekeeping can indicate lax supervision and high accident potential in general

II-27. Ans. a. Excessively heavy loads may be carried
b. Forks designed for bulky but not heavy loads are being improperly used
c. Load may be carried too far forward
d. Could cause tendency to tip truck forward
e. Forks could bend farther or fracture with a load
f. Truck cannot be properly operated with bent forks

II-28. Ans. a. Elevator may not have preventive maintenance
b. Elevator may not have regular inspections
c. Undetected faults could cause catestrophic failure
d. Undetected faults could cause failures resulting in entrapment, injury, etc.
e. Failures can result in exposure of personnel to falls during rescue
f. Undetected or unrepaired faults could cause a fire
g. Failure of interlocks can cause injuries
h. Inaccurate leveling of elevator floor can cause loads to fall off of trucks and can cause personnel to trip

Answers to Discussion Questions, Section III

III-1. Ans.
a. Large glass areas
b. Stairs
c. Elevator
d. Overhead cranes
e. Strong illumination
f. Automatic sprinklers

III-2. Ans.
a. Are flammable materials used here?
b. Why was explosion-proof equipment installed?
c. Is the refrigerator posted "NO FLAMMABLES"?
d. Is a "Hot Work" Permit required to operate a drill in this area?

III-3. Ans.
a. Lead tetraethyl is toxic
b. There is possible exposure to TEL
c. Special training and procedures are required
d. Special protective equipment is required

III-4. Ans.
a. The contents may be flammable, toxic, or corrosive
b. The drums may have become weakened and difficult to handle
c. Special disposal procedures may be needed
d. The contents may have high value
e. The records on contents may be lost

III-5. Ans.
a. Upper pallets might topple off of bags
b. Drum stacks are higher than desired
c. Drums stacked too close to ceiling
d. Drums may interfere with automatic sprinklers
e. Punctured oil drum could make floor slippery

III-6. Ans.
a. Narrow aisles make fork truck operation difficult
b. Damaged packages produce spillage and possible sticky floor
c. Collisions between fork trucks possible
d. Walking in narrow aisles hazardous

III-9. Ans.
a. Toxic material on outside of bags may be absorbed through the skin on handling
b. Wet conditions may weaken bags causing spillage
c. Fork truck may puncture bags by careless driving
d. Filling spout may leak if not properly tucked in
e. Bags may slip from grasp of laborers when being picked up or carried

III-8. Ans. a. Filled container may exceed weight rating of fork truck
b. Container is top heavy when filled
c. Dust on surface may fall on operation
d. Improper manipulation could open ball valve on bottom of bin
e. Size of bin obscures vision of fork truck operator
f. Height of bin may not clear some overhead structures
g. Weight may cause semi trailer to tip if rear end is not supported

III-9. Ans. a. Solvent is a flammable liquid in a safety can
b. Open lids permit spread of flammable and/or toxic vapors
c. Open lids negates principal function of safety can
d. Personnel do not understand safe handling of flammables

III-10. Ans. a. Could be difficult to get sufficient support under ball for lifting
b. Could rotate out of sling during lift
c. Inadequate capacity lifting device might be tried. Ball weighs about a ton.
d. Inadequate capacity ropes or cables might be used
e. Load could swing or rotate during lifting
f. Truck could be overloaded
g. Tree might strike overhead structures en route to customer
h. Ball could crush person during unloading into prepared hole

III-11. Ans. a. Cylinders are probably chlorine, a toxic gas
b. Cylinders could fall during unloading, causing injury
c. Fall could result in sheared valve and loss of contents
d. Improvised sling might be used--could slip or fail
e. Proper sling might be improperly used
f. Fire could result from spill since chlorine is a strong oxidizing agent

III-12. Ans. a. Corrosive (to skin or metals)
b. Flammable liquid
c. Explosive
d. Flammable solid
e. Oxidizing agent
f. Flammable gas
g. Do not apply water in emergency
h. Radioactive
i. Compressed gas, non flammable
j. Magnetized material
k. Poison (toxic) gas
l. Spontaneously combustible
m. Possible infectious bacteria or serum
n. Poison (toxic)
o. Organic peroxide (very rapid burning)

III-13. Ans. a. Red is used for fire protection lines such as sprinkler system or carbon dioxide system. Indicates a fire potential.

III-14. Ans. a. Contents could be highly flammable
b. " " " pyrophoric
c. " " " an oxidizing agent
d. " " " unstable
e. " " generate pressure on storage
f. " " react with other materials stored
g. " " be toxic
h. " " " corrosive to the skin
i. " " contaminate air or water
j. Disposal of contents could be hazardous

III-15. Ans. a. Could induce back strain or other strain
b. Could drop pieces on a foot or leg
c. Could smash a finger
d. Could cut hand or finger
e. Could slip and fall off of truck
f. Truck might be moved while men are working
g. Plane might move while men are working

III-16. Ans. a. Vacuum lifter may not always be used
b. Interlock can be by-passed
c. When changing dies, hands are in the danger zone
d. During maintenance, press could operate if not locked out or blocked open

III-17. Ans. a. Cases might back up if fork truck is delayed
b. Fork truck operator might take chances in driving if he is delayed
c. Man attempting to straighten cases on pallet could get caught and suffer hand injury
d. Cases might fall off of conveyor
e. Bottles could break, causing cuts to personnel
f. Glass on floor would be hazardous
g. Liquid spilled on floor would be slippery

Answers to Discussion Questions, Section IV

IV-1.
a. Excessive use of extension cords
b. Faulty extension cords and connections
c. Overloading of circuits
d. Faults in displays

IV-2.
a. Unauthorized entry if door is unlocked
b. Storage of materials within cage
c. Inadequate precautions by authorized electricians
d. Working on equipment without power off
e. Failure to lock out
f. Emergency entry in case of fire
g. Rescue attempt if person is electrocuted

IV-3.
a. Possibility of causing malfunction of exposed equipment
b. Possible fire behind panel board
c. Possible electrical short
d. Possible interference with cooling
e. Use of water in area could cause problems
f. Indicates poor supervisor attitude

IV-4.
a. Failure of transformer
b. Fire involving insulation and oil
c. Electrocution of repairmen
d. Electrocution of firemen

IV-5.
a. Burns by contacting kettle or contents
b. Steam burns
c. Heat exhaustion or heat stroke
d. Slipping hazard, water and foodstuffs on floor

IV-6.
a. Freezing of tissues upon contact with liquid nitrogen
b. Rapid pressure buildup if vents are plugged
c. Oxygen deficiency if large amount is spilled
d. Materials are brittle at low temperatures
e. Can cause ice formation and slippery conditions

IV-7.
a. Burns from flame
b. Burns from hot pans and other parts
c. Ignition of materials by flame and hot surfaces
d. Consumption of oxygen in the room
e. Carbon monoxide release from faulty flue
f. Accumulation of gas after flame-out
g. Asphyxiation by gas after flame-out
h. Explosion of gas after flame-out

Answers to Discussion Questions, Section IV

IV-8.
a. Continued heating could ignite paint
b. Damaged paint may indicate improper operation
c. Other materials in the area could be ignited
d. Electric service may be overloaded
e. Temperature control mechanism of furnace may not be operating properly
f. Combustibles may sometimes be put in kiln

IV-9.
a. Running into obstruction
b. Striking low branch or briar
c. Running under a barbed wire fence
d. Rolling off on sharp turn
e. Falling off on sudden start
f. Falling off on sharp drop or bump
g. Running over cliff
h. Running into stream

IV-10.
Ice Pick
a. Could strike hand when cutting ice
b. Could strike something or someone when carrying
c. Children might play with it
d. Could be weapon in a fight

Stapler
a. Staples can fly and penetrate if improperly used
b. Could drive staple into finger
c. Tendonitis can develop with long usage

Nail
a. Can be driven through into something else
b. Can fly if not struck squarely
c. Can be stepped on if nailed pieces are left lying
d. Can cause flat tires

IV-11.
a. Too much energy may be applied
b. Someone may walk in front of the silent car
c. Derailment could occur
d. Contents may be broken or shifted by impact

IV-12.
a. A "pilot" flame should always burn
b. A sudden large release of flammable vapors, if not ignited at the top of the flare stack, could fall to the ground and ignite there
c. Relighting of the pilot flame can require working at great height
d. Relighting may be accompanied by a flash of accumulated gas and vapors

Answers to Discussion Questions, Section IV

IV-13. a. Possible lung damage to personnel
b. Possible dust explosion hazard
c. Poor housekeeping may indicate laxity in other aspects of safety

IV-14. a. Weakening of structural steel could cause sag of process equipment
b. Pipes could corrode and spray contents
c. Electrical equipment can develop faults due to corrosion
d. Control of reactions could be lost due to instrument corrosion
e. Bonding lines can corrode out, resulting in fire or explosion of flammables
f. Possible respiratory effects of acid gases in air

IV-15. a. Possibly a radiation source, if so--
b. Lead shielding inside may have melted
c. Flange bolts and eye bolts could have been weakened in the fire
d. Heavy load difficult to handle
e. Area must be roped off until radiation readings are taken

IV-16. a. Eye damage by looking into beam
b. Eye damage from reflected beam
c. Skin burn from beam
d. Ignition of clothing or building materials from careless use

IV-17. a. Aluminized cloth reflects radiant heat
b. Thick gloves indicate he is handling hot objects; Leather apron protects clothing from burns
c. Inflated suit is most often used for manipulation with radioisotopes

IV-18. (a) a. Child climbing side fence and falling onto highway
b. Child throwing articles from walkway onto highway

IV-18. (b) a. Repeated X-rays daily can build up scatter radiation exposure to a harmful level

Answers to Discussion Questions, Section IV

IV-19. a. Excess heat needs to be removed
b. Steam should be removed for visibility
c. Contamination of other areas must be avoided

IV-20. a. Sleepy or inattentive driver may drift off of road
b. Accident may send cars out of control
(1) off the road into drop-off
(2) into oncoming traffic
c. Heart attack could cause a "wild car"
d. Fear of drop-off could cause timid person to drive in center of the road. Guard rail has psychological effect

IV-21. a. Apparatus could fail under pressure
b. Overpressure could cause catastrophic failure of apparatus
c. Release of contents is possible
d. Flash fire could result from release
e. High pressure tubing could whip after failure

IV-22. a. Crash due to improper response
b. Excessive stack-up problems due to slow-down

Quiz on SECTION I

1. Visualize a platform 30 feet above ground with railings and toe boards which meet standards. What accident potentials still exist?

2. Visualize a 20 story office building. What accident potentials attributable to high rise structures do you think applicable?

3. Why would a parked semi-trailer used for storage of paper products have more accident potential than a wood frame two-car garage used for the same purpose?

4. What maintenance deficiencies might be clues to potential major fire in a -
   a. Furniture plant
   b. Flour mill
   c. Library
   d. Motor freight terminal
   e. Fur storage and cleaning plant
   f. Surgery
   g. Plastics extrusion plant

5. List 12 clues to accident potential associated with Site and Structures.

Quiz on SECTION II

1. A large air compressor in a service station is driven by a 2 HP electric motor. Describe the accident potentials associated with the triple V-belt drive.

2. An air operated portable 3" diameter grinding wheel is used for beveling the ends of 12" pipe. What accident potential do you see?

3. An old chain hoist is to be slung from the joist of a home garage for lifting an automobile engine. What accident potentials do you see relative to the installation of the hoist and its planned use?

4. A 63-year-old night watchman must pass through areas of high intensity illumination (fine parts assembly) as well as poorly lighted store rooms and outdoor areas. Consider the accident potential of his job.

5. List 20 clues to accident potential associated with Mechanical Action.

Quiz on SECTION III

1. In a furniture plant you observe a concrete block walled room with a door labelled FLAMMABLE. Outside the room you see four red cylinders attached to a piping system. What accident potential might be deduced?

2. When you visit a large paper mill you see a dozen tanks 18 to 20 feet in diameter and about the same height. No markings on the tanks give clues as to contents. What accident potential do you see?

   A tank truck driver preparing to unload in this area is wearing a rubber suit and face shield. How does this alter your conclusions?

3. List as many words, posted or used on labels, as you can think of that connote accident potential to you. Take only five minutes for this exercise.

4. A crane with an electromagnet is used to lift steel plates, forgings, miscellaneous parts, and scrap. What accident potential do you see?

5. List 15 clues to accident potential associated with Materials and Storage.

FINAL EXAMINATION

1. List accident potentials associated with locating all plant utility lines:
   (a) Above ground
   (b) Below ground
   (c) In a tunnel

2. The steel support structure and working platform above a chlorine metering apparatus is shedding large pieces of rust. What are the accident potentials?

3. List the four major categories of clues to accident potential.

4. A punch press is equipped with two switches requiring one hand on each for operation. An operator tapes one switch closed. What accident potential has he introduced?

5. A mechanic often must replace a 60 pound bearing well above his head. No lifting equipment is available. Discuss the accident potential.

6. You observe about 50 drums lined up in two rows along the outside wall of a building where a number of punch presses are operating. Some drums are standing on end, some lying down. Most are quite rusty, but a few seem to be new. The ground they are on has some crushed stone and slopes to a sewer outlet.

   What accident potential do you see?
   What questions come to mind?

7. Men unloading a truck are required to carry 100-pound bags of potatoes up a short ramp and place them in criss-cross pattern on pallets. List the accident potentials you see in this operation.
   What would be added if work continued in the rain?
   What if it is snowing?

8. In a shop where fire engines are manufactured a great deal of electric welding is used to assemble the custom body structures. Blue flashes and grey fumes are constantly seen. List the accident potentials.

9. An aircraft jet engine is being operated at full power on a test stand in a maintenance shop. What accident potential is possible?

10. You enter a room where several large compressors are operating and the odor of ammonia is strong. Your eyes water and your nose and throat are irritated. What is the accident potential here?

Suggested Answers to Quiz on Section I

1. a. Employee could lean far enough over railing to lose balance and fall
   b. Employee could stand on railing to reach overhead object and fall over
   c. Employee might climb over railing and fall
   d. Object on top of toolbox or other surface could be knocked over toeboard
   e. Railing and toeboard might be removed to hoist up some heavy object
   f. Employee can fall at ladder or stairs
   g. Openings in platform may not be guarded

2. a. Escape via stairs would take time
   b. Fire or smoke could travel via elevator shafts and possibly stairs, pipe shafts, ventilating shafts, etc.
   c. Falls on stairs possible
   d. Falls while cleaning windows possible
   e. Materials could fall from windows
   f. Rescue via extension ladder to windows possible only for lower half of building

3. a. Floor of trailer is approximately 4 feet above ground
   b. Front end would be dark
   c. Material for storage must be lifted into and out of trailer
   d. Manual handling of stored material is probably required
   e. Might be moved by mistake while a man is working inside
   f. Makeshift lighting might be used
   g. Heating, if any, would be make-shift

4. a. Improper disposal of paint rags in furniture factory
   Inconsistent disposal of scrap, sawdust, shavings, etc.
   Deficient electrical services and maintenance
   b. Accumulation of dust on rafters, etc., in flour mill
   Inadequate electrical maintenance
   Failure to service heating equipment
   c. Careless smoking in the library
   Electrical equipment not properly maintained
   Substantial amount of trash generated
   d. Motor freight terminal handles many hazardous substance
   Inadequate knowledge of how to handle spills
   Extinguishers and sprinklers may not be inspected regularly
   e. Fur cleaning may involve solvents or waxes subject to ignition or spontaneous combustion
   Friction can be generated when handling furs
   f. Anesthetics are the principal fire potential in a surgery
   Grounding wires and equipment must be well maintained
   Grounding must be tested frequently
   Minimum accumulation of combustibles can be tolerated
   Covered, step-on type cans must be used
   g. Plastic extrusion plants generate substantial scrap which must be regularly disposed of
   Plastic dust is susceptible to dust explosions
   Heat used in softening plastics could approach the ignition temperature

Suggested Answers to Quiz on Section II

1. a. Compressor may have no belt guard
   b. Belt guard may have been removed
   c. Belt guard may be inadequate or improperly installed
   d. Belt guard may have openings large enough for fingers to be inserted
   e. Compressor may be in a location where children could be exposed
   f. Compressor could start up while a belt is being replaced

2. a. Overspeed of air motor could cause grinding wheel to fly apart
   b. Fault in grinding wheel could cause failure
   c. Wheel touching a person would cause injury
   d. Grinder laid down before wheel stops could cause unpredictable movement
   e. Severe noise problem could exist
   f. Air leakage at high pressure could result in air bubbles in the bloodstream
   g. Newly ground steel surface is sharp

3. a. Hoist is heavy to lift up to the joist
   b. Rating of the hoist may not be adequate
   c. Condition of hoist may have decreased its capacity
   d. Joist may not be strong enough to support load
   e. Sling over joist may not be strong enough
   f. Sling may be improperly placed
   g. Attachment to engine may not be secure

4. a. Older man accommodates more slowly to changes in light intensity
   b. Bright lights may temporarily blind him
   c. Going into dim lighting he may be unable to see
   d. Can stumble and fall due to lack of vision
   e. Intruder can hide in dark areas
   f. Watchman can be struck by vehicle in dark area, may be blinded by headlights
   g. Might fail to see smoke or other evidence of fire

Suggested Answers to Quiz on Section III

1.
   a. Red cylinders are an automatic fire extinguishing system
   b. Flammable liquids, solvents, and thinners are probably stored here
   c. Trained personnel only should dispense flammables
   d. Room should be well ventilated
   e. OSHA regulations require a 4" curb across door

2. a. Contents of tanks can be flammable, toxic, corrosive or a combination of hazards
   b. Errors could be made in making transfers
   c. Errors can be made in receiving deliveries
   d. Protective clothing indicates truck cargo is corrosive. Fortunately, he knows its hazard.
   e. Safety Shower and water hose must be available to unloading site

3. a. Flammable
   b. Corrosive
   c. Acid
   d. Toxic
   e. Poison
   f. Radioactive
   g. Magnetic
   h. Etiologic agent
   i. Flammable compressed gas
   j. Non flammable compressed gas
   k. Dangerous
   l. Liquified petroleum gas
   m. Propane
   n. Gasoline
   o. Combustible
   p. Oxidizers
   q. Organic peroxide
   r. Explosive
   s. Liquid hydrogen
   t. Liquid oxygen
   u. Liquid nitrogen
   v. Ammonia
   w. Keep out
   x. Keep away
   y. Keep back 500 feet
   z. Danger

4. a. Electocution due to contact with poorly insulated wiring
   b. Faulty wiring could cause current interruption and load would drop unexpectedly
   c. Pieces without adequate contact tend to fall off
   d. Load varies greatly with overload possible
   e. Magnet could swing into structure or personnel

Suggested Answers to EXAM Questions

1. a. Above ground

Electric lines could fall and cause electrocution or fire
Men working on lines can fall to ground
Break in pipe line can spray material on personnel
Supports and lines can be subject to fire exposure

b. Below ground

Breaks not immediately detected
Cave in of trench when installing or servicing
Gas can collect in trench
For electrical work wet conditions of soil increases possibility of shock
Limited space for working

c. In a tunnel

Space for working may be limited
Gas or vapor can collect in tunnel
Heat and humidity can be high
Entry permit system should be used
Men working alone would not be observed if injured
Water line break could short out electric and communications lines

2. a. Chlorine is probably causing rapid corrosion of steel
   b. Weakening of steel could cause equipment to sag or fall
   c. Movement of equipment could break pipe connections with loss of materials
   d. Personnel could be caught under a sudden collapse
   e. Chlorine level in atmosphere may exceed the TLV
   f. Allowing such a condition to advance this far indicates poor management--probably poor safety performance
   g. Corrosion may cause electrical faults or malfunctions
   h. Corrosion could affect instrument readings leading to excessive temperature, pressure, etc.

3. I. Site and Structures
   II. Mechanical Action
   III. Materials and Storage
   IV. Energy

Suggested Answers to EXAM Questions

4. a. One hand is now free to be mutilated by press
   b. Malfunction of other switch could cause press to recycle
   c. Operator who does this will take other dangerous short cuts
   d. Supervisor who permits this will condone other unsafe conditions

5. a. Muscular strain could be induced
   b. Back problem could result
   c. Could drop bearing on toes on other parts
   d. Could mash fingers as bearing approaches location
   e. Could slip or trip due to attention directed upward
   f. Could damage bearing causing it to fall

6. a. Ascertain contents of drums from supervisor
   b. Rusty drums could be leakers
   c. Leakage may be a pollutant
   d. Leakage could be flammable or toxic

7. a. Near limit for manual carrying--back strain potential
   b. Skill needed in loading onto back
   c. Very hard work could produce exhaustion
   d. In hot, humid weather heat exhaustion could result
   e. In rain, ramp would be slippery--could slip and fall
   f. In snow, ramp would be extremely slippery
   g. In snow vision might be obscured, causing misstep

8. a. Heavy electric service to welding machines
   b. Heavy cables to welders--tripping hazards
   c. Accidental arcing at joints or insulation faults
   d. Conjunctivitis from welder's arc
   e. Burns from hot metal
   f. Skids from pieces of welding rod on floor
   g. Inhalation of welding fumes
   h. Ozone toxicity

Suggested Answers to EXAM Questions

9. a. Imbalance of rotor could cause engine to fly apart
   b. Failure of rotor could cause disintegration
   c. Extremely high noise level can cause hearing loss
   d. Suction at intake can injure or kill
   e. High heat of exhaust
   f. High velocity of exhaust

10. a. Threshold limit value of ammonia is 20 parts per million
    Irritation level is about 400 parts per million
    Lethal concentration is 5,000-10,000 parts per million
    b. Chemical pneumonitis from extended overexposure
    c. Stumbling or falling because of obscured vision
    d. Injury due to panic