

9. Site Control

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Introduction

The purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. Site control is especially important in emergency situations. This chapter describes the basic components of a program to control the activities and movements of people and equipment at a hazardous waste site.

Several site control procedures can be implemented to reduce worker and public exposure to chemical, physical, biologic, and safety hazards:

- Compile a site map.
- Prepare the site for subsequent activities.
- Establish work zones.
- Use the buddy system when necessary.
- Establish and strictly enforce decontamination procedures for both personnel and equipment (see Chapter 10, *Decontamination*).
- Establish site security measures.
- Set up communication networks.
- Enforce safe work practices.

This chapter, based on EPA's *Standard Operating Safety Guides* [1], discusses general aspects of these eight control measures.

The degree of site control necessary depends on site characteristics, site size, and the surrounding community. The site control program should be established in the planning stages of a project and modified based on new information and site assessments (see Chapter 6, *Site Characterization*). The appropriate sequence for implementing these measures should be determined on a site-specific basis. In many cases, it will be necessary to implement several measures simultaneously.

Site Map

A site map showing topographic features, prevailing wind direction, drainage, and the location of buildings, containers, impoundments, pits, ponds, and tanks is helpful in:

- Planning activities.
- Assigning personnel.
- Identifying access routes, evacuation routes, and problem areas.
- Identifying areas of the site that require use of personal protective equipment.
- Supplementing the daily safety and health briefings of the field teams.

The map should be prepared prior to site entry and updated throughout the course of site operations to reflect:

- Accidents.
- Changes in site activities.
- Emergencies.
- Hazards not previously identified.
- New materials introduced on site.
- Vandalism.
- Weather conditions.

Overlays can be used to help portray information without cluttering the map.

Site Preparation

Time and effort must be spent in preparing a site for the cleanup activity to ensure that response operations go smoothly and that worker safety is protected. Site preparation can be as hazardous as site cleanup. Therefore, safety measures should be afforded the same level of care at this stage as during actual cleanup. Table 9-1 presents the major steps in site preparation prior to any cleanup activities.

Site Work Zones

To reduce the accidental spread of hazardous substances by workers from the contaminated area to the clean area, zones should be delineated on the site where different types of operations will occur, and the flow of personnel among the zones should be controlled. The establishment of work zones will help ensure that: personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

Hazardous waste sites should be divided into as many different zones as needed to meet operational and safety objectives. For illustration, this manual describes three frequently used zones:

- *Exclusion Zone*, the contaminated area.

Table 9-1. Site Preparation

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- Construct roadways to provide ease of access and a sound roadbed for heavy equipment and vehicles.
 - Arrange traffic flow patterns to ensure safe and efficient operations.
 - Eliminate physical hazards from the work area as much as possible, including:
 - ignition sources in flammable hazard areas.
 - exposed or ungrounded electrical wiring, and low overhead wiring that may entangle equipment
 - sharp or protruding edges, such as glass, nails, and torn metal, which can puncture protective clothing and equipment and inflict puncture wounds.
 - debris, holes, loose steps or flooring, protruding objects, slippery surfaces, or unsecured railings, which can cause falls, slips, and trips
 - unsecured objects, such as bricks and gas cylinders, near the edges of elevated surfaces, such as catwalks, roof tops, and scaffolding, which may dislodge and fall on workers
 - debris and weeds that obstruct visibility
 - Install skid-resistant strips and other anti-skid devices on slippery surfaces.
 - Construct operation pads for mobile facilities and temporary structures.
 - Construct loading docks, processing and staging areas, and decontamination pads.
 - Provide adequate illumination for work activities. Equip temporary lights with guards to prevent accidental contact.
 - Install all wiring and electrical equipment in accordance with the National Electric Code.
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- *Contamination Reduction Zone (CRZ)*, the area where decontamination takes place.
- *Support Zone*, the uncontaminated area where workers should not be exposed to hazardous conditions.

Delineation of these three zones should be based on sampling and monitoring results and on an evaluation of potential routes and amount of contaminant dispersion in the event of a release. Movement of personnel and equipment among these zones should be minimized and restricted to specific Access Control Points to prevent cross-contamination from contaminated areas to clean areas. A schematic representation of the layout of work zones is given in Figure 9-1.

Exclusion Zone

The Exclusion Zone is the area where contamination does or could occur. The primary activities performed in the Exclusion Zone are:

- Site characterization, such as mapping, photographing, and sampling.
- Installation of wells for groundwater monitoring.
- Cleanup work, such as drum movement, drum staging, and materials bulking.

The outer boundary of the Exclusion Zone, called the Hotline, should be established according to the criteria listed in Table 9-2. It should be clearly marked by lines, placards, hazard tape and/or signs; or enclosed by physical barriers, such as chains, fences, or ropes. Access Control Points should be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equip-

ment into and out of the zone and to help verify that proper procedures for entering and exiting are followed. If feasible, separate entrances and exits should be established to separate personnel and equipment movement into and out of the Exclusion Zone.

The Exclusion Zone can be subdivided into different areas of contamination based on the known or expected type and degree of hazard or on the incompatibility of waste streams. This allows more flexibility in safety requirements, operations, decontamination procedures, and use of resources.

The personnel working in the Exclusion Zone may include the Field Team Leader, the work parties, and specialized personnel such as heavy equipment operators. All personnel within the Exclusion Zone should wear the level of protection required by the Site Safety Plan. Within the zone, different levels of protection may be justified based on the degree of hazard presented. The level of personal protection required in each subarea (see Chapter 8, *Personal Protective Equipment*) should be specified and marked.

The required level of protection in the Exclusion Zone varies according to job assignment. For example, a worker who collects samples from open containers might require Level B protection, while one that performs walk-through ambient air monitoring might only need Level C protection. When appropriate, different levels of protection within the Exclusion Zone should be assigned to promote a more flexible, effective, and less costly operation, while still maintaining a high degree of safety.

Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is the transition area between the contaminated area and the clean area. This zone is designed to reduce the probability that the clean Support Zone will become contaminated or affected by other site hazards. The distance between the Exclusion and Support Zones provided by the CRZ, together with decontamination of workers and equipment, limits the physical transfer of hazardous substances into clean areas. The boundary between the CRZ and the Exclusion Zone is called the Hotline. The degree of contamination in the CRZ decreases as one moves from the Hotline to the Support Zone, due both to the distance and the decontamination procedures.

Decontamination procedures take place in a designated area within the CRZ called the Contamination Reduction Corridor (CRC). They begin at the Hotline. At least two lines of decontamination stations should be set up within the CRC: one for personnel and one for heavy equipment. A large operation may require more than two lines. Access into and out of the CRZ from the Exclusion Zone is through Access Control Points: one each for personnel and equipment entrance, one each for personnel and equipment exit, if feasible.

The boundary between the Support Zone and the CRZ, called the Contamination Control Line, separates the possibly low contamination area from the clean Support Zone. Access to the CRZ from the Support Zone is through two Access Control Points if feasible: one each for personnel and equipment. Personnel entering the CRZ

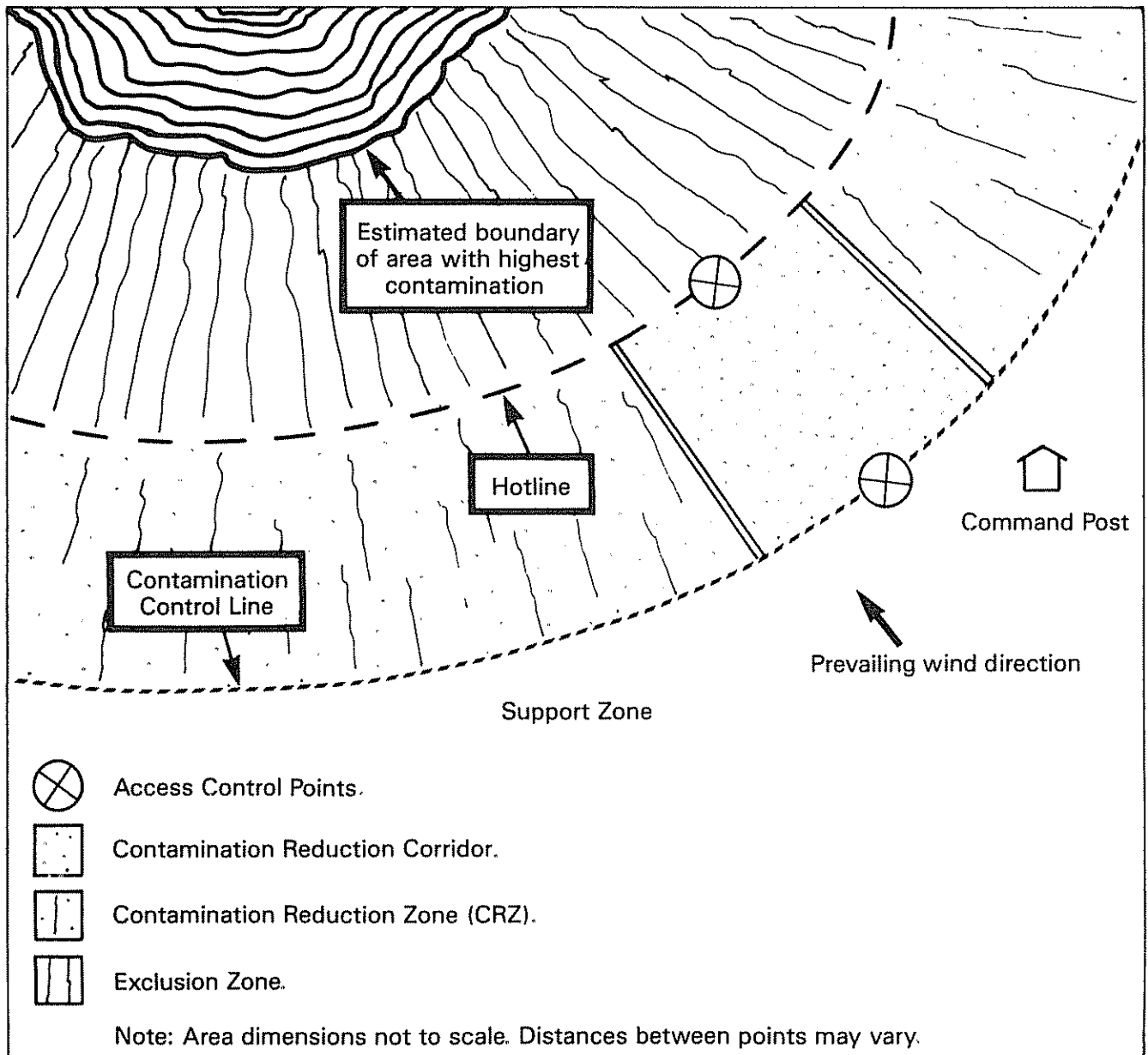


Figure 9-1. Site Work Zones. (Note that decontamination facilities are located in the Contamination Reduction Zone.)

should be required to wear the personal protective clothing and equipment prescribed for working in the CRZ. To reenter the Support Zone, workers should remove any protective clothing and equipment worn in the CRZ, and leave through the personnel exit Access Control Point.

The personnel stationed in the CRZ are usually the Site Safety Officer, a Personnel Decontamination Station (PDS) Operator, and the emergency response personnel. Additional personnel may assist the PDS Operator by conducting abbreviated decontamination procedures for sample containers.

The CRZ must be well designed to facilitate:

- Decontamination of equipment, PDS operators, personnel, and samples.

- Emergency response: transport for injured personnel (safety harness, stretcher), first-aid equipment (such as bandages, blankets, eye wash, splints, and water), containment equipment (absorbent, fire extinguisher).

- Equipment resupply: air tank changes, personal protective clothing and equipment (such as booties and gloves), sampling equipment (such as bottles and glass rods), and tools.

- Sample packaging and preparation for onsite or offsite laboratories.

- Worker temporary rest area: toilet facilities, bench, chair, liquids, and shade. Water and other potable liquids should be clearly marked and stored properly to ensure that all glasses and cups are

Table 9-2. Establishing the Hotline

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- Visually survey the immediate site environs.
 - Determine the locations of:
 - hazardous substances
 - drainage, leachate, and spilled material
 - visible discolorations
 - Evaluate data from the initial site survey indicating the presence of:
 - combustible gases
 - organic and inorganic gases, particulates, or vapors
 - ionizing radiation
 - Evaluate the results of soil and water sampling.
 - Consider the distances needed to prevent an explosion or fire from affecting personnel outside the Exclusion Zone.
 - Consider the distances that personnel must travel to and from the Exclusion Zone.
 - Consider the physical area necessary for site operations.
 - Consider meteorological conditions and the potential for contaminants to be blown from the area.
 - Secure or mark the Hotline
 - Modify its location, if necessary, as more information becomes available.
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clean. Wash facilities should be located near drinking facilities to allow employees to wash before drinking. Drinking, washing, and toilet facilities should be located in a safe area where protective clothing can be removed. Facilities should be cleaned and inspected regularly. Appropriate protective measures should be taken by maintenance workers.

- Drainage of water and other liquids that are used during decontamination.

Personnel within the CRZ should be required to maintain internal communications, line-of-sight contact with work parties, work party monitoring (e.g., for air time left, fatigue, heat stress, hypothermia), and site security.

Support Zone

The Support Zone is the location of the administrative and other support functions needed to keep the operations in the Exclusion and Contamination Reduction Zones running smoothly. Any function that need not or cannot be performed in a hazardous or potentially hazardous area is performed here. The Command Post Supervisor should be present in the Support Zone. Other personnel present will depend on the functions being performed, and may include the Project Team Leader and field team members who are preparing to enter or who have returned from the Exclusion Zone.

Personnel may wear normal work clothes within this zone. Any potentially contaminated clothing, equipment, and samples must remain in the CRZ until decontaminated.

Support Zone personnel are responsible for alerting the proper agency in the event of an emergency. All emergency telephone numbers, change for the telephone (if necessary), evacuation route maps, and vehicle keys should be kept in the Support Zone.

Support facilities, listed in Table 9-3, are located in the Support Zone. To place these facilities, consider factors such as:

- **Accessibility.** Topography, open space available, locations of highways and railroad tracks, ease of access for emergency vehicles.
- **Resources.** Adequate roads, power lines, telephones, shelter, and water.
- **Visibility.** Line-of-sight to all activities in the Exclusion Zone.
- **Wind direction.** Upwind of the Exclusion Zone, if possible.
- **Distance.** As far from the Exclusion Zone as practicable.

The Buddy System

Most activities in contaminated or otherwise hazardous areas should be conducted with a buddy who is able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the Command Post Supervisor or others if emergency help is needed.

The Access Control Point for personnel entrance to the Exclusion Zone is a convenient location for enforcing the buddy system for two reasons: enforcement is the responsibility of the Project Team Leader, who is stationed in the CRZ, and all personnel who enter the contaminated area must pass through the control point.

The buddy system alone may not be sufficient to ensure that help will be provided in an emergency. At all times, workers in the Exclusion Zone should be in line-of-sight contact or communications contact with the Command Post Supervisor or backup person in the Support Zone.

Site Security

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards.
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site.
- Prevent theft.
- Avoid interference with safe working procedures.

To maintain site security during working hours:

- Maintain security in the Support Zone and at Access Control Points.
- Establish an identification system to identify authorized persons and limitations to their approved activities.
- Assign responsibility for enforcing authority for entry and exit requirements.

- Erect a fence or other physical barrier around the site.
- If the site is not fenced, post signs around the perimeter and use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures.
- Have the Project Team Leader approve all visitors to the site. Make sure they have a valid purpose for entering the site. Have trained site personnel accompany visitors at all times and provide them with the appropriate protective equipment.

To maintain site security during off-duty hours:

- If possible, assign trained, in-house technicians for site surveillance. They will be familiar with the site, the nature of the work, the site's hazards, and respiratory protection techniques.
- If necessary, use security guards to patrol the site boundary. Such personnel may be less expensive than trained technicians, but will be more difficult to train in safety procedures and will be less confident in reacting to problems around hazardous substances.
- Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.
- Secure the equipment.



Warning signs and fences help to prevent exposure of unauthorized and unprotected people to site hazards.

Table 9-3. Support Zone Activities

FACILITY	FUNCTION
Command Post	<p>Supervision of all field operations and field teams.</p> <p>Maintenance of communications, including emergency lines of communication.</p> <p>Recordkeeping, including:</p> <ul style="list-style-type: none"> — accident reports — chain-of-custody records — daily logbooks — manifest directories and orders — medical records — personnel training records — site inventories — site safety map — up-to-date Site Safety Plans <p>Providing access to up-to-date safety and health manuals and other reference materials.</p> <p>Interfacing with the public: government agencies, local politicians, medical personnel, the media, and other interested parties.</p> <p>Monitoring work schedules and weather changes.</p> <p>Maintaining site security.</p> <p>Sanitary facilities.</p>
Medical Station	<p>First-aid administration</p> <p>Medical emergency response</p> <p>Medical monitoring activities.</p> <p>Sanitary facilities.</p>
Equipment and Supply Centers	<p>Supply, maintenance, and repair of communications, respiratory, and sampling equipment.</p> <p>Maintenance and repair of vehicles</p> <p>Replacement of expendable supplies</p> <p>Storage of monitoring equipment and supplies. Storage may be here or in an onsite field laboratory.</p>
Administration	<p>Sample shipment.</p> <p>Interface with home office.</p> <p>Maintenance of emergency telephone numbers, evacuation route maps, and vehicle keys.</p> <p>Coordination with transporters, disposal sites, and appropriate federal, state, and local regulatory agencies.</p>
Field Laboratory	<p>Coordination and processing of environmental and hazardous waste samples. Copies of the sampling plans and procedures should be available for quick reference in the laboratory.</p> <p>Packaging of materials for analysis following the decontamination of the out-sides of the sample containers which should be done in the CRZ. This packaging can also be done in a designated location in the CRZ. Shipping papers and chain-of-custody files should be kept in the Command Post.</p> <p>Maintenance and storage of laboratory notebooks in designated locations in the laboratory while in use, and in the Command Post when not in use.</p>

Communication Systems

Two sets of communication systems should be established: internal communication among personnel on site, and external communication between onsite and offsite personnel.

Internal communication is used to:

- Alert team members to emergencies.
- Pass along safety information, such as the amount of air time left before the next rest period, air change, heat stress check, etc.
- Communicate changes in the work to be accomplished.
- Maintain site control.

Verbal communication at a site can be impeded by onsite background noise and the use of personal protective equipment. For example, speech transmission through a respirator can be poor, and hearing can be impaired by protective hoods and respirator air flow. For effective communication, commands must be pre-arranged. In addition, audio or visual cues can help convey the message. The most important thing is that signals are agreed to in advance.

Table 9-4 lists common internal communication devices. Both a primary and backup system are necessary. A set of signals should be established for use only during emergencies (see Table 12-4 in Chapter 12 for examples).

Effective internal communication also requires the identification of individual workers so that commands can be addressed to the right worker. The worker's name should be marked on the suit and, for long-distance identification, color coding, numbers, or symbols can be added. Flags may be used to help locate personnel in areas where visibility is poor due to obstructions such as accumulated drums, equipment, and waste piles.

All communication devices used in a potentially explosive atmosphere must be intrinsically safe (see footnote in Table 9-4) and not capable of sparking, and should be checked daily to ensure that they are operating.

An external communication system between onsite and offsite personnel is necessary to:

- Coordinate emergency response.
- Report to management.
- Maintain contact with essential offsite personnel.

The primary means of external communication are telephone and radio. If telephone lines are not installed at a site, all team members should know the location of the nearest telephone, and the correct change and necessary telephone numbers should be readily available in the Support Zone.

Safe Work Practices

To maintain a strong safety awareness and enforce safe procedures at a site, a list of standing orders should be developed which state the practices that must always be followed and those that must never occur in the contami-

Table 9-4. Internal Communication Devices

Radio ^a
— Citizen's band
— FM
Noisemakers, including:
— Bell
— Compressed air horn
— Megaphone
— Siren
— Whistle
Visual signals, including:
— Flag
— Flares or smoke ^b
— Hand signals
— Lights
— Signal board
— Whole body movements

^aAll radios used in the Exclusion and Contamination Reduction Zones must be certified as intrinsically safe for the situation of intended use [2,3].

^bOnly from the Support Zone

Table 9-5. Sample Standing Orders

For Personnel Entering the Contamination Reduction Zone:
No smoking, eating, drinking, or application of cosmetics in this zone
No matches or lighters in this zone
Check in at the entrance Access Control Point before you enter this zone.
Check out at the exit Access Control Point before you leave this zone.
For Personnel Entering the Exclusion Zone:
No smoking, eating, drinking, or application of cosmetics in this zone.
No matches or lighters in this zone
Check in at the entrance Access Control Point before you enter this zone.
Check out at the exit Access Control Point before you leave this zone.
Always have your buddy with you in this zone.
Wear an SCBA in this zone.
If you discover any signs of radioactivity, explosivity, or unusual conditions such as dead animals at the site, exit immediately and report this finding to your supervisor.

nated areas on site. Separate standing orders should be developed for the Contamination Reduction Zone and the Exclusion Zone if the hazards are sufficiently different. Sample standing orders are given in Table 9-5. To ensure that everyone who enters the site is aware of these orders and that a high degree of familiarity with their content is maintained, the list should be:

- Distributed to everyone who enters the site.
- Posted conspicuously at the Command Post.
- Posted conspicuously at the entrance Access Control Points into the Contamination Reduction Zone and/or the Exclusion Zone.
- Reviewed by the Field Team Leader or Project Team Leader with the field crew at the beginning of each work day. In this way, personnel are immediately informed of any new standing orders

resulting from a change in site conditions or work activities.

In addition to the standing orders, a hazardous substance information form that lists the names and properties of chemicals present on site should be prepared and posted conspicuously. Employees should be briefed on the chemical information at the beginning of the project or whenever they first join the work team. Daily safety meetings should be held for all employees.

Working with tools and heavy equipment is a major hazard at sites. Injuries can result from equipment hitting or running over personnel, impacts from flying objects, burns from hot objects, and damage to protective equipment such as supplied-air respirator systems (see Chapter 8). The following precautions will help preclude injuries due to such hazards:

- Train personnel in proper operating procedures.
- Install adequate onsite roads, signs, lights, and devices.
- Install appropriate equipment guards and engineering controls on tools and equipment. These include roll-over protective structures, seat belts, emergency shutoff in case of rollover, and backup warning lights and signals.
- Provide equipment such as cranes, derricks, and power shovels with signs saying "Unlawful to operate this equipment within 10 feet of all power lines."
- Use equipment and tools that are intrinsically safe (see footnote in Table 9-4) and not capable of sparking, and pneumatically and hydraulically driven equipment.
- Where portable electric tools and appliances can be used, (i.e., where there is no potential for flammable or explosive conditions), use three-wire grounded extension cords to prevent electric shocks.
- In hydraulic power tools, use fire-resistant fluid that is capable of retaining its operating characteristics at the most extreme temperatures.
- At the start of each work day, inspect brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, steering, and splash protection.
- Keep all non-essential people out of the work area.
- Prohibit loose-fitting clothing or loose long hair around moving machinery.
- Keep cabs free of all non-essential items and secure all loose items.
- Do *not* exceed the rated load capacity of a vehicle.
- Instruct equipment operators to report to their supervisor(s) any abnormalities such as equipment failure, oozing liquids, unusual odors, etc.
- When an equipment operator must negotiate in tight quarters, provide a second person to ensure adequate clearance.
- Have a signalman direct backing as necessary.
- All onsite internal combustion engines should have spark arrestors that meet requirements for hazardous atmospheres. Refuel in safe areas. Do *not* fuel

engines while vehicle is running. Prohibit ignition sources near a fuel area.

- Lower all blades and buckets to the ground and set parking brakes before shutting off the vehicle.
- Implement an ongoing maintenance program for all tools and equipment. Inspect all tools and moving equipment regularly to ensure that parts are secured and intact with no evidence of cracks or areas of weakness, that the equipment turns smoothly with no evidence of wobble, and that it is operating according to manufacturer's specifications. Promptly repair or replace any defective items. Keep maintenance and repair logs.
- Store tools in clean, secure areas so that they will not be damaged, lost, or stolen.
- Keep all heavy equipment that is used in the Exclusion Zone in that zone until the job is done. Completely decontaminate such equipment before moving it into the clean zone.

References

1. U.S. EPA. 1984. Standard Operating Safety Guides. EPA Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, NJ.
2. National Fire Protection Association. National Electrical Code, Chapter 5, Articles 500-503. National Fire Codes, NFPA 70.
3. National Fire Protection Association. Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous Classified Locations. National Fire Codes, NFPA 497M.