EMERGENCY PREPARATION AND GREEN ENGINEERING TOOL

by

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B.S., Benedictine College, 2005

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Chemical Engineering
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2008

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Abstract

As our society continues to better prepare itself to address biological, radiological, chemical, and environmental emergencies, there is a need for better and more readily available emergency planning information for program managers and military/business personnel. An online hazardous materials and emergency planning tool for the Environmental Knowledge and Assessment Tool (EKAT: www.ekat-tool.com) would adequately fill that need.

The proposed online Emergency Preparation and Green Engineering (EPGE) tool would provide the user with information regarding links to local emergency response teams and resources, guides for developing emergency plans and reports, Hazardous Materials (HAZMAT) training information, case studies to illustrate HAZMAT situations, and the ability to judge the environmental friendliness of chemicals. In this way it will serve as a means of facilitating and educating individuals for best responses in an organized fashion.

In order to address their environmental responsibilities, public and private organizations are adopting Environmental Management Systems (EMS). The EPGE tool can be used in conjunction with Environmental Management Systems (EMS) to begin to address sustainability in a more practical setting. Currently the development of a comprehensive tool that identifies environmental, health, and safety concerns along with supplying relevant emergency data would be applicable to any business or organization. This tool will be available as an initial building block for the sustainability of the company. It can be used as a guide to better characterize and solve the environmental issues that could affect any business.

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Acknowledgements

I would like to express sincere thankfulness to my major advisor, Dr. Larry E. Erickson, for his support, guidance, and worldly exposure during my entire work with him. He challenged me in ways I felt I was not prepared for, and made me a better man for it. Also I would like to express my sincere gratitude to Dr. Jennifer Anthony, Department of Chemical Engineering, for guiding, and advising my research. She was a good friend and teacher throughout my work and studies with her. In addition, I would like to express thankfulness to Dr. John Pickrell, for guiding me, and offering his informed insight to my project.

I am also grateful to my friend Mr. Ryan Green, Center for Hazardous Substance Research, for his friendship and continued counseling. He was always there for me, and the positive impacts he has had on my life may never truly be revealed to me. I am thankful to my department colleagues, Mr. Tyler Selbe, Mr. Kyle Swanson, Mr. Mohammed Hussain, and Miss Lynnette Vera for their advice and help during my work.

My acknowledgements could not be considered complete without the mention of my wife, parents, sisters, and brother in Kansas, Nebraska, and Iowa to whom I would like to express my most profound sense of gratitude for their mental support, faith in me, and encouragement during my graduate studies.

Finally, the research described in this thesis is partially funded through the award of a contract from the United States Marine Corps System Command (MARCORSYSCOM) to M2 technologies, Inc. This will allow the emergency planning and green engineering to be primarily developed for the Marine Corps with the prospect of adding new users in the future.

CHAPTER 1 - A Growing Need for Relevant Information

Introduction

At present, the demand for accurate environmental information and the availability of useful data is increasing at a brisk rate. Agencies such as the U.S. Environmental Protection Agency (EPA)[1] and others are contributing vast amounts of information to the Internet, along with an assortment of software applications to address hazardous materials release and emergency response. Paralleled with the information addition, there is a demand for the information to be accessible and more readily available. This is not only for immediate emergency situations, but also to save time and money on research costs for the preparation for anticipated emergencies.

One of the key goals of the Environmental Knowledge and Assessment Tool [1], EKAT[2], is to find a way to organize the immense quantity of environmental information available electronically in order to facilitate utilizing this information quickly, efficiently and easily. Environmental professionals can use EKAT as a resource to screen chemicals against regulatory safety, and health requirements, as well as to draft appropriate documentation, track risk management, or estimate life-cycle impacts [1].

EKAT is an internet-based program consisting of numerous automated tools to aid in addressing environmental and safety-related issues, which has been developed with funding provided by the Marine Corps. EKAT serves as a preliminary environmental, solvent, and air emissions screening tool for identifying environmental issues of concern, in addition to serving as a resource center with links to other references, tools, and databases. Information available in EKAT® has been reviewed by environmental professionals and is considered to be from reliable sources, including the EPA, the Occupational Safety and Health Administration (OSHA), and other federal agencies and departments [1].

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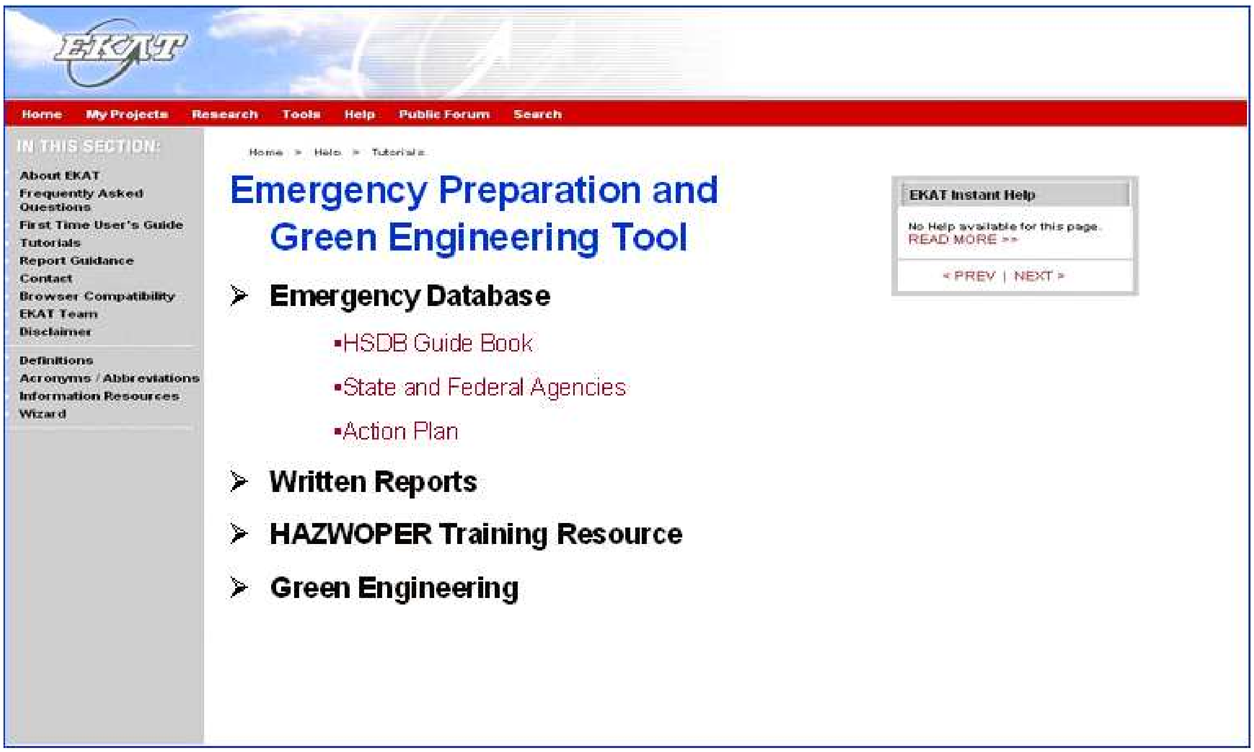
[1] Acronyms are defined in Appendix A.

[2] EKAT is a registered trade mark; however, the notation showing this is not included ever time EKAT is mentioned in this Thesis.

While content within EKAT begins to address emergency planning and response needs of users, a multi-faceted, interactive tool on this topic would directly benefit the Marine Corps as well as other potential users. It would be invaluable to have a tool that will not only guide one during hazardous materials (HAZMAT) emergencies, but also help users evaluate how chemicals affect health and environment. This work describes the Emergency Preparation and Green Engineering (EPGE) tool. The tool includes four sections; Emergency Database, Written Report Generator, HAZWOPER Training Resource, and a Green Engineering section; see Figure 1.1.

Figure 1.1 Example page layout for the EPGE tool



Present demand for the EPGE tool

The idea for this tool stems from the need for more complete, better, and more rapid availability of emergency planning information for program managers and installation/business environmental health and safety personnel. Emergency information is available on the Web, but accessing it and getting all the information that one needs can be time consuming. The Emergency Preparation and Green Engineering (EPGE) tool is designed to enable the user to find information quickly and easily.

Though the Internet is dependent upon electrical power and access, it can still provide significant advantages at a disaster or emergency site to increase the speed, safety and effectiveness of responders. A number of factors are increasing the need for network connectivity for disaster and emergency response professionals. A brief summary of these factors and further details about key drivers are presented below.

- Over time the disaster and emergency management community has developed effective processes to respond to crises. An Incident Command System (ICS), customized to the scale and nature of the event, is used by federal, state, and local agencies responding to a crisis. This process should be enabled by an underlying information technology (IT) infrastructure, and data networking can be utilized to significantly improve the enactment of the ICS.
- Communications support has historically been focused on voice. Though land mobile radio (LMR) systems can provide local and regional connectivity, and cellular telephone systems can provide national connectivity, Internet connections are rapidly becoming important as part of the IT infrastructure required for the ICS to gain information and make accommodations.
- There is an increasing need for the involvement of multiple federal, state, and local agencies with different charters. In addition, large scale disasters require response by agencies in adjoining jurisdictions. The lack of interoperability is most evident today with LMR systems where, for example, fire fighters from one city cannot communicate directly with fire fighters from an adjoining city who are trying to assist in an emergency situation [2].

This need for the EPGE tool and Internet connectivity develops in many different areas; this is especially true in the transportation industry. The events surrounding the attack on the World Trade Center on September 11, 2001 have forever changed the way that the United States and the world view emergency response to disasters. Since then, new technologies have been developed to make information more readily and completely accessible to first responders, and some of the previous ones have been updated to meet the new demands.

According to Horton [3], hazardous materials transported in the US exceed 800,000 shipments per day and result in the transport of more than 3.1 billion tons annually via air, ground, rail, and water. An estimated 63% of these shipments involve chemicals, while the remaining portions involve volatile petroleum products, medical wastes, and various other hazardous materials [3]. These substances include fuel, solvents, fertilizers, pesticides, paints, and household cleaning disinfectants commonly used by US consumers and industry. Although some hazardous materials are ubiquitous to daily life, many of them are corrosive, explosive, flammable, toxic and can be dangerous when improperly released. These materials are frequently transported over, through, and under densely populated or sensitive areas where the consequences of a hazardous materials release could result in environmental damage, severe injury, and loss of life [3]. Although most of these materials reach their destination safely, hazardous materials releases during transit do occur and have the potential to cause substantial adverse public health consequences.

Data from sixteen state health departments that participated in the Agency of Toxic Substances and Disease Registry's (ATSDR) Hazardous Substance Emergency Events Surveillance (HSEES) system were analyzed to determine the public health consequences that occurred from actual releases in transit. Of the 9392 transportation events analyzed, 9.1% resulted in injury and/or death. Most often, the population groups injured were employees, and the most common injury sustained was respiratory irritation. Evacuations were ordered in 5.5% of events affecting at least 63,686 people [3]. Human error and equipment failure were the most commonly reported factors leading to hazardous material emergencies.

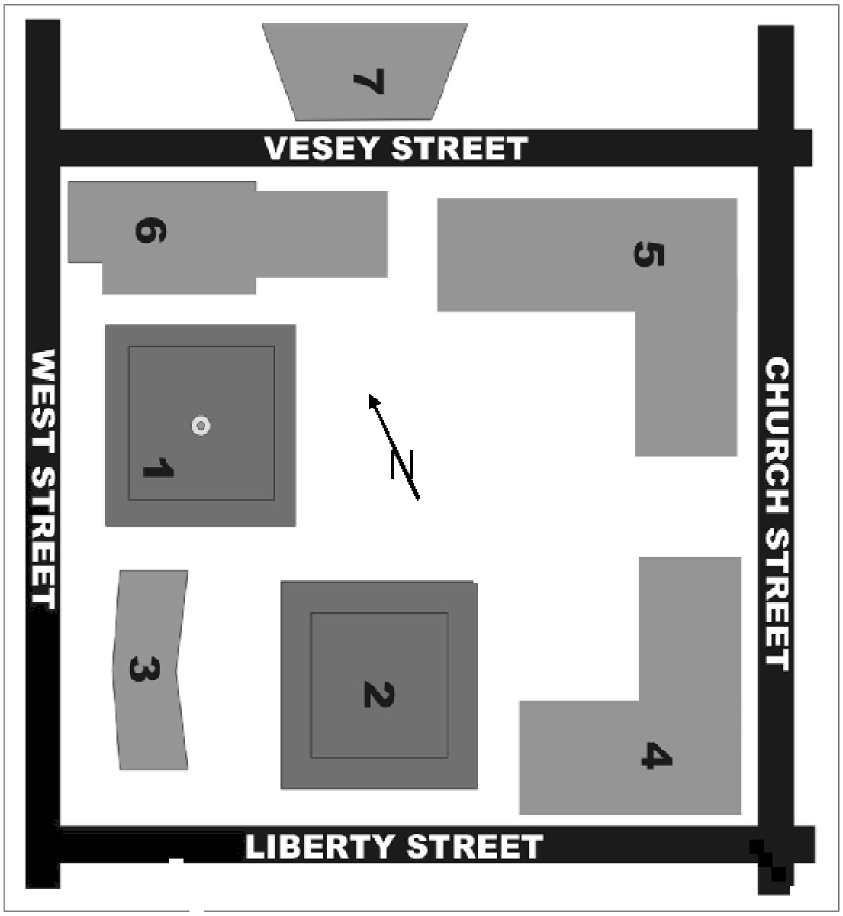
As the total amount of hazardous materials produced is forecasted to grow, the risk to the public's health could increase unless optimal courses of action can be made available in routine scenarios. Furthermore, it can never be assumed that the current emergency planning will be effective for all situations, and it is important to recognize that even the most prepared system cannot plan for every event. New York City is a great example of this. As one of the most diverse, urban centers in the United States, New York City felt the need to develop an Office of Emergency Management to coordinate communications and direct resources in the event of a mass disaster. Practice drills along with various emergency plans were put in place to assess and improve disaster preparedness. September 11, 2001 began with the unimaginable events and as events unfolded, previous plans based on drills were found not to address the unique situations faced and new plans evolved out of necessity.

In the event of a natural or manmade disaster, coordination of all aspects of the response in New York would be controlled through the Office of Emergency Management (OEM) [4]. The OEM had its headquarters in 7 World Trade Center and communication was based off the antenna on 1 World Trade Center (Fig. 1.2). Damage by falling debris and fire caused 7 World Trade Center to collapse less than 9 hours after the initial strike. The coordination of the response of the emergency medical systems, the New York Police Department (NYPD), and the Fire Department of New York (FDNY) was significantly impaired by the loss of its center of communications and many key personnel. During this attack, scene management was especially complex because of the diversity of the emergency medical systems response. In addition due to the early disruption of its communications tower and, later, the office of the OEM itself, communication between most hospitals and coordinators at the scene was almost nonexistent.

The struggle for communication because of the lose of the OEM, probably caused more problems than all other factors combined. Military strategists do not place their headquarters on the front line [4]. This teaching should hold true for all key civil communication and coordination centers. These centers should be housed in areas that are unlikely to be targets or at risk for collateral damage. If the communications center does go down and without further guidance, emergency medical systems crews will bring the injured to the closest hospital, further stressing existing resources. The triage of patients in urban and rural disasters is different and needs to be re-examined. That is why it is so important to have a tool that can aid the user in addressing these preparation issues. The EPGE tool allows the user to compose emergency response reports prior to these events, which can guide the responders though these difficult times.

It is difficult to anticipate all possible scenarios, because the unthinkable may become a reality. Cities need to have disaster plans that are tailored to specific scenarios and locations, which go beyond simple preconceived generalized plans. Airport plane crashes, stadium catastrophes, and remote mass transit accidents are all vastly different and require different responses. Further, it is important to be able to access remote databases, use Web sites and Web-based applications, and communicate with agency headquarters and other field command centers. Such capabilities can significantly improve the safety of responders and the effectiveness of the response.

Figure 1.2 The World Trade Center. (1) World Trade Center, North Tower — Communications Antenna; (2) World Trade Center, South Tower; (3) World Trade Center — Marriot Hotel; (7) World Trade Center — Office of Emergency Management [4].



Hazardous material training must become standard not only for trauma centers, but also in all hospitals [4]. The HSEES system information suggests some actions that can be taken in preparation for emergency response [3];

- Use federal, state, and local databases to determine where the highest numbers of releases are occurring,
- Develop emergency response plans before hazardous substance events occur,
- Ensure that employees and first responders who work with or around hazardous substances or contaminated victims undergo continuous job safety training, and have access to appropriate personal protective equipment (PPE),

- Emphasize the importance of preventive maintenance on equipment and vehicles used in transport,
- Route the transport of hazardous materials away form densely populated areas, where feasible.

The HSEES data, along with the events of September 11, suggests that the numbers of events where hazardous substances are released are increasing. While most releases are small scale releases, adverse public health consequences such as injuries, deaths, and evacuations do occur. These injuries primarily affect employees, members of the general public, and first responders. The occurrence of these events underscores the importance of employee training to help prevent future events from occurring and the importance of effective emergency planning and response to events at the community level, once a release has occurred.

Available Information

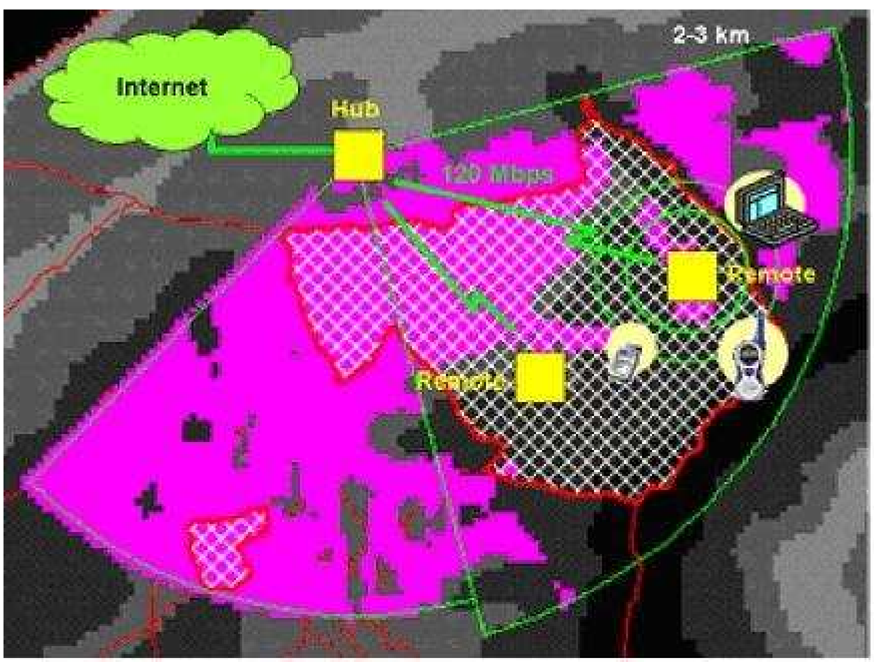
To address the increasing demand for the availability of better information, researchers are developing tools and databases that can more speedily, reliably, and completely meet the requirements of a first responder to an emergency. Some tools like Chemical Biological Response Aide (CoBRA®) [5] have been in place for some time and only need to be updated to meet current demands; however, there are many new tools that are currently being developed, which may be used in addition to the proposed Emergency Preparation and Green Engineering tool.

Virginia Tech's Center for Wireless Telecommunications (CWT) is investigating a rapidly-deployable wireless communications system for disaster and emergency response. Their goal is to provide a 120-Mbps (megabytes per second) backbone network to link a hub and up to eight field units [2]. The hub can connect to existing network infrastructure or use a satellite to provide connectivity to a global network. Alternatively, the system can be used to provide connectivity as a node - only within the disaster area. The field units provide Ethernet access to network devices, and can be extended to local area networks at remote sites. Using virtual private networks, security can be provided just over the wireless backbone or from users back to agency networks [2].

The CWT's system features three innovations to enable rapid deployment and hearty operation. First, a Geographic Information System (GIS) based tool generates coverage estimates to evaluate options for initial placement of the hub and field units. Second, a unique, low-cost broadband channel sounder is integrated into the hub and field units to allow "on-the-fly" channel measurements. The third pioneering feature of the system is an adaptive data link protocol that adjusts error coding and error recovery schemes during operation [2]. This configuration utilizes more reliable information to adjust link strength based on channel conditions, thus making the system more adaptable to less than optimal deployment.

According to Midkiff and Bostian [2], a hub or base station "illuminates" the disaster area using broadband wireless technology, as shown in Figure 1.3. Remotes or field units placed within the illuminated area connect to the base station to send and receive data. A GIS-based tool is used for initial site planning. The magenta region within a sector represents the area visible from a hub placed at the position indicated [2]. Remote field units can be placed at any location in the covered zone. Additional coverage using non-line of sight paths can also be considered.

Figure 1.3 System concept of illuminating the disaster area with broadband wireless [2].



The hub provides connectivity to the remote units and to the Internet, using either existing infrastructure or a satellite connection. The remote units provide connectivity to personal computers, notebook computers, personal digital assistants (PDA), voice over Internet protocol (VoIP) terminals, and other networked devices using wired and/or wireless local area networks (WLAN).

The team at Virginia Tech has the objective to provide a data rate of 120 Mbps, but as a starting point they used radio frequency (RF) spectrum in the licensed local multipoint distribution service (LMDS) band, which is between 28 and 31 gigahertz [2]. In theory, this band can support data rates of one gigabit per second. The system they are developing has a range, or maximum distance between the hub unit and a remote unit, of 2 to 3 kilometers. This range limitation is due to the use of off-the-shelf radios that were donated. Radios designed specifically for this application could achieve a range of 10 to 15 kilometers [2].

Security is of particular concern in wireless networks. The band that is utilized for this system greatly reduces the vulnerability to casual eavesdropping, which is a primary concern with the common Institute for Electrical and Electronics Engineers (IEEE) 802.11 wireless LANs. For stronger security, virtual private network (VPN) are an appropriate solution. A VPN provides secure end-to-end transport, thus protecting traffic over the wireless link, as well as over the public network that is likely to be used to carry traffic back to agency networks. In addition, multiple VPNs can isolate traffic and network resources belonging to different agencies that are sharing a common wireless network.

This approach utilizes three unique capabilities that enable rapid deployment and robust operation for emergency and disaster response applications.

- A Geographic Information System (GIS) “viewshed” analysis tool can be used for “on-the-fly” site planning to determine coverage within the disaster area and to indicate optimal locations for the hub and remote units. Viewshed analysis is especially important given that LMDS and other nearby bands require line-of-sight connections between the hub and remote units. The opportunity also exists for viewshed analysis to use measurements from the built-in sounder to improve its prediction and to suggest alternative locations [2].
- The hub and remote units include an integrated broadband channel sounder. More precisely, this unit is a “sampling swept time delay short pulse sounder.” Sounders are commonly used for site planning to assess radio frequency (RF) channel characteristics, but they are expensive. Development of a novel sounder

design is under way that lowers the cost to a point where it is feasible to build the sounder into the hub and remote units. A built-in sounder simplifies initial equipment set-up and allows for continuous monitoring of the RF environment that may change, for example due to the movement of trucks or heavy equipment at a disaster site [2].

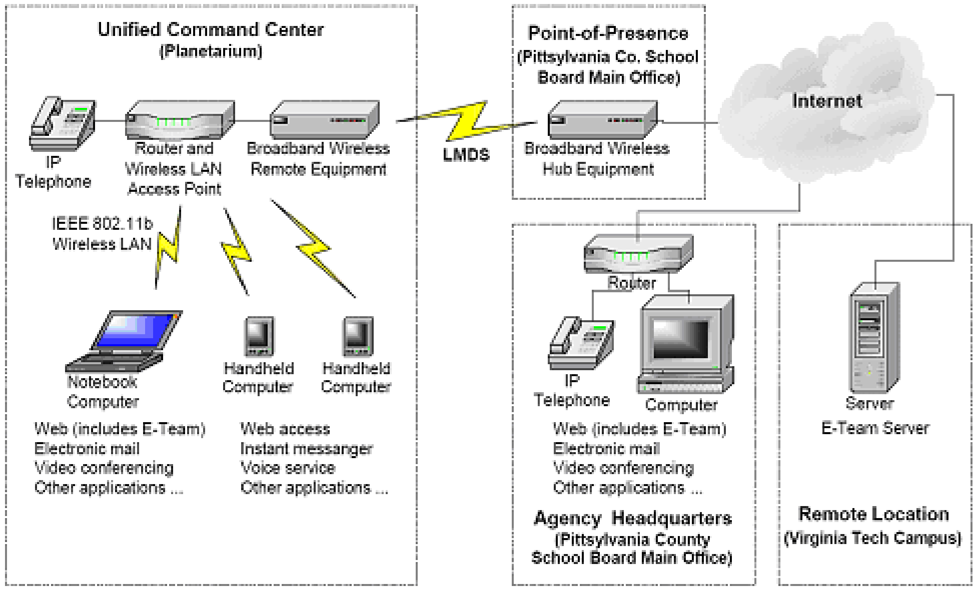
- The communications link between the hub and remote units can adapt to changes in the quality of the connection. Based on current conditions, as indicated by the built-in sounder and detected errors, an automatic retransmission request (ARQ) function is selectively enabled or disabled and forward error correction (FEC) coding is dynamically set to different levels of protection against bit errors. The goal of this data link adaptation is to achieve optimal operation based on run-time versus design-time conditions [2].

While development of the full system was not yet complete, a successful demonstration of an early prototype system was given to federal, state, and local government officials in November 2001 and January 2002. The system consisted of two stations, a hub and a remote, connected by a 10-Mbps link using LMDS. The prototype system used off-the-shelf networking equipment and 28-GHz radios. The hub was connected to the Internet. Access at the “remote” site was extended using both an IEEE 802.11b wireless LAN and a 10-Mbps Ethernet LAN.

Figure 1.4 shows the system configuration for the January 2002 demonstration, held in Chatham, VA. The “Unified Command Center” in the left portion of the figure is the remote site. The configuration for the November 2001 demonstration, held in Blacksburg, was similar.

The Rapidly-Deployable Broadband Wireless Network is an example of a current tool that will soon be available to first responders. Though this tool does offer many advantages over just looking up the information yourself, it still has short-comings in comparison to the EPGE tool. The EPGE tool offers more preparation for the emergency with its report generating section, training recourse section, and the ability to search for more environmentally friendly chemicals with the green engineering segment. This broadband wireless network tool does, however, offer advantages to the immediate emergency responder with its remote access through personal computers and hand held devices, but the information database of the EPGE tool can be used effectively in immediate emergency situations.

Figure 1.4 Prototype system used for January 2002 demonstration [2].



Though the Rapidly-Deployable Broadband Wireless Network is in the development stage, there are similar tools that are already available to emergency responders. One specific example of this is the Chemical Biological Response Aide (CoBRA®) [5]. CoBRA® is a portable decision- support tool that facilitates first responders' work in hazardous material accidents and attacks. Prior to September 11, and other recent disasters, CoBRA® supported first responder teams through guides, reference indices, and interactive checklists. While these functions are helpful in decision making, the system did not provide tools that allowed first responders to visually represent disaster scenarios. The following visual tools were added to CoBRA® as a result of this project:

- Automated briefing tool (ABT)
- A sketchpad tool that uses GIS
- ATP 45 tool that allows users to map out regions affected by chemical and hazardous materials [5]
- Global Positioning System (GPS) tool [5]

As noted above, this tool attempts to meet the need for improved information, management, and communication within first responder teams. Evident in a quantitative analysis, the added visualization tools ultimately improved the information and management of disaster situations.

During a disaster emergency, first responders gather important field data that decision-makers need to make informed decisions regarding response strategies. The automated briefing tool (ABT) is designed to expedite the transfer of information from first responders to decision makers by automating this system into a computer program that collects, organizes, and distributes the field information to decision- makers. A PowerPoint presentation is then produced and emailed out to decision-makers, which facilitates the speed with which first responders handle disaster situations.

The sketchpad tool seeks to make maps more accessible and useful by using computer maps rather than paper. Computer maps are easier to view, update, change, and share with others. In turn, the increased use of these maps can improve information sharing throughout the response to a disaster situation, including operations planning, on-site briefing, communicating with key decision-makers, and training of other responders.

With the addition of the mapping application and the ATP 45 tool, organization and identification of the isolation and protection zones is made much simpler. For example, the following information can be found in one location using the ATP 45 interface: the source of the incident, the date and time of the incident, the size of the incident, the wind speed and direction [5]. Thus, this addition allows the user to visually observe the landmarks and intersections that mark the boundaries without any additional supplies.

The original CoBRA® failed to provide the capability to locate and visualize a first responder's position within a disaster scene; however, the design of the global positioning system (GPS) tool offers this capability by providing first responders with more accurate and useful information, like the user's current latitude and longitude coordinates [5].

The updated CoBRA® decision-support tool improves communication and management of first responder teams during response. Each aspect individually enhances different areas of response, while collectively they strengthen the quality and accuracy of information available to users. Even with the updates, CoBRA® still does not offer the user the option of preparing for the emergency in the way EPGE tool does. Although the user can hold practice drills using CoBRA®, the ability to access emergency reports, and training guidance a priori would be more valuable to the user. The EPGE tool does not yet offer any Geographic Information Systems (GIS) technology. It is extremely valuable for the user to have access to digital maps during the emergency, and suggestions about how that can be used with the Emergency Preparation and Green Engineering tool, will be offered later in this work.

CHAPTER 2 - The Emergency Preparation and Green Engineering Tool

Introduction

This chapter provides information on the Emergency Preparation and Green Engineering (EPGE) tool. Other related tools that are available include the Rapidly-Deployable Broadband Wireless Network [2] which offers many advantages over just looking up the information yourself. The updated Chemical Biological Response Aide (CoBRA®) [5] decision-support tool improves communication and management of first responder teams during response. The EPGE tool offers the opportunity for more preparation for emergencies with its report generating section, training resource section, and the ability to search for more environmentally friendly chemicals with the green engineering segment.

The purposed tool includes four sections; Emergency Database, Written Report Generator, HAZWOPER Training Resource, and a Green Engineering section.

- The Emergency Database is designed for the situation when there is an actual emergency and the user needs to know what to do. This section will provide specific contact information for regional HAZMAT, and emergency response teams, along with appropriate information for first responders.
- According to the OSHAct of 1970, "Your employer must make available information on safety and health hazards in the work area, precautions to be taken, and procedures to be followed in the event of an accident or exposure to toxic substance [2]." This means that every company must have available written emergency plans. The Emergency Preparation and Green Engineering (EPGE) tool could aid the user in creating, organizing, and quickly referencing this multitude of written plans or reports, which would make the process more efficient and possibly produce better results.
- A third integral part of the tool is the creation of a HAZWOPER training resource. This comprehensive resource allows users to stay up-to-date on emergency procedures, as well as give them the opportunity to learn more about a

specific topic. In addition, this section will give information related to training courses, training locations, and instructor contact information.

- The increased interest in sustainability, environmental concerns and government regulations has inspired the chemical industry in both innovation and reformulation of products that address a broad spectrum of human and environmental health and safety factors. Section four of the proposed tool is an environmental management/waste minimization component.

The following is a comprehensive explanation of the four proposed sections of the Emergency Preparation and Green Engineering (EPGE) tool.

Emergency Database

Response operations usually follow a sequence that starts with the notification of trouble and continues through the preparation of equipment and personnel for the next emergency. The Emergency Database is in place for the situation when there is an actual emergency and the user needs to know the appropriate action plan. This section will provide specific contact information for regional HAZMAT and emergency response teams, along with suitable action information for first responders. Though this section does offer valuable insight to first responders, it is important to note that the Emergency Preparation and Green Engineering (EPGE) tool is only an aid. The information given to the users in this section and in the ones to follow can only be used as a guide for an emergency, and can’t possibly have all of the answers to every unique emergency.

In any emergency situation the first step is always contacting the proper authorities. Off-site sources must be contacted to get assistance or to inform officials about hazardous conditions that may affect public or environmental safety. The telephone is the most common mode of off-site communication; phone hook-ups are considered a necessity on all but the most remote sites. All personnel must be familiar with the protocol for contacting public emergency aid teams such as fire departments, ambulances units, and hospitals. If there is no site telephone system, all personnel must know the location of the nearest public telephone. In addition, a supply of telephone change and necessary phone numbers must be readily available.

The types of contacts that are included in the EPGE tool are the National Response Center (NRC), regional HAZMAT teams, emergency response teams, state Fire Marshal's network, federal agencies, and the Chemical Transportation Emergency Center (CHEMTREC) Call Center. The list of contact information that will be included in the EPGE tool are available in Appendix B.

The National Response Center (NRC) should be contacted in the event of a significant chemical release [6]. The primary function of the NRC is to serve as the solitary national point of contact for reporting oil, chemical, radiological, biological discharges into the environment anywhere in the United States. In addition to gathering and distributing spill data for Federal On-Scene Coordinators and serving as the communications and operations center for the National Response Team, the NRC maintains agreements with a variety of federal entities to make additional notifications regarding incidents meeting established trigger criteria [7]. Details on the NRC organization and specific responsibilities can be found in the National Oil and Hazardous Substances Pollution Contingency Plan. A simplified discussion of NRC tasking is outlined below.

The NRC works cooperatively with many different agencies, but as an example the NRC completes the following reporting tasks for the Department of Homeland Security and the United States Coast Guard:

- Briefs the White House, Office of Homeland Security, Secretary of Transportation, and Chiefs of Modal Administrations regarding all significant transportation emergencies reported to the Center
- Provides information to the Coast Guard's Office of Marine Safety, Security, and Environmental Protection as needed for a variety of reports, studies, or Congressional Inquiries
- Receives and relays reports of incidents reportable under the Hazardous Materials Transportation Act
- Provides electronic and hard copy incident reports to various DOT agencies
- And provides notification to specific DOT and National Transportation Safety Board offices of transportation related incidents that meet certain pre-established criteria.

The NRC is staffed by Coast Guard personnel who maintain a 24 hour per day, 365 day per year telephone watch. NRC Watch Standers enter telephonic reports of pollution incidents into the Incident Reporting Information System (IRIS) and immediately relay each report to the pre-designated Federal On-Scene Coordinator (FOSC). The data that is collected by the NRC is made available to the general public under the Freedom of Information Act (FOIA) and can be queried on-line via their web site [7].

The regional HAZMAT team's contact information can be acquired from the Federal Motor Carrier Safety Administration (FMCSA) State/Regional Hazardous Materials Contacts [8]. This database offers not only the four regional contact numbers, but also phone numbers for all the individual states. The primary mission of FMCSA is to reduce crashes, injuries, and fatalities involving large trucks and buses. In carrying out this mandate the FMCSA:

- Develops and enforces data-driven regulations that balance motor carrier safety with industry efficiency
- Focuses on higher risk carriers in enforcing the safety regulations
- Targets educational messages to carriers, commercial drivers, and the public
- Partners on efforts to reduce bus and truck-related crashes.

The Fire Marshal's network is included because in general the Fire Marshal in the area is the person that oversees the emergency response project [9]. Although the Fire Marshal is in charge, it is also required to contact the appropriate federal agencies for most hazardous emergencies.

The CHEMTREC call center is a hotline for fire fighters, law enforcement, and other emergency responders to obtain critical information and assistance for emergency incidents involving chemicals and hazardous materials [10]. CHEMTREC's center is linked to the largest network of chemical and hazardous material experts in the world including response specialists within the carrier community, public emergency services, and private contractors. When necessary, Environmental Support Solutions (ESS) can establish direct communications between these experts, CHEMTREC personnel, and the responders at the scene of an incident [10].

Additionally CHEMTREC helps shippers of hazardous materials comply with the US Department of Transportation hazardous materials regulations 49 CFR 172.604 [10]. This regulation requires HAZMAT shippers to provide a 24-hour emergency telephone number on shipping documents that can be called in the event of an emergency involving the hazardous material that was shipped. CHEMTREC is a 24 hours per day 7 days per week resource that coordinates and communicates a broad range of critical information that may be needed by emergency responders in mitigating a hazardous material related incident. CHEMTREC resources include [10]:

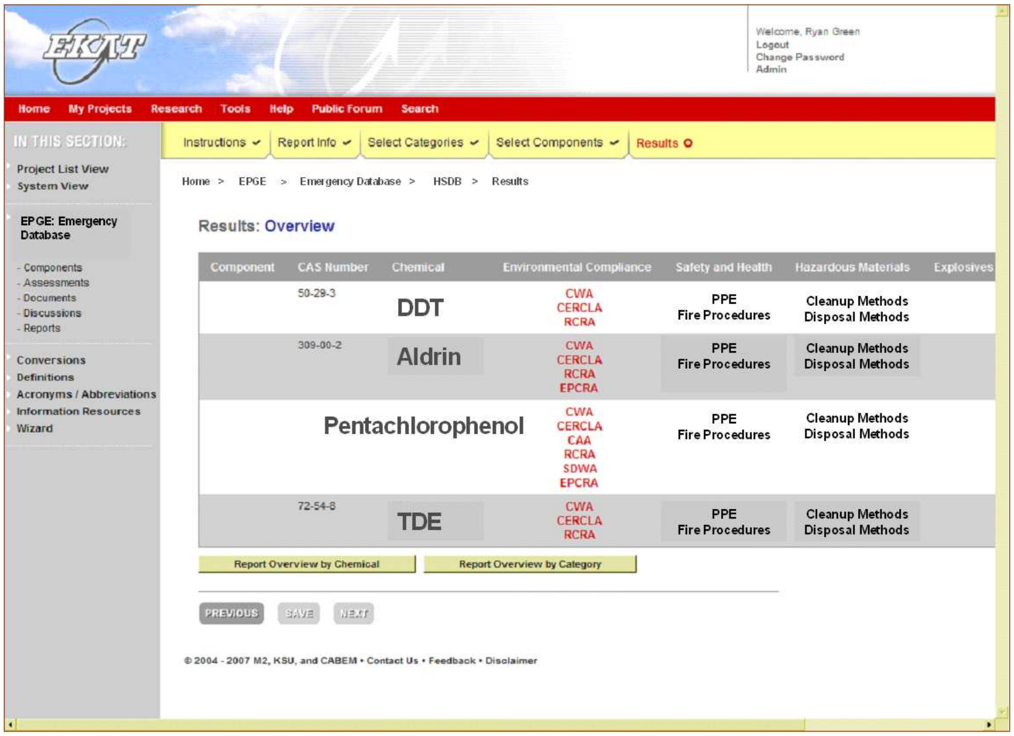
- Technical information that can be conveyed immediately to the scene in hard copy via fax, telephone, or electronically
- Direct access via CHEMTREC's telephone conferencing capabilities to thousands of shippers, manufacturing product experts and carriers
- Access to a network of chemical industry and for-hire contract emergency response teams to assist in product containment, spill mitigation and product removal.

Along with the contact information the Emergency database includes a section that is related to the Department of Transportation (DoT) guide book and the Wireless Information System for Emergency Response (WISER). This segment uses the Hazardous Substance Data Bank (HSDB) in conjunction with the format of the DoT guide book and WISER, Figure 2.1. The HSDB is a toxicology data file on the National Library of Medicine's (NLM) Toxicology Data Network (TOXNET®) [11]. It focuses on the toxicology of potentially hazardous chemicals. It is enhanced with information on human exposure, industrial hygiene, emergency handling procedures, environmental fate, regulatory requirements, and related areas. HSDB is peer-reviewed by the Scientific Review Panel (SRP), a committee of experts in the major subject areas within the data bank's scope [11].

With the information from the HSDB, a similar format as the WISER and DoT guidebook will be organized and utilized within EKAT. WISER is a system designed to assist first responders in hazardous material incidents. WISER provides a wide range of information on hazardous substances, including substance identification support, physical characteristics, human health information, and containment and suppression advice [12]. This part of the database will give the user information on correct protective equipment and physical information about a chemical. WISER acquired their database from the National Library of Medicine (NLM) and the HSDB, however, because of licensing issues EKAT is not able to incorporate WISER into its

Web site. Therefore the data bank was licensed through the NLM for EKAT, and this segment will be modeled off the WISER tool, but will not be an exact replica of the tool.

Figure 2.1 Page layout for the HSDB results



The Emergency Response Guidebook (ERG) was developed jointly by the US DoT, Transport Canada, and the Secretariat of Communications and Transportation of Mexico (SCT) [13]. It is primarily a guide to aid first responders in

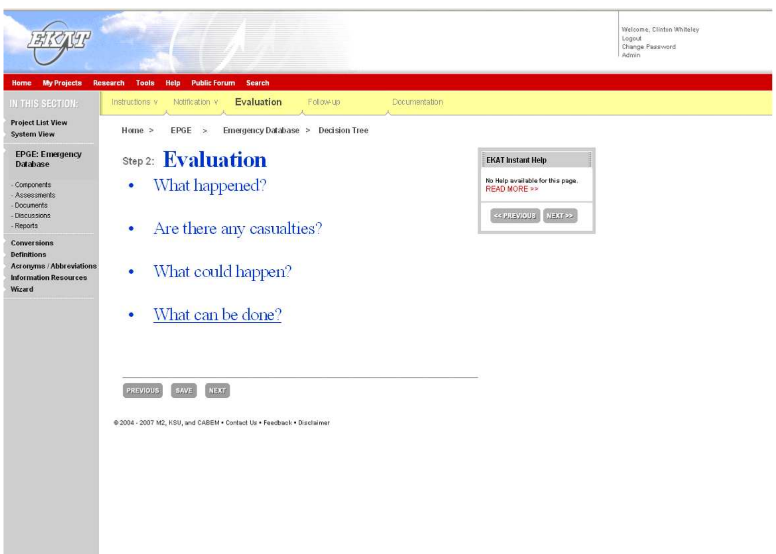
- Quickly identifying the precise classification of the materials involved in the incident
- Shielding themselves and the general public during the initial response phase of the incident. The ERG is updated every three to four years to accommodate new products and technology [13].

The final piece of the Emergency Database is a Decision Tree. Designed after the short guide given in the HAZWOPER text book, the decision tree is a place for users can go to get immediate information for emergency response. Granted the users could just go through each section of the Emergency Database and gather the information themselves, however, the

Decision Tree tries to relieve some of the stress of the emergency by lowering the risk of forgetting to gather portions of needed information. The is accomplished by integrating the previous two segments, Emergency Information and Emergency Contacts, into one final report.

Each emergency follows the same five steps; Notification, Evaluation, Rescue/Response action, Follow-up, and Documentation. As said above notification is the first step in responding to an emergency, and the Decision Tree will quickly guide the user to a list of contacts for their area. Though this list is comprehensive, there are situations when more people should be contacted that are not on the produced list. Step two involves gathering available information about the incident and emergency response capabilities. The Evaluation step contains four main questions; What happened?, Are there casualties?, What could happen?, and What can be done?. Each of these questions needs to be answered with information about the emergency and the responders. The Emergency Preparation and Green Engineering tool provides the user with these important questions and helps keep the user on track, as well as acting as a place to store the gathered information; see Figure 2.2.

Figure 2.2 Example Web page mock-up for the Emergency Database.



With the relevant data collected in step two it is time to make decisions and act. The Rescue/Response action is based on the available information. The type of action required should be decided and the necessary steps implemented. Some actions may be done concurrently. No one should attempt emergency response or rescue until backup personnel and evacuation routes have been identified. This section includes actions such as; survey casualties, allocate resources, request aid, decontaminate, transport, and evacuation. Like the format of the first two stages, the Action section also points the user down a path that may solve their emergency, but it is important to note that there are situations when suggested path may not be the more effective. It is up to the user to decide the appropriate action. The EPGE tool is only in place as a guide, and does not claim to have all the answers.

During the Action segment the emergency is to be responded to and the area secured. So the fourth portion of the Decision Tree deals with Follow-up. The Follow-up has three major pieces; Notify, Restock, and Review. Before normal site activities are resumed, personnel must be fully prepared and equipped to handle another emergency. In the Restocking stage all equipment and supplies must be restocked or repaired if needed, along with cleaning and refueling where appropriate. The last stage is the most important of the three; it is a review and revision of all aspects of the contingency plan according to new site conditions and lessons learned from the emergency.

Lastly, with respect to the Decision Tree, the project team leader should initiate the investigation and documentation of the incident. This is important in all cases, but especially so when the incident has resulted in personal injury, on-site property damage, or damage to the surrounding environment. Documentation may be used to help avert recurrences, as evidence in future legal action, for assessment of liability by insurance companies, and for review by government agencies. Methods of documenting can include a written transcript taken from tape recordings made during the emergency or a bound field book with notes.

The Emergency database is set up as a linear flow chart. In each section, including the Decision Tree, the user is asked to pick between given links that will guide them to a result. Each subsequent page offers more specific links for each topic, until the user either reaches a URL to a helpful Web site, or they are given information in a word document. The document is populated with information based on the choices that the user made while working their way towards the results section.

The database of contacts, the Hazardous Substance Data Bank, and the Decision Tree all work together in the event of an emergency to help the user gather all suitable information/data, use the data in the most effective way possible, and prepare for a similar emergency in the future.

In this way the Emergency Database section can only guide first responders in the event of an emergency, but it is still the responsibility of the users to put the information into action, or find similar information if the emergency is not covered exactly in the EPGE tool.

The Emergency Database has aspects of other innovative online tools, WISER and the DoT guidebook, but it also offers items that will further benefit the user, the Decision Tree and Contact information. The ability to gather this information is important, but if the user has to go back to the Internet to see the information that can become a burden. To solve this problem the information in the Decision Tree can be viewed in word format, and therefore printed for better mobility of the data. The next major section of the EPGE tool deals with preparation for emergencies, and helps users/companies save resources by having essential information available in a convenient form.

Report Generator

The Occupational Safety and Health Act (OSHAct) of 1970 went in effect on April 28, 1971, and was the first uniform federal safety and health regulation in the work place. Prior to this a variety of state regulations existed, but were rarely enforced. As a consequence employers started noticing an increase in illness, injury, and deaths due to the conditions employees were exposed to in the workplace. The OSHAct inspired employers to ensure that their workers have a safe and healthy environment, and if practical, to completely eliminate recognized hazards from the workplace. Some methods employers have used to eliminate hazards are; changing work procedures or by installing engineering controls, such as self-capping syringe needles, ventilation systems such as a fume hood, sound-dampening materials to reduce noise levels, safety interlocks, and radiation shielding. According to the OSHAct, if it is not possible to eliminate a potentially hazardous exposure, the employer must provide other measures to protect employees, such as personal protective equipment (PPE).

The OSHAct resulted in the creation of the Occupational Safety and Health Administration (OSHA), which is part of the U.S Department of Labor. OSHA develops workplace standards for general industry, construction work, shipyard employment, and for long shoring and marine terminals [6]. OSHA has the authority to legally enforce its standards. In order to develop these regulations, OSHA needs subject-specific information. Because of this need, the National Institute for Occupational Safety and Health (NIOSH) was created as a research agency within the Department of Health and Human Services [6]. Based on research results, NIOSH makes recommendations to OSHA regarding the creation or revision of OSHA standards, along with education and training in occupational safety and health.

Section two of the EPGE tool is a written report generator. Templates are used to help guide the user through developing the reports and plans that are needed to satisfy standard requirements. In this section the templates are used to show the clients a general way a similar report has been put together in the past. In this way they can possibly save research time and money, by being able to quickly fill out a template instead of constructing the whole thing from scratch.

The Report Generator section has its basis in the OSHA-described employer responsibilities. Where it states, “Your employer must make available information on safety and health hazards in the work area, precautions to be taken, and procedures to be followed in the event of an accident or exposure to toxic substances” [6], and “The employer is required to make available copies of appropriate OSHA standards, rules, regulations, and requirements in the workplace” [6]. This means that every company must have available written emergency plans along with the appropriate OSHA regulations. The Emergency Preparation and Green Engineering (EPGE) tool could aid the employer in creating, organizing, and quickly referencing this multitude of written plans or reports. This means that the Report Generator section is only in place to generate reports from templates, or just as a “plug and chug” report writer.

To accomplish this goal the EPGE tool would be modeled off the current report generating mechanisms already in the Environmental Knowledge and Assessment Tool (EKAT). Within EKAT the “My Projects” and the EKAT Project Manager allow multiple EKAT users to centrally organize and reliably document environmental solutions, while working collaboratively to generate reports and make decisions [1]. Much of the automated assistance EKAT can give in environmental evaluations, such as the environmental screening tool, is found under “My Projects.” The “My Projects” section lets a user choose to work on an existing project, either as the primary individual or as a participant on a project to which he or she has been invited to provide input. The user can also be asked to simply review existing project work, but not provide actual on-line changes.

Under 'My Projects,' a user has a choice of performing one of the following nine assessments: environmental screening, solvent screening, estimating the chemical concentrations in air (TECCA), estimating air emissions from a process (EmisCalc), estimating the environmental impact of a product over its life cycle (TRACI), using the environmental safety and occupational health (ESOH) compliance tool, examining National Environmental Policy Act (NEPA) or Programmatic Environment, Safety and Occupational Health Evaluation (PESHE) reporting requirements (which are specific to the U.S. Marine Corps), or conduct a system assessment [1]. A more extensive explanation of the nine different assessments is presented below.

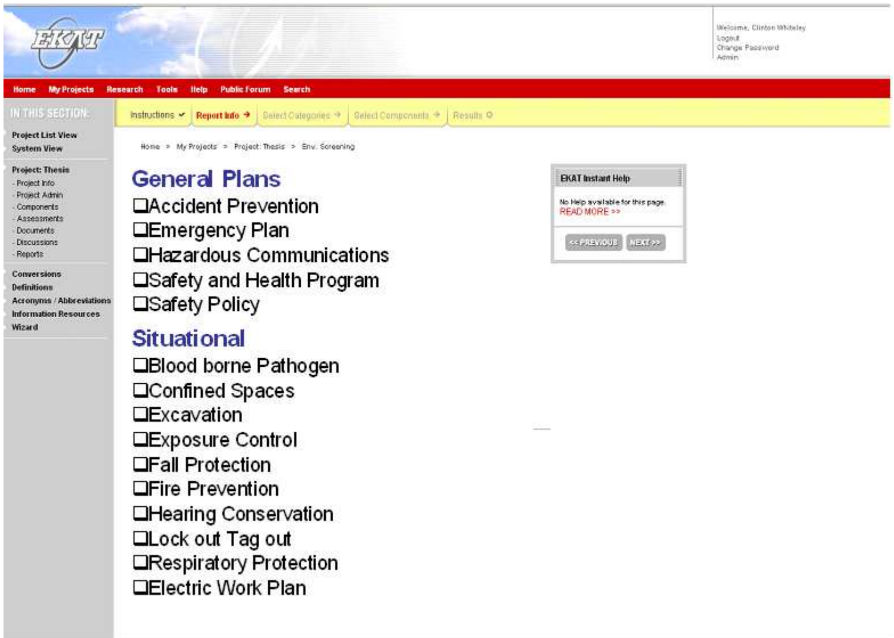
- **Environmental Screening-** The environmental screening tool compares chemicals the user enters to federal environmental regulatory lists (such as the Safe Drinking Water Act, etc.), as well as making them aware of other health and safety concerns, such as whether a chemical is listed as carcinogenic, or what permissible exposure levels OSHA has set for it. The user can transfer the results to a more-detailed report, which can be saved to a Word document.
- **Solvent Screening-** The solvent screening tool evaluates solvents for state air and hazardous waste compliance while highlighting specific Clean Air Act control technology requirements for solvent cleaning operations [1].
- **Estimating the chemical concentrations in air (TECCA) -** This tool is used to estimate the potential average concentration of a chemical in the air of a room where a volatile liquid chemical release or spill has occurred.
- **Emissions Calculator (EmisCalc) -** EmisCalc estimates pollutant emissions associated with process activities, using EPA-approved air pollution factors. Different processes are selected through a pull-down menu selection process [1]. Results are useful for air-permitting requirements and can also be integrated with the modified TRACI assessment for life-cycle evaluations.
- **Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI for EKAT)-** Developed by the EPA and

adapted to EKAT[1]. The U.S. EPA developed TRACI to assist in impact assessment for process design, life cycle assessment, pollution prevention, and sustainability metrics. TRACI for EKAT allows the user to evaluate the environmental impact of chemical emissions to air or water over a product's life cycle and to make pollution prevention decisions based on this information.

- **Environmental Safety and Occupational Health (ESOH) Compliance Tool-** The ESOH compliance tool is an interactive set of work sheets covering different types of potential hazards and issues relating to environmental safety and occupational health.
- **National Environmental Policy Act (NEPA) Decision Tree-** The NEPA Decision Tree assists Marine Corps users in meeting federally mandated requirements under NEPA to consider environmental and other related issues for proposed actions [1]. NEPA ensures that when federal agencies examine potential projects, they give the same consideration to environmental factors as they would to other components in the decision-making process. The NEPA Decision Tree contains different tools, including the evaluation of potential categorical exclusions (CEs), designed to lead the user through the NEPA process, evaluate relevant information, and compile a draft summary report containing user input and tool results [1].
- **Programmatic Environment, Safety and Occupational Health Evaluation (PESHE) Report Generator-** The PESHE Report Generator helps create a Programmatic Environmental Safety and Occupational Health Evaluation report for the Marine Corps by using information input by the user and results of other EKAT assessment reports for the project [1]. This report can then be saved to a Word document and modified outside of EKAT.
- **Systems Assessment-** The systems assessment tool provides an overview of environmental risks and recommendations for mitigating these risks for product systems. Information is organized by major subsystem for each product system. Currently, only two systems are included, tactical vehicles and computer systems [1].

In a similar manner as the previously mentioned report tools, the EPGE tool provides the user with a list of available report/plan templates, from which a user will choose and be led through a series of other questions to fill in the important information, Figure 2.3. The templates have been generated based loosely on the list given by the Business and Legal Reports (BLR) [14] list of written plan templates.

Figure 2.3 Purposed mock up for the Report Generator



Business & Legal Reports (BLR) has been helping human resources, Safety and Environmental professionals with legal compliance and professional support resources for over 30 years [14]. BLR's attorneys, analysts, and journalists are experts in their respective markets. They constantly research federal and state legislation, best practices, industry trends, and impending developments that can affect your organization. Products are delivered in print, CD-ROM, Internet, and newsletter formats. A few of BLR's products include:

- Human Resources
  - What to Do About Personnel Problems in [State]
- Compensation
  - Employee Compensation in [State]
- Safety
  - OSHA Compliance Advisor

- Environmental
    - Environmental Compliance in [State]

Although Business and Legal Reports (BLR) does offer a somewhat more comprehensive database of some of the similar aspects as the EPGE tool, a one year subscription to their Web site is approximately 800 dollars, and it will not include an Emergency Database, or a Green Engineering section. So for the EKAT user a subscription to BLR may not be financially advantageous.

The templates that are available were created in a manor such that they all meet the same basic form to make it easier to program them into the EPGE tool. A list of written report templates that will be offered is available in Table 2.1, and the actual templates are offered in Appendix C.

Table 2.1 List of available written plan templates.

General Templates	**Specific Situations**
Accident Prevention	Blood borne pathogens
Emergency Plan	Confined Spaces
Hazardous Communications	Excavation
Safety and Health Program	Exposure control
Safety Policy	Fall protection
	Fire prevention
	Hearing conservation
	Lock out Tag out
	Respiratory protection
	Electric Work plan

Along with being able to generate the report and view it as a Word document, the EPGE tool will archive the user's past reports. This may seem obvious or somewhat meaningless, but for every written plan that is made, sometime in the future it will need to be updated. To be able to go and just bring up the electronic copy and add the updates will save the employer time and money.

HAZWOPER Training Resource

One critical aspect of preparedness is worker training. Because of the hazardous nature of certain types of work, worker training is an essential aspect of occupational safety and health programs. Many OSHA standards include a component of worker training. One example of a training requirement already in place that applies to potential emergency response and terrorism incidents is the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, 29 CFR 1910.120 and 1926.65, and 40 CFR 311 [15]. The HAZWOPER standard describes requirements for employers and workers engaged in five different types of activities: cleanup operations at uncontrolled hazardous waste sites; cleanup operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA); voluntary cleanup operations at uncontrolled hazardous waste sites; operations involving hazardous wastes at treatment, storage, or disposal facilities covered by RCRA; and emergency response operations involving the release or potential release of hazardous substances, which includes chemical, biological, and nuclear agents [15].

The importance of worker training was apparent in both the successes and shortcomings of the response to the attacks at the World Trade Center and Pentagon on September 11, 2001 and the subsequent introduction of anthrax into the U.S. postal system. Previous reports have examined the role worker training played in the context of these events [16]. Some of the critical issues identified by these reports include: the need for cross-functional training (e.g., training emergency responders about the role of skilled support personnel and vice versa, so that they can function more effectively in a large recovery effort); the need for training that addresses the transition from the rescue phase to the cleanup and remediation phase; the need for incident command system (ICS) populations other than fire and police; and the need to improve coordination among the various agencies responsible for worker safety training [16].

First responders traditionally have been thought of as fire personnel, hazardous materials (HAZMAT) teams, police, and emergency medical service personnel. In the case of the World Trade Center and Pentagon emergencies, many skilled support personnel such as heavy equipment operators functioned in part as first responders. Law enforcement personnel had ‘‘dual functions’’ in performing legal/investigatory and first responder roles.

Another challenge is the transition from emergency response to the post-emergency response cleanup operations. The OSHA HAZWOPER standard distinguishes between operations during and immediately after the emergency, and post-emergency response operations that take place some time after the initial response. In particular, there are detailed training requirements for emergency responders and for workers involved in post-emergency response cleanup operations, but the requirements for training of skilled support personnel during emergency response are far less severe.

Under HAZWOPER (29 CFR 1910.120(q)(4)), skilled support personnel are required to have only an ‘‘initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment (PPE), what chemical hazards are involved, and what duties are to be performed’’ [15]. Because the transition to post-emergency response was not clearly defined during the events of September 11, 2001, training requirements for skilled support personnel under HAZWOPER were not as clear as they might have been.

Other issues that have been identified as challenges for preparedness training in the future include: the role of critical incident stress debriefing; protection of workers against the possibility of secondary threats (including intentional secondary threats); and collection and use of injury and illness data during and after the emergency response, both for first responders and for workers involved in cleanup and remediation. It should be noted that some training curricula, particularly those developed for construction safety, may have an appropriate role within the context of an emergency response operation, in contrast to longer, more detailed courses [15]. It should also be noted that training curricula should focus on hazards beyond normal responder training, such as chemical, biological, and radiological hazards, the risks associated with demolition, and the use of air purifying respirators (APRs).

The Center for Disease Control (CDC) Core Competencies for Public Health Workers identifies tasks every public health worker should be able to do [15]:

- Identify and locate the emergency plan
- Describe the role of public health
- Describe the chain of command
- Describe and demonstrate each functional role

- Recognize deviations from the norm
- Identify limits to own authority
- Describe communication roles
- Demonstrate use of communication equipment
- Apply creative problem solving skills

The Environmental Knowledge and Assessment Tool (EKAT) currently maintain NEPA Process Training, and Air Emission Training sections. The NEPA Process Training is a guide in place to help the users understand what NEPA is, who it pertains to, and how to meet the requirements. Similarly the Air Emission Training segment helps users identify who needs air permits, and how to go about getting them [1].

Following and expanding upon these initial on-line training components, a second integral part of the tool would be the insertion of case studies on various emergency planning, response, and hazardous materials topics. The training tool section is included because of the need for information availability. A comprehensive resource, allows users to stay up-to-date on emergency procedures, as well as give them the opportunity to learn more about a specific topic. In addition, this section gives information related to training courses, course locations, and instructor contact information, see Appendix D.

The case studies include various examples of emergencies with mercury, gasoline, and other hazardous materials, see Appendix E. While using the HAZWOPER Training Resource, the user will be able to read the procedures that should be done in each situation. In this way they will be able to think through a variety of scenarios, and better prepare themselves for a future emergency. The case studies about mercury were obtained from the Environmental Protection Agency (EPA). This page includes case studies of typical problems, incidents and cleanups found in schools throughout the United States. It is designed for teachers and administrators to educate them about the different kinds of mercury spills that have occurred in schools and to encourage elimination of the use of mercury in schools, promote proper management and disposal of mercury and mercury containing products, and prevent mercury spills [17].

Another example of a case study was obtained as an article in the Journal for Hazardous Materials [18]. It describes a portable plastic gasoline container explosion and fire. While working at home on a science project to determine the burn rates of different types of wood fuel, a 14-year-old boy was severely burned after flames traveled back up into the portable gasoline container and exploded. It is shown by experimentation that a flame arrester installed in the pour opening of the portable gasoline container would have prevented an explosion inside the gasoline container [18].

The last portion of the HAZWOPER Training Resource is a contact database for training courses offered around the Nation. It will include information on where and at what time HAZWOPER training can be taken, which will be state specific. This can be found at the Safety Videos, Software and Resources for OSHA Compliance Web site [19]. In addition, this section will include information about how one can become a trainer, and what OHSA requires of trainers. The OSHA Institute Education Centers Web site supplied this information [20]. In addition the HAZWOPER training that is offered through the Division of Continuing Education at Kansas State University is also included in this section [21].

Though the main focus of this portion is HAZWOPER training, there will be links to other training courses offered online. The links to other outside training tools are provided because the EKAT team realizes that in the business environment there is a need for other training in addition to the HAZWOPER certification course. Examples of other courses include; Emergency Response to Hazardous Materials incidents, Preliminary Assessment and Site Inspection training, and Introduction to Environmental Management Systems [20].

Green Engineering

The increase in interest in sustainability, environmental concerns and government regulations has inspired the chemical industry in both innovation and reformulation of products that address a broad spectrum of human and environmental health and safety factors. Defining "green" chemicals is difficult because the notion encompasses an array of factors: perception, empirical values, geographical area of use, the application for which they are used, available alternatives, knowledge of the total manufacturing process, life cycle assessment.

It is important to note that any chemical can be toxic at sufficiently high concentrations. This includes seemingly safe compounds as water, table salt, and excess nitrogen in water. Eutrophication happens when too much nitrogen is in swamp water, and no life can be supported. However at optimal concentrations nitrogen is not a hazard. With that said green engineering is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances [22]. Green engineering currently addresses both clear hazards and those linked with such global matters as climate change, energy production, availability of a safe and adequate water supply, food production, and the presence of toxic substances in the environment. The 12 Principles of Green Engineering, Figure 2.4, provide a framework for understanding and represent a reflection of those engineering techniques that are being used to become more sustainable. The challenge of sustainability will be tackled with new technologies that provide society with products while using an environmentally responsible approach.

The concept of "design" in the definition of green engineering is an essential element in requiring the deliberate use of a set of criteria, principles, and methodologies in the practice of green engineering. Because green engineering is intentionally designed, it is by definition difficult to do it by accident. The phrase the "use or generation" implies the requirement of life-cycle considerations [23]. Green engineering can be utilized anywhere in the life cycle, from cradle to grave. The term "hazardous" is used in its broadest context to include physical (e.g., explosion, flammability), environmental (e.g., ozone depletion, climate change), and safety and health (e.g., carcinogenic, mutagenic) [23]. The design of environmentally benign products and processes may be guided by the 12 Principles of Green Engineering, Figure 2.4 [23]. These principles are a characterization of the fundamental methods taken to attain the green engineering goals of benign products and processes. This list should be viewed as a reflection of science that has been done within this promising field in the recent years, as well as a direction that has been set by some of the pioneering scientists who have laid the ground work for the future [24].

It is important to note that there are many versions of these principles including the 12 Principle of Green Chemistry [23], and 9 Principles of Green Engineering [27], but they all encompass relatively the same ideas, and the version shown in Figure 2.4 covers the ideals of the EPGE tool.

Although the Principles of Green Engineering in Figure 2.4 are important and act as a guide post for green engineering, in reality there are no chemicals that can satisfy all twelve. The 12 principles should be thought of not as rules, laws or inviolable standards. Instead they are a set of guidelines for thinking in terms of sustainable design that can lead to useful advances for a wide range of engineering problems [27].

Figure 2.4 12 Principles of Green Engineering [23,27].

Principle 1 – Designers need to strive to ensure that all material and energy inputs and outputs are as inherently non hazardous as possible.
Principle 2 – It is better to prevent waste than to treat or clean up waste after it is formed.
Principle 3 – Separation and purification operations should be a component of the design framework.
Principle 4 – System components should be designed to maximize mass, energy and temporal efficiency.
Principle 5 – System components should be output pulled rather than input pushed through the use of energy and materials.
Principle 6 – Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse or beneficial disposition.
Principle 7 – Targeted durability, not immortality, should be a design goal.
Principle 8 – Design for unnecessary capacity or capability should be considered a design flaw. This includes engineering "one size fits all" solutions.
Principle 9 – Multi-component products should strive for material unification to promote disassembly and value retention (minimize material diversity).
Principle 10 – Design of processes and systems must include integration of interconnectivity with available energy and materials flows.
Principle 11 – Performance metrics include designing for performance in commercial "after-life".
Principle 12 – Design should be based on renewable and readily available inputs throughout the lifecycle.

The Principles will be a set of parameters in a complex system where there will be situations in which progress toward achieving the goal of one principle will inspire progress toward several other principles [27]. In other cases, there may be trade-offs between the application of two principles. Those trade-offs can only be resolved by specific choices and values of practitioners within the context of their specific situation or within their society. The point is to use these principles to maximize the positive aspects of chemical use and selection while minimizing the negatives. An example is bioethanol made from corn. It does meet the requirements of principle twelve, but fails one, seven, and ten. This is a good example where the EPGE tool can help in the design/development of the plant. Accomplishing this through use of multiple sections of the tool and putting them all together to get a better idea of the overall impact of the plant on the environment.

Environmental awareness created over the last three decades has led to the consideration of sustainable activities at different levels of government, corporation, and public sectors. Everyone is looking for a healthier environment at a reasonable cost. The concept of using green products emerged to help society achieve sustainable consumption, and many programs have been launched in the wake of such realizations in the industrialized nations to address this opportunity.

The development of green products is dependent on quantifying the impact that humans have on the environment. Carbon has become the currency used to assess this interference on the Earth's climate system. Impacts on climate are compared in terms of radiative forces, which can be considered as perturbations to the Earth's radiation budget prior to feedbacks from the rest of the climate system [28]. The concept of global-warming potential (GWP), where

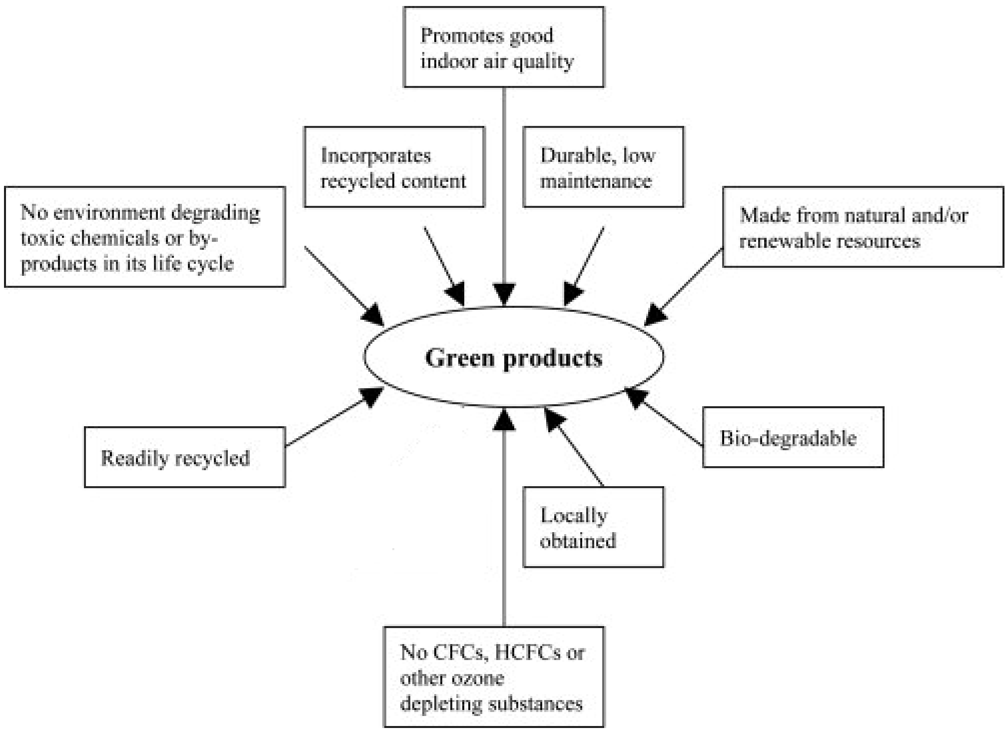
$$GWP = \frac{\int_0^{TH} a_x x(t)dt}{\int_0^{TH} a_r r(t)dt} \qquad (2.1)$$

has been adopted to convert other atmospheric constituents into their equivalent in terms of CO_2 atmospheric radiative forces [28]. At this point, `TH' is the time period the calculation is considered, a_x is the radiative efficiency due to a change in atmospheric abundance of substance x (i.e. $Wm^{-2}\,kg^{-1}$) and x(t) is the decay of the abundance from the release of the substance [28]. The denominator is the same as the numerator, but in reference to substance r, CO_2. The actual composition of equation 2.1 is not important. It is, however, important to note that the GWP comes from an actual scientific equation, instead of a panel of advisors giving their opinion.

Green products may be defined as products that contain recycled materials, reduce waste, conserve energy or water, use less packaging, and reduce the amount of toxics disposed or consumed as shown in Figure 2.5 [29]. These products are less hazardous on humans and the environment compared with the conventional products in use, and are more socially, economically, and environmentally feasible in the long term.

Pollution is generated at almost all stages in the lifecycle of a product. Consequently, adding green engineering to the manufacturing process from the start to the end of the lifecycle will have incredible impacts for the entire bionetwork. The need for pollution prevention is stronger than ever, due to environmental challenges, cost competition, consumer and shareholder demands. Above all, pollution prevention in the industrial environment means that in-plant practices, including process modifications, feedstock substitutions, product reformulation, and management practices need to be addressed. Environmentally conscious manufacturing takes into account the regulations and requirements for environmental safety, and fully incorporates them into the manufacturing processes from new product design to the end of life disposal.

Figure 2.5 Characterization of Green Products [29].



Recently, industries producing green products have increased their manufacturing due to an increase in demand. In various parts of the world green marketplaces are developing to deliver these products to those consumers whose buying decisions are at least partly affected by their personal environmental criteria. Studies show that 84% of consumers prefer buying food packaged in environmentally safe materials, with 78% willing to pay more for such packaging, clearly showing that consumers play an important role on purchasing ecologically sound products [29]. A lifecycle assessment provides useful information for comparison of green products.

If a manufacturer wants to tap into this increase in demand, then they need some background. The characteristics of green products can vary significantly depending on the materials. To gain a good background of green products one needs a working knowledge of [29]:

- Relevant health and environmental impact issues associated with different material types
- Government, industry, and third-party standards for green products, where they exist
- Available green products in the marketplace, including their specific green attributes, performance characteristics, appearance, and costs

Chemical products can be manufactured using a wide variety of synthesis routes. The designer of a chemical process must choose from alternative raw materials, solvents, reaction pathways, and reaction conditions, and these design choices can have a significant impact on the overall environmental performance of a chemical process. Ideal chemical reactions would have attributes [30] such as:

- Simplicity
- Safety
- High yield and selectivity
- Energy efficiency
- Use of renewable and recyclable reagents and raw materials

In general, synthesis processes cannot attain all of these goals at the same time, and it is the task of chemists and chemical engineers to identify reaction pathways that optimize the sought-after attributes.

Characterization of environmentally friendly pathways requires creative advances in chemistry as well as process design. Generally, quantitative design tools for identifying green chemistries are not available, because the number of choices in selecting reaction pathways is so large and the implications of those choices are so complex. Nevertheless, an extensive body of knowledge concerning green engineering exists and some design tools are emerging.

In general, green engineering is presented in two basic parts; qualitative and quantitative. Qualitative principles that may lead to environmental improvements include alternative solvents, alternative reactants, and alternative chemistries [31]. Quantitative principles are more optimization based and can be used to identify environmentally preferable reaction pathways [31]. For example, the 12 Principles of Green Engineering are all quantitative and deal with design issues.

Section four of the proposed tool includes an environmental management/minimization component focusing on Green Engineering. Instead of just examining what potential concerns the user may have with a particular material, the tool can help suggest alternative chemicals that are less toxic or ecologically hazardous. This section would take advantage of EKAT's extensive chemical database along with existing chemical compatibility spreadsheets: Building for Environmental and Economic Sustainability (BEES), Green Chemistry Expert System (GCES), Solvent Alternatives Guide (SAGE), Coating Alternatives Guide (CAGE), Handbook of Green Chemicals, and the HSDB database.

The Internet does offer some helpful tools in choosing not only green products but also green chemicals. Building for Environmental and Economic Sustainability (BEES) software is a decision support tool that helps to select cost-effective and environmentally preferable building products [29]. The tool is developed by the National Institute of Standards and Technology, and boasts a database of 230 building products and their economic performance. The environmental performance is measured by assessing a product's entire life cycle from raw material attainment to manufacture, transportation, installation, use, recycling, and waste management. Economic performance of a product is measured using the lifecycle cost method and is combined with its environmental performance into an overall performance measure to assist in multi-element decision making [29]. This same method is used in many other green product tools.

The increase in consumer demand has also spawned an increased interest in the use of green chemicals in manufacturing. In addition to the green product tools there are also tools like the Environmental Protection Agency's (EPA) Green Chemistry Expert System (GCES), which is a stand-alone computer program that can be used to select green chemicals and reactions [32]. The GCES picks chemicals and reactions that reduce or diminish the need and production of hazardous chemicals. EPA uses GCES to identify pollution prevention opportunities for the synthesis of new and existing chemicals. The GCES includes five modules; the Synthetic Methodology Assessment for Reduction Techniques (SMART), The Green Synthetic Reactions module, The Designing Safer Chemicals module, The Green Solvents/Reaction Conditions module, The Green Chemistry References module [32].

The five sections in the GCES are in place to help users build a green chemical process, design a green chemical, or examine the field of green chemistry, and it is equally useful for known and unknown chemicals and their synthetic processes [32]. Section one is the Synthetic Methodology Assessment for Reduction Techniques (SMART) which quantifies and categorizes the hazardous substances used in or generated by a chemical reaction based on information provided by the user [32]. This section operates under the assumption that reactions can be modified and reevaluated to optimize their green nature. The SMART module calculates the theoretical amount and hazard of each reaction component on an individual chemical basis and then points users to the other modules in the tool for information on a green alternative.

The Green Synthetic Reactions module provides technical information on green synthetic methods of making chemicals. It is equipped with a searchable list of green synthetic processes including descriptions, keywords, and references. The Designing Safer Chemicals module describes how chemical substances can be modified to make them safer. This module leads the user through a series of questions and then identifies molecular modifications to minimize hazards. The Green Solvents/Reaction Conditions module includes technical information on green alternatives to traditional solvent systems and allows users to search for green solvents based on physicochemical properties [32]. The Green Chemistry References module allows the user to obtain additional information using a number of search strategies as well as add references to the module [32].

The Solvent Alternatives Guide (SAGE) is a comprehensive guide designed to provide pollution prevention information on solvent and process alternatives for parts cleaning and degreasing [33]. The Coatings Guide™ contains several tools to help users identify low-volatile organic compound/hazardous air pollutant coatings that may serve as drop-in replacements for existing coating operations [34]. To date, the Coatings Guide information base has focused on alternative coatings for plastic and metal substrates.

The Handbook of Green Chemicals describes approximately 7000 trade names that provide one or more of the following green attributes: biodegradable, environmentally safe/friendly, recyclable, hazardous air pollutants(HAP's)-free, low ozone –depleting/ non-ozone-depleting, volatile organic compounds (VOC)-compliant/low-VOC/VOC-free, low global warming, low vapor pressure chemicals, non-chloro fluro carbon (CFC) /non-HCFC, significant new alternatives policy (SNAP), nonhazardous, superfund amendments and reauthorization act (SARA) -nonreportable, halogen-free, noncarcinogenic, and nontoxic [35]. Inclusion of products in this book was the result of a two-step process: manufacturers were canvassed for products meeting criteria listed above; these products were then screened for identifiable green attributes.

To make this section realistic, the EKAT team plans to assign a "greenness factor" to each chemical. This score will be based on physical and chemical information, environmental information, and safety and health information including that shown in Table 2.2. Table 2.2 is prepared to enumerate factors to consider in the evaluation of chemicals with respect to greenness. The greenness factor will be based on the chemicals appearance or absence from previously mentioned databases. For example, a chemical will be given a green light if it is not on the Safe Drinking Water Act (SDW) list or a red light if it is not biodegradable. So in this way a chemical will be given a green or red light for each of the criteria listed in Table 2.2, and it will be up to the user to decide if they should continue using the chemical of interest or look for possible alternatives. In the event that no data are available for a specific chemical, the EPGE tool will give it a yellow light. This result indicates that the user should use caution, because there is insufficient information about their chemical.

The physical and chemical information could include toxicity (permissible exposure limit (PEL), reference exposure limit (REL), immediately dangerous to life and health (IDLH)), density, vapor pressure, and solubility in water. These properties are the basic building blocks of a chemical. With this information a company could evaluate the general environment that must be maintained to support their chemicals safely.

Environmental properties are not as black and white as physical properties, but are just as important, especially in the developing global climate change situation that our society faces. These properties are important because they represent the effect that an industry's chemicals and processes have on the environment. The environmental information could include maximum contaminant level (MCL) concentration in drinking water, stratospheric ozone depletion, air quality issues, and photochemical smog formation. This section is needed to give the user an idea of what to expect when using certain chemicals, and to give them a picture of the consequences involved in manufacturing their products.

Table 2.2 List of properties included in the "Greenness Factor".

Physical and Chemical Properties	**Environmental Concerns**	**Safety and Health**
Octanol/Water coefficient	Stratospheric ozone depletion	Human carcinogens
Vapor Pressure	Photochemical smog formation	Persistence Bioaccumlative Toxins (PBT)
Vapor Density	Halogens	Health effects in air
Flash Point	Atmospheric acidification, acid rain	Health effects in water
Autoingnition Temperature	Antibiotics, hormones, and pesticides	Mutagenic compounds
Solubility in water	Clean Air Act (CAA); HAP or VOC	Respiratory irritants
Soil Adsorption coefficient	Resource conservation and recovery act (RCRA); P and U lists	Microbial/viral infection
Recyclable	Global Warming Potential	Green Products
Corrosivity	Biodegradable	Toxicity
Reactivity	Terrestrial toxicity	
Renewable		
pH	Anaerobic/ Eutrophication environments	Solvent/Coating Alternative

A safety and health section can be included in the "greenness factor" to give a general representation of how chemicals will affect their employees and the plants and animals in the surrounding area. Some of the important properties include human carcinogens, microbial and viral infection, and mutagenic compounds.

In general, the greenness factor will be assigned with the idea that the least amount of negative lists (eg. human carcinogens, mutagenic compounds, respiratory irritants) and more positive lists that the chemical shows up on, the greener the chemical. It is understood that this may not be the case, for example say a water treatment plant is examining a new chemical used for treatment, and the chemical only shows up on the Safe Drinking Water (SDW) list. Though it is unlikely that it would only show up on one list, if it did, then even though it is only on one list, indicating a relatively green chemical, the users have to realize that this can be a bad treatment option. So even though the Green Engineering section of the EPGE tool does offer helpful suggestions for greener chemicals, the users will still have to use their judgment and only use the tool as a guide.

The future challenges facing green engineering are diverse and address broad issues of sustainability. Because of this extensiveness, it should be no surprise that a number of these challenges are being pursued for reasons ranging from economic to scientific.

The challenges to research in achieving effective applications of the green engineering principles are numerous, and a detailed discussion of each is not possible. However, a listing of some of the challenges may inspire thinking about other challenges that should be included [26]:

- Development of "preventative toxicology guidance" where increasing knowledge of biological and environmental mechanisms of action are continuously incorporated into the design of chemical products.
- Incorporation of synthetic methodologies that are economic and benign to human health and the environment.
- Efficient material design in order to maximize recycle/reuse of natural resources.

Even if the research challenges are met, that does not mean that they will not get stopped by implementation challenges on the industrial scale. Adoption of environmentally benign processes may be facilitated by the following [26]:

- Flexibility in regulations.
- Tax incentives for implementing cleaner technologies.
- Research programs to facilitate technology transfer among academic institutions, government, and industry.
- Patent life extensions for cleaner process optimization.

To meet both of the previous challenges, the effort needs to start with the education of students, and others, at all levels where the philosophy and practice of green engineering can be introduced. Educators need appropriate tools, training, and materials to effectively integrate green engineering into their curriculum and research. Important steps to be taken to advance green engineering include the following [26]:

- Systematic recognition of hazard/toxicity as a physical/ chemical property of molecular structure that can be designed and manipulated.

- Development and utilization of practical laboratory experiments to illustrate green engineering principles.
- Introduction of the basic concepts of chemical toxicology and the molecular basis of hazardous properties.
- Incorporation of green engineering topics on professional certification exams.
- Teacher reference materials for incorporating green engineering into existing courses.

Sustainability poses some unique challenges for the scientific world. The growth of green engineering needs to increase at an accelerated pace if both industry and academia are going to meet these challenges. Green engineering can become the norm with the wide spread use of the 12 Principles of Green Engineering. The fourth section of the EPGE tool will aid users in this task, and give them the building blocks for a sustainable future. This last section can tie all of the sections together. In that, with the use of the previous three sections and the final Green Engineering section a detailed Environmental Management System (EMS) can be compiled. An EMS is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency [36]. These EMS's are the Environmental Protection Agency's (EPA) standard for measuring the environmental footprint of a company. In the next chapter of my thesis a detailed description of EMS's will be presented, including how they are put together, and how the Emergency Preparation and Green Engineering (EPGE) tool can aid in the production of these reports.

CHAPTER 3 - Applications for the EPGE tool

Introduction

Sustainability is the next big innovation in our society. With our dwindling resources and continual input of hazardous chemicals into the environment, any company that can show others an easy way to be more environmentally friendly, will be on the cutting edge of research and technology.

Some argue that the earth is the best teacher of sustainable practices [36]. For a company to begin to be sustainable, there are some questions that need to be answered:

- How can nature's organizing principles be applied in design, production of goods, and everyday living?
- Is a growing economy equivalent to a healthy economy?
- What are other ways of measuring success, and how can we encourage businesses to adopt sustainable practices and perspectives?
- What are the possible outcomes, and how can we create the most sustainable society for our children and ourselves?

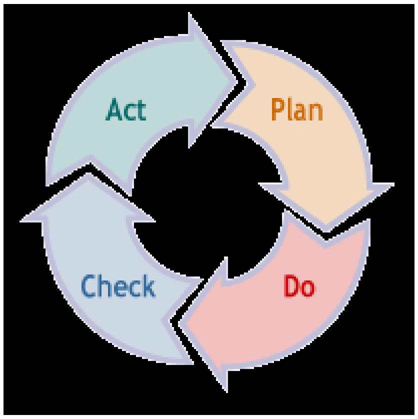
I propose to use the Emergency Preparation and Green Engineering (EPGE) tool in conjunction with Environmental Management Systems (EMS) to begin to address the idea of sustainability in a more practical setting. Currently the development of a comprehensive tool that identifies environmental, health, and safety concerns along with supplying relevant emergency data would be applicable to any business or organization. This tool will be available as an initial building block for the sustainability of the company. It can be used as a resource to better characterize and solve the environmental issues that could affect any business.

Environmental Management Systems (EMS)

In order to address their environmental responsibilities, public and private organizations have adopted Environmental Management Systems (EMS). The most common framework an EMS uses is the plan-do-check-act process, with the goal of continual improvement [36]; see Figure 3.1. Although this method is the preferred method for the Environmental Protection Agency (EPA) [36], they do not specifically favor this method over the International

Organization for Standards (ISO) 14001[37] (the international standard for EMS) or visa versa. These two sources both give an outline for EMS, and the EPA advises the use of both when putting together such a document so as to get the benefits of both.

Figure 3.1 How to use EMS [36]



The ISO 14001 was developed as a systematic management approach to the environmental concerns of an organization. The expected outcome of this approach is frequent enhancement in environmental management. Planning is accomplished by first setting an environmental policy, then making the environmental concerns of the firm clear (Aspects) and defining what will be done to control them (Objectives and Targets) [37]. Once organizational structure is established, personnel responsibilities, competency training, and implementation must begin. Communication practices, documentation control and procedural documents, operational control and emergency preparedness define the operation portion of the program. These items are usually included in an EMS Manual, which documents a program to accomplish the objectives and targets set above.

The organization’s methods for measuring and monitoring its environmental impacts are also included in the Manual, along with practices for identifying nonconformance and for implementing corrective and preventive actions. These, along with routine systems audits and record keeping, constitute the EMS checking and corrective action program [37]. And finally, the program has a routine management review of its activities. The outline above describes the general sections of an ISO 14001 EMS.

EMS’s can be applied to all types of organizations with a structured system and approach for managing environmental and regulatory responsibilities. The goal here being to improve overall environmental performance and stewardship, including areas not subject to regulation such as product design, resource conservation, energy efficiency, and other sustainable practices [37]. To ensure environmental goals are set and met, EMS's can establish a continual process of checking and in doing so facilitate the integration of the full scope of environmental considerations into the mission of the organization and improve environmental performance. A clever EMS includes procedures for both taking corrective action if problems occur and preventive action to avoid problems.

Key elements of an effective EMS include an environmental policy statement; description of environmental aspects; listing of environmental requirements; clear environmental goals; description of the environmental management program; well-defined structure and responsibility; appropriate education and training of employees; effective communication and documentation plans; appropriate documentation; operational management, and control; regular monitoring and measurement of performance; plans to address emergencies and non-conformance; good records management; and regular audit and review [36].

This is where the EPGE tool can assist companies in developing an EMS. The Written Report Generator will help documentation auditing and review. The HAZWOPER training segment is in place for the education and training of employees, and the Green Engineering section will aid efforts to incorporate sustainability into the performance of the plan.

EMS's can result in both business and environmental benefits. For example, an EMS may help [36]:

- Improve environmental performance
- Prevent pollution and conserve resources
- Reduce/mitigate risks
- Increase efficiency
- Reduce costs
- Enhance image with public, regulators, lenders, investors
- Qualify for recognition/incentive programs such as the Environmental Protection Agency (EPA) Performance Track Program [38], and the United States Department of Agriculture (USDA) Environmental Quality Incentives Program (EQIP) [39].

EPA Performance Track incentive program recognizes and drives environmental excellence by encouraging facilities with strong environmental records to go above and beyond their legal requirements [38]. Companies involved typically set four public goals to improve the quality of our nation's air, water, and land. Members include major corporations, small businesses, and public facilities that are steering a course toward environmental excellence. Currently, the program has about 500 members and welcomes all qualifying facilities.

A company's success is based on the "gold standard" for the facility, which is based on environmental performance - a standard that participating members strive to attain as they meet their goals. To encourage facilities to achieve environmental excellence through continuous improvement, EPA has benefits that add value to Performance Track membership in a variety of ways [38]:

- Recognition - Performance Track recognizes member facilities locally and nationally through letters to elected officials, trade journal articles, press releases, case studies, member listings on EPA's website, and Performance Track Awards.
- Networking - Performance Track provides networking opportunities through Annual Member Events, regional roundtables, EPA meetings, joint workshops with Performance Track partners, and meetings of the Performance Track Participants' Association.
- Regulatory and Administrative Incentives - EPA works with states and other stakeholders to provide specific regulatory and administrative benefits, such as reduced self-reporting and low-priority status for routine federal inspections, that are designed to reduce a facility's transaction costs without causing harm to the environment.
- Services – EPA encourages Performance Track facilities to take advantage of services such as the Green Suppliers Network Review, which helps manufacturers and suppliers save money and improve environmental performance, or the Performance Track Mentoring Program, which matches Performance Track members or potential members with top-performing facilities currently in the program.

- Green Investing - Leading financial advisory firms use Performance Track data in their research methods. This practice can benefit top-performing, publicly traded companies, making them more attractive to investors and increasing brand recognition.

The qualifications for the program are broad as shown by the fact that both public and private facilities have successfully qualified for membership; members range from large multinational corporations to small local businesses with fewer than 100 employees. To become a member of Performance Track a facility must have [38]:

- A proven record of regulatory compliance
- An independently audited Environmental Management System
- A history of past achievement and a commitment to continuous improvement
- Mechanisms for public outreach.

Similarly, the USDA's Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals [39]. EQIP offers financial and technical assistance to eligible participants that aids in the installation or implementation of structural and management practices on eligible agricultural land.

EQIP minimum term contract ends one year after the implementation of the last scheduled practices and can have a maximum term of ten years [39]. These contracts provide incentive payments and cost-shares to implement conservation practices. In general, persons raising livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns [39]. The practices, though adapted for local conditions, are subject to NRCS technical guidelines.

The EQIP may cost-share up to 75 percent of the costs of certain conservation practices [39]. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent [39]. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill [39].

In the National Priorities Programmatic Fiscal Year 2006 plan under EQIP the priorities are listed as follows [40]:

- Reductions of nonpoint source pollution, such as nutrients, sediment, pesticides, or excess salinity in impaired watersheds consistent with Total Daily Maximum Loads (TMDLs) where available as well as the reduction of groundwater contamination and reduction of point sources such as contamination from confined animal feeding operations
- Conservation of ground and surface water resources
- Reduction of emissions, such as particulate matter, nitrogen oxides (NOx), volatile organic compounds, and ozone precursors and depleters that contribute to air quality impairment violations of National Ambient Air Quality Standards
- Reduction in soil erosion and sedimentation from unacceptable levels on agricultural land
- Promotion of at-risk species habitat conservation.

Even with the possibility of incentives from various organizations, developing and implementing an EMS may also have some associated costs, including [36]:

- An investment of internal resources, including staff/employee time
- Costs for training of personnel
- Costs associated with hiring consulting assistance, if needed
- Costs for technical resources to analyze environmental impacts and improvement options, if needed.

Transparency and open communication have societal benefits because others can learn by reviewing the experiences and results that have been reported. Voluntary development of an environmental management system may have significant value to both the producer and society; however, financial rewards from the government for the development and implementation of an EMS can provide additional incentive to develop and make use of an EMS. Efforts to extend good environmental management to all countries of the world will require financial aid and effective communication.

Over the last several years, the Environmental Protection Agency (EPA) has been involved in a wide range of voluntary activities to facilitate EMS adoption. EMS's can improve organizational efficiency and competitiveness, provide an infrastructure for public communication and engagement, and provide a platform to address other important issues such as security [36]. EMS's do not replace the need for regulatory and enforcement programs, but they can complement them.

The EPA is committed to reduce environmental impacts and consumption of natural resources from their facility operations and comply with all legal and applicable requirements. The EPA's environmental management system (EMS) is designed to meet the following goals [36]:

- Ensure compliance by meeting or exceeding all applicable environmental requirements
- Strive to continuously improve environmental performance in terms of both regulated and unregulated environmental impacts (e.g., energy and water conservation)
- Employ source reduction and other pollution prevention approaches whenever practicable
- Require consideration of environmental factors when making purchasing and operating decisions
- Establish, track and review specific environmental performance goals; and
- Share information on environmental performance with the public and allow appropriate opportunities for input into EMS development and implementation.

Although EMS's cannot guarantee any specific level of environmental performance, when properly implemented, EMS's can help facilities achieve significantly improved environmental results and other benefits.

Environmental Impact Statement (EIS)

Within the Environmental Management Systems (EMS) field there is a sub category of Environmental Impact Statements (EIS). These can be defined as the systematic identification and evaluation of potential impacts of proposed projects, plans, programs, legislative actions relative to physical – chemical, biological, cultural, and socioeconomic components of the total environment [41]. The primary purpose of the EIS process, also called the National Environmental Policy Act (NEPA) process, is to encourage the consideration of the environment in planning any decision making and to ultimately arrive at actions which are more environmentally compatible.

The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions [42]. To meet this requirement, federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS). EPA reviews and comments on EIS's prepared by other federal agencies, maintains a national filing system for all EIS's, and assures that its own actions comply with NEPA. An EIS typically has four sections [42]:

- An introduction including a statement of the purpose and need of the proposed action
- A description of the affected environment
- A Range of alternatives to the proposed action
- An analysis of the environmental impacts of each of the possible alternatives

The purpose of NEPA is to promote informed decision-making, by federal agencies, by making "detailed information concerning significant environmental impacts" available to both agency leaders and the public. Not all federal actions require a full EIS. If the action is not likely to cause a significant impact the agency may prepare a smaller, shorter document called an Environmental Assessment (EA). However, EAs are only appropriate if there will be "no significant impact." NEPA is not in place to prohibit the federal government or its licensees/permittees from harming the environment, but merely requires that the prospective impacts be understood and disclosed in advance [42]. After the potential environmental impacts are identified the Environmental Management Systems (EMS) can be modified to appropriately consider potential environmental impacts in order to achieve desired outcomes.

The application for the EPGE tool with respect to EMS, and EIS, is only one specific example, and is specifically related to documentation, training of employees, and performance measurement. With future generations, however, the EPGE tool can be geared to suit the needs of companies developing an EMS.

CHAPTER 4 - Conclusions and Future Research

Future Research

The future use of this Emergency Preparation and Green Engineering (EPGE) tool will be enhanced with the incorporation of Geographic Information Systems (GIS) software into the overall application of the tool. The user needs to be able to make use of GIS software, EKAT and EPGE to accomplish tasks where spatial data are used. With the vast information sources available today, GIS is a key tool in organizing, distributing, and presenting spatial information to the public. People access GIS for reasons including [43]:

- measure change
- conduct spatial analysis (developing maps)
- perform spatial modeling
- transact geographic accounting
- obtain decision support

GIS technology can be used for scientific investigations, resource management, Environmental Impact Statements (EIS), development planning, cartography, and route planning. For example, a GIS can be used to map the movement of contamination plumes, or a GIS might be used to inventory hazardous waste chemicals at a military facility.

With GIS, it is possible to link information (attributes) to location data, such as people to addresses, buildings to parcels, or streets within a network [43]. Then the information can be layered to give a better understanding of how it all works together. The layers can be chosen to combine attributes based on what queries (user-created searches) need to be answered.

A GIS is most often associated with maps. There are, however, more ways in which to work with geographic data in a GIS other than simply maps. This is important, because it means that a GIS can provide a great deal more problem-solving capabilities than using a mapping program or adding data to an online mapping tool.

A GIS can be viewed in three ways [43]:

- Database View: A GIS is a unique kind of database of the world—a geographic database (geodatabase). Fundamentally, a GIS is based on a structured database that describes the world in spatial terms.
- Map View: A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Maps of the underlying geographic information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information. This is called geovisualization [43].
- Model View: A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into newly derived datasets.

GIS software is the main method through which geographic data are accessed, transferred, transformed, overlaid, processed, and displayed. There are numerous commercial, open source, and even shareware products that fill these roles. Commercial software is mostly used in industry, while government and military departments often use custom software, open source products, or more specialized products. GIS processing software is used for the task of preparing data for use within GIS. GIS analysis software takes GIS data and overlays or otherwise combines it so that the data can be visually analyzed [43]. GIS statistical software uses standard database queries to retrieve data and analyze data for decision making.

Specifically to this project, GIS's used with Hazardous Materials (HAZMAT) transportation is an example of where the Emergency Preparation and Green Engineering (EPGE) tool can be improved to aide more users. Route planning for trucks carrying HAZMATs has been in practice for decades. Traditionally, the main considerations include cost, safety in terms of risk of vehicle collision and potential exposure of the public to the HAZMAT substances [44].

A fine example where GIS's are put to use to help prepare or avert emergencies is in Singapore. Singapore's high population density and its high volume of oil refining make it a dangerous place to transport petrochemicals. Owing to land constraints, petrochemical vehicles are bound to pass through highly populated areas from Jurong Island, the petrochemical hub, to the rest of the country [44]. The destinations, which include petrochemical industries, airports, and various petrol or gasoline stations, are spread across the island.

The existing regulations only specify the allowable spots or links to be exact, but the routes are not considered. Given a set of alternate routes quantitative means of evaluating the possible routes remains unknown, as well as information explaining what makes a destination prohibited. The research by Huang [44] attempts to identify a set of evaluation criteria that can be used to route trucks carrying HAZMATs, incorporating factors addressing the security aspect (Table 3.1), in addition to cost, safety and exposure. In this case a GIS was used to quantify the identified routing criteria, and a Genetic Algorithm (GA) is applied to determine the weights of two levels of factors involved in each of the criteria. GA is a form of randomized-search optimization mimicking the natural evolutionary process of natural selection [44]. The main objective of the project was to quantify alternate routes with a unique generalized cost to determine its suitability for HAZMAT transportation, based on current conditions.

After the identification of the criteria, a number of factors that are subsets of each criterion were identified. These factors are quantifiable and each factor was assigned a numerical score ranging from 1 to 5, depending on the attribute value. Table 3.1 shows a fragment of the scoring system for the attributes.

Table 4.1 Scoring system for factors [44].

Emergency response	**1**	**2**	**3**	**4**	**5**
Nearby fire station	0-0.5 km	0.5-1 km	1-1.5 km	1.5-2 km	>2 km
Nearby police	0-0.5 km	0.5-1 km	1-1.5 km	1.5-2 km	>2 km
Nearby hospitals	0-1 km	1-2 km	2-3 km	3-4 km	>4 km
Nearby army camps	0-0.5 km	0.5-1 km	1-1.5 km	1.5-2 km	>2 km
Network redundancy	N/A	N/A	3 or more lanes	2 lanes	1 lane

Souletrette and Sathisan [45] applied GIS's in the transportation of radioactive materials. Like HAZMAT routing, key inputs include demographics, environmental features and transportation system characteristics. They identified three methodologies, namely, comparative studies, worst-case assessment and probabilistic risk assessment [45]. Another example was done by Brainard et al. [46] who demonstrated the use of GIS to route aqueous waste cargoes using four methods, namely [46]:

- routing by shortest time only
- routing by motorway and dual-carriageway encouragement
- routing to avoid population centers
- routing to avoid accidents

The first two methods were used to identify the most probable routes used by tanker drivers to deliver their shipments, and the others were risk-reducing scenarios [46].

The use of GIS in vehicle route planning offers a number of advantages over traditional methods [44]:

- Using maps alone to determine impact area and to find features is tedious and time-consuming.
- Addition of relevant layers that can be used for spatial analyses
- Offers database capabilities that can handle attribute data
- Attribute queries are easy and relatively accurate

GIS solutions are emerging as an integral component in nearly every type of business and government service. GIS networks will support a number of "cross-cutting" business drivers including homeland security, environmental security, healthcare, land use, social services, and emergency management and security. So it makes sense that the evolution of the EPGE tool should involve GIS capability to increase the application of the tool to a broader audience.

Overall Conclusions

As the demand for Environmental Management Systems (EMS) continues to expand, there will be more and more need for tools that can make information gathering and organizing easier. The Emergency Preparation and Green Engineering (EPGE) tool has the ability to help meet this demand. The EPGE tool offers a comprehensive package that is needed to prepare an EMS. The EPGE tool offers users the ability to put together large amounts of diverse data in a form that will satisfy EPA and OSHA standards.

EKAT is an internet-based program consisting of numerous automated tools to aid in addressing environmental and safety-related issues. While content within EKAT® begins to address emergency planning and response needs of users, a multi-faceted, interactive emergency response/preparation tool would directly benefit the Marine Corps as well as other potential users. It will be invaluable to have a tool that will not only guide one during hazardous materials (HAZMAT) emergencies, but also help users evaluate how chemicals affect their health and the environment.

The emergency preparation and green engineering tool has the potential to become very beneficial, based on the wide range of information and resources that it can provide. Emergency response applications have the potential to be of considerable use not only to current EKAT clients, but other public and commercial users as well. With the introduction of the green engineering section, the user is able to make informed decisions on whether or not to use more environmentally friendly chemicals. In addition to providing the user with valuable information, this tool will allow EKAT to fulfill a public need by offering a service that is not yet available online.

At the current time the Emergency Preparation and Green Engineering (EPGE) tool has not been added to EKAT to use on the Internet. Plans for the implementation are in the works, and a future deployment is anticipated. All the information needed to put the tool together has been compiled in the appendices, including:

- Contact information
- Report templates
- HAZWOPER training information
- Training case studies
- Greenness factor resources

In this way the tool will be ready to program into the Environmental Knowledge and Assessment Tool (EKAT) when funding allows. The EKAT team has expressed interest in the tool and its applications, so it is unlikely that the tool’s inception will be delayed for long.

The inspiration for this tool came from my completion of the HAZWOPER training course in January 2007. I was overwhelmed with the amount of information that was needed for first responders in the event of an emergency, and I felt that there should be a tool that can help companies prepare for emergencies, or even pick chemicals that could prevent HAZMAT emergencies. At that same time I had been trying to think of ways that EKAT could help a more general audience, and I feel that this tool makes EKAT more attractive to a larger group of companies.

Over the past year of compiling information and data for this tool, I realized just how much information is out there and how much this tool must grow before it will be as comprehensive as I envisioned it to be. Although there are many tools for emergency response, on the Internet, only the Environmental Preparation and Green Engineering (EPGE) tool offers an emergency database, a HAZWOPER training section, a report generator, and a green engineering section all in one place. This tool is innovative, accommodating, and comprehensive, and with future generations it will lead the way for emergency management.

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Appendix A - List of Acronyms

ABT-Automated Briefing Tool

APRs-Air Purifying Respirators

ARQ-Automatic Retransmission Request

ATSDR- Agency of Toxic Substances and Disease Registry

BEES-Building for Environmental and Economic Sustainability

BLR-Business and Legal Reports

CAA-Clean Air Act

CAGE-Coating Alternatives Guide

CDC-Center for Disease Control

CE- Categorical Exclusion

CFC- Chloroflurocarbon

CHEMTREC- Chemical Transportation Emergency Center

CoBRA®-Chemical Biological Response Aide

CWT-Center for Wireless Telecommunications

DOT-Department of Transportation

EIS-Environmental Impact Statement

EKAT®-Environmental Knowledge and Assessment Tool

EmisCalc-Estimating Air Emissions

EMS-Environmental Management System

EPA-Environmental Protection Agency

EPGE- Emergency Preparation and Green Engineering

EQIP-Environmental Quality Incentives Program

ERG-Emergency Response Guidebook

ESOH-Environmental Safety and Occupational Health

ESS- Environmental Support Solutions

Farm Bill-Farm Security and Rural Investment Act of 2002

FDNY-Fire Department of New York

FEC- Forward Error Correction

FEMA-Federal Emergency Management Agency

FMCSA-Federal Motor Carrier Safety Administration

FOIA-Freedom of Information Act

FOSC-Federal On-Scene Coordinator

GA-Genetic Algorithm

GCES-Green Chemistry Expert System

GIS-Geographic Information System

GPS-Global Positioning System

GWP-Global-Warming Potential

HAP-Hazardous Air Pollutants

HAZMAT-Hazardous Materials

HAZWOPER-Hazardous Waste Operations and Emergency Response

HSDB-Hazardous Substance Data Bank

HSEES-Hazardous Substance Emergency Events Surveillance

ICS-Incident Command System

IDLH-Immediately Dangerous to Life and Health

IEEE-Institute for Electrical and Electronics Engineers

LMDS-Local Multipoint Distribution Service

LMR-Land Mobile Radio

IRIS-Incident Reporting Information System

ISO-International Organization for Standards

IT-Information Technology

MCL-Maximum Contaminant level

NEPA-National Environmental Policy Act

NIOSH-National Institute for Occupational Safety and Health

NLM-National Library of Medicine's

NOx-Nitrogen Oxides

NRC-National Response Center

NYPD-New York Police Department

OEM-Office of Emergency Management

OSHA-Occupational Safety and Health Administration

OSHAct-Occupational Safety and Health Act

PBT-Persistent Bioaccumlative and Toxic

PDA-Personal Digital Assistants

PEL-Permissible Exposure Limit

PESHE-Programmatic Environment, Safety and Occupational Health Evaluation

PPE-Personal Protective Equipment

RCRA-Resource Conservation and Recovery Act of 1976

REL-Reference Exposure Limit

RF-Radio Frequency

SAGE-Solvent Alternatives Guide

SARA-Superfund Amendments and Reauthorization Act

SCT-Secretariat of Communications and Transportation of Mexico

SDW-Safe Drinking Water Act

SMART- Synthetic Methodology Assessment for Reduction Techniques

SNAP-Significant New Alternatives Policy

SRP-Scientific Review Panel

TECCA- Tool for Estimating the Chemical Concentrations in Air

TMDL- Total Daily Maximum Loads

TOXNET®-Toxicology Data Network

TRACI- Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts

USDA-United States Department of Agriculture

VOC-Volatile Organic Compounds

VoIP-Voice Over Internet Protocol

VPN-Virtual Private Network

WISER-Wireless Information System for Emergency Response

WLAN-Wireless Local Area Networks

Appendix B - Emergency Contact Information

Federal Emergency Contacts

Federal Emergency Management Agency (FEMA)

Region I

Serving:

- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

Federal Emergency Management Agency
99 High Street
6th Floor
Boston, MA 02110

(617)-956-7506

Region II

Serving:

- New Jersey
- New York
- Puerto Rico
- Virgin Islands

Federal Emergency Management Agency
26 Federal Plaza, Suite 1337
New York, NY 10278-0002

Region III

Serving:

- Delaware
- District of Columbia
- Maryland
- Pennsylvania
- Virginia
- West Virginia

Federal Emergency Management Agency
615 Chestnut Street
One Independence Mall, Sixth Floor
Philadelphia, PA 19106-4404
Main Number: (215) 931-5608
Congressional Inquiries: (215) 931-5654
Media Inquiries: (215) 931-5716

Region IV

Serving:

- Alabama
- Florida
- Georgia
- Kentucky
- Mississippi
- North Carolina
- South Carolina
- Tennessee

Federal Emergency Management Agency
3003 Chamblee Tucker Road
Atlanta, GA 30341
Main Number: 1 (770) 220-5200

Region V

Serving:

- Illinois
- Indiana
- Michigan
- Minnesota
- Ohio
- Wisconsin

Federal Emergency Management Agency
536 South Clark St., 6th Floor
Chicago, IL 60605
Telephone: (312) 408-5372

Region VI

Serving:

- Arkansas
- Louisiana
- New Mexico
- Oklahoma
- Texas

Federal Emergency Management Agency
FRC 800 North Loop 288
Denton, TX 76209-3698
Main Number: 1 (940) 898-5399
Congressional Inquiries: 1 (940) 898-5104

Region VII

Serving:

- Iowa
- Kansas
- Missouri
- Nebraska

Federal Emergency Management Agency
9221 Ward Parkway, Suite 300
Kansas City, MO. 64114-3372
Telephone: (816) 283-7063

Region VIII

Serving

- Colorado
- Montana
- North Dakota
- South Dakota
- Utah
- Wyoming

Federal Emergency Management Agency
Denver Federal Center
Building 710, Box 25267
Denver, CO 80255-02674404
Telephone: (303) 235-4909

Region IX

Serving:

- Arizona
- California
- Hawaii
- Nevada
- American Samoa
- Guam
- Commonwealth of the Northern Mariana Islands
- Republic of the Marshall Islands
- Federated States of Micronesia

Federal Emergency Management Agency
1111 Broadway, Suite 1200
Oakland, CA 94607-4052

Telephone: (510) 627-7102

Region X

Serving:

- Alaska
- Idaho
- Oregon
- Washington

Federal Regional Center

130 228th Street, Southwest

Bothell, WA 98021-8627

(425) 487-4600

Center for Disease Control (CDC)

Information of a health professional or government office:

770-488-7100

Regional Poison Control Centers:

1-800-222-1222

Coordinating Office of Terrorism Preparedness and Emergency Response:

404-639-7405

Bioterrorism Preparedness and Response Program:

404-639-0385

Agency for Toxic Substances and Disease Registry:

770-488-7100

Federal Motor Carrier Safety Administration (FMCSA)

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State Contacts

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Appendix C - Report Templates

The draft plan templates that are below are based on work that is available from Pathfinder Associates INC, and the Michigan Occupational Safety and Health Administration (MOCHA). Available at http://www.pathfndr.com/mioshaplans.html and http://www.pathfndr.com/oshaplans.html

There are many lists of example reports available online, including completed versions of some of the templates below, at the following web sites:

- The U.S. Department of Health
    1. http://www.dh.gov.uk/en/Policyandguidance/Emergencyplanning/index.htm
- Maine's state government web site
    1. http://www.safetyworksmaine.com/safe_workplace/sample_programs/evergency_evacuation.html
- Ready America
    1. www.ready.gov/
    2. http://www.ready.gov/america/_downloads/sampleplan.pdf

Accident Prevention Plan

Table of contents

Accident Prevention Plan

for

<u>Company name</u>

Management Policy Statement

The president and management of ______________________________ are committed to providing a safe and healthful work environment for all our employees and others that may work, visit, or enter our facilities.

It is our policy to manage and conduct business operations in a manner that offers maximum protection to each and every employee and any other person that may be affected by our business operations.

It is our absolute conviction that we have the responsibility for providing a safe and healthful work environment for our employees and others that may be affected as we conduct our business.

We will make every effort to provide a working environment that is free from any recognized or potential hazard.

We recognize that the success of a safety and health program is contingent and dependent upon support and involvement from management and all employees of the company.

The management of this company is committed to allocating and providing all the resources needed to promote and effectively implement this Accident Prevention Plan.

This company will establish procedures to solicit and receive comments, information, and assistance from employees about safety and health.

This company will comply with all federal, state, and local safety and health regulations.

Company management and supervisors will set an example of commitment to safety and health at this company.

This policy applies to all employees and persons affected or associated in any way by the scope of this business.

President

Authority and Accountability

The ______________(title) of ______________________ (company) accepts the responsibility for providing resources and guidance for the development and implementation of this Accident Prevention Plan.

The ______________(title) is responsible and will be held accountable for the overall implementation of this Accident Prevention Plan. The _______________(title) has the authority to delegate any or all portions of the plan to subordinates but will be held responsible for the performance of the plan. The ______________(title) also has the authority to approve or carry out disciplinary actions against those that violate policies, procedures, or rules.

The _______________(title) is/are responsible and will be held accountable to ensure that all employees under their control follow all safety and health policies, procedures, and rules established by this company. They are also responsible for administering training and guidance to employees under their direction. The _______________ (title) has/have the authority to reprimand and recommend disciplinary actions against employees that violate the safety and health policies of this company.

Employees are responsible and will be held accountable for committing to the safety and health program, abiding by the policies, procedures, rules set forth by this plan, and becoming actively involved in the program to assist in providing a safe and healthful workplace for all involved.

Employees are encouraged to communicate their safety and health concerns with management to implement changes in our program where needed to reduce injury and illness exposures in the workplace.

Contractors that provide or perform services for this company, at any location/facility, will receive the Accident Prevention Plan for review. They are responsible for ensuring that all their employees' actions and the services delivered are in a manner consistent with our commitment to safety and health.

I. Record Keeping

________________________ (company) believes that the only valid means of reviewing and identifying trends and deficiencies in a safety program is through an effective record keeping program. The record keeping element is also essential in tracking the performance of duties and responsibilities under the program.

This company is committed to implementing and maintaining an active, up-to-date record keeping program.

Injury and Illness Data

The _________________ (title) will maintain records of all work-related injuries and illnesses of our employees.

The following forms or records are applicable only to work-related injuries and illnesses:

• Occupational Safety and Health Administration (OSHA) 300*, Log of Work-Related Injuries and Illnesses* or equivalent if required;

• OSHA 301, *Injuries and Illnesses Incident Report* or equivalent if required;

• Texas Workers' Compensation Commission (TWCC) form TWCC-1, *Employer's First Report of Injury*

• Texas Workers' Compensation Commission form TWCC-7, *Non-Covered Employer's Report of Occupational Injury* or Illness; and

• record of first aid or other non-recordable accidents/ incidents.

The OSHA 300, *Log of Work-Related Injuries and Illnesses* or an equivalent record will be maintained at each work or job site. The OSHA 301 *Injuries and Illnesses Incident Report* or an acceptable substitute will be established, bearing a case number correlating with a case identifier on the OSHA 300 log and all pertinent and required information. The information contained in or entered on these records will be maintained current within seven calendar days after a recordable accident is reported. If an OSHA 300 is not

required and not kept, an injury record must be kept to satisfy TWCC Rule 120.1. The OSHA Form 300A *Summary of Work-Related Injuries and Illnesses* will be posted in a conspicuous location for employee review no later than February 1, for the previous calendar year and will remain in place until April 30.

All data pertaining to injuries or illnesses that did not require medical treatment or were otherwise not recordable on the above-mentioned documents will be maintained in written record form. This will include first aid treatment of any kind.

All injury and illness documentation will be reviewed annually in January by management and supervisors to analyze occurrences, identify developing trends, and plan courses of corrective actions.

These records will be maintained a minimum of five years or as required by law.

Safety and Health Surveys and Inspection/Program

The______________________(title) will maintain and review records of all safety audits and inspections that are conducted within or that affect the company, our employees, or facilities.

Applicable forms and records:

- comprehensive survey reports and records of action taken; and
- documented checklists of self-inspection and records of action taken.

Reports generated as a result of comprehensive surveys conducted by outside professional agencies will receive immediate attention and consideration. All hazards identified and recommendations will be acted upon in a timely manner. All methods of addressing the issues contained in the reports will be documented in writing and a copy maintained with the survey report. This documentation will also show the date corrections were made or actions taken.

These reports and all associated documentation will be maintained for record and periodic review. Members of management that receive these reports will ensure the corrective actions have been taken by the responsible personnel.

Checklists will be developed as part of the periodic self- inspection process. Checklists will be used and maintained including the name of the person performing the evaluation and the date the inspection takes place. The self inspection checklists will be reviewed by management upon completion.

All discrepancies identified during the inspection will be evaluated as soon as possible. The periodic self-inspection checklists will be reviewed and evaluated on a regular basis to ensure current applicability. This review will be performed throughout the workplace with input from supervisors and employees. The checklist will be retained along with other applicable data for review. The list will be developed with the assistance of professionals providing comprehensive surveys (insurance field safety representatives, local fire inspectors, TWCC, etc.). The hazards and recommendations noted in the comprehensive surveys will be given consideration for addition to the periodic self-inspection checklist. Area supervisors will be responsible for requisitioning and assisting in the correction process.

The formal Accident Prevention Plan components will be reviewed annually in ____________ to identify insufficiencies or component failure. Each will be audited individually with the findings documented and recorded. This documentation will be used to identify trends in the program element deficiency and to track improvement modifications. This documentation will be maintained for review.

Safety or Other Related Meetings

The ____________________(title) will maintain accurate records of all proceedings associated with the safety and health program of this company.

Applicable forms and records:

• minutes, records, and data resulting from safety meetings or other gatherings in which discussion occurs that affects the safety and health program.

Keep a record of all proceedings and appropriate management or other designated staff actions affecting the safety and health program. These records will include the name of the recorder, date, a list of attendees, details of the topics discussed, and action or corrective measures suggested, recommended, or taken. The purpose of these is to ensure that decisions affecting the safety and health program of this company are carried out, implemented, and that results are tracked.

Designate a recorder who will be responsible for the minutes or records at each meeting. During each subsequent meeting, the record of minutes for the previous meeting will be reviewed, discussed, resolved, and the document closed with an authorized signature.

Training Records

The _____________________(title) will document and maintain records of all safety- and health-related training.

Applicable forms or records:

• training documentation records.

All safety and health related training provided to employees of this company will be documented. This documentation will be maintained as proof of attendance and reviewed to assist in determining the need for additional or repeated training for employees on an individual basis. Records and documentation of training will include the presenter's name, date of training, topic or subject, legible identification of the attendee, and attendee's signature. The person providing the training is responsible for generating the documentation. The training record will become part of the employee's permanent file and will be maintained by

__________________ (title) for a minimum of five years or as required by law.

Accident Investigation

The ___________________(title) will ensure proper records and documentation of all accident and incident investigation activities are maintained and reviewed.

Applicable forms and records:

- accident investigation forms and supporting data including photographs; and
- records of corrective action or preventative measures implemented.

All accidents and near miss incidents resulting in injury or illness to a person, property damage of any magnitude, or the potential for either, will be investigated and documented.

All items on the designated accident investigation form will be addressed in detail as soon as possible following the accident/incident. The information acquired will be used and reviewed by management, supervisors, and effected employees to establish all contributing factors and causes. From the investigation, a plan of corrective action will be established to prevent recurrence of the accident/incident.

The plan of corrective action and implementation will be documented and reviewed by management.

The investigations are to find out the facts, not to place blame. Any suggestions employees may provide on how to prevent future accidents or incidents are encouraged.

Equipment Inspection and Maintenance

The ____________________ (title) will maintain records and data pertaining to equipment inspection and maintenance programs performed at or with each facility for a minimum of five years or as required by law.

Applicable forms and records include:

- routine inspection and maintenance records;
- documentation of services performed by contract agreement;
- documentation of repair and replacement of parts or equipment; and
- manufacturer’s instructions for operation and maintenance of equipment.

Accurate records will be maintained involving all routine inspection and maintenance procedures performed on equipment at this company. This documentation will be reviewed periodically by those responsible for maintaining equipment and facilities. The documentation will be utilized to determine an effective, ongoing equipment maintenance program and to ensure compliance with regulations that require inspections on certain equipment.

Analysis

The ________________ (title) of ___________________ (company) will review and analyze all records and documentation pertaining to the safety and health program. This review will be conducted on a__________ (frequency) basis and will focus on hazard and injury analysis, and recognition of developing trends.

Trend analysis will identify recurring accidents and near-miss incidents resulting in or potentially involving: injury, illness, or property damage. The analysis will also recognize repeatedly identified hazards or violations needing corrective action to establish what plan component is failing that allows the hazard to exist.

The __________________ (title) will provide information and recommendations for corrective measures for trends developing in their areas. Employees will be made aware of developing trends and hazard exposures as they are recognized. Employees will be contacted to provide their input on the methods they think would be successful in reversing any identified negative trends. Trends of accidents or hazard recurrences will be a focal point for corrective action and employee training.

The _________________ (title) will follow up on corrective measures at each location until the causal factor has been eliminated or controlled.

Employee training records will be reviewed annually in the month of _________________ to ensure an adequate and effective training program is maintained. Employees will be interviewed periodically to establish their retention of training and determine when information should be updated.

Safety and Health Training

________________________(company) is committed to providing safety and health related orientation and training to all employees at all levels of the company. The _________________(title) will develop, implement, and maintain an aggressive safety and health orientation and training programs. The plan's purpose is to educate and familiarize employees with safety and health procedures, rules, and work practices of their facility. The management of this organization will encourage and require involvement and participation of all managers, supervisors, and employees. Furthermore, the management will support the orientation and training program with allocations in funding, staff, resources, and time to develop and implement this plan.

Training Program Development

The training subjects and materials are developed utilizing industry and site specific criteria relating to identified and potential hazards, accident and incident data, and training required by federal regulations. The orientation, and subsequent training sessions will include, but not be limited to, the following:

- hazards associated with the work area;
- hazards of the job or task assignment;
- emergency procedures;
- personal protective equipment;
- hazard communication (hazardous chemicals and materials);
- specific equipment operation training;
- employee reporting requirements;
- accident investigation (supervisors and other designated personnel);
- confined space entry; and
- any federally required training not included or addressed above.

The training program shall be administered in two phases consisting of new employee or reassignment orientation and regular periodic training and refresher sessions.

Aside from the formal safety and health training classes, employees will receive guidance and instruction on safe operating procedures of each assigned job or task.

Employees are expected to provide feedback to management on the usefulness or applicability of the training provided to them.

Orientation

Orientation training will be administered to all new employees prior to the initial work assignment and to employees assigned to new or different tasks or jobs.

The orientation will consist of all required training programs as well as job and site specific safety and health information. All new employees will be given a tour of the facility and an opportunity to pose questions to expedite the familiarization process. New employees will not be released to an individual job assignment until it has been determined by _________________(title) that the individual has retained the minimal acceptable elements of the training provided and pertinent information to safely perform the assigned duties.

Ongoing Training

All managers, supervisors, and employees are required to participate and become involved in the ongoing safety and health training program. The frequency, repetitiveness, and subject matter will be determined by training assessments and audits to be performed by _______________ (title) and will be at intervals that ensure demonstration of adequate training. The assessments and audits will, for the most part, be informal questions and observations of employees and work areas.

At some point, a more formal survey, such as a written examination, may be required. At no time will an employee be approved to work more than 12 months without retraining. All employees assigned to attend a training session must demonstrate competency and retention of the minimal acceptable information of the training prior to returning to any job assignment. The _________________(titles) have the authority to assess training effectiveness and are responsible for enforcing implementation of criteria requirements of all training.

Documentation

Any and all safety and health related training administered or provided by ___________________ (company) will be documented with the following minimum information:

• date of training session;

• provider (name of person conducting training and affiliation, if not an employee of the company);

• subject matter;

• legible name of attendee(s) and supplemental identification if needed or required;

• signature or acknowledgement of attendance.

All training records and documentation will become a permanent part of each employee's record as well as a master record used to determine participation of all employees.

Individual training records will be maintained for the current year plus five more.

Safety Audit and Inspection

The ___________________ (title) has implemented a program to identify, correct, and control hazards on an ongoing basis. This program will utilize multiple resources to ensure effectiveness.

Comprehensive Surveys

This company has arranged for each operating location to receive a comprehensive safety and health audit by_______________ (title) on a regular basis — at least_____________ (frequency). These audits will identify existing and potential hazards and noncompliance issues that should be addressed. The findings of the surveys will be discussed and recommendations for corrective actions suggested. Audits will also be conducted to evaluate the overall effectiveness of the Accident Prevention Plan and employee training. Recommendations will be made to enhance the performance of the safety and health program. Reports will be forwarded to management for review.

Safety and Health Self-Inspections

The ______________ (title) at each site/facility will conduct ___________ (frequency) in-house safety and health self-inspections that will cover the entire facility and equipment.

Employees will conduct constant informal inspections of their work areas and tools. If any potential exposures or deficiencies are identified, employees are expected to communicate these to their supervisors if the employees are not able to rectify the situation immediately.

All inspections will be conducted on an ongoing basis without interruption. Management will allocate adequate time and resources to perform the inspections.

Each location will develop and maintain an inspection checklist specific to the operation. The list will be developed utilizing a general inspection checklist and will be evaluated and updated with hazards that are identified during the inspections and other pertinent data as it is acquired. The contents of this checklist will be reviewed on a regular basis to ensure that it is current and updated.

The checklist will become a part of the permanent record of the inspection and will serve as a confirmation of the audit. Each checklist will indicate the location, specific site or area inspected, name and title of the inspector, date of inspection, and corrective action taken for identified hazards or violations. The inspection report will be used in trend analysis and record keeping.

Employees must be notified of the hazards that pose an immediate threat of physical harm or property damage, and informed of measures or steps that will be taken to eliminate, correct, or control the hazard.

Management will review the inspection checklists and any other established documentation to ensure that a course of corrective action and time line has been established for eliminating each deficiency.

Accident and Hazard Investigation

Management is committed to and will correct or control all hazards identified through any of the avenues of recognition established. All identified hazards will receive a timely response.

Hazard Correction

Whenever possible and feasible, hazards identified at facilities will be corrected eliminating the cause of the hazard at the source. This will include, but not be limited to, the following:

- discontinuation from use or removal of hazardous chemicals, materials, or substances from the workplace;

• discontinuation from use or removal of hazardous equipment until replaced or repaired;

• correction of any unsafe acts or conditions in existence, by service or training.

Hazard Control

When identified hazards cannot be eliminated, the hazard will be effectively controlled by engineering, administrative procedures, work practices, personal protective equipment, or any suitable combination of these measures.

Engineering controls will include, but not be limited to, the following:

• isolation of employee exposure to the hazard;

• guarding or displacement of employee exposure to the hazard; and

• preventive maintenance and repair of machinery and equipment.

Administrative procedures will include, but not be limited to, the following:

• written programs to establish administrative guidelines for safe work practices; and

• established and implemented work rules and procedures.

Work practices will include, but not be limited to the following:

• careful planning and performance of each assigned job, duty, or task;

• reduction in duration of exposure to hazards; and

• adherence to safety and health rules and procedures.

Personal protective equipment will be the control of last resort when all other means of eliminating the hazards have not provided adequate protection to the employee.

When personal protective equipment is issued, the employee will be informed of the requirements, use, and limitations of the equipment.

Accident Reporting and Investigation

The _______________ (title) will investigate all work related accidents and near miss incidents involving employees or company property to develop preventive measures and implement corrective actions.

Employee Reporting

All employees and associates are required to report to their immediate supervisor, any of the following:

• accidents or incidents with injury or illness of any magnitude (including first aid related cases);

• accidents or incidents resulting in property or equipment damage of any magnitude; and

• any near miss incidents that could potentially have resulted in injury or illness or property damage.

Employer Reporting

The _______________ (title) will report the following as required:

• Texas Workers' Compensation Commission: Fatalities and accidents involving hospitalization of five or more injuries will be reported within 24 hours;

• OSHA: Fatalities and accidents involving hospitalization of three or more injuries will be reported within eight hours.

The _________________________________ will be maintained as this company's recordable injury log and nonrecordable injuries will be maintained on a separate log.

Accident Investigation

The _______________ (title) will be responsible for conducting investigations of accidents that occur in their areas or that affect employees under their supervision. Upon notification of an accident or near-miss incident, the responsible supervisors will begin investigation to determine the following:

• how the accident or incident occurred;
• special circumstances involved;
• underlying, indirect, or associated causes; and
• corrective actions or preventive measures and controls.

Accidents and incidents involving situations where multiple supervisors are affected (an employee of one department injured in another) will be investigated jointly. The supervisor of the area where the incident occurred will be in charge of, and be held accountable for, the investigation.

Documentation

All activities and findings of the investigators will be documented and recorded for review.

Accident investigation documentation will record as a minimum, the following information is required for injury records per TWCC Rule 120.1:

- date and time of occurrence;
- name of person involved, job title, area assigned;
- date of birth, sex, wage, length of service, and social security number;
- location of occurrence;
- nature and severity of injury or illness;
- name of person conducting the investigation;
- name of immediate supervisor of employee;
- job assignment or duties being performed at time of incident;
- special circumstances or encumbrances;
- details of how the accident occurred;
- injury and part of body affected;
- description of any equipment affected or involved;
- names and comments of witnesses;
- direct cause;
- indirect, underlying, or contributing factors (including fault or failure in safety and health program elements); and
- corrective action implemented or preventive measures taken (including safety and health program adjustments).

Review and Revision of Components

The ________________ (title) or other designated representative will review and revise the components of the Accident Prevention Plan _____________ (frequency) for effectiveness and implementation. Special attention will be devoted to areas and criteria that demonstrate failure in a program component, introduction of new procedures, processes, or equipment. Corrective measures will be taken as needed to reemphasize or restructure the Accident Prevention Plan to perform at the optimum effectiveness.

Information will be solicited from area supervisors and employees to determine the effectiveness of each program component, and to develop adjustments and corrections.

Goals and Objectives

Goals

An effective Accident Prevention Plan can achieve the following goals:

- effective involvement of each and every employee of the company in safety;
- eliminate any and all hazards (current and potential) that expose or create risk of any nature;
- reduce all work-related incidents resulting in injury or illness to employees or other person associated with our business operations;
- reduce lost work days due to incidents resulting in injury or illness to any employee or other person or property damage from such incidents;
- increase awareness of the overall safe operation of all facilities;
- increase employee morale by knowing their work environment is maintained as free as possible from any and all recognized hazards;
- eliminate work-related injuries and illnesses, property damage, and all associated losses.

Objectives

- implementation of an effective Accident Prevention Plan;
- commitment for ongoing safety program support from management and employees;
- assigned responsibilities and accountabilities for the safety program;
- allocation of adequate resources to the safety program;
- establish lines of communication between management and employees at all levels for safety and health concerns;

- effective records and documentation maintenance and review;
- completion of comprehensive surveys and periodic self-inspections;
- implementation of effective measures for hazard identification, correction and control;
- implementation of effective orientations and training programs; and
- initiation of regular program review and revision procedures.

The goals will be realized only if the objectives are carried out without hesitation or interruption, and if every employee becomes interested in the safety program and its success.

Employee Commitment and Responsibilities

We recognize the success of any company endeavor is largely dependent on its entire workforce. This company recognizes the value of employee involvement to assist us in achieving the goals we have set for ourselves.

The company president aggressively solicits from all employees the assistance for, and commitment to, the implementation of the Accident Prevention Plan.

Employees are encouraged and expected to become involved in all aspects of implementing this Accident Prevention Plan.

Employees are expected to use established procedures to submit comments, information, and assistance where safety and health is concerned.

Employees are expected to perform their job duties in a manner that is safe for themselves, as well as those around them.

Employees are required to follow all safety and health policies, procedures, and rules established or followed by this company.

Employees of this company will adhere to the safety and health regulations established by federal, state, and local agencies.

Employees are expected and required to adhere to this company's safety and health program. This is not optional!

Employee Involvement

Management encourages employee involvement in the implementation of the safety and health program of this facility. We solicit this involvement by giving each employee an opportunity to participate and be responsible for implementation of the safety program for their respective areas or job.

Departmental Safety Meetings

This company will ensure that all employees meet on a regular basis to discuss safety and health issues or concerns and increase employee awareness of the safety and health program. Regular meetings will keep the program active in the minds of the employees, and offer an avenue for employees to voice concerns regarding workplace safety and health. Meeting minutes and attendance records will be kept on file. Minutes will include all safety items and procedures discussed as well as the date and time of the meeting.

Reporting of Hazards and Unsafe Conditions

As a condition and requirement of employment, all employees are required to report hazards and unsafe conditions in the workplace to ______________ (title). He/she will take prompt and appropriate action to determine if a hazard exists. If it is determined that a hazard does exist, immediate attention for correction or interim protective measures will be taken. The reporting employee will be notified of the corrective action taken or the procedures used to conclude that no hazard existed. If practical, this information will be shared with all facility employees.

Documentation

All hazard reports and corrective measures/action taken will be documented and recorded. This documentation will be reviewed by management. Pertinent information will be made available for employee review.

Disciplinary Policy

___________________ (company) has developed a disciplinary policy that applies to the safety and health program of this company. The disciplinary policy will be a tool to ensure enforcement of the rules and procedures established by this Accident Prevention Plan to promote a safe and healthful working environment. The disciplinary policy applies to all employees of this company.

Verbal Warnings

Management or supervisors may issue verbal warnings to employees that commit minor infractions or violations of the safety rules or safe work practices. Continued violations or verbal warnings can lead to more stringent action.

Written Warnings

Management or supervisors may issue written warnings for the following:

• repeated violation of minor safety rules or procedures;

• single serious violations of a rule or procedure that could have potentially resulted in injury to themselves, another employee and/or could have caused property damage; or

• activities that could potentially result in injury and/or property damage.

Disciplinary Leave

Supervisors may recommend, and management may institute, disciplinary leave for the above reasons and the following:

• a single serious violation of a rule or procedure that results in injury to an employee and/or property damage; or

• repeated violations and/or nonconformance to safety rules or procedures.

Termination

Supervisors may recommend and management may concur in the termination of any employee for repeated serious violations of the above circumstances.

Documentation

Violations of company or safety rules, regulations, or procedures will be documented by filling out a report on the employee. The report will state the type of violation and corrective action taken. The employee must read and sign the report acknowledging that they understand the seriousness of the violation.

Self-Inspection Forms

Inspection Date:____

Location or Department Inspected:_______________________________

Signature:____

	YES	NO
1. **Housekeeping -**Is the work area clean and orderly?	□	□
2. **Floors -** Are floors in good condition (smooth, clear surfaces without holes, cracks, or humps)?	□	□
3. **Aisles -** Are aisles and passageways clear, dry, and free of tripping hazards?	□	□
4. **Stairways -**Are stairs in good condition, with handrails, and adequate lighting?	□	□
5. **Storage -** Are materials, products, or supplies properly and safely stacked to a workable height?	□	□
6. **Ladders -** Are ladders provided where needed, of standard construction, and in good physical condition?	□	□
7. **Machines & Equipment -** Are machines and equipment in safe operating condition? Are the necessary guards provided and used?	□	□
8. **Hand Tools -** Are the right tools for the job being used? Are they in good condition?	□	□
9. **Electrical -** Are all required grounds provided on power tools and extension cords?	□	□
Is electrical equipment in good operating condition?	□	□
10. **Lighting -** Is adequate lighting provided in all work areas?	□	□
11. **Eye Protection -** Are all employees provided with suitable eye protection when around operations that produce flying particles?	□	□
12. **First Aid -** Are first aid supplies provided and accessible?	□	□
13. **Fire Extinguishers -** Are fire extinguishers easily accessible and properly serviced?	□	□

14. **Entrances** -Are entrances kept dry or provided with nonskid mats?	◻	◻
15. **Exits** -Are emergency exits marked, clear, and easily accessible?	◻	◻
Are exit doors unlocked and do they swing toward the outside?	◻	◻
16. **Exterior** (sidewalks, parking lots, etc.) -Are sidewalks and parking lots smooth and free of cracks, holes, and tripping hazards?	◻	◻
17. **Training** -Are all employees trained in proper lifting techniques and material handling?	◻	◻
18. **Signs** -Are safety instructions and warning signs posted where needed?	◻	◻

Accident Prevention Plan Employee Acknowledgment

Employee Name:____

Date Hired: ____

Social Security No: ____

Driver's License: ____

I acknowledge that I have received, read, and understood the contents of the Accident Prevention. If unable to read, the contents of the Accident Prevention Plan have been explained by my supervisor.

I understand that compliance with all stated company policies, including safety, is a condition of continued employment with this company.

Signature_________________________________ Date________________________

Safety Hazard Report

Location: ____

Date: ____

Day of Week: ____

Time: ____

Hazard Description:

Recommendation:

Signature____________________________

Action Taken:

Signature________________________________

Supervisor's Report of Employee Injury Investigation

Injured Employee: ____

Date of this report: ____

Job Title:____

Age:____

Date and time of injury:____

Where injury happened:____

Report to supervisor or first aid delayed?______________________________

Why?____

Supervisor's comments regarding cause of injury:__________________________

Was there lost time as a result of this injury? ___________________________

Lost time began: ____

What should be done, and by whom to prevent recurrence of this type injury in the future?

What action will be taken to see that this is done?

Was employee's previous injury record reviewed with him or her? ________________

Total number of injuries to date?____________ Date employed:________________

Does previous injury record indicate repeated types of injuries? __________________

Supervisor's Signature ____

Training Attendance List

Date held: ____

Program Title: ____

Trainer: ____

The following personnel attended the training listed above:

NAME	SSN	SIGNATURE

Topics Discussed

____

____

____

____

____

Annual Review Accident Prevention Plan

Review Date: ____

New Exposure Identified: ____

Action Taken: ____

Reviewed By: ____

Date of next review: ____

Emergency Action Plan

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Emergency Action Plan

For

<u>(Company Name)</u>

I. GENERAL PROGRAM MANAGEMENT

Responsibility

It is the responsibility of management to protect their employees. The company safety officer or designee, ______________________ (name) is responsible for this program and has authority to make necessary decisions to ensure the success for this plan. Copies of the written program may be obtained from the office.

Program Review and Update

The Emergency Action Program will be reviewed and/or updated under these circumstances:

- Annually, on or before ______________ (date) of each year

Whenever new equipment, facility construction, personnel, or processes changes might affect the plan's procedures

II. METHODS OF COMPLIANCE

Emergency Escape Procedures

Emergency escape routes will be kept clear at all times. The escape routes and emergency procedures are documented in **Attachment A**. A copy of the escape route and emergency procedures will be posted on the employee bulletin board. This company has also designated safe areas for employees to report to in the case of an emergency. Refer to **Attachment B** for designated safe areas.

Procedures for Critical Operations

Some operations in this company, in which control in an emergency situation is critical to the safety of employees, require special procedures for proper control (e.g., monitoring plant power, water supplies or other essential operations). In these cases the following employees are responsible for these critical operations until their evacuation is necessary.

Critical Operations Personnel

Name/Position:

____

Critical Operation:

____

Name/Position:

____

Critical Operation:

____

Name/Position:

____

Critical Operation:

____

NOTE: If at any time during an emergency situation the above employees' safety is at risk, the critical operation procedures are to be abandoned and the employees are to proceed to a safe area.

Procedures to Account for Employees, Visitors, or Those With Special Needs

Supervisors will be responsible for accounting for employees after an emergency evacuation. The responsible persons will be provided with a list of names of all the employees they are responsible for in their area. This list will be updated with each new employee hired and non-employees will be deleted.

The following employees will be responsible for conducting operations to account for employees after the emergency evacuation. These procedures are designed to account for all employees, and visitors and to determine if an employee or visitor needs assistance in evacuating, and to determine their possible location.

Employees Responsible for Accounting for Other Employees or Visitors

Name/Position:

Alternate:

Department:

Name/Position:

Alternate:

Department:

Name/Position:

Alternate:

Department:

Procedure for Reporting Emergencies

The quicker and more efficiently emergencies are reported, the greater the chance for saving lives and property. The following is the procedure for reporting an emergency in this company. This procedure will be posted on the employee bulletin board.

Reporting Emergencies

Emergency Situation		Reporting Procedures
Fire	____________	____________________
Tornado	____________	____________________
Fuel or Chemical Release	____________	____________________
Earthquake	____________	____________________
Train Derailment	____________	____________________
Other	____________	____________________

Emergency phone numbers will be posted near telephones or employee notice boards and other conspicuous locations where telephones will be used as the means of reporting emergencies.

Rescue and Medical Duties

The safety officer or designee is responsible for the enlistment and training of the authorized fire brigade personnel (see the Fire Prevention Program). The fire brigade personnel will be trained in the use of fire extinguishers and first responder first aid (CPR, Abdominal Thrust, etc.).
The following personnel are the authorized members of the fire brigade:

Fire Brigade Personnel

Name/Position:

____

Designated Area:

____

Name/Position:

____

Designated Area:

____

Name/Position:

____

Designated Area:

____

Name/Position:

____

Designated Area:

____

Alarm Systems

The emergency alarm system will provide warning for necessary emergency action as called for in this program. This alarm system will be capable of being perceived above ambient noise or light levels by all employees in the workplace. Tactile devices may be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm.

Training and Record Keeping

__________________________ (employee name) is responsible for training all employees covered under this program. As part of the Emergency Action Program our employees will be trained under the following circumstances:

a. At the time of initial assignment and annually thereafter

b. When an employee's responsibilities change under this program

Employees responsible for leading the evacuation will be trained in evacuation inspections of closed rooms, alternate escape routes, employees that may need additional assistance, buddy system and hazardous areas to avoid during evacuation procedures.

For additional information or explanation of the duties under the Emergency Action Program contact the company safety officer or designee.

To ensure that proper training is given to our employees, we keep accurate records of our employees' training. This information is kept in the office. **(see Attachment D).**

Attachment A - Emergency Escape Route

(Use floor plans or workplace maps to show emergency escape route assignments, locations of exits, locations of fire extinguishers and designated safe areas.)

Attachment B - Designated Safe Areas

Emergency Situation	Department	Designated Safe Area
Fire		
Tornado		
Fuel or Chemical Release		
Earthquake		
Train Derailment		
Other		

Attachment C - Alarm Procedures

Emergency Situation	Alarm System
Fire	
Tornado	
Fuel or Chemical Release	
Hurricane	
Train Derailment	
Other	

Attachment D - Emergency Response Training Form

Date of Session: _______________Session Summary (Attached) Yes _________ No_________

Instructor(s)	**Qualifications**
Employee Signature	**Employee Job Title**

Laboratory Specific Exposure Control Plan

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Laboratory Specific Exposure Control Plan

For

(Company name)

☐ **Review work assignments to determine employee potential for exposure to laboratory-acquired infections**.

Principal investigators and laboratory supervisors need to perform an exposure determination concerning which employees may incur occupational exposure to blood or other potentially infectious materials (OPIM), biohazardous materials or lab-acquired infections. The exposure determination is made without regard to the use of personal protective equipment (i.e. employees are considered to be exposed even if they wear personal protective equipment). This exposure determination lists all job classifications in the laboratory and which employees may be expected to incur such occupational exposure, regardless of frequency. At this Laboratory the following job classifications are: ____

____

____

☐ **Identification and Responsibilities of employees covered by the Exposure Control Plan**

Not all employees in the laboratory are expected to be exposed to blood or OPIM, biohazardous materials or lab-acquired infections. However, tasks or procedures that would cause these employees to have occupational exposure are also required to be listed in order to clearly understand which employees in these categories are considered to have potential occupational exposure. At this Laboratory the job classifications and associated tasks for these types of employee categories are as follows:

Employees have the most important role in the compliance program. The ultimate execution of the Plan rests in their hands. The employee is responsible for the following activities.

- Know what tasks performed have occupational exposure
- Attend blood borne pathogen training sessions
- Plan and conduct all operations in accordance with work practice controls
- Develop and practice good personal hygiene habits

☐ **Universal precautions and specific measures on how to minimize the risk of exposure**

Universal precautions need to be observed at this laboratory in order to prevent contact with blood or other potentially infectious materials. All Blood, OPIM, zoonotic diseases, biohazardous material, infectious agents, toxins or wild/unknown sources that may be transmitted to humans need to always be considered infectious regardless of the perceived status of the source.

☐ **Engineering Controls - biosafety cabinet, centrifuge safety cups, sharps containers, etc.**

Engineering controls along with work practice controls are utilized to eliminate or minimize exposure to employees at this laboratory. Personal protective equipment needs to be used where occupational exposure remains after institution of engineering and work practice controls. At this facility the following engineering controls will be utilized: (list controls, such as biosafety cabinet, centrifuge safety cups, sharps container, etc.)

Examples:

1. Handwashing facilities or antiseptic hand cleansers, towel or antiseptic towelettes, or are readily accessible to all employees who have the potential for exposure.
2. Contaminated sharps, specimen and secondary containers should have the following characteristics:
   - puncture-resistant
   - Color-coded or labeled with a biohazard warning label
   - Leak-proof on the sides and bottom
   - Closable

The above controls should be reviewed annually and maintained on a regular schedule. The schedule for reviewing the effectiveness of the controls is as follows: list schedule such as daily, once/week, etc. Also list the person who has the responsibility to review the effectiveness of the individual controls, such as the supervisor for each Laboratory, etc.

____

Hand washing facilities are available to the employees who incur exposure to blood or other potentially infectious materials. Hand washing sinks are required in the laboratory so they will be readily accessible after incurring exposure.

At this facility hand washing facilities are located: (list locations, such as room number and area in the laboratory.

____

If hand washing facilities are not feasible, an alternative is to use antiseptic cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. If these alternatives are used hands are to then be washed with soap and running water as soon as feasibly possible. Principal investigators or supervisors who have this type of alternative because of the lack of accessible hand washing facilities should list the location, tasks, and responsibilities to ensure maintenance and accessibility of these alternatives.

____

____

After removal of personal protective gloves, employees <u>must</u> wash hands and any other potentially contaminated skin area IMMEDIATELY or AS SOON AS FEASIBLY possible with soap and water.

If employees incur exposure to their skin or mucous membranes then those areas shall be washed or flushed with water as appropriate as soon as feasibly possible following contact.

☐ **Work practices - hand washing, personal hygiene, labeling, sharps handling, etc.**

Contaminated needles and other contaminated sharps should never be bent, recapped, removed, sheared, or purposely broken. The exception to this is the procedure would require contaminated needles be recapped or removed and no alternative is feasible. If such action is required then recapping or removal of the needle must be done by the use of a mechanical device or a one-handed technique. This laboratory recapping or removal is only permitted for the following procedures: _______________

____
____

____
____________________ (List the procedures and also list the mechanical device to be used or alternately if a one-handed technique will be used).

In work areas where there is a reasonable likelihood of exposure to blood or other potentially infectious materials, employees are not to eat, drink, apply cosmetics or lip balm, smoke, or handle contact lenses. Food and beverages are not to be kept in refrigerators, freezers, shelves, cabinets, or on counter tops or bench tops where blood or other potentially infectious materials are present.

Mouth pipetting/suctioning of blood or other potentially infectious materials is prohibited.

All procedures need to be conducted in a manner which will minimize splashing, spraying, splattering, and generation of droplets of blood or OPIM. Methods which will be employed at this laboratory to accomplish this goal are: list methods, such as centrifuge cups, biosafety cabinets etc.

☐ **Personal Protective Equipment** (PPE) - gloves, lab coat, safety glasses, HEPA respirator, mask, etc.

☐ **Housekeeping** - cleaning, decontamination and waste handling.

Contaminated sharps are to be placed immediately, or as soon as possible, after use into an appropriate sharps container.

At this facility sharps containers are puncture resistant, labeled with a biohazard label, and leak proof. (Employers should list where sharps containers are located as well as who has responsibility for removing sharps from containers and how often the containers will be checked to remove the sharps).

☐ **Laboratory Specific Emergency Plan to follow if there is an exposure or release**

Laboratory Specific Emergency Plan

(Date Completed)

1. Primary Laboratory Emergency Contacts (Refer to your Emergency Notification Signage)

Note: Also include other helpful contact here (e.g. Campus Facilities, EHS, MU Police, etc.)

2. General Laboratory Response Procedures for Anticipated Biohazard Emergencies (Fire, Chemical or Biological Releases, Medical Emergency, Radiation Emergency, Tornado, Mechanical Equipment or Physical Facility Emergency, Flooding, Oral or Written Threat, etc.)

3. Emergency Evacuation Procedures (Escape Routes w/ Diagram, Critical Laboratory Operation Shutdown, Headcount and Assembly Point Coordination, Laboratory Personnel Responsibilities and Duties, etc.)

4. Description of Emergency Alarm Systems (Refer to your Building Specific Emergency Action Plan)

5. Detailed Laboratory Precautionary Procedures (List of Major Potential Laboratory Biohazards and Procedures to Reduce Biohazard Risk)

6. Additional Biohazard Emergency Information (Other Notifications, News and Media Relations, Post Emergency Meeting, Incident Report System, Frequency of Plan Updates, etc.)

☐ **Hepatitis B vaccine**

All employees who have been identified as having exposure to blood or other potentially infectious materials will be offered the Hepatitis B vaccine, at no cost to the employee. The vaccine will be offered within 10 working days of their initial assignment to work involving the potential for occupational exposure to blood or other potentially infectious materials unless the employee has previously had the vaccine wishes to submit to antibody testing which shows the employee to have sufficient immunity.

Employees who decline the Hepatitis B vaccine will sign a waiver which uses the wording in Appendix A of the OSHA standard.

Employees who initially decline the vaccine but who later wish to have it may then have the vaccine provided at no cost. (Principal Investigators and Laboratory Supervisors should list here who has responsibility for assuring that the vaccine is offered, the waivers are signed, etc. Also, the Principal Investigator should list who will administer the vaccine).

____

____

☐ **Exposure Incident Reporting and Recordkeeping**

When the employee incurs an exposure incident, it should be reported to (list who has responsibility to maintain records of exposure incidents):

____

All employees who incur an exposure incident will be offered post-exposure evaluation and follow-up in accordance with the OSHA standard. This follow-up will include the following:

- Documentation of the route of exposure and the circumstances related to the incident.
- If possible, the identification of the source individual and if possible, the status of the source individual will be tested for infection (after consent is obtained) such as HIV/HBV infectivity.
- Results of testing of the source individual will be made available to the exposed employee, with the exposed employee informed about the applicable laws and regulations concerning disclosure of the identity and infectivity of the source individual.
- The employee will be offered the option of having their blood collected for testing of the employee serological status (such as HIV/HBV). The blood sample will be preserved for up to 90 days to allow the employee to decide if the blood should be tested for serological status (such as HIV/HBV). However, if the employee decides prior to that time that testing will or will not be conducted then the appropriate action can be taken and the blood sample discarded.
- The employee will be offered post exposure prophylaxis in accordance with the current recommendations of the U.S. Public Health Service. These recommendations are currently as follows: (These recommendations may be listed as an appendix to the plan)
  ____
  ____
  ____
  ____
- The employee will be given appropriate counseling concerning precautions to take during the period after the exposure incident. The employee will also be given information on what potential illnesses to be alert for and to report any related experiences to appropriate personnel.
- The following person(s) has been designated responsible to assure that the policy outlined here is effectively carried out as well as to maintain records related to this policy:
  ____

INTERACTION WITH HEALTH CARE PROFESSIONALS

A written opinion shall be obtained from the health care professional who evaluates employees of this facility. Written opinions will be obtained in the following instances:

- When the employee is sent to obtain the Hepatitis B vaccine.
- Whenever the employee is sent to a health care professional following an exposure incident.

Health care professionals shall be instructed to limit their opinions to:

- Whether the Hepatitis B vaccine is indicated and if the employee has received the vaccine, or for evaluation following an incident.

- That the employee has been informed of the results of the evaluation.
- That the employee has been told about any medical conditions resulting from exposure to blood or other potentially infectious materials. (Note that the written opinion to the employer is not to reference any personal medical information).

☐ **Training - Initial and Annual Biohazardous Materials Training**

OSHA requires anyone working with biohazardous materials to have appropriate training. New employees are required to take an introductory course. A separate introductory training course is available for Ancillary Workers. Once initial training is received, a refresher is required every three years. Blood Borne Pathogens training - Universal Precautions needs to be taken initially with an annual refresher.

- Introduction to Biosafety - Basic Microbiological Safety Practices, Techniques and Material Acquisition
- Biosafety Refresher (every 3 years)
- Biohazardous Materials Handling and Safety for Ancillary Workers
- Biohazardous Materials Ancillary Refresher (every 3 years)
- Initial Blood Borne Pathogen Training - Universal Precautions
- Annual Blood Borne Pathogen Training - Universal Precautions Annual Refresher
- Autoclave Safety Training
- Biosafety Cabinet Training

The Principal investigator is responsible for providing the type of training needed for every individual based on their contact and the project. While no overall educational or training level can be specified for all persons who are, or will become, engaged in biohazardous activities, all should at least meet minimum requirements for the area or activity involved. Whenever gaps in educational background are noted, or whenever remedial or update training is needed, it is to be provided. Educational evaluations and additional education or training requirements are to be imposed on the basis of each individual and project.

All persons working with or around biohazardous material(s) must:

- Be instructed in the laboratory specific exposure control plan; entry control procedures; the meanings of the various signs, signals, or other controls used; applicable emergency procedures applying to their work activities and area, recognition and prevention of dangerous situations and/or exposures, and the symptoms (acute and chronic) of possible exposures.
- Receive documented training in basic biosafety controls; applicable directives (including use of this handbook); and specific methods and requirements of their work and work area.

☐ **Record Keeping**

All biosafety records including Blood Borne Pathogen Standard requirements by the Occupational Safety and Health

Administration (OSHA) will be maintained by: (Insert name of Registered User ______________________________).

DATES

All provisions required by the Laboratory Specific Exposure Control Plan will be implemented by the Registered User by:

(Insert date ____).

All employees will receive biological hazard safety training (other than EHS training) from the Principal Investigator, Supervisor or Registered User. The trainer(s) who are responsible for conducting the training are: __________________________

____

The outline for the training material (other than EHS training) is located (list where the training materials are located).

____

____

____

Bloodborne Pathogen Exposure Control Plan

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Bloodborne Pathogen Exposure Control Plan

for

Company Name

OBJECTIVE

The objective of the ***Company Name*** Bloodborne Pathogen Exposure Control Plan is to comply with the Occupational Safety and Health Administration's (OSHA) Bloodborne Pathogens Standard, 29 CFR 1910.1030, and to eliminate or minimize employee occupational exposure to blood, certain other body fluids, or other potentially infectious materials as defined below:

Blood means human blood, human blood components, and products made from human blood.

Bodily fluids means semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.

Other potentially infectious materials means any unfixed tissue or organ (other than intact skin) from a human (living or dead), and human immunodeficiency virus (HIV)-containing cell or tissue cultures, organ cultures, and HIV- or hepatitis B virus (HBV)-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

BACKGROUND

OSHA requires employers to identify situations and job classifications in which employees may be exposed to blood or other potentially infectious materials, and to provide protection to these employees in the form of engineering controls, personal protective equipment, training, and risk reduction.

ASSIGNMENT OF RESPONSIBILITY

Program Administrator

Responsible Person shall manage the Bloodborne Pathogen Exposure Control Plan for ***Company Name***, and maintain all records pertaining to the plan.

Management

Company Name will provide adequate controls and equipment that, when used properly, will minimize or eliminate risk of occupational exposure to blood or other potentially infectious materials. These shall be provided at no cost to the employees. ***Company Name*** management will ensure proper adherence to this plan through periodic audits.

Supervisors

Supervisors shall themselves follow and ensure that their employees are trained in and use proper work practices, universal precautions, the use of personal protective equipment, and proper cleanup and disposal techniques.

Employees

Employees are responsible for employing proper work practices, universal precautions, personal protective equipment and cleanup/disposal techniques as described in this plan. Employees are also responsible for reporting all exposure incidents to ***Responsible Person*** immediately or within ***Time Frame***.

Contractors

Contract employees shall be responsible for complying with this plan, and shall be provided the training described herein by ***Responsible Person***.

EXPOSURE DETERMINATION

All job classifications and locations in which employees may be expected to incur occupational exposure to blood or other potentially infections materials, based on the nature of the job or collateral duties, regardless of frequency, shall be identified and evaluated by ***Responsible Person***. This list shall be updated as job classifications or work situations change. Exposure determination shall be made without regard to the use of personal protective equipment **(employees are considered to be exposed even if they wear personal protective equipment)**.

Category I

Job classifications in which employees are exposed to blood or other potentially infectious materials on a regular basis, and in which such exposures are considered normal course of work, fall into Category I. ***Responsible Person*** shall maintain a list of these types of jobs and the locations in which the work will be performed (see Appendix A).

Category II

Job classifications in which employees may have an occasional exposure to blood or other potentially infectious materials, and in which such exposures occur only during certain tasks or procedures that are collateral to the normal job duties, fall into Category II. ***Responsible Person*** shall maintain a list of these types of jobs and the locations in which the work may be performed (see Appendix B).

These lists shall be updated as job classifications or work situations change.

IMPLEMENTATION SCHEDULE AND METHODOLOGY

Compliance Methods

Universal precautions

Universal precautions shall be used at ***Company Name*** to prevent contact with blood or other potentially infectious materials. All blood or other potentially infectious materials shall be considered infectious, regardless of the perceived status of the source individual.

Engineering Controls

The engineering and work practice controls listed below shall be used to minimize or eliminate exposure to employees at ***Company Name***.

The new needle stick rule and safety needles comes under this section and need to be addressed.

List controls such as sharps containers, bio-safety cabinets, safety needles, needleless systems, etc.

The following schedule shall be followed to review the effectiveness of the engineering controls.

list schedule (such as daily, once a week, etc.) that each control is to be reviewed, including the annual review;

review of new equipment and/or technologies present at the workplace; and

list who has the responsibility to review the effectiveness of each control, such as supervisor for each department, etc.

Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.

Needles

Except as noted below, contaminated needles and other sharps shall not be bent, recapped, removed, sheared, or purposely broken. Contaminated sharps shall be placed immediately, or as soon as possible, after use into appropriate sharps containers. All disposable sharps containers shall be puncture resistant, labeled with a biohazard label, and leak-proof.

At ***Company Name***, the following procedure(s) require a contaminated needle to be recapped or removed with a mechanical device or one-handed technique, and no alternative is feasible:

List the procedure(s) and the mechanical device(s) or one-handed technique to be used.

Containers for Reusable Sharps

Contaminated sharps that are reusable shall be placed immediately, or as soon as possible, after use into appropriate sharps containers. All reusable sharps containers shall be puncture resistant, labeled with a biohazard label, and leak-proof.

List where reusable sharps containers are located as well as the person(s) responsible for removing sharps from each container and the frequency that the containers shall be checked.

Sharps Injury Log

A needlestick or sharps injury log (see Appendix C) shall be maintained (for employers that keep records under 29 CFR 1904), and shall include the following information for each incident:

period of time the log covers;
date incident is entered on the log;
date of incident;
type and brand of device involved;
department or area of incident; and
description of incident.

The log shall be retained for five years after the end of the log year.

Hand Washing Facilities

Hand washing facilities shall be made available and readily accessible to all employees who may incur exposure to blood or other potentially infectious materials. Where hand washing facilities are not feasible, ***Company Name*** will provide an antiseptic cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. Such areas include:

List locations, tasks, and responsibilities to ensure maintenance and accessibility of these alternative hand washing methods.

When these alternatives are used, employees shall wash their hands with soap and running water as soon as feasible.

Work Area Restrictions

In work areas where there is a reasonable risk of exposure to blood or other potentially infectious materials, employees shall not eat, drink, apply cosmetics or lip balm, smoke, or handle contact lenses. Food and beverages shall not be kept in refrigerators, freezers, shelves, cabinets, or on counter tops or bench tops where blood or other potentially infectious materials may be present.

Mouth pipetting or suctioning of blood or other potentially infectious materials is prohibited.

All processes and procedures shall be conducted in a matter that will minimize splashing, spraying, splattering, and generation of droplets of blood or other potentially infectious materials.

List methods for minimizing exposure, such as covers on centrifuges, dental dams, etc.)

Specimens

Each specimen of blood or other potentially infectious material shall be placed in a container that will prevent leakage during the collection, handling, processing, storage, and transport of the specimen.

Specimen containers shall be labeled or color-coded in accordance with the requirements of the OSHA standard. *(Employers should note that the OSHA standard provides for an exemption to specimen container labeling/color coding if a facility uses universal precautions in handling of ALL specimens AND the containers are easily recognized as containing specimens. This exemption* *applies only while the specimens remain in the facility.* ***If the employer chooses to use this exemption, it should be stated here.*** *)*

Any specimens that could puncture a primary container shall be placed within a secondary puncture-resistant container. If outside contamination of the primary container occurs, the primary container shall be placed within a secondary container that will prevent leakage during handling, processing, storage, transport, or shipping of the specimen.

Contaminated Equipment

Responsible Person shall ensure that equipment that has become contaminated with blood or other potentially infectious materials is examined prior to servicing or shipping. Contaminated equipment shall be decontaminated, unless decontamination is not feasible. Contaminated equipment shall be tagged and labeled as such.

Personal Protective Equipment (PPE)

PPE Provision

Responsible Person shall ensure that the provisions regarding personal protective equipment described in this plan are met and maintained.

Personal protective equipment shall be chosen based on the anticipated exposure to blood or other potentially infectious materials. Protective equipment shall be considered appropriate only if it does not permit blood or other potentially infectious materials to pass through or reach an employees' clothing, skin, eyes, mouth, or other mucous membranes under normal and proper conditions of use and for the duration of time that the equipment will be used.

A list of personal protective equipment and associated tasks for ***Company Name*** can be found in Appendix D of this plan.

PPE Use

Responsible Person and supervisors shall ensure that employees use appropriate PPE. In cases where an employee temporarily and briefly declines to use PPE because, in the employee's professional judgement, its use may prevent delivery of healthcare or pose an increased hazard to the safety of the worker or co-worker, then the supervisor shall investigate and document the situation to determine whether changes can be instituted to prevent such occurrences in the future.

PPE Accessibility

Responsible Person shall ensure that appropriate PPE in the necessary sizes is readily accessible at the work site or is issued at no cost to employees. Hypoallergenic gloves, glove liners, powderless gloves, or other similar alternatives shall be readily accessible to those employees who are allergic to the gloves normally provided.

PPE Cleaning, Laundering and Disposal

All PPE shall be cleaned, laundered, and disposed of by ***Company Name*** at no cost to the employees. ***Company Name*** will also make all necessary repairs and replacements at no cost to employees.

All garments penetrated by blood or other potentially infectious materials shall be removed immediately or as soon as feasible. All PPE shall be removed before leaving the work area.

When PPE is removed, it shall be placed in appropriately designated areas or containers for storage, washing, decontamination, or disposal.

Types of PPE

Gloves

Disposable gloves are not to be washed or decontaminated for re-sue, and are to be replaced as soon as possible when they become contaminated. Gloves that become torn or punctured (or their ability to function as a barrier is otherwise compromised) shall be replaced immediately or as soon as feasible.

Utility gloves may be decontaminated for re-use if the integrity of the glove is uncompromised. Utility gloves shall be disposed of properly if they are cracked, peeling, torn, punctured, or they exhibit other signs of deterioration or inability to function as a barrier without compromise.

Eye and Face Protection

Masks worn in combination with eye protection devices (such as goggles or glasses with solid side shield, or chin-length face shields) are required when the occurrence of splashes, splatters, or droplets of blood or other potentially infectious materials can reasonably be anticipated to contaminate an employee’s eye, nose, or mouth. Situations at ***Company Name*** where eye and face protection is required include:

a) ***List job assignments and work areas where eye and face protection are required.***

Other PPE

Additional protective clothing (such as lab coats, gowns, aprons, clinic jackets, or similar outer garments) shall be worn in instances when gross contamination can reasonably be expected. The following situations require additional protective clothing:

<u>List job assignments and work areas where additional protective clothing is required, as well as types of additional protective clothing that are to be used.</u>

Housekeeping

This facility shall be cleaned and decontaminated regularly and as needed in the event of a gross contamination. See Appendix E for cleaning schedule and required cleaning materials. All contaminated work surfaces, bins, pails, cans, and similar receptacles shall be inspected and decontaminated regularly as described in Appendix E.

Any potentially contaminated glassware shall not be picked up directly with the hands. Reusable sharps that are contaminated with blood or other potentially infectious materials shall not be stored or processed in a manner that requires employees to reach by hand into the containers where sharps are placed.

Regulated Waste Disposal

Disposal of all regulated waste shall be in accordance with applicable federal, state, and local regulations.

Sharps

Contaminated sharps shall be discarded immediately or as soon as feasible in containers that are closable, puncture resistant, leak proof on sides and bottom, and labeled or color-coded.

During use, containers for contaminated sharps shall remain upright throughout use, shall be easily accessible to employees, and shall be located as close as feasible to the immediate area where sharps are used or can be reasonably anticipated to be found (including laundry areas). ***Responsible Person*** shall replace sharps containers routinely and not allow them to overfill.

When moving sharps containers from the area of use, the containers shall be closed immediately prior to removal or replacement to prevent spillage or protrusion of contents during handling, storage, transport, or shipping. Sharps containers shall be placed in a secondary container if leakage of the primary container is possible. The second container shall be closeable, constructed to contain all contents, and shall prevent leakage during handling, storage, transport, or shipping. The secondary container shall be labeled or color-coded to identify its contents.

Reusable containers shall not be opened, emptied, or cleaned manually or in any other manner that would expose employees to the risk of percutaneous injury.

Other Regulated Waste

Other regulated waste shall be placed in containers that are closeable, constructed to contain all contents, and will prevent leakage of fluids during handling, storage, transportation, or shipping.

All waste containers shall be labeled or color-coded and closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.

Laundry

Laundry contaminated with blood or other potentially infectious materials shall be handled as little as possible. Such laundry shall be placed in appropriately marked bags (biohazard labeled or color-coded bags) at the location where it was contaminated. Contaminated laundry shall not be sorted or rinsed in the area of contamination. *(If your facility uses Body Substance Isolation or Universal Precautions in handling of all soiled laundry (all laundry is assumed to be contaminated), then no labeling or color-coding is necessary if all employees recognize the hazards associated with the handling of the laundry.)*

The laundry at ***Company Nam***e shall be cleaned at ***Laundering Facility***. *(If your facility ships contaminated laundry to an off-site location that does not use Universal Precautions in the handling of all laundry, then contaminated laundry must be placed in bags or containers that are labeled or color-coded. One possible solution would be to include a requirement in the contract with the off-site laundry service that they also use the equivalent of Universal Precautions.)*

Hepatitis B Vaccines and Post-Exposure Evaluation and Follow Up

General

Company Name will make the Hepatitis B vaccine and vaccination series available to all employees who have the potential for occupational exposure, as well as post-exposure follow up to employees who have experienced an exposure incident.

Responsible Person shall ensure that all medical evaluations and procedures involved in the Hepatitis B vaccine and vaccination series and post-exposure follow up, including prophylaxis are:

- made available at no cost to the employee;
- made available to the employee at a reasonable time and place;
- performed by or under the supervision of a licensed physician or other licensed healthcare professional; and
- provided in accordance with the recommendations of the United States Public Health Service.

An accredited laboratory shall conduct all laboratory tests at no cost to the employee.

Hepatitis B Vaccination

Responsible Person shall manage the Hepatitis B vaccination program. ***Company Name*** has contracted with ***Healthcare Provider/Laboratory Name*** to provide this service.

Category I Employees

The Hepatitis B vaccination shall be made available to an affected Category I employee after he or she has received training in occupational exposure and within 10 working days of initial assignment to job duties that involve exposure. Exceptions to the administration of the Hepatitis B vaccination include situations where an employee has previously received the complete Hepatitis B vaccination series, antibody testing has revealed that the employee is immune, or the vaccine is contraindicated for medical reasons.

Participation in a pre-screening program shall not be a prerequisite for an affected employee to receive the Hepatitis B vaccination. If an employee initially declines the Hepatitis B vaccination, but later decides to accept the vaccination and is still covered under the OSHA standard, the vaccination shall then be made available.

All employees who decline the Hepatitis B vaccination shall sign a waiver indicating their refusal (Appendix F), as required by OSHA. If the United States Public Health Service recommends a routine booster dose of Hepatitis B vaccine, this shall also be made available free of charge to affected employees.

Category II Employees

The Hepatitis B vaccination series shall be made available and administered to Category II employees no later than 24 hours after an exposure incident (as per OSHA Letter of Interpretation, November 1, 2000). All employees who decline the Hepatitis B vaccination shall sign a waiver indicating their refusal (Appendix F).

Post-Exposure Evaluation and Follow Up

All employees must report all exposure incidents to ***Responsible Person*** immediately or within ***Time Frame***. ***Responsible Person*** shall investigate and document each exposure incident. Following a report of an exposure incident, the exposed employee shall immediately receive a confidential post-exposure evaluation and follow up, to be provided by ***Healthcare Provider/Laboratory Name***. The post-exposure evaluation and follow up shall include the following elements, at a minimum:

Documentation of the route of exposure, and the circumstances under which the exposure occurred.

Identification and documentation of the source individual, unless it can be established that identification is infeasible or prohibited by state or local law. *(This provision may need to be modified in accordance with applicable local laws on this subject.* ***Modifications should be included here****.)*

The source individual's blood shall be tested and documented as soon as feasible and after consent is obtained (if consent is required) in order to determine HBV and HIV infectivity. If consent cannot be obtained, ***Responsible Person*** shall establish and document that legally required consent cannot be obtained.

When the source individual is already known to be infected with the Hepatitis B virus (HBV) or human immunodeficiency virus (HIV), testing for the source individual's known HBV or HIV status need not be repeated.

Results of the source individual's testing shall be made available to the exposed employee, and the employee shall be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

The exposed employee’s blood shall be collected as soon as feasible and tested after consent is obtained.

The exposed employee shall be offered the option of having their blood tested for HBV and HIV serological status. The blood sample shall be preserved for up to 90 days to allow the employee to decide if their blood should be tested for HBV and HIV serological status.

Names of employees that contract HIV, Hepatitis, or tuberculosis shall not be recorded on the OSHA 300 log.

Information Provided to the Healthcare Professional

After an exposure incident occurs, ***Responsible Person*** shall ensure that the healthcare professional responsible for the exposed employee’s Hepatitis B vaccination, as well as the healthcare provider providing the post-exposure evaluation, if different, are provided with the following:

a copy of 29 CFR 1910.1030, OSHA’s Bloodborne Pathogen Standard, with emphasis on the confidentially requirements contained therein;
a written description of the exposed employee’s duties as they relate to the exposure incident;
written documentation of the route of exposure and circumstances under which the exposure occurred;
results of the source individual’s blood testing, if available; and
all medical records relevant to the appropriate treatment of the employee, including vaccination status.

Healthcare Professional’s Written Opinion

Responsible Person shall obtain and provide the exposed employee a copy of the evaluating healthcare professional’s written opinion within 15 days of completion of the evaluation.

The healthcare professional's written opinion for HBV vaccination shall be limited to whether HBV vaccination is indicated for the employees, and if the employee has received said vaccination.

The healthcare professional's written opinion for post-exposure follow up shall be limited to ONLY the following information:

- a statement that the employee has been informed of the results of the evaluation; and
- a statement that the employee has been told about any medical conditions resulting from exposure to blood or other potentially infectious materials that require further evaluation or treatment.

Other findings or diagnosis resulting from the post-exposure follow up shall remain confidential and shall not be included in the written report.

Labels and Signs

Responsible Person shall ensure that biohazard labels are affixed to containers of regulated waste, refrigerators, and freezers containing blood or other potentially infectious materials. Labels shall also be affixed to any other containers used to store, transport, or ship blood or other potentially infectious materials.

The labels shall be fluorescent orange or orange-red, and shall include the universal biohazard symbol. Red bags or containers with the universal biohazard symbol may be substituted for labels. However, regulated wastes must be handled in accordance with the rules and regulations of the entity with jurisdiction. Blood products that have been released for transfusion or other clinical use are exempted from these labeling requirements.

Training

Responsible Person shall ensure that training is provided at the time of initial assignment to tasks where occupational exposure to blood or other potentially infectious materials may occur. Training shall be repeated every 12 months, or when there are any changes to tasks or procedures affecting an employee's occupational exposure. Training shall be tailored to the education level and language of the affected employees, and offered during the normal work shift. Training shall be interactive and shall include:

a copy of 29 CFR 1910.1030, OSHA's Bloodborne Pathogen Standard;

a discussion of the epidemiology and symptoms of bloodborne diseases;

an explanation of the modes of transmission of bloodborne pathogens;

an explanation of ***Company Name's*** Bloodborne Pathogen Exposure Control Plan, and how employees can obtain a copy of the plan;

a description and recognition of tasks that may involve exposure;

an explanation of the use and limitations of the methods employed by ***Company Name*** to reduce exposure (such as engineering controls, work practices, and personal protective equipment);

information about the types, use, location, removal, handling, decontamination, and disposal of personal protective equipment;

an explanation of the basis of selection of personal protective equipment;

information about the Hepatitis B vaccination (including efficacy, safety, method of administration, and benefits), as well as an explanation that the vaccination will be provided at no charge to the employee;

instruction on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials;

an explanation of the procedures to follow if an exposure incident occurs, including the method of reporting and medical follow up;

information on the post-incident evaluation and follow up required for all exposure incidents; and

an explanation of signs, labels, and color-coding systems.

The person conducting the training shall be knowledgeable in the subject matter.

Recordkeeping

Medical Records

Responsible Person shall maintain medical records as required by 29 CFR 1910.1020 in ***Designated Location***. All records shall be kept confidential and shall be retained for at least the duration of employment plus 30 years.

Responsible Person shall also ensure that all contracts with ***Healthcare Professional/Laboratory Name*** for Hepatitis B vaccinations and post-exposure evaluations and follow ups stipulate any OSHA recordkeeping and retention requirements.

Medical records shall include:

name and social security number of the employee;
a copy of the employee's HBV vaccination status, including the dates of vaccination;
a copy of all results of examinations, medical testing, and follow-up procedures; and
a copy of the information provided to the healthcare professional, including a description of the employee's duties as they relate to an exposure incident, and documentation of the routes and circumstances of an exposure.

Training Records

Responsible Person shall maintain training records for three years from the date of training. Records shall be kept in ***Designated Place***, and shall include:

the dates of the training sessions;
an outline describing the material presented;
the names and qualifications of persons conducting the training; and
the names and job titles of all persons attending the training sessions.

Availability of Records

Whenever an employee (or designated representative) requests access to a record, ***Company Name*** shall provide access to said employee's records in a reasonable time, place, and manner in accordance with 29 CFR 1910.1020(e). An employee (or designated representative) will only be given access to his or her own records.

Transfer of Records

If ***Company Name*** ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, ***Responsible Person*** shall contact the Director of the National Institute for Occupational Safety and Health (NIOSH) three months prior to cessation of business for instruction on final disposition of the records.

Evaluation and Review

Responsible Person shall review this Bloodborne Exposure Control Plan for effectiveness at least annually and as needed to incorporate changes to the standard or changes in the work place.

Attachment A

Category I Job Classification/Expected Exposure List

Company Name

Date

At ***Company Name***, the following job classifications are expected to incur occupational exposure to blood or other possibly infectious materials:

Job Classification	Department/Location
Nurse	
Nursing assistant	
Doctor	
Janitorial Staff	

Attachment B

Category II Job Classification/Possible Exposure List

Company Name

Date

At ***Company Name***, the following job classifications may incur occupational exposure to blood or other possibly infectious materials during certain tasks or procedures:

Job Classification	Task/Procedure	Department/Location
Administrative Staff	Assisting in cleaning up blood spills	
Janitorial Staff	Assisting in cleaning up blood spills	
First Responders	Responding to medical emergency in a non-healthcare environment	

Attachment C

Sharps Injury Log

Company Name

For Period Ending: ______________

Date Entered	Date & Time of Incident	Type & Brand of Device	Department or Work Area Where Incident Occurred	Description of Incident

Retain Until ________________________ (five years after end of log year)

Attachment D

Personal Protective Equipment/Task List

<u>Company Name</u>

<u>Date</u>

Job Classification	Task/Procedure	Type of PPE to be Used	PPE to be Issued By

Attachment E

Cleaning and Decontamination Schedule

<u>Company Name</u>

Date

The following schedule describes work areas at ***Company Name*** that should be decontaminated, decontamination frequency and method, and required types of cleaning. *Information concerning usage of protective coverings used to help keep surfaces free of contamination (such as plastic wrap) should be included.*				
Work Area/Equipment	**Cleaning and Decontamination Frequency**	**Type of Cleaners or Supplies to be Used**	**Method of Cleaning to be Used**	**Responsible Person**

Attachment F

Hepatitis B Vaccine Declination

I understand that, due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring the Hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with Hepatitis B vaccine, at no charge to me. However, I decline the Hepatitis B vaccination at this time.

I understand that by declining this vaccine, I continue to be at risk of acquiring the serious disease Hepatitis B.

If, in the future, I continue to experience occupational exposure to blood or other potentially infectious materials and I wish to be vaccinated with the Hepatitis B vaccine, I can receive the vaccination series at no charge to me.

____

____

Employee Signature Date

____

____

Responsible Person Signature Date

Confined Space Program

Table of Contents

Confined Space Program

For

Company Name

I. OBJECTIVE

The purpose of ***Company Name's*** Confined Space Program is to set procedures that will ensure workers safe entry into confined spaces and permit-required confined spaces to perform routine tasks associated with their employment. This procedure is designed to provide the minimum safety requirements in accordance with the Occupational Safety and Health Administration's (OSHA) Confined Space Standard, 1910.146.

II. BACKGROUND

A confined space is defined as any location that has limited openings for entry and egress, is not intended for continuous employee occupancy, and is so enclosed that natural ventilation may not reduce air contaminants to levels below the threshold limit value (TLV). Examples of confined spaces include: manholes, stacks, pipes, storage tanks, trailers, tank cars, pits, sumps, hoppers, and bins. Entry into confined spaces without proper precautions could result in injury, impairment, or death due to:

A. an atmosphere that is flammable or explosive;
B. lack of sufficient oxygen to support life;
C. contact with or inhalation of toxic materials; or
D. general safety or work area hazards such as steam or high pressure materials.

III. ASSIGNMENT OF RESPONSIBILITY

A. Employer

In administering this Confined Space Program, ***Company Name*** will:

1. Monitor the effectiveness of the program.

2. Provide atmospheric testing and equipment as needed.
3. Provide personal protective equipment as needed.
4. Provide training to affected employees and supervisors.
5. Provide technical assistance as needed.
6. Preview and update the program on at least an annual basis or as needed.

B. Program Manager

Responsible Person is responsible for managing the Confined Space Program, and shall:

1. Ensure that a list of confined spaces at all ***Company Name*** worksites is maintained.
2. Ensure that canceled permits are reviewed for lessons learned.
3. Ensure training of personnel is conducted and documented.
4. Coordinate with outside responders.
5. Ensure that equipment is in compliance with standards.
6. Ensure that the ***Responsible Person*** in charge of confined space work shall:

    a. Ensure requirements for entry have been completed before entry is authorized.
    b. Ensure confined space monitoring is performed by personnel qualified and trained in confined space entry procedures.
    c. Ensure a list of monitoring equipment and personnel qualified to operate the equipment is maintained by the Safety and Occupational Health Office.
    d. Ensure that the rescue team has simulated a rescue in a confined space within the past twelve (12) months.
    e. Know the hazards that may be faced during entry, including the mode (how the contaminant gets into the body), signs or symptoms, and consequences of exposure.
    f. Fill out a permit.
    g. Determine the entry requirements.
    h. Require a permit review and signature from the authorized Entry Supervisor.
    i. Notify all involved employees of the permit requirements.
    j. Post the permit in a conspicuous location near the job.
    k. Renew the permit or have it reissued as needed (a new permit is required every shift).
    l. Determine the number of Attendants required to perform the work.
    m. Ensure all Attendant(s) know how to communicate with the entrants and how to obtain assistance.
    n. Post any required barriers and signs.

o. Remain alert to changing conditions that might affect the conditions of the permits (i.e., require additional atmospheric monitoring or changes in personal protective equipment).
p. Change and reissue the permit, or issue a new permit as necessary.
q. Ensure periodic atmospheric monitoring is done according to permit requirements.
r. Ensure that personnel doing the work and all support personnel adhere to permit requirements.
s. Ensure the permit is canceled with the work is done.
t. Ensure the confined space is safely closed and all workers are cleared from the area.

C. Entry Supervisors

Responsible Person(s) shall serve as the Entry Supervisor(s), and shall be qualified and authorized to approved confined space entry permits. The Entry Supervisor(s) shall be responsible for:

1. Determining if conditions are acceptable for entry.
2. Authorizing entry and overseeing entry operations.
3. Terminating entry procedures as required.
4. Serving as an Attendant, as long as the person is trained and equipped appropriately for that role.
5. Ensuring measures are in place to keep unauthorized personnel clear of the area.
6. Checking the work at least twice a shift to verify and document permit requirements are being observed (more frequent checks shall be made if operations or conditions are anticipated that could affect permit requirements).
7. Ensuring that necessary information on chemical hazards is kept at the worksite for the employees or rescue team.
8. Ensuring a rescue team is available and instructed in their rescue duties (i.e., an onsite team or a prearranged outside rescue service).
9. Ensuring the rescue team members have current certification in first aid and cardiopulmonary resuscitation (CPR).

D. Attendants

Responsible Person(s) shall function as an Attendant(s) and shall be stationed outside of the confined workspace. The Attendant(s) shall:

1. Be knowledgeable of, and be able to recognize potential confined space hazards.
2. Maintain a sign-in/sign-out log with a count of all persons in the confined space, and ensure all entrants sign in and out.
3. Monitor surrounding activities to ensure the safety of personnel.
4. Maintain effective and continuous communication with personnel during confined space entry, work, and exit.
5. Order personnel to evacuate the confined space if he/she:

    a. observes a condition which is not allowed on the entry permit;
    b. notices the entrants acting strangely, possibly as a result of exposure to hazardous substances;
    c. notices a situation outside the confined space which could endanger personnel;
    d. notices a hazard within the confined space that has not been previously recognized or taken into consideration;
    e. must leave his/her work station; or
    f. must focus attention on the rescue of personnel in some other confined space that he/she is monitoring.

6. Immediately summon the Rescue Team if crew rescue becomes necessary.
7. Keep unauthorized persons out of the confined space, order them out, or notify authorized personnel of an unauthorized entry.

E. Rescue Team

The Rescue Team members shall:

1. Complete a training drill using mannequins or personnel in a simulation of the confined space prior to the issuance of an entry permit for any confined space and at least annually thereafter.
2. Respond immediately to rescue calls from the Attendant or any other person recognizing a need for rescue from the confined space.
3. In addition to emergency response training, receive the same training as that required of the authorized entrants.
4. Have current certification in first aid and CPR.

F. Entrants/Affected Employees

Employees who are granted permission to enter a confined space shall:

1. Read and observe the entry permit requirements.
2. Remain alert to the hazards that could be encountered while in the confined space.
3. Properly use the personal protective equipment that is required by the permit.
4. Immediately exit the confined space when:

    a. they are ordered to do so by an authorized person;
    b. they notice or recognize signs or symptoms of exposure;
    c. a prohibited condition exists; or
    d. the automatic alarm system sounds.

5. Alert Attendant(s) when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.

IV. TRAINING

Company Name shall provide training so that all employees whose work is regulated by this Confined Space Program acquire the understanding, knowledge, and skills necessary for the safe performance of their duties in confined spaces.

A. Training Frequency

Responsible Person shall provide training to each affected employee:

1. before the employee is first assigned duties within a confined space;
2. before there is a change in assigned duties;
3. when there is a change in permit space operations that presents a hazard for which an employee has not been trained; and
4. when ***Company Name*** has reason to believe that there are deviations from the confined space entry procedures required in this program, or that there are inadequacies in the employee's knowledge or use of these procedures.

The training shall establish employee proficiency in the duties required in this program, and shall introduce new or revised procedures, as necessary, for compliance with this program.

B. General Training

All employees who will enter confined spaces shall be trained in entry procedures. Personnel responsible for supervising, planning, entering, or participating in confined space entry and rescue shall be adequately trained in their functional duties prior to any confined space entry. Training shall include:

1. Explanation of the general hazards associated with confined spaces.
2. Discussion of specific confined space hazards associated with the facility, location, or operation.
3. Reason for, proper use, and limitations of personal protective equipment and other safety equipment required for entry into confined spaces.
4. Explanation of permits and other procedural requirements for conducting a confined space entry.
5. A clear understanding of what conditions would prohibit entry.
6. Procedures for responding to emergencies.
7. Duties and responsibilities of the confined space entry team.
8. Description of how to recognize symptoms of overexposure to probable air contaminants in themselves and co-workers, and method(s) for alerting the Attendant(s).

Refresher training shall be conducted as needed to maintain employee competence in entry procedures and precautions.

C. Specific Training

1. Training for atmospheric monitoring personnel shall include proper use of monitoring instruments, including instruction on the following:

    a. proper use of the equipment;
    b. calibration of equipment;
    c. sampling strategies and techniques; and
    d. exposure limits

2. Training for Attendants shall include the following:

    a. procedures for summoning rescue or other emergency services; and
    b. proper utilization of equipment used for communicating with entry and emergency/rescue personnel.

3. Training for Emergency Response Personnel shall include:

   a. rescue plan and procedures developed for each type of confined space that is anticipated to be encountered;
   b. use of emergency rescue equipment;
   c. first aid and CPR techniques; and
   d. work location and confined space configuration to minimize response time.

D. Verification of Training

Periodic assessment of the effectiveness of employee training shall be conducted by ***Responsible Person***. Training sessions shall be repeated as often as necessary to maintain an acceptable level of personnel competence.

V. IDENTIFICATION OF HAZARDS AND EVALUATION OF CONFINED SPACES

A. Survey

Responsible Person shall ensure a survey of the worksite is conducted to identify confined spaces. This survey can be partially completed from initial and continuing site characterizations, as well as other available data (i.e., blueprints and job safety analyses). The purpose of the survey is to develop an inventory of those locations and/or equipment at ***Company Name*** that meet the definition of a confined space. This information shall be communicated to personnel, and appropriate confined space procedures shall be followed prior to entry. The initial surveys shall include air monitoring to determine the air quality in the confined spaces. The potential for the following situations shall be evaluated by ***Responsible Person***:

1. flammable or explosive potential;
2. oxygen deficiency; and
3. presence of toxic and corrosive material.

B. Hazard Reevaluation

The ***Responsible Person*** shall identify and reevaluate hazards based on possible changes in activities or other physical or environmental conditions that could adversely affect work. A master inventory of confined spaces shall be maintained. Any change in designation of a confined space will be routed to all affected personnel by ***Responsible Person***.

C. Pre-Entry Hazard Assessment

A hazard assessment shall be completed by ***Responsible Person(s)*** prior to any entry into a confined space. The hazard assessment should identify:

1. the sequence of work to be performed in the confined space;
2. the specific hazards known or anticipated; and
3. the control measures to be implemented to eliminate or reduce each of the hazards to an acceptable level.

No entry shall be permitted until the hazard assessment has been reviewed and discussed by all persons engaged in the activity. Personnel who are to enter confined spaces shall be informed of known or potential hazards associated with said confined spaces.

D. Hazard Controls

Hazard controls shall be instituted to address changes in the work processes and/or working environment. Hazard controls must be able to either control the health hazards by eliminating the responsible agents, reduce health hazards below harmful levels, or prevent the contaminants from coming into contact with the workers.

The following order of precedence shall be followed in reducing confined space risks.

1. Engineering Controls

Engineering controls are those controls that eliminate or reduce the hazard through implementation of sound engineering practices.

Ventilation is one of the most common engineering controls used in confined spaces. When ventilation is used to remove atmospheric contaminants from a confined space, the space shall be ventilated until the atmosphere is within the acceptable ranges. Ventilation shall be maintained during the occupancy if there is a potential for the atmospheric conditions to move out of the acceptable range. When ventilation is not possible or feasible, alternate protective measures or methods to remove air contaminants and protect occupants shall be determined by ***Responsible Person*** prior to authorizing entry.

When conditions necessitate and can accommodate continuous forced air ventilation, the following precautions shall be followed:

a. Employees shall not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.
b. Forced air ventilation shall be directed so as to ventilate the immediate areas where an employee is or will be present within the space.
c. Continuous ventilation shall be maintained until all employees have left the space.
d. Air supply or forced air ventilation shall originate from a clean source.

2. Work Practice (Administrative) Controls

Work practice (administrative) controls are those controls which eliminate or reduce the hazard through changes in the work practices (i.e., rotating workers, reducing the amount of worker exposure, and housekeeping).

3. Personal Protective Equipment (PPE)

If the hazard cannot be eliminated or reduced to a safe level through engineering and/or work practice controls, PPE should be used. ***Responsible Person(s)*** shall determine the appropriate PPE needed by all personnel entering the confined space, including rescue teams. PPE that meets the specifications of applicable standards shall be selected in accordance with the requirements of the job to be performed.

VI. ENTRY PERMITS

The Confined Space Entry Permit is the most essential tool for assuring safety during entry in confined spaces with known hazards, or with unknown or potentially hazardous atmospheres. The entry permit process guides the supervisor and workers through a systematic evaluation of the space to be entered. The permit should be used to establish appropriate conditions. Before each entry into a confined space, an entry permit will be completed by ***Responsible Person***. The ***Responsible Person*** will then communicate the contents of the permit to all employees involved in the operation, and post the permit conspicuously near the work location. A standard entry permit shall be used for all entries.

A. Key Elements of Entry Permits

A standard entry permit shall contain the following items:

1. Space to be entered.
2. Purpose of entry.
3. Date and authorized duration of the entry permit.
4. Name of authorized entrants within the permit space.
5. Means of identifying authorized entrants inside the permit space (i.e., rosters or tracking systems).
6. Name(s) of personnel serving as Attendant(s) for the permit duration.
7. Name of individual serving as Entry Supervisor, with a space for the signature or initials of the Entry Supervisor who originally authorized the entry.
8. Hazards of the permit space to be entered.
9. Measures used to isolate the permit space and to eliminate or control permit space hazards before entry (i.e., lockout/tagout of equipment and procedures for purging, ventilating, and flushing permit spaces).
10. Acceptable entry conditions.
11. Results of initial and periodic tests performed, accompanied by the names or initials of the testers and the date(s) when the tests were performed.
12. Rescue and emergency services that can be summoned, and the means of contacting those services (i.e., equipment to use, phone numbers to call).

13. Communication procedures used by authorized entrants and Attendant(s) to maintain contact during the entry.
14. Equipment to be provided for compliance with this Confined Space Program (i.e., PPE, testing, communications, alarm systems, and rescue).
15. Other information necessary for the circumstances of the particular confined space that will help ensure employee safety.
16. Additional permits, such as for hot work, that have been issued to authorize work on the permit space.

B. Permit Scope and Duration

A permit is only valid for one shift. For a permit to be renewed, the following conditions shall be met before each reentry into the confined space:

1. Atmospheric testing shall be conducted and the results should be within acceptable limits. If atmospheric test results are not within acceptable limits, precautions to protect entrants against the hazards should be addressed on the permit and should be in place.
2. ***Responsible Person*** shall verify that all precautions and other measures called for on the permit are still in effect.
3. Only operations or work originally approved on the permit shall be conducted in the confined space.

A new permit shall be issued, or the original permit will be reissued if possible, whenever changing work conditions or work activities introduce new hazards into the confined space. ***Responsible Person*** shall retain each canceled entry permit for at least one (1) year to facilitate the review of the Confined Space Entry Program. Any problems encountered during an entry operation shall be noted on the respective permit(s) so that appropriate revisions to the confined space permit program can be made.

VII. ENTRY PROCEDURES

When entry into a confined space is necessary, either the Entry Supervisor or ***Responsible Person*** may initiate entry procedures, including the completion of a confined space entry permit. Entry into a confined space shall follow the standard entry procedure below.

A. Prior to Entry

The entire confined space entry permit shall be completed before a standard entry. Entry shall be allowed only when all requirements of the permit are met and it is reviewed and signed by an Entry Supervisor. The following conditions must be met prior to standard entry:

1. Affected personnel shall be trained to establish proficiency in the duties that will be performed within the confined space.
2. The internal atmosphere within the confined space shall be tested by ***Responsible Person*** with a calibrated, direct-reading instrument.
3. Personnel shall be provided with necessary PPE as determined by the Entry Supervisor.
4. Atmospheric monitoring shall take place during the entry. If a hazardous atmosphere is detected during entry:

    a. personnel within the confined space shall be evacuated by the Attendant(s) or Entry Supervisor until the space can be evaluated by ***Responsible Person*** to determine how the hazardous atmosphere developed; and
    b. controls shall be put in place to protect employees before reentry.

B. Opening a Confined Space

Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed. When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent anyone from falling through the opening. This barrier or cover shall protect each employee working in the space from foreign objects entering the space. If it is in a traffic area, adequate barriers shall be erected.

C. Atmospheric Testing

Atmospheric test data is required prior to entry into a confined space. Atmospheric testing is required for two distinct purposes: (1) evaluation of the hazards of the permit space, and (2) verification that acceptable conditions exist for entry into that space. If a person must go into the space to obtain the needed data, then Standard Confined Space Entry Procedures shall be followed. Before entry into a confined space, ***Responsible Person*** shall conduct testing for hazardous atmospheres. The internal atmosphere shall be tested with a calibrated, direct-reading instrument for oxygen, flammable gases and vapors, and potential toxic air contaminants, in that order.

Testing equipment used in specialty areas shall be listed or approved for use in such areas by ***Responsible Person***. All testing equipment shall be approved by a nationally recognized laboratory, such as Underwriters Laboratories or Factory Mutual Systems.

1. Evaluation Testing

The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity. The analysis shall identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data and development of the entry procedure should involve a technically qualified professional (i.e., consultant, certified industrial hygienist, registered safety engineer, or certified safety professional).

2. Verification Testing

A confined space that may contain a hazardous atmosphere shall be tested for residues of all identified or suspected contaminants. The evaluation testing should be conducted with specified equipment to determine that residual concentrations at the time or testing and entry are within acceptable limits. Results of testing shall be recorded by the person performing the tests on the permit. The atmosphere shall be periodically retested (frequency to be determined by ***Responsible Person***) to verify that atmospheric conditions remain within acceptable entry parameters.

3. Acceptable Limits

The atmosphere of the confined spaces shall be considered to be within acceptable limits when the following conditions are maintained:

a. oxygen: 19.5 percent to 23.5 percent;
b. flammability: less than 10 percent of the Lower Flammable Limit (LFL); and
c. toxicity: less than recognized American Conference of Governmental Industrial Hygienists (ACGIH) exposure limits or other published exposure levels [i.e., OSHA Permissible Exposure Limits (PELs) or National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs)].

D. Isolation and Lockout/Tagout Safeguards

All energy sources that are potentially hazardous to confined space entrants shall be secured, relieved, disconnected, and/or restrained before personnel are permitted to enter the confined space. Equipment systems or processes shall be locked out and/or tagged out as required by the ***Company Name*** Lockout/Tagout Program [which complies with OSHA's 29 CFR 1910-147 and American National Standards Institute (ANSI) Z244.1-1982, Lockout/Tagout of Energy Sources] prior to permitting entry into the confined space. In confined spaces where complete isolation is not possible, ***Responsible Person*** shall evaluate the situation and make provisions for as rigorous an isolation as practical. Special precautions shall be taken when entering double-walled, jacketed, or internally insulated confined spaces that may discharge hazardous material through the vessel's internal wall.

Where there is a need to test, position, or activate equipment by temporarily removing the lock or tag or both, a procedure shall be developed and implemented to control hazards to the occupants. Any removal of locks, tags, or other protective measures shall be done in accordance with the ***Company Name*** Lockout/Tagout Program.

E. Ingress/Egress Safeguards

Means for safe entry and exit shall be provided for confined spaces. Each entry and exit points shall be evaluated by ***Responsible Person*** to determine the most effective methods and equipment that will enable employees to safely enter and exit the confined space.

Appropriate retrieval equipment or methods shall be used whenever a person enters a confined space. Use of retrieval equipment may be waived by the ***Responsible Person(s)*** if use of the equipment increases the overall risks of entry or does not contribute to the rescue. A mechanical device shall be available to retrieve personnel from vertical confined spaces greater than five (5) feet in depth.

F. Warning Signs and Symbols

All confined spaces that could be inadvertently entered shall have signs identifying them as confined spaces. Signs shall be maintained in a legible condition. The signs shall contain a warning that a permit is required before entry. Accesses to all confined spaces shall be prominently marked.

VIII. EMERGENCY RESPONSE

A. Emergency Response Plan

Responsible Person shall maintain a written plan of action that has provisions for conducting a timely rescue of individuals within a confined space, should an emergency arise. The written plan shall be kept onsite where the confined space work is being conducted. All affected personnel shall be trained on the Emergency Response Plan.

B. Retrieval Systems and Methods of Non-Entry Rescue

Retrieval systems shall be available and ready when an authorized person enters a permit space, unless such equipment increases the overall risk of entry, or the equipment would not contribute to the rescue of the entrant. Retrieval systems shall have a chest or full-body harness and a retrieval line attached at the center of the back near shoulder level or above the head. If harnesses are not feasible, or would create a greater hazard, wristlets may be used in lieu of the harness. The retrieval line shall be firmly fastened outside the space so that rescue can begin as soon as anyone is aware that retrieval is necessary. A mechanical device shall be available to retrieve personnel from vertical confined spaces more than five (5) feet deep.

ATTACHMENT A

Sample Process Duty Roster

Process: Tank Steam/Wash Rack	
Entry Supervisor	**Entrants**
1. Upon receipt of a tank for cleaning, do a visible check for product. If product is visible in the tank, then the tank will be refused. 2. Complete and attach certification and danger tag to tank. 3. Provide confined space entry permit for the tank. 4. Verify that entrants have proper training and knowledge of known hazards, including the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure.	1. Purge tanks with cold water prior to steam cleaning. 2. Obtain the confined space entry permit and authorized signature. 3. Complete a safe entry checklist prior to entering the confined space. 4. Fill out and attach the caution tag after tank is purged and cleaned. 5. Know space hazards, including information on the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure. 6. Use the correct personal protective equipment (PPE) properly. 7. Maintain communication with standby person to enable them to monitor entrant's actions and alert the entrant to evacuate if necessary. 8. Exit from permit space as soon as possible: when ordered to by authorized persons; when entrant notices or recognizes the signs or symptoms of exposure; when a prohibited condition exists; and/or when the automatic alarm system sounds. 9. Alert the standby person when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.
Process: Tank Maintenance	

Entry Supervisor	Entrants
1. Upon receipt of a tank for maintenance, do a visible check for product. If product is visible in the tank, then the tank will be refused. 2. Complete and attach certification and danger tag to tank. 3. Provide confined space entry permit for the tank. 4. Verify that entrants have proper training and knowledge of known hazards, including the mode of exposure (how it gets into the body), signs or symptoms, and the results of exposure.	1. Prior to moving any tank into the maintenance bay, ensure tank has been cleaned and/or purged per attached caution tag, test atmosphere, and record results on hot tag. (Tank will not be moved into bay until the atmosphere has been tested and is determined to be within acceptable limits.) 2. In bay, if work will require confined space entry, obtain confined space entry permit from the Service Writer. 3. Obtain the confined space entry permit and the authorized signatures. 4. Complete the safe entry checklist prior to confined space entry. 5. Know space hazards, including information on the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure. 6. Use the correct personal protective equipment (PPE) properly. 7. Maintain communication with standby person to enable them to monitor the entrant's actions and alert the entrant to evacuate if necessary. 8. Exit from permit space as soon as possible: when ordered to by authorized persons; when entrant notices or recognizes signs or symptoms of exposure; when a prohibited condition exists; and/or when the automatic alarm system sounds. 9. Alert the standby person when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.

Excavation Safety Program

Table of Contents

Excavation Safety Program
for
Company Name

I. OBJECTIVE

This Excavation Safety Program has been developed to protect employees from safety hazards that may be encountered during work in trenches and excavations. This program is intended to assure that:

A. Employees who perform work in excavations are aware of their responsibilities and know how to perform the work safely.

B. ***Company Name*** has appointed one or more individuals within the company to assure compliance with the requirements of this program.

C. The responsibilities of ***Responsible Person(s)*** and workers are clearly detailed.

D. All persons involved in excavation and trenching work have received appropriate training in the safe work practices that must be followed when performing this type of work.

II. ASSIGNMENT OF RESPONSIBILITY

A. Employer

In administering the Excavation Safety Program, ***Company Name*** will:

1. Monitor the overall effectiveness of the program.
2. Provide atmospheric testing and equipment selection as needed.
3. Provide personal protective equipment as needed.
4. Provide protective systems as needed.
5. Provide training to affected employees and supervisors.
6. Provide technical assistance as needed.
7. Preview and update the program on at least an annual basis, or as needed.

B. Program Manager

The ***Responsible Person*** acts as the competent person for ***Company Name*** in reference to this program, and must assure that:

1. The procedures described in this program are followed.

2. Employees entering excavations or trenches are properly trained and equipped to perform their duties safely.

3. All required inspections, tests, and recordkeeping functions have been performed.

C. Employees

All employees, including contractor personnel, who work in or around excavations must comply with the requirements of this program. Employees are responsible for reporting hazardous practices or situations to ***Company Name*** management, as well as reporting incidents that cause injury to themselves or other employees to ***Responsible Person***.

III. TRAINING

A. Training Schedule

1. All personnel involved in trenching or excavation work shall be trained in the requirements of this program by ***Responsible Person*** with assistance from the appropriate supervisors.

2. Training shall be performed before employees are assigned duties in excavations.

3. Retraining will be performed when work site inspections indicate that an employee does not have the necessary knowledge or skills to safely work in or around excavations, or when changes to this program are made.

4. Training records will be maintained by ***Responsible Person***, and shall include:

   a. date of the training program;
   b. name(s) of the instructor(s) who conducted the training;
   c. a copy of the written material presented; and
   d. name(s) of the employee(s) who received the training.

B. Training Components

The training provided to all personnel who perform work in excavations shall include:

1. The work practices that must be followed during excavating or working in excavations.

2. The use of personal protective equipment that will typically be required during work in excavations, including but not limited to safety shoes, hardhats, and fall protection devices.

3. Procedures to be followed if a hazardous atmosphere exists or could reasonably be expected to develop during work in an excavation.

4. The OSHA Excavation Standard, 29 CFR 1926, Subpart P.

5. Emergency and non-entry rescue methods, and the procedure for calling rescue services.

6. ***Company Name*** policy on reporting incidents that cause injury to employees.

C. Training and Duties of Program Manager

The Program Manager, ***Responsible Person***, shall receive the training detailed in this program as well as training on the requirements detailed in the OSHA Excavation Standard. The Program Manager shall:

1. Coordinate, actively participate in, and document the training of all employees affected by this program.

2. Ensure on a daily basis, or more often as detailed in this program, that worksite conditions are safe for employees to work in excavations.

3. Determine the means of protection that will be used for each excavation project.

4. Ensure, if required, that the design of a protective system has been completed and approved by a registered professional engineer before work begins in an excavation.

5. Make available a copy of this program and the OSHA Excavation Standard to any employee who requests it.

IV. EXCAVATION REQUIREMENTS

A. Utilities and Pre-Work Site Inspection

Prior to excavation, the site shall be thoroughly inspected by ***Responsible Person*** to determine if special safety measures must be taken.

B. Surface Encumbrances

All equipment, materials, supplies, permanent installations (i.e., buildings or roadways), trees, brush, boulders, and other objects at the surface that could present a hazard to employees working in the excavation shall be removed or supported as necessary to protect employees.

C. Underground Installations

1. The location of sewer, telephone, fuel, electric, water, or any other underground installations or wires that may be encountered during excavation work shall be determined and marked prior to opening an excavation. Arrangements shall be made as necessary by ***Responsible Person*** with the appropriate utility entity for the protection, removal, shutdown, or relocation of underground installations.

2. If it is not possible to establish the exact location of these installations, the work may proceed with caution if detection equipment or other safe and acceptable means are used to locate the utility.

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3. Excavation shall be done in a manner that does not endanger the underground installations or the employees engaged in the work. Utilities left in place shall be protected by barricades, shoring, suspension, or other means as necessary to protect employees.

D. Protection of the Public

Barricades, walkways, lighting, and posting shall be provided as necessary for the protection of the public prior to the start of excavation operations.

1. Guardrails, fences, or barricades shall be provided on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Warning lights or other illumination shall be maintained as necessary for the safety of the public and employees from sunset to sunrise.

2. Wells, holes, pits, shafts, and all similar hazardous excavations shall be effectively barricaded or covered and posted as necessary to prevent unauthorized access. All temporary excavations of this type shall be backfilled as soon as possible.

3. Walkways or bridges protected by standard guardrails shall be provided where employees and the general public are permitted to cross over excavations. Where workers in the excavation may pass under these walkways or bridges, a standard guardrail and toeboard shall be used to prevent the hazard of falling objects. Information on the requirements for guardrails and toeboards may be obtained by contacting ***Responsible Person*** .

E. Protection of Employees

Stairs, ladders, or ramps shall be provided at excavation sites where employees are required to enter trench excavations over four (4) feet deep. The maximum distance of lateral travel (along the length of the trench) necessary to reach the means of egress shall not exceed 25 feet.

1. Structural Ramps

    a. Structural ramps used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a person qualified in structural design, and shall be constructed in accordance with the design.

    b. Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent movement or displacement.

    c. Structural members used for ramps and runways shall be of uniform thickness.

    d. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

    e. Structural ramps used in place of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

2. Ladders

    a. When portable ladders are used, the ladder side rails shall extend a minimum of three (3) feet above the upper surface of the excavation.

    b. Ladders shall have nonconductive side rails if work will be performed near exposed energized equipment or systems.

    c. Two or more ladders, or a double-cleated ladder, will be provided where 25 or more employees will be conducting work in an excavation where ladders serve as the primary means of egress, or where ladders serve two-way traffic.

    d. Ladders will be inspected prior to use for signs of damage or defects. Damaged ladders will be removed from service and marked with “Do Not Use” until repaired.

e. Ladders shall be used only on stable and level surfaces unless secured. Ladders placed in any location where they can be displaced by workplace activities or traffic shall be secured, or barricades shall be used to keep these activities away from the ladders.

f. Non self-supporting ladders shall be positioned so that the foot of the ladder is one-quarter of the working length away from the support.

g. Employees are not permitted to carry any object or load while on a ladder that could cause them to lose their balance and fall.

F. Exposure to Vehicular Traffic

Employees exposed to vehicular traffic shall be provided with, and shall wear warning vests or other suitable garments marked with or made of reflectorized or high-visibility material. Warning vests worn by flagmen shall be red or orange, and shall be reflectorized material if worn during night work. Emergency lighting, such as spotlights or portable lights, shall be provided as needed to perform work safely.

G. Exposure to Falling Loads

No employee is permitted underneath loads being handled by lifting or digging equipment. Employees are required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles provide adequate protection for the operator during loading and unloading operations.

H. Warning System for Mobile Equipment

A warning system shall be used when mobile equipment is operated adjacent to the edge of an excavation if the operator does not have a clear and direct view of the edge of the excavation. The warning system shall consist of barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

I. Hazardous Atmospheres

Responsible Person will test the atmosphere in excavations over four (4) feet deep if a hazardous atmosphere exists or could reasonably be expected to exist. A hazardous atmosphere could be expected, for example, in excavations in landfill areas, areas where hazardous substances are stored nearby, or near areas containing gas pipelines.

1. Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or forced ventilation of the workspace.

2. Forced ventilation or other effective means shall be used to prevent employee exposure to an atmosphere containing a flammable gas in excess of ten (10) percent of the lower flammability limit of the gas.

3. When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, continuous air monitoring will be performed by ***Responsible Person***. The device used for atmospheric monitoring shall be equipped with an audible and visual alarm.

4. Atmospheric testing will be performed using a properly calibrated direct reading gas monitor. Direct reading gas detector tubes or other acceptable means may also be used to test potentially toxic atmospheres.

5. Each atmospheric testing instrument shall be calibrated by ***Responsible Person*** on a schedule and in the manner recommended by the manufacturer. In addition:

   a. Any atmospheric testing instrument that has not been used within 30 days shall be recalibrated prior to use.
   b. Each atmospheric testing instrument shall be calibrated at least every six (6) months.

6. Each atmospheric testing instrument will be field checked immediately prior to use to ensure that it is operating properly.

J. Personal Protective Equipment

1. All employees working in trenches or excavations shall wear approved hardhats and steel-toed shoes or boots.

2. Employees exposed to flying fragments, dust or other materials produced by drilling, sawing, sanding, grinding, and similar operations shall wear approved safety glasses with side shields.

3. Employees performing welding, cutting, or brazing operations, or are exposed to the hazards produced by these tasks, shall wear approved spectacles or a welding faceshield or helmet, as determined by ***Responsible Person***.

4. Employees entering bell-bottom pier holes or other similar deep and confined footing excavations shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

5. Employees shall wear, as determined by ***Responsible Person***, approved gloves or other suitable hand protection.

6. Employees using or working in the immediate vicinity of hammer drills, masonry saws, jackhammers, or similar high-noise producing equipment shall wear suitable hearing protection, as determined by ***Responsible Person***.

7. Each employee working at the edge of an excavation six (6) feet or more deep shall be protected from falling. Fall protection shall include guardrail systems, fences, barricades, covers, or a tie-back system meeting OSHA requirements, as determined by ***Responsible Person***.

8. Emergency rescue equipment, such as breathing apparatus, a safety harness and line, and a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may develop during work in an excavation. This equipment shall be attended when in use. Only personnel who have received approved training and have appropriate equipment shall attempt retrieval that would require entry into a hazardous atmosphere. If entry into a known hazardous atmosphere must be performed, then ***Responsible Person*** shall be given advance notice so that the hazards can be evaluated and rescue personnel placed on standby if necessary.

K. Walkways and Guardrails

Walkways shall be provided where employees or equipment are permitted to cross over excavations. Guardrails shall be provided where walkways, accessible only to on-site project personnel, are six (6) feet or more above lower levels.

L. Protection from Water Accumulation Hazards

1. Employees are not permitted to work in excavations that contain or are accumulating water unless precautions have been taken to protect them from the hazards posed by water accumulation. Precautions may include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of safety harnesses and lifelines.

2. If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operation shall be monitored by a person trained in the use of that equipment.

3. If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation. Precautions shall also be taken to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains shall be reinspected by ***Responsible Person*** after each rain incident to determine if additional precautions, such as special support or shield systems to protect from cave-ins, water removal to control the

level of accumulating water, or use of safety harnesses and lifelines, should be used.

4. ***Responsible Person*** shall inform affected workers of the precautions or procedures that are to be followed if water accumulates or is accumulating in an excavation.

M. Stability of Adjacent Structures

Responsible Person will determine if the excavation work could affect the stability of adjoining buildings, walls, sidewalks, or other structures.

1. Support systems (such as shoring, bracing, or underpinning) shall be used to assure the stability of structures and the protection of employees where excavation operations could affect the stability of adjoining buildings, walls, or other structures.

2. Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted, except when:

   a. a support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure;
   b. the excavation is in stable rock;
   c. a registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or
   d. a registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

3. Sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or other method of protection is provided to protect employees from the possible collapse of such structures.

4. Where review or approval of a support system by a registered professional engineer is required, ***Responsible Person*** shall secure this review and approval in writing before the work begins.

N. Protection from Falling Objects and Loose Rocks or Soil

1. Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of:

   a. scaling to remove loose material;

b. installation of protective barricades, such as wire mesh or timber, at appropriate intervals on the face of the slope to stop and contain falling material; or

c. benching sufficient to contain falling material.

2. Excavation personnel shall not be permitted to work above one another where the danger of falling rock or earth exists.

3. Employees shall be protected from excavated materials, equipment, or other materials that could pose a hazard by falling or rolling into excavations.

4. Protection shall be provided by keeping such materials or equipment at least two (2) feet from the edge of excavations, by use of restraining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

5. Materials and equipment may, as determined by ***Responsible Person***, need to be stored further than two (2) feet from the edge of the excavation if a hazardous loading condition is created on the face of the excavation.

6. Materials piled, grouped, or stacked near the edge of an excavation must be stable and self-supporting.

O. Inspection by Program Manager

1. The Program Manager, ***Responsible Person***, shall conduct daily inspections of excavations, adjacent areas, and protective systems for evidence of a situation that could result in possible cave-ins, failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by ***Responsible Person*** prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when the trench will be or is occupied by employees.

2. Where the ***Responsible Person*** finds evidence of a situation that could result in a possible cave-in, failure of protective systems, hazardous atmosphere, or other hazardous conditions, exposed employees shall be removed from the hazardous area until precautions have been taken to assure their safety.

3. ***Responsible Person*** shall maintain a written log of all inspections conducted. This log shall include the date, work site location, results of the inspection, and a summary of any action taken to correct existing hazards.

V. PROTECTIVE SYSTEM REQUIREMENTS

A. Protection of Employees

1. Employees in an excavation shall be protected from cave-ins by using either an adequate sloping and benching system or an adequate support or protective system. The only exceptions are:

a. excavations made entirely in stable rock; or
b. excavations less than five (5) feet in depth where examination of the ground by ***Responsible Person*** provides no indication of a potential cave-in.

2. Protective systems shall be capable of resisting all loads that could reasonably be expected to be applied to the system.

B. Design of Sloping and Benching Systems

The slope and configuration of sloping and benching systems shall be selected and constructed by ***Responsible Person*** in accordance with the following options:

1. Allowable configurations and slopes

a. Excavations shall be sloped at an angle no steeper than one and one-half (1 ½) horizontal to one (1) vertical (34 degrees measured from the horizontal), unless one of the options listed below is used.
b. Slopes shall be properly excavated depending on soil type as shown in 29 CFR 1926, Subpart P, Appendix B.

2. Determination of slopes and configurations using 29 CFR 1926, Subpart P, Appendices A and B

The maximum allowable slopes and allowable configurations for sloping and benching systems shall meet the requirements set forth in these appendices.

3. Designs using other tabulated data

The design of sloping or benching systems may be selected from, and shall be constructed in accordance with, other tabulated data, such as tables and charts. The tabulated data used must be in written form and include the following:

a. Identification of the factors that affect the selection of a sloping or benching system.

b. Identification of the limits of the use of the data, including the maximum height and angle of the slopes determined to be safe.

c. Other information needed by the user to make correct selection of a protective system.

d. At least one copy of the tabulated data that identifies the registered professional engineer who approved the data shall be maintained at the jobsite during construction of the protective system. After that time, the data may be stored off the jobsite, and shall be maintained by ***Responsible Person***.

4. Design by a registered professional engineer

a. Sloping or benching systems designed in a manner other than those described in the preceding three options shall be approved by a registered professional engineer.

b. Designs shall be in written form and shall include at least the following information:

i. the maximum height and angle of the slopes that were determined to be safe for a particular project; and
ii. the identity of the registered professional engineers who approved the design.

c. At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time, the design may be stored off the jobsite, and shall be maintained by ***Responsible Person***.

C. Design of Support, Shield, and Other Protective Systems

The design of support systems, shield systems, and other protective systems shall be selected and constructed by ***Responsible Person*** in accordance with the following requirements:

1. Designs using 29 CFR 1926, Subpart P, Appendices A, C and D

a. Timber shoring in trenches shall be designed in accordance with the requirements of the OSHA guidelines.

b. Aluminum hydraulic shoring shall be designed in accordance with the manufacturer's tabulated data or the requirements of the OSHA guidelines.

2. Designs using manufacturer's tabulated data

a. Support systems, shield systems, and other protective systems designed from manufacturer's tabulated data shall be constructed and used in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

b. Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall be allowed only after the manufacturer issues specific written approval.

c. Manufacturer's specifications, recommendations, and limitations, as well as the manufacturer's written approval to deviate from the specifications, recommendations, and limitations, shall be kept in written form at the jobsite during construction of the protective system(s). After that time, the information may be stored off the jobsite, and shall be maintained by ***Responsible Person***.

3. Designs using other tabulated data

Designs of support systems, shield systems, and other protective systems shall be selected from and constructed in accordance with tabulated data, such as tables and charts.

a. The tabulated data shall be in written form and shall include all of the following:

i. identification of the factors that affect the selection of a protective system drawn from such data;
ii. identification of the limits of the use of such data; and
iii. information needed by the user to make a correct selection of a protective system from the data.

b. At least one written copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time, the data may be stored off the jobsite, and shall be maintained by ***Responsible Person***.

4. Design by a registered professional engineer

Support systems, shield systems, and other protective systems designed in a manner other than the preceding three options shall be approved by a registered professional engineer.

a. Designs shall be in written form and shall include:

i. a plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and
ii. the identity of the registered professional engineer who approved the design.

b. At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, and shall be maintained by ***Responsible Person***.

D. Materials and Equipment

1. Materials and equipment used for protective systems shall be free from damage or defects that might affect their proper function.

2. Manufactured materials and equipment used for protective systems shall be used and maintained in accordance with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

3. When materials or equipment used for protective systems are damaged, ***Responsible Person*** shall ensure that these systems are examined by a competent person to evaluate suitability for continued use. If the competent person cannot assure that the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service. The material or equipment shall then be evaluated and approved by a registered professional engineer before being returned to service.

E. Installation and Removal of Supports

1. General

a. Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other potential hazards.

b. Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support systems.

c. Individual members of the support systems shall not be subjected to loads exceeding those that they were designed to support.

d. Before temporary removal of individual support members begins, additional precautions shall be taken as directed by ***Responsible Person*** to ensure the safety of employees (i.e., the installation of other structural members to carry the loads imposed on the support system).

e. Removal of support systems shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly. If there is any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation, the work shall be halted until it can be examined by ***Responsible Person***.

f. Backfilling shall progress in conjunction with the removal of support systems from excavations.

2. Additional Requirements

a. Excavation of material to a level no greater than two (2) feet below the bottom of the members of a support system is allowed, but only if the system is designed to resist the forces calculated for the full depth of the trench. There shall be no indications of a possible loss of soil from behind or below the bottom of the support system while the trench is open.

b. Installation of a support system shall be closely coordinated with the excavation of trenches.

F. Sloping and Benching Systems

Employees are not permitted to work above other employees in the faces of sloped or benched systems, except when employees at lower levels are protected from the hazards of falling, rolling, or sliding material or equipment.

G. Shield Systems

1. General

a. Shield systems shall not be subjected to loads that are greater than those they are designed to withstand.

b. Shields shall be installed in a manner that will restrict lateral or other hazardous movement of the shield and could occur during cave-in or unexpected soil movement.

c. Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

d. Employees are not permitted in trenches when shields are being installed, removed, or moved vertically.

2. Additional Requirements

a. Excavation of material to a level no greater than two (2) feet below the bottom of the shield system is allowed, but only if the system is designed to resist the forces calculated for the full depth of the trench.

b. There shall be no indications of a possible loss of soil from behind or below the bottom of the shield system while the trench is open.

VI. ACCIDENT INVESTIGATIONS

All incidents that result in injury to workers, as well as near misses, regardless of their nature, shall be reported and investigated. Investigations shall be conducted by ***Responsible Person*** as soon after an incident as possible to identify the cause and means of prevention to eliminate the risk of reoccurrence.

In the event of such an incident, the Excavation Safety Program shall be reevaluated by ***Responsible Person*** to determine if additional practices, procedures, or training are necessary to prevent similar future incidents.

VII. CHANGES TO PROGRAM

Any changes to the Excavation Safety Program shall be approved by ***Responsible Person***, and shall be reviewed by a qualified person as the job progresses to determine additional practices, procedures, or training needs necessary to prevent injuries. Affected employees shall be notified of procedure changes, and trained if necessary. A copy of this program shall be maintained at the jobsite by ***Responsible Person***.

VIII. GLOSSARY

Accepted engineering practices: the standards of practice required by a registered professional engineer.

Aluminum hydraulic shoring: a manufactured shoring system consisting of aluminum hydraulic cylinders (crossbraces) used with vertical rails (uprights) or horizontal rails (wales). This system is designed to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom pier hole: a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a bell shape.

Benching system: a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or more horizontal steps, usually with vertical or near-vertical surfaces between levels.

Cave-in: the movement of soil or rock into an excavation, or the loss of soil from under a trench shield or support system, in amounts large enough to trap, bury, or injure and immobilize a person.

Competent person: a person who has been trained to identify hazards in the workplace, or working conditions that are unsafe for employees, and who has the authority to have these hazards corrected.

Cross braces: the horizontal members of a shoring system installed from side to side of the excavation. The cross braces bear against either uprights or wales.

Excavation: any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.

Faces or sides: the vertical or inclined earth surfaces formed as a result of excavation work.

Failure: the movement or damage of a structural member or connection that makes it unable to support loads.

Hazardous atmosphere: an atmosphere that is explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, that may cause death, illness, or injury.

Kickout: the accidental movement or failure of a cross brace.

Program Manager: the individual within the company who oversees excavation work and is responsible for assuring compliance with this program.

Protective system: a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Ramp: an inclined walking or working surface that is used to gain access to one point from another. A ramp may be constructed from earth or from structural materials such as steel or wood.

Sheeting: the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield system: a structure used in an excavation to withstand cave-ins and which will protect employees working within the shield system. Shields can be permanent structures or portable units moved along as work progresses. Shields used in trenches are usually referred to as **trench boxes** or **trench shields**.

Shoring system: a structure that is built or put in place to support the sides of an excavation to prevent cave-ins.

Sides: see **faces**.

Sloping system: sloping the sides of an excavation away from the excavation to protect employees from cave-ins. The required slope will vary with soil type, weather, and surface or near surface loads that may affect the soil in the area of the trench (such as adjacent buildings, vehicles near the edge of the trench, etc.).

Stable rock: natural solid mineral material that can be excavated with vertical sides that will remain intact while exposed.

Structural ramp: a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system: a structure used as underpinning, bracing or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Tabulated data: tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Trench: a narrow excavation (in relation to its height) made below the surface of the ground.

Trench box or trench shield: see **shield**.

Uprights: the vertical members of a trench shoring system placed in contact with the earth and usually positioned so the individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called **sheeting**.

Wales: horizontal members of a shoring system placed in the direction of the excavation face whose sides bear against the vertical members of the shoring system or earth (the uprights or sheeting).

Fall Protection Program

Table of Contents

Fall Protection Program

for

Company Name

I. OBJECTIVE

The objective of the ***Company Name*** Fall Protection Program is to identify and evaluate fall hazards to which employees will be exposed, and to provide specific training as required by the Occupational Safety and Health Administration (OSHA) Fall Protection Standard, 29 CFR 1926, Subpart M**.**

II. POLICY

It is the policy of ***Company Name*** to protect its employees from occupational injuries by implementing and enforcing safe work practices and appointing a competent person(s) to manage the Fall Protection Program. The ***Company Name*** Fall Protection Program shall comply with the OSHA requirements. A copy of the OSHA Fall Protection Standard shall be made available to all employees, and may be obtained from ***Responsible Person*** .

III. ASSIGNMENT OF RESPONSIBILITY

A. Employer

It is the responsibility of ***Company Name*** to provide fall protection to affected employees, and to ensure that all employees understand and adhere to the procedures of this plan and follow the instructions of ***Responsible Person*** .

B. Program Manager

It is the responsibility of ***Responsible Person*** as the Fall Protection Program Manager to implement this program by:

1. performing routine safety checks of work operations;
2. enforcing ***Company Name*** safety policy and procedures;
3. correcting any unsafe practices or conditions immediately;

4. training employees and supervisors in recognizing fall hazards and the use of fall protection systems;

5. maintaining records of employee training, equipment issue, and fall protection systems used at ***Company Name*** jobsites; and

6. investigating and documenting all incidents that result in employee injury.

C. Employees

It is the responsibility of all employees to:

1. understand and adhere to the procedures outlined in this Fall Protection Program;

2. follow the instructions of ***Responsible Person***;

3. bring to management's attention any unsafe or hazardous conditions or practices that may cause injury to either themselves or any other employees; and

4. report any incident that causes injury to an employee, regardless of the nature of the injury.

IV. TRAINING

A. All employees who may be exposed to fall hazards are required to receive training on how to recognize such hazards, and how to minimize their exposure to them. Employees shall receive training as soon after employment as possible, and before they are required to work in areas where fall hazards exist.

B. A record of employees who have received training and training dates shall be maintained by ***Responsible Person***. Training of employees by ***Responsible Person*** shall include:

1. Nature of the fall hazards employees may be exposed to.

2. Correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems.

3. Use and operation of controlled access zones, guardrails, personal fall arrest systems, safety nets, warning lines, and safety monitoring systems.

4. Role of each employee in the Safety Monitoring System (if one is used).

5. Limitations of the use of mechanical equipment during roofing work on low-slope roofs (if applicable).

6. Correct procedures for equipment and materials handling, and storage and erection of overhead protection.

7. Role of each employee in alternative Fall Protection Plans (if used).

8. Requirements of the OSHA Fall Protection Standard, 29 CFR 1926, Subpart M.

9. ***Company Name*** requirements for reporting incidents that cause injury to an employee.

C. Additional training shall be provided on an annual basis, or as needed when changes are made to this Fall Protection Program, an alternative Fall Protection Plan, or the OSHA Fall Protection Standard.

V. CONTROLLED ACCESS ZONES

A. Masons are the only authorized employees permitted to enter controlled access zones and areas from which guardrails have been removed. All other workers are prohibited from entering controlled access zones.

B. Controlled access zones shall be defined by control lines consisting of ropes, wires, tapes, or equivalent material, with supporting stanchions, and shall be:

1. Flagged with a high-visibility material at six (6) foot intervals.

2. Rigged and supported so that the line is between 30 and 50 inches (including sag) from the walking/working surface.

3. Strong enough to sustain stress of at least 200 pounds.

4. Extended along the entire length of an unprotected or leading edge.

5. Parallel to the unprotected or leading edge.

6. Connected on each side to a guardrail system or wall.

7. Erected between six (6) feet and 25 feet from an unprotected edge, except in the following cases:

   a. when working with precast concrete members: between six (6) feet and 60 feet from the leading edge, or half the length of the member being erected, whichever is less; or

b. when performing overhand bricking or related work: between ten (10) feet and 15 feet from the working edge.

VI. EXCAVATIONS

Fall protection will be provided to employees working at the edge of an excavation that is six (6) feet or deeper. Employees in these areas are required to use the fall protection systems as designated in this program.

A. Excavations that are six (6) feet or deeper shall be protected by guardrail systems, fences, barricades, or covers.

B. Walkways that allow employees to cross over an excavation that is six (6) feet or deeper shall be equipped with guardrails.

VII. FALL PROTECTION SYSTEMS

A. Covers

1. All covers shall be secured to prevent accidental displacement.

2. Covers shall be color-coded or bear the markings “HOLE” or “COVER”.

3. Covers located in roadways shall be able to support twice the axle load of the largest vehicle that might cross them.

4. Covers shall be able to support twice the weight of employees, equipment, and materials that might cross them.

B. Guardrail Systems

Guardrail systems shall be erected at unprotected edges, ramps, runways, or holes where it is determined by ***Responsible Person*** that erecting such systems will not cause an increased hazard to employees. The following specifications will be followed in the erection of guardrail systems. Toprails shall be:

1. at least ¼ inch in diameter (steel or plastic banding is unacceptable);

2. flagged every six (6) feet or less with a high visibility material if wire rope is used;

3. inspected by ***Responsible Person*** as frequently as necessary to ensure strength and stability;

4. forty-two (42) inches (plus or minus three (3) inches) above the walking/working level; and

5. adjusted to accommodate the height of stilts, if they are in use.

Midrails, screens, mesh, intermediate vertical members, and solid panels shall be erected in accordance with the OSHA Fall Protection Standard.

Gates or removable guardrail sections shall be placed across openings of hoisting areas or holes when they are not in use to prevent access.

C. Personal Fall Arrest Systems

1. Personal fall arrest systems shall be issued to and used by employees as determined by Responsible Person and may consist of anchorage, connectors, body harness, deceleration device, lifeline, or suitable combinations. Personal fall arrest systems shall:

a. limit the maximum arresting force to 1800 pounds;

b. be rigged so an employee cannot free fall more than six (6) feet or contact any lower level;

c. bring an employee to a complete stop and limit the maximum deceleration distance traveled to three and a half (3 ½) feet;

d. be strong enough to withstand twice the potential impact energy of an employee free falling six (6) feet (or the free fall distance permitted by the system, whichever is less);

e. be inspected prior to each use for damage and deterioration; and

f. be removed from service if any damaged components are detected.

2. All components of a fall arrest system shall meet the specifications of the OSHA Fall Protection Standard, and shall be used in accordance with the manufacturer's instructions.

a. The use of non-locking snaphooks is prohibited.

b. Dee-rings and locking snaphooks shall:

i. have a minimum tensile strength of 5000 pounds; and
ii. be proof-tested to a minimum tensile load of 3600 pounds without cracking, breaking, or suffering permanent deformation.

c. Lifelines shall be:

i. designed, installed, and used under the supervision of ***<u>Responsible Person</u>***;
ii. protected against cuts and abrasions; and
iii. equipped with horizontal lifeline connection devices capable of locking in both directions on the lifeline when used on suspended scaffolds or similar work platforms that have horizontal lifelines that may become vertical lifelines.

d. Self-retracting lifelines and lanyards must have ropes and straps (webbing) made of synthetic fibers, and shall:

i. sustain a minimum tensile load of 3600 pounds if they automatically limit free fall distance to two (2) feet; or
ii. sustain a minimum tensile load of 5000 pounds (includes ripstitch, tearing, and deforming lanyards).

e. Anchorages must support at least 5000 pounds per person attached and shall be:

i. designed, installed, and used under the supervision of ***<u>Responsible Person</u>***;
ii. capable of supporting twice the weight expected to be imposed on it; and
iii. independent of any anchorage used to support or suspend platforms.

D. Positioning Device Systems

Body belt or body harness systems shall be set up so that an employee can free fall no farther than two (2) feet, and shall be secured to an anchorage capable of supporting twice the potential impact load or 3000 pounds, whichever is greater. Requirements for snaphooks, dee-rings, and other connectors are the same as detailed in this Program under *Personal Fall Arrest Systems.*

E. Safety Monitoring Systems

In situations when no other fall protection has been implemented, ***<u>Responsible Person(s)</u>*** shall monitor the safety of employees in these work areas. The ***<u>Responsible Person(s)</u>*** shall be:

1. competent in the recognition of fall hazards;
2. capable of warning workers of fall hazard dangers;

3. operating on the same walking/working surfaces as the employees and able to see them;
4. close enough to work operations to communicate orally with employees; and
5. free of other job duties that might distract them from the monitoring function.

No employees other than those engaged in the work being performed under the Safety Monitoring System shall be allowed in the area. All employees under a Safety Monitoring System are required to promptly comply with the fall hazard warnings of the ***Responsible Person(s)***.

F. Safety Net Systems

1. Safety net systems must be installed no more than 30 feet below the walking/working surface with sufficient clearance to prevent contact with the surface below, and shall be installed with sufficient vertical and horizontal distances as described in the OSHA Fall Protection Standard.

2. All nets shall be inspected at least once a week for wear, damage, or deterioration by ***Responsible Person***. Defective nets shall be removed from use and replaced with acceptable nets.

3. All nets shall be in compliance with mesh, mesh crossing, border rope, and connection specifications as described in the OSHA Fall Protection Standard.

4. When nets are used on bridges, the potential fall area from the walking/working surface shall remain unobstructed.

5. Objects that have fallen into safety nets shall be removed as soon as possible, and at least before the next working shift.

G. Warning Line Systems

Warning line systems consisting of supporting stanchions and ropes, wires, or chains shall be erected around all sides of roof work areas.

1. Lines shall be flagged at no more than six (6) foot intervals with high-visibility materials.

2. The lowest point of the line (including sag) shall be between 34 and 39 inches from the walking/working surface.

3. Stanchions of warning line systems shall be capable of resisting at least 16 pounds of force.

4. Ropes, wires, or chains must have a minimum tensile strength of 500 pounds.

5. Warning line systems shall be erected at least six (6) feet from the edge, except in areas where mechanical equipment is in use. When mechanical equipment is in use, warning line systems shall be erected at least six (6) feet from the parallel edge, and at least ten (10) feet from the perpendicular edge.

VIII. TASKS AND WORK AREAS REQUIRING FALL PROTECTION

Unless otherwise specified, ***Responsible Person(s)*** shall evaluate the worksite(s) and determine the specific type(s) of fall protection to be used in the following situations.

A. Framework and Reinforcing Steel

Fall protection will be provided when an employee is climbing or moving at a height of over 24 feet when working with rebar assemblies.

B. Hoist Areas

Guardrail systems or personal fall arrest systems will be used in hoist areas when an employee may fall six (6) feet or more. If guardrail systems must be removed for hoisting, employees are required to use personal fall arrest systems.

C. Holes

Covers or guardrail systems shall be erected around holes (including skylights) that are six (6) feet or more above lower levels. If covers or guardrail systems must be removed, employees are required to use personal fall arrest systems.

D. Leading Edges

Guardrail systems, safety net systems, or personal fall arrest systems shall be used when employees are constructing a leading edge that is six (6) feet or more above lower levels. An alternative Fall Protection Plan shall be used if ***Responsible Person(s)*** determines that the implementation of conventional fall protection systems is infeasible or creates a greater hazard to employees. All alternative Fall Protection Plans for work on leading edges shall:

1. be written specific to the particular jobsite needs;

2. include explanation of how conventional fall protection is infeasible or creates a greater hazard to employees;

3. explain what alternative fall protection will be used for each task;

4. be maintained in writing at the jobsite by ***Responsible Person***; and

5. meet the requirements of 29 CFR 1926.502(k).

E. Overhand Bricklaying and Related Work

Guardrail systems, safety net systems, personal fall arrest systems, or controlled access zones shall be provided to employees engaged in overhead bricklaying or related work six (6) feet or more above the lower level. All employees reaching more than ten (10) inches below the walking/working surface shall be protected by guardrail systems, safety net systems, or personal fall arrest systems.

F. Precast Concrete Erection

Guardrail systems, safety net systems, or personal fall arrest systems shall be provided to employees working six (6) feet or more above the lower level while erecting or grouting precast concrete members. An alternative Fall Protection Plan shall be used if ***Responsible Person(s)*** determines that the implementation of conventional fall protection systems is infeasible or creates a greater hazard to employees. All alternative Fall Protection Plans for precast concrete erection shall:

1. be written specific to the particular jobsite needs;

2. include explanation of how conventional fall protection is infeasible or creates a greater hazard to employees;

3. explain what alternative fall protection will be used for each task;

4. be maintained in writing at the jobsite by ***Responsible Person***; and

5. meet the requirements of 29 CFR 1926.502(k).

G. Residential Construction

Guardrail systems, safety net systems, or personal fall arrest systems shall be provided to employees working six (6) feet or more above the lower level on residential construction projects. However, certain tasks may be performed without the use of conventional fall protection if ***Responsible Person*** has determined that such fall protection is infeasible or creates greater hazards to employees. ***Responsible Person*** shall follow the guidelines of 29 CFR 1926, Subpart M, Appendix E in the development of alternative Fall Protection Plans for residential construction projects (see Attachment A).

H. Roofing

1. Low-Slope Roofs

Fall protection shall be provided to employees engaged in roofing activities on low-slope roofs with unprotected sides and edges six (6) feet or more above lower levels. The type(s) of fall protection needed shall be determined by ***Responsible Person***, and may consist of guardrail systems, safety net systems, personal fall arrest systems, or a combination of a warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system. On roofs 50 feet or less in width, the use of a safety monitoring system without a warning line system is permitted.

2. Steep Roofs

Guardrail systems with toeboards, safety net systems, or personal fall arrest systems will be provided to employees working on a steep roof with unprotected sides and edges six (6) feet or more above lower levels, as determined by ***Responsible Person***.

I. Wall Openings

Guardrail systems, safety net systems, or a personal fall arrest system will be provided to employees working on, at, above, or near wall openings when the outside bottom edge of the wall opening is six (6) feet or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches above the walking/working surface. The type of fall protection to be used will be determined by ***Responsible Person***.

J. Ramps, Runways, and Other Walkways

Employees using ramps, runways, and other walkways six (6) feet or more above the lower level shall be protected by guardrail systems.

IX. PROTECTION FROM FALLING OBJECTS

When guardrail systems are in use, the openings shall be small enough to prevent potential passage of falling objects. The following procedures must be followed by all employees to prevent hazards associated with falling objects.

A. No materials (except masonry and mortar) shall be stored within four (4) feet of working edges.

B. Excess debris shall be removed regularly to keep work areas clear.

C. During roofing work, materials and equipment shall be stored no less than six (6) feet from the roof edge unless guardrails are erected at the edge.

D. Stacked materials must be stable and self-supporting.

E. Canopies shall be strong enough to prevent penetration by falling objects.

F. Toeboards erected along the edges of overhead walking/working surfaces shall be:

1. capable of withstanding a force of at least 50 pounds; and

2. solid with a minimum of three and a half (3 ½) inches tall and no more than one quarter (1/4) inch clearance above the walking/working surface.

G. Equipment shall not be piled higher than the toeboard unless sufficient paneling or screening has been erected above the toeboard.

X. ACCIDENT INVESTIGATIONS

All incidents that result in injury to workers, as well as near misses, regardless of their nature, shall be reported and investigated. Investigations shall be conducted by ***Responsible Person*** as soon after an incident as possible to identify the cause and means of prevention to eliminate the risk of reoccurrence.

In the event of such an incident, the Fall Protection Program (and alternative Fall Protection Plans, if in place) shall be reevaluated by ***Responsible Person*** to determine if additional practices, procedures, or training are necessary to prevent similar future incidents.

XI. CHANGES TO THE PLAN

Any changes to the Fall Protection Program (and alternative Fall Protection Plans, if in place) shall be approved by ***Responsible Person***, and shall be reviewed by a qualified person as the job progresses to determine additional practices, procedures or training needs necessary to prevent fall injuries. Affected employees shall be notified of all procedure changes, and trained if necessary. A copy of this plan, and any additional alternative Fall Protection Plans, shall be maintained at the jobsite by ***Responsible Person***.

XII. GLOSSARY

Anchorage: a secure point of attachment for lifelines, lanyards, or deceleration devices.

Body belt: a strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device.

Body harness: straps that may be secured about the person in a manner that distributes the fall-arrest forces over at least the thighs, pelvis, waist, chest, and shoulders with a means for attaching the harness to other components of a personal fall arrest system.

Connector: A device that is used to couple (connect) parts of a personal fall arrest system or positioning device system together.

Controlled access zone: a work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems (guardrail, personal arrest, or safety net) to protect the employees working in the zone.

Deceleration device: any mechanism, such as a rope, grab, ripstitch lanyard, specially-woven lanyard, tearing lanyard, deforming lanyard, or automatic self-retracting lifeline/lanyard, which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest.

Deceleration distance: the additional vertical distance a falling person travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which a deceleration device begins to operate.

Guardrail system: a barrier erected to prevent employees from falling to lower levels.

Hole: a void or gap two (2) inches (5.1 centimeters) or more in the least dimension in a floor, roof, or other walking/working surface.

Lanyard: a flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage**.**

Leading edge: the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as a deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed.

Lifeline: a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), that serves as a means for connecting other components of a personal fall arrest system to an anchorage.

Low slope roof: a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

Opening: a gap or void 30 inches (76 centimeters) or more high and 18 inches (46 centimeters) or more wide, in a wall or partition through which employees can fall to a lower level.

Personal fall arrest system: a system including but not limited to an anchorage, connectors, and a body harness used to arrest an employee in a fall from a working level.

Positioning device system: a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning backwards.

Rope grab: a deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks to arrest a fall.

Safety monitoring system: a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.

Self-retracting lifeline/lanyard: a deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under minimal tension during normal employee movement and which, after onset of a fall, automatically locks the drum and arrests the fall.

Snaphook: a connector consisting of a hook-shaped member with a normally closed keeper, or a similar arrangement, which may be opened to permit the hook to receive an object and, when released automatically, closes to retain the object.

Steep roof: a roof having a slope greater than 4 in 12 (vertical to horizontal).

Toeboard: a low protective barrier that prevents material and equipment from falling to lower levels and which protects personnel from falling.

Unprotected sides and edges: any side or edge (except at entrances to points of access) of a walking/working surface (e.g., floor, roof, ramp, or runway) where there is no wall or guardrail system at least 39 inches (1 meter) high.

Walking/working surface: any surface, whether horizontal or vertical, on which an employee walks or works, including but not limited to floors, roofs, ramps, bridges, runways, formwork, and concrete reinforcing steel. Does not include ladders, vehicles, or trailers on which employees must be located to perform their work duties.

Warning line system: a barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge and which designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.

Attachment A
Sample Fall Protection Plan for Residential Construction

for

(Company Name)

This Fall Protection Plan is specific to the following project:

Job Location:	
Date Plan Prepared:	
Date Plan Modified:	
Plan Prepared by:	
Plan Approved by:	
Plan Supervised by:	

STATEMENT OF COMPANY POLICY

__***Company Name***__ is dedicated to the protection of its employees from occupational injuries. All employees of __***Company Name***__ have the responsibility to work safely on the job. The purpose of this Plan is to supplement our existing Fall Protection Program and to ensure that every employee who works for __***Company Name***__ recognizes workplace fall hazards and takes the appropriate measures to address those hazards.

This Fall Protection Plan addresses the use of conventional fall protection at a number of areas on the project, and identifies specific activities that require non-conventional means of fall protection. During the construction of residential buildings under 48 feet in height, it is sometimes infeasible or creates a greater hazard to use conventional fall protection systems at specific areas or for specific tasks. Such areas or tasks include, but are not limited to:

setting and bracing of roof trusses and rafters;
installation of floor sheathing and joists;
roof sheathing operations; and
erecting exterior walls.

In these cases, conventional fall protection systems may not be the safest choice for this project. This Plan is designed to enable employees to recognize fall hazards associated with this job and to establish safe procedures to prevent falls to lower levels through holes and openings in walking/working surfaces.

ASSIGNMENT OF RESPONSIBILITY

Employer

Ensure that all employees understand and adhere to the procedures of this Plan and the instructions of the crew supervisor or foreman.
Assign a competent person to be responsible for managing this Fall Protection Plan.

Provide appropriate fall protection to employees as detailed in this Plan.

Employee

Bring to the attention of ***Company Name*** management any unsafe or hazardous conditions or practices that may cause injury to themselves or other employees.

Report any incident which causes injury to self or a co-worker.

Each employee will be trained in these procedures and will be expected to strictly adhere to them except when doing so would expose him/her to a greater hazard. If, in the employee's opinion, the procedures in this Plan pose a risk, the employee is to notify ***Responsible Person*** and have their concern(s) addressed before proceeding with work.

Plan Manager

Responsible Person shall function as Manager of this Fall Protection Plan and has the following responsibilities:

Implement this Fall Protection Plan.

Perform continual observational checks of work operations to identify hazards.

Enforce the company policy and the procedures of this Plan.

Coordinate with crew supervisors or foremen to correct any unsafe practices or conditions immediately.

Provide training on this Plan to all affected employees before work begins on this project.

FALL PROTECTION TO BE USED ON THIS JOB

Installation of roof trusses/rafters, exterior wall erection, roof sheathing, floor sheathing, and joint/truss activities will be conducted by employees who are specifically trained to do this type of work and are trained to recognize fall hazards. The nature of such work normally exposes employees to fall hazards for a short period of time. This Plan details how ***Company Name*** will minimize these hazards.

Controlled Access Zones

When using this Plan to implement the fall protection options available, workers must be protected through limited access to high hazard locations. Before any non-conventional fall protection systems are used as part of this work Plan, a controlled access zone (CAZ) shall be clearly defined by a ***Responsible Person*** as an area where a recognized hazard exists. The demarcation of the CAZ shall be communicated by ***Responsible Person*** in a recognized manner, either through signs, wires, tapes, ropes, or chains.

Company Name shall take the following steps to ensure that the CAZ is clearly marked or controlled by a competent person.

All access to the CAZ shall be restricted to authorized entrants only.

All workers who are permitted in the CAZ must be listed in the appropriate sections of this Plan (or be visibly identifiable by ***Responsible Person*** prior to implementation).

Responsible Person shall ensure that all protective elements of the CAZ be implemented prior to the beginning of work.

Installation of Roof Truss or Rafter Erection

During the erection and bracing of roof trusses/rafters, conventional fall protection may present a greater hazard to workers. On this job, safety nets will not provide adequate fall protection because the nets will cause the walls to collapse. In addition, there are also no suitable attachment or anchorage points for guardrails or personal fall arrest systems.

Requiring employees on this job to use a ladder for the entire installation process will cause greater hazard because the worker must stand on the ladder with his back or side to the front of the ladder. While erecting the truss or rafter, the worker will need both hands to maneuver the truss and therefore cannot hold onto the ladder. In addition, ladders cannot be adequately protected from movement while trusses are being maneuvered into place. Employees may experience fatigue because of the increased overhead work with heavy materials, which can also lead to a greater hazard.

Exterior scaffolds cannot be utilized on this job because the ground, after recent backfilling, cannot support the scaffolding. In most cases, the erection and dismantling of the scaffold would expose workers to a greater fall hazard than the erection of the trusses/rafters.

On all walls eight (8) feet or less in height, employees will install interior scaffolds along interior walls below the location where the trusses/rafters will be erected. ASawhorse@ scaffold constructed of 46 inch sawhorses and two (2) foot by ten (10) foot planks will often allow workers to be elevated high enough to allow for the erection of trusses and rafters without working on the top plate of the wall.

In structures that have walls higher than eight (8) feet and where the use of scaffolds and ladders would create a greater hazard, safe working procedures will be used when working on the top plate, which will be monitored by ***Responsible Person*** . During all stages of truss/rafter erection, the stability of the trusses/rafters will be ensured at all times.

Company Name shall take the following steps to protect workers who are exposed to fall hazards while working from the top plate installing trusses/rafters:

> Only trained and approved workers will be allowed to work on the top plate during roof truss or rafter installation. A list of approved employees will be maintained by the ***Responsible Person*** as an attachment to this Plan.
>
> Employees shall have no other duties to perform during truss/rafter erection procedures.

All trusses/rafters will be adequately braced before any worker will be permitted to use the truss/rafter as a support.

Employees will remain on the top plate using the previously stabilized truss/rafter as a support while other trusses/rafters are being erected.

Employees will leave the area of the secured trusses only when it is necessary to secure another truss/rafter.

The first two (2) trusses/rafters will be set from ladders leaning on side walls at points where the walls can support the weight of the ladder.

An employee will climb onto the interior top plate via a ladder to secure the peaks of the first two trusses/rafters being set.

Employees responsible for detaching trusses from cranes and/or securing trusses at the peaks traditionally are positioned at the peak of the trusses/rafters. There are also situations where workers securing rafters to ridge beams will be positioned at the top of the ridge beam. ***Company Name*** will take the following steps to protect workers who are exposed to fall hazards while securing trusses/rafters at the peak of the trusses/ridge beam:

Only trained and approved workers will be allowed to work at the peak during roof truss or rafter installation. A list of approved employees will be maintained by ***Responsible Person*** as an attachment to this Plan.

Once truss or rafter installation begins, workers not involved in that activity shall not stand or walk below or adjacent to the roof opening or exterior walls in any area where they could be struck by falling objects.

Employees shall have no duties other than securing/bracing the trusses/ridge beams.

Employees positioned at the peaks, in the webs of trusses, or on top of the ridge beam shall work from a stable position. A stable position for an employee will be either sitting on a "ridge seat" or other equivalent surface that provides additional stability, or positioning themselves in previously stabilized trusses/rafters and leaning into and reaching through the trusses/rafters.

Workers shall not remain on or in the peak/ridge any longer than necessary to safely complete the task.

Roof Sheathing Operations

Workers typically install roof sheathing after all trusses/rafters and any permanent truss bracing is in place. Because roof structures are unstable until some sheathing is installed, workers installing roof sheathing cannot be protected from fall hazards by conventional fall protection systems until it is determined that the roofing system can be used as an anchorage point. At that point, employees shall be protected by personal fall arrest systems.

Trusses/rafters are subject to collapse if a worker falls while attached to a single truss with a belt/harness. Nets could also cause collapse, and there is insufficient structure to attach guardrails.

All employees will ensure that they have secure footing before they attempt to walk on the sheathing, and will clean their shoes/boots of mud or other slip hazards.

To minimize the time workers must be exposed to a fall hazard, materials will be staged to allow for the quickest installation of sheathing.

Company Name will take the following steps to protect workers who are exposed to fall hazards while installing roof sheathing:

> Once roof sheathing installation begins, employees not involved in that activity shall not stand or walk below or adjacent to the roof opening or exterior walls in any area where they could be struck by falling objects.
>
> ***Responsible Person*** shall determine the limits of this area, which shall be clearly communicated to workers prior to placement of the first piece of roof sheathing.
>
> ***Responsible Person*** may suspend work on the roof for brief periods as necessary to allow other workers to pass through such areas when this would not create a greater hazard.
>
> Only trained and approved workers will be allowed to install roof sheathing. A list of approved employees will be maintained by ***Responsible Person*** as an attachment to this Plan.
>
> The bottom row of roof sheathing may be installed by workers standing in truss webs.
>
> After the bottom row of roof sheathing is installed, a slide guard extending the width of the roof shall be securely attached to the roof. Slide guards will be at least four (4) inches in height and capable of limiting the uncontrolled slide of workers. Workers shall install the slide guard while standing in truss webs and leaning over the sheathing.

Additional rows of sheathing may be installed by workers positioned on previously installed rows of sheathing with slide guards.

Additional slide guards shall be securely attached to the roof at intervals not to exceed 13 feet as successive rows of sheathing are installed. For roofs with pitches in excess of 9 in 12, slide guards will be installed at four (4) foot intervals.

When wet weather conditions (rain, snow, or sleet) are present, roof sheathing operations shall be suspended unless safe footing can be assured for those workers installing sheathing.

When strong winds (over 40 miles per hour) are present, roof sheathing operations shall be suspended unless wind breakers are erected.

Installation of Floor Joists and Sheathing

Company Name will take the following steps to protect workers who are exposed to fall hazards while installing floor joists or floor sheathing:

Only trained and approved workers will be allowed to install floor joists and floor sheathing. A list of approved employees will be maintained by ***Responsible Person*** as an attachment to this Plan.

Materials for this work shall be conveniently staged to allow for easy access to workers.

The first-floor joints or trusses will be rolled into position and secured either from the ground, ladders, or sawhorse scaffolds.

Each successive floor joist or trust will be rolled into place and secured from a platform created from a sheet of plywood laid over the previously secured floor joists or trusses.

Except for the first row of sheathing, which will be installed from ladders or the ground, employees shall work from the established deck.

Any employees not assisting in the leading edge construction while leading edges still exist (i.e., cutting the decking for installers) shall not be permitted within six (6) feet of the leading edge under construction.

Erection of Exterior Walls

Company Name will take the following steps to protect workers who are exposed to fall hazards during the construction and erection of exterior walls:

Only trained and approved workers will be allowed to construct and erect exterior walls. A list of approved employees will be maintained by ***Responsible Person*** as an attachment to this Plan.

A painted line six (6) feet from the perimeter will be clearly marked prior to any wall erection activities to warn of the approaching unprotected edge.

Materials for operations shall be conveniently staged to minimize fall hazards.

Workers constructing exterior walls shall complete as much cutting of materials and other preparation as possible away from the edge of the deck.

ENFORCEMENT

Constant awareness of and respect for fall hazards, as well as compliance with all safety rules, are considered conditions of employment with ***Company Name*** . The crew supervisor or foreman, as well as ***Responsible Person*** or company management, reserve the right to issue disciplinary warnings to employees, up to and including termination, for failure to follow the guidelines of this Plan.

ACCIDENT INVESTIGATIONS

All incidents that result in injury to workers and near misses, regardless of their nature, shall be reported and investigated. All incidents shall be investigated as soon as possible by ***Responsible Person*** to identify the cause and means of prevention to prevent future occurrences.

In the event of such an incident, this Fall Protection Plan shall be reviewed to determine if additional practices, procedures, or training should be implemented to prevent similar incidents in the future.

CHANGES TO THE PLAN

Any changes to this Plan will be made by ***Responsible Person***. This Plan shall be reviewed by ***Responsible Person*** as the job progresses to determine if additional practices, procedures, or training are needed to improve or provide additional fall protection. Affected employees shall be notified of changes to this Plan, and retrained, if necessary. A copy of this Plan and all approved changes shall be maintained at the jobsite by ***Responsible Person***.

Fire Prevention Plan

Table of Contents

Fire Prevention Plan

for
<u>Company Name</u>
<u>Date</u>

I. OBJECTIVE

The purpose of this Fire Prevention Plan is to eliminate the causes of fire, prevent loss of life and property by fire, and to comply with the Occupational Safety and Health Administration's (OSHA) standard on fire prevention, 29 CFR 1910.39. It provides employees with information and guidelines that will assist them in recognizing, reporting, and controlling fire hazards.

II. BACKGROUND

<u>Company Name</u> is committed to minimizing the threat of fire to employees, visitors, and property. ***<u>Company Name</u>*** complies with all applicable laws, regulations, codes, and good practices pertaining to fire prevention. ***<u>Company Name's</u>*** separate Emergency Action Plan spells out the procedures for responding to fires. This Fire Prevention Plan serves to reduce the risk of fires at ***<u>Company Name/Location</u>*** in the following ways:

A. identifies materials that are potential fire hazards and their proper handling and storage procedures;
B. distinguishes potential ignition sources and the proper control procedures of those materials;
C. describes fire protection equipment and/or systems used to control fire hazards;
D. identifies persons responsible for maintaining the equipment and systems installed to prevent or control ignition of fires;
E. identifies persons responsible for the control and accumulation of flammable or combustible material;
F. describes good housekeeping procedures necessary to insure the control of accumulated flammable and combustible waste material and residues to avoid a fire emergency; and
G. provides training to employees with regard to fire hazards to which they may be exposed.

III. ASSIGNMENT OF RESPONSIBILITY

Fire safety is everyone's responsibility. All employees should know how to prevent and respond to fires, and are responsible for adhering to company policy regarding fire emergencies.

A. Management

Management determines the ***Company Name*** fire prevention and protection policies. Management will provide adequate controls to provide a safe workplace, and will provide adequate resources and training to its employees to encourage fire prevention and the safest possible response in the event of a fire emergency.

B. Plan Administrator

Responsible Person(s) shall manage the Fire Prevention Plan for ***Company Name***, and shall maintain all records pertaining to the plan. The Plan Administrator shall also:

Develop and administer the *Company Name* fire prevention training program.

Ensure that fire control equipment and systems are properly maintained.

Control fuel source hazards.

Conduct fire risk surveys (see Appendix A) and make recommendations.

C. Supervisors

Supervisors are responsible for ensuring that employees receive appropriate fire safety training, and for notifying ***Responsible Person*** when changes in operation increase the risk of fire. Supervisors are also responsible for enforcing ***Company Name*** fire prevention and protection policies.

D. Employees

All employees shall:

Complete all required training before working without supervision.

Conduct operations safely to limit the risk of fire.

Report potential fire hazards to their supervisors.

Follow fire emergency procedures.

IV. PLAN IMPLEMENTATION

A. Good Housekeeping

To limit the risk of fires, employees shall take the following precautions:

1. Minimize the storage of combustible materials.
2. Make sure that doors, hallways, stairs, and other exit routes are kept free of obstructions.

3. Dispose of combustible waste in covered, airtight, metal containers.
4. Use and store flammable materials in well-ventilated areas away from ignition sources.
5. Use only nonflammable cleaning products.
6. Keep incompatible (i.e., chemically reactive) substances away from each other.
7. Perform “hot work” (i.e., welding or working with an open flame or other ignition sources) in controlled and well-ventilated areas.
8. Keep equipment in good working order (i.e., inspect electrical wiring and appliances regularly and keep motors and machine tools free of dust and grease.
9. Ensure that heating units are safeguarded.
10. Report all gas leaks immediately. ***Responsible Person*** shall ensure that all gas leaks are repaired immediately upon notification.
11. Repair and clean up flammable liquid leaks immediately.
12. Keep work areas free of dust, lint, sawdust, scraps, and similar material.
13. Do not rely on extension cords if wiring improvements are needed, and take care not to overload circuits with multiple pieces of equipment.
14. Ensure that required hot work permits are obtained.
15. Turn off electrical equipment when not in use.

B. Maintenance

Responsible Person(s) will ensure that equipment is maintained according to manufacturers' specifications. ***Company Name*** will also comply with requirements of the National Fire Protection Association (NFPA) codes for specific equipment. Only properly trained individuals shall perform maintenance work.

The following equipment is subject to the maintenance, inspection, and testing procedures:

1. equipment installed to detect fuel leaks, control heating, and control pressurized systems;
2. portable fire extinguishers, automatic sprinkler systems, and fixed extinguishing systems;
3. detection systems for smoke, heat, or flame;
4. fire alarm systems; and
5. emergency backup systems and the equipment they support.

V. TYPES OF HAZARDS

The following sections address the major workplace fire hazards at ***Company Name’s*** facilities and the procedures for controlling the hazards.

A. Electrical Fire Hazards

Electrical system failures and the misuse of electrical equipment are leading causes of workplace fires. Fires can result from loose ground connections, wiring with frayed insulation, or overloaded fuses, circuits, motors, or outlets.

To prevent electrical fires, employees shall:

1. Make sure that worn wires are replaced.
2. Use only appropriately rated fuses.
3. Never use extension cords as substitutes for wiring improvements.
4. Use only approved extension cords [i.e., those with the Underwriters Laboratory (UL) or Factory Mutual (FM) label].
5. Check wiring in hazardous locations where the risk of fire is especially high.
6. Check electrical equipment to ensure that it is either properly grounded or double insulated.
7. Ensure adequate spacing while performing maintenance.

B. Portable Heaters

All portable heaters shall be approved by ***Responsible Person***. Portable electric heaters shall have tip-over protection that automatically shuts off the unit when it is tipped over. There shall be adequate clearance between the heater and combustible furnishings or other materials at all times.

C. Office Fire Hazards

Fire risks are not limited to ***Company Name's*** industrial facilities. Fires in offices have become more likely because of the increased use of electrical equipment, such as computers and fax machines. To prevent office fires, employees shall:

1. Avoid overloading circuits with office equipment.
2. Turn off nonessential electrical equipment at the end of each workday.
3. Keep storage areas clear of rubbish.
4. Ensure that extension cords are not placed under carpets.
5. Ensure that trash and paper set aside for recycling is not allowed to accumulate.

D. Cutting, Welding, and Open Flame Work

Responsible Person(s) will ensure the following:

1. All necessary hot work permits have been obtained prior to work beginning.
2. Cutting and welding are done by authorized personnel in designated cutting and welding areas whenever possible.
3. Adequate ventilation is provided.

4. Torches, regulators, pressure-reducing valves, and manifolds are UL listed or FM approved.
5. Oxygen-fuel gas systems are equipped with listed and/or approved backflow valves and pressure-relief devices.
6. Cutters, welders, and helpers are wearing eye protection and protective clothing as appropriate.
7. Cutting or welding is prohibited in sprinklered areas while sprinkler protection is out of service.
8. Cutting or welding is prohibited in areas where explosive atmospheres of gases, vapors, or dusts could develop from residues or accumulations in confined spaces.
9. Cutting or welding is prohibited on metal walls, ceilings, or roofs built of combustible sandwich-type panel construction or having combustible covering.
10. Confined spaces such as tanks are tested to ensure that the atmosphere is not over ten percent of the lower flammable limit before cutting or welding in or on the tank.
11. Small tanks, piping, or containers that cannot be entered are cleaned, purged, and tested before cutting or welding on them begins.
12. Fire watch has been established.

E. Flammable and Combustible Materials

Responsible Person shall regularly evaluate the presence of combustible materials at ***Company Name*** (see Appendix D).

Certain types of substances can ignite at relatively low temperatures or pose a risk of catastrophic explosion if ignited. Such substances obviously require special care and handling.

1. Class A combustibles.

These include common combustible materials (wood, paper, cloth, rubber, and plastics) that can act as fuel and are found in non-specialized areas such as offices.

To handle Class A combustibles safely:

a. Dispose of waste daily.
b. Keep trash in metal-lined receptacles with tight-fitting covers (metal wastebaskets that are emptied every day do not need to be covered).
c. Keep work areas clean and free of fuel paths that could allow a fire to spread.
d. Keep combustibles away from accidental ignition sources, such as hot plates, soldering irons, or other heat- or spark-producing devices.
e. Store paper stock in metal cabinets.
f. Store rags in metal bins with self-closing lids.

g. Do not order excessive amounts of combustibles.
h. Make frequent inspections to anticipate fires before they start.

Water, multi-purpose dry chemical (ABC), and halon 1211 are approved fire extinguishing agents for Class A combustibles.

2. Class B combustibles.

These include flammable and combustible liquids (oils, greases, tars, oil-based paints, and lacquers), flammable gases, and flammable aerosols.

To handle Class B combustibles safely:

a. Use only approved pumps, taking suction from the top, to dispense liquids from tanks, drums, barrels, or similar containers (or use approved self-closing valves or faucets).
b. Do not dispense Class B flammable liquids into containers unless the nozzle and container are electrically interconnected by contact or by a bonding wire. Either the tank or container must be grounded.
c. Store, handle, and use Class B combustibles only in approved locations where vapors are prevented from reaching ignition sources such as heating or electric equipment, open flames, or mechanical or electric sparks.
d. Do not use a flammable liquid as a cleaning agent inside a building (the only exception is in a closed machine approved for cleaning with flammable liquids).
e. Do not use, handle, or store Class B combustibles near exits, stairs, or any other areas normally used as exits.
f. Do not weld, cut, grind, or use unsafe electrical appliances or equipment near Class B combustibles.
g. Do not generate heat, allow an open flame, or smoke near Class B combustibles.
h. Know the location of and how to use the nearest portable fire extinguisher rated for Class B fire.

Water should not be used to extinguish Class B fires caused by flammable liquids. Water can cause the burning liquid to spread, making the fire worse. To extinguish a fire caused by flammable liquids, exclude the air around the burning liquid. The following fire-extinguishing agents are approved for Class B combustibles: carbon dioxide, multi-purpose dry chemical (ABC), halon 1301, and halon 1211. (**NOTE:** Halon has been determined to be an ozone-depleting substance and is no longer being manufactured. Existing systems using halon can be kept in place.)

F. Smoking

Smoking is prohibited in all ***Company Name*** buildings. Certain outdoor areas may also be designated as no smoking areas. The areas in which smoking is prohibited outdoors are identified by NO SMOKING signs.

TRAINING

Responsible Person shall present basic fire prevention training to all employees upon employment, and shall maintain documentation of the training, which includes:

A. review of 29 CFR 1910.38, including how it can be accessed;
B. this Fire Prevention Plan, including how it can be accessed;
C. good housekeeping practices;
D. proper response and notification in the event of a fire;
E. instruction on the use of portable fire extinguishers (as determined by company policy in the Emergency Action Plan); and
F. recognition of potential fire hazards.

Supervisors shall train employees about the fire hazards associated with the specific materials and processes to which they are exposed, and will maintain documentation of the training. Employees will receive this training:

A. at their initial assignment;
B. annually; and
C. when changes in work processes necessitate additional training.

VII. PROGRAM REVIEW

Responsible Person shall review this Fire Prevention Plan at least annually for necessary changes.

Attachment A

Fire Risk Survey
<u>Company Name</u>
<u>Location</u>

Type of Fire Hazard	**Location**	**Emergency Actions**	**Required PPE**

Completed by:____________________________ Date:___________________

Attachment B

<u>Company Name</u>
General Fire Prevention Checklist

Use this checklist to ensure fire prevention measures conform with the general fire prevention requirements found in OSHA standards.

□ Yes □ No Is the local fire department acquainted with your facility, its location, and specific hazards?

□ Yes □ No If you have a fire alarm system, is it tested at least annually?

□ Yes □ No If you have interior stand pipes and valves, are they inspected regularly?

□ Yes □ No If you have outside private fire hydrants, are they on a routine preventive maintenance schedule and flushed at least once a year?

□ Yes □ No Are fire doors and shutters in good operating condition?

□ Yes □ No Are fire doors and shutters unobstructed and protected against obstructions, including their counterweights?

□ Yes □ No Are automatic sprinkler system water control valves, air pressure, and water pressure checked weekly or periodically?

□ Yes □ No Has responsibility for the maintenance of automatic sprinkler systems been assigned to an employee or contractor?

□ Yes □ No Are sprinkler heads protected by metal guards?

□ Yes □ No Is proper clearance maintained below sprinkler heads?

□ Yes □ No Are portable fire extinguishers provided in adequate number and type?*

□ Yes □ No Are fire extinguishers mounted in readily accessible locations?*

□ Yes □ No Are fire extinguishers recharged regularly with the recharge date noted on an inspection tag?*

□ Yes □ No Are employees periodically instructed in the use of extinguishers and fire protection procedures?*

*(NOTE: Use of fire extinguishers is based on company policy regarding employee fire fighting in your Emergency Action Plan and local fire code.)

Completed by:_________________________ Date:_________________

Attachment C

Company Name

Exits Checklist

Use this checklist to evaluate ***Company Name's*** compliance with OSHA's standard on emergency exit routes.

□ Yes □ No Is each exit marked with an exit sign and illuminated by a reliable light source?

□ Yes □ No Are the directions to exits, when not immediately apparent, marked with visible signs?

□ Yes □ No Are doors, passageways, or stairways that are neither exits nor access to exits, and which could be mistaken for exits, marked "NOT AN EXIT" or other appropriate marking?

□ Yes □ No Are exit signs provided with the word "EXIT" in letters at least five inches high and with lettering at least one inch wide?

□ Yes □ No Are exit doors side-hinged?

□ Yes Are all exits kept free of obstructions?

□ No

□ Yes Are there at least two exit routes provided from elevated platforms, pits, or rooms where the absence of a second exit would increase the risk of injury from hot, poisonous, corrosive, suffocating, flammable, or explosive substances?

□ No

□ Yes □ No Is the number of exits from each floor of a building and from the building itself appropriate for the building occupancy? (NOTE: Do not count revolving, sliding, or overhead doors when evaluating whether there are sufficient exits.)

□ Yes □ No Are exit stairways that are required to be separated from other parts of a building enclosed by at least one-hour fire-resistant walls (or at least two-hour fire-resistant walls in buildings over four stories high)?

□ Yes □ No Are the slopes of ramps used as part of emergency building exits limited to one foot vertical and 12 feet horizontal?

□ Yes □ No Are glass doors or storm doors fully tempered, and do they meet the safety requirements for human impact?

□ Yes □ No Can exit doors be opened from the direction of exit travel without the use of a key or any special knowledge or effort?

□ Yes □ No Are doors on cold storage rooms provided with an inside release mechanism that will release the latch and open the door even if it's padlocked or otherwise locked on the outside?

□ Yes □ No Where exit doors open directly onto any street, alley, or other area where vehicles may be operated, are adequate barriers and warnings provided to prevent employees from stepping into the path of traffic?

□ Yes □ No Are doors that swing in both directions and are located between rooms where there is frequent traffic equipped with glass viewing panels?

Completed by:___________________________ Date:___________________

Attachment D

Company Name

Flammable and Combustible Material Checklist

Use this checklist to evaluate ***Company Name's*** compliance with OSHA's standards on flammable and combustible materials:

□Yes □No	Are combustible scrap, debris, and waste materials such as oily rags stored in covered metal receptacles and removed from the worksite promptly?
□Yes □No	Are approved containers and tanks used for the storage and handling of flammable and combustible liquids?
□Yes □No	Are all connections on drums and combustible liquid piping vapor and liquid tight?
□Yes □No	Are all flammable liquids kept in closed containers when not in use?
□Yes □No	Are metal drums of flammable liquids electrically grounded during dispensing?
□Yes □No	Do storage rooms for flammable and combustible liquids have appropriate ventilation systems?
□Yes □No	Are NO SMOKING signs posted on liquefied petroleum gas tanks?
□Yes □No	Are all solvent wastes and flammable liquids kept in fire-resistant covered containers until they are removed from the worksite?
□Yes □No	Is vacuuming used whenever possible rather than blowing or sweeping combustible dust?
□Yes □No	Are fuel gas cylinders and oxygen cylinders separated by distances or fire-resistant barriers while in storage?
□Yes □No	Are fire extinguishers appropriate for the materials in the areas where they are mounted?*
□Yes □No	Are appropriate fire extinguishers mounted within 75 feet of outside areas containing flammable liquids and within 10 feet of any inside storage area for such materials?*
□Yes □No	Are extinguishers free from obstruction or blockage?*
□Yes □No	Are all extinguishers serviced, maintained, and tagged at least once a year?*
□Yes □No	Are all extinguishers fully charged and in their designated places?*
□Yes □No	Where sprinkler systems are permanently installed, are the nozzle heads directed or arranged so that water will not be sprayed into operating electrical switchboards and equipment?
□Yes □No	Are NO SMOKING signs posted in areas where flammable or combustible materials are used or stored?
□Yes □No	Are safety cans utilized for dispensing flammable or combustible liquids at the point of use?
□Yes □No	Are all spills of flammable or combustible liquids cleaned up promptly?
□Yes □No	Are storage tanks adequately vented to prevent the development of an excessive vacuum or pressure that could result from filling, emptying, or temperature changes?

*(NOTE: Use of fire extinguishers is based on company policy regarding employee fire fighting in your Emergency Action Plan and local fire code.)

Completed by:___________________________

Date:__________________

Hazard Communication Program

Table of Contents

Hazard Communication Program

Company Name

I. OBJECTIVE

The objective of this program is to set forth policies and procedures concerning Hazard Communications which will enhance the safety and well being of ***Company Name*** employees. Furthermore, execution of this program is designed to provide for compliance with the Occupational Safety and Health Administration's (OSHA) Hazard Communication Standard.

II. ASSIGNMENT OF RESPONSIBILITY

Responsible person will assume duties as Hazard Communication Officer. This position carries the responsibility of insuring this program is adhered to and that proper reporting is executed. It is encouraged that an alternate or back-up Hazard Communication Officer be assigned in case the primary is not available.

III. PROGRAM

The ensuing items are to be followed to insure both compliance with the OSHA Hazard Communication Standard and the safety of our employees.

A. Hazardous Chemical List

A list of the hazardous materials and chemicals, which are used in the course of the company's business activities, will be maintained and updated. This list is to include all substances which require a Material Safety Data Sheet (MSDS).

One copy of this list is to be kept in the front of each MSDS book and one copy is to be kept on file with the Hazard Communication Officer. For each chemical used in the workplace, an MSDS sheet must be available on that jobsite.

B. Material Safety Data Sheets (MSDS)

All Material Safety Data Sheets must be kept in an organized fashion and must be placed in an identified and accessible location for all employees to view at will. A duplicate set of MSDS information must be maintained by the Hazard Communication Officer.

MSDS books and the Hazardous Chemical List must be maintained and kept up to date. As obsolete MSDS's are replaced by updated copies, they must be retained in a separate file of obsolete MSDS's. Do not throw them away. It is encouraged, particularly for routinely used chemicals, that the correct MSDS be verified since the chemicals may have been reformulated, improved, or MSDS may have been updated.

If a hazardous chemical or substance is received without a proper MSDS, the receiving person must immediately notify the Hazard Communication Officer. The manufacturer or distributor of the product must be contacted immediately and asked to fax the MSDS and mail a copy as a follow up. If, for some reason, the manufacturer or distributor is unable to produce a MSDS upon request, the Hazard Communication Officer should be notified immediately. Hazardous materials or substances received without an MSDS are to be returned to the sender.

C. Labeling

Each container of a hazardous chemical that is used in or around the work area must be properly labeled with the identity of the hazardous material, the appropriate hazard warnings, and the name and address of the manufacturer. Appropriate labels must be on all containers, regardless of size. Containers must be approved and recommended for storage and/or dispensing of the particular hazardous chemicals contained in them.

Worn and torn labels must be replaced. It is the responsibility of employees to report inappropriate labels to their supervisor. It is the responsibility of the Hazard Communication Officer to insure that appropriate labels are in place and that replacement labels are available.

Portable containers of Hazardous Materials do not require labeling if they are transferred from labeled containers and are intended for immediate use by the employee who performs the transfer. It is encouraged that portable containers not immediately used will be emptied (and cleaned when necessary) within ____ hours.

D. Training

Employee training for this Hazard Communication Program consists of the following:

1. Each affected employee working for, or associated with, ***Company Name*** is required to review the training material with the Hazard Communication Officer and sign the acknowledgment form which will be placed in the employee's file. This training is to be done during the new employee orientation process before the new employee actually assumes status as an active employee. Employees will receive training on any new hazardous chemical/material introduced in to the work place before the chemical/material is used. In addition to this training, affected employees must be shown the locations of Material Safety Data Sheets, fire extinguishers, first aid kits, and usage and storage of hazardous materials.

2. Fire extinguisher training may be provided to designated employees. An acknowledgment form must be signed by the employee and filed for documentation purposes.

3. First Aid and CPR training will be provided as required in 29 CFR 1910.151. An acknowledgment form must be signed by the employee and filed for documentation purposes.

4. If the management of ***Company Name*** engages the services of contract labor personnel, and exposure to hazardous materials is possible, the contract laborers must be made aware of the locations of the Hazardous Chemical List and the MSDS information book.

E. Storage

All storage areas for hazardous substances are to be secured, properly ventilated, and identified by signs.

F. Non-Routine Tasks

Before any non-routine task is performed, employees shall be advised and/or they must contact ***Responsible Person*** for special precautions to follow and

Responsible Person shall inform any other personnel who could be exposed. (No non-routine tasks are known to exist at the time of preparation of this program.)

If a non-routine task is necessary, ***Responsible Person*** will provide the following information about the activity as it relates to the specific chemicals expected to be encountered:

1. specific chemical name(s) and hazard(s);
2. personal protective equipment required and safety measures to be taken;
3. measures that have been taken to lessen the hazards including ventilation, respirators, presence of other employees(s); and
4. emergency procedures.

G. Other Personnel Exposures (Contractors)

Responsible Person will provide other personnel or outside contractors with the following information as follows:

1. hazardous chemicals to which they may be exposed to while in the workplace;
2. measures to minimize the possibility of exposure;
3. location of the MSDS and labeling requirements for all hazardous chemicals; and
4. procedures to follow if they are exposed.

Responsible Person will contact each contractor before work is started to gather and disseminate any information concerning chemical hazards the contractor is bringing into the workplace, and visa versa.

H. Program Compliance

Any direct or intentional violation or non-compliance with this program may result in the termination of the person or persons involved, in accordance with company policy.

ATTACHMENT A

Acknowledgement of Receipt of Hazard Communication Training

My signature below acknowledges that I have received training concerning Hazard Communications. I understand that this training fulfills the employee training requirement of OSHA's Hazard Communication Standard.

The jobsite and classroom training included the following:

1. Understanding the purpose and scope of the OSHA Hazard Communication Standard.

2. Explanation of the existence of federal, state and local right-to-know laws.

3. Definition of the classification "hazardous chemical".

4. Explanation of situations and elements that must be present for a material to be considered a health hazard.

5. Explanation and interpretation of labels, what is required on all containers, and the Hazard Materials Identification System (HMIS).

6. Understanding and interpretation of Material Safety Data Sheets (MSDS), which must be obtained for each hazardous chemical.

7. My responsibilities as an employee of ***Company Name***.

8. Policies and procedures to follow in case of exposure.

EMPLOYEE NAME (Please print)

EMPLOYEE SIGNATURE DATE

COMPANY REPRESENTATIVE DATE

ATTACHMENT B

SAMPLE INDEX/INVENTORY

INDEX NUMBER	PRODUCT	DATE INTRODUCED	DATE DISCONTINUED
1	**Clorox** **USE:** Disinfection Janitorial Staff **Trained:** Jill Smith 04-15-2000 Janet Tide 04-15-2000 Frank Jay 07-11-2000	04-15-1999	
2	**WD40** **USE:** Lubricant Maintenance **Trained:** Henry Late 04-14-2000	4-12-1998	10-01-2000

Hearing Conservation Program

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Hearing Conservation Program

for
(Company Name)

OBJECTIVE

The objective of the ***(COMPANY NAME)*** Hearing Conservation Program is to minimize occupational hearing loss by providing hearing protection, training, and annual hearing tests to all persons working in areas or with equipment that have noise levels equal to or exceeding an eight-hour time-weighted average (TWA) sound limit of 85 dBA (decibels measured on the A scale of a sound level meter). A copy of this program will be maintained by all affected departments. A copy of OSHA's Hearing Conservation Standard, 29 CFR 1910.95, can be obtained from ***Responsible Person***. A copy of the standard will also be posted in areas with affected employees.

ASSIGNMENT OF RESPONSIBILITY

Management

Use engineering and administrative controls to limit employee exposure.
Provide adequate hearing protection for employees.
Post signs and warnings in all high noise areas.

Conduct noise surveys annually or when new equipment is needed.
Conduct annual hearing test for all employees.
Conduct hearing conservation training for all new employees.
Conduct annual hearing conservation training for all employees.

Employees

Use company-issue approved hearing protection in designated high noise areas.
Request new hearing protection when needed.
Exercise proper care of issued hearing protection.

PROCEDURES

Noise Monitoring

Monitoring for noise exposure levels will be conducted by ***Responsible Person***. It is the responsibility of the individual departments to notify ***Responsible Person*** when there is a possible need for monitoring. Monitoring will be performed with the use of sound level meters and personal dosimeters at the discretion of ***Responsible Person***.

Monitoring will also be conducted whenever there is a change in equipment, process or controls that affect the noise levels. This includes the addition or removal of machinery, alteration in building structure, or substitution of new equipment in place of that previously used. The responsible supervisor must inform ***Responsible Person*** when these types of changes are instituted.

Employee Training

Affected employees will be required to attend training concerning the proper usage and wearing of hearing protection. The training will be conducted by ***Responsible Person***, or a designated representative, within a month of hire and annually thereafter.

Training shall consist of the following components:

how noise affects hearing and hearing loss;
review of the OSHA hearing protection standard;
explanation of audiometric testing;
rules and procedures;
locations within company property where hearing protection is required; and
how to use and care for hearing protectors.

Training records will be maintained by ***Responsible Person*** (see Attachment A).

Hearing Protection

Management, supervisors, and employees shall properly wear the prescribed hearing protection while working or traveling through any area that is designated as a high noise area.

Hearing protection will be provided at no cost to employees who perform tasks designated as having a high noise exposure and replaced as necessary. It is the supervisor's responsibility to require employees to wear hearing protection when noise levels reach or exceed 85 dBA. Those employees will have the opportunity to choose from at least two different types of hearing protection.

Personal stereo headsets, or "Walkmen," are not approved for hearing protection and are not permitted in any operating area of company property.

Signage is required in areas that necessitate hearing protection. It is the responsibility of ***Responsible Person*** to provide signage to the appropriate areas.

Preformed earplugs and earmuffs should be washed periodically and stored in a clean area. Foam inserts should be discarded after each use. Hands should be washed before handling preformed earplugs and foam inserts to prevent contaminants from being placed in the ear.

Responsible person will keep a log of the areas or job tasks designated as requiring hearing protection, as well as the personnel affected by this Hearing Conservation Program (see Attachment B).

Audiograms/Hearing Tests

Employees subject to the Hearing Conservation Program who have time-weighted average (TWA) noise exposures of 85 dBA or greater for an eight (8) hour work shift will be required to have both a baseline and annual audiogram. The audiograms will be provided by the ***Company Name*** and conducted by ***Responsible Company*** with no cost to the employee.

The baseline audiogram will be given to an employee within one (1) month of employment with ***Company Name*** and before any exposure to high noise levels. Annual audiograms will be performed within one year from the date of the previous audiogram. It is the responsibility of the individual and ***Responsible person*** to schedule the annual audiogram.

If an annual audiogram shows that an employee has suffered a standard threshold shift, the employee will be retested within thirty (30) days of the annual audiogram. If the retest confirms the occurrence of a standard threshold shift, the employee will be notified in writing within twenty-one (21) days of the confirmation. Employees who do experience a standard threshold shift will be refitted with hearing protection and provided more training on the effects of noise.

Attachment A
Hearing Conservation Training Log

Training Date:__________________________________

Topic:____

Training Conducted by:__________________________

Employee Name (printed)	Employee Signature	Job Title

Attachment B

Record of Hearing Protection Needs

Company Name **Personnel in Hearing Conservation Program** ***Date***				
Hearing protection is required for and has been issued to the following personnel:				
Employee Name	**Department**	**Job Description/ Equipment Being Used**	**Type of Hearing Protection Issued**	**Date Issued**

The Control of Hazardous Energy (Lockout/Tagout) Procedure

Table of Contents

Lockout/Tagout Procedure

Company Name

I. OBJECTIVE

The objective of this procedure is to establish a means of positive control to prevent the accidental starting or activating of machinery or systems while they are being repaired, cleaned and/or serviced. This program serves to:

A. Establish a safe and positive means of shutting down machinery, equipment and systems.
B. Prohibit unauthorized personnel or remote control systems from starting machinery or equipment while it is being serviced.

C. Provide a secondary control system (tagout) when it is impossible to positively lockout the machinery or equipment.
D. Establish responsibility for implementing and controlling lockout/tagout procedures.
E. Ensure that only approved locks, standardized tags and fastening devices provided by the company will be utilized in the lockout/tagout procedures.

II. ASSIGNMENT OF RESPONSIBILITY

A. ***Responsible Person*** will be responsible for implementing the lockout/tagout program.

B. ***Responsible Persons*** are responsible for enforcing the program and insuring compliance with the procedures in their departments.

C. ***Responsible Person*** is responsible for monitoring the compliance of this procedure and will conduct the annual inspection and certification of the authorized employees.

D. ***Authorized employees*** (those listed in Attachment A) are responsible for following established lockout/tagout procedures. An authorized employee is defined as a person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under 1910.147, The Control of Hazardous Energy (lockout/tagout).

E. ***Affected employees*** (all other employees in the facility) are responsible for insuring they do not attempt to restart or re-energize machines or equipment that are locked out or tagged out. An affected employee is defined as a person whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

III. PROCEDURES

The ensuing items are to be followed to ensure both compliance with the OSHA Control of Hazardous Energy Standard and the safety of our employees.

A. Preparation for Lockout or Tagout

Employees who are required to utilize the lockout/tagout procedure (see Attachment A) must be knowledgeable of the different energy sources and the proper sequence of shutting off or disconnecting energy means. The four types of energy sources are:

1. electrical (most common form);
2. hydraulic or pneumatic;
3. fluids and gases; and
4. mechanical (including gravity).

More than one energy source may be utilized on some equipment and the proper procedure must be followed in order to identify energy sources and lockout/tagout accordingly. See Attachment F for specific procedure format.

Electrical

1. Shut off power at machine and disconnect.
2. Disconnecting means must be locked or tagged.
3. Press start button to see that correct systems are locked out.
4. All controls must be returned to their safest position.
5. Points to remember:
   a. If a machine or piece of equipment contains capacitors, they must be drained of stored energy.
   b. Possible disconnecting means include the power cord, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit, relays, limit switches, and electrical interlocks.
   c. Some equipment may have a motor isolating shut-off and a control isolating shut-off.
   d. If the electrical energy is disconnected by simply unplugging the power cord, the cord must be kept under the control of the authorized employee or the plug end of the cord must be locked out or tagged out.

Hydraulic/Pneumatic

1. Shut off all energy sources (pumps and compressors). If the pumps and compressors supply energy to more than one piece of equipment, lockout or tagout the valve supplying energy to the piece of equipment being serviced.
2. Stored pressure from hydraulic/pneumatic lines shall be drained/bled when release of stored energy could cause injury to employees.
3. Make sure controls are returned to their safest position (off, stop, standby, inch, jog, etc.).

Fluids and Gases

1. Identify the type of fluid or gas and the necessary personal protective equipment.
2. Close valves to prevent flow, and lockout/tagout.
3. Determine the isolating device, then close and lockout/tagout.
4. Drain and bleed lines to zero energy state.

Some systems may have electrically controlled valves. If so, they must be shut off and locked/tagged out.

6. Check for zero energy state at the equipment.

Mechanical Energy

Mechanical energy includes gravity activation, energy stored in springs, etc.

1. Block out or use die ram safety chain.
2. Lockout or tagout safety device.
3. Shut off, lockout or tagout electrical system.
4. Check for zero energy state.
5. Return controls to safest position.

Release from Lockout/Tagout

1. Inspection: Make certain the work is completed and inventory the tools and equipment that were used.
2. Clean-up: Remove all towels, rags, work-aids, etc.
3. Replace guards: Replace all guards possible. Sometimes a particular guard may have to be left off until the start sequence is over due to possible adjustments. However, all other guards should be put back into place.
4. Check controls: All controls should be in their safest position.
5. The work area shall be checked to ensure that all employees have been safely positioned or removed and notified that the lockout/tagout devices are being removed.
6. Remove locks/tags. Remove only your lock or tag.

Service or Maintenance Involving More than One Person

When servicing and/or maintenance is performed by more than one person, each authorized employee shall place his own lock or tag on the energy isolating source. This shall be done by utilizing a multiple lock scissors clamp if the equipment is capable of being locked out. If the equipment cannot be locked out, then each authorized employee must place his tag on the equipment.

Removal of an Authorized Employee's Lockout/Tagout by the Company

Each location must develop written emergency procedures that comply with 1910.147(e)(3) to be utilized at that location. Emergency procedures for removing lockout/tagout should include the following:

1. Verification by employer that the authorized employee who applied the device is not in the facility.

2. Make reasonable efforts to advise the employee that his/her device has been removed. (This can be done when he/she returns to the facility).
3. Ensure that the authorized employee has this knowledge before he/she resumes work at the facility.

Shift or Personnel Changes

Each facility must develop written procedures based on specific needs and capabilities. Each procedure must specify how the continuity of lockout or tagout protection will be ensured at all times.

Procedures for Outside Personnel/Contractors

Outside personnel/contractors shall be advised that the company has and enforces the use of lockout/tagout procedures. They will be informed of the use of locks and tags and notified about the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

The company will obtain information from the outside personnel/contractor about their lockout/tagout procedures and advise affected employees of this information.

The outside personnel/contractor will be required to sign a certification form (see Attachment E). If outside personnel/contractor has previously signed a certification that is on file, additional signed certification is not necessary.

K. Training and Communication

Each authorized employee who will be utilizing the lockout/tagout procedure will be trained in the recognition of applicable hazardous energy sources, type and magnitude of energy available in the work place, and the methods and means necessary for energy isolation and control.

Each affected employee (all employees other than authorized employees utilizing the lockout/tagout procedure) shall be instructed in the purpose and use of the lockout/tagout procedure, and the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

Training will be certified using Attachment B (Authorized Personnel) or Attachment C (Affected Personnel). The certifications will be retained in the employee personnel files.

L. Periodic Inspection

A periodic inspection (at least annually) will be conducted of each authorized employee under the lockout/tagout procedure. This inspection shall be performed by the ***(Responsible person)***. If ***(Responsible person)*** is also using the energy control procedure being inspected, then the inspection shall be performed by another party.

The inspection will include a review between the inspector and each authorized employee of that employee's responsibilities under the energy control (lockout/tagout) procedure. The inspection will also consist of a physical inspection of the authorized employee while performing work under the procedures.

The ***(Responsible person)*** shall certify in writing that the inspection has been performed. The written certification (Attachment D) shall be retained in the individual's personnel file.

ATTACHMENT A

List of Authorized Personnel

for

Lockout/Tagout Procedures

NAME	JOB TITLE
______________________________	____________________________
______________________________	____________________________
______________________________	____________________________
______________________________	____________________________

ATTACHMENT B

Certification of Training

(Authorized Personnel)

I certify that I received training as an authorized employer under ***Company Name*** Lockout/Tagout program. I further certify that I understand the procedures and will abide by those procedures.

_______________________________________ ______________

AUTHORIZED EMPLOYEE SIGNATURE DATE

ATTACHMENT C

Certification of Training
(Affected Personnel)

I certify that I received training as an Affected Employee under ***Company Name*** Lockout/Tagout Program. I further certify and understand that I am prohibited from attempting to restart or re-energize machines or equipment that are locked out or tagged out.

______________________________ ____________

AUTHORIZED EMPLOYEE SIGNATURE DATE

ATTACHMENT D

Lockout/Tagout Inspection Certification

I certify that ***Equipment*** was inspected on this date utilizing lockout/tagout procedures. The inspection was performed while working on ***Equipment*** .

______________________________ ____________

AUTHORIZED EMPLOYEE SIGNATURE DATE

______________________________ ____________

INSPECTOR SIGNATURE DATE

ATTACHMENT E

Outside Personnel/Contractor Certification

I certify that ___________________________ and (outside personnel/contractor) have informed each other of our respective lockout/tagout procedures.

___________________________________	_____________
AUTHORIZED EMPLOYEE SIGNATURE	DATE
___________________________________	_____________
INSPECTOR SIGNATURE	DATE

ATTACHMENT F

Equipment Specific Procedure

for

<u>Company Name</u>

(Date)

<u>Machine Identification</u>

General Description:

____

____

Manufacturer:

____

____

Model Number:

____

Serial Number:*

____

____

** If more than one piece of same equipment, list all serial numbers.*

Location of equipment:

____

____

Operator Controls

The types of controls available to the operator need to be determined. This should help identify energy sources and lockout capacity for the equipment.

List types of operator controls: ____

____

____

____

____

____

____

____

____

____

Energy Sources

The energy sources, such as electrical, steam, hydraulic, pneumatic, natural gas, stored energy, etc.) present on this equipment are:

ENERGY SOURCE	LOCATION	Lockable Yes	No	Type lock or block needed

Shutdown Procedures

List the steps in order necessary to shut down and de-energize the equipment. Be specific. For stored energy, be specific about how the energy will be dissipated or restrained.

Procedure: ____
____

Lock Type & Location: ____
____

How Will De-energized State Be Verified? ____
____
____
____
____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Start Up Procedures

List the steps in order necessary to reactivate (energize) the equipment. Be specific.

Procedure: ____
____
____
____

Energy Source Activated:

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Procedures For Operations and Service/Maintenance

List those operations where the procedures above do not apply [See 29 CFR 1910.147 (a)(2)]. Alternate measures which provide effective protection must be developed for these operations. Job Safety Analysis is one method of determining appropriate measures.

Operation Name:

Affected and Authorized Employees

List each person affected by this procedure and those authorized to use this procedure.

AFFECTED EMPLOYEES	
Name	**Job Title**

AUTHORIZED EMPLOYEES	
Name	**Job Title**

Approved by Date

Respiratory Protection

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Respiratory Protection Program

I. OBJECTIVE

The ***Company Name*** Respiratory Protection Program is designed to protect employees by establishing accepted practices for respirator use, providing guidelines for training and respirator selection, and explaining proper storage, use and care of respirators. This program also serves to help the company and its employees comply with Occupational Safety and Health Administration (OSHA) respiratory protection requirements as found in 29 CFR 1910.134.

II. ASSIGNMENT OF RESPONSIBILITY

A. Employer

Company Name is responsible for providing respirators to employees when they are necessary for health protection. ***Company Name*** will provide respirators that are applicable and suitable for the intended purpose at no charge to affected employees. Any expense associated with training, medical evaluations and respiratory protection equipment will be borne by the company.

B. Program Administrator

The Program Administrator for ***____(Company Name)_______*** is ***_(Responsible Person)____***. The Program Administrator is responsible for administering the respiratory protection program. Duties of the program administrator include:

1. Identifying work areas, process or tasks that require workers to wear respirators.
2. Evaluating hazards.
3. Selecting respiratory protection options.
4. Monitoring respirator use to ensure that respirators are used in accordance with their specifications.
5. Arranging for and/or conducting training.
6. Ensuring proper storage and maintenance of respiratory protection equipment.
7. Conducting qualitative fit testing with Bitrex.
8. Administering the medical surveillance program.
9. Maintaining records required by the program.
10. Evaluating the program.
11. Updating written program, as needed.

C. Supervisors

Supervisors are responsible for ensuring that the respiratory protection program is implemented in their particular areas. In addition to being knowledgeable about the program requirements for their own protection, supervisors must also ensure that the program is understood and followed by the employees under their charge. Duties of the supervisor include:

1. Ensuring that employees under their supervision (including new hires) receive appropriate training, fit testing, and annual medical evaluation.
2. Ensuring the availability of appropriate respirators and accessories.
3. Being aware of tasks requiring the use of respiratory protection.
4. Enforcing the proper use of respiratory protection when necessary.
5. Ensuring that respirators are properly cleaned, maintained, and stored according to this program.
6. Ensuring that respirators fit well and do not cause discomfort.
7. Continually monitoring work areas and operations to identify respiratory hazards.
8. Coordinating with the Program Administrator on how to address respiratory hazards or other concerns regarding this program.

D. Employees

Each employee is responsible for wearing his or her respirator when and where required and in the manner in which they are trained. Employees must also:

1. Care for and maintain their respirators as instructed, guard them against damage, and store them in a clean, sanitary location.
2. Inform their supervisor if their respirator no longer fits well, and request a new one that fits properly.
3. Inform their supervisor or the Program Administrator of any respiratory hazards that they feel are not adequately addressed in the workplace and of any other concerns that they have regarding this program.
4. Use the respiratory protection in accordance with the manufacturer's instructions and the training received.

III. APPLICABILITY

This program applies to all employees who are required to wear respirators during normal work operations, as well as during some non-routine or emergency operations, such as a spill of a hazardous substance.

In addition, any employee who voluntarily wears a respirator when one is not required (i.e., in certain maintenance and coating operations) is subject to the medical evaluation, cleaning, maintenance, and storage elements of this program, and will be provided with necessary training. Employees who voluntarily wear filtering face pieces (dust masks) are not subject to the medical evaluation, cleaning, storage, and maintenance provisions of this program.

All employees and processes that fall under the provisions of this program are listed in Attachment D.

IV. PROGRAM

A. Hazard Assessment and Respirator Selection

The Program Administrator will select respirators to be used on site, based on the hazards to which workers are exposed and in accordance with the OSHA Respiratory Protection Standard. The Program Administrator will conduct a hazard evaluation for each operation, process, or work area where airborne contaminants may be present in routine operations or during an emergency. A log of identified hazards will be maintained by the Program Administrator (See Sample Hazard Evaluation, Attachment C). The hazard evaluations shall include:

1. Identification and development of a list of hazardous substances used in the workplace by department or work process.
2. Review of work processes to determine where potential exposures to hazardous substances may occur. This review shall be conducted by surveying the workplace, reviewing the process records, and talking with employees and supervisors.
3. Exposure monitoring to quantify potential hazardous exposures.

The proper type of respirator for the specific hazard involved will be selected in accordance with the manufacturer=s instructions. A list of employees and appropriate respiratory protection will be maintained by the Program Administrator (see Attachment D).

B. Updating the Hazard Assessment

The Program Administrator must revise and update the hazard assessment as needed (i.e., any time work process changes may potentially affect exposure). If an employee feels that respiratory protection is needed during a particular activity, he/she is to contact his/her supervisor or the Program Administrator. The Program Administrator will evaluate the potential hazard, and arrange for outside assistance as necessary. The Program Administrator will then communicate the results of that assessment to the employees. If it is determined that respiratory protection is necessary, all other elements of the respiratory protection program will be in effect for those tasks, and the respiratory program will be updated accordingly.

C. Training

The Program Administrator will provide training to respirator users and their supervisors on the contents of the ***Company Name*** Respiratory Protection Program and their responsibilities under it, and on the OSHA Respiratory Protection Standard. All affected employees and their supervisors will be trained prior to using a respirator in the workplace. Supervisors will also be trained prior to supervising employees that must wear respirators.

The training course will cover the following topics:

1. the ***Company Name*** Respiratory Protection Program;
2. the OSHA Respiratory Protection Standard (29 CFR 1910.134);
3. respiratory hazards encountered at ***Company Name*** and their health affects;
4. proper selection and use of respirators;
5. limitations of respirators;
6. respirator donning and user seal (fit) checks;
7. fit testing;
8. emergency use procedures;
9. maintenance and storage; and
10. medical signs and symptoms limiting the effective use of respirators.

Employees will be retrained annually or as needed (e.g., if they change departments or work processes and need to use a different respirator). Employees must demonstrate their understanding of the topics covered in the training through hands-on exercises and a written test. Respirator training will be documented by the Program Administrator and the documentation will include the type, model, and size of respirator for which each employee has been trained and fit tested.

D. NIOSH Certification

All respirators must be certified by the National Institute for Occupational Safety and Health (NIOSH) and shall be used in accordance with the terms of that certification. Also, all filters, cartridges, and canisters must be labeled with the appropriate NIOSH approval label. The label must not be removed or defaced while the respirator is in use.

E. Voluntary Respirator Use

The Program Administrator shall authorize voluntary use of respiratory protective equipment as requested by all other workers on a case-by-case basis, depending on specific workplace conditions and the results of medical evaluations.

The Program Administrator will provide all employees who voluntarily choose to wear the above respirators with a copy of Appendix D of the OSHA Respiratory Protection Standard. (Appendix D details the requirements for voluntary use of respirators by employees.) Employees who choose to wear a half face piece APR must comply with the procedures for Medical Evaluation, Respirator Use, Cleaning, Maintenance and Storage portions of this program.

F. Medical Evaluation

Employees who are either required to wear respirators, or who choose to wear a half face piece APR voluntarily, must pass a medical exam provided by ***Company Name*** before being permitted to wear a respirator on the job. Employees are not permitted to wear respirators until a physician has determined that they are medically able to do so. Any employee refusing the medical evaluation will not be allowed to work in an area requiring respirator use.

A licensed physician at ______***(LOCATION OF DOCTOR)***____, where all company medical services are provided, will provide the medical evaluations. Medical evaluation procedures are as follows:

1. The medical evaluation will be conducted using the questionnaire provided in Appendix C of the OSHA Respiratory Protection Standard. The Program

Administrator will provide a copy of this questionnaire to all employees requiring medical evaluations.

2. To the extent feasible, the company will provide assistance to employees who are unable to read the questionnaire. When this is not possible, the employee will be sent directly to the physician for medical evaluation.
3. All affected employees will be given a copy of the medical questionnaire to complete, along with a stamped and addressed envelope for mailing the questionnaire to the company physician. Employees will be permitted to complete the questionnaire on company time.
4. Follow-up medical exams will be granted to employees as required by the Standard, and/or as deemed necessary by the evaluating physician.
5. All employees will be granted the opportunity to speak with the physician about their medical evaluation, if they so request.
6. The Program Administrator shall provide the evaluating physician with a copy of this Program, a copy of the OSHA Respiratory Protection Standard, the list of hazardous substances by work area, and the following information about each employee requiring evaluation:

    a. his or her work area or job title;
    b. proposed respirator type and weight;
    c. length of time required to wear respirator;
    d. expected physical work load (light, moderate or heavy);
    e. potential temperature and humidity extremes; and
    f. any additional protective clothing required.

7. Positive pressure air purifying respirators will be provided to employees as required by medical necessity.
8. After an employee has received clearance to wear his or her respirator, additional medical evaluations will be provided under the following circumstances:

    a. The employee reports signs and/or symptoms related to their ability to use the respirator, such as shortness of breath, dizziness, chest pains or wheezing.
    b. The evaluating physician or supervisor informs the Program Administrator that the employee needs to be reevaluated.
    c. Information found during the implementation of this program, including observations made during the fit testing and program evaluation, indicates a need for reevaluation.
    d. A change occurs in workplace conditions that may result in an increased physiological burden on the employee.

A list of ***Company Name*** employees currently included in medical surveillance is provided in Attachment D of this program.

All examinations and questionnaires are to remain confidential between the employee and the physician. The Program Administrator will only retain the physician=s written recommendations regarding each employee=s ability to wear a respirator.

G. Fit Testing

Employees who are required to or who voluntarily wear half-face piece APRs will be fit tested:

1. prior to being allowed to wear any respirator with a tight-fitting face piece;
2. annually; or
3. when there are changes in the employee’s physical condition that could affect respiratory fit (e.g., obvious change in body weight, facial scarring, etc.).

Employees will be fit tested with the make, model, and size of respirator that they will actually wear. Employees will be provided with several models and sizes of respirators so that they may find an optimal fit. Fit testing of powered air purifying respirators will be conducted in the negative pressure mode.

The Program Administrator will conduct fit tests in accordance with the OSHA Respiratory Protection Standard.

H. General Respirator Use Procedures

1. Employees will use their respirators under conditions specified in this program, and in accordance with the training they receive on the use of each particular model. In addition, the respirator shall not be used in a manner for which it is not certified by NIOSH or by its manufacturer.

2. All employees shall conduct user seal checks each time they wear their respirators. Employees shall use either the positive or negative pressure check (depending on which test works best for them) as specified in the OSHA Respiratory Protection Standard.

    a. Positive Pressure Test: This test is performed by closing off the exhalation valve with your hand. Breathe air into the mask. The face fit is satisfactory if some pressure can be built up inside the mask without any air leaking out between the mask and the face of the wearer.

   b. Negative Pressure Test: This test is performed by closing of the inlet openings of the cartridge with the palm of you hand. Some masks may require that the filter holder be removed to seal off the intake valve. Inhale gently so that a vacuum occurs within the face piece. Hold your breath for ten (10) seconds. If the vacuum remains, and no inward leakage is detected, the respirator is fit properly.

3. All employees shall be permitted to leave the work area to go to the locker room to maintain their respirator for the following reasons:

   a. to clean their respirator if it is impeding their ability to work;
   b. to change filters or cartridges;
   c. to replace parts; or
   d. to inspect respirator if it stops functioning as intended.

   Employees should notify their supervisor before leaving the area.

4. Employees are not permitted to wear tight-fitting respirators if they have any condition, such as facial scars, facial hair, or missing dentures, that would prevent a proper seal. Employees are not permitted to wear headphones, jewelry, or other items that may interfere with the seal between the face and the face piece.

5. Before and after each use of a respirator, an employee or immediate supervisor must make an inspection of tightness or connections and the condition of the face piece, headbands, valves, filter holders and filters. Questionable items must be addressed immediately by the supervisor and/or Program Administrator.

I. Air Quality

For supplied-air respirators, only Grade D breathing air shall be used in the cylinders. The Program Administrator will coordinate deliveries of compressed air with the company's vendor and will require the vendor to certify that the air in the cylinders meets the specifications of Grade D breathing air.

The Program Administrator will maintain a minimum air supply of one fully charged replacement cylinder for each SAR unit. In addition, cylinders may be recharged as necessary from the breathing air cascade system located near the respirator storage area.

J. Change Schedules

Respirator cartridges shall be replaced as determined by the Program Administrator, supervisor(s), and manufacturers= recommendations.

K. Cleaning

Respirators are to be regularly cleaned and disinfected at the designated respirator cleaning station. Respirators issued for the exclusive use of an employee shall be cleaned as often as necessary. Atmosphere-supplying and emergency use respirators are to be cleaned and disinfected after each use.

The following procedure is to be used when cleaning and disinfecting reusable respirators:

1. Disassemble respirator, removing any filters, canisters, or cartridges.
2. Wash the face piece and all associated parts (except cartridges and elastic headbands) in an approved cleaner-disinfectant solution in warm water (about 120 degrees Fahrenheit). Do not use organic solvents. Use a hand brush to remove dirt.
3. Rinse completely in clean, warm water.
4. Disinfect all facial contact areas by spraying the respirator with an approved disinfectant.
5. Air dry in a clean area.
6. Reassemble the respirator and replace any defective parts. Insert new filters or cartridges and make sure the seal is tight.
7. Place respirator in a clean, dry plastic bag or other airtight container.

The Program Administrator will ensure an adequate supply of appropriate cleaning and disinfection materials at the cleaning station. If supplies are low, employees should notify their supervisor, who will inform the Program Administrator.

L. Maintenance

Respirators are to be properly maintained at all times in order to ensure that they function properly and protect employees adequately. Maintenance involves a thorough visual inspection for cleanliness and defects. Worn or deteriorated parts will be replaced prior to use. No components will be replaced or repairs made beyond those recommended by the manufacturer. Repairs to regulators or alarms of atmosphere-supplying respirators will be conducted by the manufacturer.

1. All respirators shall be inspected routinely before and after each use.

2. Respirators kept for emergency use shall be inspected after each use, and at least monthly by the Program Administrator to assure that they are in satisfactory working order

3. The Respirator Inspection Checklist (Attachment E) will be used when inspecting respirators.

4. A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

5. Employees are permitted to leave their work area to perform limited maintenance on their respirator in a designated area that is free of respiratory hazards. Situations when this is permitted include:

    a. washing face and respirator face piece to prevent any eye or skin irritation;
    b. replacing the filter, cartridge or canister;
    c. detection of vapor or gas breakthrough or leakage in the face piece; or
    d. detection of any other damage to the respirator or its components.

M. Storage

After inspection, cleaning, and necessary repairs, respirators shall be stored appropriately to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals.

1. Respirators must be stored in a clean, dry area, and in accordance with the manufacturer's recommendations. Each employee will clean and inspect their own air-purifying respirator in accordance with the provisions of this program, and will store their respirator in a plastic bag in the designated area. Each employee will have his/her name on the bag and that bag will only be used to store that employee's respirator.
2. Respirators shall be packed or stored so that the face piece and exhalation valve will rest in a near normal position.

3. Respirators shall not be placed in places such as lockers or toolboxes unless they are in carrying cartons.

4. Respirators maintained at stations and work areas for emergency use shall be stored in compartments built specifically for that purpose, be quickly accessible at all times, and be clearly marked.

5. The Program Administrator will store ***Company Name's*** supply of respirators and respirator components in their original manufacturer's packaging in the ***Designated Area***.

N. Respirator Malfunctions and Defects

1. For any malfunction of an ASR (atmosphere-supplying respirator), such as breakthrough, face piece leakage, or improperly working valve, the respirator wearer should inform his/her supervisor that the respirator no longer functions as intended, and go to the designated safe area to maintain the respirator. The supervisor must ensure that the employee either receives the needed parts to repair the respirator or is provided with a new respirator.

   All workers wearing atmosphere-supplying respirators will work with a buddy. The Program Administrator shall develop and inform employees of the procedures to be used when a buddy is required to assist a coworker who experiences an ASR malfunction.

2. Respirators that are defective or have defective parts shall be taken out of service immediately. If, during an inspection, an employee discovers a defect in a respirator, he/she is to bring the defect to the attention of his/her supervisor. Supervisors will give all defective respirators to the Program Administrator. The Program Administrator will decide whether to:

   a. temporarily take the respirator out of service until it can be repaired;
   b. perform a simple fix on the spot, such as replacing a head strap; or
   c. dispose of the respirator due to an irreparable problem or defect.

   When a respirator is taken out of service for an extended period of time, the respirator will be tagged out of service, and the employee will be given a replacement of a similar make, model, and size. All tagged out respirators will be kept in the ***Designated Area***.

O. Emergency Procedures

In emergency situations where an atmosphere exists in which the wearer of the respirator could be overcome by a toxic or oxygen-deficient atmosphere, the following procedure should be followed. The locations in ***Company Name*** where the potential for dangerous atmosphere exists are listed in Attachment F of this procedure. Locations of emergency respirators are also listed in Attachment F.

1. When the alarm sounds, employees in the affected area must immediately don their emergency escape respirator, shut down their process equipment, and exit the work area.

2. All other employees must immediately evacuate the building. ***Company Name's*** Emergency Action Plan describes these procedures (including proper evacuation routes and rally points) in greater detail.

3. Employees who must remain in a dangerous atmosphere must take the following precautions:

    a. Employees must never enter a dangerous atmosphere without first obtaining the proper protective equipment and permission to enter from the Program Administrator or supervisor.
    b. Employees must never enter a dangerous atmosphere without at least one additional person present. The additional person must remain in the safe atmosphere.
    c. Communications (voice, visual or signal line) must be maintained between both individuals or all present.
    d. Respiratory protection in these instances is for escape purposes only. ***Company Name*** employees are not trained as emergency responders, and are not authorized to act in such a manner.

P. Program Evaluation

The Program Administrator will conduct periodic evaluations of the workplace to ensure that the provisions of this program are being implemented. The evaluations will include regular consultations with employees who use respirators and their supervisors, site inspections, air monitoring and a review of records. Items to be considered will include:

1. comfort;
2. ability to breathe without objectionable effort;
3. adequate visibility under all conditions
4. provisions for wearing prescription glasses;
5. ability to perform all tasks without undue interference; and
6. confidence in the face piece fit.

Identified problems will be noted in an inspection log and addressed by the Program Administrator. These findings will be reported to ***(Company Name)*** management, and the report will list plans to correct deficiencies in the respirator program and target dates for the implementation of those corrections.

Q. Documentation and Recordkeeping

1. A written copy of this program and the OSHA Respiratory Protection Standard shall be kept in the Program Administrator’s office and made available to all employees who wish to review it.

2. Copies of training and fit test records shall be maintained by the Program Administrator. These records will be updated as new employees are trained, as existing employees receive refresher training, and as new fit tests are conducted

3. For employees covered under the Respiratory Protection Program, the Program Administrator shall maintain copies of the physician’s written recommendation regarding each employee’s ability to wear a respirator. The completed medical questionnaires and evaluating physician’s documented findings will remain confidential in the employee’s medical records at the location of the evaluating physician’s practice.

ATTACHMENT A

Sample Hazard Assessment Log

Hazard Assessment Log ***DATE***				
Department	**Contaminants**	**Exposure Level (8 hr TWA*)**	**PEL****	**Controls**

* Summarized from Industrial Hygiene report provided by ***Responsible Person***.

** These values were obtained from a survey on average exposures as published in the American Journal of Industrial Hygiene ________________________.

ATTACHMENT B

Sample Record of Respirator Use

Required and Voluntary Respirator Use at *(Company Name)*	
Type of Respirator	**Department/Process**
Filtering face piece (dust mask)	Voluntary use for warehouse workers
Half-face piece APR or PAPR with P100 filter	Prep and Assembly Voluntary use for maintenance workers when cleaning spray booth walls or changing spray booth filter
SAR, pressure demand, with auxiliary SCBA	Maintenance - dip coat tank cleaning
Continuous flow SAR with hood	Spray booth operations Prep (cleaning)*
Half-face piece APR with organic vapor cartridge	Voluntary use for Dip Coat Tenders, Spray Booth Operators (gun cleaning), and maintenance workers (loading coating agents into supply systems)
Escape SCBA	Dip Coat, Coatings Storage Area, Spray Booth Cleaning Area

* until ventilation is installed.

ATTACHMENT C

Sample Hazard Evaluation

Process Hazard Evaluation for__ *COMPANY NAME* ***__DATE***	
Process	**Noted Hazards**
Prep-sanding	Ventilation controls on some sanders are in place, but employees continue to be exposed to respirable wood dust at 2.5 - 7.0 mg/m3 (8 hour time-weighted-average, or TWA). Half-face piece APRs with P100 filters and goggles are required for employees sanding wood pieces. PAPRs will be available for employees who are unable to wear an APR.
Prep-cleaning	Average methylene chloride exposures measured at 70 ppm based on 8-hour TWA exposure results for workers cleaning and stripping furniture pieces. Ventilation controls are planned, but will not be implemented until designs are completed and a contract has been let for installation of the controls. In the meantime, employees must wear supplied air hoods with continuous airflow, as required by the Methylene Chloride Standard 1910.1052.
Assembly	Ventilation controls on sanders are in place, but employees continue to be exposed to respirable wood dust at 2.5 - 6.0 mg/m3 (8 hour TWA); half-face piece APRs with P100 filters and goggles are required for employees sanding wood pieces in the assembly department. PAPRs will be available for employees who are unable to wear an APR. The substitution for aqueous-based glues will eliminate exposures to formaldehyde, methylene chloride, and epoxy resins.
Maintenance	Because of potential IDLH conditions, employees cleaning dip coat tanks must wear a pressure demand SAR during the performance of this task.
Cleaning Spray Booth Walls	Employees may voluntarily wear half-face piece APRs with P100 cartridges**.** Although exposure monitoring has shown that exposures are kept within PELs during this procedure, ***_Company Name_*** will provide respirators to workers who are concerned about potential exposures
Loading Coating Agents into Supply Systems	Employees may voluntarily wear half-face piece APRs with organic vapor cartridges. Although exposure monitoring has shown that exposures are

	kept within PELs during this procedure, ***Company Name*** will provide respirators to workers who are concerned about potential exposures
Changing Booth Filters	Employees may voluntarily wear half-face piece APRs with P100 cartridges. Although exposure monitoring has shown that exposures are kept within PELs during this procedure, ***Company Name*** will provide respirators to workers who are concerned about potential exposures

(Include documentation of the sampling data that hazard evaluation is based on.

ATTACHMENT D

Sample Record of Respirator Issuance

Company Name **Personnel in Respiratory Protection Program** ***Date***				
Respiratory protection is required for and has been issued to the following personnel:				
Name	**Department**	**Job Description/ Work Procedure**	**Type of Respirator**	**Date Issued**
		Operator	Half mask APR P100 filter when sanding/ AR continuous flow hood for cleaning	
		Dip tank cleaning	SAR, pressure demand with auxiliary SCBA	
		Spray Booth	SAR, continuous	

ATTACHMENT E

Respirator Inspection Checklist

Type of Respirator:	**Location:**
Respirator Issued to:	**Type of Hazard:**
Face piece	__________ Cracks, tears, or holes __________ Face mask distortion __________ Cracked or loose lenses/face shield
Head straps	__________ Breaks or tears __________ Broken buckles
Valves:	__________ Residue or dirt __________ Cracks or tears in valve material
Filters/Cartridges:	__________ Approval designation __________ Gaskets __________ Cracks or dents in housing __________ Proper cartridge for hazard
Air Supply Systems	__________ Breathing air quality/grade __________ Condition of supply hoses __________ Hose connections __________ Settings on regulators and valves
Rubber/Elastomer Parts	__________ Pliability __________ Deterioration

Inspected by:	Date:
Action Taken:	

ATTACHMENT F

Sample Emergency Potential Log

The following work areas at ***Company Name*** have been identified as having foreseeable emergencies:

Area	**Type of Emergency**	**Location of Emergency Respirator(s)**
Spray Booth Cleaning Area	Spill of hazardous waste	Locker #1 in the Spray Booth Area
Dip Coat Area	Malfunction of ventilation system, leak in supply system	Storage cabinet #3 in Dip Coat/Drying Area
Coatings Storage Area	Spill or leak of hazardous substances	Locker #4 in the Coatings Storage Area

______________________________   ____________________

Program Administrator   Date

ATTACHMENT G

Sample Immediately Dangerous to Life and Health (IDLH) Assessment Log

The Program Administrator has identified the following area as presenting the potential for IDLH conditions:

Process	IDLH Condition	Procedure
Dip Coat Tank Cleaning	Maintenance workers will be periodically required to enter the dip tank to perform scheduled or unscheduled maintenance.	Workers will follow the permit required confined space entry procedures specified in the ***(Company Name)*** Confined Space Program. As specified in these procedures, the Program Administrator has determined that workers entering this area shall wear a pressure demand SAR. In addition, an appropriately trained and equipped standby person shall remain outside the dip tank and maintain constant voice and visual communication with the worker. In the event of an emergency requiring the standby person to enter the IDLH environment, the standby person shall immediately notify the Program Administrator and will proceed with rescue operations in accordance with rescue procedures outlined in the ***(Company Name)*** Confined Space Program.

Safety and Health Program

Table of Contents

WRITTEN SAMPLE SAFETY AND HEALTH PROGRAM

(Company Name)

I. CHECKLIST

NOTE: This form has been supplied by the Department of Labor and Economic Growth to guide employers and employees as they develop a system to address workplace safety and health. As indicated, this form is a working tool and without the accompanying documentation does not certify or verify the existence of a Written Safety and Health Program.

The written system described by the employer must be reflected on a daily basis in practice at the workplace together with the documentation of activities involving safety and health.

Firm Name:____

Address:____

Phone: ____

Type of Business: ____

Facility Manager:____

Safety and Health Employer Rep:___________________________

Safety and Health Employee Rep: ___________________________

MANAGEMENT COMMITMENT

This worksite meets its management commitment to safety and health through: (Check all that apply, place documents at end of this program.)

_____ Written Safety and Health program with duties and accountability.
_____ Designated Safety and Health person/department with duties and budget.
_____ Records showing Safety and Health goal setting and progress made.
_____ Safety and Health performance are a part of regular employee/supervisor evaluation.
_____ Safety and Health meetings, toolbox talks, agendas, minutes, actions taken.
_____ Safety and Health suggestion/promotion/incentive programs.
_____ Employee Safety/Health handbook (procedures, practices).
_____ Posts MIOSHA poster.
_____ Management takes action on identified Safety and Health concerns.
_____ Management sets, enforces, and follows Safety and Health rules.

Other:

____

____

____

EMPLOYEE INVOLVEMENT

This worksite arranges for employee participation in the safety and health program through: (Check all that apply and place documents at the end of this program.)

_____ Employees represented on safety and health committee including: agendas, actions taken, minutes.

_____ Written employee hazard reporting system or suggestion program with action taken.

_____ Negotiated safety and health contract language.

_____ Designated employee safety and health representatives.

_____ Employees participate as trainer, inspectors, and problem solvers.

_____ Employer has documented, completed or is preparing worker/manager safety and health projects.

_____ Employees have input in arrangement and content of safety and health training, including toolbox talk.

_____ Process for employees to report hazardous conditions to jobsite supervision.

Other: ____

____

____

WORKSITE ANALYSIS

This worksite tracks worker safety and health both before and after exposures and/or incidents through: (Check all that apply, place any documents at the end of this program.)

_____ Log 300 properly maintained and required supplementary forms filled out.

_____ Accidents and near misses investigated with corrective actions and follow-up.

_____ Copies of written inspections and surveys: insurance company, private consultant, fire department, in-house as required by Safety and Health Standard (i.e., hearing conservation.)

_____ Job safety and health analysis, written job descriptions with safety and health responsibilities.

______ Ergonomic analyses.

______ Firm has safety and health as a priority when planning, designing, or implementing a job, task or process.

______ A designated person makes regular worksite inspections to identify hazardous conditions and initiate correction.

Other: ____
____
____

HAZARD PREVENTION AND CONTROL

This worksite carries out an active program of identifying and controlling hazards through: (Check all that apply, place documents at the end of the program.)

______ Written system to assure guards, housekeeping and personal protective equipment are essentially in place.

______ Maintenance and repair schedules, orders, receipts for safety and health products.

______ Written programs and procedures: lockout, respirator, right to know, confined space, infection control, asbestos, benzene, lead, hearing conservation, forklift permits, as required in place.

______ Written disciplinary action against employees and/or supervisors for safety and health infractions including remedies and follow-up.

______ Timely reports of hazards and corrective actions.

______ Safe work procedures.

______ Copies of MIOSHA standards.

______ Engineering controls in place, ventilation, isolation, reflective shields, special tools, fixtures.

______ First aid, return to work, light duty, medical controls, and emergency preparedness in place.

______ Employees and supervisors can state hazards of task/tool and safe work procedures.

______ Employees are aware firm has method for identification and correction of hazards and can recall examples.

______ Supervisors correct and reinforce safe and healthful work practices as part of daily routine.

Other: ____

____

____

SAFETY AND HEALTH TRAINING

This worksite provides information on safety and health protection to employees through: (Check all that apply and place documents at the end of this program.)

_____ Training records: dates, trainees, and subjects.

_____ New employee safety orientation.

_____ Standards based training in place: right to know, noise, lockout, lift truck, confined space, ergonomics, infection control, asbestos, hazwoper, tools, ppe., first aid (documented).

_____ Safety literature, bulletin board, posters, stickers.

_____ Apprentice or other off-site safety and health training can be documented.

_____ Supervisors can explain rules and procedures for safety and health and how they teach and enforce them.

_____ Employees can explain how and why they need to do their jobs in a safe and healthful manner.

_____ Training is given periodically and pertains to the hazards of the job.

Other: ____

____

I. WRITTEN SAFETY AND HEALTH PROGRAM GUIDELINE

NOTE: This template has been supplied by the Michigan Department of Labor and Economic Growth to guide employers and employees as they develop a system to address workplace safety and health. This template is a working tool to help you begin integrating safety and health into your organization. Additional documentation will need to be developed to verify the existence of a written safety and health program.

The written program described by the employer must be a part of nearly every program, activity and department in the organization and reflected on a daily basis in practice in the workplace.

Establishment Name: ____

Address: ____

City: ____
____

Phone: ________________________ Type of Business: ___________________________

Chief Executive Officer: ____

Employer Safety and Health Representative: ____

Employee Safety and Health Representative: ____

MANAGEMENT COMMITMENT

Our corporate culture can directly influence the success of the safety and health program. Our management must play a major role to ensure its success. Our management commitment requires managing safety and health like other organizational concerns, integrating safety and health into the entire organization, becoming personally involved and assuming accountability for safety and health.

1. SAFETY AND HEALTH POLICY

"Every employee at (Name of Establishment) is entitled to a safe and healthful workplace. All employees will follow safe and healthful work practices, obey safety and health rules and regulations, and work in a manner, which maintains high safety and health standards. We will provide and maintain, safe and healthful working conditions, and we will establish and insist upon work methods and practices that promote a safe and healthful workplace at all times. Nurturing a positive employee environment with open communication, employee involvement and participation, and respect will help (Name of Establishment) achieve high safety and health performance."

____

Signature/ Chief Executive Officer

2. SAFETY COORDINATOR'S RESPONSIBILITY

It is the responsibility of (Name/Title) to coordinate, implement and administer (Name of Establishment) safety and health program. Responsibilities include:

- Conduct or facilitate safety and health training.
- Serve as a safety and health staff resource for supervisors and employees.
- Create statistical reports that compare severity and frequency rates against prior records.
- Accompany work site managers on all regulatory inspections (e.g., OSHA, Fire Inspector, etc.)

(List other company-specific assigned safety and health responsibilities.)

3. SUPERVISOR'S RESPONSIBILITY

Our supervisor's attitude plays an important part in obtaining or preventing the acceptance of safe and healthful work practices, policies, and procedures. It is the supervisor's responsibility to identify potential hazards, identify methods to control or eliminate the hazards, ensure employees engage in safe and healthful work practices, and ensure employees receive safety and health training to do their work. Safety and health performance will be part of our supervisor's evaluation.

(List other company-specific assigned safety and health supervisory responsibilities).

4. SAFETY AND HEALTH COMMITTEE

Our management will take an active role on the safety and health committee. At least annually the safety and health committee will develop written safety and health goals and track monthly progress. These goals will be communicated to all employees. Our committee will be comprised of management and hourly employees. Members will be (Elected/Appointed/Volunteer) and will serve on the committee for (Length of Time).

(See Employee Involvement on page 4 for additional safety committee information.)

5. RESPONDING TO SAFETY AND HEALTH ISSUES

Our management will take prompt consistent action when responding to safety and health issues. They will demonstrate our management commitment to addressing safety and health concerns and fostering employee participation.

Our management will develop a mechanism for employees to report hazards or potential hazards and respond to safety and health issues in a timely manner.

(Name/Title) will review, investigate and take any necessary and appropriate action on all employee reports of hazards or potential hazards. The employee reporting the hazard or potential hazard will be notified of the outcome.

(Reporting hazards or potential hazards will be without reprisal.)

6. SAFETY AND HEALTH MEETINGS

(Name/Title) will hold safety and health meetings to communicate with employees on safety and health issues. These meetings will be held (Monthly/Quarterly) or more often if needed.

7. POLICIES, PROCEDURES, SAFETY AND HEALTH RULES

Our management is responsible for implementing major decisions, policies and safety and health procedures. Specific safety and health procedures as required by OSHA will be put in writing such as; lockout, right to know, personal protective equipment assessment and certification, confined space, respiratory program, etc. Copies of these written programs are available in (Location). Written safety and health rules will be posted at (Location) and communicated with all employees. These rules will be enforced and followed by everyone at our facility. The required MIOSHA posters will be posted (Location).

EMPLOYEE INVOLVEMENT

1. SAFETY AND HEALTH COMMITTEE

The purpose of our safety and health committee is to participate in the implementation of
the safety and health program at (Name of Establishment).

Our committee will be comprised of management and employee representatives. Our committee will meet (Monthly/Quarterly).

The committee will:

- Have a formal agenda.
- Have defined goals and objectives.
- Address safety and health issues.
- Record and post minutes of the meetings.
- Involve employees in problem solving.
- Document action taken and post on the bulletin boards for all employees to read and/or comment.

Committee members are:

________________	________________	________________
________________	________________	________________

2. SAFETY INSPECTIONS

Our employees will participate in regular safety and health inspections (Monthly/Quarterly) to help identify potentially hazardous conditions and initiate corrections. Findings will be presented to (Name/Title/Safety and Health Committee) for review. Corrective action will be implemented under the direction of (Name/Title) in a timely manner.

3. SUGGESTION SYSTEM

Our employees are encouraged to make safety and health suggestions to help improve a process, prevent an accident, or to make any improvement in the safety and health program. The suggestion system will be implemented by (Name/Title) who will be responsible for determining priority and the proper means of implementation. Safety suggestions will be shared with the safety and health committee for input. Suggestion forms can be placed in suggestion boxes at (Location) or given directly to (Name/Title).

4. EMPLOYEE PARTICIPATION/INPUT

Our employees will be given an opportunity to provide input regarding recommendations on safety and health products, procedures, and training as it pertains to daily work operations. For example, employees may be given some responsibility to test out products or conduct research to substantiate recommendations. Employee input may be provided through the suggestion system, report of hazard, or through actions the safety and health committee initiates. Employees may participate as a trainer, inspector or problem solver.

WORKSITE ANALYSIS

We will conduct a worksite analysis, through systematic actions that provide information as needed to recognize and understand the hazards and potential hazards of our workplace. Listed below are types of worksite analysis actions that can assist with making an inventory of potential hazards in our workplace:

A. Comprehensive hazard surveys (insurance inspections, OSHA On-site, etc.).
B. Hazard analysis of changes in the workplace (new equipment, new processes).
C. Regular site safety and health inspections (employee & management).
D. Employee reports of hazards or potential hazards.
E. Accident and incident investigations with corrective actions and follow-up.
F. Injury and illness trend analysis.
G. Personal protective equipment assessment.
H. Job safety analysis.
I. Ergonomic analysis.
J. Specific identification of confined spaces.
K. Identification of energy sources for specific machines.
L. Copies of written inspections and surveys by: fire department, in-house as required by safety and health standards (e.g., overhead crane inspections, powered industrial truck daily inspection, etc.).

1. NEW EQUIPMENT, PROCESS, AND FACILITY HAZARD ANALYSIS

(Name/Title) will analyze new facilities, equipment, processes, and materials for hazards and potential hazards. Findings will be documented and plans developed to minimize or design out the hazards.

2. JOB SAFETY ANALYSIS (JSA) AND PERSONAL PROTECTIVE EQUIPMENT

The main purpose of our JSA is to prevent accidents by anticipating and eliminating hazards. (Name/Title) will periodically perform the JSA and personal protective equipment assessments to assure the appropriate safeguards and protection are in place and to develop safe work practices and procedures.

3. EMPLOYEE REPORT OF HAZARDS

Our employees play a key role in identifying, controlling and reporting hazards that may occur or already exist in the workplace. Employee reports of potential hazards can be an effective tool to trigger a closer look at a piece of equipment, operation, or how work is being performed. Reports of potential hazards can also provide suggestions to eliminate a hazard.

4. ACCIDENT/INCIDENT INVESTIGATION

We will conduct an investigation for all accidents/incidents. Our primary goal of conducting an investigation is to determine the "root cause" and implement corrective action to prevent the risk of future occurrence. Investigation reports can help determine injury and illness trends over time, so that patterns with common causes can be identified and prevented. Investigations are not intended to place blame.

Accidents and “near-miss” incidents will be investigated by (Name/Title). The reports will be reviewed by (Name/Safety Committee) within (Days/Hours) of an accident/incident.

HAZARD PREVENTION AND CONTROL

Our management will develop systems to prevent and control hazards. These include; the establishment of controls through engineering, work practice, personal protective equipment, and/or administrative actions; systems to track hazard correction; preventive maintenance systems; emergency preparation; and medical program.

Our written system will be implemented to assure guards, housekeeping, and personal protective equipment are provided and being used.

A written plan of action for the correction of hazards found in the work place will be implemented by (Name/Title). Actions will be communicated to all employees.

A machine-specific maintenance schedule will be established by (Name/Title). Maintenance logs will be kept to document work performed and repairs scheduled or ordered. Receipts will be kept for the purchase of safety devices or other safety and health products.

Required written programs such as; lockout/tagout, respiratory protection, right to know, confined space, blood borne infectious diseases, asbestos, benzene, lead, hearing conservation, and fork lift permits will be developed.

Copies of applicable OSHA standards will be located at (Location) for employee review.

Our supervisors will correct and reinforce safe and healthful work practices as part of their daily routine. Our written disciplinary procedure will assist in fair and consistent enforcement, and will include remedies and follow-up.

Through a team effort all employees at (Name of Establishment) will make “safety checks” a part of routine work practices.

SAFETY AND HEALTH TRAINING

Our goal of safety and health training is to provide a mechanism for our employees to understand safety and health hazards, and how to protect themselves and others. Safety and health training programs include determining the training needs, involving our employees in the program design and implementing the training.

Our training should be designed for the type of work and potential hazards employees may be exposed to. Listed below by groups are the employees that need training:

- Supervisors
- Maintenance
- Hourly/Line Workers
- Set up Operators
- Machine Operators
- Office Workers
- Other (Contractors, temporary, etc.)

All of our employees at (Name of Establishment) will be thoroughly trained to perform their jobs safely and productively. Our employee training will be documented and reviewed as necessary to ensure consistent safe and healthful work practices.

1. TRAINING SHOULD BE CONDUCTED

A. For new and current employees.
B. When required by a specific standard, equipment, or procedure.
C. When new methods are developed or changed.
D. When an employee’s responsibilities or designated job duties change.
E. When a pattern of unsafe or unhealthy behaviors are observed.
F. When new hazards are identified.
G. When new controls are implemented.
H. When personal protective equipment is provided.
I. When an employee shows a deficiency in knowledge of a company rule and procedure.

2. TRAINING RECORDS

A. All training records are kept in the safety and health training files in (Location). The records will be maintained by (Name/Title). Training documents will include; who was trained, training subject, content, and date.
B. Our training schedules will follow, at a minimum, the training requirements of the MIOSHA standards.
C. Our training shall consist of a combination of lecture, discussion, interactive computer learning, videotape, written materials, practical training and testing.

3. NEW EMPLOYEE TRAINING

A. Our new employee training program will be provided for all new employees and will be specific for the duties performed. New employee training will be conducted before the employee operates equipment or machinery or exposed to hazards. Training will be conducted by (Name/Title).

B. Examples of training to be conducted:

* Hazard Communication Program
* Respiratory Protection Program
* Confined Space Entry
* Hearing Conservation Program
* Lockout/Tagout
* Ergonomics
* Personal Protective Equipment
* HAZWOPER
* Powered Industrial Trucks
* Asbestos

* First Aid/CPR
* Bloodborne Infectious Diseases

4. SAFETY LITERATURE-BULLETIN BOARD

At (Name of Establishment), a portion of our bulletin board is reserved for safety and health documents, memos, safety and health committee minutes.

5. SAFETY AND HEALTH WORK OBSERVATIONS

Safety and health work observations will be performed periodically by supervisors.

Safety and health work observations ensure; 1) an employee has the knowledge to perform the work as trained, and 2) is actually performing their work task as trained. Specific observations or audits are especially critical for lockout/tagout, confined space, or where the risk of exposure is high. Results will be documented and follow-up training will be provided as needed.

Safety Policy

Table of Contents

Safety Policy

(Company Name)

I. OBJECTIVE

The Safety Policy of ***Company Name*** is designed to comply with the Standards of the Occupational Safety and Health Administration, and to endeavor to maintain a safe and injury/illness free workplace. A copy of the OSHA Safety and Health Standards 1926 and 1910 are available for all employees= use and reference. These Standards shall be available in the home office at all times and will be sent to the jobsite on request.

Compliance with the following Safety Policy and all items contained therein is mandatory for all employees of the company. The authorization and responsibility for enforcement has been given primarily to the ***Responsible Person***. The ***Other Responsible Person(s)*** share in this responsibility as well.

II. POLICY

It is company policy that accident prevention be a prime concern of all employees. This includes the safety and well being of our employees, subcontractors, and customers, as well as the prevention of wasteful, inefficient operations, and damage to property and equipment.

III. APPLICABILITY

This Safety Policy applies to all employees of ______***Company Name***______, regardless of position within the company. The Safety Rules contained herein apply to all subcontractors and anyone who is on a company project site.

Every employee is expected to comply with the Safety Policy, as well as OSHA Health and Safety Standards.

IV. IMPLEMENTATION

This Safety Policy supports six fundamental means of maximum employee involvement:

A. Management commitment to safety.
B. Weekly tool box safety meetings at all jobsites.
C. Effective job safety training for all categories of employees.
D. Job hazard analysis provided to all employees.
E. Audio and/or visual safety presentations given at jobsites by __*Responsible Person*__.
F. Various incentive awards for exemplary safety performance.

The __***Responsible Persons***__ will meet at least once a month to evaluate all areas of safety and make recommendations to the company president.

V. ADMINISTRATION

The Safety Policy will be carried out according to guidelines established and published in this and other related procedures. Specific instructions and assistance will be provided by ***Responsible Person*** as requested. Each supervisor will be responsible for meeting all of the requirements of the Safety Policy, and for maintaining an effective accident prevention effort within his or her area of responsibility. Each supervisor must also ensure that all accidents are thoroughly investigated and reported to ***Responsible Person(s)*** on the same day of the occurrence.

VI. REPORTING OF INJURIES

All employees will be held accountable for filling out a ANotice of Injury Form" immediately after an injury occurs, even if medical treatment is not required. (Notice must be made at or near the time of the injury and on the same day of the injury.) Employees must report the injury to their supervisor/leadman/foreman/superintendent/project manager, etc. A casual mentioning of the injury will not be sufficient. Employees must let their supervisor know:

A. How they think they hurt themselves.
B. What they were doing at the time.
C. Who they were working with at the time.
D. When and where it happened.
E. Other pertinent information that will aid in the investigation of the incident.

Failure to report an injury immediately (meaning at or near the time of the injury and on the same day of the injury) is a violation of the Safety Policy, and they may result in immediate termination, in accordance with company policy.

VII. NOTIFICATIONS

A. In Case of Serious Injury or Death

After the injured has been taken to the hospital, the leadman/foreman/supervisor shall notify the main office and ***Responsible Person(s)*** as soon as possible. Statements from witnesses shall be taken. Statements are to be signed by witnesses and should include the time and date. Photographs of the area where the incident occurred and any other relevant items are to be taken. ***Responsible Person*** will assist in the investigation. The completed accident report form will sent to the main office.

B. In Case of Inspection by OSHA Inspector

The leadman/foreman/supervisor must notify ***Responsible Person(s)*** that an OSHA Inspector is on the jobsite. It is the responsibility of all employees to make the inspector=s visit on the jobsite as pleasant and timely as possible.

VIII. BASIC SAFETY RULES

A. Compliance with applicable federal, state, county, city, client, and company safety rules and regulations is a condition of employment.

B. All injuries, regardless of how minor, must be reported to your supervisor and the Safety Office immediately. An employee who fails to fill out a "Notice Of Injury Form" and send it to the Safety Office can be issued a safety violation notice and may be subject to termination, in accordance with company policy. In the event of an accident involving personal injury or damage to property, all persons involved in any way will be required to submit to drug testing.

C. Hard hats will be worn by all employees on the project site at all times. The bill of the hard hat will be worn in front at all times. Alterations or modifications of the hat or liner is prohibited. Crane operators, when in an enclosed cab, have the option of not wearing a hard hat due to the possible obstruction of view.

D. Safety glasses will be worn as the minimum-required eye protection at all times. Additional eye and face protection such as mono-goggles and face shields are required for such operations as grinding, jack hammering, utilizing compressed air or handling chemicals, acids and caustics. Burning goggles for cutting, burning or brazing and welding hoods for welding, etc., are required.

E. Fall Protection Requirements

1. Full body harnesses and lanyards shall be worn and secured any time there is a fall hazard of more than six (6) feet.
2. Lifelines shall be erected to provide fall protection where work is required in areas where permanent protection is not in place. Horizontal lifelines shall be a minimum of 2-inch diameter wire rope. Vertical lifelines shall be 3/4 inch manila rope or equivalent and shall be used in conjunction with an approved rope grab.
3. Structural steel erectors are required to "hook up" with full body harness and lanyard.
4. Employees using lanyards to access the work or position themselves on a wall or column, etc., must use an additional safety lanyard for fall protection.
5. Manlifts must be used properly. As soon as an employee enters an articulating boom lift and before the lift is started, the employee must put on the harness and attach the lanyard to the lift. Employees are not required to wear harnesses on scissor lifts.

F. Clothing must provide adequate protection to the body. Shirts must have at least a tee sleeve. Shirts with sleeves and long pants will be worn at all times. No shorts are to be worn on projects. All employees, except welders and burners, must tuck shirt tails inside trousers. Burners and welders will not be permitted to wear polyester or nylon clothing. Sturdy work boots with rigid, slip resistant soles are required. No clogs, tennis shoes or loafers are permitted. Steel-toed tennis shoes with the ANSI label are the only alternative to the leather work boot.

G. All personnel will be required to attend safety meetings as stipulated by project requirements in order to meet OSHA Safety Standards.

H. Firearms, alcoholic beverages or illegal drugs are not allowed on company property or in company vehicles at any time. When drugs are prescribed by a physician, the ***Responsible Person*** must be informed. The use or possession of illegal drugs or alcoholic beverages on the jobsite will result in immediate termination.

I. Housekeeping shall be an integral part of every job. Supervisors\foremen\leadmen and employees are responsible for keeping their work areas clean and hazard-free. Clean up is required when a job is finished at the end of the day.

J. Burning and cutting equipment shall be checked daily before being used. Flash back arresters shall be installed at the regulators on both oxygen and LP bottles. All gas shall be shut off and hoses disconnected from bottles and manifolds at the end of the work day. Caps shall be replaced on bottles when gauges are removed. When gauges are removed and caps replaced, the oxygen and LP bottles shall be separated into storage areas no less than 20 feet apart with a ANo Fire or Smoking" sign posted and a fire extinguisher readily available. Makeshift field repairs will not be allowed.

K. Drinking water containers are to be used for drinking water and ice only. Tampering with or placing items such as drinks in the water cooler will result immediate termination. The "common drinking cup" is not allowed. Only disposable cups will be used.

L. All tools whether company or personal, must be in good working condition. Defective tools will not be used. Examples of defective tools include chisels with mushroomed heads, hammers with loose or split handles, guards missing on saws or grinders, etc.

M. All extension cords, drop cords, and electrical tools shall be checked, properly grounded with ground fault interrupters (GFI=s), and color-coded by a designated competent person each month. This shall be part of the assured grounding program.

Cords and equipment that do not meet requirements shall be immediately tagged and removed from service until repairs have been made.

N. AHorseplay" on the jobsite is strictly prohibited. Running on the jobsite is allowed only in extreme emergencies.

O. Glass containers or bottles of any kind are not permitted on jobsites or in company vehicles.

P. The jobsite speed limit is 10 MPH. No employee is permitted to ride in the bed of a truck standing up or sit on the outside edges of a truck. Employees must be sitting down inside the truck or truck bed when the vehicle is in motion. Riding as a passenger on equipment is prohibited unless the equipment has the safe capacity for transporting personnel.

Q. Adequate precautions must be taken to protect employees and equipment from hot work such as welding or burning. Fire extinguishing equipment shall be no further than 50 feet away from all hot work. Used fire extinguishers must be returned to ***(Responsible person)*** to be recharged immediately. Use of welding blinds is required in high traffic areas.

R. All scaffolding and work platforms must be built and maintained in accordance with OSHA specifications. All ladders must be in safe condition without broken rungs or split side rails. Damaged ladders shall be removed from service. Ladders shall be secured at the top and bottom and extend three (3) feet past the working surface. Metal ladders around electrical work are prohibited. A step ladder shall never be used as an extension ladder. A step ladder must only be used when fully opened with braces locked.

S. Crowfoot connections on air hoses shall be wired to prevent accidental disconnection. Compressed air shall not be used to dust off hands, face or clothing.

T. Report all unsafe conditions and near accidents to ***Responsible Person*** so corrective action can be taken.

U. All floor openings or excavations shall be barricaded on all sides to ensure employees are aware of the hazards. Floor holes shall be covered, with the covers secured and clearly marked.

V. Warning signs, barricades, and tags will be used to fullest extent and shall be obeyed.

W. Scaffold Tag System

1. Green tags are to be placed on 100 percent complete scaffolds with all braces, locks and hand, mid, and toe rails in place before use.
2. Yellow tags indicate incomplete scaffolds. If scaffold is missing a hand, mid, or toe board, it must have a yellow tag and employees on it must be tied off at all times.
3. Red tags indicate scaffolds that are in the process of either being erected or disassembled. These scaffolds are not to be used at any time.
4. Scaffold tags should be placed in a highly visible location on the scaffolds for all employees to see.

X. All OSHA Safety Standards will be followed for job processes requiring respiratory protection. ***SEE RESPIRATORY PROTECTION PROGRAM.***

Y. All OSHA Safety Standards will be followed during excavation. ***SEE EXCAVATION PROGRAM***.

Z. All OSHA Safety Standards concerning confined space entry will be followed. ***SEE CONFINED SPACE PROGRAM.***

AA. All OSHA Safety Standards concerning lockout/tagout of energized equipment will be followed. ***SEE LOCKOUT/TAGOUT PROGRAM***

BB. All OSHA Safety Standards will be followed for job processes requiring fall protection. ***SEE FALL PROTECTION PROGRAM.***

IX. ENFORCEMENT OF SAFETY POLICY

Safety violation notice(s) shall be issued to any employee, subcontractor, or anyone on the jobsite violating the safety rules or regulations by __***Responsible Person***__.

A. Any violation of safety rules can result in suspension or immediate termination.
B. Any employee receiving three (3) written general violations within a six (6) month period shall be terminated.
C. Issuance of a safety violation notice for failure to use fall protection or for failure to report a job injury (at the time of the injury) may result in immediate termination, in accordance with company policy.

It is understood that ______***Company Name***______ is not restricting itself to the above rules and regulations. Additional rules and regulations as dictated by the job will be issued and posted as needed.

ATTACHMENT A

JOB SAFETY CHECKLIST

The following Job Safety Checklist has been condensed and edited from the Occupational Safety and Health Act, Part 1926, Construction Safety and Health Regulations.

A. Safety Rules

__________ Hard hats and safety glasses worn.

__________ Shirts with sleeves worn.

__________ Work shoes worn.

__________ Subcontractors' personnel hold safety meetings as indicated by project requirements in accordance with OSHA Safety Standards.

__________ Work areas safe and clean.

__________ Safety mono-goggles/face shields worn when circumstances warrant.

__________ Electrical cords and equipment properly grounded with GFI's in place and checked by a competent person.

__________ No use of alcoholic beverages or controlled substances.

__________ Subcontractors provide fall protection for their employees in accordance with OSHA Safety Standards.

__________ All scaffolds built to specifications as established by OSHA.

__________ Excavation/trenches sloped or shored as established by OSHA.

__________ Drug testing of employees involved in accident(s) resulting in personal injury or property damage.

B. Recordkeeping

__________ OSHA poster "Safety and Health Protection on the Job" posted.

__________ OSHA " 200 Log or Occupational Injuries and Illnesses" posted during the month of February only.

__________ Hard hat sign posted in a conspicuous manner.

__________ Weekly safety meeting sign-in logs maintained in a folder with a copy forwarded to the main office weekly.

C. Housekeeping and Sanitation

__________ General neatness.

__________ Regular disposal of trash.

__________ Passageways, driveways, and walkways clear.

__________ Adequate lighting.

__________ Oil and grease removed.

__________ Waste containers provided and used.

__________ Adequate supply of drinking water.

__________ Sanitary facilities adequate and clean.

__________ Adequate ventilation.

D. First Aid

__________ First aid stations with supplies and equipment. The expiration dates of supplies checked monthly. Expired supplies discarded.

__________ Trained first aid personnel.

__________ Injuries promptly and properly reported.

E. Personal Protective Equipment

__________ Hard hats.

__________ Hearing protection.

__________ Eye and face protection.

__________ Respiratory protection.

__________ Fall protection.

F. Fire Protection

__________ Fire extinguishers charged and identified.

__________ No Smoking@ signs posted.

__________ Flammable and combustible material storage area.

__________ Fuel containers labeled.

G. Hand and Power Tools

__________ Tools inspected.
__________ Power tools properly guarded.
__________ Safety guards in place.

H. Welding & Cutting

__________ Compressed gas cylinders secured in vertical position.
__________ Hoses inspected.
__________ Cylinders, caps, valves, couplings, regulators, and hoses free of oil and grease.
__________ Caps on cylinders in storage in place.
__________ Flash back arresters in place.
__________ Welding screens in place.
__________ Fuel and oxygen cylinders separated in storage.

I. Electrical

__________ All portable tools and cords properly grounded [Ground Fault Interrupters properly installed].
__________ Daily visual inspection of caps, ends and cords for deformed or missing pins, insulation damage and internal damage.
__________ Tests of cords, tools and equipment for continuity and correct attachment of the equipment grounding connector (GFI) to the proper terminal made every month and:

1. Prior to first use.
2. Prior to return to service after repairs.
3. Prior to return to service after incident that may have caused damage to cord or equipment.

__________ Cords and equipment not meeting requirements immediately tagged and removed from service until repairs have been made.

J. Ladders

__________ Inspected at regular intervals.

__________ No broken or missing rungs or steps.

__________ No broken or split side rail.

__________ Extend at least 36 inches above landing and be secured.

__________ Side rails of 2 x 4 up to 16 feet, or 3 x 6 over 16 feet.

K. Scaffolding

__________ Inspected at regular intervals.

__________ Footings are a sound ridge and capable of carrying maximum intended load.

__________ Tied into building vertically and horizontally at 14 foot intervals.

__________ Properly cross-braced.

__________ Proper guardrails and toe boards.

__________ Scaffold planks capable of supporting at least four (4) times the maximum intended load.

__________ No unstable objects such as concrete blocks, boxes, etc., used as scaffold foundations.

__________ Use of OSHA Scaffold Tagging Program.

L. Guardrails, Handrails and Covers

__________ Guardrails, handrails and covers installed wherever there is danger of employees or materials falling through floors, roots or wall openings and shall be guarded on all exposed sides.

__________ Posts at least 2 x 4 stock and spaced no more than eight (8) feet apart.

__________ Top rail 42 inches above the floor and of 1 x 4 stock.

__________ Intermediate rail 21 inches above the floor and of 1 x 4 stock.

__________ Guardrail assemblies around floor openings equipped with toe boards. Toe boards at least four (4) inches above the floor level with no more than 1/4 inch clearance above the floor level, when there are employees below or when conditions dictate.

__________ Hole covers permanently attached to the floor or structure and identified with a hole cover sign stenciled with the word "Danger". Hole covers for holes two (2) inches or greater in diameter made of at least 3/4 inch plywood or heavier.

M. Material Hoists

__________ Inspected at regular intervals.

__________ Operating rules posted at operators station.

__________ "No Rider" signs prominently posted at all stations.

__________ All entrances properly protected.

__________ All entrance bars and gates painted with diagonal contrasting stripes.

__________ Experienced operators.

__________ Current crane certification inspection sticker and papers on the rig.

N. Motor Vehicles

__________ Lights, brakes, tires, horn, etc., inspected at regular intervals.

__________ No overloaded vehicles.

__________ Trash trucks have covers.

__________ No riding on the edge of pickup truck beds.

__________ No riding on concrete trucks, loaders, backhoes, etc.

__________ Functioning back-up alarms on loaders, tractors, backhoes, etc.

__________ Fire extinguishers installed and readily available.

__________ Seat belts worn at all times.

O. Material Storage and Handling

_________ Material at least two (2) feet from edge of excavation site.

_________ Proper temperature and moisture levels for safe storage of materials to prevent deterioration or volatile hazards within the storage area.

_________ Inventory maintained and inspected frequently.

_________ Proper protective gear worn when handling chemicals.

P. Concrete, Concrete Forms and Shoring

_________ Full body harnesses as positioning devices for employees tying rebar greater than six (6) feet above adjacent working surface have

_________ Automatic shut-off switches on trowel machines.

_________ No riding on concrete buckets or flying forms.

_________ All forms properly shored.

_________ Single post shores braced horizontally.

Q. Use of Cranes and Derricks

_________ Prohibition of the use of cranes or derricks to hoist employees on a personal platform except in the situation where no safe alternative is possible.

ATTACHMENT B

SAFETY EQUIPMENT CHECKLIST

The following is a list of Safety Equipment that should be on the job, if required, or available from the ***Responsible person*** at all times. Equipment should be checked at intervals in accordance with the applicable OSHA Safety Standards by the Superintendent to ensure that all required equipment is present and in good condition.

__________ Safety goggles, shields, and glasses.
__________ Hearing protection.
__________ Respirators.
__________ Hard hats.
__________ Fire extinguishers (properly charged).
__________ First aid kit (check list inside kit).
__________ Stretcher or stroke litter (tool room).
__________ Welding masks and goggles.
__________ Storage racks for compressed gases.
__________ Guards on all power tools.
__________ Trash barrels.
__________ OSHA forms posted.
__________ Company "Safety Policy" packet posted.
__________ Company "Hazardous Communication Program" packet posted.
__________ Emergency vehicle (vehicle designated to carry injured to hospital).

ATTACHMENT C

SAFETY MEETING REPORT

A safety meeting report is signed to indicate attendance. The form has room for employees to sign after attending their weekly safety meeting. This form shall be filled out for each jobsite safety meeting that is held. After completion of the form, make a copy to maintain at each jobsite and return the signed original copy to the main office.

Safety Meeting Date:_________________________

Topic:___________________________________

Safety Meeting Conducted

By:____

Employee Name **(printed)**	**Employee Signature**	**Job Title**

ATTACHMENT D

EMPLOYEE ACKNOWLEDGMENT

I state that I have attended the safety orientation, and have read and received a copy of the ***Company Name*** safety rules and regulations.

I further state that I understand these rules and acknowledge that compliance with the safety rules and regulations is a condition of employment. If I violate the safety rules or fail to report an injury to my supervisor immediately, I understand that I am subject to termination, in accordance with company policy.

____

EMPLOYEE SIGNATURE

____

DATE

____

__***Responsible Person***___ SIGNATURE

____

DATE

Appendix D - HAZWOPER Training Information

OSHA HAZWOPER frequently asked questions

http://www.osha.gov/html/faq-hazwoper.html

OSHA training institute education centers

http://www.osha.gov/fso/ote/training/edcenters/index.html

HAZWOPER training

http://www.osha-safety-training.net/HAZ/HAZWOPER.html

KSU HAZWOPER training – DCE-

http://www.dce.k-state.edu/conf/hazwoper/registration.shtml

Compliance Solutions-HAZWOPER Training

https://www.csregs.com/acprod/stores/2/product1.jsp?CustomerID=422029&ACBSessionID=gA5jEMnpxrCmZWNDVgPe&SID=1&Product_ID=1

-State/ location specific

http://www.csregs.com/location.html

Trainex- HAZWOPER Training

http://www.trainex.org/hazwoper.cfm

HAZWOPER textbook purchase

http://www.scm-safety.com/about/contact.html

Appendix E - Training Case Studies

EMERGENCY RESPONSE ISSUES: WHAT WENT WRONG IN GRANITEVILLE

Stephen Brittle, Emergency Planning for Chemical Spills. 2007. What Went Wrong in Graniteville. Available at http://www.chemicalspill.org/aboutauthor.html.

Everyone appreciates what emergency responders do, but there is also a time for review and analysis to prevent the reoccurrence of errors, or an opportunity to improve response. Graniteville January 5 – 12, 2005.

Emergency responders from the local volunteer fire department responded to the train crash and subsequent chlorine release without first donning personal protective gear. This severely hampered and compromised their response. Some wound up with blisters on their lungs. This volunteer fire department had HAZMAT training and equipment due to the proximity of the Savannah River Nuclear Site. One would think that the scenario of a train derailment involving hazardous materials such as chlorine would have been part of their training, as well as something the Aiken County LEPC would have contemplated and prepared for in preparing and updating its EPCRA Section 303 emergency plan. Neither law enforcement personnel nor emergency responders seemed trained/drilled/prepared for this scenario.

Civilians were mostly on their own when it came to evacuating. There were true accounts of heroism and good Samaritans. Workers at the Avondale Mills plant worked together to make sure they got away. Some trying to flee had difficulty starting their cars and trucks as the chlorine worked with the humidity in the air on ignitions. Cell phones also did not always work for the same reason.

The community had a rare resource, an emergency telephone ring-down system, but it was not activated for hours after the incident, then told people to shelter-in-place at first, when it should have told many to evacuate. Later, it was used to tell people to evacuate.

The railroad did not make the call to the National Response Center required by CERCLA 103 until over an hour and fifteen minutes after the release of chlorine. [According to the NRC report, the incident occurred on 06-JAN-05 at 02:40 local time. *Report taken by: MST3

CREWS at 03:58 on 06-JAN-05] It is unknown what effect this had on the actual response, or if the delay exacerbated the emergency response issues, but the system set up by federal law was not properly utilized. CERCLA requires an immediate phone call. Under the EPA penalty policy, penalties begin after a 15-minute delay, and the maximum penalty is assessed after one hour. The notifications from the NRC to the various state and federal emergency response agencies came after at least a fifteen-minute delay.

EPA set up a chlorine monitor at the crash site that maxed out at 1.5 ppm. Although the incident response lasted for several days, a better monitor that would show actual levels of chlorine in the ambient air was not used. It would have served the immediate community of Graniteville, as well as the nearby community and county seat of Aiken, to have had the information and technical data about maximum concentrations of chlorine at the site and a variety of off-site locations. Again, one wonders why the local volunteer fire department did not have this type of monitor, as an incident such as a local train derailment involving chlorine or other HAZMAT would be a foreseeable contingency.

The ALOHA modeling program distributed by EPA (for use by responders and emergency planners in modeling chemical spills) seems to have not worked very well in modeling this particular chlorine spill. The official account available in the press was that only one railcar was breached and leaking, but according to an ALOHA model, it would have been expected to empty rather quickly, certainly within hours. The report later was that much of the chlorine in the breached railcar did not leak into the atmosphere, and eventually was neutralized and off-loaded. There was some confusion about how many of the rail cars of chlorine were breached. Utilizing this ALOHA modeling, responders could have made an educated guess about just how far away adverse effects of the chlorine might have been felt, as well as the infiltration of dwellings.

The head of the local volunteer fire department and designated incident commander was also an employee of the railroad. It is unclear whether this had an effect on the release of information to the press and the public about the incident. I certainly got the impression that the Norfolk Southern Railroad was in control of the command center and the flow of information. All press statements and information seemed to be carefully controlled to minimize embarrassment to the company. Questioning would be cut off whenever the press asked hard questions of the rail company, at least when I was present. I was able to find out the cause of the incident almost immediately upon arrival at Breezy Hill (adjacent to Graniteville) on the morning of the 6th of January. I learned that the rail crew that parked a locomotive and two cars on the side rail by the Avondale Mills facility had not switched the diversion switch back and had gone home hours before the oncoming train with the chlorine railcars arrived. The NTSB announced some of the information a few days later, and much later announced that the crew had not made the switch back.

As I wandered the incident command center area the day after the crash, I noticed a very distressed young black woman who seemed to be ignored by the various officials and staff present at the area. I asked her and found out that she was trying to locate information about her father, Willie Tyler, and that she had not been able to get any kind of answer from hospitals or anyone. I convinced a sheriff's deputy to assist her, and she was referred to a Red Cross center some miles away. Later, Willie Tyler was found dead at the Avondale Mills plant. He was the ninth victim. It seems wrong that he was known to be missing and yet no one or official had contacted his family. It also seems wrong that she could not find out this vital information easily.

The area of evacuation was likely not sufficient. I spoke with a woman who lived about 2.5 miles downwind from the rail crash site who had not ever been evacuated by emergency responders. She had heard the crash but thought it was thunder. She awoke the morning of the crash feeling weak, and noticed what she described as "a strange fog" outside. She learned about the disaster on television. When her husband came home later that day, they left their home and went further away to some relatives, but the chlorine fumes came there also, so they went back home. Considering that the potential off-site consequence of a catastrophic release of chlorine from a rail car can be up to 14 miles away, according to EPA, it appears that the emergency response and evacuation should have looked further into the area outside the IDLH (10ppm for Chlorine), and should have conducted air monitoring periodically throughout the areas downwind. This appears to be a common problem going back to the mindset of the emergency response community using ALOHA. The area of IDLH (Immediate Danger to Life and Health) gets much attention, but the levels of chlorine in the ambient air outside an IDLH can still be at harmful levels, certainly with chronic exposure. Even the OSHA standard for workplace exposure is 0.5 ppm, TWA. People outside the designated IDLH should have been warned to avoid exposure and what symptoms might indicate an adverse effect.

Some of the medical community, despite the rail disaster, seems to have ignored the obvious. This aforementioned woman did not go to an emergency room until Sunday the 9th of January, four days after the incident, because she did not get any better. There was no notification to her and others about potential health effects to watch out for. The hospital, unfortunately, diagnosed her with pneumonia and merely gave her antibiotics, which did not help at all. She saw her primary care physician on Tuesday, the 11th of January, who realized her chlorine exposure, and prescribed something to ease the inflammation of her lungs and allow her to breathe easier.

It is always helpful when the responsible party steps up to the plate to assist in relieving the problems caused by a chemical accident. However, although Norfolk Southern Railroad set up a relief center to give people checks to cover motel and food expenses, but people had to wait hours to process paperwork and get these checks. It would have been better if this had been expedited with more staffing and resources, and it would have also looked better for the railroad company if it had not put releases for people to sign on these checks. (A court action soon ruled that these releases were invalid.)

It is unbelievable and appalling that the Federal Emergency Management Agency rejected Gov. Mark Sanford's request for federal disaster relief in the wake of the Jan. 6 train accident and chlorine gas spill that killed nine and temporarily displaced thousands in Graniteville. A Feb. 9 letter from FEMA Under Secretary Michael Brown told Sanford the agency didn't think the Graniteville derailment and chemical spill warranted an emergency declaration.

The hazardous materials contents of the railcars traveling through Graniteville or anywhere need not be a mystery. OREIS™ is a software tool that provides emergency responders, emergency planners, on-scene fire, police and EMS responders with vital information for dealing with rescue, response and counter-terrorism operations on or around railroads and highways, including those involving hazardous materials. The software provides responders with real-time information about the chemical contents of railcars and trucks that have been involved in an incident, schematics for passenger railroads and a host of other life and timesaving features for emergency responders. The concept was born in 1995 in Houston, Texas and sprang from a Federal Railroad Administration (FRA) initiative to provide hazardous materials information to emergency responders.

Case study: Flame arresters and exploding gasoline containers

Hasselbring, L.C. *Case study: Flame arresters and exploding gasoline containers.* Journal of Hazardous Materials Volume 130, Issues 1-2, 17 March 2006, Pages 64-68.

Papers Presented at the 2004 Annual Symposium of the Mary Kay O'Connor Process Safety Center. Stress Engineering Services Inc., 13800 Westfair East Drive, Houston, TX 77041, USA.

Abstract

This paper describes the case study of a portable plastic gasoline container explosion and fire. While working at home on a science project to determine the burn rates of different types of wood fuel, a 14-year-old boy was severely burned after flames traveled back up into the portable gasoline container and exploded. A witness heard the explosion and reports that the flames went perhaps 10 ft in the air. It is shown by experimentation that a flame arrester installed in the pour opening of the portable gasoline container would have prevented an explosion inside the gasoline container.

Three Case Studies for the Risk Management Framework

Prepared by:
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Submitted to:
U.S. Department of Transportation
Research and Special Programs Administration
Washington, D.C.
Delivery Order No. DTRS56-99-D-70123
November 1, 2000

Available at http://hazmat.dot.gov/riskmgmt/rmsef/risk_case_studies.pdf.

Mercury in Schools; case studies

Available at http://www.epa.gov/mercury/casestudies.htm

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Burlington, Massachusetts Public School System Case Study :

Tips, suggestions, and resources for investigating and resolving environmental, health and safety issues in schools

In 1992, the Burlington, Massachusetts Board of Health conducted a general review of environmental, health and safety issues associated with public schools in Burlington. The case study describes common sources of mercury that the Board found present in local schools, and describes actions the Board took to reduce accidental exposures to mercury and to promote proper disposal of mercury-containing materials.

Ballou High School, Washington DC

On October 2, 2003, the Washington, D.C.'s Fire Department Hazmat Unit responded to an emergency call unlike any call Ballou High School had ever had to make. What the D.C.'s Hazmat unit found that afternoon proved to be the beginning of a long, exhausting search for, and clean up of, an elemental mercury spill. A student had obtained 250 milliliters of liquid elemental mercury from a science laboratory and had sold some of it to other students. Students had to be dismissed. By the time the D.C. Hazmat Team and the D.C. public health officials arrived, it was too late to contain all the spills; varying amounts of mercury were found in the classrooms, gymnasium, and cafeteria. EPA responded by establishing a mobile command post, measuring mercury air concentrations and noting visual contamination of the science laboratory, cafeteria, gym and administration areas.

Contamination did not stop at the school. Students unknowingly carried mercury on contaminated shoes and clothing through the streets, onto city and school buses, and into their homes. Eleven homes and one common area were found to be contaminated and about 16 families were displaced for a month. EPA assisted with screening of residences.

As a result of the spill, Ballou High School was closed for 35 days and over 200 homes were tested for mercury contamination. Total cleanup costs were about $1,500,000.

Hancock High School, Kiln, Mississippi

On September 10, 2003 at the request of the Mississippi Department of Environmental Quality (MDEQ) an emergency response removal commenced at the Hancock High School, Hancock Co. Votech facility, and the Charles B. Murphy Elementary School located in Kiln, Mississippi. The response was conducted by the MDEQ, EPA, and Coast Guard.

Mercury air concentrations were measured and found to be above EPA levels. Contaminated areas were cleaned up using a spill control product and a mercury vacuum system. Three school buses were contaminated with mercury. The seats and flooring were removed. After a thorough cleaning of the buses, all seats were wiped down and the flooring disposed. Children's clothing was tested and some disposed. Private residences were screened and none were found to exceed EPA's action level. Mercury contaminated debris was transported as hazardous waste for disposal. Total cleanup costs were $200,000.

Pau-Wa-Lu Middle School, Gardnerville, Nevada

Residents in northern Nevada found out first hand how dangerous mercury can be when dozens of middle school children in Gardnerville were exposed to mercury and the vapors it gives off. On January 6, 2003 at the request of the Nevada Department of Environmental Protection (NDEP), an emergency response removal commenced at the Pau-Wa-Lu Middle School, Gardnerville, Nevada, Douglas Co. The response was conducted by the NDEP, EPA Region 9, and OSHA.

A student had brought a vial of liquid elemental mercury to school that morning that had been obtained from his grandfather's garage. The student shared the mercury with children on the bus and in the Boy's Locker Room. Liquid mercury was visible on the gym floor and in several classrooms. School staff determined that 61 students had come in contact with mercury. School officials implemented emergency procedures in a written Standard Operating Procedure (SOP) that also included provisions for mercury, notified the fire department, and began to evacuate the school. The HVAC was shut down and the 61 students decontaminated. Mercury air concentrations were measured and found to be above EPA levels. Mercury was also found on the bus.

Contaminated areas were cleaned up using a spill control product (MercX) and by removing contaminated carpet. Once these activities were completed the temperature was raised in the school overnight. All clothing and personal effects from the 61 children were bagged and checked for mercury vapor. All of these bags were analyzed and found to have 10,000 parts per trillion (ppt) or greater of mercury vapor. The clothing and personal items were laid in the gym with ventilation and later laid in the sun and allowed to air out. The bags were reanalyzed and 60% were found to have 10,000 ppt or greater mercury vapor. Clothing eventually exhibiting vapor concentrations less than 300 ppt was returned. Remaining contaminated clothing was disposed as hazardous waste. After removing carpet and using spill control product, remaining localized areas that exhibited mercury concentrations greater than 3,000 ppt were treated overnight with propane heaters. Clothing in lockers in the Boy's Locker Room and the locker room drain were found to exhibit greater mercury vapor concentrations. It was recommended to school officials that the locker room remain closed until additional cleanup efforts could be completed. The school was closed for at least 4 days and cleanup costs will exceed $100,000.

More information regarding the cleanup and news articles is available at the following website: http://www.epaosc.net/pauwalu.

Saylor Avenue, Las Vegas, Clark County, Nevada

Severe poisoning from long-term exposure to mercury vapor sent a Las Vegas 17-year-old youth to a hospital's intensive care unit for a week, and the exposure may cause lifelong effects. The 17-year-old played with elemental mercury at a residence over a 2-3 month period. A large volume of mercury was distributed throughout the house, backyard and pool area. The 17-year-old's grandmother had swept mercury out the back door and had vacuumed up some mercury in an attempt to cleanup the house. Please be aware that mercury should never be vacuumed, except by professionals with specialized equipment, as it is much more easily vaporized through vacuuming and constitutes an even greater health threat.

On January 10, 2004 the 17-year-old was rushed to the hospital for emergency medical care. The grandmother and mother were also taken to the hospital. Firefighters and emergency response personnel responded to a 911 call and were notified that, as much as 1 quart, was in the house. The National Response Center was contacted and the EPA, Clark County Health District, and the Las Vegas Fire Department responded.

Mercury air concentrations in the house were measured and found to be above EPA levels. First responders fire truck, a first aid kit, an oxygen tank, a heart monitor bag, and a uniform were found to be contaminated with mercury. At the hospital, clothing from the family was obtained and found to be contaminated with mercury. The first aid kit, oxygen tank and victim's clothing were returned to the house for treatment. The family has been relocated by the American Red Cross until the home could be decontaminated. The family dog, Snowball was found to be contaminated with mercury. Snowball was decontaminated through several baths and his hair shaved to allow for the dog to be boarded. The grandmother's car was cleaned with a special mercury vacuum. Personal effects, housing materials and furniture were bagged and mercury concentrations detected. Material exceeding 10µg/cubic meter mercury vapor were disposed in a lined roll-off bin. Disposed material volume was 60 cubic meters and included the dishwasher, refrigerator, linoleum, kitchen center island, all carpeting, bathrooms, and concrete from cutting out sidewalk cracks that had filled with mercury. The house was stripped to bare concrete and materials disposed. The bare concrete was treated with epoxy to stop the continued release of mercury vapor. The water from the pool was removed and transported as wastewater for proper disposal. Contaminated soils and the swimming pool were excavated and disposed. Mercury contaminated debris was transported as hazardous waste for disposal. Total cleanup costs are in excess of $131,827.03. This does not include the cost of renovating the house. To determine if mercury had been transported to schools, interviews were conducted with school officials. Further, the 17-year-old's high school classroom was inspected and no mercury was detected. Emergency responders from Region 9 have indicated that most mercury contamination spills in schools are the result of children bringing mercury to school.

More information regarding the Saylor Avenue mercury spill is available at the Pau-Wa-Lu Middle School Mercury Response Web site. EPA Region 9's Mercury Exposures in Nevada site provides more detailed information on the Saylor Avenue incident and the Pau-Wa-Lu Middle School mercury spill, as well as additional info and links related to mercury.

Bay Path Regional Vocational Technical High School, Charlton, Massachusetts

In 2001 and 2002, the Northeast Waste Management Officials' Association (NEWMOA) and the Massachusetts Department of Environmental Protection sponsored a pilot project to support schools interested in removing mercury from school buildings and in educating faculty, staff and students about the hazards of mercury. Specifically, the Commonwealth was interested in assisting programs at schools willing to: educate students, faculty and staff about the potential hazards of mercury; identify and remove all mercury products from the school and replace them with non-mercury alternatives; and adopt a policy of purchasing only non-mercury products wherever possible. Bay Path Regional Vocational Technical High School, located in Charlton, Massachusetts, made the decision to protect the health of students, faculty and staff, the environment, and the school's budget, by eliminating the use of mercury in classroom instruction and restricting the purchase of common products that contain mercury.

More information regarding Bay Path's experience is available at the following Web site: http://www.newmoa.org/Newmoa/htdocs/prevention/mercury/schools/BayPathCaseStudy.pdf

Determinants of response following the firework-disaster in Enschede.

Dijkema Marieke B A; Grievink Linda; Stellato Rebecca K; Roorda Jan; van der Velden Peter G Centre for Environmental Health Research (MGO) (Pb 10), National Institute for Public Health and the Environment (RIVM), PO Box 1, 3720 Bilthoven, BA, The Netherlands European journal of epidemiology (2005), 20(10), 839-47. Journal code: 8508062. ISSN:0393-2990. Journal; Article; (JOURNAL ARTICLE) written in English. PubMed ID 16283474 AN

Abstract

Very few longitudinal health studies after disasters published data on the determinants of loss to follow up. However, these determinants provide important information for future disaster studies to improve their response and reduce selection bias. For this purpose we analyzed the data of a longitudinal health survey which was performed among residents and emergency workers, at 3 weeks (n = 3662) and at 18 months (n = 2769) after a major firework disaster in The Netherlands (Enschede, May 13, 2000). The response was lower among immigrants (54%) than among native Dutch (81%). Severe damage to the house due to the disaster (OR: 1.8; 95% CI: 1.1-3.0) and being involved as an emergency workers (OR: 2.1; 95% CI: 1.2-3.4) were associated with higher response among native Dutch, while this was not the case among immigrants. Non-western immigrants with health problems in the first study were more likely to participate in the second study (for example physical symptoms OR: 2.5: 95% CI: 1.4-4.4), while the native Dutch with these symptoms were less likely to participate (OR: 0.7; 95% CI: 0.5-0.9). In conclusion,

disaster-related characteristics were associated with higher response in native Dutch. Health problems were associated with higher response among non-western immigrants and with lower response among the native Dutch.

Hepatitis A virus in urban sewage from two Mediterranean countries.

Pinto R M; Alegre D; Dominguez A; El-Senousy W M; Sanchez G; Villena C; Costafreda M I; Aragones L; Bosch A Enteric Virus Laboratory, Department of Microbiology, University of Barcelona, Barcelona, Spain Epidemiology and infection (2007), 135(2), 270-3. Journal code: 8703737. ISSN:0950-2688. Journal; Article; (JOURNAL ARTICLE); (RESEARCH SUPPORT, NON-U.S. GOV'T) written in English. PubMed ID 16817987 AN 2007092121 MEDLINE (Copyright (C) 2007 U.S. National Library of Medicine on SciFinder

Abstract

Molecular methods for the detection and typing of hepatitis A virus (HAV) strains in sewage were applied to determine its distribution in Cairo and Barcelona. The study revealed the occurrence of different patterns of hepatitis A endemicity in each city. The circulating strains characterized, whether in Cairo or Barcelona, were genotype IB. The effects of a child vaccination programmed and the increase in the immigrant population on the overall hepatitis A occurrence in Barcelona were evaluated. While vaccination contributed to a significant decrease in the number of clinical cases, the huge recent immigration flow has probably been responsible for the re-emergence of the disease in the last year of study, in the form of small outbreaks among the non-vaccinated population.

Emergency response of toxic chemicals in Taiwan: the system and case studies.

Chen, Jenq-Renn; Hung, C. H.; Fan, K. S.; Ho, T. C.; Chen, F. L.; Homg, J. J.; Ho, S. C.; Chen, W. D. Department of Safety, Health and Environmental Engineering, National Kaohsiung First University of Science and Technology, Yenchau, Kaohsiung, Taiwan. Process Safety Progress (2004), 23(3), 206-213. Publisher: John Wiley & Sons, Inc., CODEN: PSAPE2 ISSN: 1066-8527. Journal written in English. CAN 143:157926 AN 2004:1073037 CAPLUS (Copyright (C) 2007 ACS on SciFinder (R))

Abstract

In this paper we describe an emergency response system in Taiwan funded by the Taiwan Environmental Protection Administration and consisted of three local response centers held by the Industrial Technology. Research Institute, National Yunlin University of Science and

Technology. and National Kaohsiung First University of Science and Technology. In the north, central, and south part of the island, respectively. The system is set up for the effective and efficient response to incidents involving toxic chemicals, and reducing the potential impact on the environment from these incidents. Case studies are also provided for the incidents. These incidents range from afire in a chem. Plant to a spillage from a tank truck on the road. The responded incidents are analyzed and possible root causes are identified and classified. The information provided should benefit areas with growing industrial development in developing strategies to prevent or reduce the potential impacts from chem. incidents.

Code gray case studies.

McDaniel Jackie Scripps Mercy Hospital, San Diego, Calif 92103-2180, USA. jackiemcd@tns.net Critical care nursing quarterly (2003), 26(4), 303-15. Journal code: 8704517. ISSN:0887-9303. (CASE REPORTS); Journal; Article; (JOURNAL ARTICLE) written in English. PubMed ID 14604129 AN 2003526029 MEDLINE (Copyright (C) 2007 U.S. National Library of Medicine on SciFinder

Abstract

Stroke in an inpatient poses many complex, and frequently very challenging, issues. Not only does the patient present with past medical history and various comorbidities, but also has been admitted to the hospital for some other diagnosis. In addition, any organized response to these stroke patients has been largely ignored by health care. As a result, the response to stroke-like symptoms may vary from facility to facility, and patient to patient. This article presents 5 case studies in the emergency response to inpatient stroke occurrences in one urban medical center. The histories, admitting diagnoses, signs and symptoms, as well as therapeutic interventions and outcome are reviewed.

Responsiveness to life-threatening obstetric emergencies in two hospitals in Abidjan.

Gohou V; Ronsmans C; Kacou L; Yao K; Bohoussou K M; Houphouet B; Bosso P; Diarra-Nama A J; Bacci A; Filippi V Institut National de Sante Publique, Abidjan, Cote d'Ivoire. gohou@yahoo.fr Tropical medicine & international health: TM & IH (2004), 9(3), 406-15. Journal code: 9610576. ISSN:1360-2276. Journal; Article; (JOURNAL ARTICLE); (MULTICENTER STUDY); (RESEARCH SUPPORT, NON-U.S. GOV'T); (CLINICAL

TRIAL) written in English. PubMed ID 14996371 AN 2004107171 MEDLINE (Copyright (C) 2007 U.S. National Library of Medicine on SciFinder

Abstract

OBJECTIVES: To document the frequency of severe obstetric illness, and the intervals between admission or decision and life-saving surgery and the factors contributing to delays, which were reported during case reviews in two hospitals in Abidjan, Cote d'Ivoire. METHODS: The study was conducted in the teaching hospital in Cocody (CHUC) and the district hospital in Abobo (FSAS) in 2000-01. All severe obstetric cases were inventoried over a period of 1 year, and a subset of cases selected for in-depth review. For the 23 audited cases requiring emergency surgery, the interval between admission/decision and surgery was determined and reasons for the delays examined. FINDINGS: The yearly incidence of severe obstetric morbidity was 224.5 and 11.8 per 1000 live births in the CHUC and FSAS respectively. In CHUC, the decision-to-delivery time was extremely long (median 4.8 h) and this was largely determined by the time needed to obtain a complete surgical kit (median 2.8 h), either because the family had to pay for it in advance or because the kit lacked some essential components, which had to be bought separately. In FSAS, the decision-to-delivery time was much shorter (median 1.0 h). CONCLUSION: The interval between decision and emergency obstetric surgery substantially exceeded the 30 min generally advocated in industrialized countries. The reasons for the long delays were multiple and complex, but the main factors governing them were the huge case load of severe cases and the absence of any clear policy towards ensuring prompt and adequate treatment for life-threatening emergencies. In-depth reviews of cases of severe obstetric morbidity focusing in particular on the timing of emergency treatment could increase the responsiveness of the health system and providers to the needs of women requiring emergency obstetric care.

Appendix F - Greenness Factor Data

This appendix identifies where the information for the Greenness Factor, Table G.1, comes from.

Table F.1 Criteria for Greenness Factor

Physical Properties	**Environmental Concerns**	**Safety and Health**
Octanol Water coefficient	Stratospheric ozone depletion	Human carcinogens
Vapor Pressure	Photochemical smog formation	Persistence Bioacumlative toxins (PBT)
Vapor Density	Halogens	Health effects in air; Toxicity
Flash Point	atmospheric acidification, acid rain	Health effects in water; Safe drinking water act (SDW)
Autoingnition Temperature	Antibiotics, hormones, and pesticides	mutagenic compounds
Solubility in water	Clean Air Act (CAA); HAP or VOC	respiratory irritants
Soil Adsorption coefficient	Resource conservation and recovery act (RCRA); P and U lists	Microbial/viral infection
Recyclable	Global Warming Potential	Green Products
pH	Anaerobic/ Eutrophication environments	Solvent/Coating alternatives

Physical Properties:

- These will be gathered from the Hazardous Substance Data Bank (HSDB) and the EKAT database

Environmental Concerns:

- Stratospheric ozone depletion
    1. Class I: http://www.epa.gov/ozone/ods.html
    2. Class II: http://www.epa.gov/ozone/ods2.html
- Photochemical smog formation
    1. Handbook of Green Chemicals [35]
- Halogens
    1. Handbook of Green Chemicals [35]

- Atmospheric acidification, acid rain
    1. Handbook of Green Chemicals [35]
- Chemicals in water, antibiotics, hormones, and pesticides
    1. EKAT database
- CAA – HAP or VOC
    1. EKAT data base
- RCRA-P&U listed waste
    1. EKAT database
- Global Warming
    1. CO_2
    2. H_2O
    3. N_2O
    4. CH_4
    5. SO_2
- Anaerobic, or Eutrophication environments
    1. Handbook of Green Chemicals [35]

Health and Safety

- Human carcinogens, mutagenic compounds, respiratory irritants
    1. OSHA priority chemicals
- Persistence Bioacumlative Toxins (PBT)
    1. EKAT database
- Health effects in air- Toxicity (PEL, REL, IDLH,…)
    1. NIOSH database
    2. EKAT database
- Health effect in water
    1. EKAT database (SDW)
- Microbial/viral infection
    1. HSDB
- Green Products
    1. BEES
- Solvent/Coating Alternatives
    1. SAGE guide [33]
    2. CAGE guide [34]

Example Comparison

Table F.2 Benzene greenness factor evaluation

Physical and Chemical properties	**Green Light**	**Red Light**	**Yellow Light**
Octanol/Water coefficient	X		
Vapor Pressure	X		
Vapor Density		X	
Flash Point		X	
Autoingnition Temperature	X		
Solubility in water	X		
Soil Adsorption coefficient		X	
Recyclable			X
Corrosivity	X		
Reactivity		X	
Renewable			X
pH			X
Environmental concerns			
Stratospheric ozone depletion	X		
Photochemical smog formation		X	
Halogens	X		
Atmospheric acidification, acid rain	X		
Antibiotics, hormones, and pesticides	X		
Clean Air Act (CAA); HAP or VOC		X	
Resource conservation and recovery act (RCRA); P and U lists		X	
Global Warming Potential	X		
Biodegradable	X		
Terrestrial toxicity		X	
Anaerobic/ Eutrophication environments	X		
Safety and Health			
Human carcinogens		X	
Persistence Bioaccumlative Toxins (PBT)	X		
Health effects in air		X	
Health effects in water		X	
Mutagenic compounds		X	
Respiratory irritants		X	
Microbial/viral infection	X		
Green Products			X
Toxicity		X	
Solvent/Coating Alternative		X	

Table F.3 Chloroform greenness factor evaluation

Physical and Chemical properties	**Green Light**	**Red Light**	**Yellow Light**
Octanol/Water coefficient	X		
Vapor Pressure	X		
Vapor Density	X		
Flash Point			X
Autoingnition Temperature			X
Solubility in water	X		
Soil Adsorption coefficient		X	
Recyclable			X
Corrosivity		X	
Reactivity		X	
Renewable			X
pH			X
Environmental concerns			
Stratospheric ozone depletion		X	
Photochemical smog formation		X	
Halogens		X	
Atmospheric acidification, acid rain	X		
Antibiotics, hormones, and pesticides	X		
Clean Air Act (CAA); HAP or VOC		X	
Resource conservation and recovery act (RCRA); P and U lists		X	
Global Warming Potential	X		
Biodegradable		X	
Terrestrial toxicity	X		
Anaerobic/ Eutrophication environments	X		
Safety and Health			
Human carcinogens		X	
Persistence Bioaccumlative Toxins (PBT)	X		
Health effects in air		X	
Health effects in water		X	
Mutagenic compounds		X	
Respiratory irritants	X		
Microbial/viral infection	X		
Green Products		X	
Toxicity		X	
Solvent/Coating Alternative		X	