5. REMEDIAL DESIGN

This section outlines the activities that will be performed to meet the RAOs and RGs set forth in the ROD. The activities are discussed in the following sections: Mobilization, Excavation Operations, Cylinder Segregation and Staging, Cylinder Sampling, On-Site Laboratory Analysis, Cylinder Treatment, Cylinder Disposal, and Post-Removal Sampling. Figure 5-1 provides a graphical summary of the remedial action.

The cylinders will be managed under the Compressed Gas Associated (CGA) guidelines for abandoned compressed gas cylinders. These guidelines are specifically addressed in the CGA guidance document P-22, "The Responsible Management and Disposition of Compressed Gases and Their Containers" (CGA 1995a). The cylinders meet the criteria of "Abandoned Cylinder" as defined in P-22 and should follow the guidelines for management of such cylinders.

5.1 Mobilization

All required personnel and equipment will be mobilized to the site. The construction coordinator will direct all mobilization activities. The equipment list includes the following:

- Excavation equipment (Cat 320 or equivalent track-hoe excavator with containment grade polycarbonate operator shielding and Case 580 or equivalent back-hoe with Earth Resource Corporation [ERC] Cylinder Grappler@attachment and containment grade polycarbonate operator shielding)
- Cylinder racks with protective structure
- ERC Emergency Cylinder Overpacks
- Metal detectors, shallow metal detector (White model 9400-DLMAX, or equivalent) and deep metal detector (Schonstedt Magnetic Locator Model CA-72 Cd, or equivalent)
- Real-time air monitoring equipment including photo-ionization detector, combustible gas indicator, oxygen meter, sulhr dioxide detector
- ERC Valve Sampling Station®
- ERC Cylinder Recovery Vessel@,(will be brought on-site if required)
- Mobile analytical equipment **(MS** and FTIR)

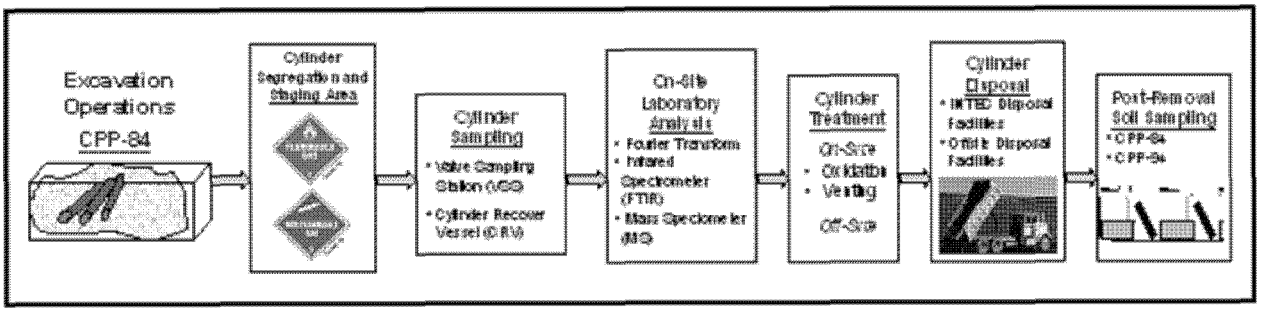

Figure 5-1. Description of remedial action.

- Communications equipment
- Cylinder handling dolly
- Personnel protection equipment
- Spill control equipment
- Miscellaneous hand and power tools
- Support vehicles
- Portable sanitary facilities.

The job site will be segregated into three work areas: EZ, contamination reduction zone (CRZ), and SZ. These zones are designed to provide site workers with safe and efficient work areas. Considerations include stockpiling of excavated soil, safe ingress and egress for equipment and personnel, sampling and laboratory operations areas, and segregated storage areas. Figure 5-2 provides a layout of the work site.

5.2 Excavation Operations

The excavation will be performed in a manner protective of worker safety and to minimize the potential for a release to the environment. Cylinders will be excavated by mechanical and hand-digging. Excavation activities will be photo-documented. During mechanical excavation, for protection against fragmentation from a catastrophic cylinder failure, workers will be protected by either containment-grade polycarbonate shielding or 1/4-in. steel plate. Mechanical excavation will be performed in 6-in. lifts and will not be performed within 6 in. of cylinders. Continuous magnetometer surveys, physical probing air monitoring, and radiological surveys will be performed to during the excavation process. Hand excavation will be performed within 6 in. of cylinders to expose the cylinders for mechanical lifting. Cylinders will be preliminarily identified visually and evaluated for stability according to CGA guidelines as expressed in pamphlets C-6 (CGA 1993), C-6.1 (CGA 1995b), C-6.3 (CGA 1999), and C-13 (CGA 2000a). The cylinders must be evaluated as safe for transfer before movement to the staging site. If the cylinders are classified as unstable they will be removed from the excavation by the cylinder grappling device designed specifically for that purpose. Figure 5-3 is a photograph of the grappling device. Identification of cylinders as unsafe for transfer will result in cessation of removal activities and re-evaluation of the hazards and excavation approach. At this time, the use of robotic excavation will be considered.

5.3 Cylinder Segregation and Staging

Cylinders will be segregated by compatibility type based on the preliminary cylinder classification. Flammability will be the segregation criteria. All cylinders that are determined by the initial inspection to contain nonflammable gases (nitrogen, oxygen, compressed air, and argon) will be segregated separately. Likewise all flammable gas cylinders (acetylene) will be staged together. The segregated groups will be staged a minimum of 30 ft apart (in accordance with CGA P-22 [CGA 1995a]) and will be situated away from the sampling and removal areas.

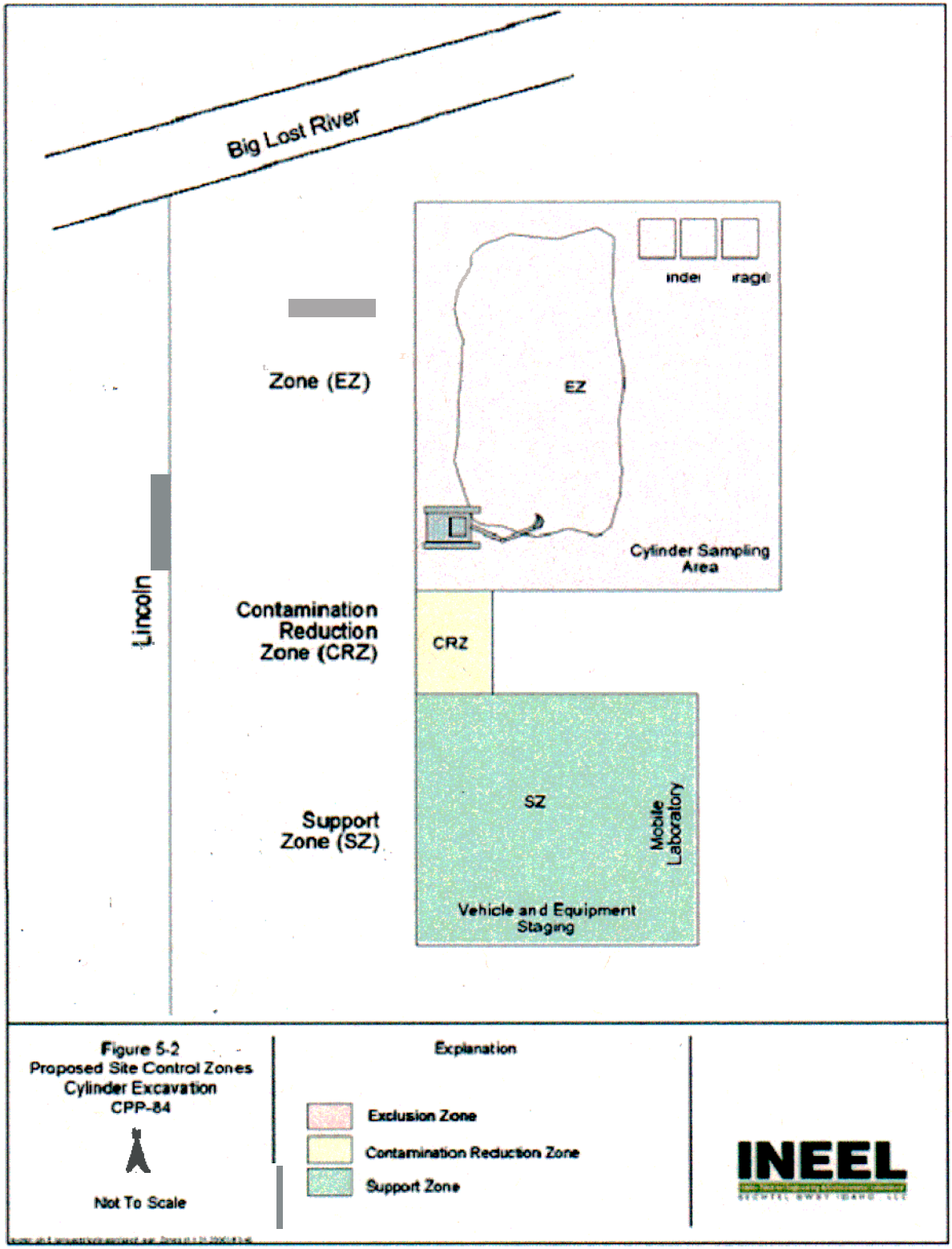

Figure 5-2. Proposed site layout.

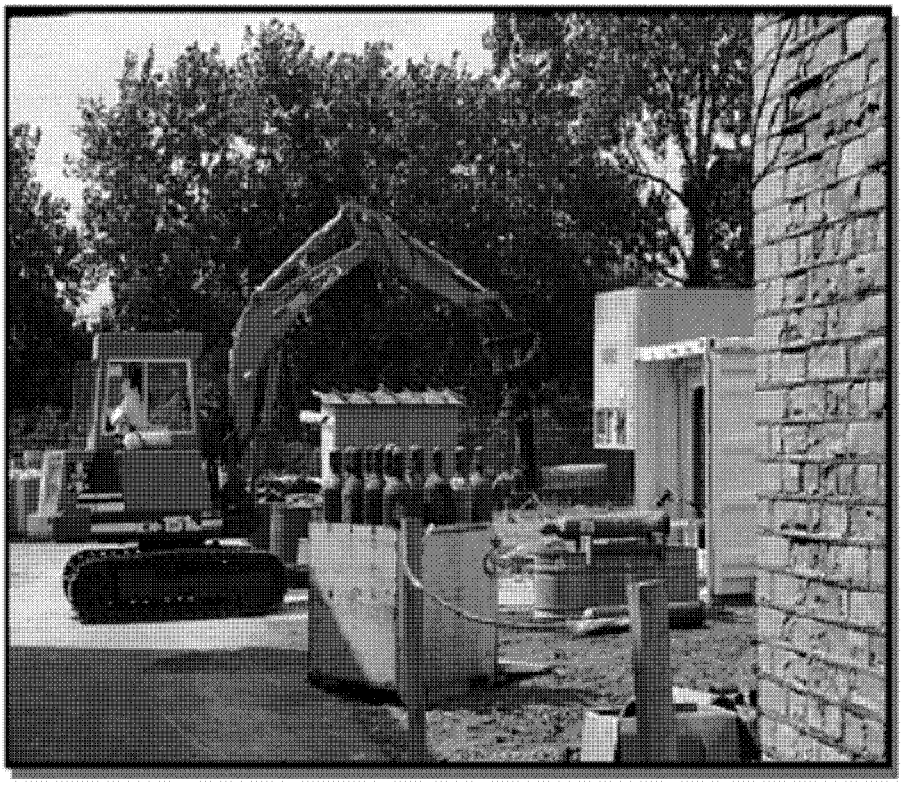

Figure 5-3. Cylinder grappling device.

The cylinders will be staged using specially designed cylinder racks. During the removal activities, field personnel will periodically inspect the staged cylinders and monitor ambient conditions. After removal is complete, access to the staging area will be limited using construction fencing and the area will be posted. The cylinder racks will be fitted with tarpaulin to protect the cylinders from the weather. Figure 5-4 is a photograph of a typical cylinder rack.

5.4 Cylinder Sampling

Cylinder sampling techniques are based solely on cylinder and valve integrity. For cylinders with operable valves, a remotely operated system, the VSS, will be used. This system allows the operator to remotely view the sampling operation using video equipment. For cylinders that are in poor condition or with inoperable valves, the CRV will be used. The CRV is a remotely operated, pressure-rated vessel that is housed within in a secondary containment chamber for the containment of fugitive gases. The cylinder is pierced within the CRV, allowing the contents of the cylinder to be sampled and analyzed. Figure 5-5 provides a schematic of the VSS and Figure 5-6 provides a photograph of the CRV.

5.5 Onsite Laboratory Analysis

One of two methods, (1) FTIR or (2) **MS,** will be used to perform analysis of cylinder contents. The infrared spectrum contains characteristics that permit identification of functional groups, or "working parts" of molecules. Through the use of an interferometer, infrared wavelengths are passed through a sample simultaneously. A laser is used to align the optics used in the process.

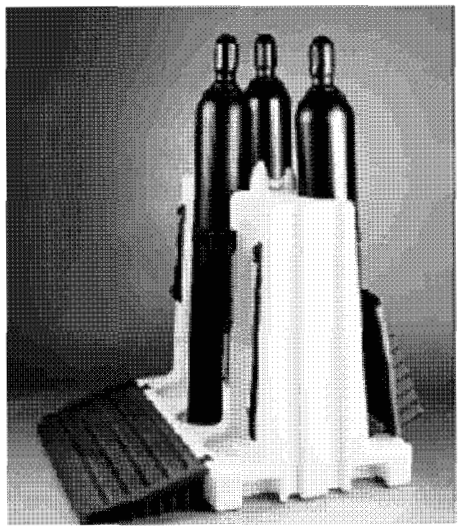

Figure 5-4. Typical cylinder rack.

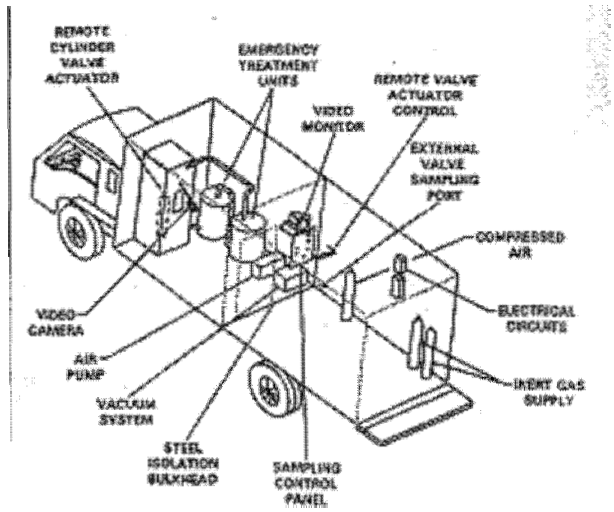

Figure 5-5. Schematic of the VSS.

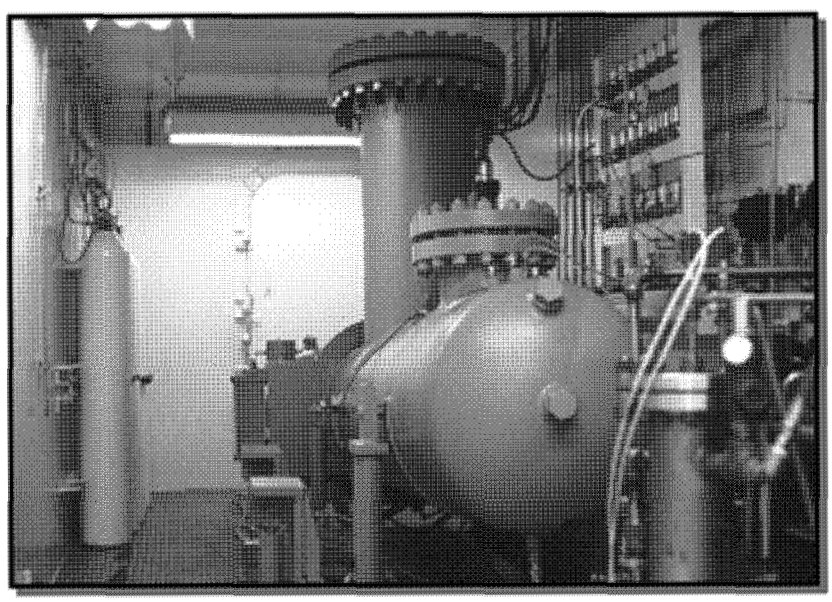

Figure 5-6. Photograph of CRV.

The FTIR will be used to qualitatively identify cylinder contents through a comparison of spectra with library references. Spectral libraries are maintained with the laboratory computer. Computer libraries are supplemented by several standard hard-copy references. The FTIR is applicable for all but elemental gases (oxygen, nitrogen, etc.). For elemental gases, **MS** is the preferred method of analysis.

The **MS** is a vacuum analyzer, which will measure total and partial pressures. The analyzer is a quadruple mass spectrometer that is capable of separating ions formed in an electron impact source according to the mass-to-charge ratio.

5.6 Cylinder Treatment

A majority of the cylinders removed from CPP-84 are expected to be treated by venting to the atmosphere. This treatment technique is appropriate for inert gases. These gases include nitrogen, oxygen, argon, helium, carbon dioxide, and compressed air. For flammable gases, such as acetylene, thermal oxidation (flaring) is the preferred treatment technique. Analysis will confirm whether the gases contained in the cylinders are common industrial gases typically associated with construction operations. Following laboratory confirmation of cylinder contents, the industrial gases will be disposed of by either controlled venting or flaring. If unexpected gases are identified cylinder overpacks may be used for off-Site shipment. Figure *5-7* shows a photograph of a typical cylinder overpack.

5.7 Cylinder Disposal

After cylinder treatment, disposal of the cylinder body is required. Disposal options are based on contents of the cylinder. Cylinders that contained inert gases (oxygen, nitrogen, compressed air, helium: argon, and carbon dioxide) will be rendered useless by drilling, cutting, and/or valve removal. Final disposition of these cylinders will be at the ICDF or the INEEL Landfill Complex.

Cylinders that contain acetylene present special waste management considerations. Acetylene cylinders are constructed with a porous filler (usually asbestos) and a solvent (acetone) to provide for safe handling and operation. After treatment, cylinders that contained acetylene will be transported off-Site for final disposition.

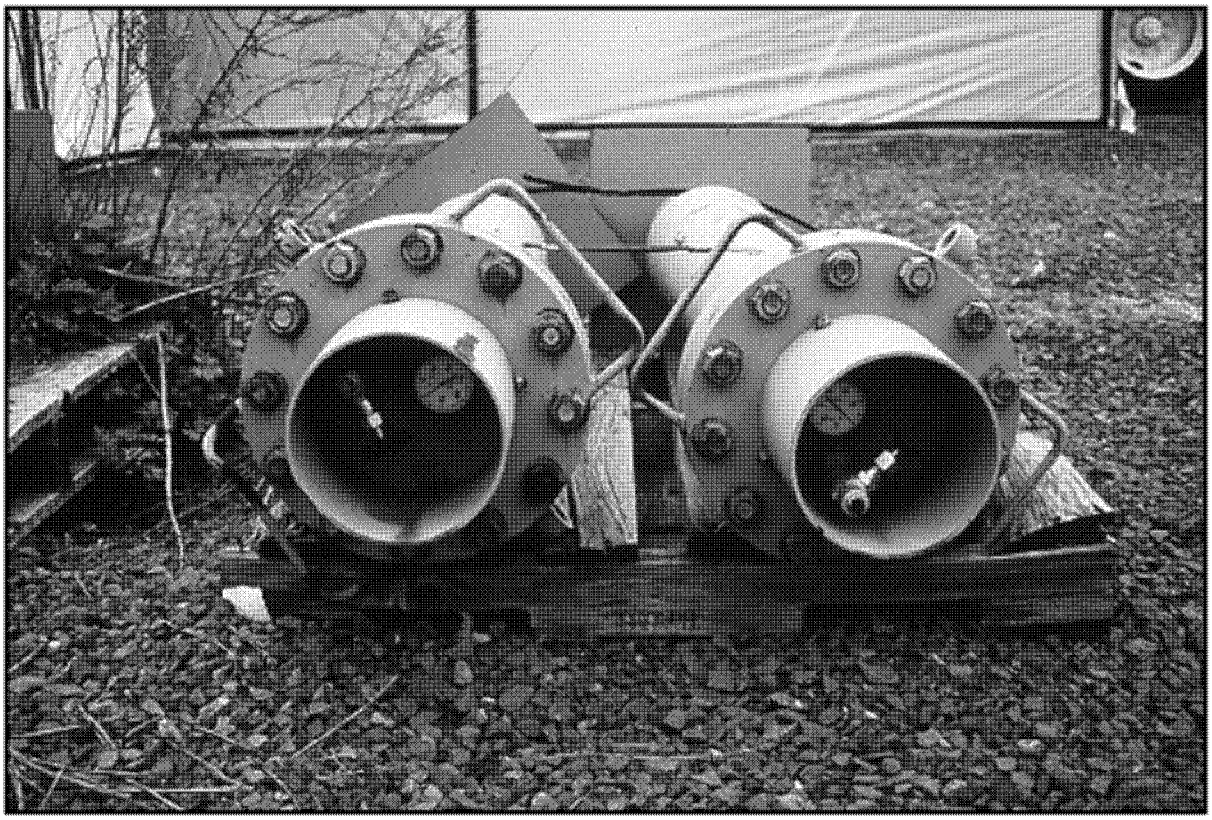

Figure 5-7. Typical cylinder overpack.

5.8 Post-Removal Sampling

Post-removal sampling activities at CPP-84 and CPP-94 consist of soil sampling to estimate the average concentrations of COPCs in the excavation, plus confirm the magnetic field survey. Based on the DQOs of this project, a simple random sampling design (utilizing composite samples) will be used for locating sampling locations. Samples will only be taken from grids where cylinders have been retrieved. Refer to Table 3-2 for details regarding the DQOs for post-removal characterization activities. Figure 5-8 provides a hypothetical grid layout with composite sampling locations for the post-removal sampling activities. **Note:** If visual evidence indicates the potential for soil contamination (e.g. obvious differences in soil color, moistness, or texture), biased (judgmental) samples will be collected to characterize the anomaly.

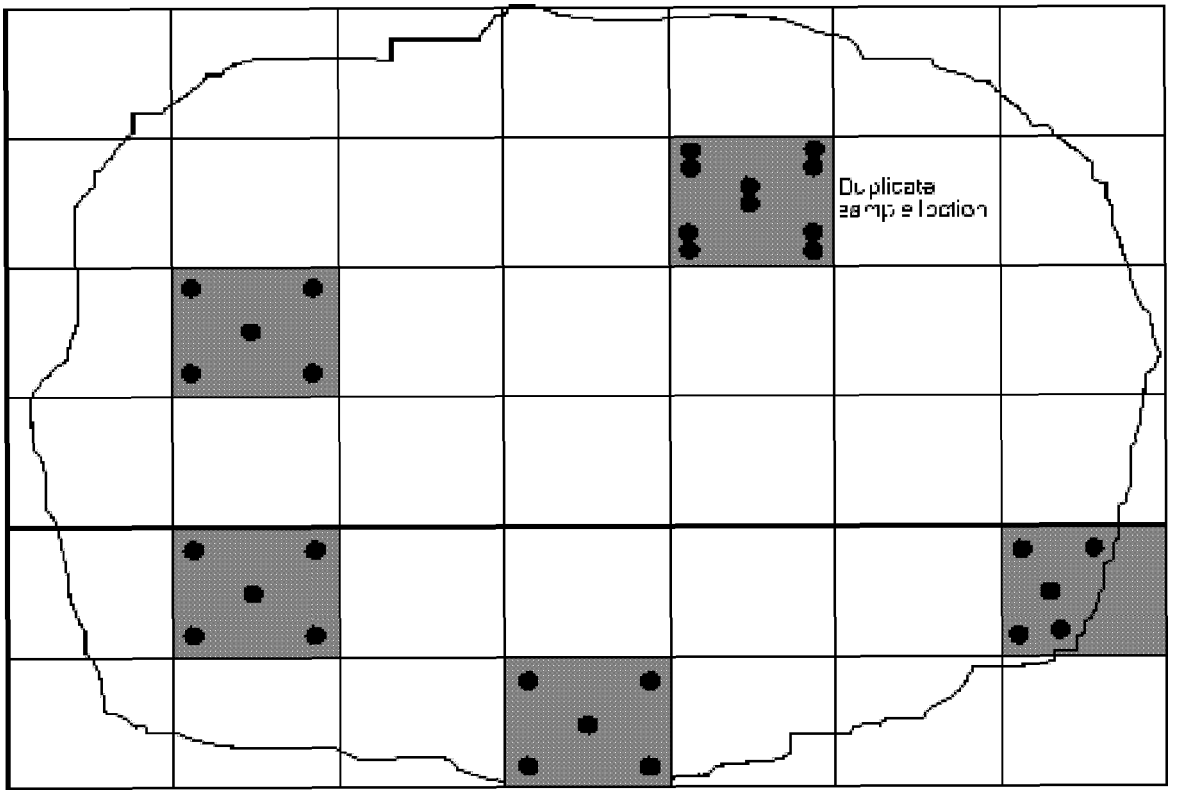

Figure 5-8. Hypothetical grid layout with composite sampling locations

6. REMEDIAL ACTOIN WORK PLAN ELEMENTS

This section provides a description of the work plan elements required to complete the remedial action. Elements provided in this section include safety and emergency response analyses, planning documents, excavation/operational guidance, project cost estimates, and project schedules.

6.1 Relevant Changes to the RD/RA Statement of Work

The *OU-13 RD/RA Scope of Work* **(SOW)** (DOE-ID 2000) identifies the scope for Group 6, Buried Gas Cylinders. At the time the **SOW** was submitted, significant concerns were identified with regards to the safe removal of the cylinders. Since then, an Engineering Design File (INEEL 2000a) and a hazard classification (INEEL 2000b) were completed to better define the distribution of cylinders at each site and evaluate the potential hazards. The results of these studies defined the areas impacted by cylinder burial and determined the hazard classification CPP-84.

The relevant changes to the scope are three-fold:

1. The hazard classification is completed and activities at both sites have been designated as low hazard activities. Removal operations are considered to be safe given proper work practices and engineering controls as identified in an auditable safety analysis (ASA) or HASP. The HASP is provided in Attachment 2.

2. Since it has been determined that the removal of cylinders does not pose an unacceptable risk to workers, the remedy of capping the cylinders in place with an engineered barrier was not selected. The remedy of removal, characterization, and treatment is the preferred option since it best meets the seven evaluation criteria (overall protection of human health and the environment, compliance with ARARs, long-term effectiveness, reduction of toxicity, mobility, or volume, short term effectiveness, implementability, and cost).

3. The cylinders at CPP-94 have been removed. The remaining work at CPP-94 includes post-removal soil sampling, backfilling, and site grading.

6.2 Emergency Response Plan

The emergency response plan (ERP) defines the responsibilities of the project and the INEEL Emergency Response Organization by providing guidance for responding to abnormal events during project activity. This plan addresses OSHA emergency response as defined by 29 CFR 1910.120/1926.65 and DOE requirements a defined by DOE Order 151.1B. The ERP is provided in Section 11 of the project HASP (Attachment 2).

6.3 INEEL Environmental Documentation

An environmental evaluation (Savkranz 2000) has been conducted at the site. The results of the site evaluation indicate that each area has been previously disturbed by site operations and that the vegetation includes sagebrush, rabbit brush and a variety of native and introduced grasses. It is unlikely that the removal action will have impacts to species of federal or state concern. The environmental evaluation further determined that this project is unlikely to have an impact on cultural resources. A copy of this evaluation is available in the project files.

6.4 Hazard Classification/Auditable Safety Analysis and Unreviewed Safety Question Review

A hazard classification was completed based on the amount of releasable radioactive and hazardous materials. The remedial actions at both sites have been designated as low hazard activities (INEEL 2000b). A low hazard designation means the activity can only affect personnel in the immediate area. The safety documentation required for a low hazard activity is an ASA, which will identify all the hazards associated with the remediation activity. Since the remedial action is classified as a low hazard activity, the health and safety plan is equivalent to an ASA. A copy of the hazard classification is provided in Attachment *3* and the HASP is provided in Attachment 2.

6.5 Evaluation of Remedial Action Against Performance Measurement Points

The remedial action of removal, treatment, and disposal meets the RAO and RG as discussed in the ROD. Magnetometer surveys plus visual and physical observations will confirm the removal of cylinders. Soil sampling will also be completed to ensure that any potential residual concentrations have been removed. Since the removal of the cylinders will mitigate any potential future safety hazards, long-term monitoring at these sites will not be required. However, a prefinal and final inspection will be completed by the Agencies. **(Note:** It may be determined that the prefinal is the only inspection needed, if this is the case, a final inspection will not be conducted, and the prefinal will serve as the final inspection.) Compliance with the performance measuring points will be discussed in the remedial action (RA) report. The RAOs and RGs are discussed in Section *3* and the soil sampling is discussed in the *Preliminary Characterization Plan* (DOE-ID 2001a) provided in Attachment 1.

6.6 Field Oversight and Construction Management

The DOE-ID remediation project manager will be responsible for notifying the EPA and IDEQ of major project activities (e.g., project start-up or closeout) and other project activities it deems appropriate. DOE-ID will serve as the single interface point for all routine contact between the EPA, IDEQ, and BBWI.

BBWI is responsible for field oversight and construction management services for this project and will provide field support for health and safety, quality assurance, and landlord services. Visitors to the project who wish to observe remediation activities must meet badging and training requirements necessary to enter INEEL and INTEC facilities. Project-specific training requirements for visitors are described in the project HASP.

6.7 Project Cost Estimate

A summary of project costs is provided in Appendix A.

6.8 Project Schedule

The remedial action working schedule for Group 6 is presented in Appendix B and includes all project tasks from preparation of this *Work Plan* through performance of the remedial action and submittal of the closure report. Administrative and document preparation and field activities are based on a 40-hour workweek. This schedule assumes concurrent contractor and DOE-ID document reviews. There is no schedule contingency for delays in field activities impacted by adverse weather conditions.

The project schedule has been revised based on limited budget and pending time constraints. The excavation and treatment of the cylinders at CPP-84 has been postponed until FY04. Table 6-1 shows the targeted activities associated with the Group 6 cylinder removal project.

Table 6-1. Summary of major Group 6 activities, future reports, and primary enforceable milestone.

Group 6 Activities	Type	Target Date	Enforceable Milestone
Perform prefinal inspection"	Other	10/01/04	NA

a. Final inspection date is determined in pre-final inspection report. Draft RA report is due 60 days following the final inspection.

6.9 Remedial Action Reporting

The remedial action process includes the preparation of at least one primary and one secondary document. The prefinal inspection report will be a secondary document that will include the following:

- Outstanding construction requirements
- Actions required to resolve items
- Completion date
- Date of final inspection.

The Agencies or their representatives will conduct the prefinal inspection. All comments will be finalized in the primary remedial action (RA) report. To the extent possible, RA reports for individual work elements will be consolidated into a single RA report. The RA report will be prepared at the completion of remedial action and will include the following:

- A brief description of outstanding items from the prefinal inspection report
- Synopsis of work defined in the *RA Work Plan* and certification that this work was performed
- Explanation of any modifications to the *RA Work Plan*
- Certification that the remedy is operational and functional
- Documentation necessary to support a notice of completion as discussed in Part XXV of the FFA/CO (DOE-ID 1991). The documentation will be sufficient to support that no hrther remedial action, including institutional controls, is required.

6.10 Health and Safety Plan

The project HASP was prepared specifically for the tasks and conditions expected during implementation and execution of this project. It is provided in Attachment 2 of this document. The HASP, which may be updated as site and project conditions dictate, includes the following elements:

- Task site(s) responsibilities

- Recordkeeping requirements
- Personnel training requirements
- Occupational medical program and medical surveillance
- Accident prevention program
- Site control and security
- Hazard assessment
- Personal protective equipment
- Decontamination procedures
- Emergency response plan.

6.11 Field Sampling Plan

The field sampling work for the buried gas cylinders is comprised of two distinct strategies:

- Soil sampling
- Cylinder sampling.

The soil sampling strategies and procedures are identified in the *Preliminary Characterization Plan for OU-3-13, Group 6, RD/RA Buried Gas Cylinder Sites: CPP-84 and CPP-94* (DOE-ID 2001a) (Attachment 1). The procedures and strategies for sampling cylinders are provided in Section 7.

6.12 Waste Management Plan

The *Waste Management Plan* (WMP) defines projected waste streams, volumes of projected waste, methods of characterization, storage and inspection requirements, and treatment and disposition options. The anticipated waste streams for the removal action are as follows:

- Inert gases (nitrogen, oxygen, argon, carbon dioxide, and compressed air)
- Flammable gases (acetylene)
- Empty, dismantled inert gas cylinders
- Empty acetylene cylinders
- PPE and miscellaneous noncontaminated waste
- Soil sampling wastes
- New waste streams.

The WMP for the Group 6 remedial action is provided in Attachment 4.

6.13 Data Management Plan

The principal objective of data management is to provide consistent and rapid access to accurate, validated data useful in the evaluation of remedial actions. The data management for the buried gas cylinders remedial action is supported by two data management strategies: (1) the management of data associated with the collection of soil data and (2) the management of data associated with removal and characterization of cylinders.

The Data Management Plan for Idaho National Engineering Laboratory Environmental Restoration Program (INEL 1995) will be used to guide the data management of the analytical results from soil sampling. Analytical results from soil samples will be to

- Ensure that uncorrupted field data are transferred to a permanent, long-term, easily accessed data storage system
- Track and organize all chemical and nonchemical data pertaining to field activities and sample collection
- Ensure that the description of each data point is meaningful and complete
- Ensure that large volumes of data can be efficiently managed
- Ensure that each data point is accurate and readily accessible

The second data management strategy is focused on collecting and maintaining field and analytical data associated with the cylinders. These efforts are guided by the *Data Management Plan for Field and Nonchemical Data, OU 3-13, Group 6, Buried Gas Cylinders* (DOE-ID *200*1b, Attachment 5 to this document). Data that will be managed under this plan are as follows:

- Excavation details
- Surveydata
- Cylinder locations
- Cylinder classification
- Cylinder sampling
- Cylinder condition
- Magnetometer surveys
- Physical probing
- Staging and segregation areas

Laboratory chemical analyses of soil samples will be arranged through INEEL Sample and Analysis Management (SAM). Data generated from these analyses are subject to the data management requirements imposed by the SAM.

6.14 Quality Assurance/Quality Control

Quality assurance and quality control requirements for all phases of this project will be controlled by two INEEL documents. First, Section 13 of the "Project Management Plan, Environmental Restoration Program Management" (PLN-694) describes the quality assurance systems used for all phases of this, and all Environmental Restoration projects.

Second, the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10 and Inactive Sites* (QAPjP) (DOE-ID 2002) provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, completeness, and comparability.

6.15 Decontamination

Large decontamination activities are not expected during this project. It is unlikely that soil contamination will exist and the decontamination of cylinder bodies is unlikely since toxic gases are not expected at CPP-84.

If soil contamination is encountered, exposed surfaces of equipment used for excavation and sampling will be decontaminated at designated decontamination areas in each work zone by brushing and wiping until all visible traces of soil and soil-related staining have been removed. If all the soil/staining cannot be removed by simple brushing and wiping, decontamination solutions (e.g., water) will be used. The management of decontamination fluids is addressed in the *Waste Management Plan* (Attachment 4).

6.16 Operations and Maintenance

An operations and maintenance plan is not required because the remedy is for complete removal of the hazard. The excavation will be filled with a suitable backfill material that will allow for compaction. The area will be evaluated for subsidence as part of the 5-year project review.

6.17 Spill Prevention/Response Plan

Any inadvertent spill or release of potentially hazardous materials (i.e. cylinder contents, equipment fluids) will be subject to the substantive requirements contained in the INEEL Emergency Plan/RCRA Contingency Plan manual (PLN-114-2).

Handling of the material and/or substance shall be in accordance with the recommendations of the applicable material safety data sheets, which will be located at the project site(s). In the event of a spill, the emergency response plan outlined in the project HASP will be activated. All materials/substances at the work site shall be stored in accordance with applicable regulations in approved containers.

6.18 Premobilization

Premobilization efforts involve all work elements that must be completed before the excavation equipment arrives on the site to start work. This includes such work as securing a contract for equipment, surveying the proposed excavation locations, marking proposed locations for underground utilities, approval of a work control package, personnel training, and approval of vendor data submittals. The

final premobilization effort is a formal pre-job meeting at which the scope of work is discussed and HASP training is conducted. Any outstanding questions about the work to be performed are resolved at this meeting.

6.19 Mobilization

Mobilization of personnel and equipment to the site and initial preparation for operations will begin following the final work plan approval. Specialized equipment is required for site operations, including the following:

- Cat 320 or equivalent track-hoe excavator with containment grade polycarbonate operator shielding
- Case 580 or equivalent back-hoe with ERC Cylinder Grappler@attachment and containment grade polycarbonate operator shielding
- Cylinder racks with protective structure
- ERC emergency cylinder overpacks
- Shallow metal detector (White model 9400-DLMAX, or equivalent)
- Deep metal detector (Schonstedt Magnetic Locator Model CA-72 Cd, or equivalent)
- Real-time air monitoring equipment including photo-ionization detector, combustible gas indicator, oxygen meter, sulhr dioxide detector
- ERC Cylinder Recovery Vessel®
- ERC Valve Sampling Station®
- Mobile analytical equipment (MS and FTIR)
- Communications equipment
- Cylinder handling dolly
- Decontamination station
- Personnel protection equipment
- Spill control equipment
- Miscellaneous hand and power tools
- Support vehicles
- Portable sanitary facilities.

Temporary storage containers (International Organization for Standards **[ISO]** shipping boxes) will be established at the site for oxidizers, flammables, and other hazardous materials. These will be

identified with appropriate National Fire Protection Association (NFPA) placards. An inventory will be maintained of the contents of each container in the site office.

A meteorological station will be set up prior to operations. This station monitors wind direction, speed, temperature and humidity.

After all equipment and facilities have been established onsite, task procedures will be demonstrated. The demonstration will cover all major-processing components. All procedures, including emergency response procedures, will be periodically implemented on a test basis. The results of these tests will be recorded in notes and field logs and will be incorporated into the final RA report.

6.20 Excavation Operations

The excavation operation requires setting up the work areas, including: (1) an EZ, (2) CRZ, and *(3)* a SZ. The work zones are identified in Figure 6-1.

Tasks included in the excavation operation include excavation of the historical cylinder burial pit; stockpiling excavated soils; providing safe ingress and egress for equipment and personnel; exposing and retrieving buried gas cylinders; performing an initial assessment of the cylinders; and placing the cylinders in a segregated storage area.

6.20.1 Objectives and Approach

The objectives of the excavation operations are to:

- Conduct all operations in a safe manner for all personnel and the public
- Conduct operations to minimize emissions
- Conduct operations with safe sloping requirements to comply with 29 CFR 1926
- Monitor the operations in a real-time mode for possible volatile or explosive atmospheres soils that may be used as backfill
- Monitor excavated soils so that possibly contaminated soils are segregated from clean
- Remove the buried cylinders from the excavation area
- Perform an initial identification and assessment of the cylinders to facilitate segregation and storage
- Store the cylinders in a segregated storage area.

The excavation approach will include surveys (visual and physical, radiological, volatile organic compound, and magnetometer) prior to and during the excavation. This will provide a real-time evaluation of hazards. The initial site activities will be to set up the work zones including the EZ, CRZ, and SZ. An excavation control grid will be established by which progress will be measured and documented. Figure 6-2 is a schematic on how the excavation will proceed and the theoretical survey spacing. The control grid will consist of 20-ft x 20-ft work areas with a 2-ft x 2-ft sub-grid for accurate documentation of surveys and cylinder locations.

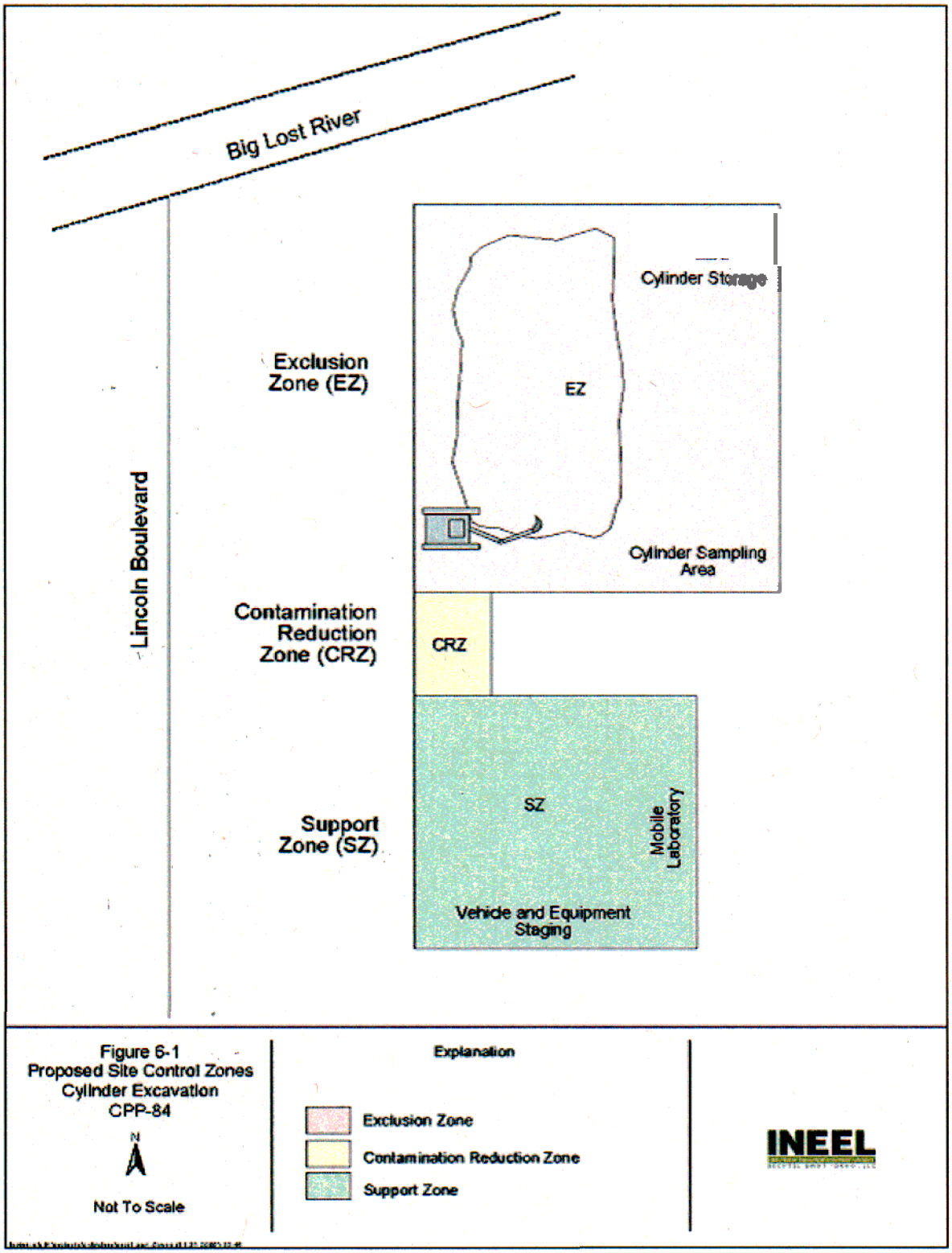

Figure 6-1. Proposed site layout.

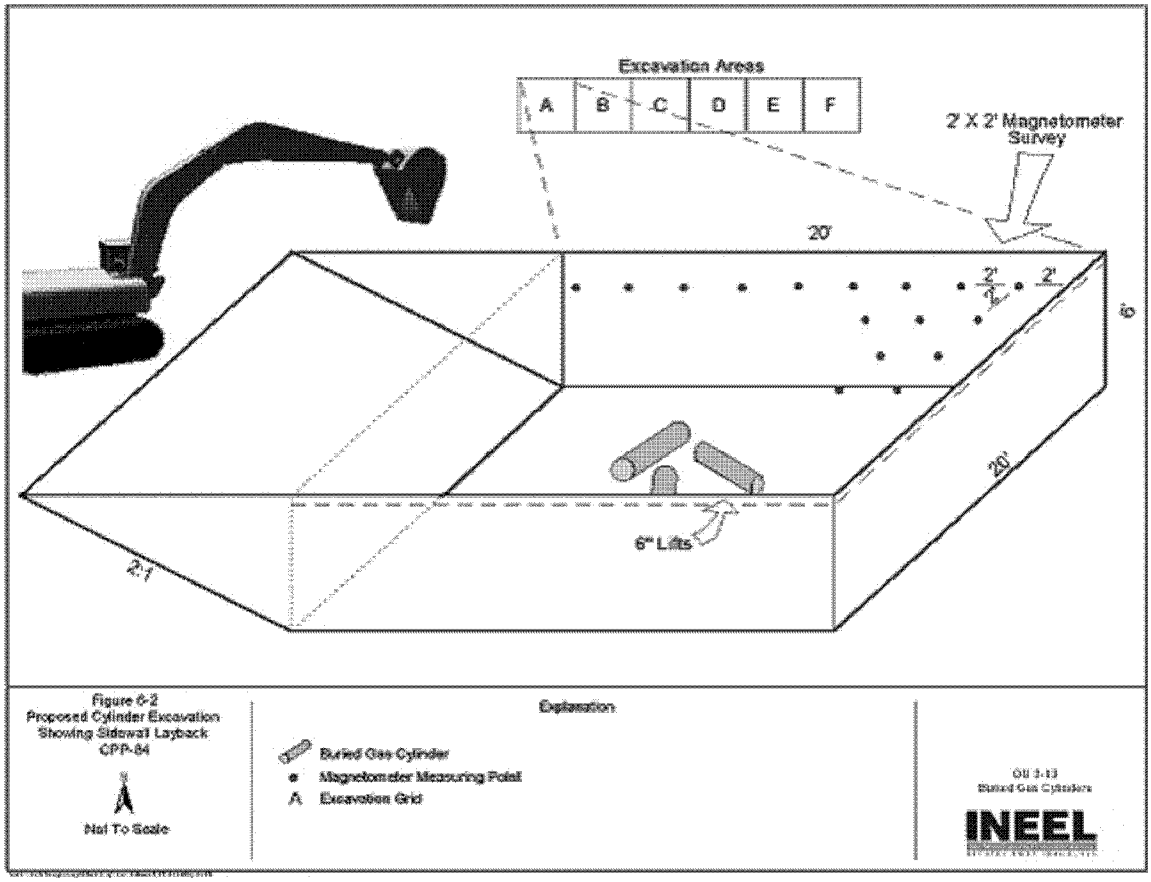

Figure 6-2. Schematic on excavation.

Work will take place sequentially in the control grid work areas starting in the southwest corner and working east then north. Figure 6-3 depicts the general excavation work flow. Shallow and deep magnetometer surveys and physical probing using a fiberglass soil probe will be used to identify buried cylinders. Mechanical excavation techniques using a track-hoe excavator fitted with a flat "toothless" bucket will be used for cylinders that are greater than 6-in. below surface or stacked laterally. Hand excavation techniques will be used to expose the cylinders. The excavation will be monitored for the presence of VOCs and explosive atmospheres periodically. Preliminary identification of the buried cylinders will be made as described in Sections 6.20.2.1 and 6.20.2.2 to confirm that they are "construction" gases (acetylene, argon, carbon dioxide, helium, nitrogen, and oxygen).

6.20.2 Safe to Operate Task

The Safe to Operate Task is intended to provide guidance for the monitoring of the excavations and the removal of cylinders from the excavation area to the storage area. These evaluations include magnetometer surveys, physical probing, physical inspections of the excavation, visual inspection of the cylinders, continuous measurement of VOCs in the atmosphere, continuous measurement of potential explosive atmospheres, and periodic radiological surveys. The Safe to Operate Task will be prior to the start of any site work and continuously throughout the performance of all other tasks. Figure 6-4 depicts the Safe to Operate Task workflow.

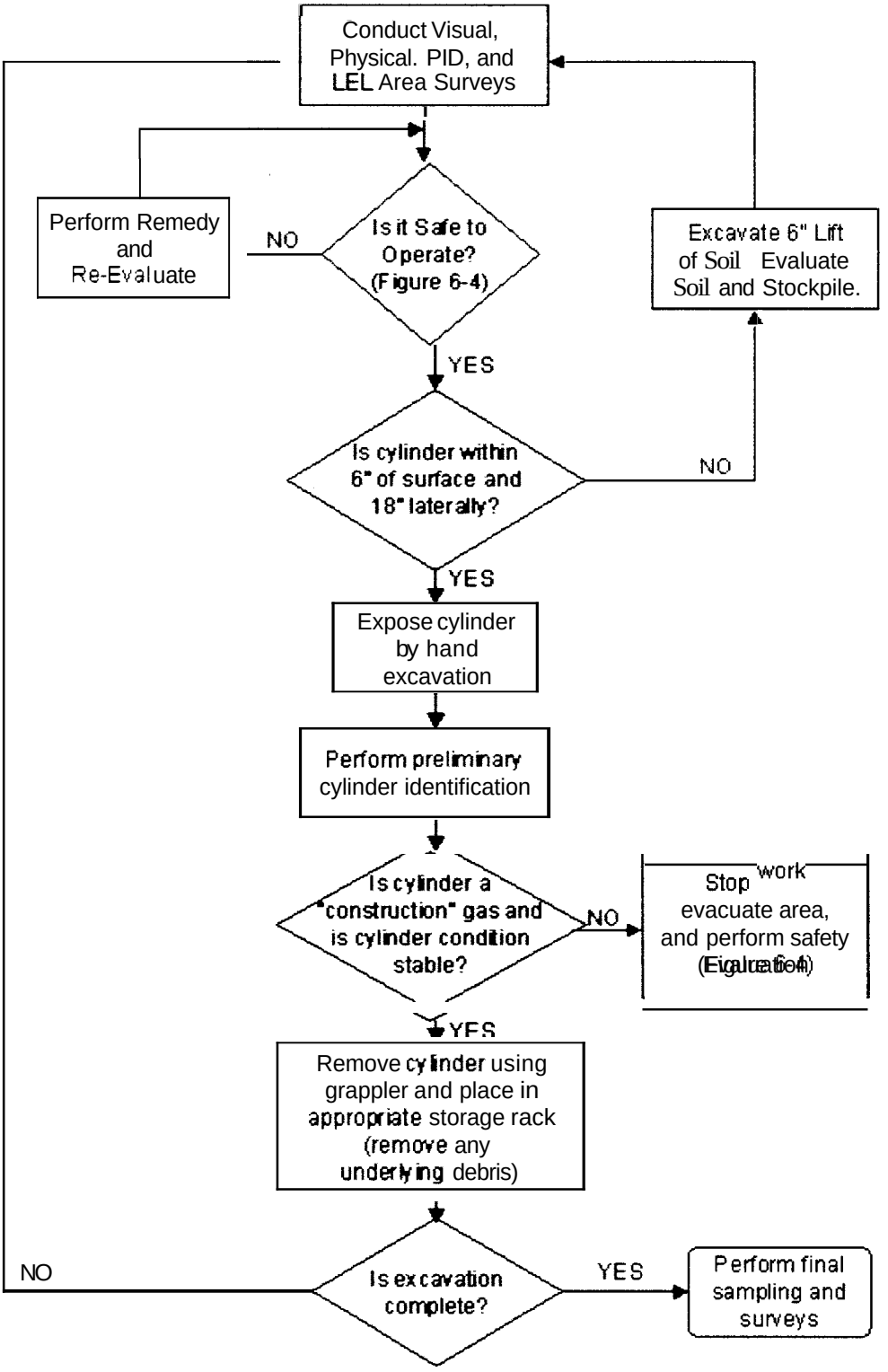

Figure 6-3. General excavation work flow

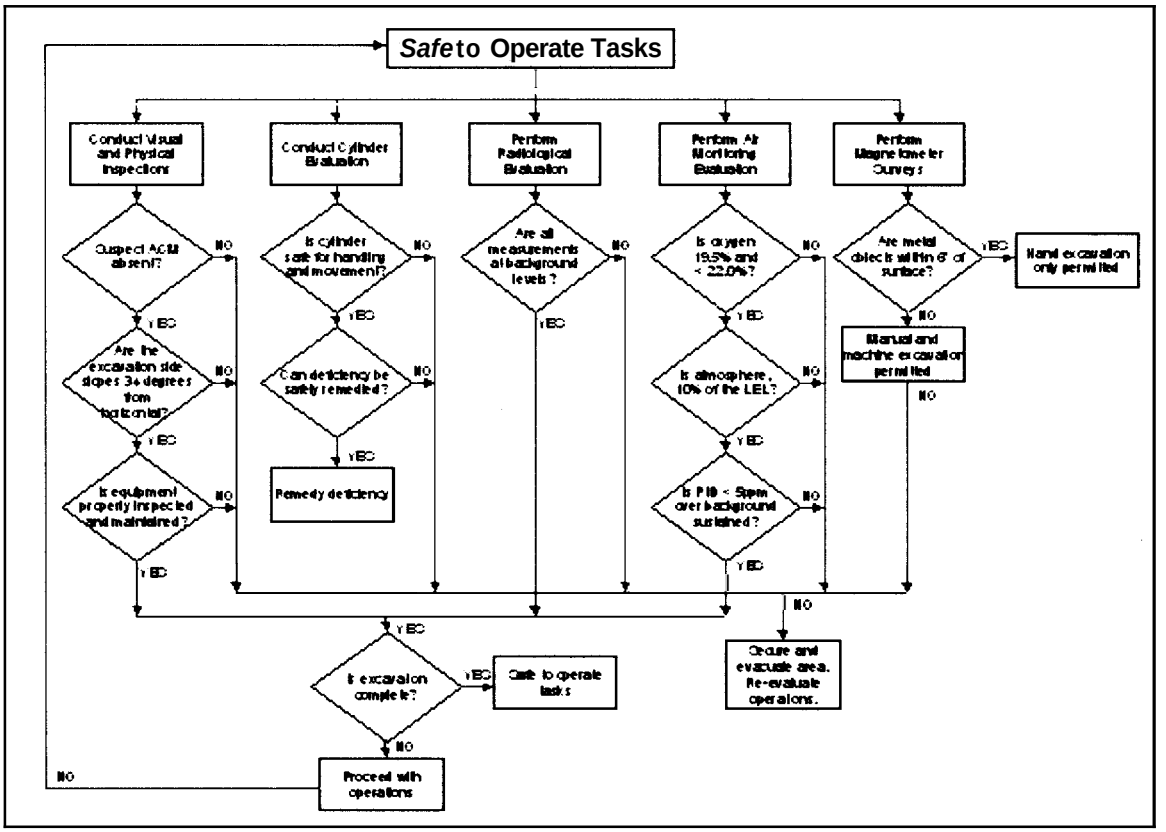

Figure 6-4. Safe to operate tasks.

6.20.2.1 Visual and Physical Evaluations. This section outlines the methods that will be used to evaluate the excavation site to ensure physically hazardous conditions are identified and corrected promptly. Visual evaluation of cylinders for identification and stability is covered in a separate section.

6.20.2.1.7 Responsibilities—The FTL or **HSO** (or designee) is responsible for ensuring that daily and on-going inspections are completed and documented, and for ensuring that work areas, equipment, vehicles, and safety barriers are in place and serviceable. They are also responsible for ensuring that corrective measures are implemented when hazardous conditions are discovered or reported.

Remediation technicians are responsible for identifying non-"construction" gas or unstable cylinders. They are also responsible for visual identification of suspect asbestos-containing materials from ruptured acetylene cylinders.

All personnel working in and around the excavation and cylinder storage areas are responsible for inspecting/monitoring work areas, vehicles, and equipment in their vicinity and under their control for compliance with general safety practices and serviceability. Each worker must immediately report unsafe conditions or unserviceable vehicles or equipment to their supervisor or site safety personnel.

6.20.2.1.2 Hazards Identification and ***Reduction***—Work areas, vehicles, and equipment will be inspected/monitored daily for safe conditions and serviceability by the worker responsible. A daily "tailgate" health and safety briefing will be conducted by the HSO and will cover the specific hazards expected to be encountered that day as well as general health and safety practices.

The FTL or HSO will monitor all operations and conditions and stop operations if unsafe conditions are observed or reported. They will ensure that immediate corrective actions are taken to maintain a safe working environment.

Acetylene cylinders commonly contain asbestos as a stabilizer. Acetylene tanks are expected to be found and will present an asbestos hazard in the unlikely circumstance that the cylinders are ruptured during removal activities or are found in a breached state.

6.20.2.1.3 Equipment and ***Materials***—

- Field logbooks/inspection forms
- First aid kit
- Fire extinguishers: (2) 4A-80B-C, (2) 3A-40B-C. Will be available and serviceable per 29 CFR 1926.50 and 29 CFR 1926.150
- Warning signs and safety barriers (construction fence, rope, barricades). Will be available and serviceable per 29 CFR 1910 and 29 CFR 1926
- Fragmentation protection (DSM Sheffield containment grade polycarbonate) screens for the excavator and remediation technicians
- Ground fault interrupter devices for generator for hand tools. Operated in accordance with 29 CFR 1926.300 and 29 CFR 1926.400.

6.20.2.1.4 ***Methods***—Physical hazards will be identified through visual observations and through daily inspections throughout the work site.

Suspect asbestos containing materials will be identified through visual observations of the cylinders and soils by asbestos awareness trained personnel. Particular attention will be paid to damaged or ruptured cylinders and soils surrounding damaged or ruptured cylinders. If suspect asbestos containing materials are observed, work will cease and the exclusion zone will be evacuated. A re-evaluation of personal protective equipment (PPE) and remedial techniques will be performed.

Excavations will be inspected by the competent person to ensure proper side slopes per 29 CFR 1926.651.

All work areas, ingress, and egress routes will be maintained free of debris, holes, or slippery surfaces.

Dust will be controlled in all work areas by watering with a hand-held sprayer or water truck.

Safety barriers including construction fences, ropes, and signs will be used to control access to hazardous areas.

Vehicles and heavy equipment will be inspected daily for serviceability by the assigned operator. Operators will ensure proper operation and use of parking brakes, backup alarms, warning lights, and seat belts in accordance with 29 CFR 1926.550 and 29 CFR 1926.600. Lift ratings will be checked and safe working loads must not be exceeded.

6.20.2.2 Cylinder Evaluation.

6.20.2.2.1 Responsibilities—The FTL, HSO, or designee will be responsible for performing the cylinder evaluation and completing the required documentation. All personnel within the excavation area will be trained in cylinder identification and are responsible for observing their general area and reporting unsafe conditions.

6.20.2.2.2 Hazards Identification and ***Reduction***—The primary hazard associated with the cylinder inspection is from gas leaking from the cylinders and causing asphyxiation, toxic exposures, explosions, and fires. These hazards are mitigated by the continuous air monitoring performed under the Air Monitoring Evaluation component of the Safe to Operate Task. Air monitoring of the cylinder valve area and in the vicinity of the cylinder will be performed prior to inspection.

6.20.2.2.3 Equipment and ***Materials***—

- Valve protection devices
- 35mm camera
- Instant camera
- Spray paint and stencils
- Brush
- Metal cylinder tags w/ punch set for marking
- Cylinder log forms
- CGA P-1, Safe Handling of Compressed Gases in Containers (CGA 2000b)
- CGA C-6, Standards for Visual Inspection of Steel Compressed Gas Cylinders (CGA 1993)
- CGA C-6.1, Standards for Visual Inspection and Requalification of High Pressure Aluminum Compressed Gas Cylinders (CGA 1995b)
- CGA C-6.2, Guidelines for Visual Inspection and Requalification of Composite High Pressure Cylinders (CGA 1996)
- CGA C-6.3, Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders (CGA 1999)
- CGA C-13, Guidelines for Periodic Visual Inspection and Requalification of Acetylene Cylinders (CGA 2000a)
- ANSI/CGA Standard V-9, Standard for Compressed Gas Cylinder Valves (ANSI/CGA 1991)

- CGA P-22, The Responsible Management and Disposition of Compressed Gases and Their Containers (CGA 1995a).

6.20.2.2.4 Methods—Cylinders will be individually inspected by the FTL, SSO, or designee. An evaluation of the cylinders will be performed to the maximum extent without removal of the cap or unnecessary handling of the cylinder. The inspection will compare cylinder external markings with the cylinder and valve type which will allow the correlation of the cylinder body with its internal contents. The inspector will also evaluate cylinder condition for stability during handling.

The inspector will approach the cylinder to be inspected but maintain adequate separation distance to avoid disturbing the cylinder. To the extent possible, without disturbing the cylinder, the personnel will complete the portions of the cylinder inspection log based on the visual examination. Pictures will be taken using the instant camera and 35mm camera. The instant photograph will be attached to the cylinder inspection log. Figure 6-5 provides an example of the cylinder inspection log.

Categorization of the cylinders for sampling technique is largely a matter of judgment based on the likelihood of valve operation and cylinder integrity. The cylinder must be safe for transportation to the temporary cylinder storage area. The inspector will make a determination on whether each cylinder is safe for handling and movement.

General criteria for safe handling includes the following:

- Extent of corrosion (i.e., percent of cylinder affected and criticality of affected areas)
- General appearance of valve as seen through cap (i.e., corrosion of valve or other damage)
- Type of cylinder valve
- Preliminary identification of contents through markings, color, and shape.

The CGA Handbook of Compressed Gases CGA, P-22, provides external inspection parameters. After the cylinder inspection for stability has been completed, the cylinder will be labeled and staged. Field personnel will record information concerning each cylinder on a cylinder inspection log. The log form includes the following:

1. Project Name. A unique project identifier will be assigned for each site. The unique identifiers for this project will be CPP-84 – Construction Gas Cylinder Landfill.
2. Cylinder Number. A unique identification number will be assigned for each cylinder. The numbering system will include the site (CPP-84) and a three digit sequential number (CPP-84-XXX).
3. Cylinder Grid Location. The work grid location (i.e., A1) from which the cylinder was excavated.
4. Date. The date of the cylinder inspection.
5. Inspector. The name and company of the individual completing the inspection.
6. Cylinder Serial Number. If available and legible, the serial number stamped on the shoulder of the cylinder.

Form 2

CYLINDER INSPECTION LOG

Project Name: _____ ERC #: _____

Date: _____ Inspector: _____

Cylinder Serial #: _____ Dimensions: _____

Color: _____ Owner Stamp: _____

DOT Rating: 3E1800 312015 3AA2400 3A2265

Other: _____ Test Date(s): _____

Cylinder Type: H.P. _____ L.P. _____ Valve Type: _____

Labels and/or Markings:

_____

General Condition: Good Fair Poor

Comments: _____

Valve Condition: Good Fair _____ Poor _____

Comments: _____

Pre-operation Weight: _____ Post-operation Weight:

Approved to Handle: Yes _____ No _____

Handling Precautions: _____

Approved for Valve Sampling: Yes _____ No _____

Sample Method: Large CRV _____ Small CRV _____ Val

Comments: _____

Sample Date: _____ Pressure: _____

Identified Contents: _____

Analytical Method: Mass Spec _____ FTIR _____ Other _____

Disposition: Caustic Scrub _____ Acid Scrub _____ Oxidizing Carbon

Mole Sinus _____ Flare _____

Recontainerized: Yes _____ No _____

Recontainerized Cylinder #: _____

"Use or disclosure of data contained on this sheet is subject to the restrictions on the title page of this plan."

ERC

Figure 6-5. Cylinder inspection log.

7. Dimensions. The approximate length and diameter of the cylinder

8. Color. Any visible coloration of the shell or cylinder cap

9. Owner Stamp. Any stamping on the cylinder shell indicating ownership.

10. ICC/DOT Rating. The specification and pressure rating of the cylinder based on stampings, if available and legible. Common cylinder types are listed on the form and may be circled as appropriate.

11. Test Date(s). Any stamped markings indicating test dates on the cylinder, if available and legible.

12. Cylinder Type. The cylinder type (high pressure or low pressure). In general, welded cylinders are considered to be low pressure and spun cylinders are considered to be high pressure. Cylinder types are illustrated in the cylinder reference documents.

13. General Cylinder Condition. A visual examination of the exterior of the cylinder will be recorded. The inspection will follow the guidelines established in the applicable cylinder reference documents for the cylinder type. Exterior defects such as corrosion, pitting, denting, bulging, or dings will be noted. A semi-quantitative measurement of the magnitude of defects will be recorded.

14. Cylinder Cap. The presence or absence of a cylinder cap will be noted. Any comments related to its appearance and potential removal problems will be noted.

15. Valve Type. If the cylinder valve is visible, the type of valve will be noted. The notation may be general (e.g. actuation mechanism, outlet type, diaphragm, packed) or, if known, the specific CGA identification (e.g., CGA 330). The presence of a plug or outlet cap should be noted. Figure 6-6 shows examples of several valve configurations.

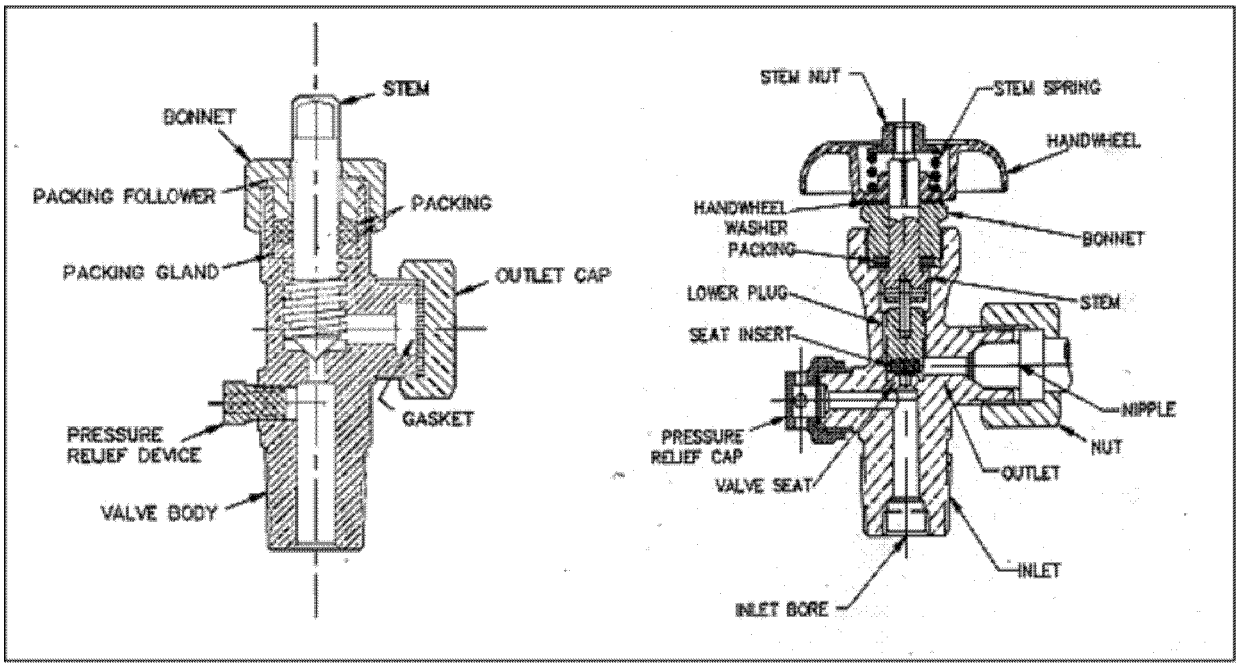

Figure 6-6. Examples of several valve configurations

16. Pressure Relief Device. The type and location of any pressure relief device will be noted.

17. Labels and/or Markings. Any information present on the cylinder should be listed. Of particular importance is any labeling concerning contents or hazards.

18. Approved to Handle. Field personnel will review the information obtained and make a determination if the cylinder is safe to handle. The field personnel will initial the determination. If the cylinder is deemed unsafe to handle, handling is prohibited until adequate precautions are developed and a re-determination of safe to handle is made.

19. Approved for Valve Sampling. The field personnel will review the information obtained and make a determination if the cylinder is suitable for valve sampling techniques. The field personnel will initial the determination.

20. Sampling Method Utilized. The method used to sample the cylinder will be recorded the conclusion of the process (VSS or CRV).

21. Laboratory and Process Information. A shaded section of the form is reserved for recording laboratory and processing information. It will be completed by the laboratory technician after verification sampling.

22. Analysis and Processing Comments. This area is provided for recording any observations associated with the analysis or processing of the cylinder.

23. Sample Date. The date the cylinder is sampled.

24. Pressure. The cylinder pressure observed during the sampling process.

25. Identified Contents. Results of the laboratory analysis listed by IUPAC chemical name. The field personnel will initial the identification determination.

26. Analytical Method. Analytical methods used to determine the contents

27. Disposition of Contents. The final disposition of the cylinder contents.

28. Disposition of Body. The final disposition of the cylinder body.

29. Recontainerized Cylinder Number. If applicable, the designated cylinder number containing the re-containerized contents will be listed by both the receiver project cylinder number and the receiver cylinder serial number.

A cylinder identification number will also be assigned and the cylinder will be labeled using spray paint and stencils, and by affixing a metal tag on the valve neck. The numbering system will include the site (CPP-84) and a three-digit sequential number (CPP-84-XXX). The cylinders will also be marked with the work grid location. The cylinders will be photographed and their location and depth recorded.

After the inspection, the cylinder will be classified. This classification will be used to determine the handling, transportation and sampling requirements for each cylinder. The cylinder classifications are defined below:

Unrestricted Cylinders - Cylinders classified as "Unrestricted" are in good condition and suitable for routine handling and transportation. They will be DOT-rated containers (with valve protection), which

are appropriately labeled. The contents are certified by the user and this forms the basis for subsequent handling. None of the cylinders from the excavation are expected to fall into this classification.

Restricted Cylinders - The "Restricted" classification will apply to the cylinders that meet CGA visual inspection criteria for filling and have external markings or features indicative of stable contents. The main difference between this classification and the "Unrestrictive" classification is the certainty of knowledge as to cylinder contents. None of the cylinders from the excavation are expected to fall into this classification.

Defective Cylinders - The "Defective" classification will apply to cylinders that do not meet CGA visual inspection criteria for refilling but appear to be structurally stable. These cylinders would be rejected for filling based upon external corrosion, dents, unauthorized or improper repair, or other observable defects such as fire damage or arc burns. Cylinders whose contents are unknown will also be classified as "defective". All or most of the cylinders are expected to fall into this classification.

Unstable Cylinders - "Unstable" cylinders are those that are in such poor condition that they may be unsafe to handle using typical techniques. This may result from extreme corrosion, damage to the cylinder shell, valve integrity, or unstable contents (i.e., unstabilized hydrogen cyanide). Upon identification of any cylinder in this type of condition the inspector will isolate the area by flagging. No hrther work will be completed in the area of such cylinders without providing for protection of others who may be working in the vicinity. Unstable cylinders may require special handling procedures (remote handling) or special transportation provisions (i.e., using a pressure vessel as an overpack). Unstable cylinders will violate "Safe to Operate" conditions and the excavation will be evacuated pending re-evaluation of work practices.

After classification of the cylinder as either unrestricted, restricted, or defective, personnel will prepare the cylinder for movement under direction of the FTL or SSO. The objective is to prepare the cylinder for routine handling. In the case where no valve protection is present, it will be necessary to provide protection for the cylinder valve. This will be done using valve caps or covers, or application of other protective structures. "Unrestricted" or "Restricted" cylinders will be loaded into cylinder racks for storage.

6.20.2.3 Radiological Evaluation. This section describes the methods and actions that are part of the Safe to Operate Task to detect radiological hazards. This section outlines methods to be employed by INEEL RCTs to identify radiological contamination in the Construction Gas Cylinder Landfill, CPP-84. Because radiological items were not identified as historically used at CPP-84 and no radiological contamination was identified in previous sampling, radiological contamination is not expected. Consequently, full-time radiological evaluation is not planned. RCTs will perform an initial survey of the site, periodic inspections during site work, and a final site survey.

6.20.2.3.1 Responsibilities The assigned RCT is responsible for performing radiological contamination surveys and for ensuring that personnel comply with the appropriate radiological requirements and controls. Soil surveys will be performed through various phases of excavating. Periodic surveys will be performed on excavation soil, samples, equipment, cylinders, personnel, and other items at the project site. Final surveys will be conducted when fieldwork is completed. The ER HSO has overall responsibility for radiological monitoring.

6.20.2.3.2 Hazards Identification and ***Reduction***—Radiological contamination hazards include gamma and beta radiations. The greatest potential for radiological contamination will be from the soil in the burial trench. Contamination in soil is of particular concern due to its mobility;

equipment, personnel, wind, rain, and other mechanisms can result in the spread of radiological contamination.

If contamination is detected, work will immediately cease. Further characterization and implementation of radiological controls will be conducted on a case-by-case basis.

6.20.2.3.3 Equipment and Materials

- Bicron/NE Electra (DP-6or AP-5 probe) or equivalent
- Eberline RM-25 (HP-380AB or HP-380A probe) or equivalent
- Grab Sampler – SAIC H-8 10 or equivalent
- Massilin cloth
- Smears
- Sample jars.

6.20.2.3.4 Methods—Soils at varying depths and locations within the excavation will be surveyed throughout the development of the excavation. All excavation equipment, tools, and personnel will be periodically monitored. Cylinders will also be surveyed. Samples, cylinders, and other items sent offsite will be surveyed for unrestricted release.

Final surveys on all equipment, and materials will be conducted when fieldwork is complete. This includes excavation equipment, tools, and specialized equipment such as the VSS and CRV.

Monitoring will be performed in accordance with INEEL procedures. Any contamination that is detected will be managed on a case-by-case basis as directed by the RCT.

6.20.2.4 Air Monitoring Evaluation. This section describes the methods and actions that are part of the Safe to Operate task to detect airborne contamination and hazards during excavation of the construction cylinder landfill, CPP-84. The possible sources of airborne hazards are acetone in acetylene cylinders, the flammable gases acetylene and propane. The acetone is present in acetylene cylinders as a stabilizing agent and will present a hazard only if the cylinder is damaged or ruptured. In addition to monitoring for acetone, oxygen, explosive atmospheres, and acetylene, monitoring will be conducted to identify unknown sources of contamination and exposure.

6.20.2.4.1 Responsibilities The HSO will use field instruments to conduct area surveys and will collect grab samples for head space analysis.

The site personnel will ensure that required surveys are performed and documented

All personnel working in and around the excavation and cylinder storage areas area are responsible for immediately reporting odors or soil staining to their supervisor or site safety personnel.

6.20.2.4.2 Hazards Identification and ***Reduction***—Any stained or discolored soils that are encountered during the excavation will be surveyed with the monitoring equipment. The soils will be monitored by area surveys and a grab sample taken in a plastic bag. The sample will be sealed and the soil agitated and warmed with a headspace reading taken.

Damaged or ruptured cylinders are to be considered a VOC hazard until surveyed. Damaged or ruptured cylinders will be surveyed by taking field instrument readings directly outside the rupture or damage. If a cylinder ruptures that contains dense gases, displacement of oxygen at the bottom of the excavation could occur. In this event, work will immediately cease, personnel will evacuate the area, and trained personnel wearing appropriate levels of PPE will conduct sampling of the area. Work will not resume until conditions are deemed safe.

Continuous area surveys of the excavation with field instrumentation will identify dangerous site conditions and help identify contaminated soils.

6.20.2.4.3 Equipment and ***Materials***—

- Photo ionization detector (PID) with a 10.2 Ev Lamp
- Tri-Gas Meter with lower explosive limit (LEL) detector, percentage oxygen sensor, and sulhr dioxide (SO_2) sensor.
- Ziploc® type plastic bags
- Field logbooks
- Field sample log form
- Calibration gas and regulator
- Calibration log form.

6.20.2.4.4 ***Methods***—PID and Tri-Gas Meter area surveys will be conducted prior to any site work and on an ongoing basis. The site health and safety officer will survey the excavation work area, cylinder storage area, and worker breathing zone areas documenting the results. The safety action level of PID measurement is any sustained reading of 5 ppm above background. The safety action level for LEL detector is 2%, the LEL for acetylene. The safety action level for oxygen is $< 19.5\%$ or $> 22\%$. The SO_2 sensor will be used to identify acetylene build up in the excavation. Per the manufacturer of the Tri-Gas Meter and SO_2 sensor, acetylene will read on a 1 to 1 basis on the SO_2 sensor. The action level will be any sustained reading 5 ppm above background.

PID headspace tests will be taken of any stained or discolored soils that are encountered during the excavation and approximately every 10 yd of excavated soil. An approximately 25-g grab sample of the soils will be collected directly into a plastic Ziploc® bag. The sample will be sealed and the soil agitated for approximately 10 s. A headspace reading with then be taken by inserting the PID intake tube into the bag with care taken not to introduce soil into the intake. The sample reading and location will be recorded.

The PID and Tri-Gas Meter will be calibrated daily and the calibration documented.

6.20.2.5 Magnetometer Surveys. This section describes the methods and actions that are part of the Safe to Operate task to detect buried gas cylinders by their magnetic signature during excavation of the construction cylinder landfill, CPP-84. The magnetometer surveys will locate compressed gas cylinders on or near the surface of the excavation area. These surveys will be ongoing throughout the excavation process.

6.20.2.5.1 Responsibilities—Field personnel will perform the magnetic surveys with guidance and direction from the HSO and FTL.

6.20.2.5.2 Hazards Identification and ***Reduction***—Magnetic surveys will be conducted prior to any digging operations. After each 6 in. excavator lift, a magnetometer survey will be performed. The surveys will be performed throughout the excavation work area. All contacts will be marked with nonmetallic pin flags or nontoxic spray paint. All contacts with metal will be considered as buried cylinders until proven otherwise. Items contacted close the surface will be carefully excavated by hand until exposed for inspection and identification as discussed in Section 6.20.2.2.

6.20.2.5.3 Equipment and Materials

- Shallow metal detector (White model 9400-DLMAX, or equivalent)
- Deep metal detector (Schonstedt Magnetic Locator Model CA-72 Cd, or equivalent)
- Nonmetallic pin flags
- Nontoxic spray paint
- Surveytape
- Field logbooks
- Previous geophysical survey maps.

6.20.2.5.4 Methods—An initial survey of the entire cylinder landfill area will be performed using the shallow magnetometer following the grid pattern to ensure no areas are missed. The shallow magnetometer will locate contacts within approximately 6 in. of the surface. Contacts will be marked by an orange nonmetallic pin flag or nontoxic spray paint. A second survey of the area will be performed using the deep magnetometer following the grid pattern to ensure no areas are missed. The deep magnetometer will locate contacts within approximately 48 in. of the surface. Contacts will be marked by a green nonmetallic pin flag or nontoxic spray paint. The results will be recorded on a separate map in a manner similar to the shallow survey.

Ongoing surveys, both shallow and deep, will be performed during all excavation operations. All areas will be surveyed prior to digging. All areas will be resurveyed after a 6 in. lift is excavated.

If contacts are believed to be close to the surface (within 6 in.), they will be exposed by hand excavation for inspection and identification. If contacts are believed to be deeper than 6 in., mechanical excavation will proceed in 6-in. lifts.

6.20.3 Site Setup Task

6.20.3.1 Excavation and Cylinder Storage Area Setup.

6.20.3.1.1 Responsibilities The FTL will direct the activities of the remediation technicians.

6.20.3.1.2 Hazards Identification and ***Reduction***—General construction work hazards apply to this task. Safe to operate evaluations will be performed prior to and during the task performance.

6.20.3.7.3 Equipment and Materials

- Orange construction fencing and T-posts
- Yellow polyethylene rope
- Warning signage
- Cylinder racks with protective structures.

6.20.3.1.4 Methods The excavation area will be laid out based on existing information including past geophysical surveys and anecdotal information. Plant personnel will clear the area for buried utilities. An Idaho Registered Land Surveyor will survey in the past geophysical survey and an initial magnetometer survey will be performed to confirm the layout area. Anomalies will be marked with nonmetallic pin flags or nontoxic spray paint. The excavation area is expected be 20 ft x 100 ft.

An EZ will be established around the excavation area with a 100-ft buffer to allow for unimpeded movement during excavation activities. The EZ will be delineated by orange construction fencing with signs will be placed on each side indicating the following:

1. Exclusion Zone
2. Danger – Remediation Area
3. Authorized Personnel Only
4. PPE Required.

The excavation will be subdivided into a 20-ft by 20-ft working area grid with 2-ft by 2-ft subdivision for documentation purposes. The working grid will identified north-south by alphabetic characters and the east-west by numbers (i.e., A1, D10, etc.).

A personnel entrance and equipment entrances will be established leading from the EZ to the CRZ and to the cylinder storage and sampling area which is also an EZ. The CRZ will be demarcated using orange construction fence and will lead to the SZ. The SZ will be demarcated by orange traffic cones and will contain equipment and tool storage areas, and personnel break areas.

The cylinders will be temporarily stored in a designated storage area. This area will be an EZ and will demarcate by orange fencing and signs in the same manner as the EZ above. Cylinders will be

segregated into two categories, flammable and nonflammable, and staged in separate cylinder storage racks separated by at least 50 ft. Cylinders will be stored in a cylinder storage rack. Each cylinder rack will be situated at least 30 ft apart and clearly marked flammable or nonflammable (CGA P-22 [CGA 1995a]). The racks will be anchored to the ground with steel rebar and have straps to secure the cylinders.

6.20.4 Excavation Task

Excavation methods to be employed include mechanical and hand techniques. Use of robotic excavation will be considered if toxic gas or unstable cylinders are found.

6.20.4.1 Mechanical Excavation. Mechanical excavation will be used for efficient removal of soils a safe distance from buried cylinders. Mechanical excavation will be performed using a track-mounted excavator with a flat "toothless" bucket.

6.20.4.1.1 Responsibilities The FTL will direct the equipment operators and ensure they communicate as needed with the remediation technicians, and HSO.

Designated equipment operators will be the only personnel authorized to operate equipment. The equipment operator will be familiar with the safety features and operation of the equipment to which they are assigned.

6.20.4.7.2 Hazards Identification and ***Reduction***—Special hazards are associated with the heavy equipment used in mechanical excavation. These hazards and their mitigation steps are as follows:

- **Traffic** – These hazards include injury to personnel and damage to equipment due to collisions. Equipment operators will use spotters when backing. All personnel will maintain eye contact with equipment operators when moving around equipment.

- **Crushing and impact hazards** – These hazards include injury to personnel from being caught between the body and tracks of the excavator and personnel being hit by a swinging excavator bucket. These hazards will be minimized by limiting personnel access to areas within the "swing" area of the excavator bucket. Personnel will enter the "swing" area only after making eye contact with the operator. The equipment operator will not operate the equipment while personnel are within "swing" range.

- **Excavation stability** – The excavation will be sloped a minimum of 1.5-ft horizontally to 1-ft vertically (34 degrees from horizontal) in accordance with the INEEL procedures.

- **Damage to and rupture of buried compressed gas cylinders** – These hazards include damage to buried cylinders by crushing from equipment on top of buried cylinders and damage to cylinders from excavator bucket during mechanical excavation. The excavation equipment will not be driven over, or placed on top of, buried gas cylinders. The areas identified as containing buried cylinders identified by magnetometer surveys will be clearly marked with pin flags and nontoxic spray paint. Equipment operators will be briefed on the location of buried gas cylinders during each tailgate health and safety meeting. The continuous magnetometer surveys will minimize the possibility of the excavator bucket contacting cylinders causing a rupture. The excavator bucket will be "toothless" to minimize the damage to a cylinder caused by errant contact.

6.20.4.7.3 Equipment and Materials

- Cat 320 or equivalent track-hoe excavator with containment grade polycarbonate operator shielding
- Case 580 or equivalent back-hoe with ERC Cylinder Grappler® attachment and containment grade polycarbonate operator shielding
- Containment grade polycarbonate mobile barricades (48 in. x 60 in.)
- Fiberglass soil probe.

6.20.4.7.4 Methods—Excavation work will be performed in one 20-ft x 20-ft work area at a time. Soils will be excavated from the work area in 6-in. lifts. Continuous magnetometer and soil probe surveys will be conducted. Mechanical excavation will cease within 6 in. of a cylinder.

All personnel within the EZ will be behind containment-grade polycarbonate shielding during any mechanical excavation operations.

Excavation side slopes of at least 1.5-ft to 1-ft will be maintained for entire excavation. Personnel access ramps of 3-ft to 1-ft slope will be maintained for every 25 linear ft of excavation perimeter.

6.20.4.2 Hand Excavation. Hand excavation will be used for careful removal of soils close to buried cylinders. Hand excavation will be performed using nonsparking hand tools.

6.20.4.2.1 Responsibilities The FTL will direct the remediation technicians and ensure they communicate as needed with other field personnel.

6.20.4.2.2 Hazards Identification and Reduction—The hazards associated hand excavation is as follows:

Excavation stability – The excavation will be sloped a minimum of 1.5-ft horizontally to 1-ft vertically (34 degrees from horizontal) in accordance with INEEL procedures.

Damage to and rupture of buried compressed gas cylinders – These hazards include damage to buried cylinders by impact from shovels during hand excavation. The areas identified as containing buried cylinders identified by magnetometer surveys will be clearly marked with pin flags and nontoxic spray paint. Remediation technicians will be briefed on the location of buried gas cylinders during each tailgate health and safety meeting. The continuous magnetometer surveys will minimize the possibility of inadvertent shovel contact with buried cylinders. The remediation technicians will exercise care when shoveling around cylinders.

6.20.4.2.3 Equipment and Materials

- Containment grade polycarbonate mobile barricades (48 in. x 60 in.)
- Fiberglass soil probe
- Nonsparking hand tools.

6.20.4.2.4 Methods—Excavation work will be performed in one 20-ft x 20-ft work area at a time. Continuous magnetometer and soil probe surveys will be conducted. Soils will be

excavated mechanically from the work area in 6-in. lifts and will stop if a cylinder is within 6 in. Hand excavation will be performed within 6 in. of a cylinder.

> *Excavation side slopes of at least 1.5 ft to 1 ft will be maintained for entire excavation. Personnel access ramps of 3-ft to 1-ft slope will be maintained for every 25 linear ft of excavation perimeter.*

6.20.4.3 Robotic Excavation. Because CPP-84 is expected to contain only construction gas cylinders, robotic excavation is not anticipated. Robotic excavation will be considered if preliminary cylinder inspections or laboratory sampling indicate the presence of shock-sensitive or poisonous gases, incompatible gas mixtures, or unstable gas cylinders. Robotic equipment will not be mobilized to the site unless cylinders are identified that are determined to be too dangerous to allow personnel to perform the removal action.

The purpose of robotic excavation would be to allow excavation of cylinders that are too dangerous for personnel to be near. The robotic manipulator can also deploy air monitoring equipment and magnetometers. Visual observations are made through a closed-circuit camera mounted on the robotic manipulator. The following sections outline the specific procedures for robotic excavation in case it is required.

6.20.4.3.1 Responsibilities—Robotics personnel are responsible for setting up the robotics equipment and operating the robotics manipulator. These personnel takes direction to excavate soils, deploy monitoring equipment, and handle cylinders from the FTL.

6.20.4.3.2 Hazards Identification and Reductio —

Special hazards are associated with the heavy equipment used in robotic excavation. These hazards and their mitigation steps are as follows:

- **Crushing and impact hazards** – These hazards include injury to personnel from being caught between the body and tracks of the excavator and personnel being hit by a swinging excavator bucket. Personnel will not be in the excavation area during robotics operation.

- **Excavation stability** – The excavation will be sloped a minimum of 1.5-ft horizontally to l-ft vertically (34 degrees from horizontal) in accordance with INEEL procedures.

- **Damage to and rupture of buried compressed gas cylinders** – These hazards include damage to buried cylinders by crushing from equipment on top of buried cylinders and damage to cylinders from excavator bucket during mechanical excavation. The excavation equipment will not be driven over, or placed on top of, buried gas cylinders. The areas identified as containing buried cylinders identified by magnetometer surveys will be clearly marked with pin flags and nontoxic spray paint. Robotics personnel will be briefed on the location of buried gas cylinders during each tailgate health and safety meeting. The continuous magnetometer surveys will minimize the possibility of the excavator bucket contacting cylinders causing a rupture. The excavator bucket will be "toothless" to minimize the damage to a cylinder caused by errant contact. Threats to personnel are minimized because personnel are not allowed in the excavation area during robotic excavation.

6.20.4.3.3 Equipment and Materials

- Cat 320 or equivalent track-hoe excavator with ERC Cylinder Grappler® attachment and containment grade polycarbonate operator shielding. **Note:** No equipment operator will be present during robotic excavation.

- Schilling T3 remote-controlled lifting device, manipulator w/6D egress freedom.

- Trailer control center.

6.20.4.3.4 Methods The primary purpose of robotics excavation is to eliminate human exposure to hazards deemed excessively dangerous. In these situations, robotics excavation will be used to uncover, inspect, survey, and remove cylinders from the landfill.

6.20.4.4 Removal, Segregation and Storage of Cylinders. This task consists of the actions to remove the cylinders from the excavation and move them to the temporary cylinder storage area. This task follows the preliminary cylinder evaluation and is only performed on "stable" cylinders with proper valve protection.

6.20.4.4.1 Responsibilities The equipment operators and remediation technicians will perform the removal, segregation, and storage of the cylinders under the immediate supervision of the cylinder identification task manager.

6.20.4.4.2 Hazards Identification and *Reduction*—

- **Traffic** – These hazards include injury to personnel and damage to equipment due to collisions. Equipment operators will use spotters when backing. All personnel will maintain eye contact with equipment operators when moving around equipment.

- **Crushing and impact hazards** – These hazards include injury to personnel from being caught between the body and tracks of the excavator and personnel being hit by a swinging excavator bucket. These hazards will be minimized by limiting personnel access to areas within the "swing" area of the excavator bucket. Personnel will enter the "swing" area only after making eye contact with the operator. The equipment operator will not operate the equipment will personnel are within "swing" range.

- **Excavation stability** – The excavation will be sloped a minimum of 1.5-ft horizontally to 1-ft vertically (34 degrees from horizontal) in accordance with INEEL procedures.

- **Damage to and rupture of buried compressed gas cylinders** – These hazards include damage to buried cylinders by crushing from equipment on top of buried cylinders and damage to cylinders from the grappler device during cylinder retrieval. The excavation equipment will not be driven over, or placed on top of, buried gas cylinders. The areas identified as containing buried cylinders identified by magnetometer surveys will be clearly marked with pin flags and nontoxic spray paint. Equipment operators will be briefed on the location of buried gas cylinders during each tailgate health and safety meeting. The continuous magnetometer surveys will minimize the possibility of the backhoe driving over cylinders causing a rupture. Technicians will be behind the polycarbonate barricades during the initial cylinder retrieval efforts.

6.20.4.4.3 Equipment and Materials

- Case 580 or equivalent back-hoe with ERC Cylinder Grappler® attachment and containment grade polycarbonate operator shielding
- Containment grade polycarbonate mobile barricades (48 in. by 60 in.)
- Two rubber tire cylinder dollies
- 10 six-cylinder racks
- 32 %-in. x 24-in. steel rebar lengths for securing cylinder racks.

6.20.4.4.4 Methods The cylinders will be removed from the excavation with cylinder grappler attachment on a backhoe. The cylinders will be placed on a flat area approximately 10 ft outside the excavation. The remediation technicians will transfer the cylinders to the storage area using a cylinder dolly.

The cylinders will temporarily stored in a designated storage area. This area will be an EZ and will demarcated by orange fencing and signs as described in the site setup task. Cylinders will be segregated into two categories, flammable and nonflammable, and staged in separate cylinder storage racks separated by at least 50 ft. Cylinders will be stored in a cylinder storage rack. Each cylinder rack will be situated at least 30 ft apart and clearly marked flammable or nonflammable. The racks will be anchored to the ground with steel rebar and have straps to secure the cylinders.