MONSANTO COMPANY
CENTRAL ENGINEERING DEPARTMENT
SAFETY & PROPERTY PROTECTION

Rev. 7/1/70

LOSS PREVENTION REVIEW CHECK LIST

DSW 333406

REFERENCE: EXHIBIT B, CED Procedure 602, Loss Prevention & Environmental Control Reviews

Form G-1425 - Copies available from Office Supplies Department St. Louis, General Offices

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LOSS PREVENTION REVIEW CHECK LIST

SECTION I - BOILER AND MACHINERY REVIEW CHECK LIST

A. Boilers

1. ASME Code constructed and stamped (Section I for 15 psi and above, Section IV for less than 15 psi).

2. Safety Valves

   a) Long and large vent lines supported.

   b) Vent line drain connection provided.

   c) First drum valve set to relieve at or below boiler design pressure.

   d) The last drum valve set to relieve at or below 103% of boiler design pressure.

   e) Superheater outlet safety valve set to relieve first in order to insure flow of steam (for cooling) through superheater.

3. Blow-off piping

   Use steel piping of next higher gauge than required for boiler pressure, avoid sharp radius ells, slope all lines and drain all low points in the lines.

4. Feedwater Piping

   The bypass around feedwater regulator should be accessible from the operating level and located where the drum level gauge glass can be seen.

5. Steam Outlet Piping

   a) Both non-return and header stop valves where two or more boilers discharge into the same piping system.

   b) A visible free blow and drain in piping between non-return and header stop valves.

   c) Condensate drain provisions for all section of piping.

   d) Adequate piping expansion flexibility and piping supports.

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Section I - Boiler & Machinery Review Check List

6. Drum Water Level

a) Provide both high and low water alarms.

b) Provide a single low water cut-off of gas or oil burners on attended boilers. (If drop or loss of plant steam pressure does not jeopardize process safety.)

c) Remote drum level gauge is independent of drum level controls.

d) Provide all fire-tube boilers and all unattended water tube boilers with two independent low water level switches interlocked with gas or oil burner safety shutoff valves.

7. Gas Burner Control and Piping - General

a) Plug cocks provided for manual shutoff service.

b) In-line strainer in gas line ahead of all regulating and safety shutoff valves.

c) Provide for stable gas pressure regulation at all loads. (This may require a small regulator in parallel with the full-sized regulator for startup or low fire service.)

d) Provide double safety shutoff and vent valve arrangement.

e) Provide automatic fuel-air ratio control.

f) Separate pressure regulation of pilot gas.

g) Safety control circuit DC, or 120V AC with the safety controls in the ungrounded circuit.

h) Insure positive, tamper-proof time period to provide minimum of 6 air changes in combustion chamber before light-off. Air flow rate during purge should be at least 25% of maximum fan capacity.

i) Controls provided to prevent burner firing rate from being reduced below minimum stable flame.

j) Controls or interlocks installed to prevent burner light-off when insufficient combustion air flow is present.

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Section I - Boiler & Machinery Review Check List

k) Interlock to assure low-fire burner light-off when light-off cycle is automatically programmed.

l) Monitoring of main burner flame for alarm and/or automatic burner shutoff in event of flame failure.

m) Shutdown interlocks on low burner gas pressure and low combustion air flow.

8. Additional gas burner controls and interlocks for unattended operation.

a) Automatic flame failure monitoring and shutdown interlocks.

b) Other interlocks for safety shutdown of burners.

1) High gas supply pressure.

2) Low boiler water (double switches).

c) Taper-proof programmed light-off sequence to purge, light and prove pilot, light and prove main flame.

d) Positioning type fuel-air ratio controls.

e) Consider a self-checking feature for flame scanner and flame scanner relay circuitry.

9. Oil Burner Controls and Piping - General

a) Oil line strainer.

b) Oil pressure control.

c) Heater for heavy oil.

d) Single safety shutoff valve.

e) Startup recirculating line (for heavy oil).

f) Positive fuel-air ratio control.

g) Low oil pressure and low combustion air flow shutdown interlocks.

h) Low oil temperature alarm or interlock (for heavy oil).

i) Low atomizing steam pressure alarm or interlock.

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j) Positive purge cycle and low fire start controls.

k) Interrupted pilot.

10. Additional oil burner controls and interlocks for unattended operation.

a) Automatic flame failure monitoring and shutdown interlocks.

b) Other interlocks for safety shutdown of burners are:

1) Low oil temperature - for heavy oils.

2) Low atomizing steam pressure.

3) Low boiler water - double switches.

c) Provide a tamper-proof programmed light-off sequence.

d) Use positioning fuel-air ratio controls.

B. Pressure Vessels

1. Unfired pressure vessels, ASME Code, Section VIII, Divisions 1 or 2, constructed and stamped.

2. In the state of Texas, unfired pressure vessels generating steam shall be ASME Code, Section I constructed and stamped.

3. Organic fluid vaporizers, ASME Code, Section I constructed and stamped.

4. Other fired pressure vessels not generating steam ASME Code Constructed and stamped. Review with S&PP Branch for Section I vs Section VIII jurisdiction.

C. Piping and Valves

1. Piping systems analyzed for stresses and movement due to thermal expansion.

2. Piping systems supported and guided.

3. Piping systems provided for anti-freezing protection, particularly cold water lines, instrument connections and lines in dead-end service such as piping at standby pumps.

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4. Do not install cast iron valves in piping subjected to strains or shock service.

5. Avoid nonrising stem valves wherever possible.

6. Use double block and bleed valves on emergency interconnections where possible cross-contamination is undesirable.

7. Provide for draining and trapping steam piping.

D. Machinery

1. Provide adequate piping supports and flexibility to keep forces on machinery due to thermal expansion of piping within acceptable limits.

2. Is there adequate separation of critical and operating speeds?

3. Check valves should be positive and fast acting to prevent reverse flow and reverse rotation of pumps, compressors and drivers.

4. Provide adequate service factors on speed changing gears in shock service.

5. Are there full-flow filters in lube-oil systems serving aluminum bearings?

6. Provide for draining and trapping steam turbine inlet and exhaust lines.

7. Provide separate visible-flow drain lines from all steam turbine drain points.

8. Driven machines must be capable of withstanding tripping speed of turbine drivers.

9. Use non-lubricated construction or non-flammable synthetic lubricants for air compressors with discharge pressures of greater than 75 psig to guard against explosion.

10. Make provisions for emergency lubrication of critical machinery during operation and during emergency shutdowns.

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Section I - Boiler & Machinery Review Check List

11. Make provisions for spare machines or critical spare parts for critical machines.

12. Provide vibration switches on interlock shutdown service for cooling tower fans.

13. Provide vibration monitoring and rotor axial movement monitoring of critical rotating machinery.

14. Is this a first-of-a-kind machine, with respect to speed and horsepower rating and other major design features?

    Obtain data on experiences of other users of similar machines. Avoid, if possible, the installation of an unproved machine for "testing and development" in a Monsanto plant.

15. Have the specifications for critical machinery and their lube oil systems been reviewed with Mechanical Specialists in the ET&S and S&PP branches of CED or in plants where this type of machinery is in service?

16. Provide dependable liquid knock-out facilities on the suction side of gas compressors and on waste process gas piping to boilers and fired heaters.

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SECTION II - ELECTRICAL SAFETY REVIEW CHECK LIST

A. What degree of power supply reliability is required for:

1. Instrumentation power?

   Is there any real need for the instrument power to be available on loss of plant power? What would be the difference in damage or downtime if the instrument power was lost at the same time as plant power for:

   a) One minute
   b) Ten minutes
   c) Two hours

2. Total unit power?

   What would be the damage and downtime for power outages of:

   a) One minute
   b) Ten minutes
   c) Two hours

3. Are there any individual power users that, if served continuous power, would reduce this damage and/or downtime?

B. Are there any special limits of power supply quality?

1. What would be the effect of a voltage variation 5% above or 5% below normal at motor control center bus?

2. What would be the effect of a 5% frequency variation high or low?

3. Are there any pieces of equipment proposed that may be damaged by over voltage peaks of 1½ times normal for 5 microseconds?

4. Are there any pieces of equipment proposed that would be seriously affected by a loss of voltage for 1/6 of one second?

C. What is the potential for expansion of the unit? How will it expand?

D. What is the planned operating cycle between plant turnarounds? The electrical portion of the job must be built so as not to be the limiting factor.

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Section II - Electrical Safety Review Check List

E. Do the electrical load blocks correspond to the process load blocks? One electrical fault should not affect more than one block of the process. No block of the process should be exposed to faults in more than one chain of electrical equipment.

F. The electrical system should be isolated physically from the process as much as possible, minimizing exposure to fire, corrosion and mechanical damage.

G. Installation should allow for maintenance during operation or at shutdown, depending on the operating cycles between turnarounds of the unit.

H. Equipment and material used in the design should be compatible with plant spares inventory as well as plant maintenance experience.

I. Review each alarm indicated on the flow sheet for importance and list it either A or B. A alarms are those announcing approaching catastrophe. B alarms are for operating convenience.

Different techniques are applied to the two by the design group but the importance should be established in the safety review.

J. Pilot lights should be reviewed as the alarms were. They too fall into two groups: (1) those whose failure to function properly may cause injury to people or major loss of money, and (2) those that are pure operating convenience.

In this consideration, it is important to be sure that the listed condition for indication is the critical variable, rather than a dependent variable.

K. Interlocks fall into three levels of importance. Each interlock should be judged against the following criteria and given a rating:

1. Safety Interlock - A safety interlock is one whose failure to operate would be likely to cause a major injury to people and/or a major dollar loss.

2. Interlock - An interlock is an arrangement of equipment to insure that certain specific conditions exist before an action can be taken or for action to continue. The failure of this interlock may cause an inconvenience and may cost money for repairs and cleanup.

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Section II - Electrical Safety Review Check List

3. Sequence Control - These interlocks insure that the process is following a prescribed sequence or one causing a specific sequence to be followed. The failure of this interlock would stop the sequence and be an inconvenience. If the stoppage in some particular point in the sequence is critical, it may be backed up by a higher level of interlock.

L. The electrical system should be simple in schematic and physical layout so that it can be operated in a straight forward manner. (This minimizes human error in switching for isolation load transfer.)

M. The electrical system should be instrumented so that equipment operation can be monitored. The objective being to eliminate downtime due to equipment failures caused by unknown overloading.

N. Overload and short circuit protective devices shall be provided.

1. These should be located in circuits for optimum isolation of faults.

2. Give the interrupting capacity.

3. Describe the coordination between the two.

4. Instruction must be furnished for field testing on installation and for later during life of equipment.

O. Bonding and grounding should be provided to:

1. Protect against static buildup.

2. Provide lightning protection.

3. Provide for personnel protection from power system faults.

P. Tankage grounding should be coordinated with cathodic protection.

Q. Review the accessibility during mishaps of power disconnects, starters, etc.

R. Describe the plant communication system (telephones, radios, signals, alarms and etc.)

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Section II - Electrical Safety Review Check List

S. Provisions must be made to dissipate static electricity. (See Monsanto Standards E.2.)

T. Structural steel must be grounded in accordance with Monsanto Standards. E.2.

U. Where sequence controllers are used, there should be an automatic check, together with alarms, at key steps after the controller has called for a change. There should also be a check together with alarms at key steps before the next sequence changes.

V. Review the effects of extremes of atmospheric humidity and temperature on instrumentation.

W. Gauges, meters, and recorders should be designed and installed in such a manner that they can be read easily.

X. Instruments which cannot be read easily should be replaced.

Y. Verify that instrument packages are properly installed, grounded and of the proper design for the environment.

Z. Procedures must be established or in effect to test and prove instrument functions including interlocks and safe action in the event of power or instrument air failure.

AA. Periodic testing to check performance and potential malfunction should be scheduled.

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SECTION III - FIRE PROTECTION REVIEW CHECK LIST

Provide the following fire protection for all CED projects where the need is established by review with the S&PP Branch.

A. Automatic sprinkler or automatic water spray (deluge) protection wherever there are combustible materials either in the construction or in the contents (See S&PP Design Guide #11).

B. Drainage for spilled flammable liquids and fire protection water from sprinklers and hose streams.

C. Arrange sprinkler waterflow alarms so that any flow of water through the sprinkler piping will give an audible local alarm and automatically transmit water flow signals to a central supervised location.

D. Locate small hose stations inside buildings so that every square foot of floor area is within 20 feet of a hose nozzle attached to not more than 75 feet of 1 1/2" woven jacketed rubber-lined hose. The nozzles should be the combination spray and solid stream with shutoff.

   Small hose should preferably be attached to risers independent of the sprinkler system if hose streams are considered needed when sprinklers are not operating. If this cannot be arranged, small hose may be attached to 2½" or larger pipe on a wet pipe system.

E. Sufficient hydrants having two outlets to provide two 2½" hose streams at any point in the property where fire may occur regardless of wind direction. This will require spacing hydrants 225 to 250 feet apart at plant with ordinary hazards. At plants having highly combustible occupancies, the spacing may need to be reduced to 100 to 150 feet. For plants with non-combustible buildings and non-hazardous occupancies, hydrant spacing may be extended to 250 to 300 feet.

   For average conditions locate hydrants 50 feet from the building or equipment protected.

F. Extension of underground fire mains to feed proposed fire protection for project. A loop system with sectional valves is recommended because it assures greater reliability by providing water flow from two or more directions. The mains should be of ample size to carry the maximum fire water demand for sprinklers, hose streams and monitors. See S&PP Design Guide #10.

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Section III - Fire Protection Review Check List

G. Sectional control valves in the underground fire mains to divide the grid system into sections and thus limit the area subject to a single impairment. Not over a total combination of six sprinkler risers and hydrants should be out of commission during any change or repair. With any one section shutoff at least one of the water supplies should be available on the remainder of the system.

H. Fire protection monitors are not a substitute for automatic sprinkler protection or hose streams. They should be used to protect equipment containing flammable liquids that is not in a building or structure protected by automatic sprinklers. Their principle advantage is to provide a quick stream of water while hose lines are being laid, particularly where manpower is a problem.

I. Fireproofing of all main load-bearing structural members that support either process piping or equipment within hazardous areas. See CED Fireproofing Design Guide A4.10 Std. 1.

J. Fire wall, fire partition, or barricades to separate: (a) important property damage values; (b) units important to continuity of production; (c) high hazard operations. See S&PP Design Guide #14.

K. Adequate spacing, diking and fire protection for tanks storing flammable and combustible liquids. See S&PP Design Guide #1 and #13.

L. Adequate spacing and fire protection for LP gas storage tanks. See S&PP Design Guide #6.

M. Fire protection for indoor and outdoor storage of flammable liquids in drums. See S&PP Design Guide #2.

N. Fire protection for warehouses. See S&PP Design Guide #4.

O. Fire protection for cooling towers. See S&PP Design Guide #3.

P. Special hazard protection where needed. This would include fixed carbon dioxide, foam, dry chemical and explosion suppression systems.

Q. Fire detectors where automatic sprinklers cannot be justified due to limited combustibles or compatible with hazard to be protected.

R. Fire extinguishing agents must be compatible with process materials.

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SECTION IV - PERSONNEL SAFETY REVIEW CHECK LIST

A. Project Site Location

1. Consider exposure to or from the neighborhood from fire, explosion, noise, air and stream pollution, and exposure to or from existing operations. (See S&PP Design Guide #16 for fire. Consultation with appropriate CED or Corporate Medical necessary in other areas.)

2. Provide a minimum of two means of access for the site to facilitate entrance by emergency vehicles and not more than one of these shall be subject to uncontrolled blockage, i.e., railroads, highways.

3. Review the access to highways which handled heavy traffic. Where congestion is anticipated, such as at shift changes, consider traffic lights.

4. Provide right-of-way, clearance, etc., for future heavy traffic such as 4-lane divided highways and limited access highways.

5. Prepare contingency plans for access roads to the site which are exposed to railroad blockage or highway congestion and other hazards. Identify railroad crossings by warning signs.

6. Provide proper banking, barricades and warning signs where sharp curves are a necessity in access roads. (In areas where fog conditions may obscure visibility, provide rumble strips to warn of approaching curve.)

B. Building and Structures

1. Follow CED Design Std. A9.2 Std. 1 and the appropriate referenced Std. in the design of stairways, platforms, ramps and fixed ladders. (Monsanto Standard A2.5, Std. 1, A4.2, Std. 2, A4.3, Std. 9, 21 and 25.)

2. Provide sufficient general exit facilities and escape routes including alternate means of escape from roofs in accordance with S&PP Design Guide #12.

3. Furnish lighting to meet or exceed the recommended lighting intensities of Monsanto Std. E5.1, Std. 5.

4. Provide emergency lighting for escape or emergency shutdown operation in the event of power failure.

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5. Hang doors and windows to avoid projecting into or blocking walkways and exits. Provide a safety railing where it is necessary that a door open into an aisle or a road for vehicles.

6. Provide a utility room on each floor level for storage of cleaning equipment (sink, sweeper, scrubber, broom, etc.).

C. Operating Areas

1. Install and arrange equipment, steam, water, air and electrical outlets to keep aisles and operating floor areas clear of hoses and cables.

2. List materials in the operation which are highly toxic. (ref: "Dangerous Properties of Industrial Materials" by Sax.)

3. Provide adequate ventilation, to keep concentrations below TLV or known permissible levels of hazardous fumes, vapors, dust and excessive heat.

4. Provide space for the temporary storage of raw materials at process points and for finished products in the manufacturing area. This will permit continued operation during abnormal situations in continuous operations and alleviate safety and operational problems in batch operations.

5. Use laminated safety glass or wire glass for windows of control rooms exposed to potential fire and explosion hazards. (Size 8" x 10")

6. Provide adequate platforms and sufficient clearance around equipment for conducting maintenance operations safely.

7. Size and locate nozzles and manholes with consideration for safe cleanout, maintenance operations and emergency removal of people from vessels. (min. of 20" diameter)

8. Provide personnel protection against contact with surfaces which may reach or exceed 130°F.

9. Provide guarding in accordance with Monsanto Standard D11.8, Std. 5 for exposed moving parts of power-driven equipment before operation startup. Give special attention to "guarded by location" requirements of the Standard.

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Section IV - Personnel Safety Review Check List

10. Interlock covers and guards with operating mechanism particularly on high speed equipment and on equipment where high personnel or property hazard exists.

11. Manually operated valves, switches, and other controls shall be readily accessible to the operator from a safe location.

12. Do not install free-swinging material hoist.

13. Material hoists must meet the requirements of the appropriate material hoist or elevator code.

14. Furnish elevator shaftway door interlocks and gate contact in accordance with the American National Standards Institute Safety Code for Elevators (A17.1) and the applicable local codes. Provide bi-parting doors with safety astragals. Do not install manually operated bi-parting doors.

15. Describe the material handling operations. Avoid manual handling in excess of 50 pounds.

16. Provide Monsanto standard emergency showers and eye baths. The number and location of these units will vary depending on the type operation. (See Monsanto Standards P6.3, Std. 1, 6, 7 and 16.)

17. Consult the CED Noise Control Engineer where there is any question of noise levels in the hazardous range. Measures should be taken to reduce the noise level to a safe range.

18. Do not locate offices inside hazardous manufacturing facilities (i.e., fire, explosion, toxic potential).

19. Install positive electrical power disconnects which provide actual physical isolation for purposes of lockout.

D. Yard

1. Lay out roadways with consideration for the safe movement of pedestrians, vehicles and emergency equipment.

2. Concerning railroad car puller installations:

   a. Protect the control stations against broken cable whiplash.

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Section IV - Personnel Safety Review Check List

b. Protect the operator from being caught between cable or rope, and capstan or cable drum. (See Monsanto Standards A8.4, Stds. 15 & 17.)

c. Install an audible warning device to alert personnel to the operation.

3. Provide static grounding on flammable liquid tank cars and tank truck loading and unloading docks. (See Monsanto Standards E2.3, Std. 11 & 12.)

4. Provide approved loading platforms, including handrails, for access to work areas of tank cars, hopper cars and trucks. (See Monsanto Standard A8.4, Stds. 10 & 13; S&PP TecFact 6.)

5. Provide safe access to tops of storage tanks on which persons go for contents measurement and vent maintenance. (Frequency of operation determines design.)

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SECTION V - PROCESS SAFETY REVIEW CHECK LIST

Note: Consider the check list in terms not only of steady state operation, but also startup, shutdown, and upsets of all conceivable types.

A. Materials

1. What provisions are being made to control process materials which are unstable, pyrophoric or spontaneously ignitable?

2. What data are available on the amount and rate of heat evolution during decomposition of all materials in the process?

3. Discuss precautions which are necessary for flammable materials including storage and piping systems. (Reference: S&PP Design Guide No. 8)

4. Define flammable dust hazards which may exist. (Reference: S&PP Brief No. 44) What precautions are needed?

5. Describe what has been done to assure that materials of construction are compatible with the chemical process materials that are involved.

6. What maintenance control is necessary to assure replacement with proper materials, e.g., to avoid excessive corrosion, to avoid producing hazardous compounds with reactants?

7. What changes have occurred in composition of raw materials and resulting changes in process?

8. Define and review procedures established to control raw material identification and quality.

9. What hazards can be created by failure of supply of one or more raw materials or improper sequence of material additions?

10. Provide reliable inert gas supply for purging, blanketing, or inerting. (Reference: NFPA 69T) What provisions are there for true sweep-through purge for startup and shutdown?

11. What precautions need to be considered relative to stability of all materials in storage?

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Section V - Process Safety Review Check List

B. Reactions

1. Define potentially hazardous reactions. How are they isolated? Prevented?

2. Define process variables which could, or do, approach limiting conditions for hazard. What safeguards are provided against such variables?

3. What unwanted hazardous reactions can be developed through unlikely flow or process conditions or through contamination?

4. What combustible mixtures can occur within equipment?

5. What precautions are taken for processes operating near or within the flammable limits? (Reference: S&PP Design Guide No. 8)

6. What are process margins of safety for all reactants and intermediates in the process?

7. List known reaction rate data on the normal and possible abnormal reactions.

8. How much heat must be removed for normal, or abnormally possible, exothermic reactions?

9. How thoroughly is the chemistry of the process including desired and undesired reactions known? (See NFPA 491 M "Manual of Hazardous Chemical Reactions".

10. What provision is made for rapid disposal of reactants if required by emergency?

11. What provisions are made for handling impending runaways and for short-stopping an existing runaway?

12. Discuss the hazardous reactions which could develop as a result of mechanical equipment (pump, agitator, etc.) failure.

13. Describe the hazardous process conditions that can result from gradual or sudden blockage in equipment including lines.

14. Review provisions for blockage removal or prevention.

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Section V - Process Safety Review Check List

15. What raw materials or process materials or process conditions can be adversely affected by extreme weather conditions? Protection against such conditions.

16. Describe the process changes including plant operation that have been made since the previous process safety review.

C. Equipment

1. In view of process changes since the last process safety review, how was adequate size of equipment assured?

2. What procedure is there for assuring adequate liquid level in liquid seals?

3. What is the potential for external fire which may create hazardous internal process conditions?

4. Is explosion suppression equipment needed to stop an explosion once started? (In any high hazard operation.)

5. Do not use equipment made of glass or other fragile material. If a more durable material cannot be used, the fragile material must be adequately protected to minimize breakage., e.g., use Corgard with flex joints. In the event of breakage discuss the resulting hazard and describe provisions that will be made to handle the situation.

6. When was pertinent equipment, especially process vessels, last checked for pressure capability?

7. What provisions are needed for complete drainage of equipment for safety in maintenance?

8. Review the requirements for concrete bulkheads or barricades to isolate highly sensitive equipment and protect adjacent areas from disruption of operations.

D. Instrumentation Control

1. What hazards will develop if all types of motive power used in instrumentation should fail nearly simultaneously?

2. In the event that all instruments fail simultaneously, will the collective operation fail-safe?

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3. Provide for process safety when an instrument, instrumental in process safety as well as in process control, is taken out of service for maintenance. When such an instrument goes through a dead time period for standardization or when, for some other reason, the instrument reading is not available, provisions must be made to maintain operational safety.

4. Minimize response time lag in instruments directly or indirectly significant to process safety.

5. How has the process safety function of instrumentation been considered integrally with the process control function throughout plant design?

6. Evaluate procedure and frequency of checking safety instruments for functionality.

7. How are highly exothermic reactions protected by dual, independent instrumentation including alarms and interlocks?

E. Operations

1. Review and revise the written operating procedure and when process or operational changes are made. Review the operating procedure for revision at least annually.

2. Train new operating personnel on initial operation and keep experienced operating personnel up to date on plant operating procedures, especially for startup, shutdown, upsets and emergencies.

3. What special cleanup requirements are there before startup and how are these checked?

4. Provide easy-to-reach emergency valves and switches.

5. Observe safety precautions in loading liquids into or withdrawing them from tanks. Control the possibility of static electricity.

6. Review process hazards introduced by routine maintenance procedures and revise procedures to eliminate the hazards on an annual basis.

7. What evaluation is made of the hazards of sewered materials during normal and abnormal operation?

Section V - Process Safety Review Check List

8. Inerting gas supplies must be dependable. Review the potential for interruption and emergency supply.

9. Review safety margins which have been narrowed by revisions of design or construction or process conditions in efforts to debottleneck operations, reduce cost, increase capacity, or improve quality.

10. What provisions does the operating manual have for coverage of startup, shutdown, upsets, and emergencies?

11. What economic evaluation has dictated the choice on process between a batch process and a continuous one?

F. Malfunctions

1. Discuss the hazards created by the loss of each feed, and by simultaneous loss of two or more feeds.

2. Discuss the hazards which may result from loss of each utility, and from simultaneous loss of two or more utilities.

3. Describe the severest credible incident, i.e. the worst conceivable combination of reasonable malfunctions, which can occur.

4. Discuss the potential for spills and the hazards that would result from them.

G. Venting

1. Flame arresters shall not normally be installed on discharge of relief valves or rupture discs on pressurized vessels.

2. Design must include provisions for removal, inspection, and replacement of relief valves and rupture discs. What is the schedule for this? How well is it adhered to?

3. Discuss the basis for sizing emergency relief devices. (Breather vents, relief valves, rupture discs, flame arresters and liquid seals. Reference: S&PP Brief #42 and #100. What is the needed trim size of relief valves?

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Section V - Process Safety Review Check List

4. Where rupture discs are used to prevent explosion damage, they must be sized relative to vessel capacity and design. (Reference S&PP Brief #100 and API-RP520, Part I).

5. Where rupture discs have delivery lines to or from the discs, adequate line size relative to desired relieving dynamics must be assured. Prevent whipping of discharge end of line. How is liquid blow to the atmosphere prevented? Should it be?

6. Avoid manifolding venting systems, e.g., deposits in lines.

7. Where manifold venting is necessary describe the system and the potential hazards and the hazard prevention means.

8. Equipment vents shall terminate outside buildings and structures and be so located as to prevent injury to personnel or damage to property in the event of discharge.

9. Describe equipment, operating under pressure, or capable of having internal pressures developed by process malfunction which is not protected by relief devices.

10. Support discharge piping independently of relief valves. Make piping as short as possible and with minimum changes in direction. Support properly to prevent bending or whipping upon relief discharge.

11. Provide drain connections or weep holes in discharge piping of relief valves and relief valves where condensate, rain or snow could collect. Weep holes should not be permitted to discharge flammable gases or liquids in such a way as to expose tank shells to fire in the event of ignition during operation of relief valves. Provide low inertia weather covers at end; provide liquid disengagement where necessary.

12. Provide relief valves on discharge side of positive displacement pumps, between positive displacement compressor and block valves, between back-pressure turbine exhaust flanges and block valves, and on any equipment where liquid can be blocked in and later warmed.

13. Where rupture discs are in series with relief valves to prevent corrosion on valve or leakage of toxic material, install rupture disc next to the vessel and monitor the

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14. section of pipe between disc and relief valve with pressure gauge and pressure bleedoff line. No valves in lines to the tee, to the pressure gauge, and to the bleedoff. Flow checks are required in bleedoff lines.

14. Make provisions for keeping piping to relief valves and vacuum breakers at proper temperature to prevent accumulation of solids from interfering with action of safety device.

15. Assure that the service temperature at which the rupture disc bursting pressure is stated by the supplier is actually the rupture disc operating temperature; this is often different from the process temperature.

H. Sight Glasses

1. Where sight glasses are necessary on process equipment which is subject to hazardous conditions (flammables, toxic, high pressure, temperature extremes) PresSure equipment should be used. (Refer to S&PP TecFact #16 for details.)

I. Control Rooms

1. Adhere to applicable provisions of S&PP Design Guide #7, revised July 21, 1967, in the Construction of Process Control Houses and Process Control Rooms.

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